Ain Shams University

Faculty of Engineering

Behavior of Green Concrete Beams Using Industrial Waste as Partial Coarse Aggregate Replacement"

BY

ALSHIMAA SABER AHMED HASANEEN HAMAD

B.Sc. 2014

Civil Engineering Department, higher Institute for Engineering & Technology,New Cairo, Fifth Settlement.

A Thesis

Submitted in Partial Fulfillment of the Requirements of the Degree of Master of Science in Structural Engineering

Under the Supervision of :

Prof. Dr. Omar Ali Mousa Elnawawi

Professor of Reinforced Concrete Structures,
Structural Engineering Department,
Faculty of Engineering,
Ain Shams University

Prof. Dr. Zeinab Salah El-din

Professor of properties and testing of materials,
Housing and Building National Research center

Dr.Khaled sami Abdallah

Assistant Professor at Civil Engineering Department,
Higher Institute for Engineering & Technology,
New Cairo, Fifth Settlment**.**

2019

Ain Shams University

Faculty of Engineering

Thesis:	**Master of Science in Civil Engineering (Structural)**
Researcher Name:	**AlShimaa Saber Ahmed HasaneenHamad**
Thesis Title:	**Behavior of Green Concrete Beams Using IndustrialWaste as PartialCoarse Aggregate Replacement"**

Supervision Committee **Signature**

Prof. Dr. Omar Ali Mousa Elnawawi
Professor of Reinforced Concrete. ……..
Structur Engineering Department
Faculty of Engineering- Ain Shams University

Prof. Dr. Zeinab Salah El-din. ……..
Professor of sterength of matrials
Housing and Bulding national research center

Dr. Khaled Sami Abdallah ……..
Assistant Professor at Civil Engineering Department
HigherInstitute for Engineering Technology
New cairo,Fifth Settlement.

Ain Shams University

Faculty of Engineering

Thesis:	**Master of Science in Civil Engineering (Structural)**
Researcher Name:	**AlShimaa Saber Ahmed HasaneenHamad**
Thesis Title:	**Behavior of Green Concrete Beams Using Industrial Waste as Partial Coarse Aggregate Replacement"**

Examiners Committee	**Signature**
Prof. Dr. AL-Sayed Abdl Raouf Nasr Professor of properties and sterength of matrialsStructur Engineering Department Faculty of Engineering- Ain Shams University	……
Prof. Dr. Mohamed Ahmed Khafaga. . Professor of sterength of matrials Housing and Bulding national research center	……
Prof. Dr. Omar Ali Mousa Elnawawi Professor of Reinforced Concrete. Structur Engineering Department Faculty of Engineering- Ain Shams University	……
Prof. Dr. Zeinab Salah El-din. . Professor of sterength of matrials Housing and Bulding national research center	……

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 Structural Engineering.

The work included in this thesis was carried out by the author at Testing and materials laboratory of Alazhar University.

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

Date: / /2019

Name: Alshimaa Saber Ahmed Hasaneen Hamad

Signature:

INFORMATION ABOUT THE RESEARCHER

Name: Alshimaa Saber Ahmed Hasaneen Hamad

Date of Birth: 10/6/1992

Nationality: Egyptian

E-mail: Engsh365@yahoo.com

Phone: 002-01144541098

ACKNOWLEDGEMENTS

First and above all, I have to thank **Allah** for giving me wisdom and knowledge I have today. I praise **Allah** for His care and support and providing me with the opportunity to present my hard work in a beneficial knowledge to people.

