The role of energy conservation standards in raising quality of life

Case Study "Low- Cost Housing"

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Abstract. Low-cost housing is spread all over Egypt from the north to the upper, many issues appeared on the horizon, such as high maintenance costs, high levels of energy consumption, and the emergence of many practices for residents of these units in an attempt to adapt between their needs and the design of low buildings. One of the most important challenges impacting the quality of life is energy conservation. This paper aims to raise the quality of life in low-cost housing from the perspective of energy conservation. The research aims to ensure enough sustainable energy to maintain a quality of life.

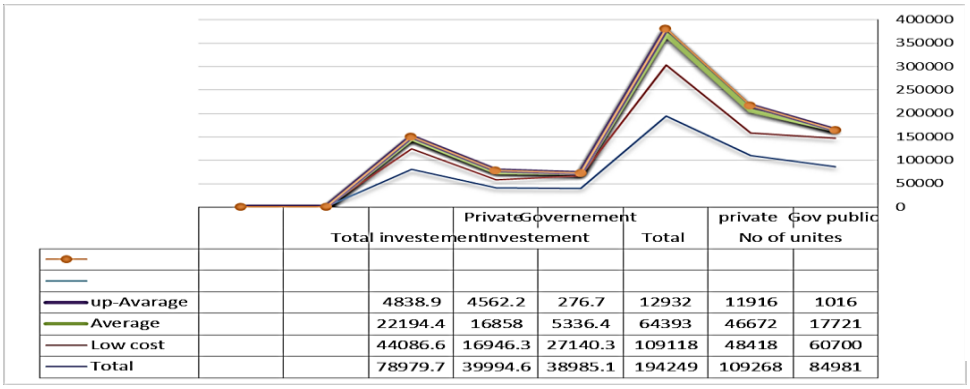
This study is based on questionnaires conducted by residents of low-cost houses projects in Egypt, namely - (Mokattem – New Cairo). Trying to find the most important problem and put forward ways to improve and raise the quality of life, especially from the perspective of energy conservation. Studying the Living satisfaction in low- cost houses. These questionnaires were analysed on a proposal design and how to apply it.

Keywords: Low-cost housing- Energy conservation -Quality of life (QOL).

1-Introduction

Over the last few years the Egyptian government has pay attention to the approach of the low-cost housing .This is becoming an issue of great importance recently as a most suitable way to obtain decent housing Compatible with the economic conditions of Egyptian society[1]. Providing a suitable residential environment is considered one of the critical challenges government encounters especially since 52% of the population is with average income. The interest of the government is shown through the number of low-cost buildings in Fig no.(1) which represents that the number of low-cost units and economic housing alone is about 84,981 during the period 2019-2020.

In light of this, Understanding quality of life is a key measurement for cities' liveability and habitability [14], especially for Low –cost housing.



			Total investement	Private Investement	Governement Investement	Total	private No of unites	Gov public No of unites
up-Avarage			4838.9	4562.2	276.7	12932	11916	1016
Average			22194.4	16858	5336.4	64393	46672	17721
Low cost			44086.6	16946.3	27140.3	109118	48418	60700
Total			78979.7	39994.6	38985.1	194249	109268	84981

Figure (1) Number of low-cost housing built by Egyptian government according to Central Agency for Mobilization and Statistics Issue: July 2021

2.Quality of Life

The expression "quality of life" (QOL) applies toward an assessment made regarding important components of a human's life or society [3]. It can be categorized as individual (physical and psychological health), interpersonal (social relationships), and -contextual (environment) aspects. It can also be could described by them or determined by 'physical indicators [4]. QOL has been determined as an interaction of social, health, economic and environmental conditions that have an impact on the development of the individual and society [5]. It is important to understand the impact of QOL on sustainable development [6].

2.1 Energy conservation QOL indicators for low -cost QOL housing

Several studies have explored the effects of energy consumption on **QOL** and human development (index HDI) [7].Recent QOL indicators have started to focus on low-cost housing evaluation [9], The research adopted appropriate and important indicators in energy conservation . A suitable set of indicators to measure quality of low-cost housing should provide relevant data on both the physical indicators of a residence [8] , as well as the inside environment which includes fundamental services. For instance well-designed housing has been identified as an important factor in promoting quality of life, orientation, internal spaces, electricity, water system, indoor running water, bathroom standards, and cooking facilities. These indicators were designed according to Sustainable Development Goals (SDGs) [10]. Neighborhood aspects are represented in the surrounding environment , level of noise, the quality of transportation services, etc. Monthly income is an essential signal of satisfaction in the household realm [11].The following table adapts several indicators of QOL according to the related items for energy conservation.

