CROSSINGS
NEWSLETTER OF THE WOOD IN TRANSPORTATION PROGRAM

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MICHIGAN FIRST TIMBER BRIDGE COMMERCIALIZATION PROJECT

In 1996, the National Wood In Transportation Program redirected its demonstration project activities to focus on economy of scales and the structural adequacy of demonstration structures. The Program began funding multiple structure projects and termed them commercialization projects. These projects build upon knowledge gained from previous research and demonstration projects. For the most part, these projects use the same basic design, engineer/engineering firm, fabricator, construction firm, and local timber resources in the construction of three or more structures. These types of projects provide for greater opportunities for design standardization, learned efficiencies, and the generation of reliable design, cost, and performance data. The intended outcome is to develop structures that showcase wood-in-transportation technology and provide those interested in timber bridges with needed information.

In 1999, the National Wood In Transportation Program awarded a grant to the Huron Pines RC&D Area Council, Inc. for a timber bridge commercialization project. The funds were used to construct five timber bridges in four Michigan counties. Four of the bridges were vehicular and one was pedestrian. This article will focus on the four vehicular bridges.

The project's goals and objectives included:

- Develop design plans and specifications, including details and scope of work, which consistently meet Michigan transportation standards for ease of construction, environmental suitability, quality control and contractual soundness.

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Michigan Vehicular Bridge . . . *continued from page 1*

- Fine-tune the repetitive use of modern timber bridge design and construction techniques, which recent projects have proven to be cost effective in Michigan.
- Encourage participation of Michigan's CCA preservative treatment and fabricating firms in the transportation industry.

The bridges were designed, fabricated and constructed by a team of private firms and local government agencies. The four bridges used similar designs and applied what had been learned from the timber bridge industrial development efforts of the Michigan Timber Bridge Initiative. Stress-lamination was used in the construction of each bridge. This allowed for the utilization of relatively low grade, native grown red pine. The stress-laminated designs were fine-tuned by Northwest Design Group, Inc.

Chromated copper arsenate (CCA), the most common and readily available preservative treatment in Michigan, was chosen as the primary wood preservative. The oil-borne preservatives creosote and pentachlorophenol were used when necessary, such as to minimize the amount of shrinkage cracks in the glulam materials. The creosote and pentachlorophenol portions of the structures met the American Wood Preservers Association (AWPA) standard of C-14 for a retention rating of 12 pounds per cubic feet of wood and were also required to undergo a post treatment cleaning process. To further protect the soil and water resources of the site, the Best Management Practices for Treated Wood Products in Aquatic Environment guidelines as issued by the Western Wood Preservers Institute were strictly adhered to and audited by a qualified inspection staff during and upon completion of each bridge. [1]

By October 2002, the bridges had been constructed and put into service. The final design and cost information for the bridges follows.

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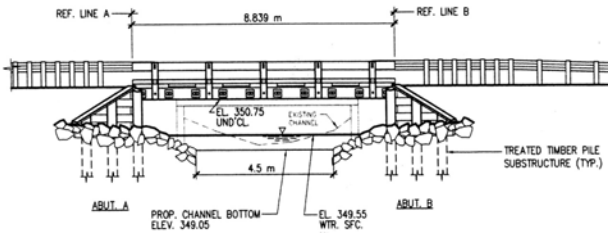
[1] During the course of this project, Michigan developed Best Management Practices for the Use of Preservative-Treated Wood in Aquatic Environments in Michigan. This publication can be viewed by visiting: *www.fs.fed.us/na/wit/WITPages/michbmp.html*.

Wilcox Bridge

Structure/Design Type: Vehicular bridge/ Stress-laminated, glued laminated
Location: Crawford County, Michigan
Owner: Crawford County Road Commission
Engineer: Paul Repasky
Spans over: East Branch of Au Sable River
Length (out-to-out): 29'
Width (out-to-out): 32'
Number of Spans/Skew: 1 / 0.0
Design Live Load: HS-20
Primary Wood Species: Red pine/ southern pine
Superstructure Preservative: CCA



Cost Information [(a)]

Preliminary costs:	$31,300
Substructure cost:	$59,780
Superstructure cost:	$82,720
Other costs:	$112,100
Surfacing	*
Total cost:	**$285,900**

* Cost of surfacing bridge and approaches ($13,500) was included in "Other costs."

