Sustainable House and Its Relation with Residents' Comfort

A Study in Selected Regions in the City of Kut

Sabeeh Lafta Farhan[1], Ihsan Abbass Jasim[2], Ahmed Naji[3]

[1] (Department of Architecture Engineering, Wasit University, Iraq, Email: sabehlafta48@gmail.com), +964(780)1764678
[2] (Ministry of Municipalities and Public Work, Iraq, Email: jasimihsan@gmail.com), +964(780)8451940
[3] (Department of Civil Engineering, Wasit University, Iraq, Email: Ahmed.naji@uowasit.edu.iq), +964(782)5628440

Abstract

This research dealt with the sustainable house and its relation with residents' satisfaction, which is the research problem. Therefore, the research aims to build a base of knowledge for sustainable housing. The research assumes that sustainability standards and controls for houses achieve the comfort of residents. The research defined the sustainable architecture as an architecture that directs designer towards designs requires less materials to preserve the natural resources. Therefore, it is an environmentally conscious design. Whereas, the sustainable design is a style focuses on the importance of the relation of buildings with the environment and aims to create integration with the environment. A theoretical scope for the criteria of sustainable house was drawn. This framework was applied on different localities in the City of Kut to measure the satisfaction of the residents. The most prominent findings of this research were: firstly, residential houses rely enormously on artificial energy for various activities such as heating, cooling and illumination, which poses a thread for the reserves of natural resources. This is because of the inconvenient temperature inside the house that is resulted from improperly designed spaces of the houses and other reasons related to not appropriate urban planning that should take into account the climate conditions.

Key words: sustainable buildings, energy conservation, Kut city, natural lighting.

Introduction

Developing world cities have witnessed a rapid urban growing, clearly related to the phenomenon of rapid urbanization doe to urban population growth. As a result, many environmental issues appeared and negatively reflected on the every-day-life activity of the city-dwellers.

Apprehending the problem and preventing any further propagation necessitates the adoption of a new line of responsible thinking of employing technological advances in switching into patterns of sustainable cities. Fundamental changes should be considered to redirect the cities from the conventional methods, which influence their formation, towards sustainability in various aspects, economic, social and environmental. This will be greatly dependent on what is available. Therefore, it is very essential to provide the adequate ground and environment to implement the concepts of sustainability. One of which, is the satisfaction of the dwellers of these cities and is the foremost indication of sustainability of the residential unit and the suburb as whole.

Research Methodology

The researchers followed a descriptive analytical method depending on the data and information extracted from different sources of literature: books, official reports, academic studies and websites to defining a theoretical scope for the sustainability of residential units. Then, measure its effects on satisfaction among residents of the surveyed regions in Kut city, and then:

1- extract the aspects of the theoretical framework of the above-mentioned items,
2- conduct field study by interviewing users and stakeholders, in addition a questionnaire distributed to a variant and comprehensive random sample of the population of 8 localities out of total of 50 locality: (**Damok, Rufiei, Imam Ali, Kafaat. Hawee . Anwar. Izza. Jihad**) in city of Kut (or Al-kut, the central city in Wasit governorate / Iraq).
3- using multiple regression model to assess the relationship between the variable which is the convenience of residents and independent variables (unexplained) and related to sustainability standards for residential units, and

The City and Urban Sustainability Achievement

Cities and sustainability

The role of urban areas in the world is growing in determining sustainable development there will be no sustainable world without sustainable cities (1). Today, more than half the world's population is city-dwellers. And according to World Bank estimates, 88% of the total world population growth will stabilize in 2025 in a fast expansion of urban areas. So, planners believe that modern lifestyles cause dissipation of natural resources; hence the importance of achieving sustainability of cities becomes very prominent. It is fact that the urban environment inevitability affects the environment, there must find ways to reduce these effects to the minimum.

