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Shake, rattle and an economic role for University earthquake research

By Sue Putnam

M. Saiid Saiidi was 12 years old when a magnitude 7.3 earthquake rattled Iran, the country of his origin. Today, the civil and environmental engineering professor is leading a project team that recently set a new milestone in earthquake research.

In February 2007 Saiidi and his team tested a four-span, 110-foot-long model of a bridge with a series of seismic simulations at the University's earthquake lab. It was the largest test of its kind: a simulated magnitude 7.5-8.0 earthquake, two times the strength of the 1994 Northridge, Calif., earthquake.

In this same lab, a cargo ship fendering system was recently tested by simulating the impact of a large vessel berthing against a wharf.

Critical to advancements in earthquake preparedness and safety, the James E. Rogers and Louis Wiener Jr. Large-Scale Structures Laboratory also demonstrates versatility that benefits business and industry. Funded in part by the National Science Foundation, the lab is one of only three "shake-table" facilities within the national George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES). Each facility is unique and offers the

Sue Putnam is a University public relations director

means to simulate a particular kind of seismic activity.

Funded research projects comprise the most important and the greatest number of tests conducted in the University lab. However, service-to-industry tests, conducted for paying clients, are accommodated when there is an opening on the facility's schedule.

Availability is an issue. The lab has three large-scale shake tables, and design and engineering is under way to construct a fourth. This fourth table will operate independently, allowing the lab to conduct multiple, simultaneous tests. Increased capacity means important



Photo by Jean Dixon

The world's largest earthquake simulation tested a 110-foot-long model bridge. More than 400 sensors on the structure compiled data that was broadcast live to scientists and engineers around the world.

research will continue, and more service-to-industry tests can be conducted as well.

Ian Buckle, director of the Center for Civil Engineering Earthquake Research at the University, sums up the lab's benefit to Nevada's private sector: "We can help make local industry more competitive nationally and internationally."

For a product that must withstand extreme force or vibration, the lab can test the point of fatigue or failure and contribute to design improvements. Buckle cites the example of a northern Nevada manufacturer whose primary customer is in Japan. "We have worked with them over the years to make the company more competitive," he says.

Buckle also notes that a stream of service-to-industry projects benefits engineering students working in the lab. "These projects don't affect

their dissertations, but they allow the students to see different kinds of tests. They gain experience and ancillary knowledge," he says.

Even the quick turnaround time for these projects presents a learning opportunity. "One of the key elements with business and industry is that it must be done yesterday. They want to get in and out, and receive their data as soon as possible. The timeline is longer for research. From the design phase to the peer-review process, a research project can have a timeline of a year or two or three," Buckle says.

The lab's research projects also contribute to new applications for business and industry. The seismic simulation test in February tested new bridge construction materials, such as nickel titanium.

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“The testing method was very effective in simulating the simultaneous effects of pier and abutment movements,” says Saiidi. “It meant the bridge design was very successful in meeting our performance objective, which was to keep it from complete collapse under the maximum credible earthquake.”

Saiidi and the team hope to dramatically improve the construction of bridges so they can withstand damage from even extremely destructive earthquakes. The tests will help determine how well new design codes work and whether they should be the benchmark for bridges worldwide.

Members of the National Science Foundation, engineers and researchers from around the world watched the test in the Large-Scale Structures Laboratory via live webcast. Join-


LOOK ONLINE

Watch a video of the earthquake simulation test of the 110-foot-long bridge at <http://www.unr.edu/nevadasilverandblue>.

ing Nevada researchers in the lab were senior bridge designers from Caltrans and the Nevada Department of Transportation, agencies that have financed other earthquake engineering research projects directed by Saiidi, as well as students and researchers from Berkeley, UC San Diego, Florida International University, Georgia Tech, Stanford, University of Kansas and University of Illinois, Chicago.

“This work is possible because of NEES,” Saiidi says. “We received a \$2 million grant two years ago from NSF through the NEES program, and have been able to pull this project together because of that funding.”

Another economic benefit for Nevada is reduced future losses. “The (College of Business Administration) did the impact analysis of our research expenditures on the region, and we calculated the impact of reduced losses in future earthquakes due to the implementation of our research findings. The reduced earthquake losses amounted to an annualized figure of \$8.6 million for northern Nevada,” said Buckle. “Compared to this number, the impact of our research expenditures was minimal.”

While economic contributions and engineering advancements are key benefits of the work conducted in the earthquake lab, Saiidi points to the ultimate and most important research outcome: “Hopefully the results will save many lives.” 



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