PUTTING RESEARCH TO WORK **BRIEF**

New Software Streamlines LRFD Design Process

When WisDOT and other states adopted AASHTO Load and Resistance Factor Design methods in 2007, it signaled a shift to a more precise approach to bridge design, one that would consider both the structural contributions and configurations of individual bridge components and the aggregate performance of assembled bridges. Though it began to be developed in the 1970s, LRFD design was only mandated by the Federal Highway Administration for new bridges beginning in October 2007. This switch to LRFD was a nationwide shift in bridge design philosophy.

What's the Problem?

LRFD Bridge Design Specifications developed by AASHTO provide values for various elements in bridge design—from friction coefficients for bearings between substructures and decks to live and dead loads of bridges.

Since 2007, WisDOT's Bureau of Structures has used different software for designing the various subcomponents of bridges. While these automated programs save a considerable amount of personnel time in the production of final bridge construction plans, the use of multiple systems introduces inefficiencies in bridge designers' time, both in learning these systems and in shifting their work between them. The differences between these programs can also lead to inconsistencies in design across the bridge and to a lack of uniformity in how bridges are designed across the state.

Research Objectives

The goal of this project was to create new control system software for automated LRFD bridge design. The software would augment current AASHTO specifications for LRFD design of prestressed girders and piers used by WisDOT by drawing on LEAP CONSPAN and LEAP RC-PIER software from Bentley Systems, Inc.

Methodology

The new software was drawn together and refined by engineers at Bentley and prepared for use by WisDOT. Developers used CONSPAN and RC-PIER in batch mode to integrate into WisDOT's existing automated drafting system and to expand its LRFD capability. This involved investigating XML file transfer technologies to move data between the systems. WisDOT bridge designers assisted developers by beta testing substructure and superstructure coding. Bentley staff produced a user's manual for bridge designers.

WisDOT uses sophisticated design software and methods to ensure that bridge performance matches bridge aesthetics, as with award-winning structures like this WIS 29 bridge (left) over US 51 in Wausau and the Claude Allouez Bridge (right) in De Pere.

Project Manager

"The new software does more accounting and incorporates more specifications, reducing the time for design and making the process more efficient. Design will be more uniform, which should improve the quality of bridges."

–Scot Becker
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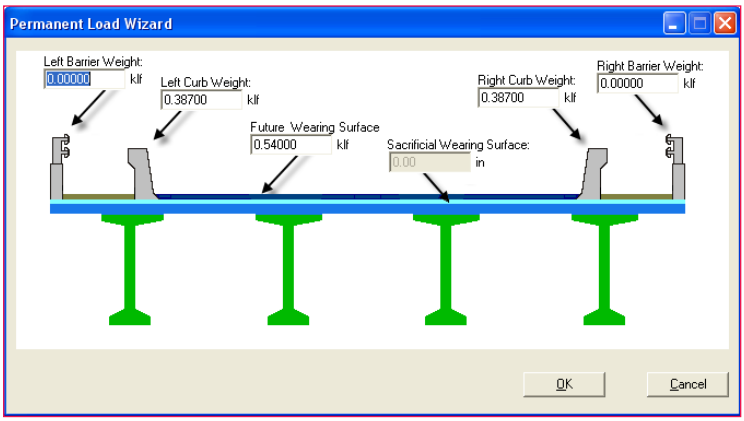

In this portion of WisDOT's new LRFD software, the Dead Load Wizard, bridge designers review the software-calculated dead load, the strain of the structure's weight with no traffic loading.

Investigator

Lee Tenase, Bentley Systems, Inc.

Results

The control system was fully updated to work with all LEAP Bridge applications (versions v8.1), including CONSPAN and RC-PIER, and with CrypKey, a security system. WisDOT reviewed and tested the package.

The user manual assists designers through the process for design, analysis and load rating of pretensioned, prestressed concrete bridge beams (LEAP CONSPAN), and for integrated design and analysis of substructure elements for multi-column and hammerhead piers; straight, tapered or variable caps; circular, rectangular or drilled-shaft columns; and footing types like isolated or combined footings supported on soil or piles (LEAP RC-PIER).

Bridge designers expect the new software package will allow for more uniform bridge design, and consequently for higher quality, more durable bridges that may require less lifetime maintenance and associated expense due to their improved, uniform quality. The project manager estimates that increased efficiency from the new software could reduce the average bridge design time by tens of hours, in large part because design efforts will be streamlined into fewer varieties of software. With the new system, data for the various bridge elements are stored in one location or database rather than in multiple files.

Ultimately, the new software streamlines the design process, makes design more uniform, improves new bridge quality and may reduce lifetime maintenance costs on new bridges. Drivers in Wisconsin will enjoy better bridges that last longer, and designers will work more efficiently, spending less time on new bridge projects.

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