Ain Shams University
Faculty of Engineering

STUDY OF FREE FLOW CONDITIONS FOR SILL UNDER GATES

BY

Eng. Gamal Mohamed Mustafa Abdelaal

A THESIS

Submitted in Partial Fulfillment of the Requirements
for the Degree of MSc. in Civil Engineering

SUPERVISED BY

Prof. Dr. M. ELNIIAZI HAMMAD
Professor of Irrigation Design
and Vice Dean of
Faculty of Engineering
Ain Shams University

Prof. Dr. TALAAT M. OWAIS
Professor of Civil Engineering
and Dean of
Faculty of Engineering
Zagazig University

Dr. Mahmoud Abdellateef Mohamed
Associate Professor,
Irrigation and Hydraulics Department,
Faculty of Engineering,
Ain Shams University

Cairo 1990

Ain Shams University
Faculty of Engineering

STUDY OF FREE FLOW CONDITIONS FOR SILL UNDER GATES

BY

Eng. Gamal Mohamed Mustafa Abdelaal

A THESIS

Submitted in Partial Fulfillment of the Requirements
for the Degree of MSc. in Civil Engineering

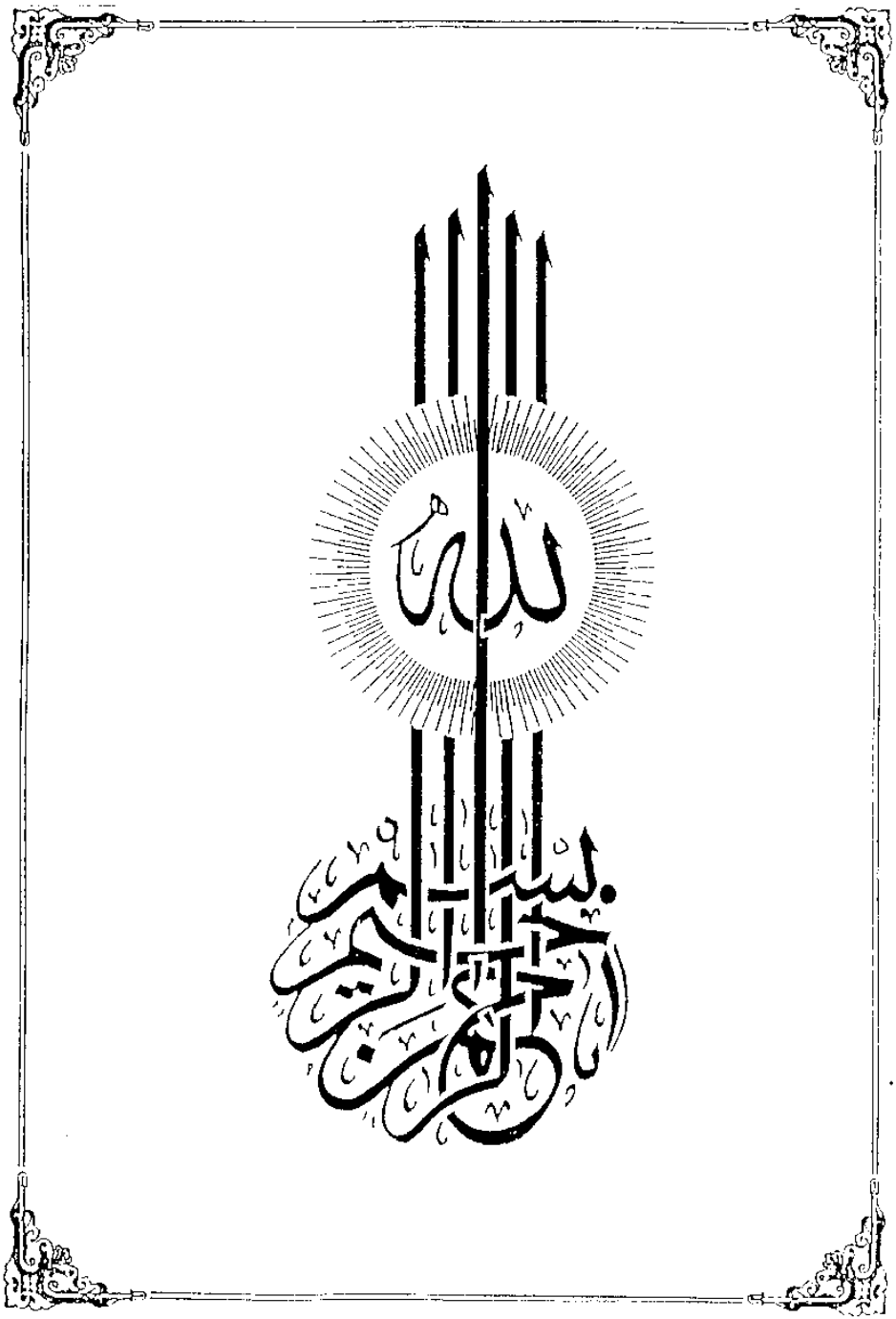
SUPERVISED BY

Prof. Dr. M. ELNIIAZI HAMMAD
Professor of Irrigation Design
and Vice Dean of
Faculty of Engineering
Ain Shams University

