STRUCTURAL BEHAVIOR OF BEAMS COMBINING ULTRA HIGH STRENGTH CONCRETE AND NORMAL STRENGTH CONCRETE

By

Ahmed Mohamed ISMAIL

A Thesis Submitted to the

Faculty of Engineering at Cairo University

in partial fulfillment of the

Requirements for the degree of

DOCTOR OF PHILOSOPHY

In

STRUCTURAL ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

2018

STRUCTURAL BEHAVIOR OF BEAMS COMBINING ULTRA HIGH STRENGTH CONCRETE AND NORMAL STRENGTH CONCRETE

By

AHMED MOHAMED ISMAIL ABU GAHIN

A Thesis Submitted to the

Faculty of Engineering at Cairo University

in partial fulfillment of the

Requirements for the degree of

DOCTOR OF PHILOSOPHY

In

STRUCTURAL ENGINEERING

Under the supervision of

Prof. Dr. Ahmed Mahmoud Ragab
Professor

Structural Engineering Dept.

Faculty of Engineering

Cairo University

Prof .Dr. Mohamed Mohsen El Attar

Professor

Structural Engineering Dept.

Faculty of Engineering

Cairo University

Prof.Dr.Hosam Zakaria El-Karmoty

Professor

Building Materials Research and Quality Control Institute

Housing & Building National Research Center

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

2018

STRUCTURAL BEHAVIOR OF BEAMS COMBINING ULTRA HIGH STRENGTH CONCRETE AND NORMAL STRENGTH CONCRETE

By

AHMED MOHAMED ISMAIL ABU GAHIN

A Thesis Submitted to the

Faculty of Engineering at Cairo University

In partial fulfillment of the

Requirements for the degree of

DOCTOR OF PHILOSOPHY

In

STRUCTURAL ENGINEERING

Approved by the
Examining Committee

Prof. Dr. Ahmed Mahmoud Ragab A. Ragab

Prof. Dr. Mohamed Mohsen El-Attar M. El-Attar

Prof. Dr. Hosam Zakaria El-Karmoty
Professor in Housing & Building National Research Center Dr. Hosam

Prof. Dr. Mohamed Ismail Abd El-Aziz Serag

Prof. Dr. Hadad Saeed Hadad
Professor in Housing & Building National Research Center Hadad Saeed Hadad

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

2018

Engineer: **Ahmed Mohamed Ismail Abu Gahin**
Date of Birth: **21 / 4 / 1979**
Nationality : **Egyptian**
E-mail : **ah_gaheen79@yahoo.com**
Phone. : **01097620585 - 0225502938**
Address : **15 may city region 9 sector d**
Registration Date: **1 / 3 / 2011**
Awarding Date: **/ / 2018**
Degree : **Doctor of Philosophy**
Department: **Structural Engineering**

Supervisors: Prof. Dr. Ahmed Mahmoud Ragab
Prof. Dr. Mohamed Mohsen El-Attar
Prof. Dr. Hosam Zakaria El-Karmouty (Professor in Housing & Building National Research Center)

Examiners:
- **Prof. Dr Hadad Saeed Hadad** (Professor in Housing & Building National Research Center) — External Examiner
- **Prof. Dr Mohamed Ismail Abd El-Aziz Serag** — Internal Examiner
- **Prof. Dr. Ahmed Mahmoud Ragab** — Thesis Main Advisor
- **Prof. Dr. Mohamed Mohsen El-Attar** — Advisor
- **Prof. Dr. Hosam Zakaria El-Karmouty** (Professor in Housing & Building National Research Center) — Advisor

Title of Thesis: " Structural Behavior Of Beams Combining Ultra High Strength Concrete And Normal Strength Concrete **"**

Key Words: Ultra High Strength Concrete, Composite Sections, Static Loads, Beams

This thesis present a study on the structural behavior of UHSC, NSC and composite beams using (UHSC) and (NSC) with the effect of different parameters under the static loads effect. This study aims mainly to reach the optimum thickness of UHSC layer in composite beams. This experimental program consists of ten reinforced concrete beams, with different parameters, which were longitudinal reinforcement ratio, type of used concrete and the thickness of UHSC layer. In addition, this research presents analytical models for beams that have been practically tested. Then the results were discussed and analyzed with a comparison between the experimental and the theoretical results.

DEDICATION

To My Dear great Father to whom I owe too much For his encouraging & to whom I will always miss him in all my life moments.

To My Dear Mother, to whom I owe and love too much, for her personal support.
God save her & gives her good Health.

To My Dear wife for her patience and support.

To My Sweety Kids YASMINE & YOUSSOF

ACKNOWLEDGEMENTS

First of all, all my gratitude to **GOD** who guided and aided me in completing this thesis.

I wish to express my great appreciation to Prof.Dr. Mohamed Mohsen El-Attar, Professor, Structural Engineering department, Faculty of Engineering, Cairo University for his Kindly support, supervision, helpful guidance, and valuable advice during execution my work in this thesis .

I also like to express my deep indebtedness and great appreciation to Prof.Dr. Hosam Zakaria EL-Karmouty, Professor, in the Building Materials Research and Quality Control Institute Housing & Building National Research Center for his generous guidance and encouraging, sincere help, consistent support by all means and asking, valuable suggestion, and precise advice through all stage of my work .

I want to express my great appreciation to Dr.Fatima Al-Zahraa in the Building Materials Research and Quality Control Institute Housing & Building National Research Center for her continuous help , support and encouraging by all meanings until finishing successfully my PHD thesis. Finally, I kindly wish to offer also my gratitude and sincere thanks to Dr.Enas Khattab in the Building Materials Research and Quality Control Institute Housing & Building National Research Center for her advices and guidance in an important part in this thesis, which help me to easily continue the rest of my works.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES