ACKNOWLEDGEMENT

It is a great privilege for me in submitting my thesis in the "Tapobhoomi" of *Pt. Madan Mohan Malviya*. I am not alone in this journey to accomplish this task in the garden of "*Baba Vishwanath* and *Ma Annapurna*". Without the blessing of Lord Shiva, Ma Annapurna and my spiritual Gurus it would have not been easy to achieve this milestone of my life. Many hands held the oars during my "sail" through the troubled water that came across my way and it is my pleasure to acknowledge all such supports.

I express my sincere gratitude and indebtedness to my venerated teacher and Supervisor *Dr. S.K. Gupta* Department of Civil Engineering; Indian Institute of Technology (BHU), whose encouragement, guidance and support from initial stage to the completion of this work enabled me to develop a thorough understanding of the subject. The completion of this dissertation work would have not been possible without his noble guidance and significant contribution. It is a great honor for me to work under his extraordinary and charismatic persona. His in-depth knowledge, inspiration, energy and efforts have tremendously helped me in carrying out this research work. I cannot find words to express my gratitude for his splendid supervision. I will lifelong remain indebted to my brilliant supervisor *Dr. S.K. Gupta*.

The author expresses his sincere thanks to Prof. Vijay P. Singh (Texas A & M University) and Dr. Bert Clemens for providing the real cost data

from a Arizona (USA) canal project. The project relates to U. S. Bureau of Reclamation (USBR), therefore, gratitude is also extended to USBR.

I am also highly obliged to *Prof. Devendra Mohan*, Head, Department of Civil Engineering, Indian Institute of Technology (BHU) for allowing me to use the facilities in the department for carrying out my research work and for his kind help during the course of my study.

I shall remain thankful to the RPC members as well as to all my respected teachers *Dr. P. R. Maiti, Dr. Subir Das, Dr. Bala Ramudu Paramkusam, Prof. Prabhat Kumar Singh, Dr. Janardan Singh, Dr. B.N.Singh, Dr. Brind Kumar, Dr. Ankit Gupta, Dr. S.B. Dwivedi, and Prof. V. Singh for their continuous co-operation and valuable suggestions during my research work.*

The cooperation, moral support and constant encouragements that I have always received from my friends and juniors cannot be expressed in words and I feel lucky to be blessed with their wonderful comradeship. Some of them who deserve special thanks are: *Ms. Snigdha Singh, Mr. Shukdev Pandey, Mr. Manish kumar Upadhyay, Mr. Rohit Mittal, Mr. Satya Prakash Maurya, Ms. Kanakbandi Salini, Mr. S. Harshad Virajdar, Dr. Vijay Kumar,* and *Dr. Ashvani* (IMS,BHU) They have made my stay in BHU a memorable one as we had wonderful time together.

And last but not the least, I would like to offer my whole-hearted

indebtedness to my family. I wish to express my deep and heartiest

gratitude to my grandparent late Mr. Gyashi lal Mishra, and my aunt late

Mrs. Chandrkanti Mishra whose kind blessing were always near to my

heart. I have lack of words to express my feeling towards my parents Er.

Krishna Kumar Mishra and Mrs. Maya Mishra under whose clemency I

have safely gone through the hurdles that used to hamper my success

towards completion of the thesis. Without their support it would have been

impossible for me to complete this job. The constant encouragement and

untiring inquiries about my work progress by my elder sister Ms. Bhavana

Mishra and younger brother Er. Raunak Mishra always gave me extra

strength and moral support for doing better and better.

Date: April 24, 2015

Place: Varanasi

(Umank Mishra)

vii