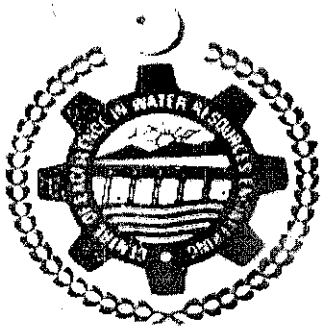
THESIS

UPGRADING DISHCARGE CAPACITIES OF OGEE CREST WITH AN ALTERNATE LABYRINTH CREST



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ABSTRACT

Spillway is provided as an integral part of the dam to pass floods of various magnitudes safely. However many dams have failed in the past because of inadequate spillway capacity. With long term global hydro meteorological changes the re-evolution of the flood frequency and flood magnitude for the existing dams are required. The dam spillway must be capable of passing extreme floods without jeopardizing the dam itself. As existing dams are scrutinized against evolving criteria, design flood flows are often enhanced requiring spillway expansion. Reservoir expansion may also require modification of spillways. These situations can require that a spillway be re-evaluated to determine performance expectations under different flow conditions.

Simly dam has gross and live storages of 47.26 Mm^3 ~ 38312 AF and 36.46 Mm^3 ~ 29562 AF respectively at NCL of 2315 ft. amsl. The design flood magnitude was based on limited data, (Q_p = 2183 m^3/s ~ 77100 cfs). The design was subsequently revised at Q_p = 2568 m^3/s ~ 90700 cfs. A main gated ogee spillway (Q_p = 1280 m^3/s ~ 45200 cfs, crest level = 2295 ft. amsl., crest length = 33.5 m ~ 110 ft) and an auxiliary ungated ogee spillway (Q_p = 1288 m^3/s ~ 45500 cfs, crest level 2317 ft. amsl., crest length = 137.2 m ~ 450 ft) are provided to pass flood water with flood surcharge of 2.45 m (~ 8 ft) and maximum water surface elevation of 2325 ft. amsl.

This study was carried out to assess the discharge capacity and surcharge requirements for a labyrinth spillway as an alternate to existing auxiliary ogee weir spillway. The performance of labyrinth weir was evaluated theoretically by a spread sheet model for the surcharge requirement to pass the PMF peak at the existing crest level (2317 ft) and crest length (450 ft) for different side leg angles of 6°, 8°, 12°, 15°, 25°, and 35°. Theoretical calculations showed that the labyrinth with side leg angle of 8° (14

labyrinth cycles) required smaller flood surcharge of 3.08 ft only than all other side leg angles. This resulted due to consequent increase in gross and net effective crest length of labyrinth weir by 5.25 and 4.5 times, respectively, of the ogee crest length. The theoretical discharge carrying capacity of ogee was also evaluated for the design flood surcharge of 8 ft.

The discharge capacity of the selected labyrinth spillway (8° side leg angle) was verified by physical model of labyrinth weir. The physical model was constructed of Plexiglas with a scale ratio of 1:35 for 2 labyrinth cycles only (model width of 560 mm) to fit within the available space and discharge limits. A physical model of ogee weir for equilent apron width (model width 560 mm) was also constructed for comparison.

It was observed that the labyrinth spillway require 2 to 2.6 times smaller surcharge than the ogee weir to pass the same discharge. On the contrary the ogee spillway requires 2.75 to 3.3 time longer crest length to pass the same discharge at the labyrinth surcharge. The discharge coefficients available in the literature for labyrinth and ogee spillway were found to be very appropriate and may be used for preliminary spillway design computations.

For Simly dam a labyrinth auxiliary spillway will require 1.525 m ≈ 5 ft. less surcharge than the ogee spillway to pass the design PMF peak. Thus for existing HFL of 2325 ft. amsl. the crest level of auxiliary spillway and reservoir NCL can be raised from 2317 ft. amsl. to 2322 ft. amsl. by adopting a labyrinth spillway in place of existing ogee spillway. This could enhance the reservoir storage potential by 3.64 Mm^3 ≈ 2949 AF; however additional modifications may be needed to the main spillway for this storage enhancement. The adequacy of a labyrinth weir having net effective crest length equal to existing ogee weir length (450 ft) [gross length 540 ft] for the ogee weir surcharge (8 ft)

was also evaluated and found that discharge capacity of labyrinth is not satisfactory due to skimming affect, and thus cannot be used.

It is recommended that labyrinth weir may be evaluated for all spillway sites along with the traditional ogee spillway option. Further that before adopting the labyrinth or ogee weir a careful physical model study must be carried out to verify the performance of the spillway weir and to evaluate the some site specific characteristics that could influence the spillway design, such as flow conditions in the approach and discharge channels, inlet losses, scour, submergence, and energy dissipation etc.