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Numerical Modeling of Local Scour at the Junction of Open Channels in Flow3D Numerical Model

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Abstract

At the junction of channels, the two corresponding flows of the main and submain channels are diverted from their main alignment and the form and the flow properties change at the junction. Changes in water level profile and depth of flow, velocity distribution, stagnation zone, constriction of public channel, energy loss and also formation of hydraulic jump are among the most important hydraulic variables in this location. For accurate recognition of hydraulic properties of flow and local scour at the junction of channels, physical models are made and constructed. Setting up a physical model requires many conditions and high costs which sometimes are not justifiable, hence appropriate numerical models could be proposed for such options. In this research using Flow3D numerical model, the numerical modelling of the flow has been performed in 3D form utilizing the available laboratory information which is calibrated and validated and accuracy of the numerical modelling, and the corresponding relative error are determined. The calibration and validation of the numerical model results demonstrate that the maximum relative error of the numerical model when simulating for maximum values of scour depth at the flow junction is equal to 8.2%. Also using the numerical model it was found that with passage of time in numerical model, from the start of scouring, the location of maximum scour is transferred towards the opposite wall of the sub main channel and is distanced from the junction position also the volume of sedimentation is increased and is translated toward the downstream main channel.

Keywords: Local Scour; Channel Intersection; Numerical Modelling; Flow3D.

1. Introduction

At the channels junction, the two main and sub main channel flows are deflected from their main route and the form and properties of the flow change at the junction. Change in water surface profile and depth of the flow, velocity distribution, stagnation zone, constriction of the public channel, energy loss and also formation of hydraulic jump are among the most important hydraulic variables in this location. At the stagnation zone which is formed at the corner of junction upstream, the first encounter between two flows corresponding to the two main and sub main channels occurs and the flow velocity at this zone is nearly zero. The deflection zone is a zone in which the main channel flow is deflected from its rout and approaches the opposite wall of the junction. The sub main channel flow after the junction distances from the inner wall of the channel and creates a zone called the separation zone, in which the flow velocity is very low and sedimentation occurs at this zone. At this zone the maximum velocity or the compression zone of flow velocity is greatly increased and when the shear stress exceeds the critical stress, local scour occurs at this zone. Estimation of the local scour at the junction of rivers and channels is one of the most important problems in Hydraulic engineering.

Mosely, performed an experiment at the junction of two Y-shaped channels with erodible walls and demonstrated that erosion starts by creating sand mounds perpendicular to the flow direction at the sub main channel which in continuation meanders in downstream channel parallel to the flow direction and creates the erosion pit at the junction

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