M.Sc. Thesis

OPTIMAL DESIGN OF TRASH RACK TO REDUCE HEAD LOSSES FOR SMALL HYDROPOWER PLANTS IN PAKISTAN

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ABSTRACT

Trash racks are provided at the entrance of intake of hydroelectric power plants to restrict the floating and submerged debris, which could otherwise cause damage to downstream structures and malfunctioning of electromechanical equipments. Conventional approaches are still being used for the design of trash racks in Pakistan with main focus on structural criteria while little attention to the proper evaluation of hydraulic criteria, which leads to an increase in total hydraulic head loss in low head hydropower schemes with integral intake.

Several formulas have been published in the past to anticipate this loss of hydraulic head. However, practice shows that the head losses calculated with these formulas are often by far lower than the losses that practically occur. The reason for this is the fact that the formulas simplified correlations do not take into account all the relevant loss parameters. This research aimed to derive new equation for optimal design of trash rack to reduce head losses for small hydropower plants in Pakistan.

A comprehensive literature has been reviewed in this study regarding the design and hydraulics of intake trash racks and CFD modeling. The low head hydropower facilities have been visited as well to conduct visual inspections and to collect relevant information about factors which mainly contributes to design of trash racks.

In order to derive new equation for optimal design of trash rack, sets of simulations have been performed in Flow 3D for trash rack of Nandipur Hydropower Plant. Trash rack models with different bar spacing, inclination and blockage ratio have been simulated corresponding to varying approach velocity. The results

indicated that the head loss through trash rack increases with increasing approach velocity, inclination angle of rack with channel bed, and blockage ratio. The results of head loss from Flow 3D modelling for numerous configurations have been fitted by a new equation that take into account all these influential parameters. Comparison of newly derived equation with existing equations has also been made in this study which validates the new equation for application in small hydropower plants of Pakistan.