CROSSINGS
NEWSLETTER OF THE WOOD IN TRANSPORTATION PROGRAM

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In This Issue

Overview of the National Wood In Transportation Program's Portable Timber Bridge Activities

One segment of the National Wood In Transportation (NWIT) program has been to develop partnerships that lead to the development and demonstration of simple, dependable, and economical portable timber bridge designs used for timber harvesting operations and other temporary stream crossing applications. One of the primary purposes for these projects is to find solutions for minimizing the environmental impacts to streams during times of temporary crossings. To date, the program has funded eight portable timber bridge projects. Three of these projects are highlighted below. In addition, the USDA Forest Service has developed a lightweight portable timber bridge design for use on skidder trails. The enclosed fact sheet highlights this effort.

Portable timber bridge projects:

- ***The Development and Testing of Glulam Portable Timber Bridge Designs*** — Auburn University, Department of Agricultural Engineering, Auburn, AL

  The objective of the work at Auburn was to develop timber bridge designs for temporary stream crossings such as those encountered on logging roads and skid trails. Cooperating with the USDA Forest Service and with several industry partners, Auburn developed and tested several different designs of portable bridges using glued-laminated timbers. These bridges include several prototypes for truck traffic and one for off-highway vehicles like wheeled skidders. These bridges have been tested and monitored for performance and longevity in typical forest harvesting operations. In addition to constructing and monitoring the prototype designs, test data were used to develop information that can be used to help in the design of future portable timber bridges. Currently, at least one manufacturer of glued-laminated timbers is fabricating and

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marketing these types of portable bridges. For additional information about this project, contact: Steve Taylor, Auburn University, at 334-844-3534, or visit the following website: *http://www.eng.auburn.edu/users/staylor/timber_bridges.html*.

- ***The Development and Testing of Stress-Laminated Portable Timber Bridge Designs*** — West Virginia University, Morgantown, WV

  The objective of this project was similar to the project objectives listed previously, except the basic design concept used stress-lamination. An effective bridge design was developed and demonstrated. A business in Morgantown is currently manufacturing and marketing this type of bridge in 30-foot and 40-foot lengths. For information about this effort, contact Curt Hassler, Clear Creek Crossings, LLC, at 304-291-3962.

  A publication titled, *Portable Timber Bridges: An Eco-friendly Solution for Stream Crossings*, documents this effort. It is available through the National Wood In Transportation Information Center at 304-285-1591 and request publication number *WIT-02-0038*. The publication can be viewed on the Web at *http://www.fs.fed.us/na/wit/pdf/portab~1.pdf*.

- ***New York City Watershed Forestry Temporary Bridge Program*** — Watershed Agricultural Council, Walton, NY

  The objective of this project was to encourage the adoption of temporary bridges as a timber harvest best management practice in the New York City watershed. Emphasis was placed on the development and/or demonstration of bridges used for skidder trails and haul road applications. To date, a skidder bridge design has been developed and demonstrated. Approximately three small businesses are currently manufacturing and marketing these types of bridges. At least one stress-laminated portable timber bridge for use on haul roads has been demonstrated and promoted. For additional information about the program, contact Justin Perry, Watershed Agricultural Council, at 607-865-7790 or visit the following website: *http://www.nycwatershed.org/forest.htm*.

Results of the Ninth National Timber Bridge Student Design Competition

Nine teams of students from universities across the United States matched wits during the Ninth National Timber Bridge Student Design Competition. Open to student chapters of the American Society of Civil Engineers (ASCE) and Forest Products Society (FPS), the competition was made possible by a grant from the USDA Forest Service, Wood In Transportation program. The Southern Pine Council of the Southern Forest Products Association, Unit Structures LLC, and Willamette Industries provided additional financial support. Southwest Mississippi Resource Conservation and Development (RC&D), Inc., coordinated the annual competition.

