شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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Implementation of Phase Change Material in Commercial building envelope to reach nZEB

A Thesis submitted in partial fulfilment of the requirements of the degree ofDoctor of Philosophy in Architecture Engineering

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1. Chapter 1 … Introduction

1.1. Zero Energy Building

A zero-energy building (ZEB) is a structure that generates enough energy to meet its own annual energy needs without relying on any other sources but its own renewable energy. This will reduce the building sector's reliance on nonrenewable energy. ZEBs employ all cost-effective techniques to reduce energy consumption through energy efficiency, as well as renewable energy systems that provide enough energy to meet the remaining energy needs. Moving to ZEBs has a number of long-term benefits, including low environmental impact, inexpensive maintenance, and low operational costs. Improved energy security and resiliency to power outages and environmental disasters.

Reducing building energy usage, whether in a modified or new structure, is a major concern worldwide. Integrated design, energy efficiency retrofits, lower plug loads, and energy conservation initiatives are some of the ways this can be accomplished. Reducing energy use makes meeting the specified renewable energy requirements easier and less expensive for the building.

ZEBs have a massive potential to transform the way buildings use energy and that is the reason why building owners want to meet ZEB and it’s a main target. Private commercial property owners are looking for ZEB as it is a tool to reach their corporate goals and this has already been achieved by some designed buildings to be zero energy. At the same time many other governments are being to take the same movement moving to regions and organizations (Peterson, 2015,).

1.2. Theoretical Background

Passive building envelope techniques are growing quickly in the building construction development field. To achieve optimum comfort and energy savings, researches focused on different passive techniques of building envelope design through building form and materials as a total system (Okba, 2015).

A good alternative for energy saving and storing in building envelope is Phase change materials (PCM). The demand for heating and cooling in building is reduced by applying PCM in building envelope, thermal comfort is better and co^2 emissions are also reduced. `

Phase change materials (PCM) have received much attention as an alternative for energy saving and storing. The energy demand for heating and cooling are addressed through computer simulation to test the co2 emissions and the thermal comfort. Lately different concepts on PCM integration in the building envelope are emerging – built-in walls, ceilings, floors, as a thin layer or large storage tanks (Kancane Liene, 2016).
The new building construction should be nearly zero-energy buildings (NZEB), all the researchers directing their research to reduce winter and summer energy with maximum thermal comfort levels they can reach (Fabrizio Ascione, 2016). It is also a direction to use the better natural resources to cover all local energy used and more to sell (Okba, 2015).
This research focuses on different building envelope materials with different specifications as an input to reach an optimized output factors such as initial cost, operational cost, thermal comfort and material allocation. Adding Building Integrated Photovoltaic (BIPV) would balance the heating, ventilation and air conditioning (HVAC) energy consumed by the building which will result in a nZEB.

1.3. Research Problem

Due to the world's current environmental crises, built environments require more innovative and creative solutions for sound development. The commercial building envelope design in Egypt has a minimal sustainable standards, as the Egyptian Code for Improving Energy Performance in Buildings ECP 306-2005(ECIEPB) has a low Resistance value compared to current sustainable and international standards. Therefore, the building envelope needs to resist the external environmental factors to improve the indoor human comfort with less reliance on HVAC and reducing the total energy consumption and relying less on the grid energy.
This leads to the need to study the parameters involved in designing different commercial building envelope compositions to reach nZEB envelope.

1.4. Aim

The aim of this study is to develop a new methodology to deal with PCM implementation on commercial building envelope in Egypt. The purpose is to provide a multi objective optimization tool for commercial building envelope. The tool will help designers to take the right decision with their designed commercial building envelope among a group of optimized cases. The PCM methodology optimize Thermal comfort, initial cost and