BRIDGE WORK

Structural engineer Bill Davids partners with Maine DOT to apply research to address state needs

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In 2007, when Gov. John Baldacci issued an executive order instructing the Maine Department of Transportation to inspect bridge infrastructure in the wake of the collapse of the I-35 bridge in Minnesota, one of the engineers to get a call was Dr. Bill Davids.

For almost a decade, Davids had been working with state transportation officials on a number of projects, including bridge safety. The chair of the University of Maine Department of Civil and Environmental Engineering was on the team of experts who reviewed the condition of Maine's bridge inventory and issued the "Keeping Our Bridges Safe" report. In 2014, he also served on the team that reviewed bridge improvements and issued an update on work that still needs to be done.

Davids has conducted internationally recognized research and has worked on some high-profile projects at the university, including the research and development of blast-resistant panels and the composite arch bridge system, commonly known as Bridge-in-a-Backpack™, at UMaine's Advanced Structures and Composites Center. There, he's also leading a NASA–funded project researching atmospheric re-entry systems for spacecraft.

But it's as a structural engineer with a strong background in bridge engineering and design that he implements much of his applied research in collaboration with Maine's transportation department to ensure the state's bridges are safe.

Davids and other UMaine researchers, both faculty and students, have partnered with MDOT to address issues identified as part of the state's ongoing bridge assessment and improvement programs. In recent years they have developed ways to more accurately assess the structural safety of certain types of bridges. Davids was the chief developer of software used for load rating of flat concrete slab bridges. Several hundred of those types of short-span bridges are in the state, he says, many of them built between 1930 and 1960, and many of those were underdesigned for today's heavy truck loads.

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>
> DR. BILL DAVIDS

In the past, the department has used design calculations to determine whether bridges were adequate, but those calculations, Davids says, can be conservative and often don't provide a realistic assessment of the structure's capacity.

"The condition of many of those bridges is pretty good," he says, "but if you do the calculations alone, you'll conclude that they're insufficient to carry today's loads, and they'll be at risk for posting for reduced loads, which can have economic consequences."

Those consequences became very real in 2003 when the transportation department posted the former Waldo-Hancock Bridge across the Penobscot River, reducing the load limit on the bridge and sending heavy commercial vehicles on a 40-mile detour, traveling to and from Down East Maine. That bridge was eventually removed after the new Penobscot Narrows Bridge opened in 2006.

The UMaine SlabRate finite-element software provides more realistic assessments of bridge capacity that has allowed the department to keep open a number of Maine bridges that — using the more conservative calculation — might have required posting for reduced loads or closure.

"Those bridges actually are OK," says Davids, UMaine's John C. Bridge Professor of Civil Engineering. "That's significant. They can be taken off the table. That's a real tool they can use and it saves real money at the end of the day."

That software is now being used not only by the transportation department, but by other consulting engineers working for MDOT to load rate other slab bridges.

In addition to developing the software for testing bridges, UMaine students and faculty are regularly in the field with MDOT crews to perform live load field testing on existing bridges. For example, in winter 2014 they were on and under a five-span truss bridge between Enfield and Howland, using the MDOT's inspection truck to reach the underside to attach sensors and other instruments. Those instruments were used to measure the effects of very large loads — four 50,000- to 60,000-pound dump trucks positioned across one span — on the bridge structure and to accurately assess its capacity.

"It was a challenging test, but we got really good data," he says. "That bridge will be OK for the next couple of years without any additional work."

That was important for MDOT engineers to know. At the time of the test, the bridge was slated for replacement within the next few years, but engineers had discovered structural shortcomings and were concerned that they would have to strengthen the bridge temporarily until they were ready to begin construction to replace it. Knowing the bridge was safe saved the department the cost of that work.

The cost for UMaine to test and analyze that bridge was about $10,000, plus the time of MDOT personnel on-site during the test, Davids says. "That's a lot less than the cost to retrofit even a small part of the structure."

UMaine researchers are also working with the department on a number of other bridges,