



## Research Project Highlight

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# Shake Table Tests on Shallow Foundations in Liquefied Soils Supported on Helical Piles

Project # 1130-NCTRRM

### Principal Investigator

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### Research Team

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- Prof. Ahmed Elgamal, Collaborator, UCSD

### Start-End Dates:

08/1/2017-7/30/2019

### Abstract

This study aims at evaluating the performance of helical piles as a cost-effective mitigation measure against liquefaction-induced settlement of shallow foundations. As a part of this research, two series of large-scale shaking table tests are conducted at the UCSD's Powell Laboratory. The first series of tests was recently completed which focused on the behavior of shallow foundations in liquefied soils without any mitigation measures (i.e. benchmark test), while the next series will evaluate the efficiency of helical piles to mitigate the liquefaction effects on shallow foundations. Figure 1 illustrates the large-size laminar box at UCSD's Powell Laboratory which is utilized to perform the large-scale shaking table tests. Figure 2 shows the benchmark model prior to the shaking. The large-scale tests are planned after an extensive series of medium-size shaking table tests at UNR. This project is a collaborative research between UNR and UCSD (Prof. Ahmed Elgamal).

### Deliverables

We will present the experimental data and interpretation of the results at the PEER Annual Meetings. In addition, a PEER report and several conference and journal papers describing the details of the shaking table tests and the results will be published.

### Research Impact

Post-disaster reconnaissance of areas affected by earthquakes such as the 2010 and 2011 earthquakes in New Zealand has documented extensive damage to residential homes and low-story structures founded on shallow foundations within liquefaction-prone areas. Such buildings are widespread throughout



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California and liquefaction has been extensively observed in its urban areas such as during the 1989 Loma Prieta earthquake.

Foundations are integral to earthquake resistant structures in soils susceptible to liquefaction in seismic events. Continuing research into the performance of foundations in seismic conditions is vital to ensure that public safety is maintained. Where existing structures are to be seismically upgraded, research is needed to provide guidelines to properly design underpinning systems. Helical piles are a type of deep foundation system used regularly to underpin both new and existing structures. Research into their performance in liquefiable soils is the purpose of this study. Current practice lacks offering a cost-effective yet robust solution for underpinning residential buildings and low-story structures. Therefore, this study tries to address this knowledge gap using 1-g shaking table tests.

### Project Images



Figure 1: Laminar Soil Box at UCSD's Powell Laboratory



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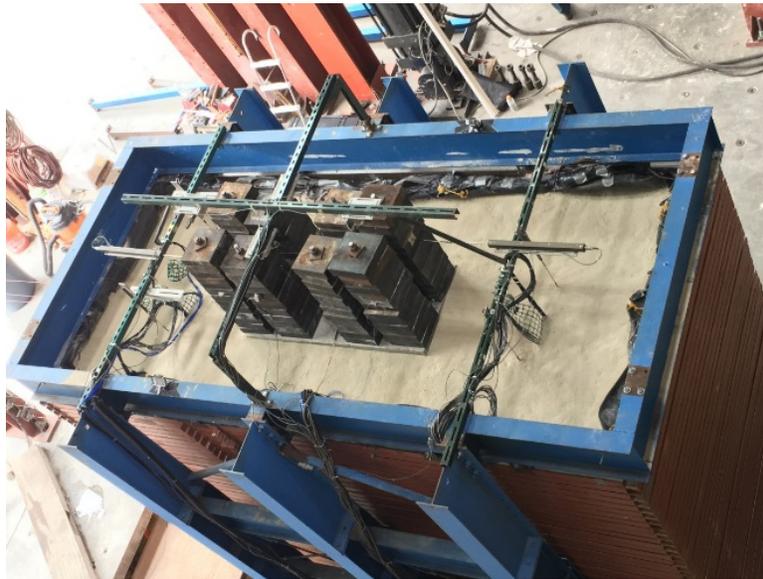


Figure 2: Photo of Model in Series 1 Tests Prior to Shaking