CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Brigitta E. Miyamoto

Project Number
S0610

Project Title
Reef to the Rescue: Which Artificial Surfing Reef Counteracts Beach Erosion Best?

Abstract

Objectives/Goals
The objective of this experiment was to determine which characteristics of an artificial surfing reef prevent beach erosion best.

Methods/Materials
A wave chamber constructed out of Plexiglas was filled with sand and water. A manual wave-generating crank was positioned at one end, and a sloped sandy beach at the other. Ten clay models of artificial surfing reefs, based on reefs in existence, under construction, or planned, were placed in the chamber and tested for their ability to protect the beach from erosion. After 10 minutes of wave generation with each model, erosion was measured by averaging 4 beach sand inflection measurements. Beach erosion data for each reef was compared to the control situation in the absence of any reef, and to data obtained with other reefs.

Results
The results suggest that the best reef design for erosion control features a shallow-sloped, concave surface towards incoming waves. The shallow slope presents a large surface area to effectively dissipate waves, and the curved concave surface additionally rotates the waves. A reef's profile facing shore was found to be less important. Erosion also decreases if the reef is placed at an angle to the shore, further dampening waves by rotating them. Optimal erosion control is achieved by a reef that dampens waves by both dissipating and rotating them.

Conclusions/Discussion
The relatively recent technology of man-made offshore reefs was first used to condition waves to improve surfing, and was later found to have the desirable secondary effect of decreasing beach erosion. The logic behind using artificial surfing reefs to counteract beach erosion stems from the fact that the bathymetry, or underwater topography, is altered by the introduction of a reef; the wave's shape and energy, and the amount of sand it transports to and fro, are altered as the bottom of the wave passes over the reef. A dampened wave transports less sand to and especially away from the beach, and erosion is checked. This experiment investigated the effect of reef design on beach erosion, and showed that artificial reefs with geometries that both dissipate and rotate waves perfom best in combating erosion. The results support the idea for an increased awareness of this novel engineering approach for erosion control.

Summary Statement
My project involves the use of a wave chamber to investigate how the geometry of an artificial surfing reef affects beach erosion, and gives us an idea of a real-life application, especially the protection of the California coastline.

Help Received
My dad helped me design and build the wave chamber. A friend built the paddle out of spare parts.