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CROSSINGS

NEWSLETTER OF THE NATIONAL TIMBER BRIDGE INITIATIVE

Editor - Tinathan Coger *Issue 16* *May 1994*

Hardwood Glulam Timber Bridge Initiative

Designs and specifications for 18 to 90 ft. clear span hardwood glued laminated (glulam) highway bridges are being developed by agricultural engineers and wood scientists at Penn State University. To date resin systems, preservative treatment processes, laminating procedures and key structural properties have been identified or determined for three commercially important hardwood species: northern red oak, red maple, and yellow poplar. The research effort is funded by the Pennsylvania Department of Transportation (PennDOT). Auxiliary projects have been funded by the Pennsylvania Hardwood Initiative. The overall goal of the initiative is to develop new uses for Pennsylvania hardwoods, especially underutilized species. A summary of key research findings to date follow.

Overview: Several off-the-shelf, room temperature curing, resorcinol-formaldehyde (RF) resin systems have been shown to provide adequate shear strength and wood failure characteristics to qualify for

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Fiscal Year 1994 Timber Bridge Construction Grants Awarded

The Timber Bridge Initiative proposal Evaluation Panel met January 26-28, 1994, at Morgantown, West Virginia to review and recommend for funding the Fiscal Year 1994 timber bridge construction grant applications. Panel members were:

Edward Cesa, Timber Bridge Initiative Coordinator, NA Representative
Kenneth Kilborn, Timber Bridge Initiative Coordinator, NA Representative
Robert Westbrook, Timber Bridge Initiative Coordinator, Southern Representative, Region 8
Clare Mitchell, Timber Bridge Initiative Coordinator, Western Representative, Region 3
Stephen Bunnell, National Forest System, Engineering, Washington Office
Michael Ritter, Forest Products Laboratory, Engineered Wood Products & Structures
John Sebelius, State and Private Forestry, Washington Office Representative
Dade Foote, Bridge Engineer, National Forest System, Region 8
Thomas Williamson, Executive General Manager, American Plywood Association
Marc Lishewski, Southern Forest Products Association
Lou Triandafilow, Federal Highway Administration, Office of Structures, Baltimore, MD
John Pasquantino, Legislative Affairs, NA Representative
Stephen C. Quintana, Timber Bridge Initiative Program Director

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Funded Bridges ... page 4

Inspection Results Yield Clues to Underwater Bridge Performance

Some interesting performance characteristics for timber bent bridges have surfaced following a statistical analysis performed by Louisiana State University using the results of a statewide underwater bridge inspection program conducted by the Louisiana Department of Transportation and Development in 1992.

Based on a seven-point grading scale in which "1" represents the critical condition and "7" the new state of a structure, the underwater substructures of timber bent bridges were discovered to deteriorate at the mean rate of 0.0266 points/year in comparison to the regression rates of 0.0157 and 0.0411 points/year for concrete and steel bent bridges respectively. Deterioration rates were found to be significantly higher in coastal areas of the state. Thanks principally to salt-water intrusion and marine borer complications, increases in the rate of decay were found to be approximately two and one-half times greater for bridges of all material types in the regions bordering the Gulf of Mexico.

Additionally, plots of bent condition vs. age for each of the material types show greater scatter in the inspection data gathered for steel and concrete bents relative to the timber bent population. Using curve-matching techniques, the timber bents were found to have deteriorated in a nearly linear fashion throughout their lifespan, while concrete and steel bents developed irregular performance curves with sudden drop in condition rating of 1 to 2 points at about 20 and 40 years of age. The steel and concrete bent performance curves followed the classical "plateau-decline-plateau" curve fit, developing wide variations in deterioration rates over the structures lifetime, with regression rates ranging from 0.0002 to 0.0071 points/year for concrete bents to an even larger range of 0.0062 to 0.0411 points/year for steel bent bridges in the plateau regions of their respective curves. Consequently, timber bents, owing to a well-defined and linear deterioration curve, were shown to possess a greater degree of underwater performance predictability in comparison to bridge substructures constructed of other materials.

A further benefit recognized in timber bent construction is found in the comparison between the substructural condition rating awarded a structure during routine abovewater inspections to that condition rating given to the same structure following the underwater inspection. Timber bents, unlike those of steel and concrete, develop a stronger correlation between the two condition ratings; consequently, the condition of the timber bridge substructure above the surface may be taken to be indicative of the underwater condition, providing a practical index for assessing the possibility of structural problems residing in unseen components of the bridge.

For further information oncerning these results, contact: Mark D, Fugler, P.E.; Department of Civil Engineering; 3502 CEBA Bldg.; Louisiana State University; Baton Rouge, Louisisana 70803.

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structural glulam fabrication for each of the hardwood species. The keys to successful bonding are proper open assembly time and clamping pressure.

