8-15-2003

Bridge Design Guide, Chapter 9 : Timber/Engineered Wood Composites, 2003

Maine Department of Transportation

Chapter 9

TIMBER/ENGINEERED WOOD COMPOSITES

West Branch Bridge, Byron

Grist Mill Bridge, Lebanon

9 TIMBER/ENGINEERED WOOD COMPOSITES

9.1 General

Timber bridge structures and components should sometimes be considered in the preliminary design of a project. Timber structures may be a viable solution when aesthetics are a driving force in the design. Durability, maintenance, and initial cost are three main factors to consider when evaluating timber alternatives. Skews should be avoided on timber bridge structures due to fabrication and constructability issues. Timber substructures are not recommended. Typically, timber bridges have a much higher initial cost compared to steel or concrete structures.

9.2 Design

Timber beams and other structural members should be designed according to the AASHTO LRFD Specification. Members should be designed for net dimensions of anticipated use conditions. Initial design strength and stiffness values are given in AASHTO LRFD, which are modified for individual use and conditions.

Adequate bracing of all structural members should be used to prevent lateral and rotational deformation. Steel bracing diaphragms are recommended over timber blocks.

Ritter (1992) is a valuable resource when designing timber structures. The book is found in the MaineDOT Library.

9.3 Beams

9.3.1 Glue-Laminated Beams

Glue-Laminated (glulam) beams can be considered as an aesthetic alternative for short span bridges. Single span glulam timber bridge structures are feasible up to about 50 feet. Initial bending strengths should be modified to take into account volume effects. Beams should be cambered a minimum two times the unfactored dead load deflection.

Glulam beams may be constructed of most wood species, assuming they conform to AASHTO M168 and can be treated for preservation. Costs should be determined during the preliminary design phase before deciding to use a species outside those defined in the code. The beam properties are calculated from the individual members that make up the glulam. The University of Maine has a computer program that can determine the beam properties given the properties of the components.

9.3.2 FRP-Reinforced Glulam Beams

Glulam beams can be used on longer spans when reinforced with fiber-reinforced polymers (FRPs). The beam depth can also be reduced with FRPs.

Direct involvement with the University of Maine is required for any project utilizing FRPs. The University has the resources and lab equipment to predict the beam properties and verify the values for design.

> *Commentary: The design of structures utilizing FRP reinforcement of timber structures is currently not addressed in the AASHTO bridge design codes.*

9.4 Decks

9.4.1 Direct-Span

Glulam decks and transversely post-tensioned decks are two options for short span structures. Direct-span decks are feasible up to about 33 feet.

9.4.2 Transverse Decking

There are two types of timber decking: solid sawn lumber and glulam.

Solid sawn lumber should be used only on low volume roads. No less then a 4x4 member should be used for the deck size. Timber running boards nailed to the deck are a common wearing surface for this deck type.

Glulam decks may be used for wider beam spacings. Glulam decks are the preferred option with glulam beams. A double layer of waterproofing membrane with a bituminous wearing surface should be used to protect the deck. Glulam decks are typically placed at a constant cross slope across the bridge. Positive drainage of the wearing surface should be achieved by super elevating the deck or by constructing cross slope in the wearing surface during the final paving. A retainer angle should be placed along the curb line to protect the pavement edge.

9.5 Preservative Treatments

All timber members must be pressure-treated to prevent microorganism and insect damage. Treated members are not allowed to be in contact with the stream or river. Creosote and pentachlorophenol are treatments that have been used in past projects. The Structural Designer must research the required treatment to match the wood species and application. The Structural Designer must also coordinate the treatment with the Environmental Coordinator. The specification for the treatment must meet the latest American Wood-Preservers Association standards.

Where possible, all holes should be predrilled into the members before a preservative treatment is applied. If field drilling is required, the holes should be treated with an approved treatment.

9.6 Bridge Rail

Timber bridge rail is available up to a crash-test rating of TL-4. Refer to Section 4.4 Bridge Rail. Steel-backed timber guardrail can be used on the approaches when it is appropriate.

References

American Wood-Preservers Association, 1995, *American Wood-Preservers Association Book of Standards*

AASHTO, 1998 and Interims*, Load and Resistance Factor Design (LRFD) Bridge Design Specifications*, Washington, DC

Ritter, Michael A, 1992, *Timber Bridges Design, Construction, Inspection, and Maintenance*, USDA Forest Service, Washington, DC