Specialty Wood Products Research Partnership

SCION FORESTS ▪ PRODUCTS ▪ INNOVATION

Fastigata Veneer Stiffness

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FOREST GROWERS RESEARCH

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FOREST GROWERS RESEARCH

EXECUTIVE SUMMARY

UPT on its own is measuring both changes in density and changes in MoE, thus without an independent density measurement it is not possible to reliably determine veneer stiffness. If the UPT is combined with density, it is reasonable to assume the quality of the MoE prediction will be significantly improved.

As the UPT to stiffness relationship is affected by density, there will be different relationships between UPT and stiffness for different species. Thus the relationship obtained for these Fastigata veneers cannot be used outside the data set it was determined on.

INTRODUCTION

The scope of this project was to understand the relationship between the JNL ultrasonic propagation times (UPT) as collected from their veneer grade and the actual veneer modulus of elasticity (MoE).

With a robust relationship it should be possible to take veneer UPT values and convert them into modulus of elasticity which could them be used as an input into Scion's LVL stiffness model. This model aims to take an inputs of veneer stiffness, customer LVL stiffness requirements and then make decisions around the likely suitability of the veneer resource.

METHODS

Juken New Zealand (JNL) supplied Scion with 100 dry 2.53m x 1.3m wide x 4.0mm thick Fastigata veneers. These veneers were individually numbered by JNL and had been run thorough JNL's Metriguard veneer grader, a data file containing the ultrasonic propagation times (UPT) was supplied to Scion.

At Scion each veneer was weighed and three time of flight measurements were taken along the length veneer sheets.

From this information Scion was able calculate the average veneer modulus of elasticity (MoE) for the each veneer from the equation

Modulus of Elasticity (MoE) = Density / Velocity^2.

RESULTS

The following figures plot;

- Figure 1 plots JNL's UPT times against Scions calculated stiffness (MoE).
- Figure 2 plots JNL's UPT times against Scions Time of Flight measurements (ToF).

