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UA team studying quake fix

By DAN SORENSON
Citizen Staff Writer

A University of Arizona engineering team is wrapping up a plan for retrofitting old bridges and buildings to withstand earthquakes such as the one that hit Los Angeles yesterday.

Using a variety of materials – from commonplace fiberglass to exotic defense industry and space program spin-offs, such as carbon fiber and Kevlar – two UA faculty members claim their process triples or quadruples older structures' ability to handle the sheer (lateral) forces of earthquakes.

Mohammad R. Ehsani and Hamid Saadatmanesh, associate professors in the UA's Department of Civil Engineering and Engineering Mechanics, are working under a $200,000 National Science Foundation grant issued after the devastating 1989 San Francisco earthquake.

The search for a new method of fixing old structures is the result of a blue ribbon commission created by the then-governor of California after the 1989 earthquake.

On Ehsani's desk, the panel's published recommendations sit – a fat, soft-cover report with an ironic title: "Competing Against Time."

The purpose of the NSF grant, said Ehsani, was to develop a method for strengthening older structures – particularly bridges – to withstand the sideways forces of earthquakes. Buildings and bridges constructed before building codes were revised in the 1970s to reflect the need for lateral strength were constructed only with the ability to carry the weight of the roadway and vehicles.

Recent bridges and buildings do a better job of withstanding those forces than the pre-1970s struc-

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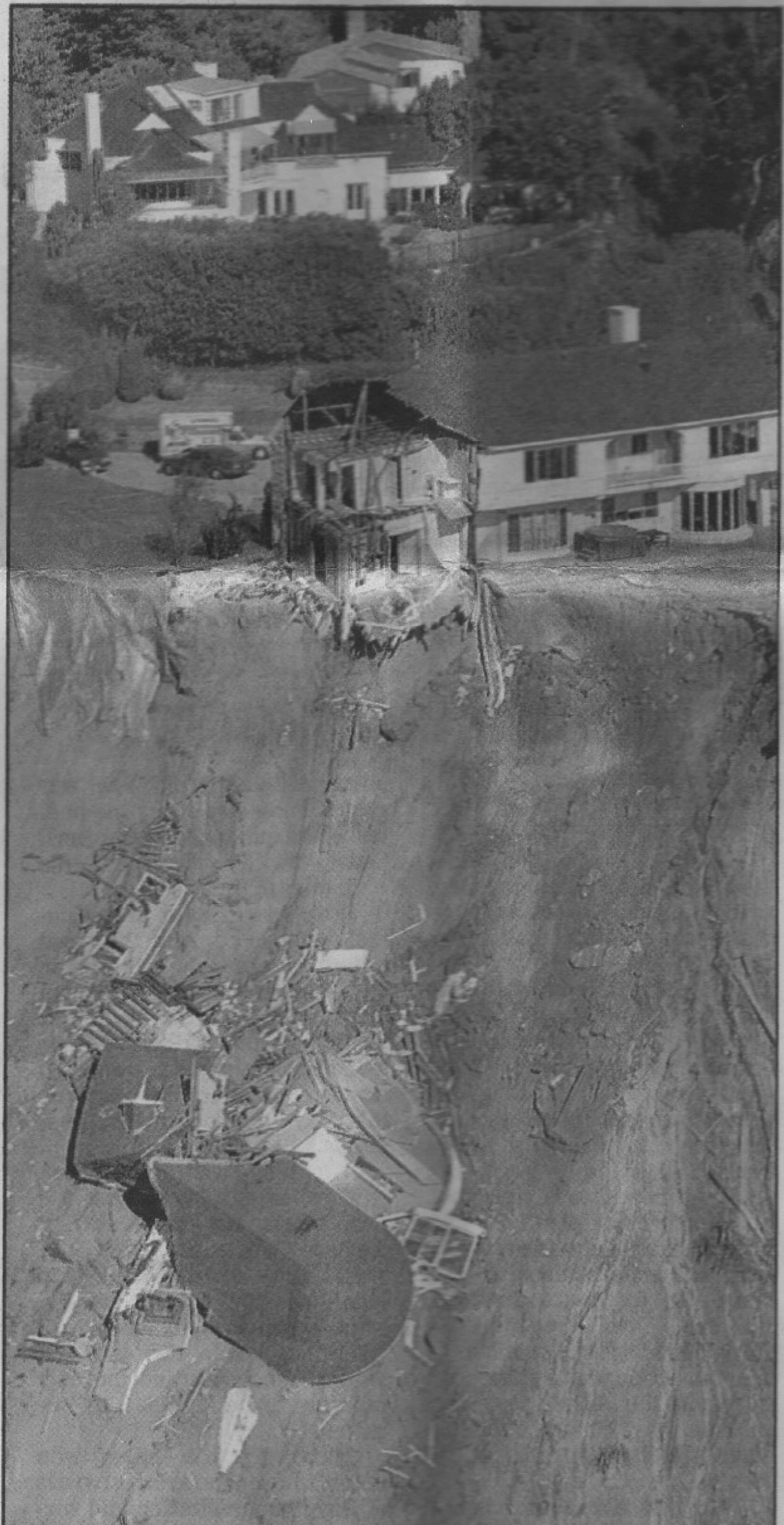

The Associated Press

CRUMBLING DOWN – A home in Pacific Palisades, a suburb of Los Angeles, rolls down the cliff it used to sit on after Monday's earthquake.

