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LONG TERM PERFORMANCE OF PORTLAND LIMESTONE CEMENT CONCRETE

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Thesis
Submitted in partial fulfillment of therequirements of the degree of
MASTER OF SCIENCE
in
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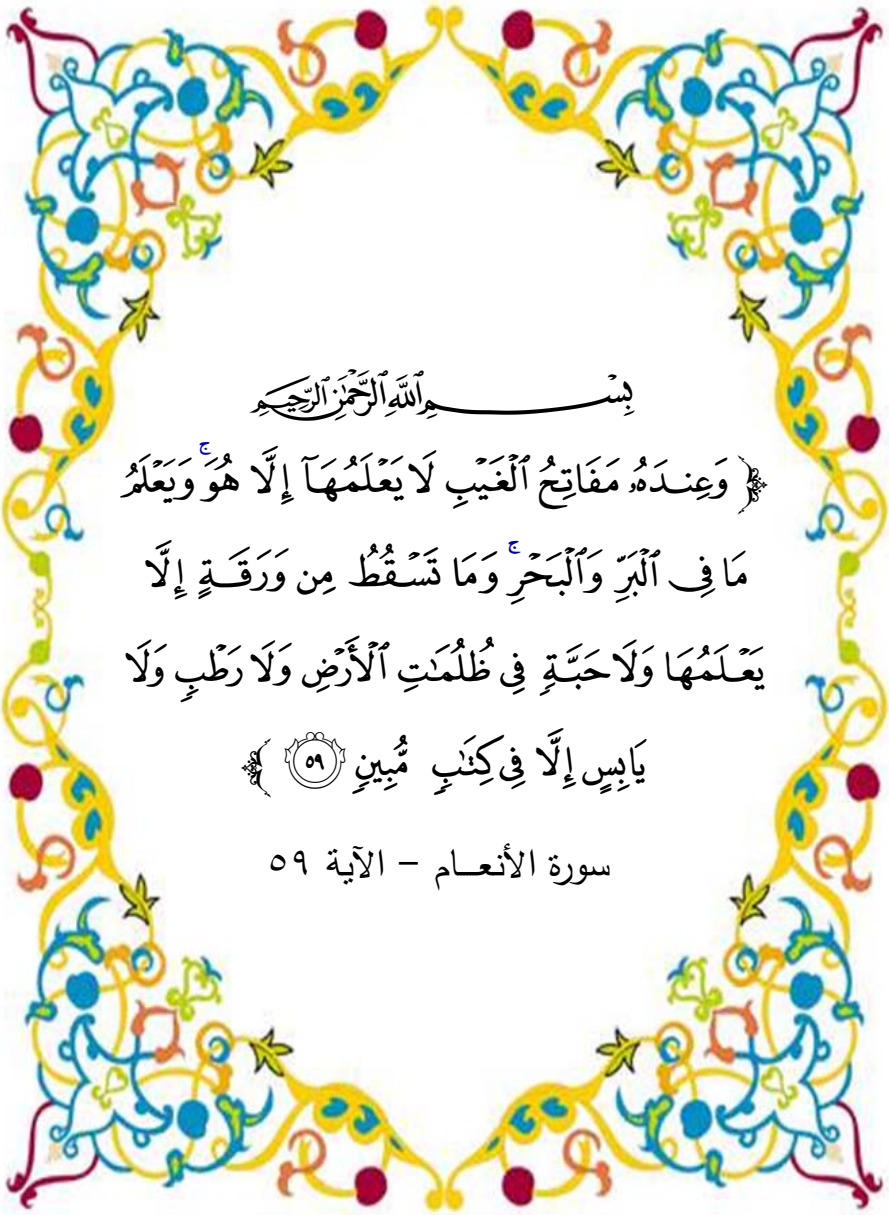

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

﴿ وَعِندَهُۥ مَفَاتِحُ ٱلْغَيْبِ لَا يَعْلَمُهَآ إِلَّا هُوَ ۚ وَيَعْلَمُ
مَا فِى ٱلْبَرِّ وَٱلْبَحْرِ ۚ وَمَا تَسْقُطُ مِن وَرَقَةٍ إِلَّا
يَعْلَمُهَا وَلَا حَبَّةٍ فِى ظُلُمَٰتِ ٱلْأَرْضِ وَلَا رَطْبٍ وَلَا
يَابِسٍ إِلَّا فِى كِتَٰبٍ مُّبِينٍ ﴿٥٩﴾ ﴾

سورة الأنعـام – الآية ٥٩

STATEMENT

This thesis is submitted to Ain Shams University, Cairo, Egypt, in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering.

