



Ain Shams University

Faculty of Engineering

Mechanical Power Engineering Department

Investigation of Energy-Efficient Alternatives for Commercial Buildings in Egypt

A Thesis submitted in partial fulfillment of the requirements of the degree of Master of Science
in Mechanical Engineering
(Mechanical Power Engineering)

By

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Master of Science in Mechanical Engineering
(Mechanical Power Engineering)

Faculty of Engineering, Ain Shams University, November 2018

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Cairo - (2018)



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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Mechanical Engineering (Mechanical Power 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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Twelfth International Conference of Fluid Dynamics (ICFD12) 19-20 December 2016, Le Méridien

Pyramids Hotel, Cairo, EGYPT

Paper No.: ICFD12-EG-5020

Paper Title: "Investigation of the Impact of Using Daylighting for Rationalization of Energy Consumption of an Office Building in Egypt"

Abstract

Given the rising living standard, population growth and global warming, buildings have been consuming energy and resources at an ever-increasing rate worldwide. To face this problem, energy saving techniques have been recently adopted in the framework of high-performance buildings, also known as zero-energy buildings. In Egypt, electricity consumption has witnessed significant increase of 55.22% since 2006 [1] of which residential and commercial buildings have the biggest share (66% to 74%). Hence, it is timely for Egypt to adopt energy saving techniques in its building construction code. This thesis investigates the effects of applying energy saving techniques for commercial buildings in Egypt. As a case study, a virtual building based on the Mechanical Engineering Department building at the Faculty of Engineering Campus of Ain Shams University, was modeled using EnergyPlus as a sample of non-residential buildings. A number of energy saving techniques have been assessed and compared to reach an improved building envelop and improved HVAC system with minimum energy needs (energy rationalization). Subsequently, a solar system is sized to cover these energy needs, thus transforming the sample building into a zero-energy building. Results of the study showed that Zero-energy buildings are applicable in Egypt and constructions recommended by international standards can be replaced by cheaper and more effective alternatives. Study also introduced simple design guidelines to achieve the Zero-Energy state for commercial buildings in Egypt.

Key words:

Zero-Energy buildings, High-Performance buildings, Energy saving, Energy conservation,
EnergyPlus, Energy simulation

Acknowledgement

I would like to express my deepest appreciation to the committee members for their inspirational instructions. Without their guidance and support, I couldn't have completed this work.

I would like to express my gratitude to my academic advisors, Prof. Nabil Abdel-Aziz, Prof. Ahmed El-Baz, and Dr. Aya Diab for their guidance and motivation during this study.

Finally, I sincerely thank my mother and my family who deserve all the credit for the encouragement in carrying out this work.

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