2.1.1 Parameters regarding energy saving:

More than 70% of the total energy consumed in residential buildings is attributed to lighting and HVAC (heating, ventilation and air conditioning) needs. Energy-saving parameters in low-cost housing play a role in dictating the energy efficiencies and are liable for energy-saving programs.

2.1.2 Parameters regarding energy production:

Access to energy is a key pillar for human wellbeing [15]. Our ultimate goal is to ensure that everyone has access to enough sustainable energy to maintain a high standard of living. For energy production, The study has obtained several indictors related to energy conservations on a scale inside and outside the low-cost housing.

Table 1: QOL indictors for energy conservation

	Indicator	Determinant purpose
Building Design	Building Mass	Building mass has an impact on day lighting, quality and hence energy consumption. Housing units are built close together on a large lot.	Preserving open space through housing clusters, housing units are built close together on a large lot, with the rest of the lot left as common open space. Each unit has a small open space.
	Building Orientation	It is important to consider the actual quantity of solar radiation on the facades of a residential unit ،as it affects the thermal load of the residential unit and controls the thermal behavior and the amount of thermal comfort of the space.	
	Optimal space standard and circulation	The prorate area of the house important for lower risk of respiratory infections. Optimal living space is also relevant to mental health. Poverty is improved access to key services and opportunities better life satisfaction.	
	Building Envelope	The building envelope protects the interior environment from less desirable exterior conditions. It is an important aspect in determining how much energy will be needed to heat or cool, light and ventilates the building.	
	Building Shape	The differences in shape between the buildings were found to have a large impact[2] and accounted for 10%-20% of their final energy demand [3].	

Openings	The most important factors regarding openings include the amount of sunshine that enters a room, the view, and human privacy. The best window room can vary. The favorite direction to the air movement path and the position of the openings completely permeates the vacuum.	
Sustainable construction materials	The use of less carbon-intensive materials (e.g. cement, steel) or materials that store carbon (e.g. wood). These could also [4]support decarburization of the industry sector, hence less need for energy-intensive resource extraction.	Natural ecosystem protection limiting expansion of urban footprint.
conservation of natural resources	The Water management system can be achieved by energy recovery, and conserving and reusing water. using low-flow faucets .	
Green Space Factor.	The ratio of land consumption to the population growth. A well-insulated roof can negate the need for mechanical systems and reduce heating ,cooling needs. Green roofs can reduce storm water volumes by up to 85% and the ceiling temperature.[5]	
Spreading bike and car roads	Creating pedestrian- and bike-friendly spaces and walking/running paths, etc. to encourage exercise and discourage unnecessary driving.	

3. Analytical Study

The study relies on two main factors the first is through a survey of visiting social low – cost housing models in Cairo (Mokattam- New Cairo) and observation the changes made by the residents to achieve their needs Fig (1,2,3), which the Egyptian government designed and implemented during the past ten years. For energy conservation we must study smart finishing to produce energy on landscape and public buildings as shown in table (3)

Figure 2 :- Changing the area and the shape of windows by closing or increasing the window space.
Ref. Take by Author

Figure 3 :- Using temporary curtain to cover balconies workplaces under buildings .
Ref. Take by Author

Figure 4 :- Narrow spaces between buildings to obtain maximum privacy.
Ref. Take by Author

4. Questionnaire result

The data used in the study was obtained from a questionnaire given to low - cost housing residents. Factors that may influence the study are quality of life and housing environment satisfaction (physical Aspects). The questionnaire was published on websites and distributed to low-income housing residents to study the problems of raising the quality of life through the concept of energy conservation.

The results were analysed by the SPSS program to obtain the percentage, mean, St Division of the

results which is a essential elements in the design proposal.

Figure 5 :- The value of the above-described approach is questionable for stratifying the residents on low- cost house location for public services found that 46% was closed and narrow to public services .

