Department of Naval Architecture and Ocean Engineering
Independent Research in Naval Engineering Final Report

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Executive Summary: Hydrodynamic Study of Coastal Haven Breakwaters

The Hydromechanics Laboratory at the United States Naval Academy, through the Department of Naval Architecture and Ocean Engineering, performed physical model tests of the original prototype, Coastal Haven Breakwater module in May 2003. Twelve scale models of the Coastal Haven modules were used in the series of shoreline protection tests. Coastal units were observed and evaluated in both single-row and double-row configurations in the Coastal Engineering Tank.

A sand beach was constructed at a 1-on-6.7 slope in the 52 ft long by 18 ft wide sediment flume. The HR Wallingford Automatic Bed Profiler was utilized to measure profile change at 5, 10, 30 and 40 minute intervals. The C. E. Tank is equipped with a piston type, servo-hydraulic control wave-maker, manufactured by MTS, capable of generating regular and irregular waves with a frequency range of 0.2 to 1.5 Hz. Instrumentation consisted of variable reluctance force blocks for all force measurements, ultrasonic and resistance wave height gauges.

The first series of tests involved passing regular waves (0.8 Hz. 1.0 Hz. & 1.2 Hz.) over the Coastal Haven breakwaters placed offshore the stabilized, model beach. Profile changes were measured at periodic intervals and compared to initial, no-breakwater conditions. The second series of tests involved measuring and comparing incident wave energy, before the wave train encountered the Coastal Haven breakwaters, with the transmitted wave energy after the wave train had passed over the breakwaters.

Coastal Haven modular units are scientifically designed and engineered for specific hydrodynamic conditions. The Coastal Haven modular units evaluated in this series of tests were "off-the-shelf" and not specifically engineered for the particular set of hydrodynamic conditions set up by the United States Naval Academy. Given that set of conditions, the Coastal Haven Breakwaters were quite effective at shoreline protection and in reducing shoreline retreat. The Coastal Haven breakwaters attenuated wave energy most effectively in the double-row configuration, creating a larger berm closer to the shoreline. Had there been an unprotected source of sand upstream of the Coastal Haven protected shoreline (as well as current/waves creating long-shore transport) it is highly probable that there would have been accretion on the protected shoreline. The results of the hydrodynamic tests and engineering analysis show that Coastal Haven breakwaters can be designed as very effective, stable and durable breakwaters, given the specific hydrodynamic conditions at any geographical position.

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