بسم الله الرحمن الرحيم

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بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

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AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF ARCHITECTURE

COST EFFICIENT SUSTAINABLE STRATEGY FOR RETROFITTING SIGNIFICANT BUILDINGS IN EGYPT

A Thesis submitted in partial fulfilment of the requirements of the degree of
"Doctor of philosophy in Architecture"

Submitted by
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Cairo - (2022)

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بسم الله الرحمن الرحيم

"وَقُلْ رَبِّ زِدْنِي عِلْمًا"

(طه: ١١٤)

صدق الله العظيم

To the soul of my father

To my family & my brothers

To my loving wife Marwa and her family

To my little sons Zeyad & Dana

For all your support and unconditional love

STATEMENT

This dissertation is submitted to Ain Shams University - Faculty of Engineering - Department of Architecture for the degree of Doctor of Philosophy in Architecture.

The work included in this thesis was accomplished by the author at the Department of Architecture, Faculty of Engineering, Ain Shams University, during the period from 2013 to 2022. No part of this thesis has been submitted for a degree or a qualification at any other university or institute.

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بسم الله الرحمن الرحيم

By the name of ALLAH, the Most Gracious, the Most Merciful

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ABSTRACT

Retrofitting approach is seeking to improve the building performance to extend the life span period of the building. Moreover, it saves the building capital and value compared to demolishing that building to build a new one. Hence, retrofitting is considered an effective means that works to preserve buildings.

This research is conducted for existing buildings in Egypt by choosing the high-rise building construction in Cairo, dated from 1980 s to 1990 s, which was the time of economic growth in Egypt. These buildings are considered as significant national treasures with their culture, use, or even age values, but with low and outdated insulation levels. Some of these buildings are still used today, while other buildings suffer from degradation problem. At the age of 30 to 40 years, facades reached the end of their technical life span and these buildings have been recognized as an inefficient consumer of costs. Particularly in high-rise buildings, façades are unfortified to face the climate change due to their exposure and unfavorable volume in terms of their surface facades. Consequently, energy consumption proportionately increases with high running costs of mechanical systems and it needs an improvement through facade retrofitting without compromising its value.

Despite there are many studies that discussed the façade retrofitting in practicability, there are no rigor results that investigated or proceeded in aspects related to a synthetic strategy configuration as creative way that contributes the scientific methods in evaluating the façade retrofitting efficiency.

This research focuses on understanding the synthetic strategy configuration's dimensions and their measurements indicator variables, as any change in these variables directly affects the level of façade retrofitting's efficiency. Seeking to fill the gaps of retrofitting practicability knowledge.

This research aims at developing a decision- making process modeling for the evaluation of the retrofitting techniques implemented at the façade of a

significant building in Egypt, without compromising its value. The evaluation is taking into consideration the requirements of sustainability and the cost efficiency along the building's life span period.

In order to achieve the decision- making process modeling, the facade retrofitting techniques that are commonly used in the building construction industry concerning the façade retrofitting concepts for the significant building's situation with their components will be evaluated through a multi-disciplinary evaluation approach, which is based on a scientific measurement method and is derived on two complementary approaches: the qualitative and the quantitative approach.

Where the qualitative evaluation approach is reflected the relativity and it is related to a multi criteria decision- making (MCDM) in the construction industry, in which the qualitative values is translated to easy negotiable quantitative numerical values. It attempts to evaluate the facade retrofitting techniques against the measuring indicator variables for the sustainable characteristics of façade retrofitting based on applying the weighted evaluation matrix method (WEMM) in order to assess the sustainable efficiency percentage for each technique. Its results are considered as independent results since they will be determined from the research study and related to existing variables and reliable processes making these results to be generic.

On the other hand, the quantitative evaluation approach is related to value management approach in the construction industry. It attempts to evaluate the facade retrofitting techniques against the measuring indicator variables for the lifecycle costs of façade retrofitting based on applying the present value evaluation method (PVEM) in order to assess the cost efficiency percentage for each technique over the façade building life span period. Its results are considered as dependent results since they will be determined from the application study and related to changeable previous variables from building to another, even they could change with time.

The proposed framework was applied for its validity and reliability through the practically investigation application for the verification process description on an existing case study to evaluate the possibility for its application and Ramses Hilton hotel building was chosen.

The results provide the conclusion that support research hypothesis which assumes that: “The evaluation of the façade retrofitting techniques through a multi- disciplinary approach: qualitative and quantitative evaluation approaches, based on linking their results and studying their measuring indicator variables; affects the level of sustainable and cost efficiency value percentage for the façade retrofitting techniques”, through a decision-making process modeling regarding scientific methods.

Finally, this process modeling offers significant potential to optimize the selection of façade retrofitting techniques alternatives for significant building without compromising its value, at the same time achieving sustainability and cost efficiency. Accordingly, it facilitates the decision- making for the architects and stockholders to judge which technique in practicability is the most suitable choice to the owner demand for solving the building problems regarding the budgetary.

KEYWORDS

Decision-making, Sustainable efficiency, Cost efficiency, Façades retrofitting techniques type, Qualitative evaluation approach, and Quantitative evaluation approach.

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