Numerical Modeling on Local Scour Characteristics at the Downstream of Free-falling Flow

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Downstream scour of hydraulic structures has been studied because of its frequent occurrence in many engineering applications. The local scour downstream of a weir structure on an alluvial bed is a most complicated phenomenon even in terms of estimating the potential maximum scour depth. During the initial and formative phases of the scour profile the local sediment transport is rather active, while approaching the equilibrium condition the phenomenon tends to a ‘‘purely hydraulic’’ (Vincenzo D’Agostino and Vito Ferro. 2004) mechanism in which the hole profile is the result of a mass balance between removed and deposited particles inside the scour hole. These scour holes at the downstream of a weir structure cause a collapse of hydraulic structures. So protection works are needed downstream of hydraulic structures for safety and engineers need to consider such effects before design and construction.

This study, therefore, was conducted to analyze the hydraulic characteristics of local scour at the downstream due to free-falling flow using the CFD code, FLOW-3D developed by Flow Science (2003). Numerical experiments were conducted for the sharp crested weir with 0.1m and 0.2m height in the prismatic channel, the width of 0.8m and length of 3.0m as shown in Figure 1. Initial overflow water depths were 0.1m and 0.05m, respectively. Total meshes of 1,680,000 were used to simulate the hydraulic characteristics at the downstream of weir including bed. The LES (Large Eddy Simulation) was employed as turbulence closure model and sediment scouring model from Flow-3D was used to simulate bed alteration.

It was found from results in this study that scour depths were increase due to height of weir was increased. The maximum scour depth was increased 20% while height of weir increase 0.1m to 0.2m. Scour depths were increase due to height of over falling depth was increased. The maximum scour depth was increased 50% while height of over falling depth increase 0.05m to 0.1m. and scour area were expended.

Finally, essential database will be offered for the economic and reliable design for weirs in fluvial systems. In near future, laboratory experiments will be conducted to provide better understanding hydraulic characteristics.

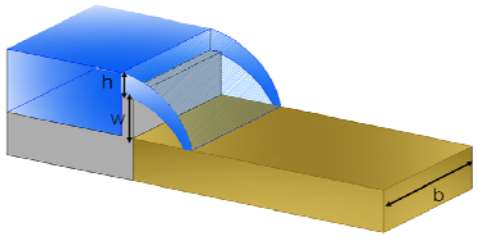

Figure 1. sharp crested weir conducted numerical experiment

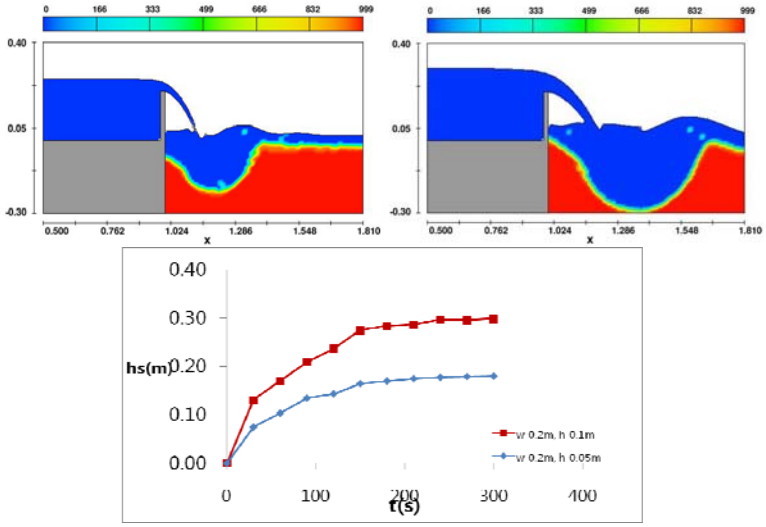

Figure 2. Flow velocity and scour at the Downstream of Free-falling Flow

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