CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

33431

Project Title

Investigating Wave Barriers to Reduce the Power of Storm Surges

Abstract

Objectives/Goals

Storm surges are the rise of water caused by storms like Hurricane Sandy. They flood and damage coastlines. My experiment tested which wave-barrier reduces wave power, but also minimizes cost and environmental impact and allows coastal navigation. Current barriers, such as movable walls or Reef Balls, do not meet all of these requirements. I hypothesized that a metal mesh suspended with small stones, simulating an artificial coral reef, would be the most effective barrier overall. Its irregular shape and surface area increase drag. This decreases wave height and time period between waves, reducing wave power.

Methods/Materials

I tested the following barriers: bricks, angled half-bricks, a window screen, a half-submerged, vertical piece of wood, a fully submerged, slanted piece of wood, a lowered metal mesh, and a raised metal mesh. I constructed a wave tank with an artificial beach to absorb rebounding waves, a wave generator plate, and a plexiglass viewing window. I attached rulers to measure wave height at fixed points before and after the barrier, located near the box#s center. For each barrier, I generated ten large single waves and five series of fifteen small waves at half-second intervals. I took videos of these waves through the viewing window.

Results

For the multi-wave tests, I calculated each wave#s peak to trough height before and after the barrier. The multi-wave height ratios were inconsistent because of rebounding waves and variable wave generation. The wave time period had a range of 0.3 seconds, which is insignificant. The single wave height ratios were more consistent. I ranked the barriers# height ratios from least to most effective: control, lowered metal mesh, window screen, two bricks, three half-bricks, slanted wood, raised metal mesh, and vertical wood. The vertical wood and raised metal mesh were effective partly because they were close to water level.

Conclusions/Discussion

The optimal barrier would be a lightweight, semi-porous material raised to the water level. It would significantly reduce wave power, have a low cost because of less material, and allow tidal flows, salt levels, and marine life to pass underneath. Gaps could allow navigation of ships. In future experiments, I could increase accuracy and test different positions, shapes, and materials for barriers.

Summary Statement

Using a wave tank, I tested which barriers most effectively reduced wave power, and concluded that a raised, semi-porous material is most effective, and practical in terms of cost and environmental factors.

Help Received

Dad helped construct wave tank.