EVALUATION OF PUMPABILITY OF CONCRETE

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Degree of Master of Science

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where acknowledgement is made in the text.

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The above candidate has carried out research for the Masters under my supervision.

Name of the supervisor: Prof. S. M. A. Nanayakkara

Signature of the Supervisor: Date:

DEDICATION

To my beloved parents, my loving husband and family for their overwhelming support and courage extended to me throughout this research project

And

To Prof. S. M. A. Nanayakkara, Dr. (Mrs.) M. T. P. Hettiarchchi and all of my dear teachers, who are the reasons behind my every successful step

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Evaluation of Pumpability of Concrete

ABSTRACT

Current guidelines and practices at construction sites on concrete pumping has not been based on theoretical understanding of pipe flow of fresh concrete. In fact, only the slump value is monitored at construction sites, even-though any single point test is insufficient to represent flow curve properties of fresh concrete.

Based on flow curves of concrete and basic rheological properties, a theoretical model for horizontal straight flow has been developed and validated in previous studies. Yet, properties of concrete flow at horizontal and vertical bends, tapered sections and vertical lengths had to be investigated. In this research study, experimental investigations were carried out at two high rise building construction sites which included monitoring rheology of fresh concrete with ICAR plus concrete rheometer and pressure at some points of the concrete pumping pipe line with a pressure transducer and several strain gauges. In the horizontal straight section, theoretical pressure drop based on sheared plus plug flow condition could reasonably estimate the actual pressure drop with a 20% margin. Pressure drop at a horizontal bend was in between 0.5 to 1.7 bar while in a vertical bend it was around 6 bar. Pressure drop in the vertical straight length was equal to the pressure needed to overcome the self-weight only. Hence, concrete pumping pressure could be estimated within 20% margin.

Moreover, understanding on the influence of mix design parameters on concrete rheology is much useful for deciding the mix proportions of concrete at the mix design stage. A series of laboratory experiments were conducted at paste and mortar phases of concrete. Correct admixture concentration, increase of w/c ratio, decrease of fine aggregate volume concentration and round shape fine aggregates over angular shape found to be improving the rheological properties and hence the pumpability of concrete.

Key words: fresh concrete rheology, concrete pumping, concrete pipe flow

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LIST OF ABBREVIATIONS

ACI	-	*American Concrete Institute*
JSCE	-	*Japan Society of Civil Engineers*
rpm	-	*revolutions per minute*
SYS	-	*Static Yield Stress*
DYS	-	*Dynamic Yield Stress*
PV	-	*Plastic Viscosity*
CA	-	*Coarse Aggregate*
FA	-	*Fine Aggregate*
w/c	-	*Water to Cement ratio by weight*
CCC	-	*Colombo City Centre*
OPC	-	*Ordinary Portland Cement*
PCE	-	*Poly Carboxylic Ether*
PLC	-	*Portland Limestone Cement*
MS	-	*Manufactures Sand*