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COLLEGE OF ENGINEERING

Prosperity through innovation.

Oregon State UNIVERSITY | College of Engineering

ON THE COVER: OSU undergraduate engineering students Kate Bradbury and Laurel Senger are part of a research team led by structural engineering professor Chris Higgins. The team is innovating new bridge repair techniques and helping the state of Oregon better allocate its bridge repair funds (see full story on p. 6).

BRIDGE DOCTOR

Professor and Students Help Oregon Stretch Bridge Dollars

Call him a bridge doctor. He's helping the state treat her aging bridges so they live longer and cost citizens less.

Christopher Higgins, professor of structural engineering, came to OSU in 2000 and went to work putting in a structural testing laboratory that's attracted more than $4 million in research funding – the lion's share from the Oregon Department of Transportation.

ODOT engineers came to Higgins in 2001 when they discovered that many of Oregon's older bridges were showing diagonal cracks in the concrete girders. ODOT needed to know more about the bridges in question, fast.

Higgins and his student team used a $1.6 million ODOT grant to analyze the problem, performing much of the research in the OSU Structures Laboratory, where they tested bridge girders to the failure point using massive hydraulic cylinders to simulate the load of thousands of trucks crossing a bridge.

When the dust settled, the researchers had produced a better way to determine the remaining strength of bridge girders. Using this approach, ODOT determined that not all of the cracked bridges needed to be replaced and others could be temporarily remedied. This allowed ODOT to distribute limited funds to the most important bridges.

"ODOT was able to modify their program based on our outcomes," Higgins says. "Our work allowed them to extend available resources to address the most pressing problems. Without these findings, an additional $500 million would have been needed to deal with the number of affected bridges. That's a pretty good return on the $1.6 million investment."

Since then, ODOT has funded approximately $2 million in additional bridge research with Higgins, who is part of the College's Kiewit Center for Infrastructure and Transportation Research Cluster. Higgins' team is currently working on a range of new bridge research, including the use of acoustic sensors to "listen" to the sounds bridges make, which can identify where damage is occurring.

"Sometimes, only a small portion of a bridge needs attention, while the remaining 90 percent may be adequate," Higgins says. "So it is possible to strengthen only the weakest section instead of replacing the entire bridge."

The researchers are also experimenting with new repair methods, including the use of high-performance steel, carbon fiber polymers, and high-tech adhesives, all of which can extend a bridge's lifespan. In order to study how Mother Nature affects these materials, they are constructing a 30-ft.-long, custom-made, environmental chamber where full-size bridge girders can be repeatedly frozen and thawed while simultaneously applying loads. "This experimental capability is truly unique," Higgins says.

Another project is a collaboration with the College's Hinsdale Wave Research Laboratory, where researchers are testing the response of a 12-ft. scale model of a pre-stressed concrete bridge located in Florida. The model will be subjected to hurricane induced waves, and the results will help prevent the kind of losses seen after Hurricane Katrina.

"We're doing incredibly interesting things here," Higgins says with the grin of a good doctor. The ultimate beneficiary of his work? Anyone who ever drives across a bridge – in Oregon or beyond.

Chris Higgins and two of his undergraduate engineering researchers, Kate Bradbury and Laurel Senger, stand on the Van Buren Street Bridge over the Willamette River in downtown Corvallis, Oregon.