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To:	Dean Satchell	**From:**	Bruce Davy
Organisation:	Farm Forestry Timbers Society C/- New Zealand Farm Forestry Association	**Subject:**	Redwood Ingrade test results
Location:	P.O.Box 10349 the Terrace, Wellington 6143	**Date:**	9 December 2013
Fax No.:	04 4720432	**No. of Pages:**	8
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Dean,

With reference to the 100x50 and 115x40 Redwood timber supplied for in-grade testing.

Timber History (as supplied by Russell Coker)
Undressed 100x50 ex Nelson area, age approximately 75 years

Dressed 115x40 ex Mangatu, age 38 years

The timber was visually graded to the Farm Forestry Timbers No. 1 Structural grade, as follows: http://www.nzffa.org.nz/specialty-timber-market/brand-grades/structural-grading/

Appendix F lists these visual grade rules.

Timber Testing

The timber was tested for bending strength and stiffness as a joist, Tension strength Compression Strength and Shear Strength in accordance with AS/NZS4063.1:2010.

All the testing was undertaken in our Grade 1 Baldwin Universal test machine with the exception of the tension strength testing which was done in the tension testing machine.

The strength testing was completed in the Timber Engineering laboratory of Scion, Rotorua, New Zealand.

Strength and Stiffness Test Results

The characteristic strength and stiffness properties have been calculated using the calculations and procedures set out in AS/NZS4063.2:2010.
The following Tables 1 & 2 show the statistical test data of the timber from the two sources.
Table 3 shows the characteristic strength and stiffness values for the combined sample of Redwood timber along with a statistical summary.
Table 4 lists the New Zealand characteristic grade stresses for the SG visual grades

Appendix's A to E list the raw test data collected.

Table 1: *Bending Strength and Stiffness properties - ex Nelson 75 year*

	100 x 50 Redwood – ex Nelson 75 year				
	Bending Stiffness MoEj (GPa)	**Bending Strength MoRj (MPa)**	**Tension Strength (MPa)**	**Shear Strength (MPa)**	**Compression Strength (MPa)**
Mean	6.28	24.46	11.36	2.73	25.40
Minimum	3.38	11.24	3.71	1.26	15.76
Maximum	8.12	33.19	16.98	4.16	35.34
Range	4.74	21.95	13.27	2.89	19.58
Standard Deviation	1.40	6.84	4.11	0.93	5.01
Coefficient of Variation	22.34%	27.95%	36.21%	34.20%	19.70%
Count	15	15	15	15	30

Table 2: *Bending Strength and Stiffness properties – ex Mangatu 38 year*

	115 x 40 Redwood – ex Mangatu 38 year				
	Bending Stiffness MoEj (GPa)	**Bending Strength MoRj (MPa)**	**Tension Strength (MPa)**	**Shear Strength (MPa)**	**Compression Strength (MPa)**
Mean	6.98	24.32	14.51	2.63	28.93
Minimum	3.70	10.37	7.02	1.56	12.47
Maximum	9.78	46.06	23.16	4.07	40.82
Range	6.07	35.69	16.13	2.51	28.35
Standard Deviation	1.90	9.62	4.52	0.65	6.83
Coefficient of Variation	27.27%	39.54%	31.15%	24.76%	23.60%
Count	15	15	15	15	30

Table 3: *Bending Strength and Stiffness properties – Combined*

	Combined Redwood – Mangatu & Nelson				
	Bending Stiffness MoEj (GPa)	**Bending Strength MoRj (MPa)**	**Tension Strength (MPa)**	**Shear Strength (MPa)**	**Compression Strength (MPa)**
Mean	6.63	24.39	12.93	2.68	27.17
Minimum	3.38	10.37	3.71	1.26	12.47
Maximum	9.78	46.06	23.16	4.16	40.82
Range	6.39	35.69	19.45	2.89	28.35
Standard Deviation	1.68	8.20	4.54	0.79	6.20
Coefficient of Variation	25.35%	33.62%	35.08%	29.56%	22.80%
Count	30	30	30	30	60
Characteristic Strength (MPa)		**11.55**	**4.89**	**1.38**	**16.64**
Characteristic Stiffness (GPa)	**5.48**				
Assigned Grade	**Reject**	**SG 6**	**SG 6**	**Reject**	**SG 6**

