

Geotechnical/
Structures

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Project Title:
Earthquake Ground Motion
Hazard Characterization

Task Number: 3699

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UCLA Geohazards Program

Improved hazard characterization results in more cost effective and reliable bridges

WHAT IS THE NEED?

Seismic loading controls the designs of most Caltrans bridges and past earthquakes have shown shaking levels to be highly variable. Improving Caltrans' ability to predict locations of intense shaking will translate into more reliable and cost efficient bridges. The potential for ground failure is also a concern since moderate levels of ground shaking can cause loose saturated soil to lose strength, a process called liquefaction. This weakened soil can reduce a foundation's ability to carry bridge loads.

Furthermore, liquefied soil can move laterally, causing bridge footings to displace sideways resulting in severe column damage and possible unseating of the superstructure. Lastly, Caltrans has over 100 bridges that cross earthquake faults. The potential for large offsets across these faults is a major concern since they may lead to bridge collapse unless special measures are taken.

WHAT ARE WE DOING?

Caltrans is creating the Geohazard Research Program at the Natural Hazards Risk and Resiliency Research (NHR3) Center at the Garrick Institute of Risk Sciences, University of California, Los Angeles. Working through the NHR3 Center will allow Caltrans to partner with other lifeline providers to address common interest geohazard issues. The Geohazard Research Program will focus on the following topics:

- Ground motion modeling : Improve Caltrans' ability to predict the severity of ground shaking at project locations from different sized earthquakes.



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- Use of earthquake records for performance based engineering design: Develop design methods that utilize earthquake records and nonlinear structural analysis to predict the likelihood that various levels of damage will occur.
- Liquefaction: Develop new methods for predicting liquefaction triggering and the evaluation of the consequences should liquefaction occur.
- Fault rupture hazard: Develop prediction models for fault displacement along the fault strike and at locations some distance off the mapped fault.

WHAT IS OUR GOAL?

The goal of the program is to better characterize earthquake related hazards such as strong shaking, ground failure and fault rupture. Improved prediction models will be incorporated into performance based design methods that focus on achieving reliability targets.

WHAT IS THE BENEFIT?

A common characteristic of all earthquake related hazards is that they are subject to high levels of variability. Past earthquakes have shown that two bridges located at similar distances from a rupturing fault can experience dramatically different levels of shaking. Similarly, some bridges incur liquefaction with little or no damage while for others it can be catastrophic. The Geohazards Program seeks to improve Caltrans' understanding of this large variability so that we can better predict under which conditions high seismic demands will occur. This knowledge will allow Caltrans to more sharply focus preventative mitigation resulting in increased reliability and cost effectiveness.

WHAT IS THE PROGRESS TO DATE?

The program began in May 1, 2020. Several groups have been working on Task Orders 01 and 02 of this program. The research team and scope of work for each task is selected through a request for proposal process administered through the NHR3 Center. Task Orders 03, 04 and 05 will be deployed soon.