شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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Architecture

Retrofitting School Buildings towards Attaining Net Zero-Energy Buildings

A Thesis submitted for the requirements of the degree of

Master of Science in Architectural Engineering

(Architecture Engineering)

by

Aya Helmy Zakaria

Bachelor of Architectural Engineering

(Architecture Engineering)

Faculty of Engineering, El-Shorouk Academy, 2014

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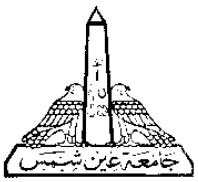
Cairo - (2021)



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Degree: Master of Science in Architectural Engineering

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- Faculty board approval: ……/…… /……
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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Architectural Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Acknowledgment

To Dr. Morad Abdel Kader, my esteemed supervisor, whose door was always open for me at any time. I would like to represent my grateful thanks to you for accepting me to be your student at the first place, your warm encouragement, thoughtful guidance, critical comments, and your support during the whole period of the study. Your gentle way and caring manner were always a source of great comfort to me throughout this endeavor .I consider myself to be so lucky for working under your kind and expert supervision.

My honest gratitude goes to my family, especially my parents for always being my backbone and for believing in me. I would have never been here without you. Thank you my mother Dr.Hanan Ahmed, for teaching me passion and discipline. Thank you, my father Dr.Helmy Zakaria, for teaching me hard work and perfection. My brothers Ahmed, Zakaria and Yahia ,for always being there for me .A very sincere appreciation would go to my husband Eng. Abdelrahman Samir , for being my supportive through the hard times, and for his honest gladness whenever I achieve a success. Thank you my mother in law Asmaa Fahmy, for supporting and helping me in my hard time. Thank you my lovely kids Yousif and Lina for being my main motivation throughout this whole process .I would also like to thank my master‘s colleagues and especially my friend Eng. Aya Gaber for her sincere willingness to help me whenever I needed help. Last but not least. I am grateful for having all of you in my life and I hope to make you all proud.

Abstract

Educational sector in Egypt needs a great interest; in order to update educational buildings especially school buildings. The existing school buildings represent both the problem and the solution, because dealing with existing school buildings would reflect directly on the current energy consumption condition. Private schools depend heavily on air conditioners to achieve thermal comfort to students without paying attention to passive design strategies, and this leads to high energy consumption and increased carbon dioxide emission. The objective of this thesis is to propose a methodology that can be used to convert private school buildings in Egypt from high energy demand into net-zero energy buildings

Net Zero Energy Building (NZEB) construct is the future aim for saving energy. NZEB concept has risen in worldwide discussions targeting efficient built environment. The research discusses the combination between two strategies: energy efficiency retrofitting techniques to reduce energy consumption, and renewable energy systems to generate enough energy, which would result in an annual net zero energy.

Design Builder simulation software is used to test the feasibility of combining these two strategies in an existing school building located in the Fifth Settlement, New Cairo. The simulation goes through three stages, the first stage concludes determine the actual energy performance and the user‘s electric consumption (base case study), to identify the maximum energy consumption kWh. In the second stage three energy efficiency retrofitting techniques such as; insulation and glazing in the building envelope, and retrofitting of lighting systems, are investigated in the first stage aiming to reach the maximum energy reduction. In stage three renewable energy sources such as PV panels and solar thermal techniques are installed to generate enough energy to cover the remaining energy from stage two. A cost analysis was performed to find the profit return from using the energy efficiency retrofitting techniques and renewable energy integration.

After applying all energy efficiency retrofitting types including (opening retrofitting, wall retrofitting and lighting retrofitting), the energy reduction for the whole school achieved 34.68%. And by integrating photovoltaic panels on the roof, the energy reduction achieved 100%. The research concluded that existing school building can be converted to nZEB by using retrofitting strategies and installing PV system with a total cost of 1,495,260 LE, and the return on investment of the building envelope is 24.5 years and for PV panels is 4.6 years.

Key words: Retrofitting School Buildings- Net Zero Energy Building (NZEB)- Energy Efficiency- Renewable Energy.