RESEARCH in Progress

NATIONAL CENTER FOR WOOD TRANSPORTATION STRUCTURES
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Improved Modeling of Historic Covered Bridges—Phase II

Covered bridges are complex structures containing eccentric connections, various load paths, connection uncertainty between the subassemblies (trusses and arches), and interaction between trusses and their housing (Figure 1). When these factors are combined with material variability, the conclusion that some bridges just shouldn't be standing is an understandable option. As noted in the Federal Highway Administration (FHWA) publication FHWA-HRT-04-098, *Covered Bridge Manual*, there are inconsistencies with the assumptions of traditional simple, static analyses of trusses that are frequently used to analyze covered bridges.

Figure 1—Burr Arch covered bridge.

Background

The USDA Forest Products Laboratory in cooperation with Iowa State University has been improving the analytical modeling for covered bridges, specifically the Burr Arch and Queen Post Truss (Figure 2). The objective of this research is to develop techniques and provide recommendations for improving the analysis of historic covered timber bridges. Initial work indicated a critical need to identify material properties of dominant members to improve the correlation between measured loading test results and modeling. Typically, wood used in historic structures was local to the bridge and of a species not traditionally used in modern construction, for which engineering properties are readily available. This work focused on planer models and using modulus of elasticity values determined by nondestructive results of load rating tests. The work also noted that additional important parameters are connection behavior (Figure 3) and out-of-plane deformations.

Objective

The objective of this research is to develop techniques and provide recommendations for improving the analysis of historic covered timber bridges.

Approach

- Review Phase I modeling approaches to identify shortcomings
- Conduct experimental connection tests for model input
- Assist ongoing covered bridge rating work
- Develop model for load-rated bridges
- Compare analysis model with load test data
- Incorporate support and end conditions into models
- Access influence of out-of-plane deformations
- Develop covered bridge modeling manual

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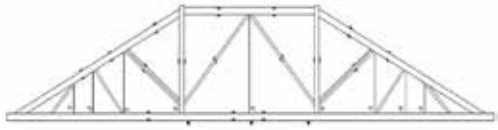

Figure 2—Phase I Queen Post Truss in Flint, Vermont.

Expected Outcomes

We expect to publish recommendations for modeling procedures that will improve the structural analysis of historic covered timber bridges and provide an assessment of modeling procedures with respect to load tests and field evaluation reports.

Timeline

Preliminary planning for both field and analytical work will take place in early 2013. Review of Phase I modeling approaches, identification of associated weaknesses of the models, and planning of connection experiments will take place in spring 2013. Experiments will be conducted over the next 18 months. Load test modeling that incorporates the experimental connection information will be compared to field load tests. A modeling manual will be drafted in 2015.

Figure 3—Bottom chord connection detail.

Cooperators

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