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Study of Morning-Glory Spillway Structure in Hydraulic Characteristics by CFD Model

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Abstract : Spillways are one of the most important hydraulic structures of dams that provide the stability of the dam and downstream areas at the time of flood. Morning-Glory spillway is one of the common spillways for discharging the overflow water behind dams, these kinds of spillways are constructed in dams with small reservoirs. In this research, the hydraulic flow characteristics of a morning-glory spillways are investigated with CFD model. Two dimensional unsteady RANS equations were solved numerically using Finite Volume Method. The PISO scheme was applied for the velocity-pressure coupling. The mostly used two-equation turbulence models, k-□ and k-,□ were chosen to model Reynolds shear stress term. The power law scheme was used for discretization of momentum, k □, and □ equations. The VOF method (geometrically reconstruction algorithm) was adopted for interface simulation. The results show that the fine computational grid, the input speed condition for the flow input boundary, and the output pressure for the boundaries that are in contact with the air provide the best possible results. Also, the standard wall function is chosen for the effect of the wall function, and the turbulent model k -ε (Standard) has the most consistent results with experimental results. When the jet is getting closer to end of basin, the computational results increase with the numerical results of their differences. The lower profile of the water jet has less sensitivity to the hydraulic jet profile than the hydraulic jet profile. In the pressure test, it was also found that the results show that the numerical values of the pressure in the lower landing number differ greatly in experimental results. The characteristics of the complex flows over a Morning-Glory spillway were studied numerically using a RANS solver. Grid study showed that numerical results of a 57512-node grid had the best agreement with the experimental values. The desired downstream channel length was preferred to be 1.5 meter, and the standard k-ε turbulence model produced the best results in Morning-Glory spillway. The numerical free-surface profiles followed the theoretical equations very well.

Keywords : morning-glory spillway, CFD model, hydraulic characteristics, wall function
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