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Experimental Investigation of Wave-Current Flow on a Two-Dimensional bed-Form

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1-Introduction

Flow structure is important in physical and numerical modelling specially as related to sediment transport problems. Numbers of studies have been carried out on wave-current flow conditions without taking the bed-form into consideration. Submerged structures and obstacles could significantly alter not only the flow parameters like as turbulence intensity, Reynolds stresses and correlation coefficient ([1], [2]) but also the boundary layer parameters will be affected.

Experimental studies of flow-bed forms interaction started with investigation in laboratory canals and the researchers tried classified different forms of bed related to current conditions ([3]). Modern experimental techniques as hot wire, hot film and Laser Doppler Anemometery (LDA), helped detail analyzing mean flow and turbulence field related to bed forms as ripples and dunes ([4], [5], [6], [7]). Previous studies showed sensivity of flow to the bed forms ([8]) so the influence of topographic acceleration and deceleration of flow due to these forms should be considered. In current condition on downstream of the dune crest, vertical component of the velocity are negative, i.e., singe of a recirculation zone and separation point ([9]). Acceleration could alter logarithmic mean-velocity profile, too ([10]).

In Wave condition, too, the dunes, present two different effects: first, modification of flow and the waves (related to obstacle or dune length scale), and the second, local effect as turbulence and vortex generation (related to wave height). If in current condition, some kind of permanent equilibrium of bed forms could be considered ([11], [12]), but in wave condition, the response of the bed form to temporal change of the waves will be with a delay, so permanent equilibrium could not achieved especially in wave-current flow.

Complexes interaction of bed form and wave or bed form and wave current present in coastal zone and development of the bed forms are controlled by different parameters as sediments characteristics, current properties and wave energy.

Analysis of the wave deformation and sediment transport in this case, needs the knowledge of flow condition. Multiple experimental, numerical and in situ studies, had investigated wave problem on bed form (([13], [14], [15], [16], [17]). The results of [18] showed that when the vertical dimension of the bed form is an order of mean water depth, the waves begin to affected by the bed and become distorted or beaked (Fig. 1).