The term sustainable urban development

Sustainable urban development is to find a balance between environmental, economic and social requirements process and apply this balance at the local level (city) (2). With the rapid expansion of the urban population, there has been a need to raise awareness about minimizing the environmental costs of urbanization. This raised concerns about the environmental damages, the depletion of non-renewable resources and the high pollution levels in urban areas. As cities have become places of environmental degradation in urban areas and wasteful use of resources, which has become costly for the current and future generations. The problem cannot be alleviated only by reducing the over-reliance on non-

renewable resources and recourse to the environmentally sustainable economic development, because there is a very significant and inherent risk in the urban growth and expansion in lifestyles in urban areas. This risk is represented in the increase in the usage of resources and the waste produced and piled in the environment, growing in a manner cannot be naturally recycled. The solution lies in sustainable eco-city (3). From what proceeded, the idea of sustainable urban development at the Earth Summit in (Rio de, Janeiro 1992) was envisaged and known as Agenda 21. The UN-HABITAT 2 conference, which was held in Istanbul in 1996, also recommended that every individual has the right to own dedicated space for housing. Conference 21, Berlin 2000, presented examples of best practice in the application of sustainable urban development in cities around the world. The concept of sustainable urban development re-emerged in 2002 in Johannesburg conference.

Sustainable Development conferences emphasized the importance of the contribution of the public sector, local governments and the need for involvement of local communities in directing sustainable development conferences (4).

Many of the ideas that have shown that there is a strong argument for saying that the city's future can be assured only if the approach to adopt a more "sustainable" urban development and the city where most people live in the current millennium has emerged (4). There are several factors working to identify these levels of consumption in the city, such as consumption patterns, lifestyles, income levels, and the form and urban infrastructure, national and local environmental policies (5). Therefore, it is very essential to understand

Sustainable Buildings (Sustainable Architecture)

It is, also called the green buildings, an environmentally responsible and efficient process of utilizing resources in all aspects of a building lifecycle (6). This can be achieved through:

- efficient use of energy, water and other non-renewable resources, and
- reducing the byproduct waste and pollutant that cause environmental degradation.

There is an equivalent approach yet different, that is the natural buildings. This usually exists on smaller scale and it focuses on utilizing the natural resources that are locally available.

Sustainable building also means finding healthy environmental management depends on the efficiency in using resources and respecting the principles that lead to a harmony with the environment (٧). It is a style of construction that pursue for integration between perfection and economical and social performance of a building (٨).

Sustainable architecture is kind of architecture that directs the designer towards designs consume less resource to preserve the natural resources. Whereas, sustainable design is a designing movement focuses on the importance of the relation between the building and environment. It aims to create integration with the environment.

Research Gap

There is lack of information in the body of knowledge about the relation between sustainability of residential unit and the level of satisfaction among the households in city of Kut.

Research Objectives

The objectives of this research are:

- To investigate the relationship between house properties and occupants' satisfaction achievement under the sustainable buildings standards.
- To compare between the current state of the residential units in city of Kut and the sustainability standards.

Research Hypothesis

The main assumption of this research is that sustainability criteria and controls for housing unit should achieve the satisfaction of occupants.

Measurements

Sustainability variables of residential units and their impact on the state of satisfaction among the residents were measured through the main points of the theoretical framework for sustainability characteristics and the characteristics of the population, as described in Annex (1).

Research Design

To verify the extent to which the housing units meet the standards of sustainability for the residential areas within the area of study in Kut and also to figure the impact on the state of satisfaction among the residents, a questionnaire was prepared to conduct a field study for selected areas as a sample.

The Questionnaire Form

The questionnaire form includes 13 questions, dealt with the physical environment of the house and the characteristics of the population and the availability of home garden and natural lighting and the type of construction materials used and the noise level.

