Sac State plays a pivotal role in seismic structural tests

Can California’s building codes be upgraded to not only make structures more resistant to earthquake damage but, over time, compensate for the increased construction costs?

Sacramento State Engineering Professor Ben Fell and his colleagues at Stanford University believe they can. They contend that seismic upgrades should lower insurance premiums, reduce home repair costs and lessen the burden of relocating families during the repairs. The structural engineering specialists have been working for the past three years on a federally funded project to prove that.

Fell, along with two Stanford faculty members, secured a $1.2 million grant from the Network for Earthquake Engineering Simulation, an arm of the National Science Foundation. The multiyear award is aimed to discover a process to improve the performance of residential structures during earthquakes.

The project began four years ago with connector and small-scale wall tests at Stanford to identify construction materials that would accomplish the integration of structural and architectural components. These tests were complemented by large-scale quasi-static wall tests at Sac State’s Structural Engineering Testing Facility (http://bit.ly/XwXKTw) and at UC Berkeley.

The final phase, conducted in mid-September at UC San Diego, consisted of a full-scale, two-story wood-frame house (1,500 square feet) with wall finishes tested on a shake table to track the behavior of unibody structures under dynamic loads. Subjected to several large ground motions, the structure was connected to more than 100 sensors to monitor global displacements, wall displacements, inter-story drifts and floor accelerations.

A numerical model of the house was created and calibrated using quasi-static test results to predict the behavior and loads acting on the structure. A Maximum Considered Earthquake (MCE) shaking test did not prompt significant structural bearing failure. (http://youtu.be/ygDQs7oPXZc) It performed very well, and there were only two hairline cracks, about 1 inch long, after inspecting the entire structure.

“This groundbreaking project,” Fell says, “has the potential to design residential structures with a ‘unibody’ methodology, taking advantage of gypsum sheathed walls previously considered nonstructural and consequently disregarded.” He likens it to the engineering gains made in automobile assembly going from a chassis mounted design to a more durable unibody construction.

Fell was confident in the project’s objective based on preliminary experimental and analytical work at Stanford, where he completed his master’s degree. While conceding the difficulty of making major changes to building codes, he believes the findings “could change the design of residential structures in seismic regions for years to come.” The research team hopes it could be a “paradigm shift” in seismic design.
For media assistance, contact Sacramento State’s Public Affairs office at (916) 278-6156. – Alan Miller