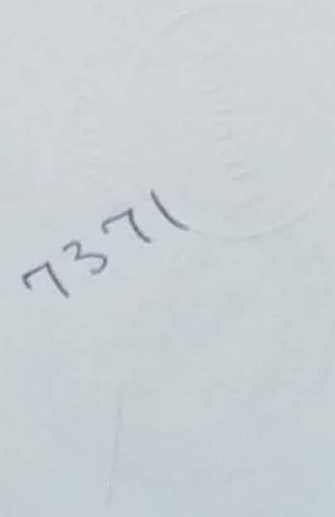


M.Sc. THESIS

POST CONSTRUCTION PERFORMANCE OF INTAKE UNDER WATER
TOE WEIGHT FOR RAISED MANGLA DAM



ADVISOR

PROF. DR. ABDUL SATTAR SHAKIR

Submitted By:

SARFRAZ KHALID
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CENTER OF EXCELLENCE IN WATER RESOURCES ENGINEERING
University of Engineering and Technology Lahore, Pakistan

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ABSTRACT

The designed gross storage capacity of Mangla reservoir was 5.88 MAF, which reduced to 4.73MAF. In order to recover the loss of gross storage capacity, WAPDA launched the feasibility study and detailed design of the Mangla Dam Raising Project in the year 2002. Mangla dam is the first dam in Pakistan which was raised during the period of 2004 to 2009 to increase its storage capacity. Toe Weight was constructed during dam construction to counter shear stresses.

The objective of study includes slope stability analysis of the upstream slope of the intake embankment to establish the usefulness of the provision of the toe weight. It also includes to investigate the performance of underwater toe weight under existing and future water levels. Slope stability analysis was carried out by using Slope-W to achieve the required factor of safety (FOS) 1.5.

Data and reports of main Mangla were collected from Mangla site office, NESPAK, MJV and WAPDA office Mangla. The input required for model was divided into different groups and sequence of input to Slope-W. The input data include coordinates for geometry of cross-section, method of analysis, soil type and properties, problem verification and solution of problem.

In order to establish the requirement of toe wright and limiting height corresponding to target safety factor, analysis was carried out for gradual increments in height. First of all pre-raising toe weight scenario was analyzed i.e. raised toe weight was taken as zero. Then analysis was carried out for increment of 20 ft upto 80 ft height of toe weight.

The increasing value of Factor of Safety with the increment in toe weight height indicated that safety of embankment has gradually increased which in turn depicts the significance of raised toe weight for the stability of U/S slope of intake embankment.

Performance of toe weight was analyzed through surveys conducted during the year 2011 and 2013. With some variations along crest of the embankment, a maximum settlement of 0.06 ft was observed in 2011 which increased to about 0.11 ft in 2013. The observed settlement for the raised embankment was very small and indicated satisfactory performance of the upstream Toe Weight.

Results of study depicted that 80 ft high toe weight is an optimized option. The small settlement for the raised dam was observed which indicates satisfactory performance of the upstream toe weight. Although limits equilibrium method provides a range of methods of stability analysis but to refine the study results, limit analysis method is recommended to be used. Slope stability of intake embankment in the presence raised toe weight is also required to be checked against reservoir level of 1250 ft and 1260 ft (maximum reservoir level).