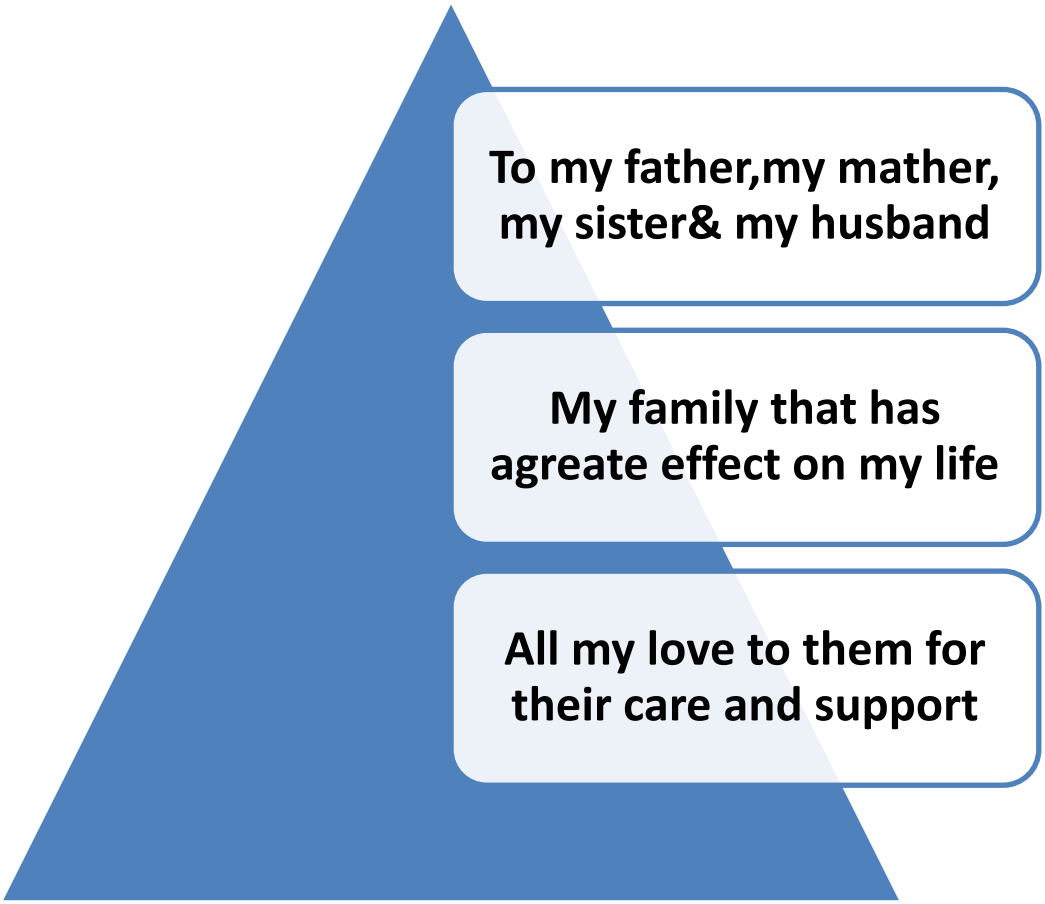
I would like to deeply thank my respectful supervisor **Prof. Dr. Omar Ali Mousa Elnawawy;** who offered me the opportunity to be under his supervision. I also thank him for his valuable advice, continuous interest and for his efforts to make my thesis appear in its current form.

I would like to deep appreciation my respectful supervisor **Por.f Dr. Zeinab Salah El-din;** for her encouragement and her flexible treatment during my thesis. I also extremely grateful for her continuous support, valuable advice, caring, patience, and her great effort to make my thesis appear in its present form.

I would like to express my deepest thanks and confession of favor to respectful supervisor**Dr.Khaled Sami Abdallah;** for his mentorship, information, patience, and powerful support during my thesis. I appreciate his great effort to make my thesis appear in its current form. In addition to the above, I thank him for benefiting me culturally, socially, and ethically.

Finally, I would like to thank **my family and my husband** for their continuous encouragement, support, care, and patience, especially during the hard times.

DEDICATION


To my father,my mather, my sister& my husband
My family that has agreate effect on my life
All my love to them for their care and support

Behavior of Green Concrete Beams Using Industrial Waste as Partial Coarse Aggregate Replacement",
Master of Science, 2019,
Eng. Alshimaa Saber Ahmed Hasaneen Hamad,
Structural Engineering Department, Faculty of Engineering,
Ain Shams University.

ABSTRACT

In previous years, the use of virgin aggregates increased in the concrete works, which led to increased consumption and lack of access in the future,

This study focuses on the using of steel slag and crushed concrete in deferent percentages with the natural aggregate in concrete mixes for reinforced concrete beams and comparing them with others dolomite beams.

Concrete cubes were implemented with different percentages of replacement of steel slag and crushed concrete and compared with cubes with normal concrete until the best replacement ratio which was obtained as 40% of steel slag andcrushed concrete.

Three concrete mixtures were made by steel slag, crushed concrete, and virgin concrete, were used in the work of reinforced concrete beams to study the behavior of reinforced concrete beams containing steel slag and RCA and compare them with convention concrete.

Asix reinforced concrete beams were cast to study the shear and flexural behavior.

