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Simplified procedure for determining of drop and stilling basin invert elevations

Ali R. Vatankhah *

Department of Irrigation and Reclamation Engineering, University College of Agriculture and Natural Resources, University of Tehran, P.O. Box 4111, Karaj 31587-77871, Iran

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Abstract Drops are used to effectively dissipate the surplus energy of the water flow. A closed conduit drop conveys water and stills it at its downstream. I-type pipe drop is one kind of the closed conduit drops which is used in irrigation networks as a typical hydraulic structure. Sump elevation is an important design parameter for I-type pipe drop. Similarly, in supercritical flow structures, such as open channel chutes, determination of stilling basin invert elevation is very important. At present, these key design parameters are determined by the momentum and energy equations using tedious trial-and-error procedure. In this study, square conduit drop, pipe drop, and rectangular stilling basin are considered, and three explicit equations have been developed by (multiple) nonlinear regression technique to determine the sump and stilling basin invert elevations. Being very simple and accurate, these equations can be easily used to design the closed conduit drops and stilling basins by hydraulic engineers.

1. Introduction

A pipe drop conveys water from a higher point to a lower one. The height of the drop is considered between 1 and about 5 m [1]. This structure dissipates the excess energy and stills the water after reaching the lower elevation. I-type and II-type pipe drops are two general types of closed conduit drops which are used in irrigation networks as typical hydraulic structures. In this research, only the I-type pipe drop is considered. The I-type pipe drop (Fig. 1) is a practical and economical drop and is used as an inline canal structure where the possibility of clogging is minimal [1]. To dissipate the excess energy from the supercritical flow in the sloped part of the structure, stilling is completed by providing a depressed section of pipe near the outlet end.

Similarly, open channel chutes are used to convey water from a higher elevation to a lower elevation (Fig. 2). In a chute, water flows down the steep slope section at a velocity greater than the critical velocity. The abrupt change in slope, forces the water into a hydraulic jump, and thus, energy is dissipated [1]. The stilling basin is usually proportioned to contain the jump. For a stilling basin to operate properly, the Froude number should be between 4.5 and 15 [1]. It is not the purpose of this study to describe in detail the components and design

* Tel.: +98 02632221119.
E-mail address: arvatan@ut.ac.ir.
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