

Professor shakes up seismic safety

Matthew Malone, California State University Hornet, 10-2-14

The house didn't look significant. A collection of stucco-clad wooden frames, it rocked back and forth on the shake table shifting unpredictably beneath it.

But the house, and the earthquake-resistant features inside it, could make residential construction in quake-prone areas much safer.

Benjamin Fell, a structural engineering professor at Sacramento State, is working with professors and graduate students from Stanford University to develop new ways of designing houses to prevent damage during earthquakes. During an interview Thursday, Fell showed videos of recent earthquake simulations at a shake table in San Diego.

With his research, Fell wants to avoid devastation like that caused by the Northridge earthquake in 1994. That quake left 60,000 people displaced and damaged \$20 billion worth of property.

"The idea is, can we find another design methodology in order to be able to reduce or eliminate the damage during a design-level earthquake so you don't have that huge dollar loss?" Fell said.

The project, funded by the Network for Earthquake Engineering Simulation, has two main focuses. One is a low-cost isolation system, a group of three-foot-wide steel pads placed between a house and its foundation. The system would allow a house to slide back and forth when an earthquake hits, reducing the forces on the structure.

The other focal point is called unibody construction. Fell said the concept draws its name from automotive design and is meant to make each part of an object interact with the other parts. By adhering drywall to the wall studs, holding stucco against exterior walls with large screws and anchoring walls to the ground, Fell and his colleagues hoped to stiffen a structure and help it withstand seismic shaking.

In 2012, the first phase of the project involved wall panel tests at Sac State's Structural Engineering Testing Facility next to Riverside Hall. Phase 2 in 2013 brought room tests at UC Berkeley.

The most recent phase of the project, shake table tests with a full-size model house, took place at UC San Diego two weeks ago and is the culmination of a multiphase process that received funding in 2011 and had been in the planning stages for a couple years before that, according to Fell.

"So it's been a long project from first conception, probably like five, six years ago up till now," Fell said.

Kevan Shafizadeh, chair of the Department of Civil Engineering at Sac State, said Fell's work fit an established pattern of professors researching to keep their chosen field up to date.

"Dr. Fell teaches courses in structural engineering and that's what his research is in. And so it's a feedback loop. We teach the state of the practice, and then we find ourselves modifying that state of the practice in our research," Shafizadeh said.

Fell sees this project as potentially transformative. He said most homes are designed with the understanding they will sustain heavy damage in an earthquake. The forces involved are so powerful and rare that measures like isolation systems are thought cost-effective only for large structures. Fell said the idea of a damage-free house encounters a lot of skepticism.

“And in fact when we present the idea we get laughed at. Some people are very skeptical just because it’s very different,” he said.

Building committees would be most resistant to implementing features used in the project, Fell said, because the features would increase cost - about 5 percent, by Fell’s estimation.

Fell said a good message could convince the public of the features’ merits. The latest tests finished so recently that the researchers are still working on their message, deciding what papers they want to write, what order to release them in.

“I think if we tell the story right, they [the public] could see a pretty big benefit from it,” he said.