CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

33311

Project Title

Will Your Land Sink? The Effects of Porosity and Permeability of Different Grain Sizes of Soil on Liquefaction

Abstract

Objectives/Goals

The purpose of this experiment was to investigate the characteristics of different grain sizes of soil by determining their porosity and permeability and how these affect earthquake liquefaction susceptibility.

Methods/Materials

Five different grain sizes of soil were tested for porosity and permeability and then a liquefaction experiment took place. 500ml of each dry soil sample was used to determine porosity. For permeability of each soil, 40cm of dry soil samples were poured into clear PVC pipes. Next, 200ml of water was then poured into the pipe. The volume of water that passed through the soil per second was recorded. For liquefaction, 10 liters of each type of soil was poured in containers and saturated with water. A marked brick was placed on top of the saturated soil and vibration was administered as a seismic wave by tapping the side of the container with a rubber mallet. A metronome was used in order to ensure the tapping was consistent. After the rate and volume of sinking was calculated, five trials for each soil type, the results were analyzed with porosity and permeability data.

Results

As the porosity of the soil was high, the rate and volume of sinking was high. Over all, finer grain soils had higher porosity compared to coarser grain soils and had a higher rate and volume of sinking when the soil was saturated. As the permeability of the soil became higher the rate and volume of sinking became lower. Coarser grain soil had higher permeability but a lower rate and volume of sinking. Local soil had the lowest permeability, but it had the highest rate and volume of sinking.

Conclusions/Discussion

To mitigate liquefaction hazards, lower porosity and higher permeability must be achieved. It is possible that not only sandy (cohessionless) types of soil with high porosity and low permeability are more susceptible to liquefaction, but silt like soil with high porosity and low permeability is also severely susceptible to liquefaction in a different manner if the soil is saturated.

Summary Statement

The effects of porosity and permeability of different grain sizes of soil on liquefaction.

Help Received

My parents assisted with conducting the experiments since three people were required.