USE OF COMPUTATIONAL FLUID DYNAMICS TO STUDY THE HEAD-DISCHARGE RELATIONSHIP OF PIANO KEY WEIR AT GIRITALE RESERVOIR

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ABSTRACT

In Sri Lanka, comprehensive rehabilitation projects have been initiated to upgrade dam spillways to minimize the flood risk and to optimize the storage and the discharge. One innovative design that has demonstrated effectiveness in various countries, including France and India is the Piano Key Weir (PKW). This study focuses on Testing a Computational Fluid Dynamics (CFD) for the Giritale PKW dam located in Northern-Central Province of Sri Lanka, utilizing numerical simulations conducted in Ansys Fluent. Given that this study is the first attempt at using CFD in PKW related studies, it was a major step at introducing the use of CFD for Hydraulic related studies in Sri Lanka. Computational domain, which encompasses the PKW, is constructed using the Ansys Spaceclaim software which is included in the Ansys software package. Subsequently, two sizes of meshes are generated using Ansys Fluent Meshing. The simulations are performed to simulate the flow conditions employing a Reynolds-averaged Navier-Stokes (RANS) model in combination with k-omega and volume of fluid models. Two sizes of mesh sizes were employed to the simulations. Initially the simulations were carried out for the 0.3 m mesh size and a further refinement is employed reducing the mesh size to 0.2 m in the next set of simulations. The accuracy of the numerical results is assessed by comparing the results with the experimental rating curve, which reveals an error percentage of 12.93% for the discharge rate. It is possible that further refinement of mesh have introduced some numerical complications. A mesh quality study could be recommended to assess the quality of mesh structures, also to do further refinement of mesh to identify where the solution converges. Linear extrapolation to determine the discharge from the whole PKW structure must have contributed to this error percentage, thus modeling of this PKW structure to the whole crest length also be recommended to avoid the errors that must have caused from the linear extrapolation.