Engineers use composite materials to extend life of existing bridges

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A team of University of Kansas engineers is testing a new class of devices that could double the life of America's existing bridges using composite materials.

"This is the kind of technology that will allow our existing infrastructure — as well as new bridges — to be safer for longer," said Ron Barrett-Gonzalez, associate professor of aerospace engineering at KU. "The use of composites can double or more the life of these steel structures, and the application is created with an eye toward cost and ease of use."

The research is funded through a grant from KU's Transportation Research Institute sponsored by a federal grant through the U.S. Department of Transportation. Four faculty members are conducting the research, including Barrett-Gonzalez and Stanley Rolfe, the Albert P. Learned Distinguished Professor; Adolfo Matamoros, associate professor; and Caroline Bennett, assistant professor, all from the Department of Civil, Environmental and Architectural Engineering.

Composite doublers were originally used to repair cracks around stress points and rivets in airplanes. They take stress that would cause the rivet or crack to fail and allow that stress to pass through the composite material and over the rivet or crack without stressing the airplane.

To create these "detail doubler fuses" for bridges, layers of composite material are applied to a joint or stress point on a bridge. Once set, the doubler takes the stress from a car or truck and allows it to pass without the joint receiving any stress, extending the life of the bridge.

Once the doubler begins to wear out, it also will function as a simple warning system for bridge inspectors and road workers.

"We are building these as a fatigue 'fuse,' " Barrett-Gonzalez said. "When they are about to fail, they pop off of the joint, and we will include an indicator — whether it's bright red paint or some other form — that will serve as an obvious sign that it needs to be replaced.

"One of the major problems with bridges and the inspection process is that you can't always see the problems. There are some systems that are being developed, but we felt this would be a simple, inexpensive indicator that would simultaneously double the life of the structures being sensed."

Use of the doublers would be quite simple, Barrett-Gonzalez said. Once the materials are ready for full use, a bridge inspector could do a normal inspection, and when fatigue points are found, the composite doubler could be applied on the spot, allowed to set and ready to extend the life of a bridge.

The idea for the doublers came from a casual discussion between aerospace engineers and civil engineers at KU.

"We were comparing notes on various things one day and decided to give it a try. That's one of the great things about the environment here at KU is that faculty and researchers are interdependent," Barrett-Gonzalez said. "Collaboration at some institutions can be strained, but I can honestly say that the faculty and researchers here look at each other as complementary colleagues. Collaboration is not only a good thing to do to maintain fresh ideas in a given group, it's a way of life around here."

"So why can't we use the materials that we use in aerospace to help with the problems in today's bridges?" he asked rhetorically.

The doublers are in the small-scale test phase, and the concept has been proved, Barrett-Gonzalez said. Researchers are working on a large-scale bridge model that will be tested under complex loading conditions later this year. The upcoming project is of such great interest that nearly a dozen states have chipped in $1 million to support a "pooled-fund study" to take this technology to the next level.

One of the greatest advantages to the composite doublers is their purpose as a high-tech, low-cost way to improve the nation's infrastructure.

"There are high-dollar solutions to many of the problems with our bridges," Barrett-Gonzalez said. "But we can take a low-dollar solution and double the life of these bridges while making them substantially safer at the same time."

Source: University of Kansas

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