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Investigating Effect of Different Parameters of the Submerged Vanes on the Lateral Intake Discharge Located in the 180 Degree Bend Using the Numerical Model

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Abstract

Intakes are widely used for flow diversion and its control in the open channels or rivers. During passing flow, part of the suspended sediment along with the flow enters the lateral channel and deposits in the lateral intake channel entrance, causing a change in the direction of the flow line towards the shore in front of the reservoir, which reduces the intake efficiency. Submerged vanes are small hydraulic structures that, by creating a secondary flow in their downstream, cause changes in the flow pattern and guide line to the drainage span, and the most important parameters affecting sediment input to the waterfall is the ratio of flow rate. Investigating a laboratory model has high costs and times, which in some cases cannot be justified, therefore, suitable numerical models can be proposed for such options. In this study, using Flow3D, three-dimensional numerical modeling of the flow was calibrated and verified using existing data and numerical modeling accuracy, the relative error of the numerical model was determined. In this study, all effective parameters including submerged vanes type, submerged vanes number, submerged vanes size and Froude number changes in the main channel and type of submerged vanes layout have been investigated. The results of the numerical model show that the angle of inclination of 60 degrees in the entrance intake and the chassis layout in the Froude numbers 0.21-0.33 will result in the most lateral intake discharge.

Keywords: Submerged Vanes; Lateral Intake; Discharge; Bend; Flow3D.

1. Introduction

At the juncture of canals, the two main and sub-main flows are diverted from their original path and the flow pattern and properties are changed. Change in the water surface profile and flow depth, velocity distribution, stagnation zone, channel contraction, energy loss and formation of hydraulic jump are among the most important hydraulic variables at this point. At the stagnation point which is created at the upstream corner of the juncture, the first contact between the two main and sub-main flows occurs and the flow velocity is nearly zero at this zone. The diversion zone, is where the main canal flow is deviated from its main path and approaches the opposite juncture wall. The sub-main canal flow distances from the inner canal wall after joining it and creates a zone named as the separation zone, where the flow velocity is very low and sedimentation occurs there. At the maximum velocity zone or the contraction zone, the flow velocity is highly increased and where the shear stress exceeds the critical one local erosion occurs there. Estimation of the local erosion at the juncture of the rivers and canals is among the most important problems in hydraulic engineering.

Use of the submerged vanes technique which are the developed and modified form of the deep panels was investigated for the first time by Odgaard and Kennedy (1983) at the hydraulic institute of Iowa University for Prevention of the outer

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