CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
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Project Number
J0323

Project Title
Commotion in the Ocean: The Effect of Wave Barriers on Tsunami-Induced Seiche Waves

Abstract

Objectives/Goals
The goal of this experiment was to determine the effectiveness of different wave barriers at different locations on a tsunami-induced seiche wave.

Methods/Materials
A wave tank was constructed using PVC pipe, clear vinyl sheet, and duct tape. Two barriers were constructed using painter sticks and hardware. The other two barriers consisted of a flat brick and a brick placed vertically on its long side. A tsunami wave was generated by pushing a cookie sheet forward eight inches from one end of the tank. Each barrier was tested 10 times at three predetermined locations within the wave tank that corresponded to three points within a standing wave. Each trial was videotaped from 3 different angles and timed with a stop watch.

Results
Using video analysis, wave amplitude, speed, and power were calculated at each of the 3 data points. Each wave's dissipation time was determined by measuring the time from the wave initiation to the time the wave's crest and trough diminished below a preset level. The results demonstrate that the flat brick was the most effective barrier at the standing wave node. This barrier reduced wave power by 54.43% at point 1, 99.59% at point 2, and 100% at point 3 compared to the control. The vertical brick simulating a sea wall had the fastest energy dissipation time but demonstrated increased wave power at barrier positions 2 and 3. The barrier with the brackets showed little change in energy dissipation time compared to the control, but was effective at reducing wave power 73.5% to 84.9% at data point 3 (the point closest to "shore"). The brick barriers were more effective when they were farthest from shore, while the smaller barriers were more effective closest to shore.

Conclusions/Discussion
The location of a wave barrier determines its effectiveness against tsunami waves and tsunami-induced seiche waves. The hypothesis was not supported through the experiment. The increased wave power noted for the seawall brick was likely due to wave reflection and interference. The barrier with the attached brackets reduced wave energy effectively and could be a practical alternative for protecting shorelines with minimal impact on marine life. Further research should explore what plays a greater role for a barrier: the position within the seiche wave or the position relative to the shore.

Summary Statement
This experiment explored the effectiveness of wave barriers at different locations on tsunami-induced seiche waves.

Help Received
Mother built the wave tank, helped type report, and was the wave generator for the experiment. Father helped with math and wave power formulas.