Method For Predicting Sediment Sorting And Bed Variation In River Channels With A Broad Sediment Size Distribution

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The present dissertation presents the results of numerical and experimental investigations on treatment of non-uniform sediment transportation, sediment sorting and river bed variation in river channels with a broad sediment size distribution. These are performed in different case studies during doctoral degree at Ritsumeikan University, Japan. The content consists of 5 chapters which are introduced briefly as follows.

In Chapter 1, an introduction of sediment problems and background of studies.

In Chapter 2, a new treatment of the exchange layer thickness to evaluate sediment sorting and armoring process concerning to straight open channel flow are presented. In this treatment, a thickness of bed load layer is evaluated as a function of bed shear stress, and is introduced into a well known exchange layer model which firstly proposed by Hirano (1971). The results predicted by the present method on sediment sorting, armoring and associated bed degradation accord with flume data. This suggests that sediment sorting and associated problems can be predicted well using an automatically determined thickness of bed -load layer, although the well known constant layer model can give good results on the problems under consideration if one determines the thickness properly by try and error.

In Chapter 3, field data of topography change, bed material, water surface elevation and hydrograph at Tan Chau reach in Vietnam is presented to understand mechanism of the river change. The results of field survey show that bank shifting tends to occur toward anti-clock wise and sand bars migrate downstream, resulting in a much larger bar, which is influenced by co-presence of non-cohesive and cohesive sediment and artificial works. In addition, bed material loads are originated by bank erosion. A two dimensional numerical model is proposed to simulate flow pattern and associated river change. In this model, erosion rate formula for cohesive material and formula for estimating the thickness of sediment transport layer as a function of bed shear stress are introduced into the standard layer model which was firstly proposed by Hirano (1971). The proposed model can estimate the sediment transport rate on the bed composed of non-cohesive and cohesive material and predict the topography change of study reach.

In Chapter 4, bed and bank material which had been sampled along the Tonle Sap River from Chaktomuk to the Tonle Sap Lake are presented. Furthermore, one dimensional bed deformation analysis has been performed and seasonal morphological change has been reproduced. One dimensional bed deformation model employed in the study can treat of cross-sectional shapes to reproduce the flow and sediment transport rate during both the dry and the flood seasons. Both bed and suspended loads are taken into account to estimate the sediment transport rate. The numerical results show that suspended load dominates to bed load and plays an important role in bed deformation. The sediment tends to deposit near Chaktomuk and the Tonle Sap Lake in the reverse flow stage and the deposited sediment is eroded in the normal flow stage. As a result, the total yearly bed deformation is small. The mean sediment size becomes small in the reverse flow and large in the normal flow, respectively, according to the deposition and erosion of finer sediment.

In Chapter 5, the summaries of obtained results of present study are described.