EFFECT OF ENCROACHMENT ON FLOW CHARACTERISTICS IN A COMPOUND MEANDERING CHANNEL: AN EXPERIMENTAL STUDY

SHARMINA NASREEN

DEPARTMENT OF WATER RESOURCES ENGINEERING
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET), DHAKA – 1000

AUGUST 2013

EFFECT OF ENCROACHMENT ON FLOW CHARACTERISTICS IN A COMPOUND MEANDERING CHANNEL: AN EXPERIMENTAL STUDY

A Thesis Submitted by

Sharmina Nasreen
(0409162020 P)

In partial fulfillment of the requirements for the degree
of
Master of Science in Water Resources Engineering

Department of Water Resources Engineering
Bangladesh University of Engineering and Technology (BUET)
DHAKA - 1000

August 2013

CERTIFICATION OF APPROVAL

The thesis titled **"Effect of Encroachment on Flow Characteristics in a Compound Meandering Channel : An Experimental Study"**, submitted by Sharmina Nasreen, Roll No. 0409162020P, Session: April 2009, has been accepted as satisfactory in partial fulfillment of the requirement for the degree of **Master of Science in Water Resources Engineering** on 17th August, 2013.

_____

Dr. Md. Sabbir Mostafa Khan — **Chairman**
Professor
Department of Water Resources Engineering
BUET, Dhaka-1000, Bangladesh

_____

Dr. Md. Sabbir Mostafa Khan — **Member (Ex-Officio)**
Head
Department of WRE, BUET, Dhaka.

_____

Dr. Umme Kulsum Navera — **Member**
Professor
Department of Water Resources Engineering,
BUET, Dhaka-1000, Bangladesh

_____

Dr. Anika Yunus — **Member**
Assistant Professor
Department of Water Resources Engineering,
BUET, Dhaka-1000, Bangladesh

_____

Prof. Dr. M. R. Kabir — **Member (External)**
Pro Vice-Chancellor
University of Asia Pacific,
Block-A, House No. 49/C, Road No. 4/A
Dhanmondi R/A, Dhaka-1209.

AUGUST 2013

DECLARATION

It is hereby declared that this thesis work or any part of it has not been submitted elsewhere for the award of any degree or diploma.

Sharmina Nasreen

Signature of the Candidate

TABLE OF CONTENTS

Page No.

Page No.

Page No.

`

LIST OF FIGURES

Page No.

Page No.

Page No.

LIST OF TABLES

Page No.

LIST OF SYMBOLS

A	Area of channel cross section
a	Dimensionless property of the fluid (function of velocity)
b	Width of the main channel bottom
D	Depth ratio
d	Depth of water
g	Gravitational acceleration
H	Total water depth
h_f	Floodplain water depth
i	Cross section location number
k	Von Karman constant
P	Wetted perimeter of the channel section
R	Hydraulic radius of the channel cross section
r_m	Radius of curvature
S_r	Channel sinuosity
U*	The friction velocity
V_x	Longitudinal velocity
V_y	Transverse velocity
W	River width
z	Height above bed
z_o	Height of hydraulic roughness
α_m	Amplitude
ΔA_i	Area of the segment
θ_o	Meandering angle
ρ	Density of flowing fluid,
τ_b	Bed shear stress
α	Coriolis coefficient
β	Boussinesq coefficient

LIST OF ABBREVIATIONS

ADV	Acoustic Doppler Velocity-meter
BUET	Bangladesh University of Engineering and Technology
LF	Left Floodplain
MC	Main Channel
RF	Right Floodplain

ACKNOWLEDGEMENT

The author acknowledges her deepest gratitude to her supervisor Dr. Md. Sabbir Mostofa Khan, Professor, Department of Water Resources Engineering, BUET for providing an interesting idea for the thesis and encouraging to work with it. His cordial supervision, valuable suggestion and expertise contributed greatly to this dissertation.

The author is also grateful to the members of the examination committee Dr. Umme Kulsum Navera, Professor, Department of Water Resources Engineering, BUET, Dr. Anika Yunus, Assistant Professor, Department of Water Resources Engineering, BUET and Prof. Dr. M. R. Kabir, Pro Vice-Chancellor, University of Asia Pacific. Their valuable comments on this thesis are duly acknowledged.

Above all, the author is grateful to almighty Allah, Who has given him the opportunity to work hard.

Sharmina Nasreen
August 2013

ABSTRACT

The behavior of flow in a compound meandering channel, consisting of a deep main channel bounded by shallow floodplains, is very complex and influenced by several kinds of forces and hydraulic parameters. Encroachment of floodplains, i.e. various human settlements and related activities modifies such overbank flow processes due to the presence of different types of interventions. Hence, in addition to the classical turbulent interaction at the interface between the main channel and floodplain, the presence of an obstacle strongly disturbs the flow dynamics of the encroached compound channels. The location of encroachment, i.e., whether encroachment occurs in the bends or straight cross-over portion of a meandering channel, also affects the velocity and shear stress distribution at and near the encroached area. Moreover, the presence of encroachment in single overbank or both overbanks is likely to have a considerable effect on the variation of these hydraulic parameters. To investigate these effects, a systematic experimental study was carried out in the physical modeling facility of the Department of Water Resources Engineering, BUET. The experiment was conducted in a compound meandering channel with five different set-ups of various encroachment conditions for depth ratio of 0.285 and 0.375. A large volume of data was collected using Acoustic Doppler Velocity-meter (ADV) from ten experimental runs. Analyses of the study showed that the distribution of flow in a compound meandering channel is affected by the encroachment condition. When encroachment occurs in bend, the floodplain flow reduces significantly compared to encroachment in crossover. The non-uniform velocity distribution near the encroached area increases the value of both the energy and momentum coefficients, specially when encroachment occurs on both floodplains of a bend. For this condition the main channel velocity was found maximum. There has been no rapid change of shear stress at main channel at any conditions but shear stress increases at the location when encroachment was placed on both side of floodplain at bend and crossover. Finally, dye tracer technique was utilized to visualize the complex flow pattern for various encroachment conditions and the observations were found consistent with the experimental measurements and analyses.