STRUCTURAL BEHAVIOR OF SELF-CURED LIGHTWEIGHT CONCRETE COLUMNS BEFORE AND AFTER EXPOSURE TO ELEVATED TEMPERATURE

By

Eng. Mohamed Ahmed Hassan Ahmed

**A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Structural Engineering**

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Dedications

This thesis is dedicated to my parents, brother, sister, wife and my daughters

For their endless love, caring, support and encouragement

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ABSTRACT

Structural lightweight concrete is an “important in modern construction. This concrete offers technical, environmental benefits, so it’s designed to become material in the millennium. For structural applications of lightweight concrete, the density is often more important than the strength”. A decreased density for the same strength level reduces the self-weight, “foundation size and construction costs. In addition, further benefits such as heat and sound isolation could be gained by using lightweight concrete instead of normal weight concrete. Special type “self-cured lightweight concrete” has been produced to use the voids in lightweight aggregate” water reservoirs for providing water needed for curing.

Experimental work was carried out to study the structural behavior of self-cured lightweight concrete columns before and after exposure to elevated temperatures. The experimental investigation was conducted on twenty-four reinforced concrete columns that were prepared and tested. From each mix, one column was tested at room temperature and two columns were exposed to elevated temperature, as for the cubes it was conducted on ninety-six concrete cubes were prepared and tested at room temperature and after exposure to elevated temperature.

The test variables considered were: concrete type (normal weight concrete and lightweight concrete), cement content (350, 400 and 450 kg/m^3), temperature degree (400 and 600 $^{\circ}$C) and exposure duration to elevated temperature (1 and 2 hours)

CHAPTER (1)
INTRODUCTION

1.1 General

Sometimes the need to reduce the weight of a structural element has not less importance than increasing its strength, especially in heavy structures such as tall buildings and bridges where the own weight of the structure is one of the main problems that faces the designers. Another important demand in concrete structures is to get monolithic fair-faced concrete, which does not only possess high visual qualities. Monolithic concrete structures are also particularly durable, and the fact that no plastering or cladding is required leads to cost savings and makes buildings more sustainable and easier to recycle. However, due to the high thermal conductivity of normal concrete, fair-faced concrete without insulation causes prohibitive air conditioning costs in cold and warm countries like Germany and Egypt respectively.

Today, Lightweight Aggregates (LWA) is available in a wide range of densities, strengths, and sizes. This makes it possible to design Lightweight Concrete (LWC) with a very wide spectrum, a concrete of very low density for insulation and, at the same time, a high strength lightweight concrete for structural purposes.

Structural lightweight aggregate concrete is need in many and varied applications including multistory building frames and floors, bridges, offshore oil platforms, and prestressed or precast elements of all types. Many architects, engineers, and contractors recognize the inherent economies and advantages offered by this material, as evidenced by the many impressive lightweight concrete structures found today throughout the world. Structural lightweight concrete offers design flexibility and substantial cost savings by providing: less dead load, improved seismic structural response, longer spans, better fire ratings, thinner sections, smaller size structural members, less reinforcing steel and lower foundation costs. Lightweight concrete precast elements offer reduced transportation and placement costs.

Lightweight Concrete is used instead of the normal weight concrete because it needs more water and also lightweight aggregate is better in water absorption than normal aggregates due to its inner voids.

Therefore, this thesis shows the activities, progress and performance of lightweight concrete such as compressive strength tests and also studying the structural behavior of self-cured lightweight concrete columns before and after exposure to elevated temperature and compare it with normal weight concrete at the same variables.

1.2 Thesis outline

This thesis is divided into five chapters as follows:

Chapter (1): The introduction.

Chapter (2): Literature review, in which a presentation of previous studies and research works, about the definition, types, composition and application of lightweight concrete as well as the mechanical properties of lightweight concrete.

Chapter (3): Experimental program, in which a general outline of the experimental work is presented and the properties of the used materials and conducted tests are also presented.

Chapter (4): Test results and discussions

Chapter (5): Conclusions and recommendations.