Each team designed, constructed, and tested their bridges on their home campus, then submitted documentation of their activities and results to a panel of judges for review. The competition was conducted online via the Internet. Each team was required to post design drawings, test results, and project highlights on the Web at *www.msrcd.org (www.msrcd.org/bridge.htm*). To view details of competition results and to access each entry in its entirety, click on "2001 Competition Results."

Winner of the **Best Overall Design Award** sponsored by Willamette Industries was the **Mississippi State University ASCE Chapter**. Their design used multiple members in both tension and compression to minimize weight and deflection. A 1-inch by 4-inch tongue and groove deck was supported by seven glued-laminated longitudinal stringers. Four steel cable assemblies were added to limit tension in the bridge. All wood members were southern pine treated with bromated copper arsenate at 0.40 pounds per cubic foot. This entry also placed *second* in **Best Deck Performance** and *second* in **Most Aesthetic Design**. The Team received cash awards totaling $2,350 for their efforts.

Top money winner was the **United States Military Academy ASCE Chapter** with awards totaling $2,500. Their entry placed *first* in **Best Deck Performance** and **Most Practical Design** and *second* place in **Best Support Structure Performance** and the **Willamette Industries Best Design**. Their design featured a transverse deck of 2-inch by 6-inch CCA-treated southern pine ship-lapped and edge-glued. The deck was supported by three longitudinal parallel trusses built of southern pine 2-inch by 4-inch lumber using standard nail plates. Their goal was practicality and speed of construction, combined with strength and lightweight.

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The **ASCE Chapter of Washington University at St. Louis** was another big winner, receiving $2,000 for *first* place in **Best Support Structure Performance**, *second* in **Most Practical Design,** and *third* in **Best Design** and **Best Deck Performance**. Their twin composite I-beam structure used CCA-treated southern pine with 2-inch by 6-inch transverse stiffeners spanned by a longitudinal deck of southern pine 2-inch by 6-inch planks.

The final first-place entry was produced by **San Jose State University's ASCE Chapter**. Their above-deck parallel-chord trusses combined with longitudinal 2-inch by 6-inch Douglas fir deck caught the eyes of all three judges to win *first* place as **Most Aesthetic**. Adding two *third* place awards in **Most Practical Design** and **Best Support Structure** brought their total awards to $1,350.

The **Virginia Polytechnic Institute and State University's Forest Products Society Chapter** captured *first* place for the **Most Innovative Design** for their arch-suspension bridge. **Clarkson University** and **Oklahoma State** settled for a *second* place tie in this category.

Other teams competing in the competition included Merrimack College ASCE and Rose-Hulman Institute of Technology ASCE.

For a complete review of competition results and each individual entry, go to *www.msrcd.org* and follow the links. Results of 2000, 1999, and 1998 competitions are also posted online. The 2002 Competition begins in September 2001 with rules being posted on the website in late August 2001. For additional information, contact Southwest Mississippi RC&D, Inc., 747 Industrial Park Road, NE, Brookhaven, MS 39601. Phone: 601-833-5539, Fax: 601-835-0054, e-mail: *southwest@msrcd.org,* or visit the Wood In Transportation website at *www.fs.fed.us/na/wit*.

The competition's objectives are to promote interest in the use of wood as a competitive bridge construction material, to generate innovative and cost-effective timber bridge design techniques, and to develop an appreciation of the engineering capabilities of wood among future transportation and forest products engineers. Following the competition, most of the bridges are placed into use as trail bridges for pedestrians, horses, snow mobiles, etc.

The test bridges were 13 feet long and 4 feet wide and were loaded with a test weight of approximately 4,500 pounds. Average weight of the bridge models was 722 pounds. At full loading, maximum bridge deflection ranged from 4.42 mm to 9.91mm. Maximum allowable deflection was 10 mm. Net deck deflection for the three bridges that met the maximum allowable deflection of deck span divided by 400 averaged 74 percent of maximum allowable. Percent non-wood materials in the bridges averaged 8.5 percent; maximum percent non-wood materials allowed was 25 percent by weight. A total of 68 students spent 1,583 hours on the competition, competing for $10,000 in prizes. Judges for the competition were Bert Lovell, Willamette Industries; Nelson Hernandez, USDA Forest Service; and Shannon McCarty, USDA Natural Resources Conservation Service.