The Studied (Sample) Areas

A sample of eight localities (Damok, Rufiei, Imam Ali, Kafaat. Hawee . Anwar. Izza. Jihad) was selected to represent the main characteristics of Kut city. The selection of these suburbs was built on preferences that serve the goal of this research. The sample localities are located within the basic design of Kut city in scattered locations that ensured the verity and some others points such as

1- the variation in the social characteristics, and
2- the variation in the economic levels of this localities residents.

Participants Samples

Fifty samples of housing-units from each locality were selected randomly to participate in the survey by that the total of surveyed samples was 400 which represented 1% of the population of the area under study in the city of Kut.

The Relation between the Sustainability and the Comfort in the Houses in the City of Kut

Wasit governorate, its central city is Kut, is located between 32° 01' and 33° 30' latitudes in the north and 44° 30' and 46° 26' longitude to the east. The area of Wasit province is about 17153 km^2 while the city of Kut built-up area covers 40 km^2, 4000 hectares. Kut city is located in an important location in the divergence of the rivers Gharraf and Dujaili of the Tigris River. City of Kut is about 180 km from Baghdad, and as the capital city of Wasit governorate it connects Baghdad with the other cities in Wasit governorate and also with Iraqi southern governorates.

Land use in the city of Kut was significantly influenced by the form of waterways that divide the city. Tigris River divides the city into two parts, southern and northern, which contains most of the administrative, commercial and service activities and contains the city center.

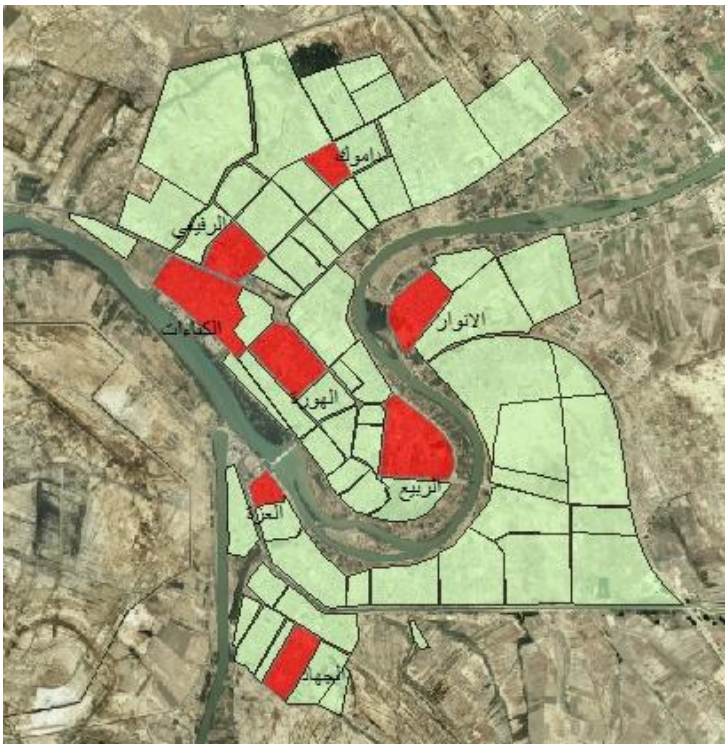

Figure 1 Satellite image for surveyed area

Results

Based on the survey results, this research has been divided into two parts. The first part investigated for providing the requirements of sustainable buildings in the residential units in the city of Kut. The second part then a statistical analysis and correlation analysis were conducted specifically to investigate the relationship between comfort in the housing units and the requirements of sustainable buildings, and also addressed the relations between sustainable buildings requirements.

Sustainability requirements in housing units

Results of the survey are summarized and are presented in Table 1.

