



بسم الله الرحمن الرحيم

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Cairo University

**OPTIMIZING ENERGY EFFICIENCY AND INDOOR
ENVIRONMENTAL QUALITY IN ADMINISTRATIVE
BUILDINGS THROUGH INTRODUCING BIM AT
DESIGN STAGES**

By

Wael Muhammad Abdelwahhab Mousa

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
INTERDISCIPLINARY-MASTER OF SCIENCE
in
Integrated Engineering Design in Construction Projects

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Title of Thesis:

**Optimizing Energy Efficiency and Indoor Environmental Quality in
Administrative Buildings through Introducing BIM at Design Stages**

Key Words:

BIM; Solar Radiation; Thermal Comfort; Energy Consumption; Green Building.

Summary:

The sun plays an important role to humankind on Earth as it provides many useful things such as light and warmth to all living organisms. However, the solar radiation that strikes buildings' envelope is considered as one of the main challenges that faces the designers of administrative buildings' projects. This research discusses the problems that are resulted from the negative effects of solar radiation on existed administrative buildings when not considered in the design. In addition, it introduces a solution by involving Building Information Modelling (BIM) in the design stage, which helps designers to model their design, simulate its performance using BIM predictive software, and then accordingly modify the design to reach to the best performance.

A case study of an existing office building is introduced to monitor the building actual performance in terms of energy and thermal comfort as a baseline, then using its data in a BIM model to improve its performance.

At the end, the research concludes that using BIM process in design not only solves problem of negative effects of the heat gain coming into building and high-energy consumption for air condition system, but also enhances building performance and users' thermal comfort as well, which is part of indoor environmental quality.

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: Wael Muhammad Abdelwahhab Mousa

Date: / /2022

Signature:

Dedication

To my parent's soul.
To my wife and my kids.
To my supervisors.

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Nomenclature

BIM:

Building Information Modelling

POC:

Proof of Concept

ASHRAE:

The American Society of Heating, Refrigerating, and Air-conditioning Engineers

AEC:

Architecture Engineering Construction

LEED:

Leadership for Environmental and Energy Design

GPRS:

Green Pyramid Rating System

BREEAM:

Building Research Establishment Environmental Assessment Method

EPA:

Environmental Protection Agency

CAD:

Computer Aided Design

SDG:

Sustainable Development Goals

UN:

United Nation

DGNB:

Deutsche Gesellschaft für Nachhaltiges Bauen (German Sustainable Building Council)

GSAS:

Global Sustainability Assessment System

IGBC:

Indian Green Building Council

CASBEE:

Comprehensive Assessment System of Building Environmental Efficiency

USGBC:

U. S. Green Building Council

GSA:

General Services Administration in U. S

iBIM:

intelligent Building Information Modelling

GBS:

Green Building Studio

IES:

Integrated Environmental Solutions

VE:

Virtual Environment

SQM:

Squared Meter