ABIES GRANDIS
BENDING TESTING to AS/NZS4063:2010

For Ruapehu Sawmills

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REPORT INFORMATION SHEET

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ABIES GRANDIS BENDING TESTING TO AS/NZS4063:2010

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OBJECTIVE

To evaluate in teRSM of the Australian/New Zealand standards AS/NZS4063 the bending strength/stiffness and wood properties of dry 100x50 Abies grandis timber was visually stress graded by Ruapehu Sawmills to the number one framing grade (Table 1).

Table 1: *100x50 Abies grandis supplied*

Ruapehu Sawmills Packet Number	Ruapehu Sawmills Description	Number of pieces
RSM 04014	Butt Log, From Outer boards, No Wane ends painted White	30
RSM 04015	Butt Log, Near Core, No Pith, No wane Ends painted White	30
RSM 04016	Mid Log, No Wane Ends painted Green	30
RSM 04017	Head Log, No Wane ends painted Orange	30
RSM 04018	Butt Log, outer wood, No Wane, Quarter sawn	30
RSM 04020	Butt Log, outer wood, No Wane, Flat sawn	30

MECHANICAL TEST METHODS

Characteristic bending strength and stiffness testing

- All the timber was then 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 1800mm. The test pieces were tested in their dry rough sawn 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 5th September - 23rd September 2023.

Density and Moisture content

- From ten only of 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 and 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.

TEST RESULTS

Strength and Stiffness

The characteristic strength and stiffness properties have been calculated using the calculations and procedures set out in AS/NZS4063.2:2010. The following Table 2 shows the characteristic strength and stiffness values for the 100x50 Abies grandis timber with Table 3 listing the New Zealand characteristic grade stresses for the 'SG' grades from the NZS AS 1720.1:2022 Timber structures, Part 1: Design methods standard.

Tables 4-10 shows a statistical summary of the strength/stiffness and wood property data with Appendix A listing the raw test data collected.

***Table 2**: 100x50 Abies grandis Characteristic Bending Strength Properties*

100x50 Abies Grandis	**Bending Stiffness MoE As a Joist MPa**	**Bending Strength MoR As a Joist MPa**	**Density at test** Kg/m^3	**Nominal Density** Kg/m^3
Packet **RSM 04014** (Indicated SG grade)	8030 (SG8)	18.91 (SG8)		
Packet **RSM 04015** (Indicated SG grade)	5800 (Reject)	12.59 (SG6)		
Packet **RSM 04016** (Indicated SG grade)	7940 (SG6)	17.63 (SG8)		
Packet **RSM 04017** (Indicated SG grade)	6560 (SG6)	17.78 (SG8)		
Packet **RSM 04018** (Indicated SG grade)	7250 (SG6)	16.86 (SG8)		
Packet **RSM 04020** (Indicated SG grade)	8200 (SG8)	15.47 (SG8)		
All Packets **Combined** (Indicated SG grade)	7420 (SG6)	16.27 (SG8)	386 #	346 #

 # note with only 10 density specimens selected from each packet group there was only sufficient specimens to calculate a characteristic density for all groups combined

Table 3: *Characteristic stresses for machine graded timber NZS AS 1720.1*

		Moisture Content – Dry (m/c ≤ 15%)							
	Stress Grade	**Design density** kg/m^3	**Characteristic density** (ρ') kg/m^3	**Bending** (f_b') MPa	**Compression parallel-to-grain** (f_c') MPa	**Tension parallel-to-grain** (f_t') MPa	**Tension perpendicular-to-grain** (f_{tp}') MPa	**Short duration average modulus of elasticity** (E') MPa	**Lower bound short duration modulus of elasticity** (E_{lb}) MPa
Verified timber	SG 15	570	475	41.0	35.0	23.0	0.5	15200	11500
	SG 12	540	450	28.0	25.0	14.0	0.5	12000	9000
	SG 10	500	415	20.0	20.0	8.0	0.5	10000	7500
	SG 8	450	375	14.0	18.0	6.0	0.4	8000	5400
	SG 6	400	330	10.0	15.0	4.0	0.4	6000	4000

NOTES:

1. *Shear in beams for seasoned radiata pine shall be taken as f'_s = 3.8 MPa. shear in beams for seasoned Douglas fir shall be taken as f'_s = 3.0 MPa.*
2. *Bearing perpendicular-to-grain for seasoned radiata pine and Douglas fir shall be taken as f'_p = 6.9 MPa. This strength has been determined in accordance with Section 2.8 of AS/NZS4063 divided by the length of bearing factor k_7. This value includes stress spreading and hanging edge effects and is reported at a deformation of 2mm into the timber. Should the perpendicular-to-grain strength without the effects of stress spreading and hanging edge be required, refer to Franke, S., and Quenneville, P. (2010), The Material Behaviour of Radiata Pine Under Compression, New Zealand Timber Design Journal, VOL 18, ISSUE 3*
3. *Short duration average modulus of rigidity shall be taken as $G' = E'/15$.*
4. *Grades shall be verified in accordance with NZS 3622.*
5. *The design density for use only in computing the dead load due to mass of timber*
6. *The characteristic density is to be used for the design of connections using the detailed method.*

Table 4*: 100x50 Abies grandis Packet* ***RSM04014*** *Strength and Stiffness Statistical Summary as Tested*

100x50 Abies Grandis Packet RSM04014	**Bending Stiffness MoE As a Joist MPa**	**Bending Strength MoR As a Joist MPa**	**Moisture Content %**	**Density at Test kg/m^3**	**Nominal Density kg/m^3**	**Average Ring Width mm**	**Distance from Pith mm**
Average	8391	37.83	12.69	384.81	341.56	10.13	82.30
Minimum	5080	17.94	10.65	327.95	289.75	5.58	0.00
Maximum	11630	65.27	15.14	450.42	403.93	16.77	385.00
Range	6550.0	47.33	4.49	122.48	114.18	11.20	385.00
Standard Deviation	1771	12.81	1.44	43.61	39.61	3.41	111.02
Coefficient of Variation%	21.11%	33.88%	11.38%	11.33%	11.60%	33.64%	134.89%
Count	30	30	10	10	10	10	10

***Table 5**: 100x50 Abies grandis Packet **RSM04015** Strength and Stiffness*
Statistical Summary as Tested

100x50 Abies Grandis Packet RSM04015	Bending Stiffness MoE As a Joist MPa	Bending Strength MoR As a Joist MPa	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Distance from Pith mm
Average	6782	30.43	12.07	403.08	359.62	9.68	134.90
Minimum	3000	7.87	11.14	340.83	302.89	7.70	30.00
Maximum	10100	50.40	13.03	463.40	412.44	14.80	295.00
Range	7100.0	42.53	1.89	122.57	109.55	7.10	265.00
Standard Deviation	1624	10.39	0.58	40.74	35.64	2.14	93.10
Coefficient of Variation%	23.95%	34.13%	4.82%	10.11%	9.91%	22.10%	69.01%
Count	30	30	10	10	10	10	10

***Table 6**: 100x50 Abies grandis Packet **RSM04016** Strength and Stiffness*
Statistical Summary as Tested

100x50 Abies Grandis Packet RSM04016	Bending Stiffness MoE As a Joist MPa	Bending Strength MoR As a Joist MPa	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Distance from Pith mm
Average	8089	34.36	10.85	389.89	351.74	12.09	84.50
Minimum	5880	13.38	10.34	297.95	268.52	7.87	22.00
Maximum	10260	50.39	11.51	444.88	401.85	17.69	300.00
Range	4380.0	37.01	1.17	146.94	133.33	9.81	278.00
Standard Deviation	1191	9.63	0.35	42.92	38.77	2.97	79.49
Coefficient of Variation%	14.72%	28.04%	3.23%	11.01%	11.02%	24.54%	94.07%
Count	30	30	10	10	10	10	10

***Table 7**: 100x50 Abies grandis Packet **RSM04017** Strength and Stiffness*
Statistical Summary as Tested

100x50 Abies Grandis Packet RSM04017	Bending Stiffness MoE As a Joist MPa	Bending Strength MoR As a Joist MPa	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Distance from Pith mm
Average	6700	26.65	11.06	371.05	333.99	10.74	46.90
Minimum	4570	16.34	10.52	306.15	276.91	8.87	5.00
Maximum	9110	43.13	11.75	433.15	388.89	14.24	160.00
Range	4540.0	26.79	1.22	127.00	111.98	5.37	155.00
Standard Deviation	1116	7.13	0.40	48.13	42.38	1.65	43.23
Coefficient of Variation%	16.65%	26.75%	3.61%	12.97%	12.69%	15.40%	92.18%
Count	30	30	10	10	10	10	10