Table 4: *Characteristic stresses for SG graded timber NZS3603 A4*

1. Moisture Content – Dry (m/c = 16%)					
Radiata pine and Douglas Fir	**Bending Strength MPa**	**Compression Strength MPa**	**Tension Strength MPa**	**Bending Stiffness GPa**	**Lower bound Bending Stiffness GPa**
SG10 (Dry)	20.0	20.0	8.0	10.0	6.7
SG8 (Dry)	14.0	18.0	6.0	8.0	5.6
SG 6 (Dry)	10.0	16.0	4.0	6.0	4.0
Verified Heartland	14	16	4.0	6.0	4.0
2. Moisture Content – Green (m/c = 25%)					
SG 10 (Wet)	15	14.0	5.0	8.0	5.6
SG 8 (Wet)	11.7	12.0	4.0	6.5	4.4
SG 6 (Wet)	7.5	11.0	3.0	4.8	3.2

Note:

- The shear strength for dry Radiata pine, (all grades) shall be taken as fs = 3.8 MPa.

References

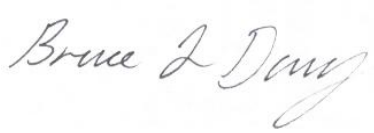
1. AS/NZS4063.1:2010, Characterization of structural timber Part 1: Test methods. Standards Australia/Standards New Zealand.
2. AS/NZS4063.2:2010, Characterization of structural timber Part 1: Determination of characteristic values. Standards Australia/Standards New Zealand.

Summary

Comparing Tables 1 & 2 shows the:

- The Younger material from Mangatu appeared to have slightly better Stiffness, Tension Strength and Compression Strength.
- This sample of Redwood failed to achieve the required structural properties for bending stiffness and shear, for SG6 grade.

I trust this initial information meets with your approval, please feel free to contact me if you have any queries



Bruce Davy

Appendix A: *Bending Test data for the Nelson Redwood*

Lab No.	Client ID.	Width (mm)	Depth (mm)	MoEj (GPa)	MoRj (MPa)
268526		51.49	99.68	6.77	29.63
268527		52.28	100.88	4.90	19.15
268528		50.83	100.30	7.06	24.11
268529		51.72	101.71	4.07	12.63
268530		50.70	97.91	7.19	29.42
268531		50.92	100.33	6.98	32.69
268532		51.27	100.49	7.83	30.23
268533		50.99	102.38	4.45	17.48
268534		51.24	100.83	6.51	29.31
268535		50.91	100.35	8.12	33.19
268536		52.04	100.70	7.12	22.33
268537		51.70	100.04	6.48	23.46
268538		52.20	100.99	6.65	26.29
268539		51.24	102.31	6.69	25.75
268540		51.44	100.21	3.38	11.24

Appendix B: *Bending Test data for the Mangatu Redwood*

Lab No.	Client ID.	Width (mm)	Depth (mm)	MoEj (GPa)	MoRj (MPa)
268511	RWF 9	39.66	115.06	8.93	16.59
268512	RWF 2	39.61	115.19	3.70	33.07
268513	RWF 13	39.69	114.99	7.04	16.93
268514	RWF 14	39.76	114.76	9.78	26.77
268515	RWF 20	39.72	115.00	8.28	46.06
268516	RWF 22	39.81	114.60	6.88	31.23
268517	RWF 21	39.83	114.48	6.23	17.98
268518	RWF 28	39.71	114.78	7.31	25.45
268519	RWF 12	39.85	114.88	8.70	22.66
268520	RWF 19	40.02	114.79	6.84	22.72
268521	RWF 27	39.80	115.01	8.61	20.42
268522	RWF 5	39.70	114.97	4.01	10.45
268523	RWF 3	39.82	114.77	3.79	10.37
268524	RWF 16	39.85	115.28	8.04	34.13
268525	RWF 26	39.77	115.04	6.50	30.02

