Strategic Integrated Research in Timber

Effects of drying on the dimensional stability of discs of Spruce wood

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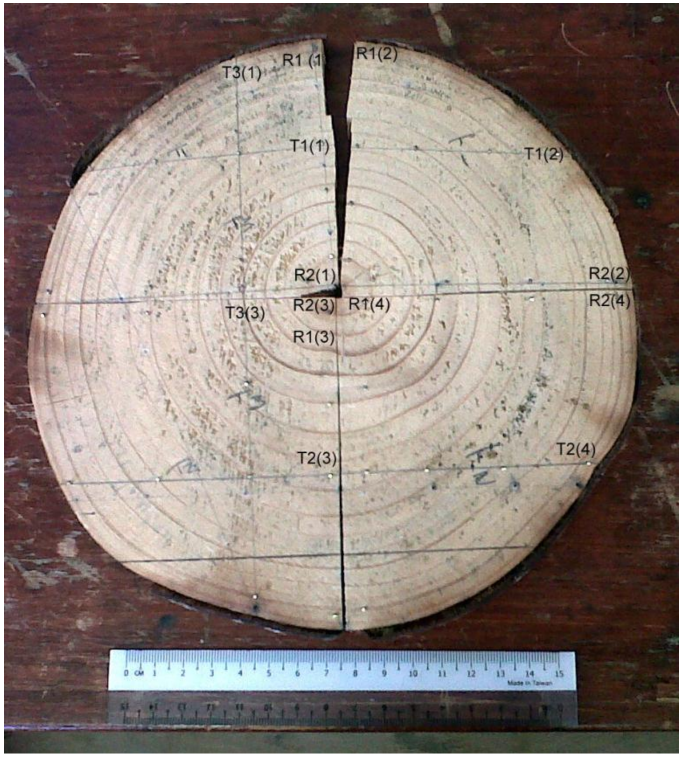


Problem of distortion

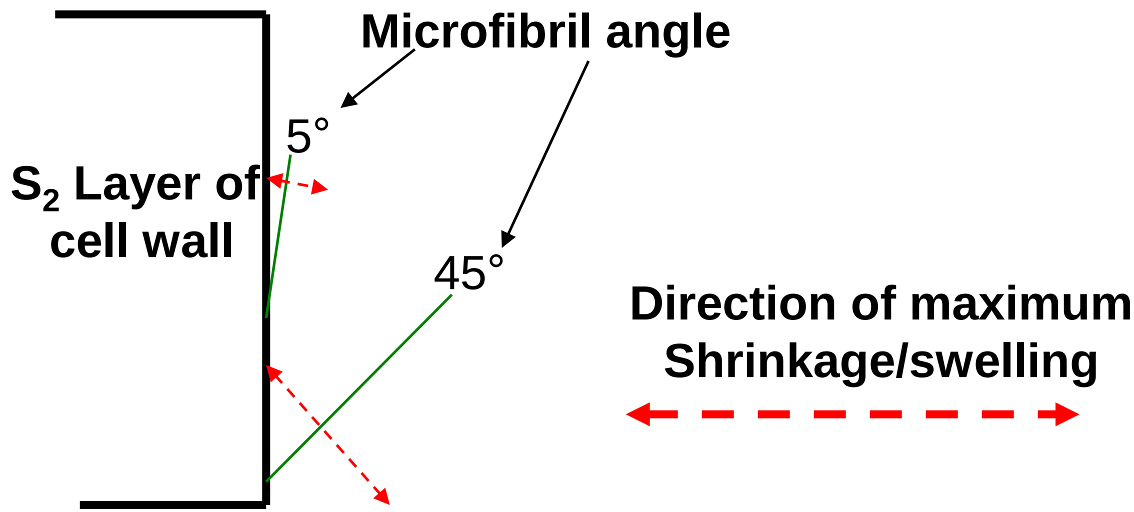
- Kiln drying of Spruce wood often results in distortion

- Shrinkage occurs when moisture content passes through fibre saturation point (FSP) until equilibrium moisture content (EMC) is achieved

- The effects of the drying beyond FSP are still not fully understood in relation to the commercial drying of wood

