TechLine

Forest Products Laboratory

Improved Use of Ponderosa Pine in Glulam Beams

In the United States, almost 300 million acres of forests are severely overcrowded with small-diameter, densely stocked trees. These forests need to be thinned to improve their health and reduce the risk of catastrophic wildfire.

However, thinning is an expensive task, costing from $200 to $1,500 per acre. Traditionally, there has not been a market for this material once it has been thinned. Uses for small-diameter wood must be found and markets for the products created in order to offset the cost of thinning.

For several years, the Forest Products Laboratory (FPL) has conducted cooperative studies with local communities and industry to improve the use of wood from small-diameter trees. One of the most common species in these stands is ponderosa pine. Preliminary testing on ponderosa pine lumber indicates that if mechanical grading technology is applied, this material could be used in higher valued structural applications such as glued-laminated timber (glulam).

Researchers tested the properties of glulam beams made with mechanically graded ponderosa pine in hopes of providing a valuable use for the most common species in the western United States.

Background

Glulam standards currently account for use of ponderosa pine within a large commercial species group called Softwood Species. This species group is typically specified for use in the inner glulam laminations and is assigned lower design values for structural applications. In some cases, glulam combinations have been eliminated because of the large variation in stresses between the Softwood Species in the inner laminations and the higher quality species in the outer laminations. Many FPL studies have shown that lumber resources can be put to better use in glulam beams by mechanically grading the lumber and placing the higher grades in the outer laminations and lower grades in the inner laminations.

Objective

The objective of this study was to evaluate the mechanical properties of glulam beams made with mechanically graded ponderosa pine laminations.

Approach

Researchers tested the following mechanical properties of glulam beams: edge-wise bending strength, flat-wise bending strength, bending stiffness, tensile strength, and shear. In addition to the glulam beams, specimens from each lumber grade were tested individually for the same properties. Information from these lumber tests will be used as input for a mathematical model that has been developed. This model predicts the mechanical properties of glulam members based on the mechanical properties of lumber.

Outcome

Laboratory test results showed that this new glulam combination achieved over 60% greater edge-wise bending strength properties, over 100% greater flat-wise bending strength and tensile strength properties, and over 30% greater bending stiffness properties than those currently published in glulam standards for the Softwood Species group. This glulam combination achieved only 62% of the shear strength published in the glulam standard for the Softwood Species group.

Trade associations will use these results to verify design values for ponderosa pine glulam beams. These design values will be incorporated into glulam standards, which will allow for use of ponderosa pine in value-added structural products. Mathematical modeling will also be helpful in developing new combinations of glulam with fewer expensive laboratory tests of full-size beams. Using this small-diameter material to produce a valuable structural product provides economic incentives for thinning the overstocked forest by offsetting the costs associated with the process.

USDA

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