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An Investigation on Vernacular Houses Regarding Sustainable Architecture (A Case of Shiraz, Iran)

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Abstract

There are different factors such as topography, climate features, economy, livelihood, water resources, etc. leading to the formation of different urban forms in both rural and urban fabrics in Iran. Over the centuries, specific climatic and geographical conditions of this land along with pasts' intelligence in utilizing natural resources and preserving them helped to emerge architecture. Current crises such as climate change and short of resources have led architects to decode the vernacular architecture of different areas, adapted its achievements to the modern needs, and so moved a step closer to achieving sustainable architecture. Since the basic cause of environmental degradation can be traced in the field of architecture and urban planning and as the house is the most fundamental unit in architecture and urbanization, this article aimed at analyzing vernacular residential buildings of Shiraz, which is assumed to meet the environmental and biological comfort in the past, and examined its closeness to the principles of sustainable architecture. To this end, six historical buildings (from Qajar dynasty and before it) were selected randomly. Library research and field observation have been conducted. The results indicated that the vernacular buildings of Shiraz had the highest conformity with the principles of sustainable architecture.

Keywords: Sustainable Architecture; Vernacular Architecture; Shiraz

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1- Introduction

Many researches have been conducted on vernacular architecture of Iran and its conformity with climate condition and sustainable construction; among which these ones can be mentioned: Diba and Yaghini () studies the vernacular architecture in Gilan, and have evaluated several types of residential buildings based on houses' surrounding. They finally pointed out that the climatic limitations should be carefully considered in designing, and the local materials should be used in new constructions. Saghafi and Saed () examined the compatibility between environment and local materials in one hand and energy saving on the other hand. They believed it is a crucial issue due to the energy crisis in the world, growing incompatibility of materials and depreciation of buildings, especially in some specific environmental conditions. Ghazanfarpour () have examined the relation between climate and housing in Kerman and stated that there is no attention to climatic design in recent decades. He considered the solar radiation impacts, temperature importance and the building orientation against wind, and then proposed some criteria and principles for the construction regarding plan, materials' color and their types to use renewable energy properly. Mellatparast () evaluated the tradition architecture of Iranian desert cities. He concluded that the traditional architecture of this region has been in full compliance with the principles of sustainable architecture. Shams and Khodakarami () studied traditional climatic architecture and emphasized to use natural factors and adhere to the principles of sustainability in constructions. Parvardi () in examining sustainability of residential buildings pointed out that using the principles of traditional architecture along with the application of new technology is also very effective in sustainable constructions. In line with climatic and sustainable architecture in Iran, Ghobadian (2009) believed that with the advent of new technology, considering local climatic conditions was ignored while climate design is an

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important part of sustainable architecture. Analyzing data obtained from a research on sustainable architecture in rural housing, Feyzabadi () stated that rural sustainable architecture is an architecture that is based on vernacular construction of rural settlements.

According to different researches on climatic building design, one can concludes that these investigations have not considered the traditional buildings and sustainable construction as a particular topic. Some investigations have also emphasized the importance of energy in the building and discussed how to use renewable energy. In this work, therefore, all studies have been collected; then, based on different samples, the Iranian traditional architectural features have been examined in relation to the sustainability.

1- Sustainable Development

The term sustainable development has been used widely since the mid-70's and after the oil crisis in 1973. Today, sustainable development is one of the main issues at the international community (like world environmental organizations and United Nations) and around the world. According to the United Nations World Commission, sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The World Bank defines sustainable development as "a durable development" (Azizi, 2002: 20).

2-1- Sustainable Architecture Principles

According to Ghiasvand (2007: 4) the principles that should be considered in a sustainable building include energy preservation; climate coordination; reduced use of new resources; residents' needs; coordination with the site; and holism.

2- Recognizing Characteristics of Vernacular Architecture with Sustainable Architecture Principles

Fig 1: Bazrafshan House in Shiraz. Vernacular architectural features, presented in Section 3, can be seen here (source: authors).

East Elevation :نمای شرق

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پلان بام: roof plan

پلان طبقه اول: first floor plan

موقعیت: situation

دید به فضا: View

3-1- Energy Preservation

Using natural resources and energy is one of the fundamentals of construction in traditional buildings (Asadpour, 2006: 70). There are some ways one can preserve energy in buildings mentioned here.

3-1-1- Earth-sheltering

It refers to using earth against building to apply thermal mass in different seasons, which preserve energy through time delay.

3-1-2- Spaces

Plans are compact and so the building's exterior surface-to-volume ratio decrease to the minimum. This compactness of plans and buildings minimizes the amount of heat exchange in winter and summer and creates shadow on the surfaces.

3-1-3- The Number and Area of the Openings and Doors

In order to preserve the interior spaces against the adverse outdoor conditions, the number of openings should be kept as low as possible. Openings and windows related to the external environment should be installed in the upper part of the walls to keep grime and dust out of home as well as decrease the amount of reflected radiation penetrating the building. It is also better to design most of the openings and windows facing central courtyard, which is not under harsh wether condition.

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3-1-4- Façade and Surfaces in Shiraz Climatic Condition

Light-colored surfaces and facades are chosen in order to absorb the minimum amount of solar heat and reflect the maximum solar radiation. Using Light-colored finishes such as stucco, adobe (a mixture of straw, gravel and clay), and finely chopped straw in adobe make it possible to have a smoother and more polished facades.

