CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
S0802

Project Title
The Effect of Geologic Material on Shear-Wave Velocity and Ground Shaking During an Earthquake at Critical Structures

Abstract

Objectives/Goals
The purpose of this experiment was to evaluate the relationship between shear-wave velocity and density of different geologic materials at various critical structures, and how it effects the amplification of the ground shaking during an earthquake.

Methods/Materials
Materials: Seismograph, Geophones, Take Out Cable, Measuring Tape, Hammer with a Trigger, Shear-wave Generating Bar, Battery (for seismograph), Hand Shovel, Scale, Jar of Sand (graduated)

Procedure: The experiment started out by measuring the density of the geologic material twice at each site by collecting a known volume of the material and later weighing them and calculating the densities. Then, once all the seismic equipment was setup, the shear-wave bar was hit twice, once on each side, with a hammer that had a timing trigger that was connected to the seismograph, which recorded the data from the hit. The shear-wave bar was hit on both sides and on both sides of the line, in two different locations on the site to make sure the data was accurate. Later, the seismograms were overlapped to find the arrival time of the shear-wave at each geophone, this created a line and the inverse slope was calculated to determine the velocity of the shear wave. The procedures were then repeated for each of the 4 locations: the beach, Woodbridge High School, San Onofre Nuclear Power Plant, and Syphon Dam.

Results
The beach had the lowest density, 1.29 g/mL, and slowest shear-wave velocity, 124 m/s, but the rock under the Nuclear Power Plant adjacent to the beach had the most dense material, 2.99 g/mL, and highest shear-wave velocity, 476 m/s.

Conclusions/Discussion
The data showed that the material with a lower density allowed the shear-wave to have a slower velocity, while the material with a higher density had a faster shear-wave velocity. This means if a critical structure were to be constructed, it would have lower ground shaking during the same size earthquake on the rock under the Nuclear Power Plant adjacent to the beach as opposed to on the beach.

Summary Statement
This experiment evaluated the relationship between shear-wave velocity and density of different geologic materials at various critical structures, and how it effects the amplification of the ground shaking during an earthquake.

Help Received
Father helped gather equipment