M.Sc THESIS

HYDRAULIC SIMULATION OF FLOW OVER DOMELI DAM SPILLWAY USING CFD MODEL

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ABSTRACT

Spillway is one of the important structures in dam that ensures the safe removal of flood water towards the downstream. The excessive water is transferred through spillway so that the dam can be preserved through overtopping and controls the flow. Spillway can be a part of a dam or can be provided separately depending upon the site conditions for the dam construction. Regime of flow in spillway is sub-critical at upstream and super-critical at the face. As the flow conditions are rapidly varied in the spillway so it is difficult to check the hydraulic conditions of the spillway. In spillway design, the discharge capacity should be properly investigated as it is the main reason for the failure of the dam's spillway.

Small dams are an important source of both primary and productive water for rural communities. Domeli dam is one of the small dam situated in Punjab province of Pakistan, which was designed against flood of 1185 cumecs. Unfortunately, dam's spillway was failed and its chute and stilling basin were severely damaged/washed away in 2015. In 2015 a severe flood of 1427 cumecs was reported through investigation of past flood marks. It was learnt that there was an obstruction on downstream of the stilling basin, which might have caused the backwater flow, whirlpool etc. due to which shear stresses might have gone beyond the permissible limit. Domeli Dam spillway severely damaged due to any of the following reasons: high discharge of 1427 cumecs whereas its capacity was 1185 cumecs, hydraulic shear stresses, downstream obstruction, poor energy dissipation system and cavitation problem. So, there was a need to investigate the flow parameters over the Domeli dam spillway to investigate the most likely cause of the failure.

In the present study, the flow characteristics of Domeli dam spillway were investigated using CFD modelling. The engineering drawings have been converted into 3 dimensional drawings for the preparation of geometry in the model. These 3-dimensional solid objects have been converted into stereo lithography files (.stl) which have been used as geometry files in Flow-3D model. Once the data has been incorporated, Validation of software was carried out.

Flow-3D was well validated for flow depths as the difference between simulated and observed values calculated to be 8.5%. Computational fluid dynamics model had successfully estimated the flow characteristics of Domeli dam spillway and is recommended for future similar studies. Also, the energy dissipation system was found adequate as Froude number decreased significantly over the spillway and about 70% of energy was dissipated which is efficient enough.