TechLine

Forest Products Laboratory

Structural Grading of Logs from Small-Diameter Trees

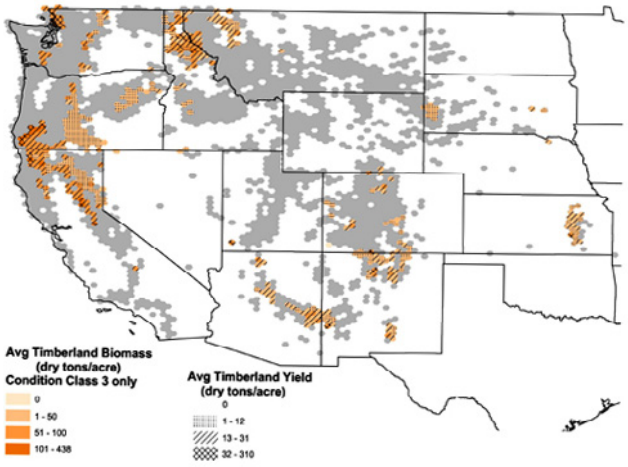

Figure 1. High-priority thinning opportunities. (Photo used with permission from D. May, J. of Forestry, February 2003.)

In the West, millions of acres of forestland have lost ecological integrity because of changes in vegetative structure and composition. Such stands are at significant risk for disease and insect attack, and ultimately at risk for catastrophic wildfire. Especially at risk are those stands containing high levels of fuel loading in Class 3 fire zones (Fig. 1). Finding alternative and higher value uses for thinned material can help pay for mechanical thinning.

Background

An alternative use for logs from small-diameter trees is in applications such as roundwood engineered structures and floor joists for log homes. Some advantages of using logs in the round form instead of sawing them into lumber include the following:

- Less susceptible to warp
- Lower processing costs
- Higher economic value

Properties are currently assigned to round timbers graded by visual techniques. However, these techniques were initially developed for large-diameter logs. Little data exists to demonstrate how well visual grading techniques predict the properties of logs in the 4- to 7-inch-diameter range.

Figure 2. Six-inch-diameter lodgepole pine used in 5,000-ft² library under construction in Darby, Montana.

What We Are Doing

A study is in progress to evaluate the applicability of visual and mechanical grading techniques to logs from small-diameter ponderosa pine and Douglas-fir trees. The study consists of three parts:

- Bending tests on peeled logs (FPL)
- Compression tests on peeled logs (FPL)
- Bending tests on logs machined to uniform diameter (University of Idaho)

Cooperators in the study are the USDA Forest Service, Forest Products Laboratory (FPL), Madison, Wisconsin; University of Idaho, Moscow, Idaho; and Timber Products Inspection Service, Vancouver, Washington.

What We Are Learning

Two hundred 3- to 6-inch-diameter Douglas-fir and ponderosa pine logs were obtained from the Shasta–Trinity National Forest in Hayfork, California. These logs were debarked and conditioned to a moisture content of about

USDA FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Forest Products Laboratory • Engineering Properties of Wood
One Gifford Pinchot Dr. • Madison, WI 53726–2398 • 608–231–9200 • 608–231–9592 (fax)
mailroom_forest_products_laboratory@fs.fed.us • www.fpl.fs.fed.us

GR–1
Issued 03/04

15%. After recording physical characteristics and obtaining nondestructive measurements of stiffness, the logs were tested in 1/3-point bending.

Results on these peeled logs indicate that the relationship between bending strength (MOR) and bending stiffness (MOE) is virtually independent of species and log diameter.

The MOR–MOE relationship for these small-diameter logs is virtually the same as those found previously for 9-inch-diameter logs of Engelmann spruce, alpine fir and lodgepole pine (ES–AF–LP).

Research has also shown that modulus of elasticity is not very sensitive to changes in moisture content.

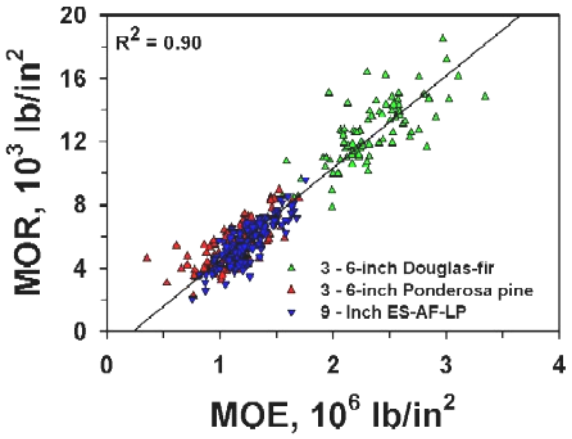

Figure 3. Bending strength–stiffness relationship for round logs at 15% moisture content.

What's Next

Testing is in progress at FPL to determine the strength of the small-diameter logs in compression parallel-to-the-grain and at the University of Idaho to determine bending properties for small-diameter logs machined to a constant diameter. The information presented in Figure 1, plus the information from the tests in progress, will allow us to propose a mechanical grading system for use with small-diameter logs. Such a system has already been proposed for the large-diameter logs typically used by log home manufacturers. A study is just getting underway to evaluate the effect of changes in moisture content on bending and compression properties.

Construction of roundwood engineered structures using small-diameter logs is in its early stages. Recently constructed buildings include

- Information kiosks for the 2002 Winter Olympics in Salt Lake City, Utah
- Darby Library (Fig. 2)
- 32- by 64-ft community pavilion in Westcliffe, Colorado

A 127-ft-span cable suspension bridge is planned for Traveler's Rest State Park in Lolo, Montana.

Additional Information

Visit the Engineering Properties of Wood (EPW) and Technology Marketing Unit (TMU) websites:

- www.fpl.fs.fed.us/epw
- www.fpl.fs.fed.us/tmu