Strategic partnership formed to build first vehicular bridge using lightweight advanced composites

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STRATEGIC PARTNERSHIP FORMED TO BUILD FIRST VEHICULAR BRIDGE USING LIGHTWEIGHT ADVANCED COMPOSITES

In a high-tech version of beating swords into plowshares, a collaboration of researchers from the University of California, San Diego and the defense industry will soon evaluate ways to enlist lightweight composite materials--developed and used in military aircraft--for a new earthquake-resistant bridge in San Diego.

If constructed, it would be the first bridge of its kind built for vehicular traffic, anywhere in the world.

The initial phase of the bridge is being funded by a $1.6 million grant from the Federal Highway Administration to UCSD. The research and development team, which is headed by UCSD Applied Mechanics and Structural Engineering Professors Gilbert Hegemier and Frieder Seible, consists of a consortium of seven defense industry participants who have worked extensively with fiber-reinforced composites for the military.

Industrial participants of the Advanced Composite Technology Transfer Consortium, include: E. I. du Pont de Nemours and Company and Hercules Inc., both of Wilmington, Del.; Lockheed Missiles and Space Company, Palo Alto, Calif.; B.P. Chemicals (Hitco) Inc., Santa Ana, Calif.; J. Muiller International, Trans- Science Corporation, and XXsys Technologies, all of San Diego.

"The project represents a new opportunity for the defense industry to move from national security needs to the revitalization of the nation's infrastructure and its economic competitiveness," said Hegemier, director of UCSD's Charles Lee Powell Structural Systems Laboratory.

Known as a cable-stayed bridge, it would be supported by a series of cables connected to an A-frame pylon located on the west side of 1-5, or Interstate 5, in the "Golden Triangle" region of San Diego. The bridge, 60-feet wide, would be designed for two, 12-foot vehicle lanes, a 13-foot walkway, a utility tunnel, and two bicycle lanes. The 450-foot long structure would connect the West side of the UCSD campus, including the School of Medicine, to the East campus and UCSD's new John M. and Sally B. Thornton Hospital, which will open this summer.

The entire structure, including cables and bridge deck, would be built with advanced composites--designer materials whose properties and performance can be tailored for specific applications. Such materials--usually consisting of glass, carbon and polymer fibers--are lighter, stronger, and more durable than conventional materials such as steel or concrete.

Hegemier estimates that the new bridge could be as much as one-fifth to one-tenth as light as a comparable bridge built from conventional materials. If applied elsewhere, bridges, highways and buildings composed of these new materials therefore should be easier and quicker to build, significantly reducing construction costs. And since such bridges would be much lighter, they would be less sensitive to ground motion from earthquakes. "Taken together, the payoff of these advantages could be enormous," said Hegemier.

Seible, associate director of the Powell Laboratory, further noted that manufacturing breakthroughs from the project could extend to the construction of bridges and other infrastructure facilities in the Third World countries, using local labor. The techniques also could permit retrofitting of existing domestic bridges and support structures. "These new materials will find application in the development of lifeline facilities including gas, water and communications lines," he said.

Under the 18-month grant, UCSD and the members of its industrial consortium are expected to identify, analyze and evaluate all research areas critical to the bridge's development.

The program will involve experimental pilot tests at UCSD of materials components and subassemblages to verify manufacturers' claims on properties and variabilities. Independent design teams, drawn from the consortium and outside consultants, also will assist with bridge design, analysis, materials, fabrication, testing and construction. At each step, researchers will conduct both computer simulations and experiments to verify how well the new materials respond to extreme environmental and load conditions. Components including deck superstructures, cables, pylons and their connections also will be tested, with much of the work to be carried out at the Powell Laboratory.

The research and development phase of the project should take about three years, Hegemier estimated. Following this phase, the project must receive approvals from various local, state and federal agencies and the University of California before the project can proceed. Following these approvals, Hegemier estimates that construction should take about one year. Funding for the remainder of the project is being sought from several government agencies.

Hegemier estimates that the total cost of the four-year effort, including research, development and construction, would be approximately $55 million.

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