Pressure treatment cycles required to attain 10 to 12 pcf retention of creosote in northern red oak, red maple, and yellow poplar glulam girders had no adverse affect upon the flexual strength or stiffness of glulam girders or deck panels. Significantly, the research has shown that the methods currently used to design lamination layups for softwood glulams can also be used for designing red maple glulam layups. Another cooperative effort between Penn State, FPL, and West Virginia University has demonstrated that yellow poplar glulam girders with Fb=2400 psi) and $E = 1.8 \times 10^6$ psi are also technically feasible.

Fabrication and Construction: Most hardwood lumber is not structurally graded nor is hardwood generally available in standard dimension sizes as are softwoods. The current lack of such materials is a major challenge to the use of hardwoods in glulam applications.

Members of the Penn State Research Team procured the red oak logs, arranged for primary processing and drying of the lumber, and then sorted and graded the lumber in accordance with AITC's hardwood laminating specifications (AITC-119, 1985). The team also supervised and oversaw the fabrication of the girders, deck panels, and railing materials at Unadilla Laminated Products, Inc. in Sidney, NY. As part of the fabrication process, Unadilla planed and cut all of the glulam members to the required finished size to eliminate any field cutting after preservative treatment.

Dimensional stability was also a concern in the fabrication/construction phase. Laminating procedures require lumber to be at moisture less than 14%. In service over a stream, treated lumber equilibrates at approximately 19% moisture content. Thus, adequate spacing, the magnitude of which is somewhat species dependent, must be specified between deck panels. However, some of the moisture expansion occurs during creosote treatment. Thus, the panel widths at the site must be measured prior to installation and panel spacings may have to be reduced in the field.

Summary: Glulam highway bridge standard designs are being prepared for hardwoods as part of the National Timber Bridge Initiative and Pennsylvania's Hardwood Initiative. A northern red oak glued laminated highway bridge has been designed, fabricated, constructed, and load tested. The bridge design is a longitudinal glulam stringer with a transverse glulam deck system. Live load deflections, as determined by load tests, are less than deflections predicted by elastic analysis using recommended E-values and non composite girder-deck assumptions.

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Bridge Construction Grants Awarded ... *continued from page 1*

Over 90 proposals were evaluated and 37 proposals were selected for funding for Fiscal Year 1994. The total dollar amount awarded was $1,008,606. Following is a list of the approved bridges.

FUNDED BRIDGES

State	County	State	County
AK	Yukon-Koyukuk	NH	Belknap
AL	Marion	NY	Allegany
AL	Tuscaloosa (2)**	NY	Ontario
AZ	Apache	ND	McKenzie
CT	Tolland *	OH	Ashtabula
FL	Santa Rosa *	OH	Richland
GA	Appling	OH	Morgan
ID	Fremont	OH	Coshocton
IL	Shelby	OK	Choctaw
IA	Cedar	PA	Centre
KS	Sumner	PA	Jefferson *
LA	Caldwell Parish	PA	Bucks
LA	Iberia Parish (2)***	TN	Sullivan *
LA	St. Tammany *	TX	Cameron
ME	Penobscot	VA	Chesapeake *
MD	Dorchester	VA	Roanoke *
MI	Arenac *	WV	Pending
MI	Kalamazoo		
MI	Otsego		

* Pedestrian Bridges
** One Proposal - 2 bridges funded
*** Two proposals - 11 bridges funded

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in the School of Forest Resources at Penn State, and Ms. Maria DiCola, Research Technician in the School of Forest Resources at Penn State are gratefully acknowledged.

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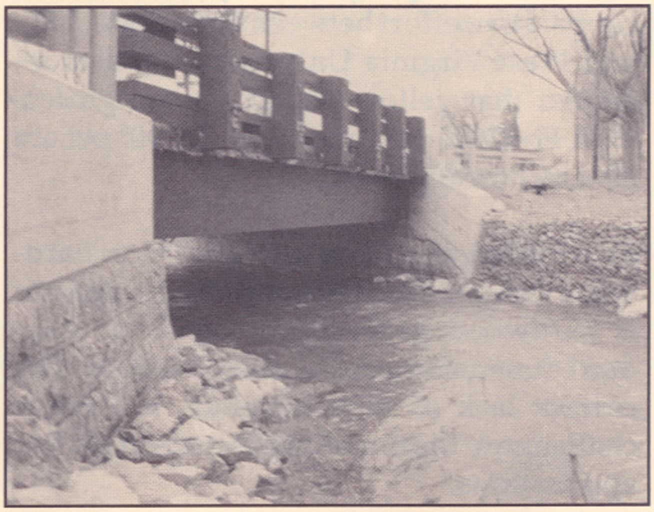

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