

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

STUDY OF TURBULENT LAYER CHARACTERISTICS OF HYDRAULIC JUMP OVER REGULAR ROUGH BEDS IN OPEN CHANNELS

BY
ENG. Abdel-Rahim Abdel-Hamid Ibrahim
(B. Sc. Civil Engineering)

A Thesis
Submitted in Partial Fulfilment of The Requirements
For The Degree of M. Sc. in Civil Engineering

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سُبْحَانَكَ

لَا إِلَهَ إِلَّا أَنْتَ أَعْلَمُ لَنَا أَلَمًا عَلَّمْنَا أَنْتَ أَعْلَمُ الْحَكِيمُ

صَدَقَ اللَّهُ الْعَظِيمُ

سورة البقرة آية ٢٥٥

TO
MY FAMILY

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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 to Oct. 1990.

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

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ABSTRACT

The objective of the present study is to investigate the effect of using half cylinders (as strip roughness) with different radii and different intensities upon the characteristics of the free hydraulic jump. In the theoretical study, the dimensional analysis was employed to relate the different factors affecting this studied phenomenon. Moreover, the continuity equation and the impulse-momentum principle, were used to derive expressions relating the relative depth ratio, the relative length of jump and the relative energy loss to the other parameters. Experiments were conducted in a small rectangular flume. Models with different roughness heights ($r=0.4, 0.6, \text{ \& } 0.9$ cm) and different intensities (10%, 20%, 40%, 80% & 100%) were tested under various flow conditions. Another model of roughness height $r=1.1$ cm and intensities (12.5, 25, 50, & 100%) was also tested. The case of smooth bed was tested and its results were compared with other roughness cases.

Using the experimental data, relationships were plotted to describe the main characteristics of the free hydraulic jump. The experimental data was analyzed and the results of this analysis were presented graphically. Empirical Formulae for the the relative length of the jump, the relative depth and the relative energy loss were obtained using statistical analysis. The analysis of the experimental data revealed that the best roughness intensity of the half cylinders strip roughness is 100%. Also, it was found that the shortest relative jump length on a rough bed will occur when the relative roughness height equals 0.26 for Froude number less than 3.0 and equals 0.55 for Froude number larger than or equals 3.0, and the best roughness ratio (within the experimental range of this study) equals 0.82 for the experimental range of Froude number

TABLE OF CONTENTS

<u>TITLE</u>	<u>PAGE</u>
ACKNOWLEDGEMENTS	i
ABSTRACT	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF PHOTOS	xiv
NOTATIONS AND ABBREVIATIONS	xv

CHAPTER ONE INTRODUCTION

1.1 Background	1
1.2 Organization of The Thesis	2
1.3 Objectives of The Study	3

CHAPTER TWO LITERATURE REVIEW

2.1 Introduction	5
2.2 Hydraulic Jump on Smooth Horizontal Floors	5
2.3 Forced Hydraulic Jump	17
2.4 Effect of Roughness on The Hydraulic Jump	43

CHAPTER THREE THEORETICAL APPROACH

3.1 Introduction	53
3.2 Dimensional Analysis	54
3.3 The Macroscopic Approach	58

CHAPTER FOUR EXPERIMENTAL ARRANGEMENT

4.1 Introduction	69
4.2 Experimental Equip ment	69
4.2.1 The Flume	69
4.2.2 The Sluice Gate	72
4.2.3 The Tail Gate	75
4.2.4 The Measuring Carriage	75
4.3 Methods of Measuring and Instruments	77
4.3.1 Discharge Measurements	77
4.3.2 The Right Angled V-notch	78
4.3.3 Water Depth Measurements	78
4.3.4 Length Measurements	80
4.4 Tested Models	80
4.5 Test Procedure	87

CHAPTER FIVE EXPERIMENTAL RESULTS

5.1 Introduction	89
5.2 The Relative Depth	89
5.3 The Relative Jump Length	100
5.4 The Relative Energy Loss	100

CHAPTER SIX ANALYSIS AND DISCUSSION OF RESULTS

6.1 Introduction	122
6.2 The Relative Depth	122

6.3 The Relative Jump Length	130
6.4 The Relative Energy Loss	137
6.5 Optimum Roughness Intensity	145
6.6 Optimum Relative Roughness Height	153
6.7 The Best Roughness Ratio	161