The work included in this thesis was carried out by the author at properties and testing of Materials lab of the faculty of engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or qualification at any other university or institute.

Date : / / 2011

Name : Jehan Mahmoud Ali Elsamni

Signature : *Jehan Elsamni*

To my father,
You are always remembered and greatly missed

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Abstract of M.Sc. Thesis submitted by: Jehan Mahmoud Ali Elsamni

Title: "**LONG TERM PERFORMANCE OF PORTLAND LIMESTONE CEMENT CONCRETE "**

Supervisors:
1. Prof .Dr . Salah A. Abo-El- Enein
2. Dr . Ahmed Fathy Abdel-Aziz
3. Dr . Hany Mohamed Elshafie

ABSTRACT

New edition of the Egyptian Standard Specifications 4756-1/2005, for different types of cement has been issued recently following the European Specification EN 197-1/2004 for common cements. These specifications contain different categories of cements including Portland blended cements (Designated by CEM II) which compose mainly of Ordinary Portland Cement (OPC) with a percentage varies from 65 to 94 % and pozzolanic materials or inert fillers with a percentage varies from 6 to 35%. One of the popular types of the Portland blended cement is Portland Limestone Cement (PLC) where Ordinary Portland Cement is

blended with finely grounded limestone which is considered as chemically inert filler. Blending of limestone powder with OPC has beneficial effect on reducing the amount of energy needed for manufacturing the cement and consequently reducing the cement cost and producing more environmental friendly cement. The limestone powder is inert and does not add to the cement strength, however, owing to its physical properties, it has some advantages on the concrete properties including workability, capillarity, bleeding, and cracking tendency. Compared to OPC concrete, the PLC concrete may have comparable short term strength, but its strength development with time under different exposure conditions and long term performance need to be addressed.

Based on the new specifications, many of the local cement manufacturers have been producing PLC. Properties of these types of cement depend on the manufacturing method and composition of limestone which changes from one location to another. As a new type of cement in the local market, it has not to be used in producing concrete before evaluating the long term performance of the concrete. Therefore, this research has been initiated to study the long term performance and high temperature resistance of the concrete produced by Portland limestone cement. The main variables to be covered in the current study include cement and limestone contents and exposure conditions. The long term characteristics of the concrete to be considered are strength development under different exposure conditions, resistance to sulfate attack and reinforcing steel corrosion, and high temperature resistance.

From the analysis and discussion of the test results obtained in the current research, it is concluded that for the same cement content and water/cement ratio the compressive strength for PLC concrete is less than that of OPC concrete and the reduction in compressive strength is proportional to the limestone content. However, to attain comparable compressive strength with OPC concrete, PLC concrete should contain higher cement content and lower water/cement ratio. It is concluded that if the compressive strengths of both PLC and OPC concretes are comparable, PLC concrete is as good as OPC in both short and long term characteristics. On the other hand, compared to OPC concrete, PLC concrete has lower drying shrinkage and comparable high temperature resistance. Therefore, it is concluded that PLC can be used in producing plain and reinforced concrete provided that the cement content and water/ cement ratio are modified to achieve the specified compressive strength.

Keywords : Compressive Strength, Corrosion Resistance, Drying Shrinkage, Pozzolanic materials, Durability, Long Term Performance, Fly Ash, Silica Fume, Ordinary Portland Cement (OPC), Portland Limestone Cement (PLC), Sulfate Attack and Fire Resistance.

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