EVALUATION OF RISK OF PLASTIC SHRINKAGE CRACKING IN CONCRETE

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Degree of Master of Science

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Thesis submitted in partial fulfilment of the requirements for the degree Master of Science

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DECLARATION

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Prof. S.M.A. Nanayakkara

ABSTRACT

Plastic shrinkage cracking is a common phenomenon associated with concreting in hot and windy weather. Excess evaporation of bleed water causes loss of water from the concrete surface and plastic shrinkage occurs due to that at very early age i.e. within first 4-6 hours. Tensile strain will be developed as a result of this shrinkage and cracking will occur when it exceeds the tensile strain capacity of concrete

The measurement of tensile strain capacity of fresh concrete is important to predict the risk of plastic shrinkage cracking. Data on strain capacities at the very early age i.e during first few hours is hard to determine as concrete is still in fresh state. The report contains the procedure adopted to develop a simple test method to measure the local strain along a sample of fresh concrete. The influence of cement type, fine aggregate type and mortar phase for the strain capacity was studied. Results indicate that the addition of fly ash and manufactured sand has increased the tensile strain capacities.

In order to evaluate the risk of plastic shrinkage cracking it is necessary to develop a model to simulate strain development in fresh concrete due to plastic shrinkage. First, key factors affecting shrinkage, bleeding and evaporation, were modeled and the starting time of drying was identified. Subsequent loss of water was calculated and incorporated in a finite element model to simulate the tensile strain development. Calculated strains were very similar to the measured strains and therefore the model can be used to predict the development of early age tensile strain due to plastic shrinkage.

Tensile strain capacities determined from the test and the modeled strain development were compared to evaluate the risk of plastic shrinkage cracking in concrete with OPC and fly ash. Although there was an increase in strain capacity of concrete with fly ash blended cement, model predicted that the risk of cracking was higher in concrete with fly ash blended cement as there was a significant increase in strain developed as a result of drying. Further experimental studies are needed to prove the prediction and also to find the influence of other factors (PLC and admixtures) to plastic shrinkage cracking in concrete.

Key words: plastic shrinkage cracking, tensile strain capacity, strain development model, finite element modeling

ACKNOWLEDGEMENT

I wish to thank University of Moratuwa and Department of Civil Engineering for providing me the opportunity to carry out this research. My sincere gratitude goes to Prof. S.M.A Nanayakkara for his guidance and support extended for the success of the research. I want to give special gratitude to all the staff members and lab assistants of department of civil engineering, University of Moratuwa for the help given by all means. And thanks to my colleagues for being so supportive in experiments. Finally I would like to thank Holcim (lanka) PLC for providing the necessary funding for the research.

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