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3D Numerical Simulation and Uncertainty Analysis for Amuping Desilting Tunnels

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Abstract

The Shimen Reservoir is lack of desilting construction using the hydraulic force. Since the maximum heavy rainfall results from the climate change due to global warming with high likelihood, there is problem with the capacity of desilting and discharging flood through the present facilities. To enhance the desilting and drainage ability in the Shimen Reservoir, two projects, i.e. Feasibility Study of Dawanping Desilting Tunnel Project in Shimen Reservoir and Feasibility Study of Amuping Desilting Tunnel Project in Shimen Reservoir. These two projects primarily enhance the capability of flood prevention and desilting during typhoon events in order to achieve the goal of separating the clear water and turbidity water. Thus, the project of new sediment bypass tunnels for Shimen Reservoir was proposed and it is expected to achieve the annual average desilting amount of 1,350,000 m^3. In the annual average amount, 710,000 m^3 is expected to be delivered through the Dawanping tunnel and the remaining amount of 640,000 m^3 was done by the Amuping tunnel.

This study first adopts the 3D numerical simulation to establish the rating curve of discharge for Dawanping and Amuping basins to demonstrate the accuracy of the inflow discharge under the consideration of a specific water level. In the original design, the hydraulic jump is occurred easily in Amuping desilting basin due to the mild slope of desilting basin. And, the expansion angle between the tunnel and the basin hardly works well attributed to the separate flow zone. As a result, a lot of energy is possibly eliminated so as to lead to the worse desilting condition. After the numerical analysis for the flow filed, the resulting steeper slope of desilting can provide enough capability of erosion with a steady velocity 12m/s for the inflow discharge 600 m^3/s.

Using the 3D numerical model, the pressure on the steel pope can be simulated in the Dawanping and Amuping basins. The results indicate the entrance of the steel pope is aced by a large pressure due to a high inflow speed. And there is open channel flow behind the age, so that the pressure on the channel bed is about 6 m- 8 m. The simulation of pressure in the reservoir can be carried to and they can be referred to construction design.

As for the comparison of results from the numerical simulation and the physical experiment, the results indicate that the resistance force acting on the solid is overestimated so as to reduce the effect of flow convention to desiliting. This leads to a 20% of difference in the sediment transport in the horizontal direction at the 19th section

along the Shimen Reservoir watershed. That is to say, there still exists the uncertainty in the sediment transport capability on the flood plain. Therefore, to reduce the above uncertainty, a further physical experiment would be done for the follow-up analysis.

Keywords: Amuping Desilting Tunnel, 3D numerical simulation,

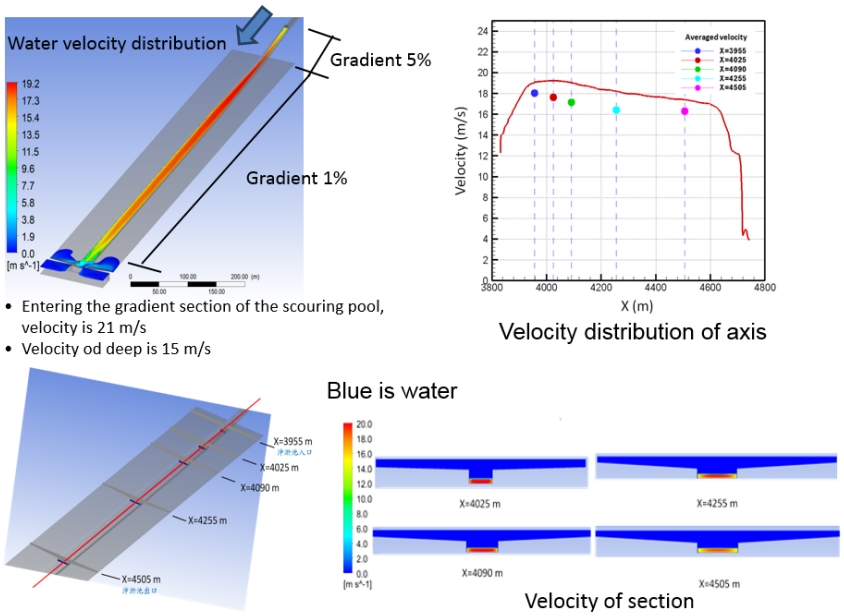

Fig. 1 Result of deep section of deep groove in scouring pool

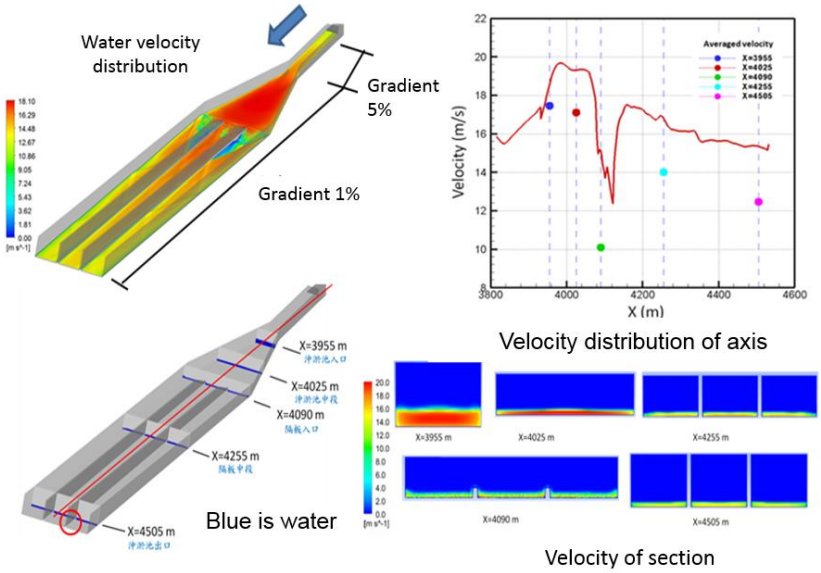

Fig. 2 Result of three-slot type case in scouring pool

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