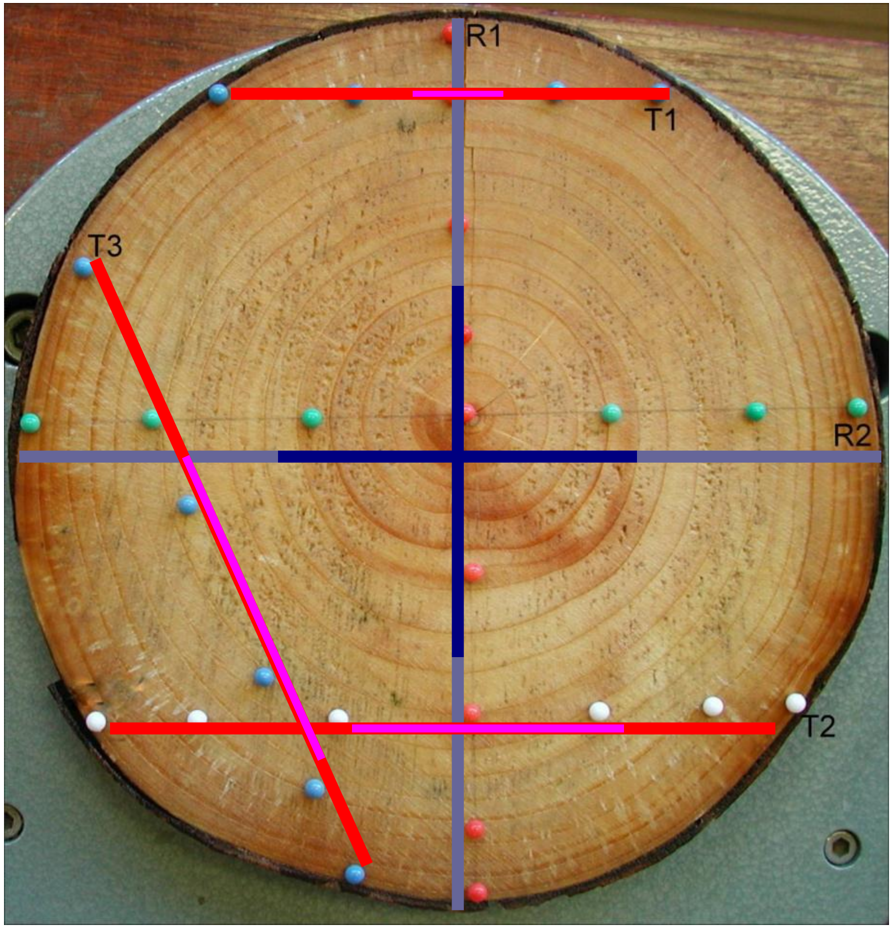
Two possible mechanisms that may influence distortion on shrinkage;

(1); an increase in shrinkage, in both radial and tangential directions, with distance from the centre of the disc, consistent with increasing microfibril angle (MFA)



Shrinkage due to water lost from the cell-wall matrix is greatest at 90° angles to the MFA, therefore the degree of shrinkage is dependant on the variation in MFA. This gives rise to internal stresses within logs or discs which are released when cracks develop or when wood is sawn.

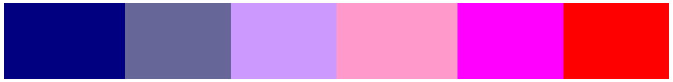
Mechanism(2) Greater shrinkage in the tangential than in the radial direction throughout the disc.



Example of possible patterns of shrinkage suggested by mechanism (2)

Microfibril angle or its effect on shrinkage must differ between the radial and tangential planes for this mechanism to operate

Increasing level of shrinkage

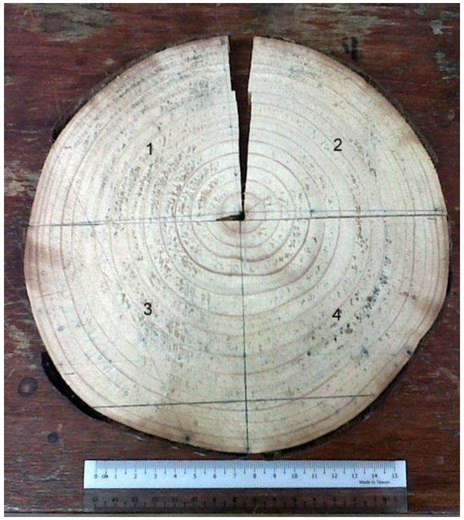


Low **High**

Method

To investigate the origins of these stresses a disc of Sitka spruce was pinned along the radial and tangential planes, allowed to reach FSP and then left to dry to EMC.

The same disc was then quarter sawn and the experiment repeated to assess the impact of the release of stresses within the disc.

