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**BUILDING BRIDGES: REINFORCED
PLASTIC MIGHT BOLSTER AGING STEEL
AND PROTECT COMMUNICATIONS SYSTEMS**

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As the nation's steel bridges and water mains continue to deteriorate, scientists at the Georgia Institute of Technology are assessing the strength of fiber-reinforced plastics to see if these strong, non-corrosive composites are suitable for rehabilitating aging infrastructures.

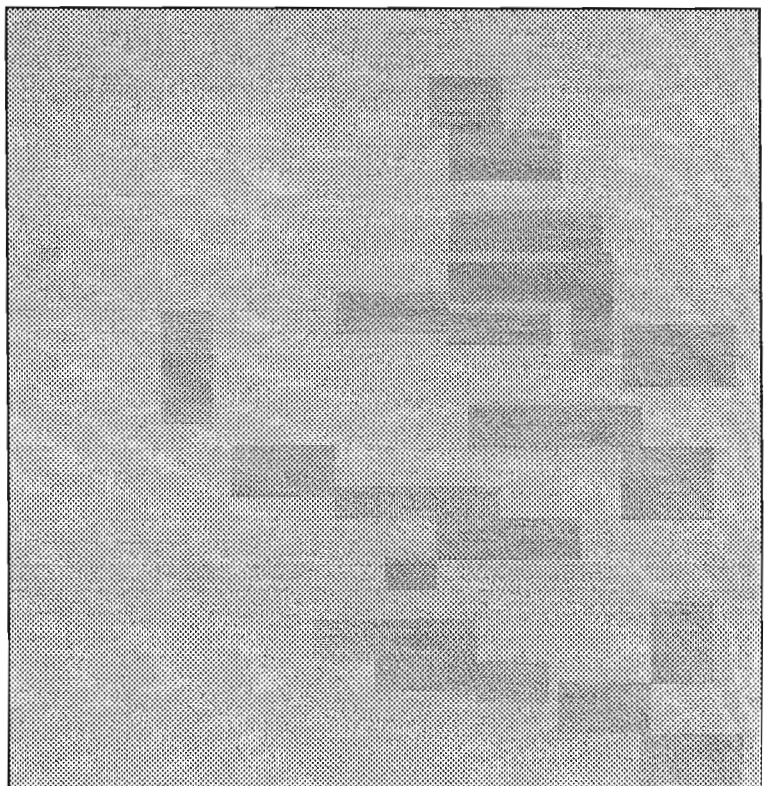
Roughly one-fourth the weight of steel, fiber-reinforced plastic could potentially lower transportation and construction costs while speeding the development of new bridges, water systems, emergency shelters or warehouses, according to Dr. Abdul-Hamid Zureick of Georgia Tech.

Since plastic reinforced with glass fibers is non-conductive and "invisible" to electromagnetic signals, Zureick added, it could be especially useful in shields known as radomes, which protect communications systems from harsh weather conditions. As a protective cover for antennae, military radar instruments, broadcasting towers or weather tracking devices, these radomes help prevent corrosion and weather damage without causing signal interference, Zureick explained.

A civil engineer recognized for developing a mathematical solution to stress concentration problems in composites and similar materials, Zureick is now studying the behavior of fiber-reinforced plastic structural components subjected to various loading conditions. Ultimately, he hopes to generate design guidelines for using such components in structural frameworks.

"Last year, the Federal Highway Administration reported that almost 40 percent of the nation's 570,000 bridges are structurally deficient or functionally obsolete and in need of rehabilitation or replacement," Zureick said. "Some of these bridges are deteriorating due to environmental factors; others are inadequate to carry today's traffic volumes and loads. We have to search for innovative and cost-effective rehabilitation techniques."

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Dr. Abdul-Hamid Zureick inspects local buckling in the 10-inch-wide-flange of a fiber-reinforced plastic column subjected to 80,000 pounds of axial compression.

Fiber-reinforced plastic components may be the answer to some of these problems, Zureick said, but more information is needed to fully characterize such materials and determine the most appropriate applications for them.

Sponsored by the National Science Foundation, Zureick and his students are testing various lengths of Extren fiberglass I-shaped sections donated by Morrison Molded Fiber Glass Company of Bristol, Va.

A common structural component in bridges and building framework, I-sections are being put to the test in Georgia Tech's hydraulic pressing instrument. Located in the School of Civil Engineering, the device is capable of applying 450,000 pounds, Zureick said.

Research began in September last year, and results from an analytical phase of the project have been "promising," Zureick reported. In experimental studies, Zureick applies axial or 'top-down' compression to I-sections up to 14 feet in length -- common sizes for steel components in existing structures.

Using strain gauges and other instruments, Zureick is measuring the short-term responses of I-sections compressed to the failure stage. To determine the long-term load capacity and deflection responses of fiber-reinforced plastic, researchers will perform additional tests on components subjected to compression for 18 months.

According to the Morrison Molded Fiber Glass Company, commercially available Extren I-sections can withstand 30,000 pounds-per-square-inch of compression, a level comparable to the strength of many steel components found in buildings and bridges. But some plastic materials tend to deflect or bend more than steel under certain loading conditions, Zureick noted, and this presents various design challenges.

"In the future, we may need to determine the optimum shapes for using this material so that the deflection is minimized and the strength and low-weight characteristics are maximized," he said.

Design engineers and contractors need to understand the static and dynamic behaviors of fiber-reinforced plastics more fully before they can realize all the uses for these versatile materials, he added.

In 1989, Zureick received the Norman Medal, awarded by the American Society of Civil Engineers, for a paper he co-authored with Dr. Robert A. Eubanks of the University of Illinois at Urbana. The paper described a new technique for analyzing the complex stress responses of "anisotropic" materials such as composites, which demonstrate various levels of conductivity, elasticity and other properties, depending on the direction in which these properties are measured. (Isotropic materials like steel demonstrate the same properties in all directions, and are therefore generally more predictable from an engineering standpoint.) Zureick and Eubanks derived an exact, three-dimensional solution to the phenomenon of stress concentration in a transversely isotropic medium containing a spheroidal cavity -- a problem that plays an important role in predicting fractures in flawed composites.

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