INVESTIGATING THE IMPLICATIONS OF SUSTAINABLE ARCHITECTURE IN THE NATIVE ARCHITECTURE OF RESIDENTIAL AREAS IN IRAN (A CASE STUDY OF WARM AND DRIED CLIMATE IN KASHAN CITY)

Seyyedeh Maryam Mojtabavi[1-*], Mohammad Taghi Validad[2]

1. MSc Architecture, Young Researchers and Elite Club, Mashhad Branch, Islamic Azad University, Mashhad, Iran
2. *MSc Urban Design, International University of Imam Reza (pbuh)*, Mashhad, Iran

pii: S238315531500006-4

Received: 08 Feb. 2014
Accepted: 21 Apr. 2014
Revised: 11 Oct. 2015
Published: 25 Dec. 2015

*Corresponding Author
E-mail:
Mojtabavi_m@yahoo.com

ABSTRACT:
In the modern world, as time passes by, native methods that are compatible with the nature are gradually being forgotten. Buildings and their architecture are getting more technology oriented, and have no harmony with nature and human's soul. One way to achieve quality missing in today's world can be a peaceful return to the indigenous construction techniques leading us to a satisfactory quality that we, as humans, need in our houses. This article refers to the principles of sustainable architecture and in the meantime it tries to assess the traditional houses in Kashan regarding their indigenous architecture. Studied cases are comparatively evaluated with the principles of sustainable architecture. With the use of these experiences, native methods could be used to reconstruct such residential areas. As a conclusion we can say unlike the architecture of modern buildings, indigenous architecture experiences and techniques, because they optimize the use of natural climatic factors, have been very successful, and can be used to design new climatically oriented architecture.

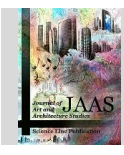
KEYWORDS:
Sustainable Quality, Indigenous, Residential, Kashan

1-INTRODUCTION

Vernacular methods consistent with the nature of the modern world were gradually neglected and buildings which were based on technology and ignored human beings the nature was created. One way to achieve the lost quality in today's world is referring to local building techniques and methods to reach the desired quality in contemporary houses. This article refers to the principles of sustainable architecture to assess the climatic factors of the traditional houses in Kashan. Houses have been compared with the principles of sustainability by the use of comparative methods. Understanding these experiences can be used to reproduce the residential areas. Then we draw the conclusion that vernacular architecture, as opposed to modern buildings, have been very successful because of the efficient use of natural climatic factors and we can use the experiences and techniques of vernacular architecture in the design of a new climate.

Humans are part of nature. So if you are aware enough of the laws of nature and the environment and matchourlives with the constant flow of nature, beside comfort and financial and economic benefits, we can have a varied and pleasant environment in all seasons. If we want to live in harmony with our environment, we need to follow what our forefathers have acquired after many years of experience in the design of climate; otherwise, a large part of the sustainable qualities of human experiences will be lost.

Looking at the structure of residential buildings, we find that the use of renewable energy such as solar energy and wind has been important to human beings. Housing arrangement , empty and full spaces, establishment of planning and building, the size of the original elements, the spatial relationship of the key elements of the plan, distributed architecture, materials used, dimensions of space, and all the phenomena associated with climate we redefined and regulated without ignoring the importance of cultural, social, political and



economic factors. It is obvious that this relation is not sudden, but has developed by employing the local experience of trial and error and during ages [1].

Vernacular architecture traditionally refers to forms which are based on the needs and constraints of local residents and climate of a region. In this architecture, building mass distribution is in a way that in addition to taking full advantage of sunlight, air flow out of the building is reduced to a minimum. Also in the summer, while minimizing thermal conduction, radiation is used to cool the building. In the winter, the building takes the most advantage of sunlight so it minimizes the thermal conductivity. Also during the summer, while causing a delay in the thermal conductivity, proper ventilation is created [2].

The development of this kind of architecture, due to applying local and ecological materials, will often have a relatively simple process and easily responds to the needs of the residents. That's why some designers consider it as a responsive and sustainable model of architecture. Obviously, nowadays, understanding and assessing the role of climate on traditional buildings and structures are among the most important programs and priorities in reducing energy consumption, using natural resources instead of mechanical systems and creating convenient, normal, and durable living spaces. Despite advances in science and technology, environmental and climatic designing have not been given much attention. Inappropriate policy-making, priority of short-term goals over long term goals, unethical competition, inadequate education, access to cheap, subsidized fossil resources such as oil and gas, and the like can be among the reasons for this negligence. it is important to mention that in chapter 19 of the National Building Regulations we read that the design and architecture of buildings should match the climate in order to save energy consumption in heat and cold [3].

2-Statement Of The Problem And Research Objectives

Therefore, in this study the open spaces, and especially central courtyards as one of the basic elements are evaluated in terms of stability and their role in achieving sustainable domestic architecture is investigated.

3- Literature

Valuable research has been done about open spaces. G. H. Me'marian has conducted valuable studies about courtyards in Iranian vernacular architecture. Farhad Ahmadi (2005) has also investigated the central courtyard in terms of sustainability.

