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Northland Regional Council
Poplar Glulam testing

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Report information sheet

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Executive summary

Objective

To determine the characteristic bending strength and stiffness stresses for a sample of 80 x 45 Poplar Glulam graded as supplied by Northland Regional Council, along with measuring the materials density and moisture content.

Key results

1. On the basis of the bending strength the 80 x 45 Poplar Glulam could be assigned a Glulam grade of SG12.

2. On the basis of the bending stiffness the 80 x 45 Poplar Glulam could be assigned a Glulam grade of SG10.

3. Overall the 80 x 45 Poplar Glulam could be assigned the Glulam grade of SG10

4. The Average moisture content at the time of testing was 12.7%

5. The average Density at test (using mass at test) was 494kg/m^3

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Introduction

To determine the characteristic bending strength and stiffness stresses for a 32 piece sample of 80 x 45 Poplar Glulam as supplied by Dean Satchell of Northland Regional Council.

The glulam was supplied dry and planar gauged to 80x45 in approximately 2.0m lengths. The glulam comprised of four finger-jointed laminates

Ideally to determine characteristic properties we need to test full dimension timber, covering a range of structural sizes in bending, tension, compression, and shear. This would require a large volume of timber and for tension testing long lengths. However, 90% of the span tables in NZS3604 are governed by bending strength and stiffness

Thus, as a start on this process it was suggested that only bending strength and stiffness be tested for.

Materials and methods

From information supplied to Scion;

- The Glulam was produced by Laminated Beams Ltd, Tauranga.
- The timber was Kawa Poplar supplied as 100mm x 25mm to Laminated Beams.
- The glulam shooks were selected to be clearwood, the number of finger-joints per test beam ranged from 1 to 5 (see Appendix A).
- 4mm structural finger joints were used bonded with melamine urea-formaldehyde (MUF) adhesive to produce 3.0m finger jointed lengths.
- The finger-jointed lengths were dressed to 20mm thick, and the test beams were glued as 4 laminates to 80mm depth with melamine urea-formaldehyde (MUF) adhesive.
- The glulam was then cross cut to the 1.5m lengths and ripped in two, then dressed to 45mm wide to produce the thirty-two 80x45 glulam beams.
- Wood moisture content at gluing was measured at 13%

Characteristic bending strength and stiffness testing

- All the timber was tested for bending strength and stiffness as a joist (on edge) in accordance with AS/NZS4063.1:2010 & AS/NZS4063.2:2010 over a span to depth ratio of equal to 18:1 at 1440mm. The test pieces were tested in their dry gauged state.
- All the bending testing was undertaken in our Grade 1 Baldwin Universal test machine. The strength testing was completed in the Timber Engineering laboratory of Scion, Rotorua over the period 7th – 8th November 2022.

Density and Moisture content

- From all the bending test samples a short cross section was then cut from an undamaged clear wood section close to the failure point of each test specimen for density, moisture content determination
- Moisture content was measured using the oven drying method.
- Nominal density was calculated for each section from the oven dry weight over volume at test.
- Density at test was calculated for each section from the test weight over volume at test.

Results and discussion

The characteristic strength and stiffness properties have been calculated using the calculations and procedures set out in AS/NZS4063.2:2010.

Table 1 shows the characteristic strength and stiffness values for the 80x45 Poplar Glulam timber along with a statistical summary.

Table 2 lists the New Zealand characteristic grade stresses for the Glulam grades

Table 3 shows a statistical summary of the moisture content and density testing.

Appendix A lists the raw test data collected.

***Table 1**: Poplar Glulam Characteristic Bending Strength/Stiffness & Density properties*

Poplar Glulam	**80x45**		
	Bending Stiffness MoEj (GPa)	**Bending Strength MoRj (MPa)**	**Density at test (kg/m^3)**
Mean	11.03	60.71	494.77
Minimum	9.71	21.27	443.77
Maximum	12.24	80.35	551.96
Range	2.53	59.08	108.19
Standard Deviation	0.60	15.01	24.72
Coefficient of Variation	5.47%	24.72%	5.00%
Count	32	32	32
Characteristic Strength (MPa)		**32.6**	
Characteristic Stiffness (GPa)	**11.0**		
Characteristic Density at Test (kg/m^3)			**491.7**
Assigned Grade	**GL10**	**GL12**	

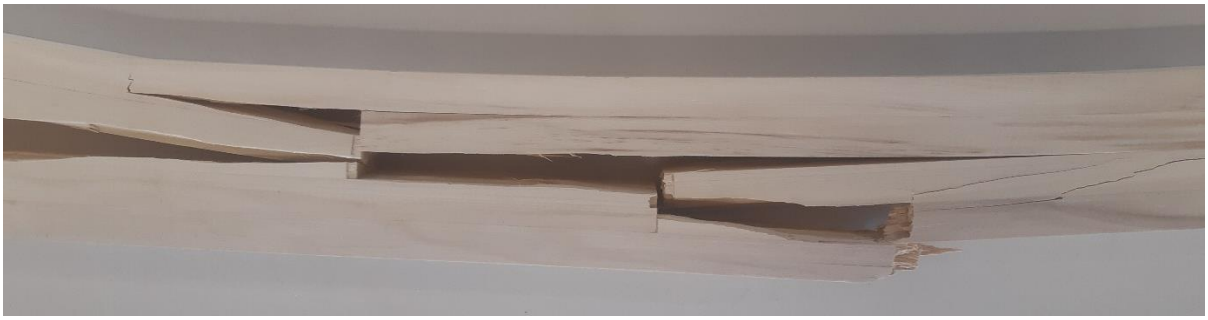
***Table 2**: Characteristic Values For Structural Design—GL-Grades (Moisture content 15% or less)*