***Table 8**: 100x50 Abies grandis Packet **RSM04018** Strength and Stiffness*
Statistical Summary as Tested

100x50 Abies Grandis Packet RSM04018	Bending Stiffness MoE As a Joist MPa	Bending Strength MoR As a Joist MPa	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Distance from Pith mm
Average	7371	31.61	10.77	379.60	342.66	10.05	74.60
Minimum	4720	10.93	10.32	309.41	279.37	7.39	10.00
Maximum	8940	51.37	11.05	449.02	404.33	15.99	120.00
Range	4220.0	40.44	0.73	139.61	124.96	8.61	110.00
Standard Deviation	899	9.33	0.25	54.75	49.21	2.79	38.19
Coefficient of Variation%	12.20%	29.52%	2.29%	14.42%	14.36%	27.74%	51.19%
Count	30	30	10	10	10	10	10

***Table 9**: 100x50 Abies grandis Packet **RSM04020** Strength and Stiffness Statistical Summary as Tested*

100x50 Abies Grandis Packet RSM04020	Bending Stiffness MoE As a Joist MPa	Bending Strength MoR As a Joist MPa	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Distance from Pith mm
Average	8404	33.93	12.78	412.90	366.20	9.99	181.30
Minimum	6060	15.73	10.69	346.68	313.06	6.70	37.00
Maximum	12370	56.62	23.72	461.35	410.58	12.69	305.00
Range	6310.0	40.89	13.02	114.67	97.52	5.99	268.00
Standard Deviation	1622	12.19	3.90	33.48	28.52	1.81	100.56
Coefficient of Variation%	19.30%	35.93%	30.49%	8.11%	7.79%	18.11%	55.47%
Count	30	30	10	10	10	10	10

***Table 10**: 100x50 Abies grandis all Packets combined Strength and Stiffness Statistical Summary as Tested*

100x50 Abies Grandis Combined	Bending Stiffness MoE As a Joist MPa	Bending Strength MoR As a Joist MPa	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Distance from Pith mm
Average	7.62	32.47	11.70	390.22	349.29	10.45	100.75
Minimum	3.00	7.87	10.32	297.95	268.52	5.58	0.00
Maximum	12.37	65.27	23.72	463.40	412.44	17.69	385.00
Range	9.37	57.40	13.40	165.45	143.92	12.11	385.00
Standard Deviation	1.56	10.85	1.86	44.81	39.43	2.56	90.68
Coefficient of Variation%	20.47%	33.43%	15.90%	11.48%	11.29%	24.53%	90.01%
Count	180	180	60	60	60	60	60

Summary

1. Overall the 100x50 Abies grandis as tested for bending strength and stiffness could be assigned the Structural grade S6.
2. Potentially with machine stress grading some timber would be graded as SG8
3. The timber had been uniformly dried down 11-12 % moisture content.

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 2: Determination of characteristic values. Standards Australia/Standards New Zealand.

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

APPENDIX A: Raw Data

Table A1: *100x50 Abies grandis Packet* ***RSM04014*** *- Bending as a joist Strength and Stiffness*

