IMPACT RATIO FOR THE LAND AREAS ON THE BUILDING ENERGY DEMANDS IN BAGHDAD CITY

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Abstract - The efficiency of energy conservation of the main axes to provide occupant's thermal comfort of green architecture buildings. One of the variables affecting the efficiency of energy conservation is the land area. This study focused on the role of "The land area's impact on the energy reduction in the building spaces for the occupant's thermal comfort". The research problem was the lack of standards of the land area's impact ratio on the energy demands.
According to this lack of studies, a major objective for the research was established which is: (determining the land area's impact ratio on the building energy demands inside its spaces). In order to achieve this, the following methods are required:
a- Determining a theoretical frame in the land area subject in order to identify its importance and its role in preserving energy in buildings through the previous studies.
b- Determining a ratio of the land area impact on the energy demands in its spaces, through scientific studies on residential building map (test sample) by using thePassive House Planning Package (PHPP) to measure the energy demands then analyzing it to reach the results.
In the end of the study, conclusions were present, which cover the aim of the research. It was proved that positive relationship between energy demands and land area at a rate (% 31.6) to cool down the building in the summer period, and (26.1%) to warm it up in the cold period for each increase of additional (100 m^2) in the land area.

Keywords - Building shape, Energy demands, Green buildings,Land area, Thermal comfort.

I. INTRODUCTION

In the last decades, the attention of researchers and interested in the topics green buildings were directed towards finding energy producing recourses and the methods of preserving them. The designers seek to determine designing variable in the building that affects the energy demands, the land area as a variable of the designing variables affects in providing thermal comfort in the internal environment In order to achieve high-energy efficiency within buildings. Most of the Iraqi Laws and regulations determined the land area according to the urban area, which limited between (100-800) m2, and did not refer to the extent of the relation between those areas and the energy demands. . Therefore, the idea of research was the role of the land area on the energy efficiency within buildings and the ratio of its impact on the building energy demands inside it.

II. LITERATURE REVIEW AND RESEARCH PROBLEM

Several research were reviewed that addressed the role of land area on the building energy demands, and it was found that despite that these researches addressing the subject, but it didn't address the ratio of the impact of the land area on the building energy demands. Therefore, the study seeks to determine the ratio of the land area impact on the building energy demands, to help designers in providing thermal comfort for the building's occupants by control in the land area.

III. ENERGY EFFICIENCY AND EXHAUSTION DEMANDS

The concept of the building energy efficiency is the method of reducing energy efficiency (renewable and non-renewable), which is released as a final product in the operation and maintenance of building amenities. The guide to the energy preservation is by reducing the thermal load (Reducing gain and loss of energy) to prevent adding new thermal load on the building. The new thermal load needs additional exhaustion of energy to achieve the Thermal balance, and conservation is a confirmation to reduce the use of mechanical devices used to obtain the requirements of the quality of the internal environment.

The trend towards energy efficiency in the building is done by two concepts:
a- Increasing the technical efficiency and using it to serve the architectural work, which is known as the effective systems, such as the emergence of the modern air conditioning devices that consumes less energy compared to the previous devices
b- Reducing the need to use energy through the designs that takes the weather conditions in the design consideration [1]. Moreover, the energy consumption range in the building is determined since the beginning of the building's life cycle. The building components and systems are selected and decided based, on which the rest of the factors that affect the energy consumption are determined in the construction and operation phase. The operating stage is the longest and the most energy consuming Some

trends in architecture have focused attention on the process of energy efficiency. Such as passive systems adopted in their designs to take advantage of the positive conditions of the surrounding environment. That need for privacy and attention to the architectural design to take advantage of the energy conservation opportunities provided by the local climate to be a translation of the old traditional buildings, which have proven their efficiency in adapting to environmental conditions for many years. It works to ensure the level of thermal comfort for the user at the lowest cost of energy and reduce the transfer of heat through the outer envelope of the building. whether through environmental treatments to reduce the loss of heat from inside the building outside the winter or to reduce the thermal gain from outside the building into the summer and thus reduce the use of Energy and maximum utilization of natural ventilation and natural lighting [2].

