Including Multiple Criteria for Bridge Management

To manage their inventory of bridges, transportation agencies must determine when and how to maintain bridges to keep them safe and performing well as they age. Bridge managers must establish performance measures and the most cost-effective use of limited funds to meet those measures.

The AASHTOWare Bridge Management software, formerly called Pontis, allows users to track and store bridge maintenance data; model the expected deterioration of bridges; and ultimately make more cost-effective decisions for bridge preservation, rehabilitation, and replacement. The tool also helps agencies comply with the highly detailed inspection regimen required by FHWA.

Bridge management must consider performance measures beyond life-cycle costs.

Traditionally, this and similar software tools allowed users to make decisions based only on the objective of minimizing long-term costs as bridges deteriorate. However, other objectives are important to bridge agencies, including safety; traffic flow disruption; and vulnerability to scour, fatigue, and other hazards. Accounting for trade-offs between these various performance criteria allows more balanced bridge management decisions.

The state of the practice in bridge management was based on bridge deterioration,” says Michael Johnson, chief of Caltrans Office of Specialty Investigations and Bridge Management, “yet 40 percent of the money I spend is on vulnerabilities. We needed a way to integrate condition-based objectives with vulnerability criteria.”

Todd Thompson, bridge management engineer for South Dakota DOT, commented further on the need. “Bridge management must consider performance measures beyond life-cycle costs,” Thompson says. “It must optimize multiple objectives to minimize risk.”

The AASHTOWare Bridge Management Task Force proposed a project to update the existing Pontis software. The resulting NCHRP Project 12-67 produced NCHRP Report 590: Multi-Objective Optimization for Bridge Management Systems (trb.org/Main/Public/Blurbs/159292.aspx).

Implementation Strategies

AT A GLANCE

• Collaboration with AASHTO: Close ties between research champions and the appropriate AASHTO committee ensured a highly useful research product.

• Communicating Results, Influencing Legislative Change: Dissemination of results played a role in the signing of MAP-21 legislation, which requires risk-based asset management by states.

• Addressing a Critical Need: The project was steered from the beginning to address a need that was important to practitioners.

NCHRP—Transportation research that works

Objective national highway research since 1962 • Focused on practical problems of state DOTs • Contract researchers competitively selected • Overseen by balanced panels of technical experts • Reviewed by TRB highway specialists
This proactive approach to communicating results has had broad consequences. “Our dissemination of results for this project played a role in the signing of federal legislation,” Johnson says. Signed into law in 2012, the Moving Ahead for Progress in the 21st Century Act (MAP-21) requires risk-based asset management by states. “MAP-21 has very broad implications,” Johnson says. “It will change the way bridges are inspected.”

A proactive project panel addresses a critical need

The panel for this project was active not just in communicating results and facilitating the update of AASHTOware Bridge Management software, but also in steering the project from the beginning to address a critical need.

“Communicating results, influencing legislative change

Beyond their critical overlapping roles in AASHTO, panel members also made presentations at various bridge management conferences and annual meetings.

“The whole project panel has been important,” Johnson says. “They have been positive advocates for a multi-objective approach.” Johnson himself made a presentation to FHWA, and others have gone before AASHTO and TRB committees and facilitated webinars.

Thompson notes that 43 of 50 states use AASHTOware Bridge Management software. “They contribute a license fee,” Thompson says, “so it was important to frame this project to address their needs.”

Johnson adds, “This project was very timely. It addressed a real-life need that a lot of people were struggling with.”

Implementation Success

Ultimately, the improved software will help practitioners make asset management decisions in the most cost-effective ways.

“This project will dramatically improve our method for optimizing bridge projects,” Thompson says.

Moreover, the benefits will go well beyond the transportation industry, according to Johnson.

“The concepts that we were researching in this project are broadly applicable methods for modeling and prioritizing needs,” he says. “The multi-objective optimization framework developed as part of this project has become the current state of the practice in asset management in general, and not just for bridges or the transportation industry.”

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