Lab No	Width mm	Depth mm	Slope N/mm	Max Load N	Bending Stiffness MoEj MPa	Bending Strength MoRj MPa	Failure Description
291768	49.59	99.30	296.77	6176	7590	22.73	Grain
291769	49.48	97.73	390.14	16049	10490	61.13	Timber
291770	49.16	98.96	259.08	8165	6750	30.53	Grain - knot
291771	53.57	98.52	376.21	10469	9120	36.24	Edge knot Grain
291772	46.27	97.15	384.53	15835	11260	65.27	Grain
291773	49.76	100.40	371.95	10972	9170	39.37	Small knot
291774	53.79	99.84	370.92	9297	8610	31.21	Edge knot
291775	53.05	100.92	301.35	7113	6860	23.70	Edge knot
291776	51.66	99.19	266.86	6377	6570	22.58	Grain knot group
291777	49.98	98.87	266.70	8024	6860	29.56	grain
291778	49.78	98.87	254.01	8045	6560	29.76	knot group
291779	52.43	99.66	212.22	5191	5080	17.94	knot group
291780	49.58	100.33	241.76	7455	6000	26.89	Grain - small knots
291781	51.65	100.32	361.06	11487	8600	39.78	Face knot
291782	51.53	99.58	351.75	12184	8590	42.92	face knot
291783	50.15	100.23	326.49	10483	8030	37.45	grain
291784	49.49	100.48	381.71	12693	9440	45.73	timber
291785	50.55	95.95	251.62	5727	7000	22.15	edge knot
291786	50.00	94.74	372.93	13155	10890	52.76	timber
291787	47.22	96.84	401.39	12760	11630	51.87	timber
291788	50.09	92.29	210.68	4876	6650	20.57	grain
291789	49.53	100.22	268.62	7897	6690	28.57	knot group
291790	50.25	100.58	421.99	13370	10250	47.34	timber
291791	49.53	100.64	371.15	11233	9130	40.30	knot group
291792	48.37	96.80	409.95	15379	11610	61.08	timber
291793	49.56	99.13	307.04	10235	7900	37.83	edge knot
291794	48.12	99.68	380.35	14046	9910	52.88	grain
291795	48.48	98.70	357.71	11206	9530	42.71	edge knot
291796	49.58	98.76	293.85	10864	7640	40.44	grain
291797	52.90	97.54	289.62	9364	7330	33.49	knots

Table A2: *100x50 Abies grandis Packet* ***RSM04015*** *- Bending as a joist Strength and Stiffness*

Lab No	Width mm	Depth mm	Slope N/mm	Max Load N	Bending Stiffness MoEj MPa	Bending Strength MoRj MPa	Failure Description
291738	50.10	99.25	255	7087	6470	25.85	Grain
291739	50.70	99.09	119	2177	3000	7.87	Knot
291740	50.28	99.56	200	4441	5010	16.04	Knot Group
291741	50.43	100.09	247	8473	6060	30.19	Knot Group
291742	49.59	99.24	276	11454	7080	42.21	Grain close to knot
291743	52.36	99.74	422	12197	10100	42.15	Mechanical Damage
291744	49.02	100.25	313	8868	7860	32.40	Timber
291745	50.49	100.48	302	9223	7330	32.57	Timber
291746	49.70	100.60	325	9873	7990	35.33	Timber
291747	48.88	100.49	335	11883	8380	43.33	Timber
291748	53.64	106.11	409	8480	7930	25.27	Knot Group
291749	53.02	100.70	186	5124	4260	17.15	Knot Group
291750	52.20	100.69	296	7623	6910	25.93	Knot Group
291751	49.72	100.78	264	8848	6450	31.54	Timber
291752	49.74	100.16	301	10268	7480	37.04	Grain
291753	50.12	99.81	213	5071	5300	18.28	Knot Group
291754	50.15	100.63	336	9739	8170	34.52	Timber
291755	50.27	101.02	289	9418	6930	33.05	Knot Group
291756	50.91	101.09	345	9585	8160	33.16	Timber
291757	49.90	99.91	310	11648	7740	42.09	Timber
291758	50.05	100.80	261	6551	6320	23.19	
291759	50.03	100.95	320	10108	7710	35.69	Grain
291760	50.09	100.72	162	2478	3930	8.78	Knot
291761	50.55	100.58	258	8406	6240	29.59	Shear along pith
291762	51.28	100.71	389	14562	9220	50.40	
291763	47.84	99.93	174	5881	4520	22.16	Knot Group
291764	49.47	100.13	222	7663	5550	27.81	Timber
291765	49.77	99.38	220	6939	5590	25.41	Edge knot
291766	48.74	99.70	284	10536	7310	39.14	Face Knot
291767	49.65	95.48	295	11286	8470	44.88	

Table A3: *100x50 Abies grandis Packet* ***RSM04016*** *- Bending as a joist Strength and Stiffness*