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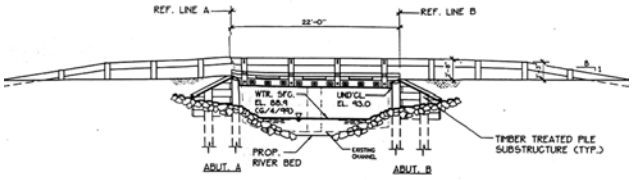
Michigan Vehicular Bridge . . . *continued from page 2*

Lewiston Grade Road Bridge

Structure/Design Type: Vehicular bridge/ Stress-laminated sawn lumber
Location: Crawford County, Michigan
Owner: Crawford County Road Commission
Engineer: Howard Haselschwardt
Spans over: East Branch of Au Sable River
Length (out-to-out): 22'
Width (out-to-out): 16'
Number of Spans/Skew: 1 / 0.0
Design Live Load: HS-20
Primary Wood Species: Red pine
Superstructure Preservative: CCA

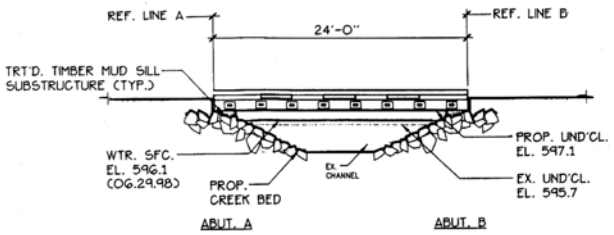


Cost Information [(a)]

Preliminary costs:	$14,300
Substructure cost:	$47,400
Superstructure cost:	$24,000
Other costs:	$34,400
Surfacing	$2,200
Total cost:	**$122,300**

Camp Petosega Bridge

Structure/Design Type: Vehicular bridge/ Stress-laminated sawn lumber
Location: Emmet County, Michigan
Owner: Emmet County
Engineer: Howard Haselschwardt
Spans over: Cedar Creek
Length (out-to-out): 24'
Width (out-to-out): 14'
Number of Spans/Skew: 1 / 0.0
Design Live Load: HS-15
Primary Wood Species: Red pine
Superstructure Preservative: CCA



Cost Information [(a)]

Preliminary costs:	$12,000
Substructure cost:	$3,002
Superstructure cost:	$24,354
Other costs:	$7,300
Surfacing:	*$0
Total cost:	**$46,656**

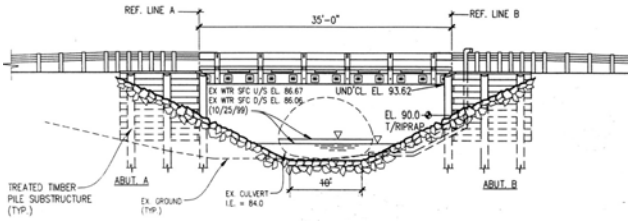
*Bridge was not surfaced

Continued Page 4

Michigan Vehicular Bridge . . . *continued from page 3*

North Sharon Road Bridge

Structure/Design Type: Vehicular bridge/ Stress-laminated, glued laminated
Location: Kalkaska County, Michigan
Owner: Kalkaska County Road Commission
Engineer: Howard Haselschwardt
Spans over: North Branch of Manistee River
Length (out-to-out): 35'
Width (out-to-out): 32'
Number of Spans/Skew: 1 / 0.0
Design Live Load: HS-25
Primary Wood Species: Red pine/southern pine
Superstructure Preservative: CCA



Cost Information [a]

Preliminary costs:	$30,690
Substructure cost:	$64,315
Superstructure cost:	$97,734
Other costs:	$80,664
Surfacing:	*
Total cost:	**$273,403**

***** Surfacing was not included in original bridge design.

For further information concernig this project, contact:

Huron Pines Resource Conservation & Development Area Council, Inc.
501 Norway Street
Grayling, Michigan 49738
Phone: 517-348-9319
FAX: 517-348-7945
Email: huron@freeway.net
Web site: www.huronpines.org

(a)

Preliminary Costs include costs associated with surveys, soils investigations, design, staking, and other costs that precede construction work.

Substructure Costs include costs associated with excavation, abutments, bents/piers and on-site work associated with the placement and assembly of the bridge substructure.

Superstructure Costs include costs associated with materials, labor, and preservative treatment of decks, beams/stringers, and railings and on-site work associated with the placement and assembly of the bridge superstructure.

Other Costs include costs associated with detours, mobilization, demolition, site work/approaches, monitoring costs.

Surfacing Costs include costs of materials for superstructure only, and costs associated with the installation of surfacing materials.

WOOD IN TRANSPORTATION DEMONSTRATION PROJECTS FUNDED IN FISCAL YEAR 2003

In May 2003, a national evaluation panel consisting of engineers and forest products technologists from the USDA Forest Service and Federal Highway Administration and WIT management selected six projects for funding in federal fiscal year 2003. The primary focus of these projects is to commercialize proven and emerging technologies in design, fabrication, and materials through the construction and installation of the most cost-effective, structurally-sound timber structures. These projects will also focus on using local timber resources and businesses to the fullest extent practical.