Table 1 Results of eight localities

No.	Locality / Questions	Hawee	Damok	Rufiei	Kafaat	Imam Ali	Anwar	Izza	Jihad	Total
1	House area (≤ 200m^2)	٥٠	٣٧	٣	٨	٤١	٤٨	٥٠	٥٠	287
2	Number of residents (≤ 4)	١٠	٦	١٣	١٠	١٠	٨	٩	٧	73
3	Number of rooms (≤ 3)	١٢	١٠	٨	٣	٧	٢٠	٢٦	١٩	105
4	Number of stories (one story)	٢١	٣	٧	٥	١	١٧	٢٢	١٥	91

5	Do you feel comfortable in your current accommodation?	٣٣	٣٩	٣٨	٢٧	٣٠	٢٧	٢٣	٢٠	237
6	Is it possible to rely on natural illumination during day?	٢٨	٣٠	٣٥	٢١	٢٧	٣٥	٣٦	٣٧	249
7	How many windows per rooms (≤ 3)	١٧	١٢	٥	٥	١٤	18	21	19	111
8	Do you use cool/heat the house	٣٥	٤٢	٣٤	٤٣	٣٩	30	33	29	285
9	Is the house front shaded?	٩	١٧	١٩	١٥	٢١	١٢	١١	٨	112
10	What kind of materials are used for walls (clay brick)	٤٩	٤٨	٥٠	٥٠	٤١	40	41	38	357
11	What kind of materials are used for ceiling (concrete)	٢٦	٤٧	٣٥	٤٥	٤٠	3٦	37	32	291
12	Is there garden in the house	٢٩	٤٨	٤٩	٢٧	٤٣	27	23	20	266
13	Do you feel the noise	٣٣	١٧	١٠	٨	٢٠	37	38	39	202

Energy saving and accommodating with the environment

The results show a great deal of residents of the surveyed areas, rely on the artificial methods in air conditioning and illumination. With equal percentages for the eight regions, a total of 287 participants out of 400, pointed out that they are completely dependent on heating and cooling appliances to control the inner environment of the house. Over the half (249) of the participants responded that they use natural illumination where the percentage varied from almost 100% reliance on artificial illumination in Kafaat to 70% reliance on sun light in Rufiei.

In terms of accommodating to the environment, the survey results show negative indication. A small percentage of the participants mentioned that they considered adding shading elements to the front of their house to reduce the heat. While, only 112 participants answered that they have shading elements in their houses. Both examples indicate a high level of energy consumption and not sustainable practices.

Environmental friendly building materials

Kut city, as the most of the Iraqi cities, depend on the clay bricks in very extended manner. Raw materials that are used to produce bricks are locally available which means saving in the transportation energy. However, producing clay bricks requires high energy consumption and intensely pollutes the air. Alternative building materials still have very limited use. A number of 357 housing units were built by using clay bricks.

The same is true for ceiling materials. Although, all the materials are produced locally, except reinforcement steel bars, providing these materials consumes enormous energy.

Illumination and ventilation

Number of windows in a housing unit is regarded as indicator for ventilation quality and type of illumination. Based on this criterion, housing unit with adequate number of windows is considered sustainable or not. The number of houses that have more than three windows is 289 out of 400 units. Nevertheless, it seems that dwellers of these areas do not fully make use of the window as 50% of the surveyed houses are illuminated artificially.

General assessment

The results of this research show that housing units city of Kut lack to most of sustainability requirements. They consume enormous amount of energy and pollute the environment during construction. In addition, the construction materials are not recyclable only with small percentage. The

houses depend mainly on heating and cooling systems and do not depend on the natural light. 50% of the population of the surveyed areas does not feel comfortable despite the amount of the used energy and the high cost budget allocated for its construction.

The Correlation between Comfort in the Housing Units and the Requirements of Sustainable Buildings

The statistical program (SPSS) was used to find the correlation between the comfort and sustainability of houses criteria. The correlation analysis results showed several indications and they are discussed in two sets of relations. The first set discussed how sustainability related to comfort of occupants and the second set discussed the relations of the variables with each other.

The relation of comfort with criteria and requirements of sustainability

The results showed a direct correlation with 89% level of significance. The correlation between existence of home garden and the comfort of the occupants was 99%. This is a normal result for what comfort features gardens have. The results also showed a direct correlation by 73% between the comfort of residents and the use of bricks for walls.