CHAPTER SEVEN CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions	165
7.2 Recommendations For Future Studies	166
REFERENCES	168
APPENDIX : EXPERIMENTAL DATA	177

LIST OF TABLES

<u>TABLE No.</u>	<u>TITLE</u>	<u>PAGE</u>
4.1	Dimensions of The Tested Models	86
4.2	Selection of Roughness Intensity For $r=0.4, 0.6$ & 0.9 cm	87
4.3	Selection of Roughness Intensity For $r=1.1$ cm	87
6.1	Values of A_1 and B_1 of Eq. (6.1)	123
6.2	Values of A_2 and B_2 of Eq. (6.2)	131
6.3	Values of A_3 and B_3 of Eq. (6.3)	136
6.4	Values of A_4 and B_4 of Eq. (6.4)	154
6.5	Values of A_5 and B_5 of Eq. (6.5)	155
6.6	Values of A_6 and B_6 of Eq. (6.6)	157
7.1	Percentage Reduction in $y/y_1, L_1/y$ and Percentage increase in E_L/E_1	166

LIST OF FIGURES

<u>FIG. No.</u>	<u>TITLE</u>	<u>PAGE</u>
3.1	Definition Sketch	55
4.1	The Apparatus Used	70
4.2	Smooth Bed Case, $r=0.0$, $I=0.0\%$	81
4.3	The Experimental Model For Rough Bed, $r=0.4$, $I=100\%$	82
4.4	The Experimental Model For Rough Bed, $r=0.6$, $I=40\%$	83
4.5	The Experimental Model For Rough Bed, $r=0.9$, $I=10\%$	84
4.6	The Experimental Model For Rough Bed, $r=1.1$, $I=50\%$	85
5.1	Relation Between F_1 and y_2/y_1 For Smooth Bed	90
5.2	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.4$ cm & $I=10\%$)	90
5.3	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.4$ cm & $I=20\%$)	91
5.4	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.4$ cm & $I=40\%$)	91
5.5	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.4$ cm & $I=80\%$)	92
5.6	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.4$ cm & $I=100\%$)	92
5.7	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.6$ cm & $I=10\%$)	93
5.8	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.6$ cm & $I=20\%$)	93
5.9	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.6$ cm & $I=40\%$)	94
5.10	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.6$ cm & $I=80\%$)	94

5.11	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.6$ cm & $I=100\%$)	95
5.12	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.9$ cm & $I=10\%$)	95
5.13	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.9$ cm & $I=20\%$)	96
5.14	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.9$ cm & $I=40\%$)	96
5.15	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.9$ cm & $I=60\%$)	97
5.16	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=0.9$ cm & $I=100\%$)	97
5.17	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=1.1$ cm & $I=12.5\%$)	98
5.18	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=1.1$ cm & $I=25\%$)	98
5.19	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=1.1$ cm & $I=50\%$)	99
5.20	Relation Between F_1 and y_2/y_1 For Rough Bed ($r=1.1$ cm & $I=100\%$)	99
5.21	Relation Between F_1 and L_1/y_1 For Smooth bed	101
5.22	Relation Between F_1 and L_1/y_1 For Rough Bed ($r=0.4$ cm & $I=10\%$)	101
5.23	Relation Between F_1 and L_1/y_1 For Rough Bed ($r=0.4$ cm & $I=20\%$)	102
5.24	Relation Between F_1 and L_1/y_1 For Rough Bed ($r=0.4$ cm & $I=40\%$)	102
5.25	Relation Between F_1 and L_1/y_1 For Rough Bed ($r=0.4$ cm & $I=80\%$)	103
5.26	Relation Between F_1 and L_1/y_1 For Rough Bed ($r=0.4$ cm & $I=100\%$)	103
5.27	Relation Between F_1 and L_1/y_1 For Rough Bed ($r=0.6$ cm & $I=10\%$)	104