

Engineers help secure California highways and roads

December 15 2009



Dawn Cheng, a UCSD engineering alumna and now a civil engineering professor at UC Davis, is working with Caltrans to come up with improved seismic designs for retaining walls across California. Credit: UC San Diego

Sprays of dirt flew out of a soil box that held a retaining wall as it violently shook from a simulated 7.4 magnitude earthquake. The wall was put to test recently by engineers at the UC San Diego Englekirk Structural Engineering Center, which has the largest outdoor shake table in the United States. During the first series of tests, led by Dawn Cheng, a UCSD engineering alumna and now a civil engineering professor at UC Davis, researchers investigated the seismic response of a semi-gravity reinforced concrete cantilever wall.

California has thousands of miles of these types of retaining walls on highways, roads, bridges and oceanside bluffs that have withstood

earthquakes in the past. However, the [seismic design](#) of these walls has not been extensively developed. The outcome of this research, funded by Caltrans, will ensure that future retaining wall systems are designed to a higher performance standard and existing systems are upgraded and retrofitted to offer satisfactory performance to provide a safe and mobile transportation system in California.

Retaining walls - mostly made of [concrete](#) and [steel](#) - are normally used to support traffic loads and to create more of an abrupt change in elevation than a slope typically can.

"The main objective is trying to come up with a better understanding by observing how these structures behave and what kind of failure we can expect during an earthquake and to obtain some of the performance data so we can come up with better analytical models and design guideline methodologies," Cheng said. "We also want to look at the behavior of the structure when the soil is interacting with the system under earthquake shaking."



Engineers tested two types of retaining wall systems -- one without a sound barrier (foreground) and one with a sound wall (background) during a series of rigorous simulated earthquake tests at UCSD's Englekirk Structural Engineering Center, which has the largest outdoor shake table in the world. Credit: UC San Diego

During the series of shake tests, no significant damage was observed in the retaining walls themselves, but the sound wall during the second set of tests had severe cracking near the bottom section, Cheng observed.

"A lot of the sound walls are connected to the retaining walls. The design of that is critical because you are handling a bigger structure. The behavior is different," she said. "A lot of the retaining walls are supporting the sound walls in the field on the highways and overpasses. The performance under a dynamic earthquake is different when you have a sound wall on top because of the additional mass that changes the weight and stiffness of the system. In an earthquake you have to take that into account during the design process."

This project is unique, Cheng said, because it is the first comprehensive system level earthquake simulation test of a full-scale interactive soil-retaining wall structure supporting a sound wall. "UC San Diego has one of largest and most unique testing facilities in the world," she said. "The Englekirk Center has all the state-of-the-art testing facilities and there is a lot of technical support. The other reason this site was unique is because it has a large Caltrans funded laminar soil box and a soil pit on the site. UCSD is also the place where I did my Ph.D. research".



A semi-gravity reinforced concrete retaining wall backs against a soil box as it undergoes a series of violent simulated earthquakes on the shake table at the UCSD Englekirk Structural Engineering Center. Credit: UC San Diego

The research performed by Cheng and her colleagues will give Caltrans the opportunity to check its current retaining wall designs and input any necessary changes, according to Kathryn Griswell, ERS Specialist for Caltrans' Office of Design & Technical Services.

"This is a brand new modification and it's time to find out how it behaves under an [earthquake](#)," Griswell said.

"These types of walls rarely fall down and cause hazards or loss of lives or other safety issues. Normally what we have to deal with are maintenance issues and costly repairs from earthquakes so we're looking to modify the designs whenever necessary to keep costs down."

Provided by University of California - San Diego

Citation: Engineers help secure California highways and roads (2009, December 15) retrieved 23 April 2024 from <https://phys.org/news/2009-12-california-highways-roads.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.