Researchers using data-driven approach to make earthquakes less damaging

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The 1994 Northridge earthquake was one of the costliest natural disasters in U.S. history. Fifty-seven people died, more than 8,700 were injured, and property damages amounted to billions of dollars. In the 25 years since the 6.7 quake shook Southern California at 4:30 a.m. on Jan.17—collapsing buildings, bridges and freeways—what have we learned?

Quite a lot thanks in part to the work of scientists and engineers at UCLA, who are continuing to make structures safer and help identify earthquake hotspots.

Nearly half of the people who died were trapped in buildings with "soft stories," the openings on the first level often used for parking spaces in smaller apartment buildings. Due to a lack of support below, apartments came crashing down.

In 2015, Los Angeles Mayor Eric Garcetti signed a measure requiring seismic retrofitting of soft-story buildings within seven years, and provided 25 years for upgrades to concrete structures.

"Simply stated, seismic retrofit works," said Yousef Bozorgnia, a professor of civil and environmental engineering in the UCLA Samueli School of Engineering and principal investigator of a research project on residential wood buildings. "Recent simulations of seismic performance of wood-frame buildings clearly show that upgrading older residential buildings is effective both for life safety and reducing financial loss."

Bozorgnia and other UCLA engineering researchers are now amplifying their knowledge with the latest information and technology that simply wasn't available 25 years ago to mitigate damage from future temblors.

Technology, such as ShakeAlertLA, an earthquake warning application released by the City of Los Angeles earlier this month, is a reminder of the ongoing behind-the-scenes expertise required in keeping Angelenos as safe as possible.

Accelerometers and artificial intelligence

Structural engineering professors Henry Burton and John Wallace are working with the City of Los Angeles to systematically assess data from accelerometers, or sensor networks, placed in downtown Los Angeles' skyscrapers. Using data, such as the ambient vibration in buildings that comes from the surrounding environment, which often remains unanalyzed, Burton and Wallace aim to model and contribute to the design of tall buildings that can better withstand the forces of an earthquake. They also want to help establish a coordinated response to earthquake damage and disruption throughout downtown Los Angeles.

Additionally, Burton is using artificial intelligence to help guide post-earthquake inspections to assess how much the structural strength of tall buildings is reduced by earthquake damage. The technology can inform optimal sensor placement in these buildings, as well as provide real-time risk projections in aftershock environments.

Machine learning

Chukwuebuka Nweke, a UCLA postdoc in geotechnical engineering, is studying basin effects in Southern California using relational databases, cloud computing, and machine learning techniques. Southern California is a geologically diverse region composed of flat low-lying areas consisting of sediment-filled basins surrounded by mountains. The thick sediments in the basins influence propagation of earthquake waves, causing them to be different from the ground motion at the bottom of the basin, which leads to shaking on the surface that is higher in intensity (or lower) than what would be expected based on the size of the waves traveling deeper below ground.

Nweke's research explores the extent to which local basin models differ from similar models of other parts of the world, and will result in a region-specific model that will improve seismic hazard analysis in Southern California.

Provided by University of California, Los Angeles

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