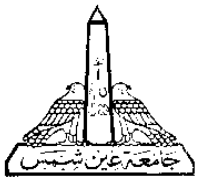

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Structural Engineering

A BIM-based decision making facility management workflow to reduce energy costs in buildings

A Thesis submitted in partial fulfillment of the requirements of the degree
Master of Science in Civil Engineering
(Structural Engineering)

by

Yussra Mohamed Emam Rashed
Bachelor of Science in Civil Engineering
(Structural Engineering)
Faculty of Engineering, Ain Shams University, 2013

Supervised By

Prof. Dr. Ibrahim Abd El Rasheed
Prof. Dr. Khaled Nassar

Cairo - (2019)

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Examiners' Committee

Name and Affiliation	**Signature**
Prof. Dr. Ahmed Samer Ezz Eldin (Examiner) Department of Construction Engineering American University in Cairo	…….
Prof. Dr. Ali Sherif Abdel Fayad (Examiner) Department of Structural Engineering Ain Shams University	…….
Prof. Dr. Ibrahim Abd El Rasheed (Advisor) Department of Structural Engineering Ain Shams University	…….
Prof. Dr. Khaled Nassar (Advisor) Department of Construction Engineering American University in Cairo	…….

Date: …/…/……

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Civil 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.

Student name

Yussra Mohamed Emam Rashed

Signature

……...…….

Date:19 September 2019

Researcher Data

Name	: Yussra Mohamed Emam Rashed
Date of birth	: 01/03/1991
Place of birth	: Giza, Egypt
Last academic degree	: Bachelor of Science in Civil Engineering
Field of specialization	: Structural Engineering
University issued the degree	: Ain Shams University, Faculty of Engineering
Date of issued degree	: 25/09/2013
Current job	: Demonstrator in Faculty of Engineering, Ain Shams University

Thesis Summary

The rapid and continuous rise in the energy costs dictates significant cost control efforts during buildings' operation phase. Controlling the energy costs task is often assigned to the facility manager, despite the fact that achieving remarkable energy cost reductions are highly governed by the decisions and choices made during earlier phases of the construction project, when the facility manager is not involved. Nonetheless, valuable Building Information Modelling (BIM) data that ought to enable informed cost-effective recommendations early on are not exploited by facility managers, in addition to the absence of a workflow tailored for facility managers that equips them to reach the best cost-effective decisions.

This study aims to create a workflow for facility managers that exploits BIM to reduce energy costs. The workflow proposed presents a means for the facility manager to take a part in the building envelope assemblies' selection either early on in the project during the design phase, or in the retrofitting phase in order to achieve energy cost savings during the operation phase.

To achieve this aim, case studies are used to apply the workflow, construct a BIM model, perform energy simulations and Life Cycle Costs (LCC) calculations. The building envelope assemblies studied in this research are the external wall assemblies, roof assemblies and glazing assemblies for the external windows. Two different case studies are carried out to compare the LCC of different types of building envelope assemblies. The first case study is a school complex in Jubail, Kingdom of Saudi Arabia (KSA) and the second case study is a commercial office building in New Cairo, Egypt. The economic evaluation techniques used in both case studies on all the assemblies are the present value LCC, benefit-cost ratio, and payback period. Furthermore, a sensitivity analysis is carried out to test the effect of changing the energy escalation rate and unit energy price on the selection. The results of the first case study show that savings up to 18% in the operational energy costs can be achieved just by selecting the proper roof assembly type, whereas operational energy cost savings up to 4% and 8% respectively can be achieved by choosing the suitable wall and glazing assemblies. In the second case study up to 10% savings in operational energy costs can be obtained with the right glazing assembly selection, also a payback period as short as 2 years can be obtained.

Conclusively, the proposed workflow can be used by facility managers or other members of the construction team during the initial design stages of the building project, where cost-effective recommendations for the envelope assemblies can be presented to achieve cost savings afterwards during the operation phase.

Keywords: Facility Management, BIM, Life Cycle Cost, Building Envelope, Energy Management

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Table of Contents