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INFLUENCE ON WAVE RUN-UP OF A CURRENT STRIKING NORMAL TO SMOOTH AND ROUGH SLOPES OF COASTAL STRUCTURES

V. VINOVAN, A.C. VINOJIT, K. SASIKUMAR, S. SABESAN, S. PARANEETHARAN, A.H.A. SAVERIRAJAN AND J.J. WIJETUNGE

Department of Civil Engineering, Faculty of Engineering, University of Peradeniya

Wave run-up is the upper limit of wave uprush above the still sea level. The run-up height is required to determine the crest level of structures that are designed for no or only marginal overtopping such as revetments, dikes and breakwaters for small craft fishery harbors. Most coastal structures in Sri Lanka are located in relatively shallow water, and in such near-shore sea, numerous current systems such as the tidal currents, the longshore currents, and the rip currents are often present, in addition to the waves. However, unfortunately, little information is available on the influence of such currents on the wave run-up. Therefore, the primary objective of the present paper is to examine the effect of currents on the wave run-up over both smooth and rough slopes of coastal structures.

The experiments were carried out in a towing tank with facility for two dimensional regular wave generation in the Fluids Laboratory. A model structure was fitted to the underside of a movable trolley running on the channel. Two types of surfaces were used: a) smooth, and, b) two layers of gravel of median diameter 20 mm placed on an impermeable surface. By changing the velocity of the trolley with the slope attached to it, different current velocities could be simulated. This is because the experimental case of a slope moving in still water is similar to the prototype situation of a current striking against a slope, if we consider the motion relative to the slope. A resistant type wave gauge was used for wave measurements while the wave run-up on the slopes was recorded using a digital video camera.

The wave run-up (R) over a slope under the present experimental conditions of waves plus currents depends on H, the incident wave height; d_s, the depth at the toe of the slope; T, the wave period; k, the roughness height; α, the slope of the structure measured from the horizontal; U, the current velocity; and, g, the acceleration due to gravity. Thus, the non-dimensional run-up (R/H) may be expressed as a function of the following dimensionless groups, if we assume that the flow is turbulent: $R/H = \phi\left(d_s/H, \zeta, k/H, U/\sqrt{gH}\right)$, where, ζ is a breaker parameter.

Measured values of run-up over the smooth slopes due to currents alone showed good agreement with a simple theoretical formula derived using energy considerations. A comparison of measured values of run-up due to waves alone too showed satisfactory agreement with previous results.

The non-dimensional run-up due to the combined presence of waves and currents (R_{CW}/H) over both the smooth and rough slopes appears to increase approximately linearly with $U/\sqrt{gH}$. Further, the present measurements suggest that the interaction of run-up due to currents alone (R_c) and that due to waves alone (R_w) to yield the combined wave-current run-up, is non-linear over both the smooth and the rough slopes tested. Further work is in progress towards quantifying the influence of currents on the wave run-up over a range of values of ζ and for its inclusion in the design formulae.