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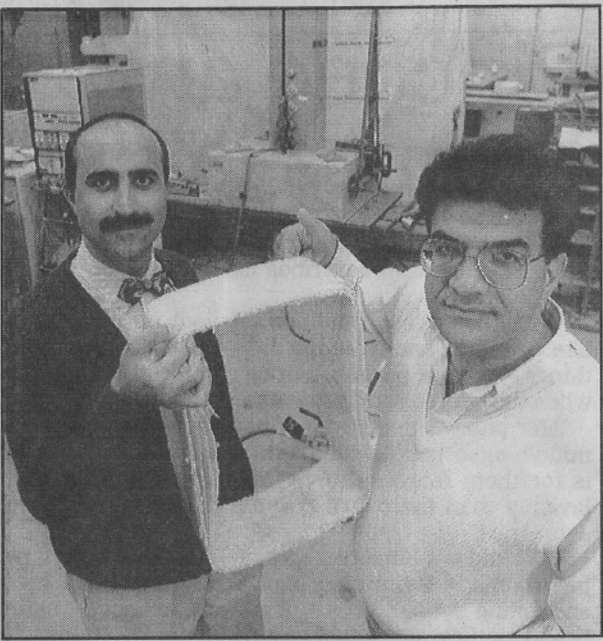

RICK WILEY/Tucson Citizen

University of Arizona researchers Mohammad R. Ehsani (left) and Hamid Saadatmanesh display a lightweight fabric that can protect columns from quakes.

UA team has plan for quake-proofing existing structures

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tures, said Ehsani. But there are billions of dollars worth of older structures that the country can't afford to replace – and could not easily stand to do without while they were being replaced, even if it could afford them.

"There are so many of these structures that you cannot really afford to be without them," said Ehsani.

In a factory-size lab in the civil engineering building at East Second Street and North Palm, Ehsani, Saadatmanesh and their students use hydraulic rams to simulate the sheer forces of earthquakes on quarter-scale models of bridge pillars.

Sensors on the pillars – traditional concrete strengthened with reinforcing iron bars, or "rebar" – measure how much the pillars bend before breaking, with and without the clear, six layers of fiberglass.

Looking at the 8-foot high scale model pillars and the powerful hydraulic machinery, it's easy to imagine the photographs of the car sandwich made when the 1989 San Francisco earthquake crumbled the double-decker Nimitz Freeway.

Under the UA team's plan, contractors would simply place the flexible prefabricated pillar-sized glass fiber wraps on bridge supports and apply some epoxy to bond the layers to one another and the pillars.

Another method, pioneered at the University of California San Diego, strengthens old pillars by clamping them in steel jackets. While Ehsani said the steel jacketing method does increase strength, he said it also is more difficult to install, more expensive and has the potential for rust.

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The emphasis in Saadatmanesh's work is on using the retrofit technology to strengthen existing brick and block masonry buildings. He said an almost invisible layer of the material on both sides of a brick or block wall can substantially strengthen its resistance to lateral forces.

And while it would be difficult, although he says not impossible, to place layers on both sides of brick walls in finished buildings, he said many of the deaths and much of the damage from masonry buildings during earthquakes comes from pieces falling from parapets – the roofless walls that surround the tops of buildings.

Ehsani and Saadatmanesh said the process has potential for so-called defense conversion – converting defense industry technology to civilian uses. He said the most advanced of the modern materials that could be used in versions of the retrofitting process were developed for use in defense projects such as stealth fighters and bombers.

While the most exotic of these materials offer much more strength per pound than commonplace fiberglass, Ehsani said their cost is many times as high and the weight is not a major concern.

Although Ehsani said the research grant's goal and most of the outside interest in the project is for strengthening older structures against earthquake forces, the larger issue of the nation's crumbling infrastructure may hold even more potential.

Ehsani said tests have shown that a relatively thin layer of the material, affixed to the bottom of a bridge roadway, dramatically increases its load- carrying capacity.

Ehsani said articles about the process already have been published in professional journals. He expects to finish his work in May.

The next steps are for the methods to be approved as construction techniques by government regulatory and construction industry organizations.

Ehsani said UA also stands to gain international stature in the civil engineering field in two years, when the university hosts the first international conference on the use of advanced composites in public works projects.