Lab No	Width mm	Depth mm	Slope N/mm	Max Load N	Bending Stiffness MoEj MPa	Bending Strength MoRj MPa	Failure Description
291798	50.89	99.49	372	12874	9220	46.00	Clear
291799	51.48	97.96	301	9806	7710	35.73	Face knot
291800	48.87	97.98	371	13135	10010	50.39	Grain
291801	49.24	96.88	276	3436	7670	13.38	Edge knot
291802	49.66	98.55	356	10550	9310	39.37	knot
291803	49.81	98.52	332	10576	8650	39.38	knots
291804	48.46	99.92	255	8627	6550	32.10	knot group
291805	51.90	98.04	249	8915	6330	32.17	knot group
291806	52.93	100.43	350	11842	8100	39.93	grain
291807	52.64	99.26	309	8587	7460	29.80	grain
291808	49.90	99.53	243	7817	6150	28.46	knot
291809	50.54	100.78	391	11246	9390	39.44	knot group
291810	49.56	100.46	320	9364	7910	33.70	knot
291811	49.19	100.41	294	9089	7320	32.99	grain
291812	49.82	95.83	323	12599	9140	49.57	grain
291813	49.67	100.84	286	8654	6990	30.84	knot
291814	51.89	100.69	374	12097	8770	41.39	knot
291815	50.05	100.79	416	12593	10080	44.58	knot
291816	50.67	99.76	307	7797	7570	27.83	knot
291817	49.08	99.03	338	8654	8810	32.36	knot
291818	49.02	100.36	356	10871	8920	39.63	small knot
291819	46.64	101.14	399	11775	10260	44.43	Timber grain
291820	51.53	100.60	366	10362	8660	35.77	knot
291821	47.76	98.75	278	5727	7500	22.13	knot
291822	50.36	98.80	322	9739	8240	35.66	knot
291823	47.87	99.94	251	4294	6510	16.17	knot
291824	49.25	100.77	317	7395	7810	26.62	grain
291825	52.23	100.59	366	13390	8550	45.61	grain
291826	47.70	100.24	228	3630	5880	13.63	knot
291827	52.22	99.27	296	9036	7200	31.61	knot group

Table A4: *100x50 Abies grandis Packet* ***RSM04017*** *- Bending as a joist Strength and Stiffness*

Lab No	Width mm	Depth mm	Slope N/mm	Max Load N	Bending Stiffness MoEj MPa	Bending Strength MoRj MPa	Failure Description
291828	48.92	98.04	263	7207	7090	27.59	Knot Group
291829	48.82	98.76	272	6779	7180	25.63	Knot Group
291830	52.49	98.83	248	8004	6080	28.10	Timber
291831	47.99	98.18	249	6162	6810	23.98	Knot Group
291832	49.49	99.23	277	8433	7120	31.15	Grain
291833	47.90	99.70	279	6604	7290	24.97	Knot Group
291834	48.43	100.05	219	5466	5600	20.30	X grain
291835	49.61	100.58	215	5325	5290	19.10	knot group
291836	48.46	99.75	304	7924	7860	29.58	Grain
291837	49.20	99.55	256	10342	6550	38.18	Grain
291838	49.37	98.68	262	6270	6850	23.48	Knot Group
291839	49.37	99.85	354	7542	8950	27.58	edge knot
291840	52.53	100.21	247	4789	5800	16.34	x grain
291841	50.00	100.86	204	5633	4940	19.93	Knot Group
291842	52.51	100.06	249	6980	5890	23.90	Grain
291843	49.80	98.71	260	7482	6750	27.75	Knot Group
291844	49.69	100.44	252	6089	6210	21.86	Knot Group
291845	50.21	101.09	266	7703	6380	27.02	Grain
291846	49.14	98.45	344	10610	9110	40.10	Knot Group
291847	49.79	101.29	190	5010	4570	17.65	Grain
291848	51.39	100.22	298	11005	7160	38.38	Timber
291849	51.31	99.63	294	8152	7200	28.81	timber / knot
291850	52.70	99.76	239	6263	5660	21.49	Knot Group
291851	50.40	100.92	230	5894	5510	20.67	Knot
291852	49.42	100.65	352	11996	8680	43.13	Knot
291853	50.52	98.87	284	5225	7210	19.04	Knot
291854	52.30	99.80	342	11742	8160	40.57	Knot Group
291855	53.72	100.90	272	7361	6110	24.23	knot
291856	49.11	99.62	242	6544	6190	24.17	Grain
291857	49.13	99.09	261	6618	6790	24.69	Knot Group

Table A5: *100x50 Abies grandis Packet* ***RSM04018*** *- Bending as a joist Strength and Stiffness*

