APPLICATION OF EXPERIMENTAL OBSERVATIONS IN OPTIMISATION OF SIDE CHANNEL SPILLWAY ESTIMATIONS

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Longitudinal and cross sectional water surface profiles of a side channel spillway model are presented. The model under consideration is a scale model of the prototype of an actual side channel spillway recently constructed in Iran with non-prismatic geometry and trapezoidal cross sections. Observed longitudinal water surface profiles are compared with the one-dimensional theoretical profiles. With particular attention to the differences in the results, the shape of the channel is recognized to be the governing factor. Incorporating the implications of the shape into the dynamic equation, closer agreements of theoretical and experimental water surface profiles were achieved.

The model is comprised of different parts: standard ogee spillway, non-prismatic side channel with trapezoidal cross section (variant bottom width), transition channel after side channel (trapezoidal to rectangular with the same bottom width), straight rectangular channel and the sill at the end. Spillway model is connected to a 5 x 6 (m) reservoir and is fed by it. Experimental tests included measurement of water surface profile both in longitudinal and cross sectional directions. Eight discharges were tested covering a range of flows from very low to design discharge of spillway. The discharge per unit length of spillway were (0.16, 0.32, 0.48, 0.64, 0.80, 0.96, 1.12, 1.28 Lit/s.cm).

Measurement facilities comprised: a graded ruler that was installed on a graded rail parallel to ogee crest and a common point gauge that was installed on the graded ruler. Therefore measurements of water surface elevation along side channel at cross sections could be carried out.

Theoretical analysis of flow in side channel is very complex as is evident from observations in the present experiments. One of the most comprehensive approaches in establishing complete equations for spatially varied flow with increasing discharge is presented by Harry G. Wenzel and Ben Chi Yen (1970). They derived respective equations based on both momentum and energy approaches. Almost all of the effective parameters were taken into account in their equations; however, to provide a greater degree of accuracy and compatibility with observed results, some factors require closer examinations. A simplified approach may suffice for estimation of the water surface profiles in the case of simple practical side channel design. In a more sophisticated novel geometry as is the case with the present study, one needs to verify the theory using careful examination of the physical model results. In this study, water surface profiles were computed using both momentum and energy equations. As a result, nature and magnitude of parameters which cause the discrepancy between experimental and theoretical results were located. At the very upstream of this type of side channel, the bottom width is smaller and hence the discharge is small too. When the cross sectional flow is delivered from the ogee crest, the inherent momentum forces the flow to run up the facing wall and then flow in the downstream direction on return. The facing wall has an angle of 11 degrees with the side channel longitudinal axis. Therefore, the returned flow has a reflection angle that provides an added momentum in the longitudinal direction of flow. This component of momentum changes the slope of water surface profile. When the effect of this component is included into the dynamic equation, the values obtained from the modified format of the equation show closer agreements with the experimental values. This is presented in Fig.1.

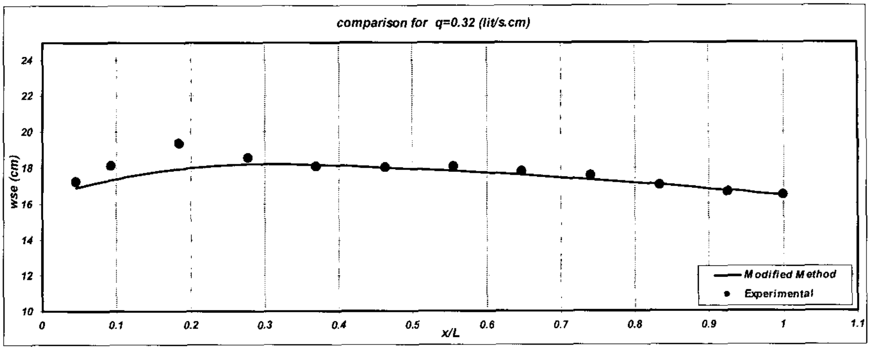

Fig. 1 Comparison of experimental and computed w.s.p. with modified equation

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