Following the researched just mentioned, this research mostly focuses on the residential spaces which are related to central courtyards, especially in the vernacular architecture of Kashan. It emphasizes the pivotal role of open spaces in the central courtyard sin realizing the principles of sustainability.

4- RESEARCH METHODOLOGY

This descriptive-historical research is a qualitative study. Population of the study includes traditional architecture of desert and warm and dry climate of Kashan. Sampling method is purposeful and data collection sources include documents, maps, and objective observations of attitudes.

In the course of the study to clarify the role of local open space for the emergence of sustainable architecture, sustainable architecture principles were first explored and then, by drawing on comparative method, the principles of sustainable architecture and central courtyard houses in the sample were compared.

5- Sustainable Architecture

Sustainable architecture is an attempt to reduce the negative impacts of architecture on the environment. Accordingly, in the construction of the man-made environment attention should be paid to the natural resources available and renewable resources such as fossil fuels in order to save and preserve the energy for next generations. According to the definition of sustainable architecture, traditional architecture in hot and dry climates is considered as a symbol of comfort and climatic design [4].

5-1- Principles of Sustainable Architecture

These principles include:

1- Conserving energy: The building should be built in a way to reduce its need for fossil fuels.

2-Climatic considerations: The building should be in harmony with the climate and energy sources in the construction site.

3- Reducing the use of new resources for materials: Buildings should be designed to reduce the amount of new resources as much as possible.

4- Meeting the needs of residents: Meeting the emotional and physical needs of the residents is important (Human-Centered Design).

5- Coordination with the site (location): The building should gently land on the site and should be congruent with the environment.

6- Holism: The whole principles of sustainable architecture should be considered in a complete process that leads to a healthy environment [5].

Traditional architecture in the central plateau, where the climate is hot and dry is a good model for the design and architecture in this climate and is considered sustainable architecture [6].

5- Kashan

The city of Kashan in Iran, which dates back to prehistoric eras, is one of the old and historical cities. Archaeological investigations in the history of

settlement and civilization in Kashan Silk Hill reveal that this region goes back to 4200 years BC [7].

Kashan is located at 33 degrees 59 minutes north latitude and 51 degrees 27 minutes east longitude at an altitude of about 982 meters above sea level. Kashan, with annual rainfall of about 150 mm, is one of the driest cities in Iran.

Hot and dry summers, cold winters, winter and summer tornadoes make the climate harsh. Although Kashan sits on the coast of the desert, it has never been affected by winds and mighty sand storms. Neither the grueling summer heat of the desert northe cold winter has affected the city [8].

Vernacular architecture measures have been carefully taken in Kashan in order to simultaneously cope with the heat and cold temperatures.

6-The role of the central courtyard in sustainable vernacular architecture

Open spaces have had a pivotal role in Iranian cities and their vernacular architecture.

6-1- Central Courtyard and Energy Conservation:

Brick walls are wide and bulky due to limited resistance to pressure. Therefore, they make the following things happen:

- The thick adobe walls, due to the high heat capacity, act as heat sink.
- Adobe walls with low heat transfer area good insulation for buildings.
- Due to the coarse texture, color and atmosphere, absorbing and scattering radiation is limit and its reflection is high.
- Because of the large mass, their acoustics is very efficient.
- Clay, due to the high heat capacity, can absorb the energy during summer days, but, due to low heat transfer coefficient, effectively delays the heat transfer. Meanwhile adobe structures because of the lack of any metallic or chemical material easily are easily recycled in nature [9].

By creating a cool and wet climate adjacent to the building, courtyards will help to reduce the energy required for cooling the building. Putting a pond in the middle of the house and planting trees would reduce the influence of the warm summer weather and the entry of sunlight into the room as well as the absorption of by the walls and heat transfer from floor of the building to the building itself. However, because of plants, trees and water pools in the courtyard, courtyard temperature decreases and heat transfer from outside to the room is reduced. Heat transfer out of the rooms also reduces [6].

In the porch and deflector wall in the middle of the central courtyard building makes a favorable airflow through the platform [9]. Vernacular architecture in desert regions of Iran, despite the harsh environmental conditions of these areas, provides the possibility of comfortable and stable life for thousands of years.

Table 1. calculating the ratio of indoor areas to outdoor areas in native buildings
Open and not built areas Filled and built areas

The ratio of the filled space to the empty space	The area of outdoor (Empty space)	The area of the indoor (Filled space)	The filled and empty space of plan	Structures name
3/64	166 m^2	605 m^2		Jahan Arayee
2/21	226 m^2	502 m^2		Brujerdiha
2/10	630 m^2	1325 m^2		Tabatabayeeha

6-2- Central Courtyard and Climatic Considerations:

Introverted houses in hot and dry climates are like heavens in the center of desert. Introverted space is closed like a warm embrace from every side into the lead. In the land between houses, introverted houses are proper response to dry air, annoying wind, sharp sands and harsh sun [10].

