RESEARCH in Progress

Coalition for Advanced Wood Structures
a university, industry, government partnership

Remote Monitoring of Historic Covered Timber Bridges in Madison County for Prevention of Arson and Vandalism

In 2002, a series of acts of vandalism and arson to covered bridges in Madison County, Iowa, resulted in the complete loss of the Cedar Bridge. Exactly one year later, a second bridge was set on fire, and a third soon after. Prevention of future acts of vandalism and arson is important to retaining these important historic structures. Remote monitoring has become an increasingly desirable alternative for many bridge applications, including maintaining security.

Roseman Bridge, Madison County, Iowa.

Background

More than 1,500 covered bridges remain in the United States. Architecturally sound and uniquely suited to the woodland country, these bridges have weathered time with the same ease with which they spanned the nation's streams a century ago.

Though most common in Pennsylvania, Ohio, Indiana, and the New England States, these sturdy structures can be found as far west as California, as far south as Louisiana, and as far north as Alaska. However, the midwestern and central plain states are almost devoid of these landmarks, perhaps because they did not become densely populated until after the covered bridge era (the great land rush during the 1800s was to the western coastal states).

Not the least of the casualties of the Civil War was the destruction of hundred of these bridges. Many citizens are now dedicated to ensuring that the covered bridge will continue to add its special charm to rural America: camera-laden tourists wander off the well-trodden path in search of them, artists and poets have become "covered bridge buffs," and civic groups are committed to their restoration and reconstruction.

Covered bridges not only are an important part of our history but also represent the type of craftsmanship that often eludes us in our search for rapid, cost-effective bridge construction. Thus, given the recent successes and attempts at destroying these historical landmarks, a systematic approach to prevent further vandalism is warranted.

Objectives

Three primary objectives are associated with this work:

- To develop a tool that will ensure the long-term preservation of historic bridges
- To develop and demonstrate a system for long-term monitoring of timber bridges of various types
- To advance the state-of-the-art and to develop expertise in design, installation, and implementation of long-term remote monitoring systems.

USDA Forest Service Forest Products Laboratory

Iowa State University of Science and Technology

U. S. Department of Agriculture
Forest Service • Forest Products Laboratory

Approach

To accomplish the project objectives, six general tasks will be completed: vandalism and arson assessment, literature review, system development, system installation, long-term monitoring, and final documentation.

Working with law enforcement, bridge owners, and other interested parties, the vulnerabilities of the covered bridges of Madison County will be identified. At this time, the most likely vulnerabilities are thought to be nighttime minor vandalism and arson. A network of "who to contact" will be established among all interested parties, such that potential destructive activities can be mitigated in a timely and effective manner.

With the specific activities of interest identified, a product review will be conducted to identify sensors and data collection systems that can be used in the identification of potential destructive activities. Several types of sensing systems will likely be needed to identify the types of potential destructive activities that could impact timber bridges.

With information collected on available sensors, a system will be designed, constructed, and beta-tested. In addition to the integration of sensors and other data sources, pattern recognition software and other algorithms may be created to allow instantaneous assessment of threats from the collected information.

Upon completion of successful beta-testing, the system will be installed on at least one covered bridge location. Connection to the Internet will allow data to be broadcast to the world and to Iowa State University for real-time processing and threat notification.

Each installed system will be monitored to assess its long-term performance. To test the full functionality of the system, simulated acts of vandalism and arson will be conducted with the assistance of local law enforcement.

The final task to be completed during this study will be the development of a comprehensive and concise report on the study findings. This report will focus on lessons learned and how the developed system could be utilized on similar covered bridges. The report will also document lessons learned with respect to monitoring other types of important bridges for threat assessment. This research may lead to the development of recommendations for system design for monitoring bridge security.

Expected Outcomes

This study will result in (1) installation of a functioning system that will help ensure that the covered bridges of Madison County will remain intact for many generations to enjoy, (2) recommendations on how the employed technologies could be used to monitor other bridge types for various types of threats, and (3) development of a comprehensive, yet concise, report on the study findings.

Timeline

Preliminary system design will be completed by early fall 2004. A review of available technologies will be completed by late fall 2004, with all components purchased by the end of 2004. System integration and beta-testing will be completed by February 2005, with installation of the system immediately following. Field testing of the system will be completed through July 2005, with continued monitoring. Drafting of the final report will also be completed by July 2005, with a report addendum to be developed at the conclusion of monitoring.

Cooperators

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

Contact Information

Terry Wipf, Director
Bridge Engineering Center
Iowa State University
Ames, IA 50010
515-294-6979

Brent Phares, Associate Director
Bridge Engineering Center
Iowa State University
Ames, IA 50010
515-294-5879