IV. THE VARIABLE DESIGNING IMPACTS ON THE ENERGY DEMANDS

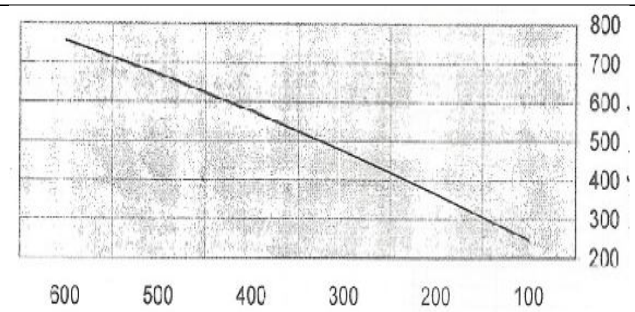
Energy-efficient buildings are the buildings with low energy demand compared to the other buildings by a (25-50%) [3]. And the designing decisions affects in its different stages on achieving their general goals through constructional means, by using the least technology possible that makes the building consumes less energy without loss [4]. In addition, its objectives are achieved by controlling a group of designing variable to reach the best performance of the building and to reduce the energy consumption demand in the building [5]:

- The design of buildings in simplified forms and in the least space without complexity and with appropriate guidance
- Thermal insulation and compact construction (for floors, walls, ceilings).
- Energy preserving windows with external shading devise.
- Ventilation and air recovery system
- Nighttime natural ventilation

V. THE LAND AREA

The land area mean that area of the piece of land dedicated to the construction of the building on it. Moreover, it is one of the main factors that determines the shape of the building beside the surface area, and if we know that the building's shape impact is more important than thermal performance of the building [6]. Building shape is determined from the impact of air temperature and sun radiation, to determine the engineering relation between weather elements and the building, the selection of the shape aims to reduce the impact of the contrast in the external weather factors on the internal environment. The fixed standard for the shape efficiency is the surface area ratio to the volume that are used by some studies, and its related directly by the method of construction of the building's cover and the method of thermal load impact on it [7]. In addition, the ideal shape is the one with the least possible surface area to any fixed volume and for the same construction area. Practically, the rectangular shape and the shapes similar to it are the best shapes regarding the low impact, because of the thermal loads and achieves the highest efficiency in reducing energy waste, and by using the right methods [8]. And the ratio of the building's exposure to the external weather elements can be determined by the shape of the cover, because the function of the thermal flow through the shape is the amount of internal temperature and the changes that happens in the external environment that are positively proportional with the change in the external surface area of the building[9].

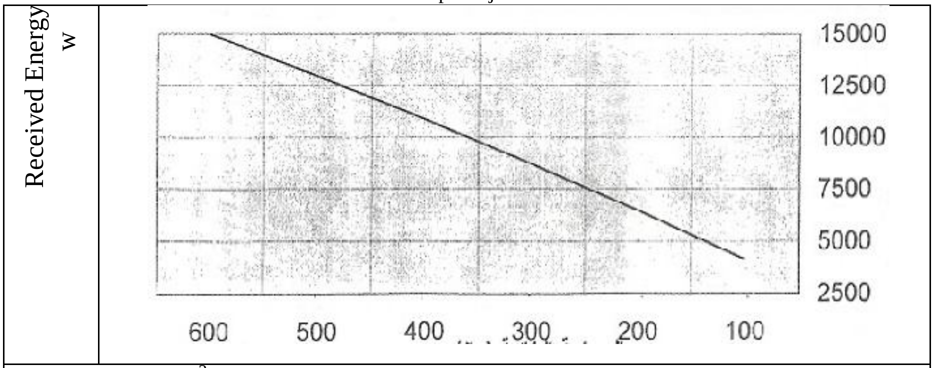
The surface area m^2



The land area: m^2

The surface area of the reference shape m^2 120+1.3 = 0.0004

Fig. 1: the relation between the construction area and the energy ratio it receives [10].



The land area: m²

The received energy = 1740 + 7433 – 0.038

Fig. 2: the curves of the surface area of the ideal shapes with one floor and two floorbuildings [11]

VI. THE PRACTICAL STUDY

There was an attempt in the practical study to determine the impact ratio of the land area on the building energy demands for the both cold and hot periods, according to the following methodology:

a. Putting hypotheses

b. Choosing the sample and determining the no. of studying cases of the sample

c. Measuring and analyzing the energy consumption demands

A. Hypotheses:

Through what was mentioned in the paragraphs above, we could determine as a hypothesis the existence of a positive relationship between the land area and the building energy demands in the hot and cold period.