For the other variables that are related to the sustainability of the house, the results did not show any direct correlation nor indirect correlation. Whereas, all levels of significance were out of range of statistical precision. This result opens the doors for many other queries about the nature of the Iraqi people. This may indicate lacking in the engineering and social studies. For example, the level of comfort must increases when the number of family members who live in the same house less than 4 because of availability of more room per person. The same is applicable for the area of the house which did not indicate any positive correlation. It seems that the residents are interested in the provided services rather than the area of the house. Therefore,

The relation between sustainability requirements

The results of the correlation analysis showed a small number of realistic correlations statistically acceptable and can be employed. A 73% direct correlation with 95% level of significance appeared between using air conditioning systems for cooling and heating and the reinforced concrete ceiling. Also a direct correlation of 89% and 99% level of significance between level of noise and the increase in the number of houses with area of 200m was found. This is a logical result as larger areas increase the distance between noise sources and residents. Also, direct correlation 73% and 95% level of significance between shading structure and reduction in noise level. A significant direct correlation and high level of significance, 78% and 95% respectively, for the number of rooms; increase in rooms number leads to greater dependent of natural lighting and greater dependent on natural lighting leads to increase the need for air conditioning system with 85% correlation and 99% level of significance.

Most of correlation analysis results did not show significant relations in most of the correlation. No positive correlation between being affected with noise and home garden was found. While very clear and strong correlation was anticipated to appear. There were other characteristics did not show any relation with noise level such as number of stories, number of residents in the unit and building material. It can be assumed that sensing the noise is subjective factor could not be measured precisely by the participants.

Conclusion

A survey was conducted on households to measure the satisfaction about the sustainability of houses in eight regions in Kut city, Iraq. Based on the acquired results, two main points can be concluded. First of all, the type of residential buildings in the surveyed area, and that is applicable for most of Kut city, is not sustainable as it consumes enormous amount of energy for daily activities such as lightening and interior climate control. Secondly, houses of the surveyed area are also causing pollution during construction. The reason can be related to the improper designs which did not consider the city climate and did not explore alternative material that helps in accommodating the climate.

Recommendation

The researchers come up with few recommendations to respond to the problem:

1- It is very important to take into consideration when planning for and designing buildings, the climate conditions of the area and this is regarded as principle of green architecture.
2- It is very important to use the natural light in illumination the building by choosing the right opening size.
3- It is very important to use shading members and insulation material or depending on vegetation to enhance the interior climate of the building and absorbing the noise.
4- It is very important to educate the public by campaigns about wise use of energy and sustainability.

References

1. **Benton-Shor, Liza and Short, John Rennie.** *Cities and Nature.* Abingdon, Oxon : Routledge, 2007.

2. *Achievement to Sustainable Urban Development Using City Cevelopment Strategies: A Comparison between Cities and Aliance and the World Bank Definitions.* **Rasoolimanesh, Mostafa.** 5, s.l. : Jornal of Suatainable Development, 2011, Vol. 4.

3. **Hojer, Mattias.** *Images of the Future City: Time and Space for Sustainable Developement.* Heidelberg : Springer, 2011.

4. **Nation, United.** *Conference on Environment and Development, the Rio Declaration, June 1992 Agenda 21.* Rio, Brazil : United Nation, 1992.

5. **Thorns, David.** *Op. City.*

6. *State of the World's Cities.* 2008.

7. **Hart, Kelly.** Sustainable Architecture. [Online] http://www.greenhomebuilding.com.

٨. *العمارة البيئية المعاصرة.* **خالد سليم نجال.** القاهرة : جامعة الازهر، ٢٠٠٤.

٩. **رشيد اكرم شلهوب.** العمارة الخضراء. [متصل] ٢٠٠٧. http://www.alamal-chd.org/a18/a18s2.htm.