

LTU, MDOT Study Use of Carbon Fiber to Replace Steel on Bridges, Overpasses

By Stefanie Carano
Staff Reporter

Lawrence Technological University is conducting studies on the use of a new material for bridges and overpasses to reduce corrosion and costs.

Realizing the state is faced with an infrastructure that is decades old and a tight budget to maintain it, LTU is examining the use of carbon fiber-reinforced polymer, also referred to as "carbon fiber," in place of steel to maintain safety while reducing costs.

"Bridges are the most conservative science because you have to be right," said Kirk Steudle, director of MDOT. "When a bridge falls down, people get injured. This is a 50 percent scale of a bridge and it's doing well."

Under the leadership of Nabil Grace, the director of the Center for Innovative Materials Research, a test to prove the worth of the material was recently conducted on a 30-foot sample of a wide box beam bridge consisting of carbon fiber supporting concrete. The carbon fiber cables were able to sustain up to 160,000 pounds of force and nine inches of deflection, two times the overload limit.

"This far exceeded expectation," Grace said.

A similar 54-foot box beam on Southfield Freeway's Pembroke Avenue overpass is scheduled to be put in place next year.

Grace said a widespread use of carbon fiber would mean drivers in Michigan no



PHOTO: ERIC POPE
MDOT DIRECTOR Kirk Steudle, left, speaks to Nabil Grace of Lawrence Tech during a test on the strength of carbon fiber.

longer have to see plywood as they drive under a bridge.

"This is Michigan and we have the materials and the ability to improve the infrastructure," he said.

In his presentation to representatives from MDOT, the U.S. Department of Transportation, the Michigan Economic Development Corporation and members of the public, Grace said that carbon fiber is initially more expensive than black and epoxy-coated steel, but has lower long-term costs, as its life cycle is longer and its maintenance costs are less.

The initial cost for carbon fiber is about 92 cents per foot, compared to 60 cents for epoxy-coated steel (a type of reinforced steel) and 59 cents for black steel.

Yet, in a life cycle cost

analysis conducted by the center, carbon fiber had an estimated cost of \$1.55 million at an estimated life cycle of 100 years – more than 50 percent the life cycle of black steel at \$6.8 million from its initial cost to its breaking point and epoxy-coated steel at \$3.3 million.

"There's lots of talks going on, how we utilize this, the main discussion is cost," Steudle said. "I believe this is the material of the future. I'm happy we're involved in developing that material. We still have to walk before we can run."

Part of the cost of carbon fiber is that it needs to be imported from Japan. Companies like Great Lakes Carbon Fiber, based in Rochester, are interested in opening a carbon fiber manufacturing facility in the U.S. Great Lakes Car-



PHOTO: ERIC POPE
NABIL GRACE, director of Lawrence Tech's Center for Innovative Materials Research, presents the benefits of using carbon fiber in place of steel on area bridges.

bon Fiber's founder, Nader Afshar was one of the observers of the carbon fiber bridge testing at LTU.

"Manufacturing in Michigan would reduce costs immensely," Afshar said. "Fiber enters the U.S. as raw material and has 6.8 to 7 percent duty, not to mention shipping and fuel costs."

Afshar said the company is waiting for approval of a manufacturer's license and a loan guarantee from MDOT before moving forward with plans.

Steudle said before the state will consider the use of carbon fiber in place of steel, it's critical to understand the true life cycle costs of the material, which hasn't been put

to a real-life-situation test.

Grace said the center continues to collect data from the university's oldest carbon fiber project, implemented in 2001, called the Bridge Street Bridge project. The Bridge Street Bridge in Southfield was the first U.S. bridge to use carbon fiber as the principal structure reinforcement.