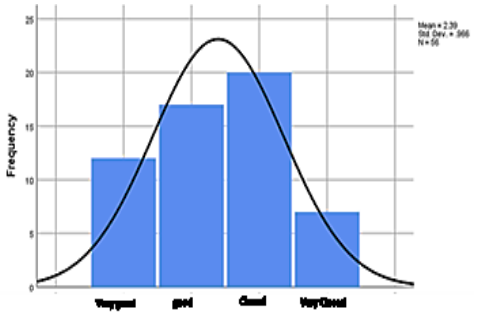


Figure 6 :- Housing units are built close together found that it was 43% for good spaces between the building and 21 % for very closed spaces between the building .

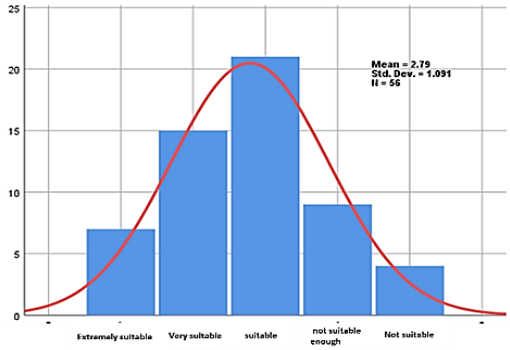


Figure 7 :- For the orientation of widows the results found it suitable for natural 34% was think it was not suitable and not suitable very enough and 56% was staffing to windows orientation.

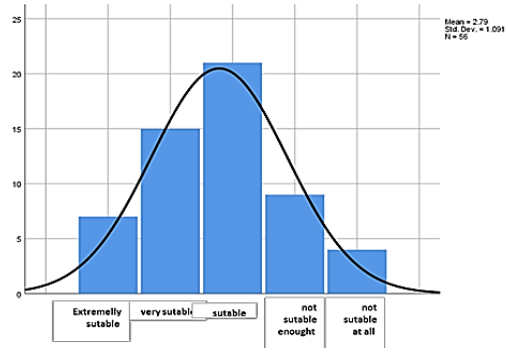


Figure 8 :- for natural lighting and the widows area found that 49% thought that it was very suitable and suitable for natural lighting 51% thought it wasnot suitable enough.

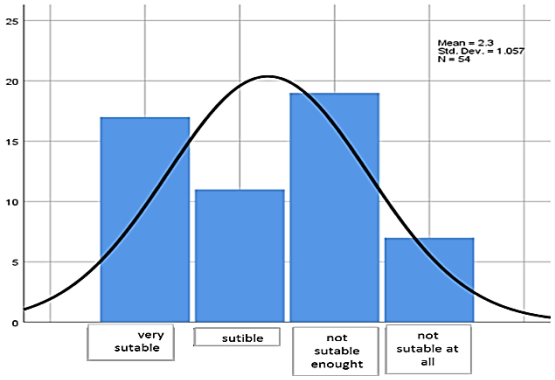


Figure 9 :- For The internal spaces inside the unit disposed of it was found that 53% thought it was suitable for them and 47% have thought it was not suitable.

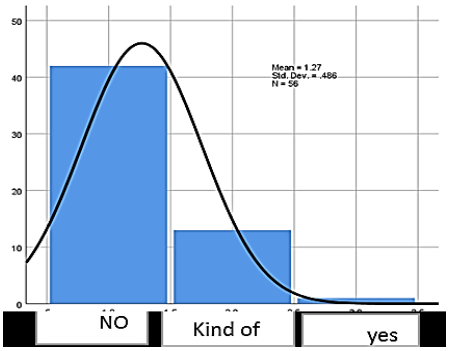


Figure 10 :- For the suitable methods to dispose of construction waste properly 75% of them are suitable .

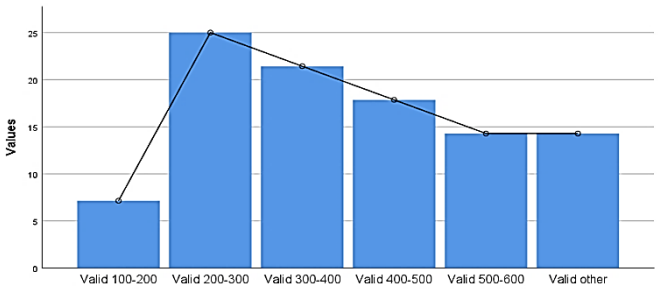


Figure 11 :- For the range of monthly electric bill 30% mentioned that it was 400-600 L.E . It is so high compared to their income .45% between 200-400 L.E and it is considered high according to low-cost housing .

