TBIRC
Timber Bridge Information Resource Center

CROSSINGS
NEWSLETTER OF THE NATIONAL TIMBER BRIDGE INITIATIVE

Editor - Tinathan Coger *Issue 14* *November 1993*

Covered Bridge Park Pedestrian Bridge

South Whitehall Township in Lehigh County, Pennsylvania has developed a park that borders both sides of the Jordan Creek and extends between two, 19th century, timber, covered bridges. In order to preserve the Pennsylvania German tradition and complement the rural setting, the Township selected wood for a pedestrian bridge that is located midway between the two historic covered bridges.

The pedestrian bridge is constructed of two, 10-1/2" wide x 72" deep, glue-laminated wood beams resting in concrete abutments trimmed with native field stone. Atop the 90 foot span bridge are 8" x 8" timber portals and structural members meant to evoke the architecture and character of the adjacent covered bridges. These members have been stained barn red to match the covered bridges and German barns in the area.

Other features of the bridge include a large semicircular wall upstream of the south abutment which is meant to deflect objects such as trees and ice floes that are swept downstream during periods of flooding. Incidentally, the need to clear the 100 year flood explains

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Red Maple Structural Products

Pennsylvania Bureau of Forestry, Pennsylvania Wood Industry Association, Pennsylvania Hardwood Development Council, Bradford Forest Products, and West Virginia University's Appalachian Hardwood Center are cooperating on a U.S. Forest Service Timber Bridge Initiative funded project NA-07-92 on Cost Effectiveness of Producing Timber Bridge Structural Members from Appalachian Red Maple. The objective of the project is to determine the potential for using red maple hardwood (Acer Rubrum) for structural purposes, such as timber bridges. The data collection phase of this project is now complete. The final sizing and grading of the Saw-Dry-Rip (SDR) material produced as a part of this project is now being completed.

The Timber Bridge Information Resource Center (TBIRC) provided a grant to the Pennsylvania Wood Industry Association (PWIA) to perform a structural yield and economic analysis study of manufacturing structural lumber from red maple. The main objectives of the study are to determine whether or not red maple structural lumber can be produced commercially and to determine structural lumber yields from red maple logs.

The study considered two sawing methods. The first and in current use is a process which removes appearance grade lumber from the log, leaving the heartwood or cant for manufacturing structural grade lumber. The second sawing method applies the USDA Forest Service, Forest Products Laboratory, Madison, WI; the Saw Dried Rip Method. Logs are sawn into lumber or flitches, then dried and ripped into structural size materials.

The study advisory committee was established and recommended comparing both methods of processing structural grade lumber to compare the cost effectiveness and structural yield of material.

The study included the sawing of 300 red maple logs at a sawmill in northeastern Pennsylvania. The first 150 logs were sawn by standard practices, (i.e. 1 common and better appearance grade lumber was cut from the logs and the remaining cants were broken into structural material (2 x 6's). The remaining 150 logs were sawn using the Saw-Dry-Rip method. These logs were sawn into flitches, dried, and then ripped into specific width lumber.

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The Role of New Technology Adoption in the Timber Bridge Market and its Affect on Rural Economic Development

The need for infrastructure improvements in rural areas and their role in economic development has been well documented. The National Timber Bridge Initiative has demonstrated that new timber bridge technology can assist in improving rural infrastructure while stimulating local economies. This project is investigating the barriers that continue to exist for this technology.

The main objective of the project is to provide information that will aid in increasing timber bridge use and ultimately increase economic activity in rural areas. The study will also provide information that will aid in identifying areas where additional research or promotional activites may be needed. Specific objectives are:

1. Compare selected states in terms of barriers and incentives that affect the adoption of timber in bridge systems. Identify the most important non-structural material attributes by bridge design engineers. Selected states include Virginia, Wisconsin, Mississippi, and Washington.

2. Identify the most promising market segments for timber bridges and the technology transfer and research needs in these segments.

3. Characterize the bridge material decision making process using the Analytical Hierarchy Process and identify the most influential attributes for the bridge purchase decision.

4. Determine current marketing practices of firms identified as timber bridge manufacturers.

The long-term success of timber bridges in the rural infrastructure will depend not only on the current "technological push", but also on the marketplace acceptance of the concept (the consumer pull). This study will provide a better understanding of the conditions that promote and retard the acceptance of this technology. The information will facilitate the development of strategies to increase timber bridge adoption throughout the United States and aid in targeting the use of limited promotional and research resources.

