THE EFFECT OF INITIAL GREEN STATE MOISTURE GRADIENTS ON STRESSES IN TIMBER BOARDS DURING DRYING

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ABSTRACT

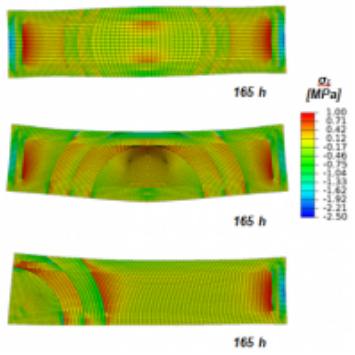
For timber boards consisting of both heartwood and sapwood, a rather large initial difference in moisture content [MC] over the cross section can be present in the green state. Larsen and Ormarsson [2013] showed that such a variation has a marked effect on the development of strains, stresses and cracks during the drying process.

In order to simulate the moisture related stresses during kiln drying, both an experimental and numerical approach were employed. The aim of the experiments was to explore the dependence of the temperature and the humidity on the water flux in the radial and tangential material directions. The data were retrieved from Norway spruce samples exposed to temperatures of 20, 60 and 90 degrees Celsius, and relative humidity's of respectively 70, 80 and 90%.

The numerical approach consists of a new simulation model of the transient moisture flow which was linked with the distortion model developed earlier by Ormarsson [1999]. Rectangular timber boards were studied, containing 4 sub-volumes (heartwood, two transition zones, and sapwood) each with a unique location of the pith. The sub-volumes were distinguished by individual material properties.

Three simulations were performed to verify the influence of the sawing pattern and the shrinkage coefficients on the stress variation during the drying process. Attention was paid primarily to the tangential stress variation.

The simulations of the boards showed that the variation of the MC in the initial green state, the shrinkage coefficients, and the sawing patterns of the log have a marked effect on the stress development in the tangential direction during drying. With use of a climate chamber and a digital image correlation system the obtained computational strain fields will be verified under well-defined climatic conditions.



References

[1] Larsen F. and Ormarsson S.: Numerical and experimental study of moisture-induced stress and strain field developments in timber logs. Wood Science and Technology, 2013.
[2] Ormarsson S., Numerical analysis of moisture-related distortions in sawn timber. PhD Thesis. ISBN 91-7197-834-8. Göteborg, Sweden, 1999.