Oscillatory Ripple Geometry

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1. Introduction:

The problem of formation of ripples by wave action is of considerable interest, because this type of bottom surface is very common in nature and phenomena such as Sediment transport, wave attenuation and wave induced currents are significantly affected by the Conditions near the bed. The size of ripple relative to the amplitude of water particle motion induced by wave governs the friction factor which is used to determine the fluid shear stress at the bed from the known amplitude of the orbital velocity of fluid. Knowledge of the shear stress together with the profile of velocity provides the profile of eddy viscosity or diffusion coefficient which is used to describe the profile of suspended sediment or rate of sediment transport. The formation of ripples by wave action has recieved only very limited attention compared to that by unidirectinal flows. This is mainly due to lack of insight into the differences between oscillating beds and oscillating fluids and their interactions with bed sediments.

This study of oscillatory ripples is based on the results obtained by the first author in a wave basin at the water resources division of Asian Institute of Technology, (A. I. T.) Thailand. The more details can be found in Ref1. In this study, the ripple geometry (ie ripple length & height) and its relation with waves and sand characteristics are discussed.

2. Experimental Setups & methodology:

A wave basin of the dimensions 8×6m shown in fig. 1. was prepared. The sand of diameter 0.25mm was uniformly spread over the ground upto 400cm from the shore line. Water was filled into the basin upto a depth of 11cm which was measured at a marked point in the basin Shown in fig. 2. A flap type wave generator mechanism was used to generate the artificial waves in the basin. In this system, a motor with regulator for changing the r.p.m. was used and later on the rotatory motion of wheel was changed into the translatory motion. The waves of wave height 2cm & wave period of 0.85sec. was generated. Sand was supplied at a rate of 190 gmf/min. With the help of hopper regulated with a controller to avoid the discontinuity in sand supply from upstream. Three types of models were tested in the basin using (1) straight jetty (2) crank Jetty and (3) without Jetty. The location of straight Jetty is shown in fig. 2.

The ripple dimensions (ripple length & height) and water depth were measured at 10 different points in the wave basin after every 6hr. intervals upto 18 hrs. in two ways:

(A) with the help of wave profiler ; and (B) with the help of point gauge

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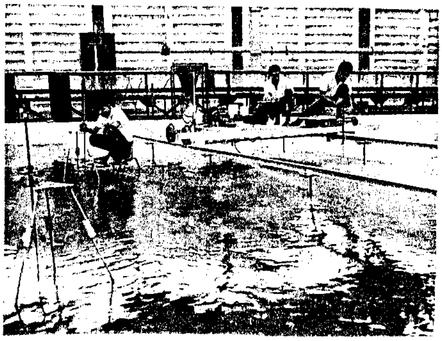

Fig. 1. WAVE BASIN MODEL

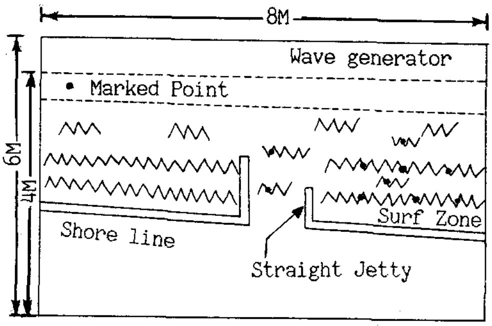

Fig. 2. WITH STRAIGHT JETTY

3. METHOD OF CALCULATIONS:

wave height, $H = 2.0$cm , wave period, $T = 0.85$sec. Sand particle diameter $D = 0.25$mm. Wave length was calculated by using linear wave theory. wave length,

$L = \tanh(2\pi h/L)gT^2/(2\pi)$; here, L was calculated by error and trial.

$a_{1m} = a/\sinh(2\pi h/L)$; h : water depth ; a : wave amplitude ; L : wave length

$a_* = a_{1m}/D$; a_* : non-dimensional parameter ; D : mean diameter of sediment

4. RESULTS AND DISCUSSIONS:

It is feasible to use stroke theory or cnoidal wave theory for shallow water but linear wave theory is used in this study for easy computation. By reviewing the results, the following Conclusions are made in this study.

1. Ripple increases in length and height upto certain value of a_* and after attaining the maximum value they starts to decrease in height. Some of them becomes three dimentional which are not measured in this study.
2. It is also found that the shape of jetty has no much effect on the ripple geometry. So the authors found a relationship between ripple geometry and wave and sediment characteristics parameters.
3. The ripple at the time of growing stage is called by the authors as growing ripple and at the time of decaying stage as decaying ripple.
4. From plotting the points on the graph, the following relationship is found.

(a) For growing ripple: Two types of pattern are seen.

(A) $\lambda/D = C_1$; $\eta/D = C_2$

(B) $\lambda/D = C_3 a_* + D_1$; $\eta/D = C_4 a_* + D_2$

where λ and η are the length and height of the ripple respectively and C_1, C_2, C_3, C_4, D_1, D_2, are the slopes of the fitted line to the experimental data for growing ripples.

(b) For decaying ripple: Only one pattern is seen.

$\lambda/D = C_5 a_* + D_3$; $\eta/D = C_6 a_* + D_4$

Where C_5, C_6, D_3, D_4 are the slopes of the fitted line to the experimental data for decaying ripples. The supporting materials with figures will be shown during the presentation of this study in the conference.

5. Reference:

1. Suphat, V. (1984), Oscillatory ripple geometry, ASCE, Vol. 110, HY no. 3