Stanford researchers create earthquake-proof system for houses

Erica Evans, Stanford Daily, 11-19-14

Stanford researchers have created and tested a system that prevents damage by allowing houses to slide back and forth instead of shaking during an earthquake.

Over the summer, contractors built a full-scale model home, and Stanford engineers tested the system in September at the earthquake plate at University of California, San Diego.

“The first shaking test was a little scary,” said Gregory G. Deierlein, director of the John A. Blume Earthquake Engineering Center.

“We made our computer models, but if something goes wrong, it could throw off the whole scale,” he added.

In the end however, the calculations and predictions proved to be accurate. The earthquake-resistant system was so effective that it resulted in almost no damage to the house during the test.

“We were able to reduce the damage to near zero, and so I think that’s a lot of potential,” said Ezra A. Jampole, one of Stanford’s Ph.D. students leading the project.

Even when the test’s intensity was scaled up to more than three times that of the 1989 Loma Prieta earthquake, the house stood strong.

Project’s inception and technology

The sliding house project was started nearly six years ago by a doctoral student named Scott Swenson; now, the project is managed by Ezra Jampole and Cristian E. Acevedo under the supervision of Deierlein and Eduardo Miranda, an associate professor of civil and environmental engineering.

The technology for the earthquake resistant house consists of two parts: the isolation system and the unibody.

The seismic isolator system works by placing the house on small sliding – puck-like – units, instead of attaching it directly to the ground. When an earthquake occurs, the house is able to slide from side to side over the ground instead of falling apart due to the violent and sporadic movements of the earthquake.

According to Acevedo, the unibody draws its name from the car industry, because car frames are made in one piece. Stanford engineers applied this idea to home-building by gluing the structural components of the house (walls and studs) to the architectural components (dry-wall and stucco).

By gluing these parts together, Acevedo and his teammates were able to create a structure that moved together as one unit.

“The whole thing is just one unit working together to try and resist the lateral forces of the earthquake,” Acevedo said. “[Furthermore], I saw this project and saw the practicalities of it – how it can be applied to real life – and that’s what drew me in.”

According to Jampole, most earthquake damage prevention research and systems focus on large structures. What makes Stanford's project unique is that it focuses on small light-frame residential buildings.

"A lot of it is just the potential impact this could have on residential construction," Jampole said.

Difficulties of implementation

Now that several weeks have passed since the full-scale experiment, the students are continuing to analyze the collected data and as well as beginning to study how this system will hold up over time.

The next step is for early adopters to come in and start using the product. According to Deierlein, however, this could take a while due to the complexity of the industry.

"From what we're doing now till when it will be more routine could be 10 to 15 years," Deierlein said. "When other folks start to see that this idea is really viable and economic, it will start to gain more widespread use."

Because the Stanford engineers used easily accessible materials, contractors who have the design will be able to find the materials and build a house that uses the unibody and isolation systems.

"Earthquakes – we're all aware of them, but we tend to not appreciate, when they come, how much damage they can cause," Deierlein said.