A. Choosing the sample and determining the no. of case study for it:

In the beginning, a simple map of a simple residential building was chosen with an area of (10x20) m² from the maps of residential buildings in Baghdad as a sample in order to perform the practical study; it consists on one floor as in figure (3) and table no. (1).

The analysis results:

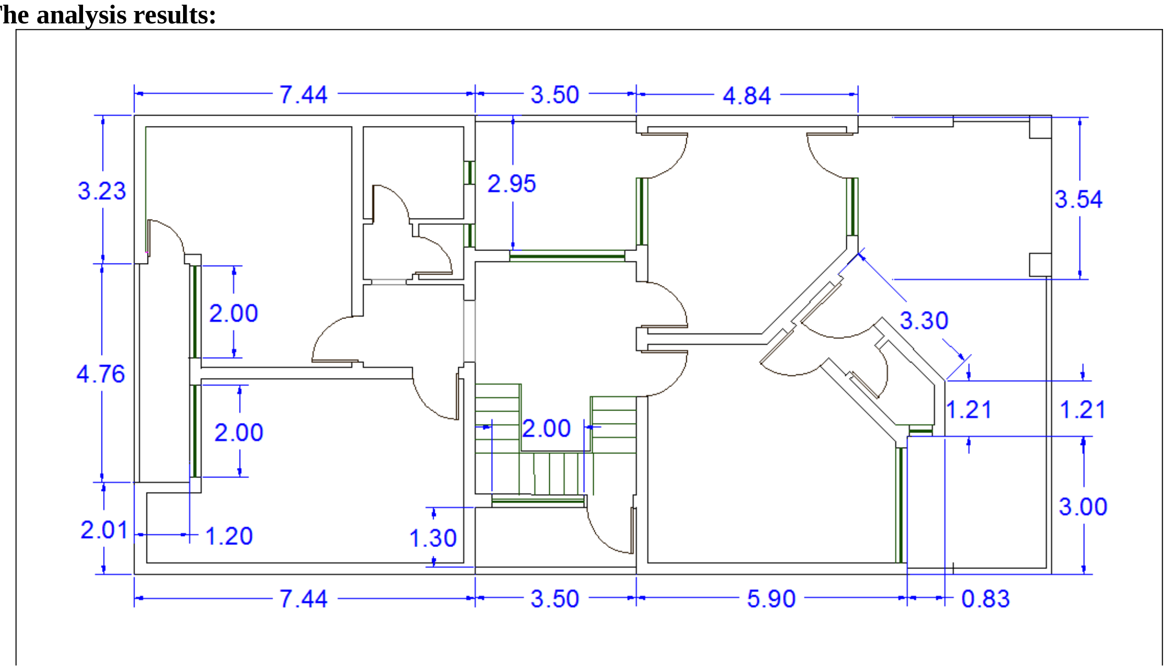


Fig. 3: The map of residential building sample no. (1)

Table 1: The information of sample no. (1)

Residential house consists on ground floor + attic		
1	Dimensions of the plot	10.00x20.00m²
2	Area of the ground floor	150.00m²
3	Total area	165.00m²
4	The length of the building premises	64.00m
5	The height of the floor and the building	Relate with case study
6	Other dimensions of the house	

No.	Elev.	level	Walls m)	Windows(m^2)	Doors (m^2)
A	1	1	2.01	2x2x2	1x2.5x1
			4.76	1.50x1.50x1	
			3.23		
			1.30		
			2.95		
		2	4.35		
	Total		18.8		
B	2	1	7.44	2x2x1	
			3.50	2x1.5x1	
			4.84		
			1.20		
		2	4.00		
	Total		20.95		
C	3	1	3.30		1.25x2.1x1
	Total		3.30		
D	4	1	3.54	1.25x1.5x1	1x2.1 x2
			1.21	2.5x2x1	
			3.0	0.5x0.65x2	
			2.95		
			1.30		
		2	4.35		
	Total		16.45		
E	5	1	0.83	0.5x0.65x1	1x2.1x2
			5.90	2x2x1	
			3.50		
			7.44		
			1.20		
		2	3.30		
	Total		22.12		

The dimensions of the case study were fixed in tables, and preparing them for processing in the next stage according to the table no. (2).

