RESEARCH in Progress

NATIONAL CENTER FOR WOOD TRANSPORTATION STRUCTURES

Development of Design Recommendations to Minimize Timber Deck Panel Differential Deflection

In 2001, a project was initiated by the USDA Forest Products Laboratory to develop deflection criteria for timber bridges. To accomplish this, several timber deck panel bridges across the country were tested under live loadings. At the same time, detailed inspections were conducted such that observed deterioration of the wearing surface could be related to bridge behavior. Although several recommendations resulted from this work, one of the most important was that design details need to be developed that minimize differential panel deflection in these bridges.

Figure 1. Transverse deck panels on glulam girders.

Background

The poor performance of timber bridge wearing surfaces can have a direct impact on the unfavorable perception of timber bridges. Properly maintained, timber bridges can be an efficient, cost-effective, aesthetically pleasing alternative for today's transportation system.

To address the problem of wearing surface performance on timber bridges, a research project was conducted that included the testing of 12 bridges. Eight were timber girder bridges with transverse timber panel decks (Fig. 1), and four were longitudinal timber panel deck bridges. Of the 10 bridges tested with asphalt wearing surfaces, nine exhibited some level of deterioration to the wearing surface. Deterioration varied from minor hairline cracks to significant cracks measuring almost an inch in width (Fig. 2). In all cases the most severe cracking of the asphalt wearing surface corresponded to the locations of the deck panel joints. Furthermore, the cracks were evident on both aged and newly placed wearing surfaces.

Figure 2. Transverse cracks in the asphalt wearing surface at panel joints.

Test results from the 12 bridges suggested that one factor affecting the deterioration of the wearing surfaces was differential deflection between adjacent deck panels. Test results indicated that bridges with reduced girder and differential panel deflections performed the best.

Objective

The objective of this work is to develop design detail recommendations for minimizing differential panel

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deflection of glued-laminated timber panels used in bridge decks. This work will consist of developing, testing, and deploying design details to minimize differential panel deflection. It is envisioned that these design details will be in a form suitable for incorporation in national design recommendations and standards. To accomplish this, four general tasks will be completed: development of potential design details, laboratory testing of design details, deployment of design details, and final documentation.

Approach

The study will be completed in three main phases: detail design and selection, laboratory testing, and field testing.

The joint detail design and selection phase will focus on developing several potential design details for new and existing timber deck panel bridges. These details will include specific attributes for minimizing differential panel deflection using mechanical attachments to the top, middle, and/or bottom of the deck panels.

In the laboratory testing phase, the most promising details will be evaluated for their effectiveness at reducing live-load-induced differential deflections. These tests will simulate the worst case scenarios for field loadings.

The field testing phase will implement the most effective designs into a full-scale field application. In the 2001 field testing, a bridge was identified in Butler County, Alabama, that has an asphalt wearing surface with severe deterioration induced by differential deflection. The research team will plan to work with the Butler County highway department, or another suitable bridge owner, to develop a repair configuration based on the details deemed most promising from the laboratory testing. Although not likely to occur during the duration of this work, the research team would continue to monitor the performance of the design during several years of in-service use.

Expected Outcomes

The research study will result in (1) design detail recommendations for minimizing differential panel deflection of glued-laminated timber panels used in bridge decks, (2) joint detail plans in a form suitable for incorporation in national design recommendations and standards, (3) documentation of study findings and test results, and (4) development of a comprehensive, yet concise, report on the study findings, focusing on joint details found to be most promising and how they can be effectively implemented in both existing and new timber deck panel bridges.

Timeline

Exploratory design details will be developed and drafted by early summer 2004. Design of the detail components, bridge girders, and panels will be completed by early fall 2004. Construction and testing of the laboratory specimens will be completed by November 2004. Data reduction and analysis of preliminary results will be completed by January 2005. Implementation of the selected joint detail into a full-scale bridge application will be completed by March 2005. Final reduction of data and drafting of the final report will be completed by July 2005.

Cooperators

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