This is a USDA Forest Service Timber Bridge Initiative funded project (SP, R8-03-92) with the primary project cooperator being the Center for Forest Products Marketing, VA Tech, Blacksburg, VA. Project results will be available by March 1994.

Performance of Red Maple Glulam Timber Beams

Red maple is rapidly becoming one of the predominant hardwood species in the forests of the Northeastern United States. Because it has not been considered for structural applications, there has been little interest in development of red maple lumber products. The emerging prominence of red maple in the forests makes red maple product development of vital interest to landowners and to wood processors, fabricators and designers.

Red maple has excellent mechanical properties, treats well, and has good gluing characteristics (Wood Handbook, 1987). Thus, it is a good candidate for structural applications such as structural glued-laminated (glulam) timber beams. Preliminary research on red maple lumber suggested that red maple glulam beams with design bending stress of 16.5 MPa (2400 psi) and a modulus of elasticity (MOE) of 12.4 GPa (1.8 x 10^6 psi) were possible. Consequently, a cooperative research project was conducted between the Pennsylvania State University and the USDA Forest Service, Forest Products Laboratory to validate the assumptions used in developing these target design values.

1. Red maple glulam beams with Fb = 16.5MPa(2400psi) and MOE = 12.4 GPa (18 x 10^6psi) are technically feasible.

2. ASTM D3737 calculation procedures satisfactorily predicted ADV's of red maple glulam beams.

3. The volume effects for flexual strength for red maple glulams is predicted by the same model (Eq.1) as for softwoods using an exponent value (x=y=z) of 0.071.

Results show that red maple beam properties are predictable using ASTM D3737 procedures, red maple glulam beams with Fb=16.5 MPa(2400 psi) and E=12.4(GPa(1.8 x 10^6psi) are technically feasible, and the volume effect for strength is similar to that for softwood glulams.

NOTE: This article is summarized for publication by the editor. The original publication by H.B. Manbeck; J.J. Janowiak; P.R. Blankenhorn; P.L. Labosky; The Pensylvania State University and R. Moody; R. Hernandez, USDA-FS Forest Products Laboratory. "Performance of Red Maple Glulam Timber Beams" was presented at the December 15-18, 1992 International Winter Meeting, Paper No. 92-4555 American Society of Agricultural Engineers, 2950 Niles Rd., St. Joseph, MI 49085-9659. For additional information, contact the Timber Bridge Information Resource Center at 304-285-1591.

New Publications from TBIRC

Following is a brief summary of two publications that have been produced as part of a technology transfer effort on timber bridge technology conducted by the USDA Forest Service, Timber Bridge Information Resource Center in cooperation with The Pennsylvania State University and the Constructed Facilities Center, West Virginia University. These papers were presented at the 1992 National Hardwood Timber Bridge Conference hosted by the Office of Research and Special Studies, Department of Transportation, Commonwealth of Pennsylvania at The Pennsylvania State University.

These publications, available in their entirety, may be obtained by contacting the Timber Bridge Information Resource Center at 304-285-1591.

Stressed Timber Bridge Decks with Steel Sandwich Plates *by Ralph R. Mozingo, Associate Professor, The Pennsylvania State University.*

This publication features the methodology and design specifications for the optimization of single layer and multiple layer stressed timber bridge decks which contain steel sandwich plates. Also, the design aspects which are affected by the inclusion of the plates, in combination with three possible butt joint patterns, are accentuated in this publication. Design optimization is considered in chapter two and a design example in chapter three. The information provided, will allow engineers to design well-proportioned stressed timber decks for spans up to sixty feet that are structually sound.

Design of Stress-laminated T-system Timber Bridges *by J.F. Davalos, Ph.D. and H.A. Salim, MSCE, West Virginia University.*

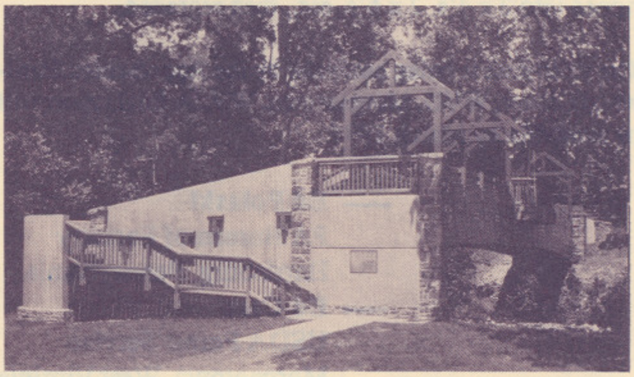
In this publication, West Virginia University presents a step-by-step design guideline for stress-laminated T-system bridges. This publication is concerned with the design of the superstructure only. Section three outlines the design procedure followed by a detailed design example of a two-lane bridge in sections three and four.

