THESIS

HYDROLOGIC AND HYDRAULIC PERFORMANCE OF SEHWAN BARRAGE

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ABSTRACT

The problem of floods and their computation is one of the main concerns of hydrologists and engineers for optimal development of water resources project design and construction of hydraulic structures such as dams, barrages, etc. For economical design of a structure that passes floodwater, the estimation of design flood and resulting its hydraulic performance is very essential, so that the design be safe.

The Sehwan Barrage is proposed on river Indus in District Dadu of Sindh province, about 120 miles d/s of Sukkar barrage and 100 miles u/s of Kotri barrage. Presently feasibility level study has been completed in June 2004. The objectives of the present study were to evaluate the hydrologic and hydraulic performance of the proposed design and specifically to perform flood frequency analysis at proposed barrage site, water surface profiles calculation and performance of energy dissipation devices.

Flood frequency analysis was done by using Gumbel EV-I, Log Pearson-Type-III and Log Normal distributions. For this computer software Dfw 1.30 was used. The main conclusions of the study are that the Gumbel EV-I distribution best fitted the observed data for flood frequency analysis as compared to other distributions.

The flood peak discharges of best fit Gumbel EV-I distribution with upper 95% confidence limit for periods of 50, 100, 200, 500 and 1000 years were 1041000, 1182000, 1263000, 1429000 and 1520000 cusecs respectively. This study calculated 100 years flood discharge is very close to design flood (1,200,000 cusecs), adopted for this project.

Computer model HEC-RAS 3.1.3 was used to calculate the water surface profiles of different discharges. The model was calibrated by using historical rating curves available in the study reach at different gauging stations. Water surface profiles calculated for design discharge and 20% concentration discharge indicated that flood protection bunds raising proposed on the u/s side of the barrage, by the consultants is (1.60 ft to 3.40 ft) on lower side than determined by this study. Note that freeboard is taken same as was calculated by consultants, in this study.

The performance of d/s energy dissipation devices was analyzed by conjugate depth method and HEC-RAS. For this the position of hydraulic jump was calculated. Analysis was done for the present and expected riverbed degraded conditions on d/s of the barrage. Ignoring d/s degradation, hydraulic jump is determined to form on d/s glacis except for very high discharge (more than 1300000 cusecs), where it goes to d/s floor. The downstream impervious floor level needs to be lowered to about 1ft. The d/s floor length is adequate for expected discharges.

The results after expected d/s degradation showed that hydraulic jump may not form on proper location but is likely to be repelled away from the downstream glacis toe, for most of the flow values except for high flows. Due to this expected worst degradation, in the weir portion of the barrage, the hydraulic jump is forming on d/s glacis and is close to the toe. For discharges less than this the hydraulic jump may move to d/s impervious floor. In the case of undersluice portion of the barrage, the hydraulic jump is forming on d/s glacis for discharges above 14,00,000 cusecs only. For discharges lower than this, the hydraulic jump may move to d/s impervious floor. Thus indicating unsafe d/s floor level and need to lowering it for proper location of hydraulic jump. The present study recommends this lowering to an EL. 84 ft a.m.s.l.

The performance of the energy dissipation devices was examined on the basis of energy dissipation efficiency (jump efficiency) and Montague's criteria (based on values of Froude no. of different flows passing over the friction blocks) was used.

Hydraulic jump efficiency is less than minimum required (30%), for most of the discharges and the flow passing over the downstream friction blocks is likely to be either critical or supercritical which allows the formation of undesirable secondary jump. So in the construction/design stage of proposed Sehwan Barrage different remedial measures may need.