Rattlesnake Creek Bridge Showcases Innovative Uses For Salvaged Small-Diameter Lodgepole Pine Logs

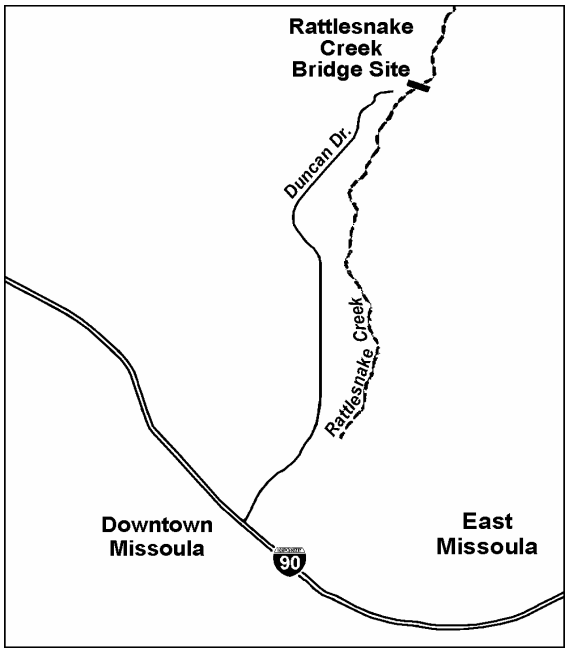

Figure 1. Rattlesnake Creek Bridge location, northeast of Missoula, Montana

The pine bark beetle has killed large areas of lodgepole pine in the Pacific Northwest. These standing dead trees are largely going to waste. Construction of buildings and bridges using 6- to 9-inch diameter logs offer a tremendous opportunity to use this resource. A new 90-foot pedestrian bridge over Rattlesnake Creek, northeast of Missoula, MT, demonstrates this opportunity. The bridge connects neighborhood trails and paths from the city's trail system to that of the Rattlesnake National Recreational Area within the Lolo National Forest (Fig.1).

The Bridge

The bridge is a unique design by Brad Miller, engineer with HDR Engineering, Inc., Missoula, MT (Fig. 2). It is a cable suspension bridge that uses stiffening trusses of 6-inch-diameter ponderosa pine half rounds and 4 by 12 decking made of a new industrial grade fiber-plastic composite. The lodgepole pine logs were salvaged from beetle-killed trees harvested from the Nez Perce National Forest near Elk City, ID. Steel top and bottom tees facilitate connections and eliminate the cord splice that was an inherent weakness in historic Forest Service designs.

The logs were supplied by Porterbuilt, Inc, of Hamilton, MT, and graded by a new "mechanical grading" procedure developed jointly by the Forest Products Laboratory (FPL), Madison, WI, and the Department of Forest Products, University of Idaho, Moscow. The decking was developed by the Wood Materials and Engineering Laboratory, Washington State University, Pullman, WA, and fabricated by McFarland Cascade, Tacoma, WA.

USDA Forest Service, State & Private Forestry, through its Technology Marketing Unit and National Wood in Transportation Program, provided 75% of the needed funding.

Figure 2. Cable suspension bridge across Rattlesnake Creek

What We're Doing

Allowable engineering design properties are available for round timbers. However, these properties are based on visual inspection of log defects and may not be precise enough for a highly engineered structure such as a cable suspension bridge. Mechanical grading has been used with 2-inch-thick dimension lumber for many years, but was never developed for other types of wood products such as round logs.

Research conducted in a joint program by the FPL and the University of Idaho (UID), in cooperation with Timber Products Inspection (TP) of Vancouver, WA (a major U.S. grading agency), developed the technical basis for the mechanical grading procedure for round timbers. This procedure combines nondestructive measurement of the stiffness (MOE) of each log with a visual assessment of log defects to estimate log strength (MOR). Tests on more than 500 logs of several species and sizes have shown that this procedure gives a more precise estimate of mechanical properties than is possible using visual assessment (Fig. 3).

FPL assistance was requested in mechanical grading the logs for the Rattlesnake Bridge. Non-destructive testing and property estimation were completed by the FPL-UID team, with TP providing visual grading of the logs for comparison with mechanical grading results.

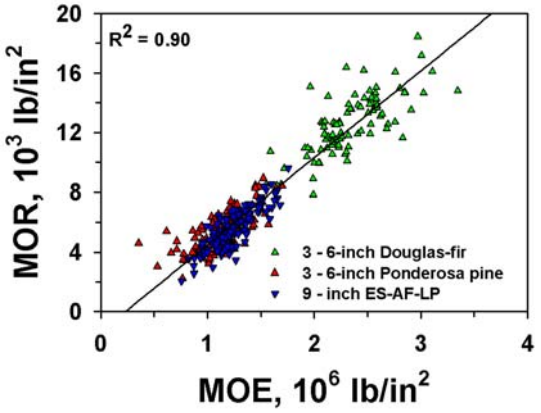

Figure 3. Bending strength–stiffness relationship for round logs at 15% moisture content

Of the 236 logs that made at least a No.3 visual grade, 80% made a visual grade of No.1. However, mechanical grading demonstrated that 91% of these logs would have an MOE that was 27% greater than that assigned the No.1 grade, and an estimated MOR that was 72% greater. Thus, both yield and properties could be increased using mechanical grading.

In July 2005, the logs were graded by the cooperators at Porterbilt Company, Inc., Hamilton, MT. The bridge was constructed over the winter and was dedicated in April 2006.

Read More About It

Mechanical grading of round timber beams by David W. Green, Thomas M. Gorman, James W. Evans, and Joseph F. Murphy. 2006. Journal of Materials in Civil Engineering, 18(1):1-10.

Mechanical grading of 6-inch-diameter lodgepole pine logs for the Travelers' Rest and Rattlesnake Creek bridges. D.W. Green, J.W. Evans, J.F. Murphy, C.A. Hatfield, and T.M. Gorman. 2005. FPL-RN-0297, USDA Forest Service, Forest Products Laboratory, Madison, WI.

For Additional Information Contact

Dr. David W. Green
USDA Forest Service
Forest Products Laboratory
Madison, WI 53726-2398
(608) 231-9261, dwgreen@fs.fed.us

Dr. Thomas M. Gorman
Department of Forest Products
University of Idaho
Moscow, ID 83844
(208) 885-7402, tgorman@uidaho.edu

Mark Knaebe, Technology Marketing Unit
USDA Forest Service, State & Private Forestry
Forest Products Laboratory
Madison, WI 53726-2398
(608) 231-9422, mknaebe@fs.fed.us