# The Relief of Growth Stresses in Young Hardwood Logs

By

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# CERTIFICATE OF AUTHORSHIP /ORIGINALITY

I certify that the work in this thesis has not been previously submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of this thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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# ABSTRACT

The efficient utilisations of broadleaved plantation logs, mainly the 20 to 35 year old eucalyptus, require the relief of growth stresses before sawing. Analysis of the effect of growth stresses shows that the presence of longitudinal stresses causes bending of boards, encountered when sawing a log longitudinally because the fibres closer to the pith of the tree expand, and those closer to the outside contract.

The new engineering approach used in this research project is based on well known engineering principles. The growth stresses create forces to push the wood to the outside direction resulting in the distortion of the board sawn longitudinally. Consequently, if a force is created in the inside direction to balance the force exerted by the growth stresses, then boards can be sawn straight. This was possible by creating a minimal amount of drying acting on the layer of the cambium, where most nutrients and moisture exist in the tree, hence the largest amount of water.

The drying process used was a microwave drying that dries first the area which contains the largest amount of water. The microwave heating causes the sapwood to dry before other areas of the tree trunk, which balance the growth stresses.

The research project was carried out in two stages. Initially, in the preliminary research stage, the technique was applied to small samples, 350 mm long specimens of young trees to prove the concept before embarking on commercial sized samples. Finally, commercial sized specimens, 2.5 meter in length were tested.

The measuring technique developed by Yoshida & Okuyama (2002) combined with hand sawn grooves inserted to relieve the stress instead of holes was used to measure the strain in samples.

The results of the preliminary research showed that 70.6% reduction in the strain could be obtained by a microwave drying treatment on the samples by reducing the sample weights by only 0.5% of the original green weight.

Logs were dried by about 2% of their green weight during the commercial sized specimens' research. This did not change the moisture content of the logs by much and treated logs were above the 50% moisture content and nearly considered as green condition. Additionally, the treatment had no adverse effects on the rigidity of the boards sawn from treated logs. The average MOE (Modulus of Elasticity) of five

treated boards was found to be higher by 10% than the average MOE of five untreated boards which confirmed that the integrity of the natural wood was not compromised in the treatment process.

The treatment reduced the strain by 132%. Therefore, since the strain is a function of stress, it follows that the treatment had successfully reduced the stress in logs of timber as well as the strain.

Furthermore, treatment had also reduced distortion in 50 mm boards by 145% and by 200% in 25 mm boards.

The technique developed during this research program was carried out as one process and consumed only 137kW/$m^3$. Furthermore, it relieved the growth stresses effects by comparing the strain before and after treatment. Also, the distortions measured in the treated boards were far less than the distortions measured in the untreated boards.

The great advantage of this treatment is in its simplicity and practicality. The treatment procedure is to reduce the weight of the logs by only 2%. In general, sawmills receive their supply of logs with known weights, so to reduce it by 2% would be a simple mathematical exercise.

A mathematical model of a polynomial function based on the experimental results was developed and used in this research project to express the distortion at the middle of the board as a function of major variables, namely, length, diameter, area, weight, density, moisture content, loss of moisture content during treatment and time of treatment.

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