Following is a brief description of each project.

Commercialization project in Lancaster County, Nebraska

The National Arbor Day Foundation will receive $100,000 to construct two multi-span truss pedestrian bridges at the Arbor Day Farm in Nebraska City, Nebraska. Each bridge will be approximately 10 feet in width and 110 feet in length, and consist of five spans. Pentachlorophenol treated Douglas-fir will be used as the primary building materials. The live load design for the bridges is 85 pounds per square foot.

Commercialization project in Braxton and Barbour County, West Virginia

The West Virginia Division of Highways will receive $100,000 to replace or rehabilitate three vehicular bridges. The bridges will be 15 feet in width and range from 33 feet to 45 feet in length. The basic design calls for a creosote treated parallel laminated lumber deck installed on and supported by structural steel rolled beams. The bridges will be designed to AASHTO standards with a design live load of HS-20.

Pedestrian bridge in Vernon County, Wisconsin

The Kickapoo Reserve Management Board will receive $20,000 for the construction of a single span glulam pedestrian timber bridge. The bridge will connect the villages of La Farge and Rockton and serve as the southern entry point to the Kickapoo Valley Reserve. It will be 65 feet in length and 10 feet in width. Its deck and guardrails will be constructed of chromated copper arsenate treated southern pine. The glulam beams will be fabricated using pentachlorophenol treated Douglas-fir. The live load design for the bridge is 85 pounds per square foot.

Special project in Penobscot County, Maine

The University of Maine will receive $40,448 for the replacement of a retaining wall/seawall at the waterline of Castine Harbor in Penobscot Bay. The wall supports a paved roadway, providing vehicular access to the public waterfront/pier facilities at the Maine Maritime Academy. The new wall will be constructed using extruded wood-plastic composite timbers developed by the University of Maine's Advanced Engineered Wood Composites Center.

Vehicular bridge project in Davidson County, Tennessee

The Tennessee Division of Forestry will receive $50,000 to construct a bridge to replace a culvert in Pikeville, Tennessee. The bridge will be 26 feet wide and 50 feet long. The bridge's deck, stringers, beams, and guardrails will be fabricated using creosote treated southern pine glulams. The stringers and deck panels will be sized to recommended specifications according to AASHTO HS-20-44 requirements.

Commercialization project in CambriaCounty, Pennsylvania

The Conemaugh Valley Conservancy will receive $50,000 towards the cost of constructing a pedestrian bridge over the Conemaugh River. The bridge will be 580 feet in length and between 12 to 14 feet wide. The bridge's deck will be constructed of wood and a woodfiber-plastic composite developed by Washington State University. The project will compare the differences between the wood and the woodfiber-plastic composite to determine specific longevity factors.

For additional information about these projects, please contact the National Wood In Transportation Information Center at 304-285-1591

—— **Jeffery Bejune**
Forest Products Technologist

RESULTS OF THE ELEVENTH NATIONAL TIMBER BRIDGE STUDENT DESIGN COMPETITION

Five teams of students from universities across the United States matched wits during the National Timber Bridge Design Competition. Open to student chapters of 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. Southern Pine Council of the Southern Forest Products Association, Unit Structures LLC, Wood Protection Products, Inc., and Weyerhaeuser Company 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 is conducted online via the Internet. Each team is required to post design drawings, test results, and project highlights on the Web at *www.msrcd.org.*

Winner of the **Best Overall Design Award** sponsored by Weyerhaeuser Company was the **United States Military Academy ASCE**. Their design used 5 laminated veneer lumber (LVL) I-beams with top flanges of 2-inch by 12-inch CCA treated southern pine that formed a continuous "subdeck" supporting a transverse deck of 2-inch by 8-inch southern pine with ship-lap joints screwed together and into the compressive flange of the I-beam supports. This entry also placed **first** in **Best Deck Design** and **Most Practical Design**, and **second** in **Most Innovative and Best Support Structure**. The team received cash awards totaling $3,850 for their efforts.

The second place money winner was **Oregon State University ASCE** with awards totaling $2,550. Their entry placed **first** in **Most Aesthetic Design**, **second** in both **Best Overall Design** and **Most Practical**, **third** in **Most Innovative**, and **Best Support Structure**. Their design featured a deck of 2-inch by 6-inch Douglas Fir placed longitudinally over 12 engineered I-joist transverse floor beams supported by 2 outside parallel-chord trusses incorporating a tension rod suspension of "M" configuration.