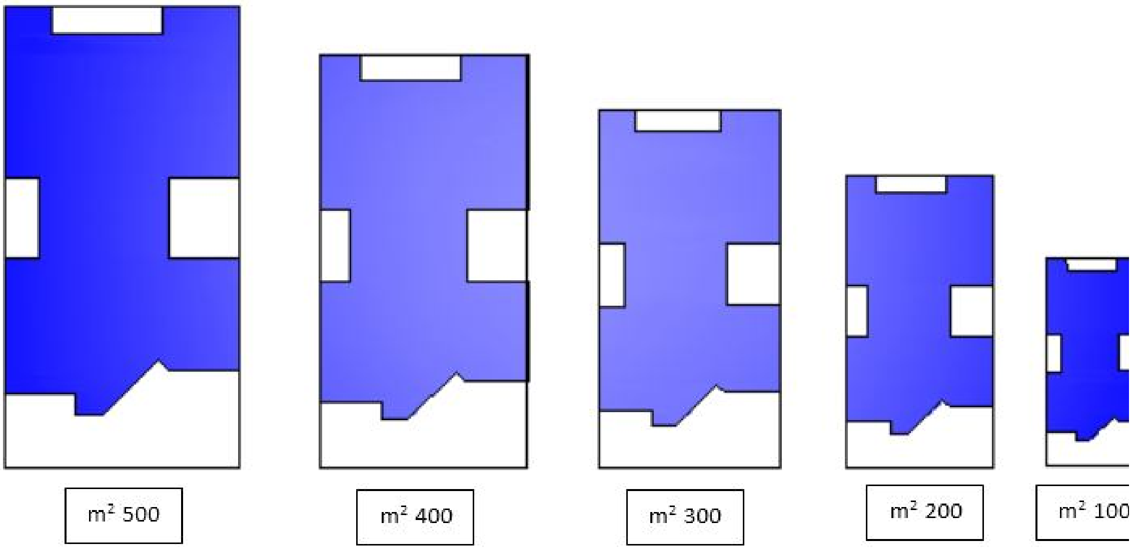


Fig. 4: The land area

Table 2: The no. of study cases for the variable

No.	Variables	Details	Cases
1	The land area without change window's area	Five different area of the building (100, 200, 300, 400, 500) m^2 in eight directions (135, 90, 0,45, 225, 180, 315, 27)	40

C. Measurement and analysis of energy demands:

In the measurement process, the Passive House Planning Package (PHPP) from the Passive House Institute was used to evaluate the building energy demands. Which is a specialist in energy conservation in buildings, one of the most powerful design tools available to design energy efficient buildings.

In order to analyze the data, the Microsoft Office 2013Excel program was used after encoding every variable among the groups in order to conduct the practical study and determining the percentage, and the relations between the affecting and affected variables as shown below for the results of the study.

D. Analysis results:

Through the study of the impact of five plots of land in varies areas and same design for the sample in eight directions, it was found that:

- When the building area is changed according to the size of the sample land area. This affects the energy requirements for the cooling down the building in the warm period. The consumed energy were (kWh9219) for an area of (100 m^2), and (kWh13842) for an area (200 m^2), with an increase of (4623 kWh) at an increase rate of (25.17%) in the increase of every (100 m^2). For the area (300 m^2, the energy spent in it were (19116 kWh), in an increase of (5273 kWh) with an increase rate (31.19%) in the increase of each (100 m^2). In the area (400 m^2), it was (24364 kWh) in an increase of (5249kWh) with a ratio (34.26%) in an increase every (100m^2), where the increase ratio was (35.95%) in an increase every (100 m^2) with highest energy consumption (29783 kWh) in the plot with an area of (500 m2) with an increase of (5319 kWh). As a result, there are an increase ratio in the energy consumption demands (5116 kWh) every (100m^2) increase in the land area for the cold period, in a ratio of (31.64%).
- The building energy requirements for the heating in the cold period were also affect by the change in the land area for the sample area. The consumed energy was (3849 kWh) for the area of (100 m^2), and the energy consumption rate increased to (5964 kWh) for the area of (200 m^2), with an increase of (2115 kWh) with an increase rate of (22.55%) in an increase for every (100 m^2).

