THESIS

NUMERICAL ANALYSIS OF CAVITATIONAL DAMAGE OF STEEP SPILLWAYS AND ITS REMEDIAL MEASURES

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ABSTRACT

Steep flowing surfaces like spillways, sluicing outlets and bottom outlets are important hydraulic structures for safety of a dam. Due to high velocities combined with low pressure cavitation may occur on the bottom surface of the chute causing major damage or even endanger the dam stability.

Spillway of Diamer Bhasha Dam designed at feasibility stage has a very steep slope (chute angle of 53.13°) with 98 m chute length. The high velocities over the chute may induce cavitation over the chute but no remedial measures for cavitation have been suggested. This study was carried out to analyze the Diamer Basha Dam spillway for cavitational risk. Data was taken from the report of the model study (Basha Diamer Dam project hydraulic model studies sectional model of spillway Technical Report June, 2005).

The flow velocities and depth along the spillway profile were available at 12 selected points in the data. To obtain these parameters throughout the spillway interpolation of the data was done. To ascertain the risk of cavitation throughout the spillway profile caviation index and Froud number were calculated. The values of flow velocity ranging from 25-30 m/sec, cavitation index ($\sigma \leq 0.2$) and froude number ($F_r \geq 6$) are the critical limits for possible occurance of cavitation damage .The calculated values of flow velocity, cavitaion index and froude number were checked against these critical values. The flow velocity, cavitation index (σ) and Froude number values become critical at invert level of 1111.79, 1110.46 and 1150.42 m asl respectively hence indicating risk of cavitation on surface of the chute. Therefore as a remedial measure an

aerator being a simple and effective method to protect spillway surface against cavitation damage is suggested in this study.

Providing an aerator on a spillway surface requires its location, type, size and need for another aerator. The first aerator location was determined at an invert level of 1113.12 m asl by marking the first critical location where the flow velocities approached 30 m/sec subject to the condition that cavitation index also lies within safe limits (> 0.2). For the above determined location of the aerator, different set of ramp/offset and ramp angle were tested against air entrainment capacity, air flow velocity and length of jet trajectory. An aerator having dimensions i.e. ramp height (t_r = 0.2 m), offset (t_o = 1.0 m) with ramp angle of 6°is recommended to avoid cavitation damage. Physical model studies should be conducted to analyze the effectiveness of the designed aerator system as recommended in this study.