—— **Bennie F. Hutchins**
RC&D Coordinator
Southwest Mississippi RC&D, Inc.

Design of Wood Highway Sound Barriers

As new and existing United States residential areas and high volume highways continue to intermingle, traffic noise abatement procedures continue to be important. This study investigated the acoustic effectiveness, public acceptance, and structural requirements of various designs and types of sound barriers. In addition, the acoustic effectiveness of a prototype sound barrier is reported. Results are presented on the acoustic effectiveness from in situ measurements of one cement bonded composite panel barrier and four precast concrete, two plywood, two glued-laminated, and three post and panel barriers. The research on public acceptance of sound barriers focused on the perception of visual compatibility. Based on results from semantic-differential and individual ratings, wood and concrete barrier designs were perceived to have favored "rural" qualities. Data collected during the research on acoustic effectiveness and public acceptance were used to develop structural requirements and construction details for a prototype wood sound barrier. The prototype wood sound barrier provided insertion losses of 15 dB or greater, exceeding the 10-dB acceptable performance for a highway sound barrier.

To obtain a copy, please contact the National Wood In Transportation Information Center at 304-285-1591 and request publication number *WIT-02-0062* or visit the Wood In Transportation website at *www.fs.fed.us/na/wit*; click on "New Publications Available".

NEW PUBLICATIONS

Field Performance of Timber Bridges 21. Humphrey Stress-Laminated T-Beam Bridge

The Humphrey Bridge was constructed during the summer and fall of 1993 in Cattaraugus County, New York. The bridge is a single-span, stress-laminated T-beam structure that measures 14.1 m (48.6 ft) long and 10.2 m (33.5 ft) wide. Performance of the bridge was monitored for 35 months, beginning approximately eight months after installation. Monitoring involved gathering and evaluating data relative to the moisture content of the wood components, force level of the stressing bars, and behavior of the bridge under static load conditions. In addition, comprehensive visual inspections were conducted to assess the overall condition of the structure. Based on field evaluations, the bridge is performing well, with only a few minor serviceability issues.

To obtain a copy, please contact the National Wood In Transportation Information Center at 304-285-1591 and request publication number *WIT-06-0042*, or visit the Wood In Transportation website at *www.fs.fed.us/na/wit*; click on "New Publications Available".

Analysis of Thermal Change in Stress-Laminated Timber Bridge Decks

As the timber bridge design has evolved, some engineers have been concerned about the integrity of the stress-laminated system in cold climates. The structural integrity of a stress-laminated bridge depends on the level of interlaminar compression (between the wood laminations). Temperature change can cause material shrinkage, which could lead to substantial performance problems based on material mechanics and the nature of the stress-laminated system. In this study, to determine the effects of thermal change on interlaminar compression, four stress-laminated timber deck sections were put through a warm-cold-warm cycle. Various interlaminar stress levels and three moisture content levels were tested. Results showed that interlaminar compression in stress-laminated decks of this size was not affected by extremely cold temperatures when the moisture content was less than 19 percent and when initial bar force was sufficient.

To obtain a copy, please contact the National Wood In Transportation Information Center at 304-285-1591 and request publication number *WIT-06-0041*, or visit the Wood In Transportation website at *www.fs.fed.us/na/wit*; click on "New Publications Available".

Article contributions, questions, or comments may be sent to Ed Cesa, Program Coordinator, National Wood In Transportation Information Center or Mr. Chris Grant, Program Assistant, USDA Forest Service, 180 Canfield Street, Morgantown, WV 26505; Phone: (304) 285-1591; FAX: 304-285-1587, or e-mail cgrant@fs.fed.us. A change of address may also be submitted to cgrant@fs.fed.us. For publication requests, e-mail jnorth@fs.fed.us.

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