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Next generation biomaterials

Facsimile

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Organisation:	Farm Forestry Timbers Society C/- New Zealand Farm Forestry Association	**Subject:**	Totara Ingrade test results
Location:	P.O.Box 10349 the Terrace, Wellington 6143	**Date:**	20 May 2013
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Dean,

With reference to the 100x50 Totara timber supplied for in-grade testing.

Timber History (as supplied by Dean Satchell)
In May 2009 35 Totara trees were felled on a beef-farm near Kawakawa in Northland. The trees were all in a pastoral environment and stood as groups and individual trees. These "farm-grown" stands had presumably regenerated within the last 80-150 years, following early land-clearances and/or disturbance. As an untended resource, tree-form naturally varied from open-grown multi-stemmed trees and edge trees with heavy branching on one side, to straight-boled and relatively branch-free trees within small stands. A total of 62 logs of widely varying quality were recovered and milled on-site using a combination of a portable sawmill (Lucas) and a chainsaw-mill for slabs.

The logs were sawn into 55 mm slabs and the timber was immediately transferred to an open barn with good air flow for air-drying and air dried for two years.

Slabs were selected to represent a large cross section of logs and further processed on a woodmizer bandsaw to yield 100 x 55 boards. These were filleted and further air-dried in a warm, dry, closed in, ventilated, concrete floored half-round barn for a further year. The timber was then machined and despatched for testing at Scion, Rotorua.

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 E lists these visual grade rules.

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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 Table 1 shows the characteristic strength and stiffness values for the Totara timber along with a statistical summary.
Table 2 lists the New Zealand characteristic grade stresses for the SG visual grades

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

Table 1: *Bending Strength and Stiffness properties*

	100 x 50 Totara				
	Bending Stiffness MoEj (GPa)	**Bending Strength MoRj (MPa)**	**Tension Strength (MPa)**	**Shear Strength (MPa)**	**Compression Strength (MPa)**
Mean	7.55	54.94	22.39	5.43	35.24
Minimum	4.73	15.10	11.99	3.70	26.44
Maximum	9.49	72.99	40.41	7.13	42.91
Range	4.76	57.89	28.42	3.43	16.47
Standard Deviation	1.25	15.66	7.97	0.73	4.29
Coefficient of Variation	16.56%	28.50%	35.61%	13.53%	12.18%
Count	30	30	30	30	60
Characteristic Strength (MPa)		**20.50**	**10.63**	**4.43**	**30.19**
Characteristic Stiffness (GPa)	**7.39**				
Assigned Grade	**SG 6**	**SG 10**	**SG 10**	**SG 10**	**SG 10**

Table 2: *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 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.

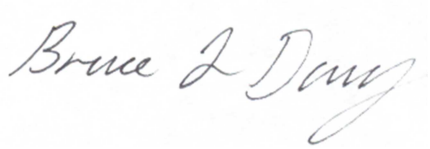
2. AS/NZS4063.2:2010, Characterization of structural timber Part 1: Determination of characteristic values. Standards Australia/Standards New Zealand.

Summary

Comparing Tables 1 & 2 shows the:

- The 100 x 50 Totara timber achieving the NZ visual grade SG6 for bending stiffness, but exceeding SG10 for bending strength, compression strength. Shear strength, and tension strength.

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 100x50 Totara*

Lab No.	Client ID.	Width (mm)	Depth (mm)	MoEj (GPa)	MoRj (MPa)
265732		49.78	99.81	5.83	15.10
265733		49.89	99.77	8.57	72.99
265734		49.73	99.57	8.09	64.36
265735		49.72	99.38	7.82	59.82
265736		49.68	99.04	6.80	50.77
265737		49.83	99.99	7.45	58.99
265738		49.78	99.51	7.75	61.21
265739		49.72	99.74	7.35	42.64
265740		49.64	99.55	8.53	59.71
265741		49.70	99.69	8.02	59.58
265742		49.69	99.67	9.36	72.07
265743		49.83	99.84	7.76	59.04
265744		49.92	99.94	7.52	56.96
265745		49.88	100.15	7.80	61.93
265746		49.95	99.30	5.90	44.74
265747		49.74	99.20	9.28	56.54
265748		49.83	99.72	5.92	46.94
265749		49.83	99.81	8.39	51.85
265750		49.68	99.78	7.85	65.68
265751		49.71	99.72	6.18	15.79
265752		49.73	99.46	9.49	70.45
265753		49.10	99.45	9.45	67.05
265754		49.94	99.23	7.37	67.94
265755		49.96	99.50	6.86	67.35
265756		49.93	99.82	6.51	25.93
265757		49.80	99.72	7.36	61.96
265758		49.70	99.05	9.38	65.39
265759		49.62	99.65	5.46	44.02
265760		49.71	99.60	4.73	31.26
265761		49.90	99.37	7.82	70.19

