C16

Study of the Characteristics of the Flow around a Sequence of Non-Typical Shape of Spur-dikes Installed in Fluvial Channel

○Amir-Reza MANSOORI, Hajime NAKAGAWA, Kenji KAWAIKE and Hao ZHANG

1. Introduction

Spur dike is one of the main transverse hydraulic structures which is installed in the streams to prevent the bank erosion and to improve navigation's routes in rivers. Recently it is also used to provide better environment to the stream species which are in need of a diverse bed with various range of hydrodynamic, topographic and biologic conditions in rivers. Based on the construction method and materials or the hydraulic conditions of inflow, spur dikes can be categorized as impermeable or non-impermeable, emerged or submerged, respectively. Moreover, based on the shapes of the spur dike in the plan, different kinds of spur dikes can be recognized: "Straight shape or I-type", "T-type", "L-type" and etc. Indeed, the typical type of the spur dikes which has been constructed in the rivers over the years is mainly straight one. After installation of transverse structures in the rivers, due to the separation of approaching flow and the formation of shear layers, a fully three dimensional turbulent flow will be appeared locally around the structures as well as inside the main stream. This can be lead to the movement of sediment particles of the bed, the erosion along the bed and banks of the river and ultimately to the changes in the morphology of the stream reach. Numerous studies has been proved that by installing a series of straight spur dike in the stream, a local score hole will be formed and the eroded material can form a series of point bar downstream of the spur dike. In long span, these big bars would be able to interrupt the route of the navigation in the rivers. Increasing the resistance of the flow and consequently raising the risk of the flooding can be other results of the formation of such kind of bars along the river. Alternatively, very limited studies of non-typical shapes of the spur dikes show that these types of spur dike are capable of having a better performance to decrease the topological changes in the stream.

2. Numerical model

In the present study a numerical code will be utilized to solve the governing 3-D RANS equations. The code uses standard k-ε turbulence to close the turbulent stresses in the Reynolds-averaged equations. The convection terms are discretized using the SOU scheme. For velocity-pressure coupling, the SIMPLE algorithm is adopted. Water surface calculation was also applied in order to incorporate fully 3D turbulent modeling and free-surface flow.

3. Case studies and results

Two different series of spur dikes, a simple series of straight spur dikes and a simple series of spur dikes with T-shape head, will be considered and the effect of the length of the spur dikes' field and the hydraulic conditions of the inflow on the pattern of flow field will be discussed. The discussions will be mostly focused on the comparison of the mean characteristics of the structure of turbulent flow around these two types of the spur dikes in order to evaluate the performance of a series of T-shape spur dikes with that of straight ones based on the primary objectives of the designs of the spur dikes.