Another first place winner was the entry of the **Washington University at St. Louis ASCE** team, capturing **first place** in **Best Support Structure** for their fabricated I-beams that incorporated the top flange of 2-inch by 8-inch southern pine into a longitudinal deck with load transferred by 1-inch by 4-inch transverse purlins acting as floor beams. The four I-beams used a web of 3/4-inch plywood. This

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Student Design Competition Results . . .
continued from page 6

lightweight bridge also was awarded **third place** in both **Best Overall Design** and **Most Practical Design**. Awards totaled $1,700.

The final **first place** award was for **Most Innovative Design** awarded to the entry of **Virginia Tech's FPS chapter**. The team used CCA-treated southern pine recycled from residential exterior decks to construct the 2 outside arch supports incorporating six 1/4-inch steel suspension cables per arch. The arches were constructed of 2-inch by 6-inch by 14-inch CCA southern pine glued with Resorcinol Resin using an experimental coupling agent, hydroxymethylresorcinol (HMR). The deck was composed of carbon fiber sheets sandwiched between 1/4-inch plywood and 1-inch by 6-inch southern pine. The 5 longitudinal I-joists were treated with ACQ (Ammonical Copper Quat). The VT entry also placed **second** in **Best Deck Design** and **third** in **Most Aesthetic**, receiving $1,200 in awards.

The **Ohio State University ASCE** team received $600 for their **second place** finish as **Most Aesthetic** and **third place** in **Best Deck Design**. Their entry

featured 2 LVL box beams supporting a 3-layered deck of 11/4-inch southern pine.

The test bridges were 12.5 feet (3.8m) long and 4.6 feet (1.4m) wide and were loaded with a test weight of approximately 4,500 pounds. Average weight of the bridge models was 909 pounds (412 kg). At full loading, maximum bridge deflection ranged from 2.66mm to 6.05mm. Maximum allowable deflection was 9.5 mm. Percent non-wood materials in the bridges averaged 3.7 percent; maximum percent non-wood materials allowed was 25 percent, by weight.

For a complete review of 2003 Competition Results and each individual entry including drawings and photos, go to *www.msrcd.org/bridge.htm* and select from menu. Results of 1998-2002 competitions are also posted online. Rules for the 2004 competition will be posted online during September 2003. For additional information, contact Southwest Mississippi RC&D, Inc., competition coordinator at *southwest@msrcd.org*.

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 were placed into use as trail bridges.

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

NEW PUBLICATIONS

The Trail Bridge Catalog Made Available For World Wide Web Access

The National Wood In Transportation Program is pleased to announce that it now hosts the "Trail Bridge Catalog" Web site. The site is intended to help land managers and engineers select from different trail bridge types, decks, rail systems, abutment systems, and materials. Those who visit the Web site, have access to trail bridge drawings, pictures, and other applicable information. The USDOT Federal Highway Administration's Recreation Trail Program provided funding for the project. It was completed through the cooperative efforts of the USDA Forest Service's Missoula Technology & Development Center (MTDC) and the National Wood In Transportation Program. Merv Eriksson, USDA Forest Service structural engineer, conceived of the idea, wrote the text, and assembled the needed material for the Web site. Jacob Cowgill, MTDC Webmaster, was responsible for the Web site's design and development. The catalog can be viewed by visiting: *www.fs.fed.us/na/wit/WITPages/bridgecatalog/*.

Cold Temperature Effects on Stress-Laminated Timber Bridges

Stress-laminated bridges perform well if adequate bar force is maintained to provide the interlaminar friction and load transfer between adjacent deck laminations. Stress-laminated decks are made of both wood and steel components; therefore, different material thermal properties may cause bar force to change as the temperture changes. In response to concerns about the performance of stress-laminated bridges in extremely cold climates, a cooperative research project between the University of Minnesota, the USDA Forest Service Forest Products Laboratory, and the Federal Highway Administration was initiated to evaluate system performance at temperatures ranging from 21.1°C to –34.4°C. Stress-laminated bridge deck sections, constructed of red pine lumber and high-strength steel crossing bars, were placed in cold temperature settings of –12.2°C, –28.9°C, and –34.4°C, while bar force measurements were collected. Testing was completed at three different moisture contents: >30%, 17%, and 7%. At –34.4°C, bar force losses were high when the deck moisture content was above fiber saturation and were moderate to low when the moisture content was below 18%. In all cases, bar force loss was fully recovered after temperatures rose to 21.1°C.

To obtain a copy, please contact the National Wood In Transportation Information Center at 304-285-1591 and request publication number WIT-06-0043, or visit the Wood In Transportation Web site at *www.fs.fed.us/na/wit* to download a copy.

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

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