

**UNIVERSITI TEKNOLOGI MARA**

**EQUATION DEVELOPMENT FOR RESISTANCE  
COEFFICIENT ESTIMATION FOR SELECTED RIVERS  
IN THE HIGHLAND AREAS OF MALAYSIA**

**SUSIE NADYA ANAK DAVID ASEN**

Thesis submitted in fulfillment of the requirements  
for the degree of  
**Master of Science**

**Faculty of Civil Engineering**

**November 2010**

## Candidate's Declaration

I declare that the work of this thesis was carried out in accordance with the regulations of University Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree to subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

Name of Candidate	<u>Susie Nadya Anak David Asen</u>
Candidate's ID No.	<u>2007149169</u>
Programme	<u>Master of Science in Civil Engineering</u>
Faculty	<u>Civil Engineering</u>
Thesis Title	<u>Equation Development for Resistance Coefficient Estimation for Selected Rivers in the Highland Areas of Malaysia</u>
Signature of Candidate	<u><i>Susie Nadya</i></u>
Date	15 November 2010

## ABSTRACT

At present state-of-knowledge, the selection of roughness coefficients for natural rivers still remains chiefly-an-art and is merely done by referring to typical tabulated values listed in any hydraulic textbooks or handbook manuals alongside with photographs of rivers which the values are mostly unjustified for rivers in other areas of different conditions. Computations that are based solely on assumptions or predictions from secondary sources often result to error in hydraulic design. Despite various studies conducted to quantify the Manning's  $n$  values for various river conditions as happening in developed countries, Malaysia is still lack of such activities. Thus, the present study attempts to derive an equation to estimate the roughness coefficient for rivers specifically located in the highland areas of Malaysia because a proper understanding on rivers should start from its nearest source by ensuring that extensive field database from these rivers are made available for proper quantification of the bed roughness coefficient which would be very useful for future planning of the rivers. Comprehensive field measurements at 29 rivers located in the highland areas throughout Malaysia were conducted which involve data collection and laboratory analysis over an extended period of time. The newly collected database was used to evaluate the existing resistance equations to obtain Manning, Darcy-Weisbach and Chezy resistance coefficients. Suitability checking was carried out by comparing the results of the calculated velocity ( $V_{calc}$ ) with the measured velocity ( $V_{meas}$ ) obtained from field measurements. 30 existing resistance equations were evaluated and checked for their discrepancy ratios within range of 0.5 to 2.0, which none of the equations exceed 50% passing. Therefore, development of an equation was carried out using 77 data. The new equation;  $f = 1.309(R/d_{50})^{-1.86E-03}(RS/d_{50})^{0.048}$  presented here was developed through the Multiple Linear Regression Analysis, was found suitable to estimate the Darcy-Weisbach resistance coefficient for rivers in the highland area having water-surface slope,  $S_o(\%)$  ranging from 0.1 to 5.7 and bed material grain size ranging from 1mm to 3072mm. Suitability test was carried out again to validate the equation with 24 holdout samples which then the discrepancy ratio obtained a percentage of 58.33%.

## ACKNOWLEDGEMENT

First and foremost, praise to God for His Grace and Blessings in guiding me make my daily life's choices and help me face everyday's challenge with perseverance and strong will. No pray goes unanswered nor has He ever abandoned me in my time of needs. I would also like to express my deepest gratitude to my supervisor, Dr. Shanker Kumar Sinnakaudan for his guidance and valuable suggestions from the initial to the final level that enabled me to develop an understanding of the subject. Not forgetting also, I wish to gratefully acknowledge Professor Chih Ted Yang from the University of Colorado, USA for his advice and constructive comments given during his visit to UiTM Penang Branch.

I would also like to dedicate my heartfelt appreciation to Water Resources Engineering and Research Management Center.(WAREM), Universiti Teknologi MARA Kampus Pulau Pinang especially to my wonderful team members; Mr. Mohd. Sofiyan bin Sulaiman, Mr. Ahmad. Shahir Hayadin, Mr. Mohd. Ashraf bin Mohd. Nazri, Mr. Ahmad Khairi bin Mohd., Mdm. Ritta Mundat, Ms. Adibah Akmal Abdullah, Ms. Sharon Mujan Thomas, Mdm. Nurul Ilyani Ruslan, Ms. Siti Jamnah Siraj and to the rest who has involved directly or indirectly throughout my study. I am indebted to everyone who has given me assistance and support in any respects during the completion of my study.

It is a pleasure also to thank all my faithful friends who have always been by my side cheering and supporting me during my moments of ups and downs, especially to Ms. Nadiazan Abdul Rahim, Mdm. Laura Bundan, Ms. Marjorie Tarang, Mdm. Fauziah Nawi, Ms. Lenny Rahman, Mr. McGlen Frederick, Mr. Endy Raymond and Mr. Farid.

Lastly, I offer my sincere appreciation and blessings to my parents, family and loved ones for their constant trust, unconditional love and never-ending encouragement during my 3-year undertakings.

May God Bless All Of You.

Susie Nadya Anak David Asen  
November 2010

## TABLE OF CONTENTS

	Page
TITLE PAGE	
AUTHOR'S DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	ix
LIST OF FIGURES	xi
<b>CHAPTER 1:INTRODUCTION</b>	
1.0 Background of Research	1
1.1 Problem Statement	2
1.2 Objectives of Research	5
1.3 Study Area	5
1.4 Research Limitations	9
1.5 Thesis Structure	10
<b>CHAPTER 2:LITERATURE REVIEW</b>	
2.0 Introduction	11
2.1 Importance of Rivers and Its Challenge	11
2.2 Natural Channel	12
2.2.1 River Stages	14
2.2.2 River Equilibrium	16
2.3 Stream Classification System	17
2.3.1 Characteristics of Rivers in Highland Areas	18
2.4 Flow Resistance Relationship	22
2.4.1 Manning's Equation	23
2.4.2 Chezy's Equation	24
2.2.3 Darcy-Weisbach's Equation	25