THESIS

HYDRAULIC EVALUATION OF CULVERT GEOMETRIC DESIGN FOR JANDERBAIN NULLAH

By

Muhammad Waseem
(2009-PG-WRE-05)

For the Degree of

MASTER OF SCIENCE

IN

WATER RESOURCES ENGINEERING

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING
University of Engineering & Technology, Lahore, Pakistan

2011

ABSTRACT

Culverts is a hydraulic structure used to pass flow beneath a roadway or similar structure without causing excessive backwater or overtopping of the structure as well as preventing the creation of excessive downstream velocities. Culverts are hydraulically complex structures. Sometime these are used as a temporary structure in a major project but it plays a key role in project execution/completion process. Choking of inlet of culvert, overtopping of structure, excessive backwater effect, adjacent road damage, especially in culverts have been chronic problems. The reasons are several, but the most conspicuous are excessive sediment inflow (entry) into culverts and underestimated design discharge.

The proposed research was focused on the evaluation of hydraulic performance of a culvert located at Janderbain Nullah in the vicinity of Jhelum River in Neelum Jhelum Hydroelectric project. The study was planned in four sections to meet the objectives i.e. hydrological analysis to select design discharge, evaluation of existing culvert geometric design, performing sediment analysis to evaluate the sediment loading and deposition and considering the optimum culvert hydraulic section for the selected site by using different culvert geometry/shape with varying diameter using computer model.

Hydrological analysis involve analysis of Mozaffarabad & Ghari Dopatta rainfall data and synthesizing as the selected site has no gauge station and selection of design discharge by comparison of results oriented from flood frequency analysis i.e. Log-Pearson type-III & Gumbel method and SCS Curve No. method results.

The hydraulic performance of existing culvert was evaluated by using empirical relation i.e. AASHTO method and by using computer model (HEC-RAS) for different

discharges i.e. at low flow and at high flow. The sediment analysis involved the computation of sediment loading by Acer-White method & Brownli Method and performing the Quasi Sediment analysis by using the computer model to evaluate the sediment deposition in the channel and the culvert section. At the end considering the best culvert geometric design with respect to evaluated hydraulic performance of existing culvert geometry and by performing sediment analysis& hydraulic analysis of different culvert geometry with varying diameter by using computer model.

Hydrological analysis resulted that the calculated value of peak discharges for different return period of time by different empirical methods are almost same. Gumbel's method resulted values was used to select design discharge. By carrying out the hydraulic analysis, it was resulted that the existing culvert was not enough for selected site having heavy sediment and high discharge; it was feasible up to 35cumecs.Sediment analysis carried indicates that the selected site carries heavy sediments causing considerably deposition and erosion at the selected site. The Irish bridge/culvert having 9(nine) circular or box barrels having 2.25 m diameter each or 2.25m spans & 2.25 m height respectively is more feasible up to discharge of the 50 years return period at the selected site.

By the comprehensive analysis, it was highly recommended that culvert, a small but complex hydraulic structure, should be design on proper hydrological & hydraulic analysis. For case study heaving heavy sediment load computer models HEC-RAS and HEC-6 combination and incorporation of GIS with the HY-8 should be carried out for culvert design. Bridge or suspension bridge study should be used as an alternate option.