ARAB ACADEMY FOR SCIENCE, TECHNOLOGY AND MARITIME TRANSPORT

College of Engineering and Technology

Architectural Engineering & Environmental Design Department

ASSESSMENT OF ENERGY RETROFITTING OF RESIDENTIAL BUIDLINGS VIA LIFE CYCLE COST ANALYSIS

Case Study: Officers' Buildings – Mostafa Kamel, Alexandria

By

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ABSTRACT

Energy retrofitting is considered an innovative way to improve energy performance of the existing building and improve indoor environment. It can be more cost-effective than building a new facility. Since buildings consume a significant amount of energy and because the existing buildings comprise the largest segment of the built environment, it is important to initiate energy conservation retrofits in order to reduce energy consumption and the cost of heating, cooling, and lighting. This study aims to introduce the real energy saving potential of retrofitting an existing building, since, energy retrofitting is considered as an effective solution of high energy consumption and thermal discomfort.

The Egyptian building stock is about 12 million buildings and 60% of buildings units are in the residential sector. More than 52% of the total electricity consumption is attributed to residential buildings. The objectives of this study are to investigate the effect of suitable retrofitting scenarios on residential buildings' cooling energy in the climate of Alexandria, which is one of the highest expanding urban communities using one of existing energy modeling techniques. Then, to assess the different scenarios of the energy retrofitting via life cycle cost analysis in order to find the optimum solution.

A representative model for the existing residential building is developed using Design builder, which gives the status before retrofitting. Retrofits on the building envelope are defined, analyzed and ranked to indicate the long-term energy savings and economic profits. The effect of these improvements on the building's energy consumption is evaluated. Then the life cycle cost of the each scenario is examined.

The results showed that retrofitting strategies on the building envelope could have high potential in reducing the energy consumption levels of residential buildings in Alexandria, reaching a 52.3% cooling load reduction in the last floor and 37% in the typical floors of the building. The external wall insulation and roof insulation can cause reduction by 14% and 12.5% respectively, while decreasing the air infiltration rate can cause reduction by 13.5%. It is also cleared that not necessarily the option with the highest energy reduction is the most economical solution, sometimes due to its high cost it doesn't provide an appropriate payback period and hence it became an uneconomical solution.

Finally, it is proved that using a combination of measures to retrofit an existing building is an ideal solution, where in the fifth floor energy was reduced by 26% with a payback period 6 years and 36% in the last floor with a payback period 6.2 years. According to this, it is recommended to encourage the retrofitting process due to the great already built areas in Egypt which will always remain as a constraint against any step forward.