IN THE NAME OF ALLAH

HYDRAULIC ALGORITHM OF INCLINED SIDE WEIRS IN NON-PRISMATIC CHANNELS

BY:

TOORAJ HONAR

THESIS

SUBMITTED TO THE OFFICE OF VICE-CHANCELLOR FOR GRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D.)

IN

IRRIGATION SCIENCE AND ENGINEERING

SHIRAZ UNIVERSITY

SHIRAZ, IRAN

EVALUATED AND APPROVED BY THE THESIS COMMITTEE AS: EXCELLENT

M. JAVAN, Ph.D., ASSISTANT PROF.OF IRRIGATION DEPARTMENT (CHAIRMAN)

A. R. KESHAVARZI, Ph.D., ASSISTANT PROF. OF IRRIGATION DEPARTMENT

S. A. A. MOOSAVI, Ph.D., ASSISTANT PROF. OF IRRIGATION DEPARTMENT

FEBRUARY 2002

Dedication

This thesis is dedicated to my dear mother and father and also to my wife, *Mahban*.

Acknowledgements

It is impossible to thank all persons who have co-operated during this study, but some people should be mentioned.

First, I would like to appreciate my thesis supervisor, Dr. Mahmood Javan and also other thesis committee members, Dr. Ali Reza Keshavarzi and Ali Akbar Moosavi for their encouragement, support and guidance.

Special thanks to Dr. Abedini of the Civil Engineering Department of Shiraz University for his valuable comments throughout my study.

I would like to extend my thanks to Mr. Shamsodini for his cooperation in the experimental setup.

I am also thankful to God for giving me the opportunity to study at Irrigation Department. I would also like to thank my teachers during the course of my education.

In addition, I would like to thank the head of Irrigation Department and administration of College of Agriculture for their help and support for setting up my physical model.

I am deeply indebted to my parents for their love and support. I have no words to express my feelings towards my wife for encouragement for the completion of this research.

Abstract

Hydraulic Algorithm of Inclined Side Weirs In Non-Prismatic Channels

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Tooraj Honar

Spatially varied flow has a nonuniform discharge resulting from the addition or diminution of water along the course of flow. The hydraulic behavior of a spatially varied flow is more complicated than that of a flow of constant discharge. In this study, the special type of gradually varied flow considered as decreasing discharge in the direction of the channel, is discussed. An example of this type is flow over side weir or flow over side-channel spillway.

This study first presents an overview of the literature on side weirs in both theoretical and experimental aspects. The literature review indicates that little attention was made on flow in non-prismatic channel and inclined side weirs. Therefore, the objective of this research is to investigate the effect of inclined side weir crest on overall discharge coefficient and elementary discharge coefficient along the inclined side weir in non-prismatic rectangular channel.

To investigate the effect of inclined side weir crest on discharge coefficient, an experimental study was carried out in a rectangular channel, 15 m long, 0.35 m wide and 0.45 m deep with a broad crested rectangular side weir.

In this study, three series of experiments were conducted, one in prismatic channel and two in non-prismatic rectangular channel. Also in all experiments downstream gate was used to control water depth on the vicinity of side weir. The gate was set in three positions, one open-end and two semi-closed-end. Wide range of variables were used and seven hundred tests were made.

The evaluation of thirty-two non-dimensional variables showed that the discharge coefficient is correlated to:

- The ratio of upstream and downstream bed width (b_1/b_2), side weir upstream Froude number (F_{r1}), water depth over upstream of side weir crest to side weir length ratio ($(Y_1 - P_1)/L$) and water depth over downstream side weir crest to side weir width ratio ($(Y_2 - P_2)/W$) for open-end condition.
- Upstream to downstream bed width (b_1/b_2), water depth over side weir crest to channel water depth in upstream of side weir ($(Y_1 - P_1)/Y_1$) and side weir crest slope related to channel bed (γ) for semi closed-end experiments.
- Upstream to downstream bed width (b_1/b_2), side weir upstream Froude number (F_{r1}), upstream side weir height to channel water depth on side weir upstream (P_1/Y_1) and water depth over upstream side weir crest to side weir length ratio ($(Y_1 - P_1)/L$) for all condition without considering prismatic factor and downstream control.

Finally, a model based on statistical analysis was proposed. The model can predict the discharge coefficient of side weir and in particular inclined broad crested side weir. The model was also verified by experimental data of this study and previous published data. The results showed that the absolute residual error for overall discharge coefficient model was less than 7% and for elementary discharge coefficient model was less than 6.1% for side weir discharge prediction.

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Chapter I

Introduction

1. Introduction

Side weirs have been used extensively for water level control in irrigation and drainage canal systems, as a means of diverting excess water into relief channels for flood protection works, and as storm overflows from urban sewage systems. A complete analytical solution of the equations governing the flow in side weir channels is not possible, and until quite recently, approximate methods have been used, based on experiments conducted over a limited range of the many variables involved. In many cases, the use of such approximate methods has involved substantial errors in the calculated spill discharge.

The flow over side weir in a rectangular channel has been the subject of many investigations (Engels 1920; Coleman and Smith 1923; Tyler et al. 1929; Forchheimer 1930; Frazer 1954; Allen 1957; Collinge 1957; Kumar and Pathak 1987; Ranga Raju et al. 1979). Probably the first theoretical approach to the hydraulics of flow over a side weir in a rectangular channel was reported by De Marchi (1934). Theoretical and experimental studies for a side weir in a circular channel reported in the literature include Uyumaz (1982), Uyumaz and Muslu (1985). Their experimental works and theoretical analyses have been confined to the flow over side weir in rectangular and circular channels. Only one study pertinent to side weir exists for U-shaped channels (Hager et al. 1983).

Methods of analyzing spatially varied flow in a channel with a side weir have been developed to give accurate computations for certain cases. These cases include subcritical and supercritical flow in the upstream channel and along the weir (De Marchi 1934; El-Khashab 1975; El-Khashab, and Smith 1976).