3-1-5- Insulation in Traditional Architecture

Iranians have long been familiar with insulation and built their homes by using available construction materials; they changed the thickness of the walls to decrease the needs for heating and cooling. Insulation reduces unwanted heat loss, in winter, or gain, in summer, and can decrease the energy demands of heating and cooling. Insulation played an important role in traditional architecture of Iran so that there is no roofing, either flat or curved, which were not insulated. It was light as well as preventing heat exchange between inner and outer (Pirnia, 1382: 156).

3-2- Climate Coordination

The total volume of all six buildings is compact. As density and compactness of buildings increase, the surfaces exposed to the acute conditions of that regions decrease; and, therefore, heat exchange between the outer and inner spaces are minimized. All the living spaces of this area (such as urban spaces, streets, walkways, courtyards and buildings) are protected against adverse weather conditions and unfavorable winds. However, building orientation let both cool wind and solar radiation reach the house in summer and winter respectively.

3-3- Reduced Use of New Resources

Using local materials with appropriate heat capacity has been an appropriate approach used in Iranian architecture through history. This would not only use the suitable materials adopted to the climate but also save costs for transportation, and finally the embodied energy would

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decrease. It is obvious in central and desert regions of Iran in which soil, clay and brick have been employed in constructions. Field observation showed that the samples under this study were constructed by local materials; construction remains and wastes were also used among the walls to fill the gaps and the holes. Furthermore, the materials are of modular kinds i.e. it is possible to transfer and exploit them anywhere and anytime if necessary.

3-4- To Meet Residents' Needs

Introversion, working inside the building aesthetically, and not paying attention to the building appearance have found the way into architecture by some architects. In Iranian architecture, therefore, the outer envelope and façade is constructed by mud but the inside is a wonderful world. Introverted home features are as follows:

1- Not having direct visual from outside spaces into the inside of the home;

2- Its different spaces are organized by elements such as central courtyard or entirely closed iwan so that all the openings are opened to them (Memarian, 1381). Introversion is also penetrated into the urban fabric. Density of buildings has helped to reach a climatic design, defending the city against invaders as well as improving the social relations within the city.

Furthermore, spatial hierarchy of houses including separation of different parts with different usages (e.g. the place for winter or summer settlement in the house), and combination of different parts with different usages (e.g. the rooms which can be used for sleeping during the night, used for working during the day and also used as dining room and guest room in some special moments) are design to provide the residents' needs.

3-5- Coordination with the Site

The building orientation is towards Qibla. Therefore, from a climatic point of view, the rooms used for winter (i.e. rooms located in the north side of the building to enjoy the sunshine) or summer settlement (i.e. rooms against the Qibla which are located in the south side of the building) find their orients logically. Proper orientation protects residents against direct solar heat as well as preventing unpleasant winds from entering the rooms. As can be seen in Fig 1. Building orientations is towards south and sun. In fact, the buildings do not imposed themselves to the urban fabric.

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3-6- Holism

Gardens with low-water trees and plant can provide shade and beauty as well as compensation the ambient humidity. These green surfaces absorb solar radiation and prevent unwanted reflections and heat. They sometimes also play a role as a windbreaker. Selecting the type of trees depends on their orientation. Providing springhouse and pond in the middle of the courtyard or in the cellar to create a pleasant air, creating perfect visual views and sound by fountains and inspiring a sense of calm are all among the advantages of using water in residential buildings. In hot and dry climates, evaporation can reduce temperatures. The evaporation level in an enclosed space (such as interior courtyards) depends upon the water surface area, the relative humidity and water temperature (Dekey and Brown, 2013: 124). The ancients were well aware of this fact. In winter, the rooms facing south are used to absorb solar heat with large openings. As was mentioned, rooms used for winter settlement are in north side of the building, and rooms used for summer settlement are in the south side of the building; they have openings (facing north) which are less exposed to the solar radiation. In the central courtyard green surfaces, poles and fountains are placed to create moisture in dry climate. In the night, the cold weather subsides into the ground and stores in the walls and courtyard. It releases during the day when there is a maximum amount of solar radiation, and then modifies the temperature inner the building and courtyard.

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3- Results

Table 1: The results obtained by field observation of six samples regarding sustainable architecture principles (source: authors)

	energy preservation	**climate coordination**	**reduced use of new resources**	**residents' needs**	**coordination with the site**	**holism**
1. Mansori	earth-sheltered	compact fabric	appropriate materials	introversion	towards Qibla	pond
2. Talebanfar	the minimum surface to volume ratio	compact fabric	appropriate materials	introversion	towards Qibla	green space
3. Hasanpour	No. of openings	compact fabric	roofing	introversion	towards Qibla	pond
4. Jalalian	compact plan	compact fabric	roofing	introversion	towards Qibla	green space
5. Amoee	the color of	compact	appropriat	introversio	towards	pond

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	surfaces and façade	fabric	e materials	n	Qibla	
6. Bazarafshan	earth-sheltered	compact fabric	appropriate materials	introversion	towards Qibla	green space

4- Conclusion

In vernacular buildings, six principles of sustainable architecture were among the inseparable parts of buildings and architects' concerns. It was also tried to leave the minimal impact on the environment. However, in modern architecture, we face the overuse of non-renewable energy due to the use of inappropriate materials and design and employing heating and cooling equipment. Designing basements and using earth-sheltered technique, decreasing surface to volume ratio, reducing the number of openings, designing compact plan, using light-colored surfaces and facades, choosing appropriate building orientation, employing suitable materials and type of roofing, being introversion, using green space and pool all have helped to provide sustainable architecture principles and meet residents' comfort and needs (which is the main goal). In modern architecture, first, the human needs should be recognized and then responded to them based on the past architecture's experiences.

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