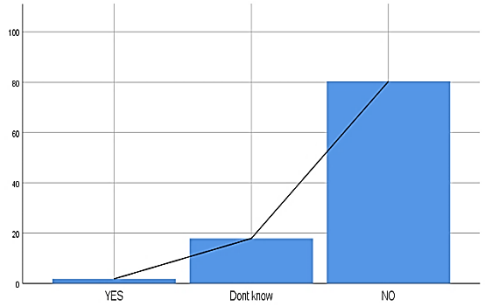


Figure 12 :- For conserving and reusing rainwater 80% represents that there is no method for conserving rain .

5. Result and Discussion:

The analytical study was based on result in the previous questionnaire, which showed varying rates in satisfaction on the design and rates of energy saving and comfort within spaces , Based on the results, we make the following observations :

5.1 Building design

- **Building Mass :separating** Housing units Preserving open space through housing clusters
- **Building Orientation:** The unit should take 3 different directions at less In order to improve the rates of lighting and thermal comfort.
- **Building Shape:** The use of the Square shape in spaces design Preserving open space through housing clusters.
- **Optimal space standard and circulation :**Taking into account the proportions in the design spaces significantly contributed to the reducing waste area in spaces and be more accommodate future needs
- **Openings**: There must be windows in every space regard the favorite direction and air movement path. Fig 13

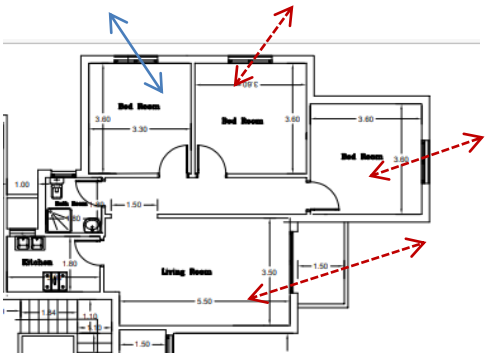


Figure 13 : designing the windows in different orientation allowing good air movement path

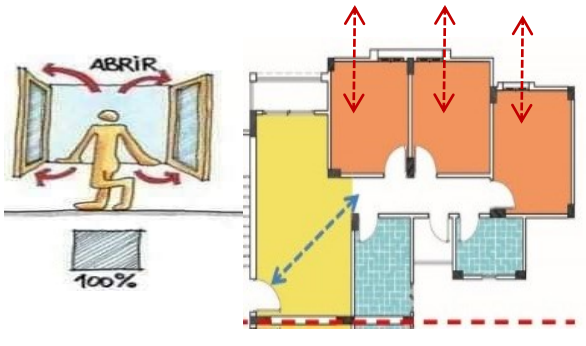


Figure 14:- The current situation in low cost housing windows was designed in one orientation

5.2 Urban and energy production

Regarding energy production in QOL indicators for Low -cost housing some important strategies are presented to achieve the production of energy:

- **Conservation of natural resources:** Water management system can be achieved by energy recovery, and conserving and reusing water. Using low-flow faucets.

- **Green Space Factor**: Raising the rate of green elements in Law cost housing urban spaces, encourage people to use Green roofs techniques which can reduce storm water volumes by up to 85% and the ceiling temperature.
    - Spreading bike and car roads Creating pedestrian- and bike-friendly spaces and walking/running paths.
- **Sustainable construction materials:**
    - Roads with Solar Panels: It is a new technique that combines environmental corridors and lighting together) lighting paths), instead of traditional lighting poles .
    - Artificial wind tree : Wind tree is used for the generation of energy from wind The leaves act as mini wind turbines which are capable of providing power.
    - Solar PV Parking Structure: putting Parking Lot Solar PV ,By power shading structure we are not only able to make more use of the land Parking lot solar
    - Wind and solar - powered hybrid street lamp: It can transfer solar and wind power to electric power and incorporates Stable operation, non-cable working ,No conventional energy consumption, long life span.
    - Tilfs for energy production: It converts the kinetic energy into electric energy and is stored in the units under the title to be used in various activities inside the building. One step produces 5-7 watts.
    - Photovoltaic cells: The building's facades and surfaces are supported by photovoltaic units to transform solar energy into electrical energy and can be placed on the hospital buildings in a decent manner providing aesthetic areas.