A Comparison was done to evaluate the performance for different types of materials which used in concrete mixes for beams.

The concrete mixes were tested in both fresh and hardened states.

Results showed that beam of steel slag (40% and 60% normal dolomite and (40%crushed concrete 60% dolomite) can resist both flexural and shear stresses. In addition, beams of steel slag showed the highest performance under both shear and flexural stresses.

Key Words: Steel slag, Crushed concrete, Reinforced concrete beams, Optimum percentage, Compressive strength.

PUBLICATIONS

Alshimaa S.A. Hasaneen , Omar A.M.ELnawawi , Zeinab S.EL-Din, and Khaled S.Abdallah.(2018), "Behavior of Green Concrete Beams Using Industrial Waste As Partial Coarse Aggregate Replacement", International Journal of Scientific & Engineering Research, Volume 9, Issue 9, September-2018, ISSN 2229-5518.

TABLE OF CONTENTS

	Page No.
Acknowledgments	i
Dedication	ii
Abstract	iii
Publications	v
Table of Contents	vi
List of Tables	x
List of Figures	ix
CHAPTER ONE: INTRODUCTION	1
1.1 General	1
1.2 Objectives	2
1.3 Research Methodology	2
1.4 Layout of Thesis	3
1.4.1 Chapter 1: Introduction	3
1.4.2 Chapter 2: Literature Review	3
1.4.3 Chapter 3: Experimental Program	3
1.4.4 Chapter 4: Results and Discussion	3
1.4.5 Chapter 5: Conclusions and Recommendations	3
CHAPTER TWO: LITERATURE REVIEW	4
2.1 General	4
2.2 Using Recycled Aggregate In Concrete Beams	5
2.3 Using Steel Slag in Concrete Beams	12
2.4 Uncovered Research Points	18
CHAPTER THREE: EXPERIMENTAL PROGRAM	19
3.1 Introduction	19
3.2 Experimental Program	20

Page No.

3.3 properties of used martial 22

3.3.1 Cement 23

3.3.2 Aggregates 23

3.3.2.1 Fine Aggregates 23

3.3.2.2 Natural Aggregates 24

3. 3.2.3 Coarse Aggregates 25

3.3.2.4 Steel Slag 26

3.3.3 Water..... 28

3.3.4 chemical admixtures 28

3.4 concrete Mixes..... 29

3.4.1 Mixing 29

3.4.2 Mixing procedure..... 32

3.4.3 Steps of making concrete beam 33

3.4.4 Curing beam..... 35

3.4.5 Curing cubs 36

3.5 testing 36

3.5.1 Fresh concrete tests 36

A. Slump Test 36

3.5.2 Hardened Concrete Tests 37

A. Compressive Strength 37

B. Tensile Strength 38

3.5.3 Strain gauge 39

3.6 the tested Reinforced Concrete Beams 39

3.7 Dimensions and details of reinforced for beams specimens..... 40

4.7.1 Group1-shear group 40

Page No.

4.7.2 Group2-moment group 41

4.8 **Experimental test set up** 42

CHAPTER FOUR: RESULTS AND DISCUSSION 44

4.1 Introduction 44

4.2 Fresh concrete properties 44

4.2.1 Workability 44

4.2.2 Hardened concrete properties 47

4.2.2.1 Compressive Strength 47

4.2.2.2 Tensile Strength..... 51

4.3 Test results of shear control beam (B2) 52

4.4 Test results of moment control beam (B1) 55

4.5 Test results of moment recycled aggregate beam (RAC-B3) 58

4.6 Test results of shear recycled aggregate beam (RAC-B4) 61

4.7 Test results of moment steel slag beam (SS-B5) 64

4.8 Test results of steel slag beam (SS-B6) 67

4.9 Analysis of beams…….. 71

4.9.1 Shear Group…….. 71

4.9.2 Flexure Group…….. 74

CHAPTER FIVE: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 78

5.1 Introduction..... 78

5.2 Rust of fresh and hardened concrete 78

5.3 Rust of tested beams 79

5.3.1 Flexural behavior 79

Page No.

5.3.2 Shear behavior 80

5.4 Cracking behavior and mode of failure..... 81

5.4.1 Flexural behavior**……** **81**

5.4.2 Shear behavior…… **81**

5.5 Stiffness……. 81

5.6 Ductility……. 82

5.7 toughness…… 82

5.8 Recommendations…… **83**

References **84**