CIRCULAR ECONOMY FOR MITIGATING CLIMATE CHANGE IMPACTS: APPLICATIONS OF AGRICULTURAL WASTES AS NATURAL THERMAL INSULATION MATERIALS – CASE STUDY OF RESIDENTIAL BUILDINGS TO ACHIEVE SUSTAINABILITY

By

Sarah Adel Mohamed Saleh GadAllah

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
Architectural Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2020

CIRCULAR ECONOMY FOR MITIGATING CLIMATE CHANGE IMPACTS: APPLICATIONS OF AGRICULTURAL WASTES AS NATURAL THERMAL INSULATION MATERIALS – CASE STUDY OF RESIDENTIAL BUILDINGS TO ACHIEVE SUSTAINABILITY

By
Sarah Adel Mohamed Saleh GadAllah

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
Architectural Engineering

Under the Supervision of

Prof. Dr. Mohsen M. Aboulnaga

Professor of Architecture and Sustainable
Built Environment
Department of Architecture
Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2020

CIRCULAR ECONOMY FOR MITIGATING CLIMATE CHANGE IMPACTS: APPLICATIONS OF AGRICULTURAL WASTES AS NATURAL THERMAL INSULATION MATERIALS – CASE STUDY OF RESIDENTIAL BUILDINGS TO ACHIEVE SUSTAINABILITY

By
Sarah Adel Mohamed Saleh GadAllah

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
Architectural Engineering

Approved by the
Examining Committee

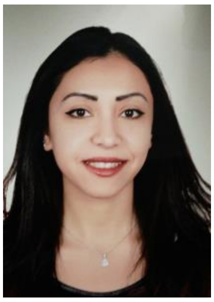
____
Prof. Dr. Mohsen M. Aboulnaga, **Thesis Main Advisor**

____
Prof. Dr. Ayman Hassan Ahmed, **Internal Examiner**

____
Prof. Dr. Mourad Abdelkader Abdelmohsen, **External Examiner**
- Professor of Architecture and Environmental Control
  Faculty of Engineering, Ain Shams University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2020

Engineer's Name: Sarah Adel Mohamed Saleh
Date of Birth: 28/09/1987
Nationality: Egyptian
E-mail: Sarah_adel4909@hotmail.com
Phone: 01008613582
Address: 3rd district, Nerco, Zahraa AL-Maadi



Registration Date: 01/03/2015
Awarding Date: …./…./ 2020
Degree: Master of Science
Department: Architectural Engineering

Supervisors:

Prof. Dr. Mohsen Aboulnaga

Examiners:

Prof. Dr. Mourad Abdelmohsen (External examiner)
Professor of Architecture and Environmental Control,
Faculty of Engineering, Ain Shams University
Prof. Dr. Ayman Hassan Ahmed (Internal examiner)
Prof. Dr. Mohsen Aboulnaga (Thesis main advisor)

Title of Thesis:

Circular Economy for Mitigating Climate Change Impacts: Applications of Agricultural Wastes as Natural Thermal Insulation Materials – Case Study of Residential Buildings to Achieve Sustainability

Key Words:
Circular economy; Climate change; Natural thermal insulation materials; Agricultural waste; and Sustainability

Summary:
Conventional thermal insulation materials in buildings consume huge amount of embodied energy. Nonetheless, these materials cause many harms whether indoors or outdoors; hence, increase carbon emissions that resulted in climate change. Buildings are accounted for around 40 per cent of the total consumption of energy. The research aims at utilization of agricultural wastes, as natural thermal insulation materials, which reflects the concept of circular economy, to lessen the harmful carbon dioxide emissions. This research is concerned with realizing the importance of thermal insulation materials in different climates, and reviewing their development worldwide, as well as the comparison between conventional and non-conventional thermal insulation materials. The research methodology depends on theoretical and applied studies through simulation to assess the application of agricultural residues in residential buildings; which reached a conclusion that these residues provide good thermal insulation and lessen carbon emissions and mitigate climate change.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Sarah Adel Mohamed Saleh GadAllah Date:

Signature:

Dedication

I would like to dedicate my thesis to my mother, my role model and super woman.

The strongest woman I have ever seen, she's our source of light, and ultimate happiness.

Acknowledgments

I would like to express my ultimate gratitude to my supervisor, Professor Dr. Mohsen M. Aboulnaga for his continuous support and crucial advice, in addition to his motivation, tremendous patience, and most importantly, his vast and sophisticated knowledge. Professor Dr. Mohsen M. Aboulnaga has a huge contribution in developing and finalizing this thesis.

Also, I would like to thank the Department of Architecture and Faculty of Engineering at Cairo University for the support and assistance that they have shown, and for giving me the opportunity to conduct my postgraduate studies and promote my research work and master thesis.

Thanks to Professor Dr. Mourad Abdelkader Abdelmohsen, External Examiner and Professor Dr. Ayman Hassan Ahmed, Internal Examiner.

Last but not the least, to my brother and sister; whom I would not have done anything without their support. To my husband for his continuous assistance that makes me always aspire for more.

Table of Contents

List of Tables

List of Figures