Determining Moisture Content of Laminated Veneer Lumber (LVL)

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Summary

The purpose of this study is to investigate the moisture properties of LVL and the correlation between moisture sensor readings and the actual moisture content determined from accurate weighing of the samples. Laboratory measurements were made of two different wooden materials using 20 identical sensors. The test was conducted on samples of LVL flanges and samples of pine lumber. The test results show for the LVL samples, that the resistance values given by the resistance method were too high compared to the more accurate gravimetric method. Conversely, the measured values were too low for the pine and spruce samples.

Key words: Building physics; Structures and materials; Moisture Introduction

1. Introduction

This paper examines the differences between measuring moisture content by the gravimetric method and the resistance method, respectively, and possible causes of these differences. It also investigates the difference between the moisture content of mixed spruce/pine LVL and pine lumber (*pinus sylvestris)* according to the resistance method, and whether the glue between the veneer layers in LVL can affect the conductivity of the material.

There are two assumptions made in the gravimetric method: that the water is completely removed by oven drying and that only water is removed, and that no other parts of the material are affected during the measurement period.

This paper examines the following research questions:

1. What are the differences between the measured moisture absorption in LVL and pine?
2. To what extent do the resistance method and the gravimetric method give different results for the two materials?
3. What causes electric resistance measurements of LVL to give different moisture content readings to wood?

The tests were limited to investigating moisture absorption properties, as desorption studies were deemed infeasible, given the practical constraints of the study. Scots pine (*pinus sylvestris)* lumber was used as reference sources, which may cause results to deviate slightly from studies conducted of southern yellow pine (SYP) or other spruce lumber. Only one type of electric resistance sensor was used in the research. The main motivation for the research was to establish correlation curves in order to evaluate the moisture performance of the compact wooden roofs with smart vapour barrier pilot projects going on in Norway.

2. Methods

The paper is based on a laboratory experiment and a literature search concerning moisture in wood. Laboratory measurements were made of 20 pieces of wood. The test was conducted mainly on the LVL, but also on six pinewood samples, to compare the results.

The laboratory measurements took place in the lab of SINTEF and NTNU in Trondheim. By placing the test samples in different climates, between 23% to 98% relative humidity (RH), data from the sensors and from weighing each sample could be used to determine the connection between the measuring methods. See Figure 1. The system's operating temperature of 23°C is maintained within a tolerance of ± 1°C.The last part of the experiment was conducted by laying the wood samples in liquid water to find the absolute moisture content. To gain the hysteresis effect, the same test samples were moved from one climate to another to examine the moisture values at different humidity with different moisture history.

Figure 1 Omnisense sensor placed in an LVL sample, with the electrodes perpendicular to the grain direction. Also parallel to the grain direction was tested. The nails are not insulated.

3. Results and discussion

LVL appears to absorb moisture faster and to a greater degree than pine. According to measurements, the resistance method will yield too high moisture readings from around 65% RH upwards. It seems evident that the two measurement methods give different results for both the materials examined. For low moisture levels, the two methods were accurate for both materials, but at higher moisture levels the resistance method reported too low RH in pine and spruce, and too high RH in LVL. No significant difference was seen between measurement by the resistance method perpendicular and parallel to the grain direction.

4. Conclusion

Results show that LVL takes up more moisture than pine and that some factors affect the resistance in LVL when the RH goes above 65%. The resistance method then yields a too high moisture content above 65% RH, a deviation that increases on higher RH. Conversely, for pine the resistance method gives a wood moisture equivalent that is around respectively 3 weight-% too low. To achieve a good result on measuring the moisture content of LVL, it is important that there are no holes (knotholes or other imperfections) in the material where the sensors are placed and that the screws are tight. However, this may not always be possible to assess from the surface of the sample.

The literature search shows that the measurements of moisture in LVL are affected by the glue, although thorough investigations into the physical mechanisms have not been conducted in this paper. It is theorised that capillary suction in the interface between the glue and veneer layers may cause the material to absorb moisture more easily.

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