Prof. Dr. TALAAT M. OWAIS
Professor of Civil Engineering
and Dean of
Faculty of Engineering
Zagazig University

Dr. Mahmoud Abdellateef Mohamed
Associate Professor,
Irrigation and Hydraulics Department,
Faculty of Engineering,
Ain Shams University

Cairo 1990



بسم الله الرحمن الرحيم

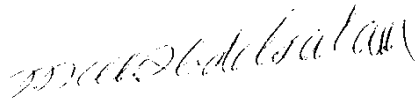
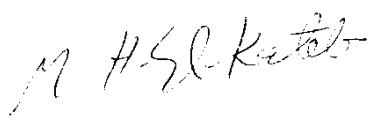
..... رَبِّ أَوْزِعْنِيٓ أَنْ أَشْكُرَ
نِعْمَتَكَ ٱلَّتِيٓ أَنْعَمْتَ عَلَيَّ وَعَلَىٰ وَٰلِدَيَّ وَأَنْ أَعْمَلَ صَٰلِحًا
تَرْضَىٰهُ وَأَصْلِحْ لِي فِي ذُرِّيَّتِيٓ ۖ إِنِّي تُبْتُ إِلَيْكَ وَإِنِّي
مِنَ ٱلْمُسْلِمِينَ ﴿١٥﴾

صدق الله العظيم
" سورة الاحقاف"

TO

MY FAMILY

EXAMINERS COMMITTEE

Name, Title & Affiliation	Signature
1. **Prof. Dr. Mohamed El-Niazi Hammad** Prof. of Irrigation Design and Hydraulics, and Vice Dean of Faculty of Engineering, Ain Shams University	
2. **Prof. Dr. Mohamed Wafaie Abdel-Salam** Prof. of Irrigation Design, Faculty of Engineering, Ain Shams University	
3. **Prof. Dr. Mohamed Hamdy El-Kateb** Prof. of Irrigation Design, Faculty of Engineering, Cairo University	
4. **Prof. Dr. Talaat Mohamed Owais** Prof. of Irrigation Design and Hydraulics, and Dean of Faculty of Engineering, Zagazig University	

STATEMENT

This Thesis is submitted to Ain Shams University for the degree of M. Sc. in Civil Engineering.

The work included in this Thesis was carried out by the author in the Department of Irrigation and Hydraulics, Ain Shams University, from October 1986 to Sep. 1990.

No part of this Thesis has been submitted for a degree or a qualification at any university or institution.

Date : 31 / 12 /1990

Signature :

Name :Gamal M. Mostafa

ACKNOWLEDGMENTS

I wish to express my deep gratitude and appreciation to **Prof. Dr. Talaat M. Owais**, Prof. of Irrigation design and Dean of Faculty of Engineering, Zagazig University, for his help, guidance, useful suggestions, and encouragement throughout this work.

Special acknowledgment to **Prof. Dr. M. El-Niazi Hammad**, Prof. of Irrigation design and Vice Dean of Faculty of Engineering, Ain Shams University. His kind supervision, comments and stimulating discussion are gratefully acknowledged and sincerely appreciated.

Special ward of thanks to **Dr. Mahmoud Abdellateef** Assoc. Prof., Irrigation and Hydraulic Dept., Faculty of Engineering, Ain shams university for his kind assistance, valuable advice and devoted time and effort throughout this work.

Special word of thanks to the staff of hydraulic laboratory, Ain Shams University.

Thanks to all my colleagues.

ABSTRACT

The objective of the present study is to investigate the effect of using under gate sill with different downstream slopes and of different heights upon the characteristics of the free hydraulic jump. In the theoretical study, the dimensional analysis was employed to relate the different factors affecting the studied phenomena. Moreover, the continuity equation and the impulse-momentum principles, were used to get expressions relating the relative depth and the other parameters. Experiments were conducted on a small rectangular channel. Models with different downstream slopes (1:1, 3:1, 5:1, 7:1 & 9:1) and of different heights (1, 2 & 3 cm) were tested using variable flow parameters.

Using the experimental data, relationships were plotted to describe the main characteristics of the free hydraulic jump. The experimental data were analyzed and the results of this analysis were presented graphically in a number of charts.

It was found that the case on nonsilled-gate gives the shortest relative length of jump. While, the best downstream slope of sill was found to be 5:1 which gives the shortest relative length of jump within the tested models.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES