
# Development of Mix Design Guidelines for Concrete Produced Using Portland Cement Types Manufactured According to New Egyptian Standard Specifications

A Thesis
Submitted to the Faculty of Engineering
Ain Shams University for the partial Fulfillment
of the Requirement of M.Sc. Degree
In Civil Engineering

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B.Sc. in Civil Engineering, June 2010
Higher Institute of Engineering – El Shorouk Academy

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**(STRUCTURE ENGINEERING)**

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## THESIS APPROVAL

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**Date: 5/1/2016**

## STATEMENT

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the department of Structure Engineering, Faculty of Engineering, Ain Shams University, from 2013 to 2016.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

Date: - 5/1 / 2016

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## ABSTRACT

Manufacturing of one ton of the Ordinary Portland Cement clinker (OPC) generates 900 kg of $CO_2$. The total volume of cement production per year is approximately 5% of global anthropogenic $CO_2$ production [15]. One of the alternatives to lower $CO_2$ emission is to use blended cement.

The main objective of the current study is to develop guidelines that can be used for designing concrete mixtures incorporating locally produced new cement types manufactured according to the new Egyptian standard specifications for cement and locally available aggregates typically used in producing concrete.

In the current study, 156 different concrete mixes were developed, designed, and carried out experimentally in order to develop design guidelines for the concrete mixtures having cements with different types (Ordinary Portland Cement (CEM I) and blended cement with different additions of limestone and slag (CEM II)), different classes regarding the compressive strength (52.5, 42.5, 32.5), different rates of strength gain (Normal (N) and Rapid (R)), and different production factories (sources), having coarse aggregates with different types typically used (gravel and crushed dolomite) and different maximum sizes (10, 20, and 40 mm), and having fine aggregate (sand) with different gradation zones (fine and coarse). In order to establish a water cement ratio - compressive strength relationships, the concrete mixes considered in the current study were divided into groups, each has the same concrete materials with different water cement ratios and the concrete compressive strength was evaluated by testing standard cubes in compression at ages of 3, 7, 28, 56, and 91 days where a total of 2340 standard cubes were tested. In all mixes, the water content needed to achieve the desired

consistency (measured by slump test) was estimated following the guidelines given in the British Standard for concrete mix design.

One of the main outputs of the current study was establishing the water cement ratio – compressive strength relationships for concrete mixtures having different types of locally available concrete materials including new cement types and aggregates typically used in concrete. Moreover, it was verified that estimate of the water content needed to achieve the desired consistency for fresh concrete following the guidelines given in the British Standard for concrete mix design can be followed for concrete mixtures incorporating locally available cements and aggregates. Accordingly, design guidelines for the concrete mixtures; incorporating locally available concrete materials including new cement types and typically used aggregated; were successfully developed.

**Keywords**: cement, concrete, compressive strength, workability, mix design concrete.

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**Mohamed Ali Nower**

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