In the area of (300 m^2) the energy consumed in it (8562 kWh), an increase of (2598 kWh) with, an increase rate of (25.88%) in the increase of every (100 m^2). In the area (400 m^2) it was (11141 kWh) with an increase of (2579 kWh) with an increase rate of (27.67%) increase every (100 m^2), while the highest value of the energy consumption was (13788 kWh) in the area (500 m^2), an increase of (2647 kWh) at an increase rate of (28.39%) in every (100 m^2) increase and in land area for the cold period with an increase rate of (26.12%) increase in every (100 m^2).

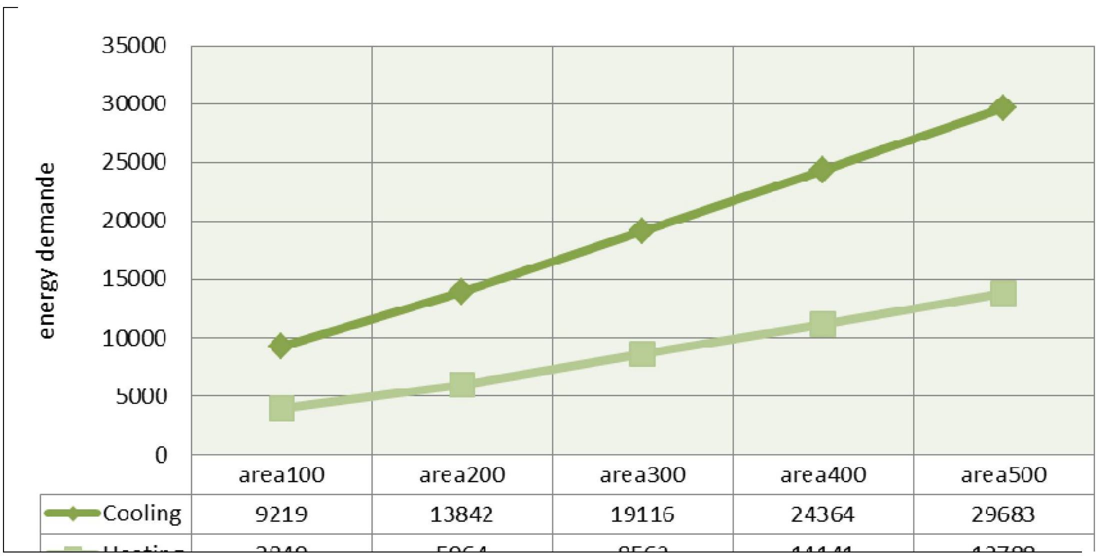


Fig. 5: the relation of the land area with the building energy demands

- The bigger land areamean's the greater the surface area. Therefore, the area exposed to heat exchange will increase, and the more it will be exposed to solar radiation, on the other hand, as well as the size of the internal space of the building that increases with the demand for energy consumption in order to cool it down in the worm period and to worm in the cold period.
- The rate of increase in the energy consumption (31.46%) for each additional (100m^2) in the area of the plot for the warm period, and the rate of (26.12%) for the cold period, according to table (3).

Table 3: The rate of the impact of the land area on the building energy demands

The rate of energy demand	The period	The difference in the areas (%)				The rate of change in the energy demands for every 100 m^2
		100-200	200-300	300-400	400-500	
	Hot	15.25	31.19	34.36	35.95	31.64%
	Cold	22.55	25.88	27.67	28.39	26.12%

CONCLUSIONS AND RECOMMENDATIONS

The study concluded a group of results:

- decreasing the land area acts to conserve energy in buildings
- The larger the land area that mean the bigger in the surface area, which causes the increase in the area exposed to the heat exchange and the exchange of solar radiation. As well, as increase in the internal space is increasing energy demands to cool in the warm period and warm in the cold period.
- A positive relationship between energy demands and land area at a rate (% 31.6) to cool down the building in the summer period, and (26.1%) to warm it up in the cold period for each increase of additional (100m^2) in the land area.

Therefore, the study recommends:

- Not to resort to increase of the land area without justification and act to reduce the area of the building exposed to the solar radiation and heat reduction by reducing the surface area of the building and then reducing the energy demands in the building.
- we there is need to increase the land area, the study recommends to use continuous dwelling type and being in close proximity with other buildings or shading by neighboring building and afforestation area exposed to gain and loss of heat to increase the efficiency of energy. As well as, the use of materials with thermal properties of building materials, prevent the processes of gain and loss of heat.

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