Three-Story Structure Slammed in Magnitude 8 Earthquake on Shake Table

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Engineers at UC San Diego's Englekirk Center are testing the seismic response of precast concrete floor systems that are used in parking garages, college dormitories, hotels, stadiums, prisons and increasingly in office buildings.

Engineering researchers are subjecting a three-story structure resembling a parking garage to a sequence of earthquake "shake test" jolts as powerful as magnitude 8.0 as part of a series of seismic tests to help improve building codes across the nation.

The 1 million-pound precast concrete structure has the largest footprint of any structure ever tested on a shake table in the United States; the shaking of the structure will continue through May with the most violent shakes coming in June. The increasing intensity of the seismic shaking will duplicate ground motions measured in actual earthquakes and

adapted specific conditions in Knoxville, TN., Seattle, WA., and Northridge, CA. Engineers are testing the seismic response of precast concrete floor systems that are used in parking garages, college dormitories, hotels, stadiums, prisons and increasingly in office buildings.

“This is a landmark test that will enable a very fast and economically advantageous high technology construction method to be used in seismically active regions of the United States,” said Gilbert A. Hegemier, director of UC San Diego’s Powell Structural Research Laboratories, and professor and chair of the Jacobs School of Engineering’s Department of Structural Engineering.

The seismic tests of the one-half-scale structure involve a collaboration among UC San Diego, the University of Arizona, and Lehigh University. The $2.3 million project is being funded by the Precast/Prestressed Concrete Institute and its member companies and organizations, the National Science Foundation, the Charles Pankow Foundation, and the Network for Earthquake Engineering Simulation (NEES).

The goal of the project is to design a building by 2012 that can withstand a major earthquake. In the past, due in part to lack of industry knowledge, individual precast elements pulled apart, much like what happened with the collapse of the nine parking garages during the Northridge Earthquake in Los Angeles in 1994. Since that quake occurred in the early morning, one only one person died. However, experts say the death toll could have been much higher. The other problem is the seismic code for these types of precast buildings is 20 years old. The Precast/Prestressed Concrete Institute recently launched a competition to design better floors for such buildings.

“There are significant construction advantages in assembling concrete structures from pieces that are built ahead of time, but the challenge in

using precast concrete is that the structure is not one continuous piece of concrete, but many individual ones that are connected together," said Robert Fleischman, a civil engineering professor at the University of Arizona and principal investigator of this research project. "The floor section edges are interconnected and they sit on ledges; you can see these in any parking garage. These connections have had problems in earthquakes."

The earthquake tests are being conducted at the Jacobs School of Engineering's Englekirk Structural Engineering Center, which is about eight miles east of the university's main campus. The $9 million Englekirk shake table is one of 15 earthquake testing facilities for NEES. The UCSD-NEES shake table, the largest in the United States and the only outdoor shake table in the world, is ideally suited for testing tall, full-scale buildings.

"The earthquake simulator at UC San Diego was designed to conduct state-of-the-art research and ultimately mitigate the disastrous impact of earthquakes in our communities," said Jose Restrepo, co-principal investigator for the shake test and UCSD structural engineering professor. "The test on the precast concrete building is an example of how to use the latest construction and testing techniques to develop the next generation of design methodologies."

Source: University of California