Appendix C: *Compression Parallel Test data*

Nelson Redwood			
Lab No.	**Width (mm)**	**Depth (mm)**	**Comp'n Stress (MPa)**
268571	51.73	101.52	17.43
268572	51.85	98.63	15.76
268573	52.19	98.20	29.23
268574	51.95	101.75	17.58
268575	51.57	98.56	24.61
268576	55.97	100.61	25.26
268577	51.84	99.47	26.72
268578	51.61	101.74	27.01
268579	49.99	99.99	26.21
268580	51.27	100.77	30.48
268581	51.46	100.00	25.53
268582	50.56	99.28	27.56
268583	51.70	99.17	21.99
268584	52.42	102.50	23.47
268585	52.27	102.71	28.33
268586	52.61	100.76	18.25
268587	50.93	99.10	30.28
268588	51.54	100.05	35.34
268589	51.71	98.42	24.29
268590	50.89	100.02	23.90
268591	52.02	100.45	30.58
268592	51.26	101.39	21.32
268593	52.05	100.91	27.78
268594	51.40	100.17	31.75
268595	51.76	100.82	30.41
268596	51.39	101.64	22.62
268597	51.54	100.77	27.72
268598	51.16	98.40	32.44
268599	50.82	100.83	18.19
268600	52.08	101.29	20.11

Mangatu Redwood			
Lab No.	**Width (mm)**	**Depth (mm)**	**Comp'n Stress (MPa)**
268541	39.75	115.06	29.95
268542	39.72	114.72	35.97
268543	39.65	115.58	36.97
268544	39.84	114.94	32.35
268545	39.91	115.07	29.53
268546	39.88	114.92	26.55
268547	39.80	114.13	39.79
268548	39.94	113.90	31.76
268549	39.33	115.83	29.28
268550	39.66	114.92	26.42
268551	40.18	115.10	13.98
268552	39.82	113.74	25.67
268553	39.63	115.29	31.84
268554	39.79	114.31	40.82
268555	39.74	114.84	31.56
268556	39.81	114.82	34.72
268557	39.90	114.82	18.60
268558	39.84	113.70	28.55
268559	39.81	114.77	29.84
268560	39.88	114.92	31.47
268561	39.60	115.23	30.82
268562	39.70	115.17	27.09
268563	39.73	114.60	26.99
268564	39.96	114.73	32.33
268565	39.45	115.03	29.70
268566	39.67	115.00	27.70
268567	39.77	113.80	31.55
268568	39.74	114.84	30.26
268569	114.58	114.84	12.47
268570	114.32	114.84	13.33

Appendix D: *Tension Test data for the Redwood*

Nelson Redwood				
Lab No.	**Client ID.**	**Width (mm)**	**Depth (mm)**	**Tensile Stress (MPa)**
268616		51.44	100.21	10.69
268617		51.24	102.31	6.09
268618		50.99	102.38	3.71
268619		51.24	100.83	15.53
268620		51.27	100.49	15.00
268621		52.04	100.70	12.55
268622		52.20	100.99	10.49
268623		51.70	100.02	16.98
268624		52.28	100.88	4.81
268625		51.72	101.71	9.29
268626		50.92	100.33	12.62
268627		50.91	100.35	10.20
268628		50.70	97.91	14.26
268629		50.83	100.30	16.55
268630		51.49	99.68	11.67

