ETH zürich

Chute Aerators - Air Transport and Internal Flow Features

Aerators represent the only technical measure in hydraulic engineering to protect spillways effectively against cavitation damage. Air entrained into a high-speed flow adds compressibility to the flow preventing thereby the formation of cavitation damage. Today, chute bottom aerators are a component of each larger mainly flat spillway; aerators are usually designed as deflectors with a lateral air supply.

Until today, the performance of chute aerators is described exclusively by the average entrained air discharge. Because cavitation damage appears always at the flow boundaries, the bottom air concentrations caused by chute aerators seem a more meaningful parameter. Currently, this knowledge is normally not available and further investigations are required.

Figure 1: Chute model at VAW

The objectives of the present investigation are, therefore:

- Local distribution and development of both air concentration and flow velocity in the near downstream reach of a chute aerator with particular consideration of the bottom air concentration
- Analysis of streamwise dynamic pressure distribution downstream of a chute aerator
- Description of the physical flow features responsible for air entrainment by a chute aerator, and
- Examination of air detrainment beyond a chute aerator at the jet impact area caused by the deflectors.

Chute aerators are experimentally investigated at the Laboratory of Hydraulics, Hydrology and Glaciology VAW of the Swiss Federal Institute of Technology ETH (Figure 1). To simulate typical prototype conditions, the model chute angle can be varied between 30 and 50°. A fiber-optical probe is used to measure air concentration and flow velocity. A range of Froude numbers in the approach flow are generated by a jet box.

This PhD-thesis represents both a continuation and an addition of preceding research at VAW. After examining the detrainment mechanisms in high-speed currents, the etrainment mechanisms by a deflector type chute aerator are described and quantified. This project is supported by the Swiss National Science Foundation SNF.

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