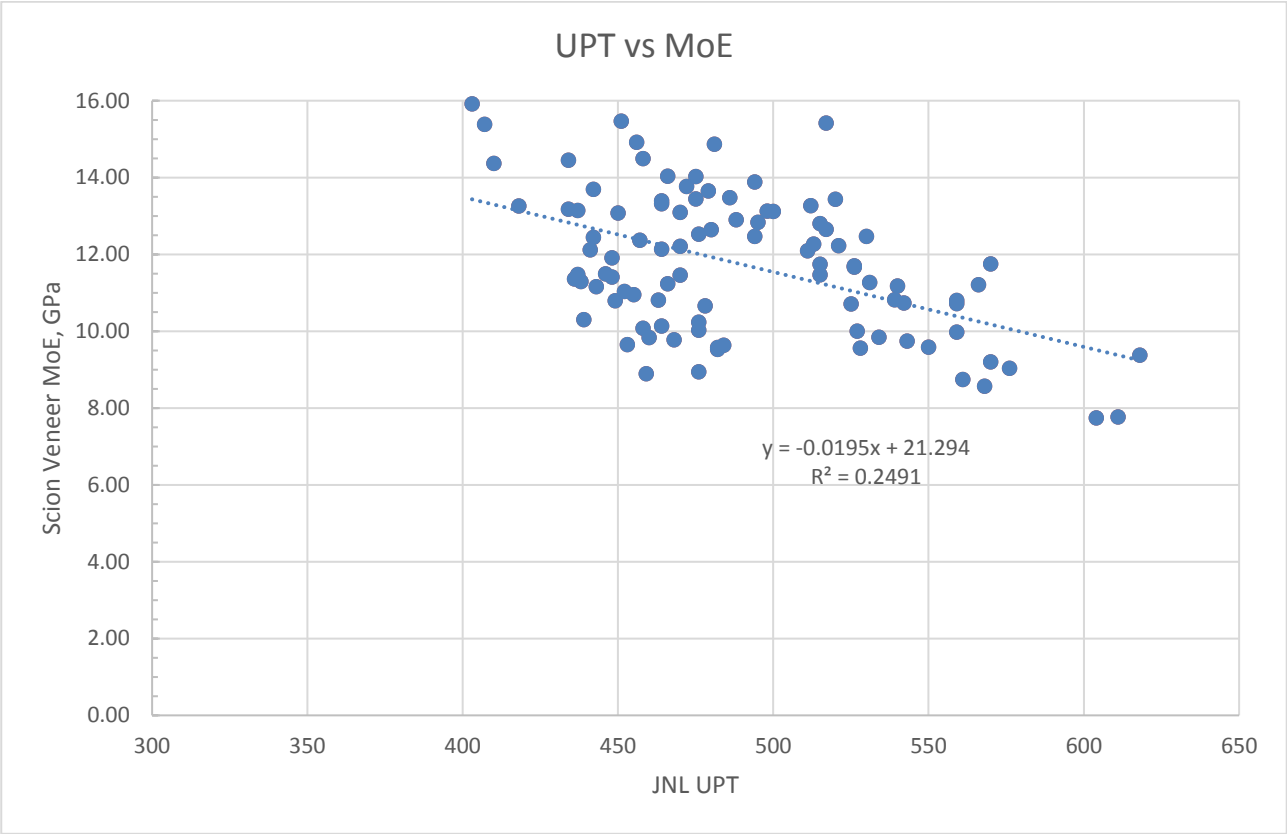

Figure 1: *Plot of JNL UPT vs Scion MoE*

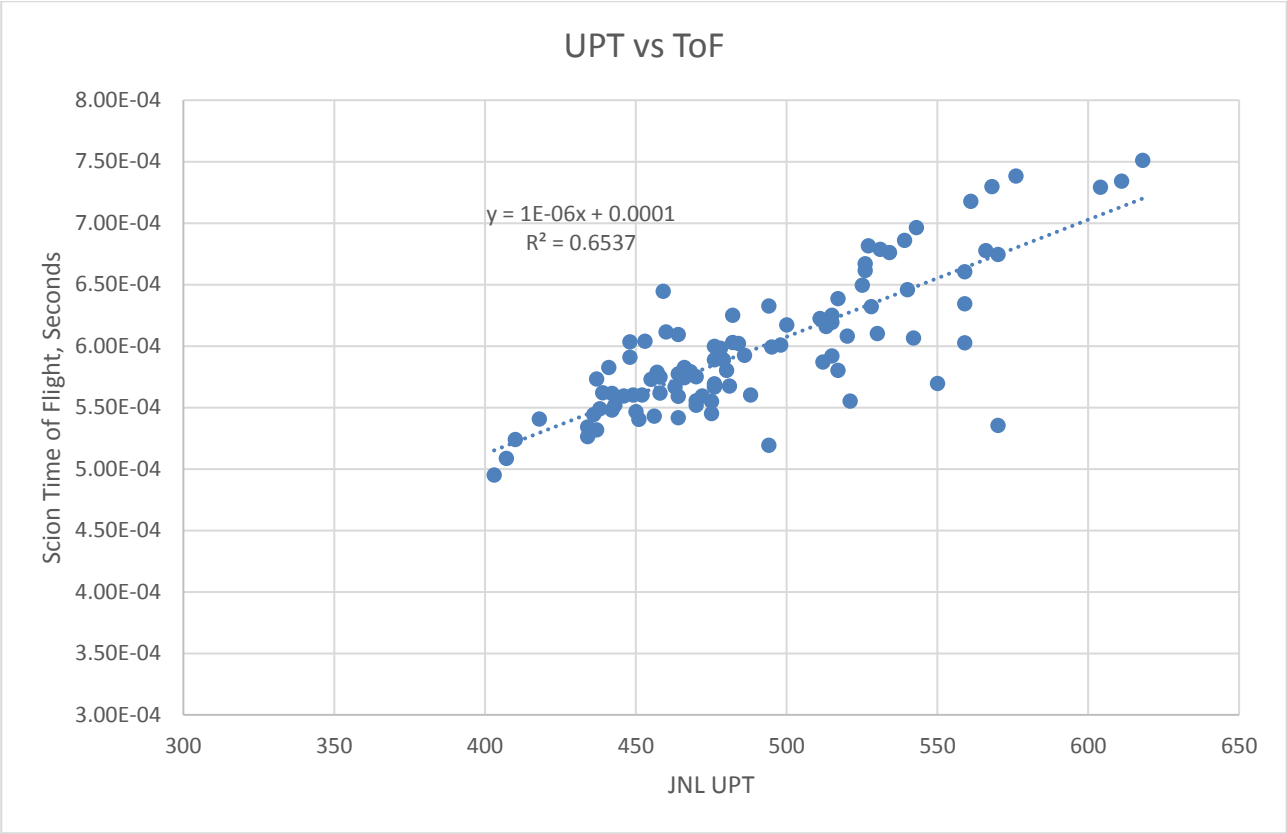

Figure 2: *Plot of JNL UPT vs Scion Time of Flight (ToF)*

Observations

1. As expected as the UPT decreases the MoE increases as speed of sound is quicker thorough denser and stiffer materials but with a relativity poor correlation coefficient ($R^{2)}$ of 0.25.
    a. For instance for an UPT time of 450 you could get veneers ranging from 10 to 15GPa.
    b. For instance for a MoE of 12GPa the UPT could vary between 440 and 530.

2. There is a reasonable correlation between JNL's UPT values and Scions ToF measurements with a correlation coefficient $R^2 = 0.65$ which indicates that JNL Metriguard is collecting reasonable data.

CONCLUSION

UPT on its own is measuring both changes in density and changes in MoE, thus without an independent density measurement it is not possible to reliably determine veneer stiffness. If the UPT is combined with density, it is reasonable to assume the quality of the MoE prediction to be closer to that in Figure 2.