Mangatu Redwood				
Lab No.	**Client ID.**	**Width (mm)**	**Depth (mm)**	**Tensile Stress (MPa)**
268601	RWT 5	39.79	114.85	14.75
268602	RWT 12	40.15	114.18	10.21
268603	RWT 1	39.87	114.56	9.03
268604	RWT 6	39.94	114.70	19.91
268605	RWT 3	39.92	114.29	18.10
268606	RWT 15	39.98	115.15	15.92
268607	RWT 16	39.76	115.73	14.08
268608	RWT 9	39.95	115.22	23.16
268609	RWT 13	39.89	115.64	10.09
268610	RWT 11	39.65	115.44	11.33
268611	RWT 19	39.71	115.38	13.95
268612	RWT 17	39.18	115.32	14.91
268613	RWT 14	39.96	114.66	14.98
268614	RWT 8	39.89	115.63	7.02
268615	RWT 18	39.70	115.02	20.15

Appendix E: *Shear Test data for the 100x50 Totara*

Nelson Redwood				
Lab No.	**Client ID.**	**Width (mm)**	**Depth (mm)**	**Shear Stress (MPa)**
268646		51.65	99.76	2.13
268647		50.80	101.01	1.51
268648		51.38	99.91	3.16
268649		53.82	101.50	1.26
268650		52.28	99.70	1.32
268651		52.47	99.73	2.39
268652		51.58	101.00	3.29
268653		51.69	99.60	3.75
268654		52.83	100.62	4.16
268655		51.29	100.80	3.50
268656		51.78	101.88	2.29
268657		51.51	98.56	3.95
268658		50.93	100.86	3.17
268659		52.04	100.95	2.63
268660		51.61	100.05	2.45

Mangatu Redwood				
Lab No.	**Client ID.**	**Width (mm)**	**Depth (mm)**	**Shear Stress (MPa)**
268661	RWF 3	39.90	114.86	1.75
268662	RWF 21	39.72	113.96	1.86
268663	RWF 1	39.93	114.65	2.55
268664	RWF 14	39.88	114.06	3.14
268665	RWF 22	39.92	114.27	2.07
268666	RWF 9	39.72	114.50	4.07
268667	RWF 28	39.61	114.85	3.00
268668	RWF 26	39.68	115.14	2.89
268669	RWF 8	40.01	114.29	1.56
268670	RWF 17	39.29	114.55	2.39
268671	RWF 19	39.83	114.62	2.58
268672	RWF 5	39.67	114.64	2.89
268673	RWF 12	39.74	114.90	3.11
268674	RWF 18	39.91	116.43	3.11
268675	RWF 6	39.99	114.75	2.54

Appendix F: No. 1 structural grade rules

(As supplied by Dean Satchell Email 11 April 2013)

Distortion

- Bow maximum 40/1
- Crook maximum 200/1
- Twist minimal
- Cup 75/1

Knots, holes, voids, bark-inclusion, bark-pockets, resin pockets, pith, decay, wane, sloping grain greater than 1/10 (including sloping grain surrounding spike knots [Sloping grain surrounding spoke knots, being a serious weakness causing defect, must be taken into account when determining the cross section of a spike knot.]) and other weakness-causing defect:

- Not more than 1/3 of cross section in combination up to 150 mm board;
- Not more than 1/4 of cross section in combination for larger than 150 mm board.

No voids ["Voids" include holes, bark-pockets, resin pockets and bark inclusion] longer than the width of the face of the piece. Where bark inclusion and associated voids do not exceed 5% of the cross section the length is not restricted.

Checks, collapse and pith are not restricted.

Pith includes surrounding wood to a radius of 10 mm.

Wane and skip are to be kept to a minimum. No more than 5% of cross section.

Splits not allowed. Shakes not allowed.

Maximum sloping grain: 1 in 10

Spike knots:

The length of the longest edge [As seen on the face of the piece and where adjacent sloping grain is greater than 1 in 10] of a spike knot must not be greater than 75% of the width of the face of the piece. Where structural members are of square cross section this does not apply.

Sapwood shall be treated to h1.2.