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NUMERICAL ANALYSIS OF FLOW AND BED CHANGES BY WATER LEVEL DRAWDOWN AT THE HAMAN WEIR IN THE NAKDONG RIVER USING THE CCHE2D MODEL

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The Four Rivers Restoration Project has been conducted in Korea to secure abundant water resources, to implement comprehensive flood control measures, to improve water quality and restore the ecosystem, and to create multipurpose spaces such as waterfront for local residents. For this project, 16 large scale weirs have been constructed along the main stream of the four major rivers and especially 8 weirs were built in the Nakdong River. The Haman Weir which is the last weir among 8 weirs is constructed at the downstream end in the Lower Nakdong River. Therefore, it is expected that the decreased velocity in the mild slope causes the sedimentation problem in the upstream channel of the Haman Weir. There are several methods such as sediment dredging, flushing, and sluicing to prevent and reduce the deposited sediment in the upstream area of a dam or weir. It is expected that the sediment sluicing or flushing methods by water level drawdown are applicable to the case of Haman Weir because of the multi-gates for underflow and overflow. Therefore, it is necessary to analyze the sedimentation characteristics in the upstream channel of the Haman Weir and to evaluate the feasibility of the sedimentation reduction method by water level drawdown applying the gate opening for the Haman Weir.

In this study, the flow characteristics and bed changes for 1000 m^3/s of flow discharge (averaging 30 days occurrence per year) and 5.0 EL.m of the management water level were analyzed using the CCHE2D model which is the 2 dimensional flow and bed change model. Also, the bed changes for 4.5 EL.m (applying 0.5 m water level drawdown) of the water level at the Haman Weir were simulated to evaluate the feasibility of the sedimentation reduction method by water level drawdown**.**

As a result of simulation for 5.0 EL.m of the management water level at the Haman Weir, it was represented that the flow velocity at the bed condition after 30 days became slower than the initial bed condition. The maximum velocity was 0.833 m/s at the initial bed condition and 0.711 m/s at the bed condition after 30 days. The location for the maximum velocity was 0.78 km upstream of the Haman Weir where the channel width was the narrowest. As shown in Figure 1 for the case of bed changes, the sediment deposition is dominant rather than the erosion across the channel. The deposited heights of channel bed were 0.372 m, 0.729 m, and 0.572 m in the section of 0.15 km, 2.6 km, and 3.3 km upstream of the Haman Weir. However, the channel bed was eroded 1.683 m in the section of 0.78 km upstream due to the narrow channel width. As a result of simulation for water level drawdown from 5.0 EL.m to 4.5 EL.m at the Haman Weir, the flow velocity became faster 10% and the maximum velocity was 0.92 m/s at the narrowest section. As shown in Figure 2, sediment deposition is still dominant rather than erosion across the channel except the narrowest section. The maximum depositional height was 1.431 m at the 2.6 km

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upstream of the Haman Weir, which was two times greater than the simulation result (0.729 m) of 5.0 EL.m of the management water level. The maximum bed erosion was 2.224 m at the same location of the simulation with 5.0 EL.m, which was also 1.4 times greater than the simulation result (1.683 m) of 5.0 EL.m.

Consequently, the water level drawdown at the Haman Weir induced the amplification of sedimentation and erosion in the upstream channel. Therefore it is concluded that the sedimentation reduction method by water level drawdown applying the gate opening for the Haman Weir is not be feasible to reduce the bed changes. The channel section with the narrowest width should be modified to extend the channel width and to reduce flow velocities. The decreased velocity by channel extension could reduce the amplification of erosion.

Figure 1 Bed Change after 30 days for 5.0 EL.m Downstream Water Level.

Figure 2 Bed Change after 30 days for 4.5 EL.m Downstream Water Level.