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Benchmarking the wood properties of radiata pine plantations: Tasmania Summary Report

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www.fwprdc.org.au
FWPRDC
PO Box 69, World Trade Centre
Melbourne 8005, Victoria
T +61 3 9614 7544 F +61 3 9614 6822

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Researchers:

D. Cown, R. McKinley, M. Kimberley, P. Hodgkiss
Ensis
49 Sala St, Rotorua, New Zealand

G.Downes, J. Bruce, M. Hall
Ensis
Private Bag 12, Hobart, Tasmania 7001

D. McConchie
Wood Quality Focus
PO Box 6274, Rotorua, New Zealand

M. Lausberg
Consultant

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Forest and Wood Products Research and Development Corporation
PO Box 69, World Trade Centre, Victoria 8005
Phone: 03 9614 7544 Fax: 03 9614 6822 Email: info@fwprdc.org.au
Web: www.fwprdc.org.au

Benchmarking the wood properties of radiata pine plantations: Tasmania

Summary Report

Prepared for the

Forest & Wood Products
Research & Development Corporation

by

D. Cown, R. McKinley, G. Downes, M. Kimberley, J. Bruce, M. Hall,
P. Hodgkiss, D. McConchie, and M. Lausberg

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EXECUTIVE SUMMARY

Objectives

The major project objective was to:

- Identify the major sources of variation in wood properties affecting structural lumber recoveries across Tasmania (within and between sites) in crops within 10 years of harvest. The sources to be examined were environmental effects (latitude, altitude, rainfall, soil type) and between and within stem variation.

Subsidiary objectives were:

- Validate the use of standing tree tools as a means of predicting the log (and by inference, lumber) stiffness.
- Validate the density algorithm and customise for the Tasmanian resource.

Key Results

In discussion with the two major companies, Rayonier and Norske Skog, twenty-six sites within ten years of harvest (20 to 31 years old) were selected for non-destructive field sampling across the main plantation forest areas of Tasmania. The assessments included visual observations of crown characteristics (branch size and distribution) and breast height diameter, standing tree acoustics (ST300 and IML Hammer) and wood density cores (5mm).

Outerwood cores and standing tree acoustics (two tools[1]) were used across all sites to give non-destructive assessments of aspects of stand quality. A high degree of variability was found in all the characteristics measured, but both approaches gave similar rankings of stands. While the two standing tree acoustic tools gave different values (different by about 0.5km/sec) the correlations between them were very good (79% for individual stems; 88% for site averages), indicating a fairly robust relationship. The correlations between outerwood density and the two standing tree acoustic tools were also very good at the site level (80% and 81% at the site mean level), proving that the two approaches give very similar results. However, the relationship at the single tree level was only fair (44%).

Across twenty sites, a sample of five stems was felled for the measurement of stem and log acoustics (5m logs). In addition, wood discs (from breast height and 5m intervals from the butt to 100mm top diameter) were collected. The average site log acoustics followed the same pattern as the average site standing tree values and both tools showed relatively high correlations with log and stem values (IML Hammer: r^2 = 80%; ST300: r^2 = 74%). Outerwood density was a very good predictor of weighted stem density (r^2 = 74%) and also had a reasonable relationship with the average stem sonic value (r^2 = 55%). Disc samples were used for an assessment of log and stem wood density to allow the measurement and to provide information on density and spiral grain gradients within stems. The correlations of outerwood density to log and stem densities were very good (outerwood prediction of stem density – r^2 = 74%; S.E. 15 kg/m^3).

Wood properties followed the expected gradients within and between trees, but the Green Triangle wood density algorithm was found to slightly over predict stem average density, and was customised to provide better predictions from outerwood core density.

Additional outerwood samples (48 sites) were obtained from the two companies and used to extend the scope of the survey by including more and younger stands (down to 15 years old). The customised Tasmanian wood density algorithm was used to predict stem density at a uniform rotation age (30 years). This exercise showed that while there is less variation across the resource at a constant age, there are still significant differences due to factors such as site type, silviculture (fragmentary information) and, potentially, seedlot (not recorded). The Green Triangle report

[1] ST300 from 30 trees/plot; IML from 5 felled trees/plot only

indicated that outerwood density (assessed by SilviScan) is a good indicator of average board stiffness (r^2 = about 70%). As outerwood density is still increasing up to at least 30 years in Tasmania, a strategy to increase stiffness is to increase stand age. Small differences were found in the average properties of the three main growing areas (northeast, northwest and south), but the greatest sources of variation were the between and within-tree variation. Thinning in semi-mature stands will also increase the volume of stiffer outerwood on individual stems.

An analysis of site factors revealed that of the measurements collected, site altitude (negative) and mean annual temperature (positive) were significantly related to structural properties. Rainfall was not correlated with wood density or acoustic velocity. A simple model has been developed to predict outerwood density using average maximum temperature, site index and age (r^2 = 74%)

Previous studies have shown good correlations between log sonic readings and lumber grade recovery, so it can be assumed that the standing tree values are also indicative at least of relative recovery of structural grades. An unknown factor is the influence of knots on the sonic readings. While they are known to affect actual board stiffness grades (particularly in NZ), definitive studies have not yet been completed on the effect on stem or log acoustics. Branch sizes in the Tasmanian resource are relatively small, and may not be very influential.

An opportunity was taken to document some other wood properties in the sample trees – spiral grain, branching characteristics, resin blemishes.

Application of Results

Since there is a lot of confidence in using wood density to predict stiffness, it is recommended that density information be included as a management tool in determining harvest age. For instance, current and predicted outerwood density or velocity values could be used to influence silvicultural decisions (such as thinning and rotation length). Stands could be identified which might be marginal for the production of structural logs and in which acoustic segregation using log sonics will be required (in forest or at mill). This approach needs to be validated for the region by undertaking some targeted batch sawing studies where the stands and log batches have been carefully selected. This would allow companies to put some hard numbers around the relationship between stand density and grade recovery.

The use of the standing tree acoustic tools is fast and convenient in the forest, and could potentially be a tool for identifying stems for thinning, but at the moment the information cannot be "grown forward" as for density, and so is of limited strategic value. In future, confidence may be gained in the use of standing tree acoustic tools, and an algorithm may be developed, but currently they cannot be used with confidence to predict log and board stiffness into the future.