RESEARCH in Progress

NATIONAL CENTER FOR WOOD TRANSPORTATION STRUCTURES

Design of a Timber Bridge to Evaluate Deck Design Details

When properly designed and protected from elements such as water, insects, and fire, timber is a structurally capable, cost-effective, and aesthetically pleasing material suitable in many structural applications. However, when not properly designed or protected, timber structures are susceptible to deterioration, which can result in a decrease in structural capacity.

Modern timber bridge decks are typically panelized systems constructed on engineered wood products.

As a result of the accelerated and repeated deterioration of wearing surfaces (i.e., transverse cracking along deck panel joints) on timber bridges, the overall perception of these structures, despite their excellent structural performance, has consistently remained at less than acceptable. The unacceptable performance of timber bridge wearing surfaces, typically asphalt, has posed question and concern over the performance of the underlying superstructure and its affect on the wearing surface performance. For an acceptable and competitive alternative, a timber bridge and its wearing surface must be designed such that both deterioration and maintenance are minimized.

Background

Previous research conducted at Iowa State University involved the field-load testing of eight glued-laminated timber girder bridges in the mid-1990s and again in 2003. Results from that testing indicate that the severity of wearing surface deterioration tends to vary from bridge to bridge due to a number of factors. However, there were a couple of factors commonly found on bridges with the most severe wearing surface deterioration, including the physical condition of the glued-laminated deck panels and differential panel deflections.

Differential panel deflection, the relative deflection of one panel relative to an adjacent panel, results in increases in the magnitude and frequency of stress reversals in the wearing surface. Consequently, the most common and severe deterioration found on the majority of the subject bridges was transverse cracking at the deck panel joints on girder bridges with transverse decks and longitudinal cracks at the panel joints on longitudinal deck panel bridges. Results and recommendations from that research were published in eight bridge performance reports, and a final report summarized the results and recommendations from that work.

A follow-up laboratory investigation, in which a full-scale timber bridge was constructed at the Iowa State University Structural Engineering Laboratory, developed several design details for the purpose of limiting differential panel deflection between adjacent panels. These details were tested under simulated truck loadings and compared against a no treatment (control) condition. Several of these developed details were able to reduce differential deflection by 50% to below the recommended design limit. These alternatives were

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also evaluated in terms of construction and cost effectiveness.

Objective

The objective of this project is to design and coordinate the construction of a timber bridge with two or more of the above laboratory-tested design details.

Approach

This work will consist of the following tasks:

1. Locate a bridge owner that will construct a bridge between July 2008 and July 2009.
2. Design a site-specific bridge that incorporates two or more innovative deck design details.
3. Facilitate the donation of bridge construction materials.

Expected Outcomes

It is expected that this work will result in the development of standard design details for panel decks. Benefactors of this work will be bridge owners and designers. It is felt that with enhanced durability characteristics a greater number of bridge owners will request construction using timber.

Timeline

It is anticipated that Task 1 will be completed by December 1, 2007; Task 2 will be completed by March 1, 2008; Task 3 will be completed by July 1, 2008.

Cooperators

Iowa State University, Bridge Engineering Center
USDA Forest Service, Forest Products Laboratory

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