Appendix B: *Compression Parallel Test data for the 100x50 Totara*

Lab No.	Width (mm)	Depth (mm)	Comp'n Stress (MPa)
265762	49.94	99.77	37.77
265763	49.78	99.16	38.32
265764	49.78	99.17	40.19
265765	49.84	99.18	40.52
265766	49.65	99.22	35.87
265767	49.72	99.81	30.38
265768	49.86	99.13	33.63
265769	49.82	99.84	32.36
265770	49.83	99.65	32.54
265771	49.74	99.64	38.58
265772	49.84	99.15	34.35
265773	49.60	99.18	40.68
265774	49.91	99.62	30.25
265775	49.78	99.81	37.47
265776	49.87	99.62	40.17
265777	49.67	99.49	34.71
265778	49.98	99.22	31.80
265779	49.47	99.41	42.20
265780	49.83	99.77	38.93
265781	49.79	99.45	41.67
265782	49.79	99.41	33.56
265783	49.73	99.57	38.20
265784	49.70	99.65	36.17
265785	49.83	99.55	36.95
265786	49.92	99.68	30.63
265787	50.12	99.74	33.94
265788	49.72	99.36	26.77
265789	49.54	99.83	31.15
265790	49.59	99.15	34.04
265791	49.56	99.76	39.91

Lab No.	Width (mm)	Depth (mm)	Comp'n Stress (MPa)
265792	49.77	99.47	39.04
265793	49.52	99.48	32.91
265794	49.53	99.76	34.46
265795	49.57	99.82	41.77
265796	49.83	99.61	33.20
265797	49.71	99.74	42.91
265798	49.61	99.77	34.08
265799	49.82	99.64	30.58
265800	49.88	100.08	33.38
265801	49.72	99.51	30.77
265802	49.29	99.65	41.75
265803	49.48	99.02	38.20
265804	49.49	99.44	33.31
265805	49.85	99.66	32.34
265806	49.85	99.66	37.54
265807	49.86	99.35	36.01
265808	49.83	99.85	36.73
265809	49.80	99.83	34.51
265810	49.95	99.91	29.33
265811	49.67	99.40	27.49
265812	49.86	99.43	27.24
265813	49.79	79.44	39.43
265814	49.70	99.07	30.73
265815	49.70	98.94	42.06
265816	49.92	99.29	33.97
265817	49.80	99.43	33.63
265818	49.82	99.87	26.44
265819	49.77	98.74	35.94
265820	49.70	99.54	40.31
265821	49.65	99.70	30.77

Appendix C: *Tension Test data for the 100x50 Totara*

Lab No.	Client ID.	Width (mm)	Depth (mm)	Tensile Stress (MPa)
265822		49.97	99.99	25.13
265823		49.81	99.21	20.20
265824		49.88	99.87	11.99
265825		49.64	99.01	28.55
265826		50.03	99.62	13.50
265827		49.88	100.24	12.52
265828		50.14	99.68	16.46
265829		49.74	99.79	14.72
265830		49.86	99.91	31.16
265831		49.82	99.56	19.26
265832		49.91	99.53	26.10
265833		49.83	99.66	19.15
265834		49.75	99.26	18.27
265835		50.01	99.95	22.31
265836		50.02	99.70	22.48
265837		49.88	99.70	12.53
265838		49.95	99.98	35.95
265839		49.76	100.03	20.82
265840		49.87	99.89	40.41
265841		49.81	99.88	17.93
265842		49.72	99.79	18.87
265843		49.67	99.75	39.41
265844		49.77	99.73	20.04
265845		49.97	99.76	32.72
265846		49.68	99.43	22.71
265847		49.65	99.32	32.94
265848		49.77	99.87	20.87
265849		49.78	99.82	15.24
265850		49.78	99.90	14.03
265851		49.89	99.27	25.50

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

Lab No.	Client ID.	Width (mm)	Depth (mm)	Tensile Stress (MPa)
265852		49.78	99.45	5.10
265853		49.84	99.60	5.59
265854		49.64	99.48	7.13
265855		49.82	99.81	5.83
265856		49.91	99.60	5.19
265857		49.82	99.81	5.43
265858		50.11	100.23	5.07
265859		49.84	99.80	5.24
265860		49.73	99.46	5.79
265861		49.81	99.33	3.70
265862		49.75	99.76	4.93
265863		49.67	94.19	3.85
265864		49.52	99.56	4.99
265865		49.91	99.33	5.35
265866		49.80	99.76	6.35
265867		49.76	99.88	6.61
265868		49.73	99.23	5.16
265869		49.84	99.83	5.86
265870		50.12	100.43	4.85
265871		49.54	98.38	5.38
265872		49.69	99.89	6.03
265873		49.55	99.97	5.73
265874		49.90	99.76	6.54
265875		49.57	99.75	5.27
265876		49.90	100.11	4.93
265877		49.93	99.97	4.54
265878		49.84	99.89	5.54
265879		49.81	99.98	6.17
265880		49.75	99.87	5.56
265881		50.00	99.52	5.28

Appendix E: 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.