As the UPT to stiffness relationship is affected by density there will be different relationships between UPT and stiffness for different species. Thus the relationship in Figure 1 cannot be used outside the data set it was determined on.

APPENDICES

Appendix: Test Data

Average speed (m/s)	Density (kg/m3)	MoE, GPa
4.73E+03	5.26E+02	11.74
4.90E+03	5.79E+02	13.88
4.56E+03	5.88E+02	12.22
4.65E+03	6.49E+02	14.02
4.56E+03	6.46E+02	13.44
3.72E+03	6.53E+02	9.02
5.41E+03	6.72E+02	19.64
3.55E+03	7.60E+02	9.58
3.37E+03	8.25E+02	9.38
3.32E+03	8.19E+02	9.03
3.83E+03	7.97E+02	11.66
4.10E+03	6.99E+02	11.74
4.11E+03	7.26E+02	12.27
3.21E+03	7.52E+02	7.76
3.78E+03	7.84E+02	11.21
3.67E+03	8.17E+02	11.03
3.78E+03	7.89E+02	11.27
3.99E+03	7.96E+02	12.64
3.83E+03	7.97E+02	11.70
4.14E+03	7.65E+02	13.12
4.03E+03	7.69E+02	12.47
4.24E+03	7.13E+02	12.83
4.21E+03	7.40E+02	13.12
3.57E+03	6.86E+02	8.74
4.05E+03	7.80E+02	12.80
3.72E+03	7.84E+02	10.82
4.27E+03	7.38E+02	13.47
3.67E+03	7.24E+02	9.74
3.47E+03	7.11E+02	8.57
4.32E+03	7.30E+02	13.64
4.08E+03	7.26E+02	12.09
4.66E+03	6.87E+02	14.91
4.51E+03	7.11E+02	14.49
3.75E+03	7.01E+02	9.84
3.71E+03	7.24E+02	10.00
3.90E+03	7.05E+02	10.71
4.31E+03	7.15E+02	13.27
4.53E+03	6.48E+02	13.31
4.53E+03	6.70E+02	13.76
3.47E+03	6.43E+02	7.74
4.15E+03	7.25E+02	12.47

Average speed (m/s)	Density (kg/m3)	MoE, GPa
3.83E+03	6.79E+02	9.97
4.46E+03	7.48E+02	14.87
4.68E+03	7.05E+02	15.46
4.41E+03	7.21E+02	14.03
3.75E+03	6.54E+02	9.20
3.92E+03	7.28E+02	11.17
3.99E+03	6.79E+02	10.80
4.37E+03	8.06E+02	15.42
4.17E+03	7.72E+02	13.43
4.20E+03	6.07E+02	10.71
4.01E+03	5.95E+02	9.56
4.18E+03	6.14E+02	10.73
4.52E+03	6.32E+02	12.90
4.59E+03	6.23E+02	13.09
4.47E+03	6.27E+02	12.52
4.67E+03	6.13E+02	13.39
4.27E+03	6.28E+02	11.47
4.36E+03	6.64E+02	12.64
4.40E+03	6.29E+02	12.20
4.40E+03	6.26E+02	12.13
4.37E+03	6.47E+02	12.36
4.35E+03	5.94E+02	11.23
4.06E+03	5.81E+02	9.58
4.35E+03	6.41E+02	12.11
4.30E+03	6.18E+02	11.40
4.73E+03	6.45E+02	14.45
4.16E+03	5.68E+02	9.83
4.20E+03	5.40E+02	9.52
4.42E+03	5.87E+02	11.47
4.63E+03	5.81E+02	12.44
4.70E+03	5.99E+02	13.25
4.98E+03	6.20E+02	15.38
4.84E+03	6.13E+02	14.36
5.11E+03	6.10E+02	15.91
4.22E+03	5.02E+02	8.94
4.41E+03	5.19E+02	10.07
4.38E+03	5.10E+02	9.77
4.58E+03	5.31E+02	11.15
4.52E+03	5.28E+02	10.79
4.65E+03	5.26E+02	11.36
4.61E+03	5.31E+02	11.29
4.51E+03	5.06E+02	10.30
4.81E+03	5.70E+02	13.17
4.43E+03	5.58E+02	10.95
4.76E+03	5.79E+02	13.14

Average speed (m/s)	Density (kg/m3)	MoE, GPa
4.53E+03	5.60E+02	11.49
4.17E+03	6.16E+02	10.70
3.93E+03	5.76E+02	8.89
4.51E+03	6.72E+02	13.69
4.23E+03	6.65E+02	11.90
4.11E+03	5.96E+02	10.09
4.26E+03	5.87E+02	10.65
4.63E+03	6.09E+02	13.07
4.23E+03	5.40E+02	9.65
4.44E+03	5.18E+02	10.23
4.56E+03	5.52E+02	11.45
4.22E+03	5.41E+02	9.63
4.17E+03	5.83E+02	10.13
4.46E+03	5.42E+02	10.80
4.30E+03	5.42E+02	10.02
4.53E+03	5.39E+02	11.04