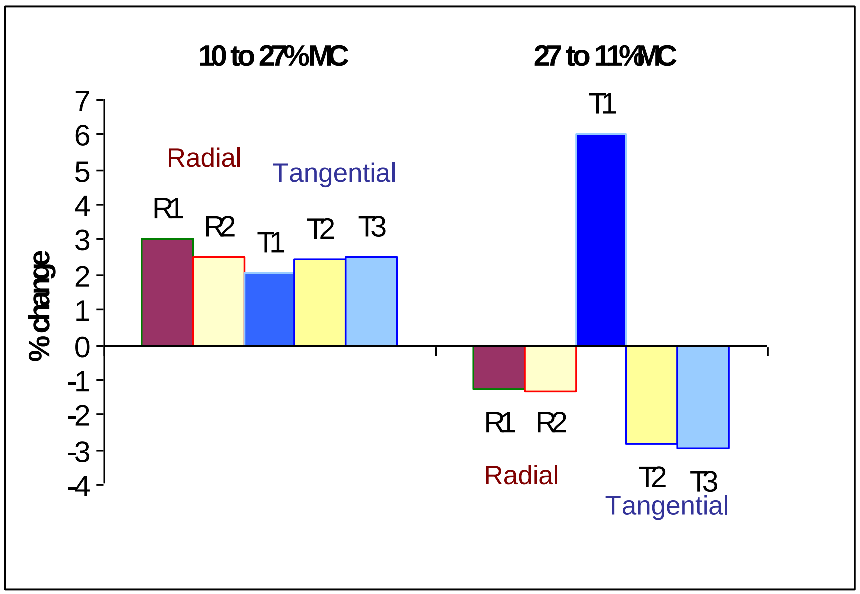


Results

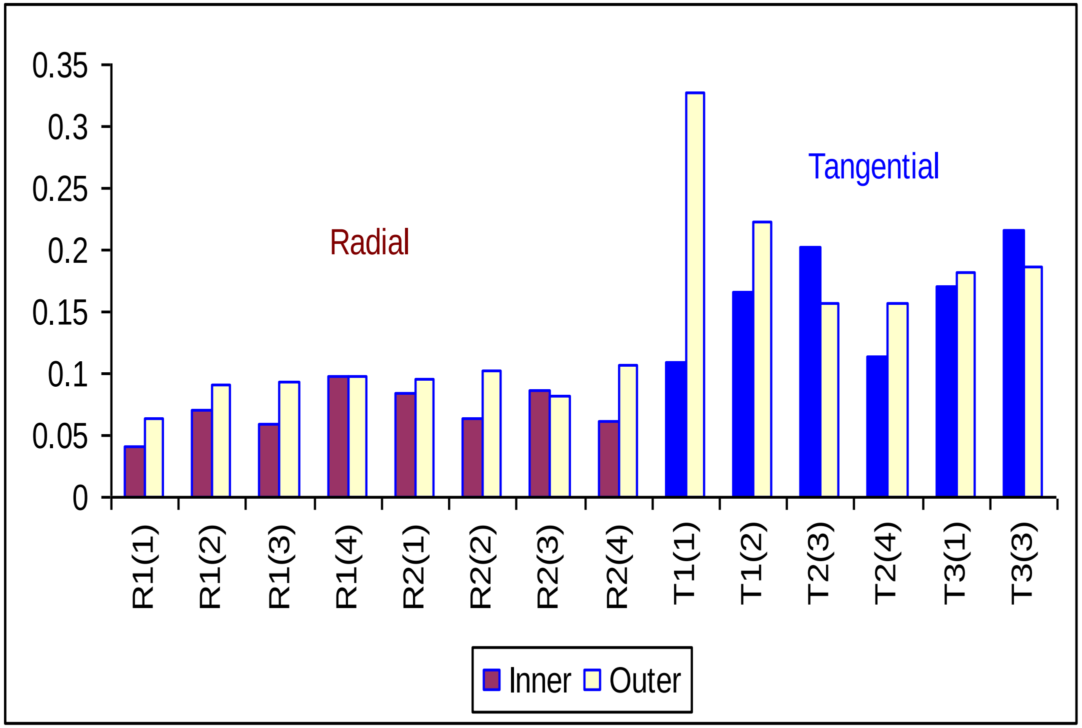
Prior to experimentation 2 possible mechanisms were proposed;

(1) An increase in shrinkage in both directions with distance from the centre of the disc, consistent with increasing microfibril angle

(2) Greater shrinkage in the tangential than in the radial direction throughout the disc



On the left, the intact disc shows less variation between radial and tangential swelling than on the right where a crack has developed at T1.
Tangential shrinkage is roughly double that of radial after tension has been released.



Approximate area of measurements;
Inner and **Outer**

Variation in measurements taken near to the pith (inner) compared with those taken nearer the bark (outer) in a quartered disc. Mean radial shrinkage was greater in the outer than in the inner part of each segment (p = 0.02)

Conclusions

As soon as a radial crack dissipated some of the tension, tangential shrinkage exceeded radial shrinkage by nearly a factor of two.

Radial shrinkage was significantly less in the inner than in the outer part of the disc but this effect was small compared to the difference between radial and tangential shrinkage.

The results support the theory suggested by mechanism (2); that differences in MFA between radial and tangential planes or other unknown differences, appear to effect greater shrinkage in the tangential direction than in the radial direction.

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