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Faculty of Engineering
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Properties of Concrete Incorporating Locally Produced Portland Limestone Cement

A Thesis

Submitted in Partial Fulfillment for the Requirements
of the Degree of Master of Science
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STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in civil engineering (Structural Engineering).

The work included in this thesis has been carried out by the author at properties and testing of material lab, the Department of Structural Engineering, Ain Shams University.

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

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ABSTRACT

The use of limestone as a component of Portland cement is now common practice worldwide. Reducing the amount of cement clinker with limestone additions is considered a highly efficient way of saving natural resources, saving energy and lowering the carbon dioxide footprint of the cement and concrete industries on the environment.

Many specifications permit the use of limestone additions in the cement. The Egyptian Standard Specifications E.S. 4756-1 (2007) and the European Standard EN 197-1 (2000) identify two types of Portland limestone cement containing 6-20% limestone (CEM II/A-L) and 21-35% limestone (CEM II/B-L). Nevertheless, the Egyptian Standards prohibit the use of limestone cement in structural concrete. Thus the aim of this research is to evaluate the properties of the limestone cement concrete compared to those of ordinary concrete. To achieve this goal a review of previous studies and an experimental investigation were carried out and were illustrated in details throughout the different chapters of this thesis.

The literature review included the previous investigations and researches on the subjects concerning the environmental benefits of using limestone cements, Portland limestone cement constituents, the manufacture of limestone cement, the properties of limestone cement and the properties of concrete using limestone additions.

The experimental study compared between twelve concrete mixtures using four types of Portland cement, CEM I 42.5N, CEM II/A-L, CEM I 32.5, and CEM II/B-L with cement contents 300, 350 and 400 kg/m³. Tests were performed to evaluate the fresh properties (workability, setting time,

and heat of hydration), hardened properties (compressive, tensile, flexural and bond strengths), and durability properties (permeability, sulphate resistance, and abrasion resistance). Also a limited microstructural investigation was performed on the concrete.

This investigation concluded that concrete made with CEM II (A-L) accomplished competitive results with OPC concrete. Furthermore, all Portland limestone cement concretes achieved lower water permeability compared to ordinary Portland cement concretes.

Keywords: Ordinary Portland cement (OPC), Portland limestone cement(PLC), water permeability, sulphate resistance, rapid chloride penetration.

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