	Characteristic strengths (MPa)				Elastic moduli (MPa)	
Glulam Grade	**Bending** f'_b	**Tension parallel to grain** f'_t	**Shear in beam** f'_s	**Compression parallel to grain** f'_c	**Short duration average modulus of elasticity parallel to the grain** E	**Short duration average modulus of rigidity for beams** G
GL18	45	22.5	5.0	45.0	18500	1230
GL17	40	18.9	4.2	31.5	16700	1110
GL13	33	14.4	4.2	29.7	13300	900
GL12	25	11.3	4.2	26.1	11500	770
GL10	22	9.9	3.7	23.4	10000	670
GL8	19	9.0	3.7	21.6	8000	530

***Table 3:** Statistical Summary of Density and Moisture content results*

	Moisture Content %	Density at Test kg/m^3	Nominal Density kg/m^3
Mean	12.73	494.77	438.91
Minimum	11.56	443.77	392.77
Maximum	17.37	551.96	490.43
Range	5.81	108.19	97.66
Standard Deviation	0.95	24.72	21.43
Coefficient of Variation	7.47%	5.00%	4.88%
Count	32	32	32

Typical Failure Mode Photographs



***Photograph 1:** Typical failure starting with Finger-joint failure on tension edge then progressing through the inner finger-joints, Beam 289947.*

Photograph 2: *Failure starting with Finger-joint failure on tension edge, Beam 289946*

Photograph 3: *Typical Tension failure in Clearwood also with compression wrinkle in Clearwood, Beam 289924*

Conclusions

- On the basis of the bending stiffness and strength testing the 80 x 45 Poplar Glulam could be assigned the Glulam grade of SG10 (limited by bending stiffness).

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.

3. NZS 1720.1:2022 Timber structures Part 1: Design methods. Standards New Zealand

Appendix A

***Table A1**: 80x45 Poplar Glulam- Test data*

Lab No.	Number of F/J's in beam	Width (mm)	Depth (mm)	MoEj (GPa)	MoRj (MPa)	Moisture Content (%)	Density at Test kg/m^3	Nominal Density kg/m^3	Failure mode
289923	2	43.05	79.77	11.94	75.72	12.5	478.5	425.2	
289924	2	45.03	79.78	11.25	76.81	12.3	530.4	472.4	
289925	5	43.02	79.69	11.27	37.51	12.4	514.3	457.5	Tension FJ fail
289926	2	43.12	79.84	9.98	68.80	12.5	552.0	490.4	
289927	5	45.05	79.60	10.63	64.22	13.0	443.8	392.8	
289928	1	43.08	79.60	11.82	80.35	12.5	507.1	450.8	
289929	2	43.04	79.93	11.59	42.88	12.4	497.7	442.6	
289930	2	43.03	79.94	10.63	62.69	12.8	466.9	413.9	
289931	3	43.18	79.72	10.57	64.36	12.7	456.9	405.4	
289932	3	42.99	79.82	10.03	58.39	12.4	477.7	425.0	
289933	5	43.06	79.84	11.25	68.59	12.4	486.1	432.3	
289934	3	43.19	79.73	11.07	63.32	13.1	477.6	422.2	
289935	1	42.97	79.95	10.44	70.76	12.4	473.3	421.1	
289936	3	45.09	80.19	11.20	21.27	12.6	518.6	460.5	Tension FJ fail
289937	2	45.10	79.86	11.09	67.71	12.8	498.9	442.4	
289938	2	43.04	79.74	10.22	66.73	12.4	488.8	434.9	
289939	3	45.07	79.78	10.81	52.67	13.0	507.9	449.6	
289940	1	43.04	79.80	10.82	64.68	12.3	478.4	426.2	
289941	3	45.03	79.72	11.21	65.78	12.4	474.9	422.5	
289942	3	45.10	79.72	11.37	58.35	12.5	520.6	462.6	
289943	3	45.07	79.59	9.71	59.39	12.2	484.3	431.5	
289944	2	45.09	79.83	11.52	40.38	12.8	486.2	430.9	Tension FJ fail
289945	2	45.12	79.79	11.14	44.97	12.3	528.8	470.6	
289946	1	45.09	79.86	10.78	31.92	14.3	478.2	418.3	Tension FJ fail
289947	2	45.02	79.60	10.86	71.46	12.7	498.3	442.1	
289948	2	45.29	79.80	11.66	72.31	17.4	539.6	459.7	
289949	1	43.02	80.02	12.24	74.81	12.2	518.4	462.2	
289950	1	42.94	79.96	11.78	71.07	12.3	496.5	442.2	
289951	3	43.08	79.56	10.96	74.77	12.9	498.3	441.5	
289952	3	44.98	79.70	11.83	71.00	12.4	510.6	454.2	
289953	2	43.13	80.68	10.49	67.21	12.6	472.8	419.8	
289954	4	43.05	79.96	10.90	31.78	11.6	470.4	421.6	Tension FJ fail