DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Geotechnical /Structures

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Project Title:

Next Generation Liquefaction (NGL) Models for Predicting Triggering and Manifestation of Liquefaction

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DRISI provides solutions and knowledge that improves California's transportation system.

Next Generation Liquefaction (NGL) Models for Predicting Triggering and Manifestation of Liquefaction

This research aims to enhance liquefaction triggering models by utilizing the recently created Next Generation Liquefaction (NGL) database.

WHAT IS THE NEED?

Soil liquefaction has caused significant bridge damage during past earthquakes. Liquefaction weakens soil layers beneath bridge foundations, leading to settlement and potentially causing horizontal ground movement that exerts lateral loads on the foundation, increasing the risk of unseating the bridge superstructure. Accurately assessing the potential for liquefaction or experience severe strength loss in soil is crucial in geotechnical seismic hazard assessments for bridge design.

Current liquefaction triggering models still face uncertainty regarding the influence of fines in sandy soils on penetration resistance and soil response to cyclic loading. Additionally, traditional intensity measures like peak ground acceleration and magnitude may not be the best predictors of liquefaction, as suggested by recent laboratory studies. Alternative intensity measures, such as Arias intensity and cumulative absolute velocity, could be more effective. However, the depth-independence of these measures is not yet fully understood, necessitating further investigation.

WHAT ARE WE DOING?

This project seeks to update liquefaction triggering models by addressing two key areas of uncertainty:

- **Effect of fines in sandy soils on penetration resistance and cyclic loading response.** The research team will develop preliminary models to quantify the influence of fines on penetration resistance and relative density. They will analyze existing data from the NGL project to evaluate the effects of varying fines content at different levels of relative density.

- **Depth variations in ground motion demand parameters.** Using nonlinear total stress ground response simulations, the team will establish depth-dependent relationships for intensity measures. Recent laboratory test data will guide the creation of adjustment factors that account for fines content, overburden stress, and pre-shaking shear stress.

WHAT IS OUR GOAL?

This project aims to develop a correction for fines content that separates its effects on penetration resistance and cyclic strength. Additionally, it seeks to evaluate the effectiveness of ground motion intensity measures beyond peak acceleration and magnitude for predicting liquefaction triggering and manifestation.

WHAT IS THE BENEFIT?

This research will clarify the role of fines in sandy soils on liquefaction triggering, leading to more accurate and reliable liquefaction assessments. By improving the understanding of how earthquake intensity measures vary with depth, the project will enhance seismic hazard evaluations and bridge resilience to liquefaction-related risks.

WHAT IS THE PROGRESS TO DATE?

The research is currently focused on three main tasks:

1. Conducting a literature review to identify calibration chamber and centrifuge tests involving soil penetration.
2. Investigating the effects of fines on liquefaction resistance for a given relative density.
3. Performing ground response simulations to develop depth-dependent relationships for intensity measures.

Based on the completed literature review, the team is working on corrections for the impact of fines content on cyclic strength. The next phase will involve ground response simulations to investigate how intensity measures vary with depth and to develop adjustment factors for overburden stress and pre-shaking shear stress.