

SIMULATION OF SORTING IN THE CROSSSHORE DIRECTION AND TOPOGRAPHY CHANGE OF BEACH COMPOSED OF FINE AND COARSE SANDS

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ABSTRACT

Numerical models for predicting topography change caused by sediment transport so far are generally carried out by using representative grain size. But actually bed material in the field often has wide grain size distribution. In a beach where grain size distributes widely, the direction of bed material transport depends on its grain size because the mode of transport of fine bed material is different from that of coarse bed material in the cross-shore direction every now and then. The purpose of this study is to simulate sorting process of the bed materials in the cross-shore direction due to difference of transport direction between fine and coarse materials and topography change by applying SBEACH model (Larson and Kraus, 1989).

Although representative grain size such as the mean grain size is originally used in SBEACH, in this study the model is extended to apply to the beach composed of mixed bed materials. In this expanded model, sediment transport rate and transport direction of each grain size are estimated separately on the presumption that the beach is uniformly composed of bed material of each grain size. Total sediment transport rate is evaluated as the summation of the product of transport rate and content rate of each grain size. This expanded model can take account of grain size distribution for sediment transport rate. The change in the grain size distribution at the surface layer is calculated by conservation of mass of bed material of each grain size in the exchange layer.

We carried out simulation to reproduce the hydraulic model tests. Simulated grain size distributions gave qualitative explanation for the observed one by the hydraulic model tests. Calculated results showed that the coarse materials and fine materials tend to move to the counter direction just like the measured results in model tests.

KEY WORDS: Mixed sand and gravel beach; topography change; bed material sorting, SBEACH

INTRODUCTION

In the present numerical model for predicting topography change caused by sediment transport is generally evaluated by using representative grain size, for example, the mean grain size. In a beach with narrow grain size distribution, such a procedure can be applied because almost all of the bed materials are transported in the same mode. But actually bed material in the field often has wide grain size distribution. In a beach where grain size distribution is wide, the direction of bed material transport depends on its grain size because the mode of transport of fine bed material is often different from that of coarse bed material in the cross-shore direction. For an accurate prediction, the interaction between fine and coarse bed materials has to be taken into account.

Some laboratory experiments have already done to examine the effect of the grain size distribution on the sediment transport (Tanaka et al. 2000 and Nakamura et al. 2001). Although difference of sediment transport rate between beaches composed with uniform grain size and mixed sand and gravel beaches is confirmed in these experiments, mechanics of sorting as a result of difference of transport direction between fine and coarse materials have never been concerned.

In this study, SBEACH (Larson and Kraus, 1989) is extended to apply to the beach composed of mixed bed materials. We carried out simulation to reproduce the hydraulic model tests using mixed coarse and fine materials. And mechanics of sorting in the cross-shore direction are examined.

EXTENDED SBEACH TO MIXED SAND AND GRAVEL BEACH

Calculation of Sediment Transport Rate in SBEACH

SBEACH was developed on the basis of quantitative analysis of beach profile change by using large water tanks. The domain of model extends from the depth of significant net cross-shore sediment