Note to User: The information presented provides guidelines for the design of these timber bridge structures. The Timber Bridge Initiative program has sponsored several demonstration bridges using these concepts. These designs are experimental in nature and are not currently approved by AASHTO. Any commentary you may have would be appreciated by the TBIRC for sharing with other users.

Covered Bridge Park Pedestrian Bridge ... *continued from page 1*

the 12 foot height of the bridge on its south side. To provide access from the bridge down to the flood plain a switchback of timber steps and ramps was cantilevered from a center concrete wall, thereby eliminating any supports which could be swept away during a flood. Special care was taken in the detailing of the railing and portal connections to allow the connected members to breathe and to conceal the galvanized steel connection plates.

The main attraction of the bridge is a partially suspended outlook area located in the middle of the bridge which allows pedestrians (even small children) a clear view of the Jordan Creek below. Coupled with the scenic beauty of Covered Bridge Park and the Jordan Creek, the bridge has become an exciting and popular feature of the Park.



DIMENSIONS:	10-1/2" wide x 72" deep glulam beams notched to 54" @ 1 end and at center outlooks; 90' c. to c. of bearings; 8'-0" inside width tops of beams used as parapet walls.
MATERIALS:	Southern Yellow Pine
COST:	$157,000 including approaches
DESIGNER:	G. Edwin Pidcock Co. - Consulting Engineers and Architects - Allentown, Pennsylvania
CONTRACTOR:	Bi-State Construction Co., Inc. - Easton, Pennsylvania
FABRICATOR:	Unadilla Laminated Products

—— **John S. Pidcock**
G. Edwin Pidcock Company
Allentown, Pennsylvania

Red Maple Structural Products ...

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The logs were divided into two groups with these categories in mind. The two sets of 150 logs were divided into the following categories:

US FOREST SERVICE LOG GRADE	DIAMETER CLASS	NUMBER OF LOGS
1	10"	10
2	10"	10
3	10"	10
1	12"	10
2	12"	10
3	12"	10
1	14"	10
2	14"	10
3	14"	10
1	16"	10
2	16"	10
3	16"	10
1	18"	10
2	18"	10
3	18"	10
		150 logs

The green boards and flitches were structurally graded and regraded after kiln-drying by a Northeastern Lumber Manufacturers Association certified structural lumber grader. The green flitches were graded by estimating the amount of structural lumber a flitch will produce. The dry flitches were ripped into 2 x 4's, 2 x 6's, etc., then regraded.

The yield data is being analyzed by the Appalachian Hardwood Center, WVU, Morgantown, WV. A final report will be available by March 1994.

— **Ed Polaski**
PA Bureau of Forestry
Harrisburg, Pennsylvania
— **Ed Cesa**
USDA Forest Service
Morgantown, West Virginia

North Hyde Park Installs a Timber Binwall and Holds Workshop

Timber. A renewable resource material for construction purposes is finding a renewed use as retaining walls in Vermont. The construction of a 124 foot retaining wall in North Hyde Park Village marks the first highway application of the new design which utilizes locally grown timber.

Timber retaining walls are created by constructing bins of interconnected pressure treated wooden timbers which are placed in the desired location to hold road banks, parking lots and landscaping around buildings.

The pressure treated wood is resistant to decay and the damage caused to other construction materials by salt and de-icing chemicals. It is durable and easily handled by construction workers.

The cost of materials for the North Hyde Park wall was $12.26 per square foot of front face. This makes timber very cost effective. The Resource Conservation and Development areas in New Hampshire and Vermont are at this time exploring other designs which can be used where construction conditions are less demanding. You will be hearing more about this in the future.

Timber is aesthetically pleasing to the eye. Timber retaining walls have a natural texture which blends into the landscape. This use of timber strengthens local markets for pine and hemlock.

Editors Note: *The above article was reprinted from the "Vermont RC&D Messenger, August 1993, Issue 11, Volume 1." For more information about the North Hyde Park retaining wall, contact Tom Maclay, Northern Vermont Resource Conservation and Development; RR 1, Box 2270; Morrisville, Vermont 05661; Phone: 802-888-3223.*

Article contributions, questions or comments may be sent to Stephen C. Quintana, Program Director, P.E. or Ms. Tinathan A. Coger, Information Assistant; USDA Forest Service; 180 Canfield Street; Morgantown, WV 26505; Phone: 304-285-1591 or 304-285-1596; or FAX: 304-285-1505; DG: S24L08A.

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