US Army Corps of Engineers®
Engineer Research and Development Center

Prediction and Prevention of Rubble Mound Structure Damage

Description

The Corps of Engineers maintains over 500 coastal structures. Most of the structures are rubble mounds and have exceeded their intended lifetime. Many are in need of repair. Replacement cost on these structures is on the order of $10M to $100M. Most of these structures sustain small amounts of damage each year because they were built to be "flexible" under extreme storm conditions.

Repair of North jetty - Yaquina, Oregon

Issue

Prior to this R&D, there were few tools available to predict damage development to coastal rubble mound structures. There were no math models available to predict damage to large jetties, which are vital to maintaining the nations channel entrances to harbors. This research effort was focused on developing tools for predicting armor stone movement on coastal rubble mounds.

Users

District Engineers and Consultants involved with rubble mound design.

Products

Products from this research include empirical math models for predicting erosion of rubble mounds as a function of time, wave conditions and water levels. Physics-based armor stability equations were developed. Technical reports, journal papers, conference papers, as well as CHETN and CEM additions were published. These methods have been integrated into life cycle risk methods within a separate R&D effort. High-speed robotic laser profilers and associated analysis software were developed to profile small-scale coastal structure models in the laboratory. Historically, rod and level surveys of structures in the lab were cost prohibitive and yielded spatially and temporally crude measurements. With the new profiling technology, profile measurements are done at very high spatial and temporal resolutions.

Benefits

The data have resulted in improved understanding of armor stone movement. Measurements from this technology have led to new empirical formulas that predict the rate of stone movement on breakwaters, revetments and jetties exposed to a series of storms. Further, equations for predicting the variability of damage along the structure and the variability in time have been developed. The relations are the first equations of this kind and are crucial for performing life-cycle analyses of structures. This research has led to a more physics-based approach to armor stability. The result is reduced costs of design, more reliable designs, and an ability to predict damage.

Corps Program

Navigation Systems R&D Program

Point of Contact

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