TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

PULCHOWK CAMPUS

DEPARMENT OF CIVIL ENGINEERING

M.Sc. PROGRAM IN STRUCTURAL ENGINEERING

Thesis. No. SS00115

"THE EFFECT OF AMBIENT AIR TEMPERATURE ON STRIPPING TIME OF FORMWORK OF HORIZONTAL MEMBER OF HIGHSTRENGTH CONCRETE IN CONTEXT OF KATHMANDU VALLEY"

Piyush Pradhan

IOE, PULCHOWK CAMPUS

FEBRUARY 2010

TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS
DEPARMENT OF CIVIL ENGINEERING
M.Sc. PROGRAM IN STRUCTURAL ENGINEERING

Thesis No. SS00115

"THE EFFECT OF AMBIENT AIR TEMPERATURE ON STRIPPING TIME OF FORMWORK OF HORIZENTAL MEMBER OF HIGHSTRENGTH CONCRETE IN CONTEXT OF KATHMANDU VALLEY"

A Thesis
Submitted by:
Piyush Pradhan
062/MSS/r/105

In the partial fulfillment of requirements for the degree of

MASTER OF SCIENCE
IN
STRUCTURAL ENGINEERING
IOE, PULCHOWK CAMPUS
FEBRUARY 2010

CERTIFICATE

It is certified that the work contained in this thesis entitled **"The effect of ambient air temperature on stripping time of formwork horizontal member of high strength concrete in context of Kathmandu Valley"** in partial fulfillment of the requirements for the degree of Master of Science in Structural Engineering, as a record of research work, has been carried out by Mr. Piyush Pradhan (062/MSS/R/105), under my supervision and guidance in the Institute of Engineering, Pulchowk Campus, Lalitpur. The work embodied in this thesis has not submitted elsewhere for a degree.

……

(Dr. Roshan Tuladhar)
Associate Professor
Department of Civil Engineering
Institute of Engineering, T.U.
Pulchowk Campus
Lalitpur, Napel.
February, 2010

CERTIFICATE

It is certified that the work contained in this thesis entitled **"The effect of ambient air temperature on stripping time of formwork horizontal member of high strength concrete in context of Kathmandu Valley"** in partial fulfillment of the requirements for the degree of Master of Science in Structural Engineering, as a record of research work, has been carried out by Mr. Piyush Pradhan (062/MSS/R/105), under my supervision and guidance in the Institute of Engineering, Pulchowk Campus, Lalitpur. The work embodied in this thesis has not submitted elsewhere for a degree.

……

(Dr. Roshan Tuladhar)
Associate Professor
Department of Civil Engineering
Institute of Engineering, T.U.
Pulchowk Campus
Lalitpur, Napel.
February, 2010

This thesis proudly dedicate to my father and mother
Professor Dr. Panna Lal Pradhan
and
Durga Devi Pradhan.

ACKNOWLEDGEMENTS

I express my sincere thanks and gratitude to my supervisor Associate Professor Dr Roshan Tuladhar for his continuous guidance and support during the entire thesis work. Without his moral and technical support the successful completion of the work was not possible. I express my sincere gratitude to all professors of Department of Civil Engineering, particularly Professor Dr. Prem Nath Maskey, Professor Dr. Hikmat Raj Joshi, Dr. Prajwar Lal Pradhan and Professor Dr. Akkal Bahadur Sing for their valuable suggestions during the orientation as well as comment during mid-term evaluations of the work.

I express thanks to Mr. laxmi Prashad Subedi, Deepak Tiwari and Rabindra Singh of New Technical Water Proofing Service & Rehabilitation (P) Ltd. Kathmandu for providing Super plasticizer, Micro silica.

The special appreciation and great acknowledgment are presented to the excellent colleague, Er. Anup Kumar Subedi for his discussion and collaboration in the experimental work and also special thanks goes to brother Mr. Sunil and Mr. Ram Lab Staff) for his helps in the experimental work.

I express sincere gratitude to Mr. / Mrs. Anand Lal Pradhan and Mr. / Mrs. Manik Lal Pradhan for their moral support in my entire education from the beginning.

