RESEARCH in Progress

Coalition for Advanced Wood Structures
a university, industry, government partnership

Effect of Multiple Knots in Close Proximity on Southern Pine Lumber Properties

Knots derive from tree branches. When boards are sawn from a log, the sawblade cuts through cross sections of ingrown branches, leaving round, dark-colored masses called knots (Fig. 1). Because the grain of a knot runs more or less perpendicular to the length of a board, it weakens the board, similar to how a hole at that location might weaken the board. Although multiple knots in close proximity are known to weaken lumber performance even further, lumber grading rules used to assess knot groupings in southern pine are somewhat qualitative and subjective.

Figure 1. Multiple knots in close proximity found in southern yellow pine lumber.

Background

The southeastern quadrant of the United States includes hundreds of millions of acres of southern yellow pine forest populated with trees worth billions of dollars. Some forest management practices (for example, how trees are spaced or thinned) lead to the development of multiple knots in close proximity when trees are sawn into lumber. From 2010 to 2012, design values (minimum strength values allowed for engineering purposes) of southern yellow pine lumber were reduced, which reduced the utility value of southern pine lumber materials. A better understanding of how knot groupings contribute to reduction of strength properties in boards would allow both lumber manufacturers and silviculturists to better manage and mitigate those effects. This program represents a significant economic opportunity for southern pine producers.

Objective

The objective of this research is to investigate and quantify the effect that different kinds of knot groupings have on strength and stiffness properties of southern pine lumber. Over the long term, this study may also be used to improve lumber valuation practices and overall design performance.

Approach

This project will involve (1) procurement of southern pine lumber samples exhibiting multiple knots in close proximity, (2) measurement, description, and classification of those knot groupings, (3) mechanical testing of those specimens (Fig. 2), and (4) statistical analysis of resulting data.

We anticipate that 300 candidate pieces of 2×4 dimension southern yellow pine lumber exhibiting multiple knots in close proximity will be gathered from participating mills. Researchers will carefully map and measure knot sizes and positions on both faces and edges to determine the residual cross section of clear wood and its moment of inertia. Four-point bending tests to measure modulus of rupture (MOR) and modulus of elasticity (MOE) will apply maximum stress through the knotted section. Summed knot characteristics and residual moments of inertia will be correlated with MOR and MOE.

U.S. Department of Agriculture • Forest Service
Forest Products Laboratory
www.fpl.fs.fed.us

MISSISSIPPI STATE UNIVERSITY

Figure 2. Mechanical testing of specimens in an Instron universal testing machine.

Researchers will also procure and mechanically test another 200 southern pine lumber samples to examine statistical distribution of strength properties in mill run lumber. Such work will provide insight to the statistical distribution of strength and stiffness in pine lumber.

Expected Outcomes

This investigation is expected to reveal what kind of knot patterns affect strength, stiffness, and ultimate performance of southern yellow pine lumber the most. Once these patterns have been identified and classified, results will be shared with grading rule writing agencies, which could lead to the improvement of specific grading rules or valuation techniques. From this work, it will be possible to work with foresters to modify silvicultural practices to reduce the occurrence of knots in close proximity. The end results could shore up the future value of southern pine materials for the benefit of lumber manufacturers and landowners.

Timeline

The experimental phase of the project will run from July 2016 through June of 2018. Statistical analysis will follow and conclude by September 2018. Findings will be composed and disseminated to academic journals between October 2018 and July 2019.

Cooperators

Mississippi State University

USDA Forest Service, Forest Products Laboratory

Contact Information

Rubin Shmulsky
Mississippi State University
Starkville, Mississippi
(662) 325-2116; rs26@msstate.edu

Robert J. Ross
USDA Forest Service, Forest Products Laboratory
Madison, Wisconsin
(608) 231-9221; rjross@fs.fed.us