CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

J0325

Project Title

It's All About That Place: How Wave Barrier Location Impacts Tsunami-Induced Seiche Wave Power

Abstract

Objectives/Goals

The goal of the first year of this project was to explore the effect of different wave barriers at different locations on a tsunami-induced seiche wave. The wave barriers were effective at reducing wave power but, due to wave reflection and interference, it was unclear if they were effective because of their location within the seiche wave or their distance from shore. The objective for this year was to determine which of these factors affected seiche wave power reduction more.

Methods/Materials

A wave tank with a temporary wall and wave attenuator was built. The two most effective wave barriers from the first year (upright brackets, flat brick) were used. Another barrier was constructed with a twin turbine that could face horizontally or vertically for two additional barriers. Waves were generated by a powered chain drive motor at a frequency of 78 waves/minute. Using the temporary wall, the four barriers were tested for 10 trials at 3 locations that corresponded to 2 nodes and 1 anti-node points within the seiche wave. The temporary wall was removed and the process was repeated for the 4 barriers at the 3 locations for 10 progressive waves. Each wave was videotaped at four data points across the entire tank.

Results

Using video analysis, wave amplitude, speed, and power were calculated at each of the 4 data points for each trial of standing and progressive waves. The wave power at all four data points for each barrier was then compared to the control wave power (no barrier) for each wave type. For seiche waves, all four barriers reduced wave power at one node position differently compared to the other node position. Barrier C and D significantly increased seiche wave power at shoreline while in the anti-node position. For progressive waves, all four barriers were effective in reducing wave power at data point 4 (shoreline) no matter what location they were in although barriers B,C, and D were most effective farthest from shore.

Conclusions/Discussion

If the position within a seiche wave was a determining factor, you would expect wave power to be affected similarly at both node positions. Barrier B and D were more effective at one node position compared to the other node position. Therefore, the distance from shore is the more important factor for these barriers. These findings support my hypothesis. Barrier distance from shore does not appear to be a big factor for most progressive wave barriers.

Summary Statement

This project explored whether a wave barrier's effectiveness was determined by its location within a seiche wave or its distance from shore.

Help Received

My parents helped build the wave tank. My mom helped with typing my report. My dad helped with excel graphs and math calculations. Dr. Ed Clifton, USGS Emeritus, answered my questions about wave tank design. Gerald Nachtigall, my shop teacher, helped weld my barriers.