6. Applied Study:

Designing the units may have been the main factor explaining the rising of consuming energy its related to some more factors(Building Mass- Building Orientation- Building Envelope- Building Shape) From that the research suggest an Architectural proposal design plan of a low-cost housing regarding energy and economic issues**.**

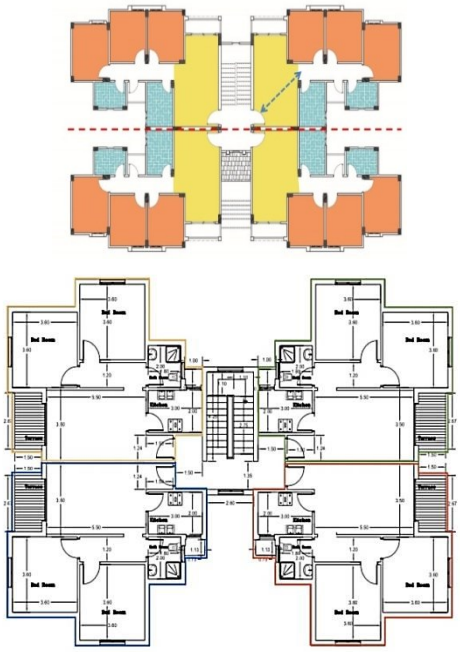


Figure 16 Design proposal for the 70m2 separating the building mass –regarding the orientation for every unit – avoiding the cross-sections in circulation By the Author

Figure 15: The current situation for 90 m 2 , Orientation The unit take 2 different directions at max, Rectangle shape , No Flexibly according accommodate future needs

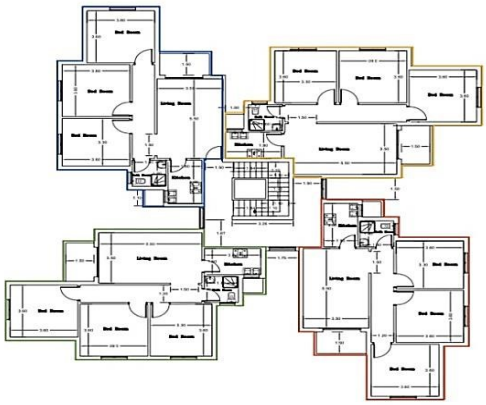


Figure 17 Design proposal for the 90m2 separating the building mass –regarding the orientation for every unit – avoiding the cross-sections in internal circulation By the Author

5. CONSULATION:

The analytical study focused on assessing and analysing the questionnaire and suggesting the necessary .modifications to solve the previously mentioned problems through the evaluation of rationalization and production of energy in terms of different items as introduced in a table.

The quality-of-life indicators were studied in terms of (energy rationalization and production). Conducting a questionnaire that measures the extent to which these criteria are applied, as low housing costs by the resident population.

These indicators were analysed to make a redesign of the current situation of low-cost housing. It achieves the following:

A) The minimum surface area for one room is less than 3.3.

B). Attention to the direction of the openings of the doors, and Considering the shape of the square-shaped unit.

C) Orientation per unit to 3 directions instead of 2 directions, and Considering privacy.

6. RECOMMENDATIONS:

1) Applying the indicators of energy conservation by taking into account the design standards, both internally and externally in Low -cost housing.

2) The smart technique should be Focused on the start of planning instead of treatment, and it is not considered expensive if it is compared to with the executed quantity and the time element.

3) The possibility of transforming existing Low -cost housing to energy producers building through the cultivation of solar cell surfaces, the use of wind and solar-powered hybrid street lamps, solar-powered glass, energy-producing floors and landscape can be easily achieved from the preliminary stages of design as shown in the proposed design.

4)The researchers recommend the application of energy-producing technologies in there various forms inside public buildings attached to low-cost housing to security aspects of maintenance work and to produce energy to reduce expenditures on the citizen's priest.

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