

## Abstract

The main objective of this research is to develop an automatically wood drying controlled system by using internal stress information obtained from the restoring force measurement. The developed system is capable of controlling the magnitude of the restoring force in the first stage of drying before stress reversal. Vents are continuously opened if the force magnitude is smaller than the predetermined value. On the other hand, once the force magnitude is greater than the set value, vents are then closed and if necessary steam is introduced to increase humidity inside the drying kiln. In a two-step drying schedule, the restoring force is controlled at a particular level in the first stage of drying followed by a more severe drying in the second stage after stress reversal. However, it was found that the final restoring force value left within the lumber after drying using this two-step drying schedule is approximately at the same level as using the severe drying schedule for the entire drying process. In the early stage of drying prior to stress reversal, there are some moments that humidity inside the drying kiln is relatively low causing an abrupt change in the force magnitude. It was observed that not only the magnitude of the force but also a rate of changing in the restoring force in the early stage that affects the final restoring force value obtained in the second stage of drying under the severe drying condition. In order to limit the magnitude of the internal stress in the second drying stage, the author proposes an algorithm to control both the magnitude and the rate of the restoring force in the early stage of drying. By this means, the final value of the restoring force after drying is largely unaffected by the severe drying schedule performed in the second stage of drying. Examination of drying rate of the lumber during drying reveals that moisture content of the lumber decreases quickly in the first stage of drying. After reaching the fiber saturation point, the drying rate of the lumber becomes very much slower. Furthermore, the drying schedules containing more periods of relatively high humidity during the first stage of drying usually produce longer drying times. Therefore, controlling of the internal stress level within lumber must be compromised with the reduced drying rate of lumber during the drying process.