Lab No	Width mm	Depth mm	Slope N/mm	Max Load N	Bending Stiffness MoEj MPa	Bending Strength MoRj MPa	Failure Description
291858	49.54	99.95	312	8674	7840	31.55	Spike knot
291859	49.30	100.40	278	5915	6920	21.42	knot
291860	53.00	99.97	272	8882	6370	30.18	knot group
291861	48.24	99.86	183	2920	4720	10.93	local grain
291862	50.07	99.72	292	9364	7310	33.85	knot
291863	48.69	99.63	313	8286	8080	30.86	grain
291864	51.59	100.96	283	5318	6610	18.20	grain
291865	52.36	100.50	304	7180	7110	24.44	knot
291866	49.80	100.14	296	6370	7360	22.96	knot
291867	50.06	99.85	274	10463	6830	37.73	timber
291868	49.07	100.25	336	9465	8450	34.55	timber
291869	49.67	99.98	304	8031	7610	29.12	grain
291870	50.91	100.01	284	6069	6920	21.45	grain
291871	50.22	100.91	303	6357	7290	22.38	shear (photo)
291872	49.35	100.64	345	9759	8520	35.14	knot
291873	54.24	100.51	360	10074	8120	33.09	knot
291874	53.30	100.92	300	11186	6800	37.09	grain
291875	52.55	100.02	273	8031	6460	27.50	knot
291876	50.25	100.43	327	10315	7980	36.63	grain
291877	52.74	100.95	328	8319	7500	27.86	knot
291878	49.64	100.05	317	10516	7910	38.09	grain
291879	49.83	100.66	315	10871	7710	38.76	Compression
291880	50.35	100.19	308	9619	7560	34.26	grain
291881	48.35	100.08	266	5466	6830	20.32	knot
291882	49.86	100.58	353	13396	8630	47.80	timber
291883	52.55	98.75	283	7817	6950	27.46	grain
291884	49.69	100.19	283	12117	7020	43.73	timber - decay
291885	49.44	100.54	362	13524	8940	48.71	timber
291886	48.52	99.85	340	13805	8740	51.37	Timber
291887	48.93	100.12	239	8386	6050	30.78	Knot Decay

Table A6: *100x50 Abies grandis Packet* ***RSM04020*** *- Bending as a joist Strength and Stiffness*

Lab No	Width mm	Depth mm	Slope N/mm	Max Load N	Bending Stiffness MoEj MPa	Bending Strength MoRj MPa	Failure Description
291888	50.11	98.77	375	9987	9640	36.77	Knot
291889	48.75	93.26	344	12559	10800	53.32	Surface Decay
291890	46.53	98.37	351	10570	9830	42.26	edge knot
291891	47.36	99.59	315	8098	8360	31.03	edge knot
291892	48.75	99.92	340	11219	8690	41.49	grain
291893	52.64	98.05	320	11206	8010	39.86	timber
291894	50.71	98.15	352	13430	9120	49.49	timber
291895	46.88	100.47	250	6531	6540	24.84	grain
291896	52.47	100.25	258	5466	6060	18.66	Knot
291897	49.27	97.29	251	6470	6870	24.97	edge knot
291898	46.30	98.34	321	7053	9070	28.35	edge knot
291899	44.43	99.93	320	9377	8960	38.04	Knot
291900	49.79	100.26	372	10175	9210	36.59	grain
291901	49.30	100.52	272	4354	6740	15.73	grain
291902	49.39	98.83	375	13859	9760	51.71	timber
291903	50.57	98.10	385	9143	10020	33.82	grain
291904	52.54	99.34	337	9793	8130	34.00	timber
291905	52.37	100.83	276	6115	6390	20.67	grain
291906	49.02	100.81	363	9558	8980	34.53	grain
291907	49.56	100.63	265	5419	6510	19.44	edge knot
291908	49.38	97.80	460	14857	12370	56.62	grain
291909	49.47	98.68	249	4247	6490	15.87	edge knot
291910	50.74	98.95	396	13343	10010	48.34	grain
291911	52.09	100.10	262	6169	6220	21.27	knot / grain
291912	49.80	99.62	348	10710	8780	39.01	grain due to near knot
291913	50.08	97.43	308	7984	8260	30.23	edge knot
291914	48.90	98.97	240	4481	6300	16.84	knot
291915	51.20	99.42	284	5921	7000	21.06	knot group
291916	49.33	98.70	320	11869	8370	44.46	timber grain
291917	49.39	98.47	403	12901	10620	48.49	timber