Last, but not the least, I am obliged to my beloved wife Shanti Pradhan, lovely sons Ayush and Aryan and sisters for their continuous moral support in the entire study and thesis work.

Piyush Pradhan

062/MSS/R/105

ABSTRACT

Demand of High Strength Concrete in construction of high rise building is increased, due to the stability and earthquake resistance. Especially in Kathmandu Valley the number of high rise building construction is rapidly increased. The major component of the concrete construction is also the estimation of strength of concrete and the stripping time of the formworks. Maturity method is the appropriate technique for predicting concrete strength based on which formwork removal time is identified. In this thesis present some guide line of stripping time of formwork of concrete, which are identified by the experiment on the lab and the maturity method concept.

The experiment was carried with the Ordinary Portland Cement of 53 grade. Fine Aggregate and Coarse Aggregate collected from Belkhu and Mahadev Besi. powerflow 2239 Plastisizer and micro silica were used for prepared concrete mix grade M40 and M60. The maximum size of the coarse aggregates was 12.5 mm. The concrete mix design was adopted as trial and error method. The concrete mixed proportion for M40 concrete was 0.4: 1: 1.65: 2.92 (W: C: FA: CA) and Admixture (MC-powerflow 2239) 1.2% by weight of cement and micro silica 4% by weight of cement. The concrete mixed proportion for M60 concrete was 0.29: 1: 1.35: 2.19 (W: C: FA: CA) and Admixture (MC-powerflow 2239) 2% by weight of cement and micro silica 4% by weight of cement. The compression test carried out at different age (days) of concrete from 1, 2, 3, 4, 7, 14, 21, and 28 days curing at temperature range of 5^{o}C -10 ^{o}C, 10 ^{o}C -15 ^{o}C, 15 ^{o}C - 20 ^{o}C, 20 ^{o}C -25 ^{o}C, 25 ^{o}C -30 ^{o}C, and 30 ^{o}C - 35 ^{o}C. All the experiment was conducted in IOE lab.

Stripping time of the concrete grade M40 and M60 was identified on the basis of various literatures and the experiment. On the basis of previous experiment and literatures it has

been assumed that 70% of design strength of concrete is reasonable to remove the form work especially from the bottom of the slab and beam. This concept has been used to identify maturity of the concrete at deferent temperatures from 5 ^{o}C to 35 ^{o}C in Kathmandu valley. It has been obtained from the experimental that the stripping time of concrete grade M40 for slab varies from 1.72 days to 31.09 days depending open the ambient temperature From 40 ^{o}C to 0 ^{o}C and for M40 concrete varies from 1.67 days to 30.17 days. Similarly stripping time of concrete grade M40 for beam varies from 3.44days to 62.18 days depending open the ambient temperature From 40 ^{o}C to 0 ^{o}C and for M60 concrete varies from 3.34 days to 60.34 days. It was also observed that stripping time of M40 and M60 concrete is 2 to 14 days earlier than the M20 concrete.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF ABBREVIATIONS AND SYMBOLS

^{O} C = Degree Celsius.

M = Maturity at age t^{o} C- days.

T = Average concrete temperature ^{o} C, during the time interval Δt.

T_o = Datum temperature.

T = Elapsed temperature.

Δt = Time interval days.

t_e = The equivalent age at the reference temperature.

T_r = The reference temperature 23^{o} C.

E = Apparent activation energy, J/ mol.

R = Universal gas constent, 8.3144 J/ mol-K

S = Strength at age t.

S_∞ = Limiting strength.

α = Age conversion factor.

K_r = Rate constant, 1/day.

t_o = Age at start of strength development.

M40, M60 = Grade of concrete, M denote the mix design and 40 denotes the grade of concrete.

M40.5.10 = Mix design of concrete 40 MPa at temperature range 5^{o} C to 10^{o} C.

NSC = Normal strength concrete.

HSC = High strength concrete.

MPa = Mega pascal, N/mm^2.

OPC = Ordinary Portland cement.

W/C = Water/ cement ratio.