Table A7: *100x50 Abies grandis Packet* ***RSM04014*** *– Wood Properties*

Lab No	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Average Distance from Pith mm
291768	11.66	381.66	341.82	9.9	60
291771	11.36	360.94	324.12	7.9	295
291774	12.52	420.39	373.63	9.7	255
291777	11.14	395.55	355.90	7.8	75
291780	12.23	370.10	329.76	9.4	130
291783	12.04	407.15	363.40	14.8	86
291786	13.03	454.06	401.70	11.0	83
291789	12.53	340.83	302.89	10.3	30
291792	11.83	436.73	390.54	7.7	95
291795	12.36	463.40	412.44	8.2	240

Table A8: *100x50 Abies grandis Packet* ***RSM04015*** *– Wood Properties*

Lab No	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Average Distance from Pith mm
291738	10.65	380.53	343.92	8.6	25
291741	15.14	373.79	324.66	12.4	25
291744	13.20	398.04	351.61	14.0	65
291747	11.81	450.42	402.84	8.8	62
291750	13.18	327.95	289.75	9.2	18
291753	12.15	345.23	307.83	6.4	105
291756	14.53	409.74	357.77	9.6	385
291759	13.40	381.20	336.16	5.6	80
291762	11.34	449.74	403.93	16.8	58
291765	11.53	331.43	297.17	9.9	0

Table A9: *100x50 Abies grandis Packet* ***RSM04016*** *– Wood Properties*

Lab No	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Average Distance from Pith mm
291798	10.81	428.30	386.52	7.9	50
291801	10.34	411.64	373.07	17.7	83
291804	10.98	357.16	321.83	14.4	50
291807	10.70	408.87	369.35	11.9	22
291810	11.51	414.12	371.39	10.7	53
291813	10.96	297.95	268.52	9.1	40
291816	11.31	400.47	359.79	9.4	55
291819	10.71	444.88	401.85	14.3	300
291822	10.56	363.18	328.48	13.6	100
291825	10.63	372.36	336.58	12.0	92

Table A10: *100x50 Abies grandis Packet* ***RSM04017*** *– Wood Properties*

Lab No	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Average Distance from Pith mm
291828	10.52	319.31	288.91	9.8	43
291831	10.83	325.70	293.86	11.2	25
291834	11.75	411.08	367.87	12.4	45
291837	11.12	393.00	353.66	14.2	10
291840	10.99	329.82	297.17	11.2	45
291843	10.56	306.15	276.91	9.5	29
291846	11.55	421.27	377.66	9.5	160
291849	11.01	359.80	324.11	9.6	52
291852	11.38	433.15	388.89	8.9	55
291855	10.90	411.24	370.84	11.1	5

Table A11: *100x50 Abies grandis Packet* ***RSM04018*** *– Wood Properties*

Lab No	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Average Distance from Pith mm
291858	10.75	309.41	279.37	9.0	120
291861	10.32	330.74	299.80	7.8	10
291864	10.83	387.45	349.58	16.0	74
291867	11.03	428.53	385.95	10.2	115
291870	11.00	310.97	280.16	8.2	35
291873	10.68	390.18	352.54	14.0	44
291876	10.68	330.31	298.45	9.1	95
291879	10.46	437.40	395.99	9.7	58
291882	10.93	422.01	380.43	8.9	75
291885	11.05	449.02	404.33	7.4	120

Table A12: *100x50 Abies grandis Packet* ***RSM04020*** *– Wood Properties*

Lab No	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Average Distance from Pith mm
291888	10.69	380.10	343.38	6.7	275
291891	10.74	346.68	313.06	9.0	42
291894	11.66	418.78	375.06	11.7	305
291897	12.53	414.20	368.07	9.8	182
291900	12.37	461.35	410.58	11.7	270
291903	23.72	431.23	348.56	12.7	202
291906	12.17	452.44	403.34	8.5	37
291909	11.40	401.15	360.08	9.5	153
291912	11.30	401.44	360.69	11.2	267
291915	11.20	421.63	379.17	9.2	80