In the courtyards of indigenous houses in the desert, all the elements together provide a small livable climate. They act like a smart element against cold, heat, humidity and wind and provide an oasis of natural light, water, wind and plants in adverse environmental conditions for the residents. Wooded interior courtyard with pool and plants is one of the most effective causes of moisture in arid areas. So the rooms, which are just open to the courtyards, are protected against wind and sandstorms [11].

Design of different full and empty spaces, such as central courtyard with high and shady walls, roofed porch spaces, rooms in different directions, corner room with water pool, basement, and roof, each has been built for specific hours of the day and night and hot, cold and mild seasons of the year in a way that man can live in harmony with climatic change and select the living environment [12].

Creative making of garden in the central courtyard, in addition to creating a micro climate, provides better access to subterranean spring water and makes watering plants easier. The central courtyard and portico of four pages using the walls and wind towers in the middle of the central courtyard of the building provides proper airflow.

In the courtyard of the buildings or street or alley or bus to the local market as “porch” is coplanar with the surface of the porch or yard with a height difference would be stepping into the yard. The relationship between the level crossing and lane or street with a few stairs is so arranged that the result will be lower than the yard or alleyway. Certainly the vestibule prevents strong winds and hurricanes that result from wind flow is from the alley into the courtyard. Furthermore, the reason for the difference between the yard and the building and

the street is because it is protective against severe strong wind sand warm winds and prevents their penetration into the building [13].

Courtyard with a sunken garden: Example of this kind of courtyard is seen in Nain, Kashan and other desert regions. Sunken garden and the space around it actually play the role of underground spaces. The floor space is located around terrace and sunken garden with green trees, because it is hollowness, creates cool space [14].

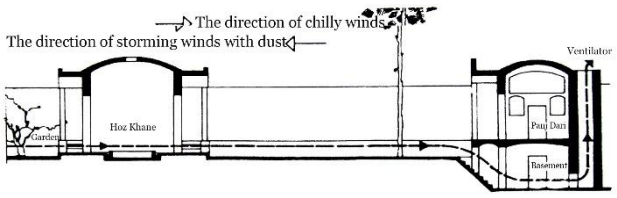


Figure 1. a structure of a residential building equipped with a yard and a basement (in Aran area, a part of Kashan city) [6].

6-3- Central Courtyard and Materials:

Self-efficacy is one of the principles of Persian architecture that its effect on Kashan architecture is obvious. In the present status of construction in Iran, building materials in the two states will be considered native materials: materials available in the village or the city and those brought to villages or cities from a short distance [15].

Clay, which is produced with little change in the environment and maximum compatibility with it, is also the most economical material. Underground aqueduct has now led to the creation of materials with minimal energy use and non-local additions, so most of the materials required are provided within the local construction site [9].

Brick structure, due to heat, acoustics, structure, economy, simple technology, zero pollution production, zero energy production, self-transport, not changing the environment seen in the extract, non-chemical nature, naturalness, not creating a shield against cosmic spheres and finally recyclability, has a high degree of stability [9].

6-4- Central Courtyard and Response to Residents' Needs (Respect for Residents)

Some features of desirable homes as mentioned in Islamic Hadith include:

- Violating privacy must be avoided
- Avoiding having view of opposite houses
- It is recommended that the home should be a comfortable place and that the home completes nature.
- Complete separation(with numerous articulated fit like outer vestibule and hallways and courtyards) between inside and outside spaces
- Each house should have open and natural spaces like the courtyard as well as semi-enclosed spaces such as porches and also closed spaces in order to use them in different seasons and different times of the day and also take the most use out of natural facilities
- Independent and free communication with nature (using water, plants and animals) at home
- Complete and appropriate use of natural facilities such as the sky, wind, sun, cold and heat [16].

Therefore, the man with the range of all personal, social, geographic and historic architecture considerations is the main theme of architecture. Architecture does not only address human origin but also human purpose. In traditional Iranian houses not only low levels of human needs such as physiological needs have been considered, but also high-level needs such as safety, belonging and love, self-esteem, aesthetics and self-development have all been taken into account. Hence, houses are human-centered and the vary purpose of their foundation has been human needs, which is an important factor in today's sustainable architecture. Thanks to the small and happy nature of courtyards, connection with nature which is one of the primary rights of human beings is provided. The courtyard not only satisfies the physical needs but also provides calmness and relaxation for body and soul [17].

Generally, the reason for the existence of the porch is to avoid the bad air into the house, and also to avoid looking into the interior parts of the house [18]. The central courtyard is like private garden for house. By maintaining a presence in the garden, a sense of belonging and attachment to the place emerges among residents [19].

Figure 2. the main yard, the connection of human and nature, Borujerdis' house, Kashan

6-5- Central Courtyard and Coordination with the Site:

Site, or the context of the project, is the environment where the architecture is formed and takes both the content and the form. Paying attention to contextual, physical, climatic, geographical, historical, social and cultural environment of the site as well as understanding the environment is the key principles of sustainable architecture [20].

Francis Tibbalds'golden rule entitled "Places Matter Most" also expresses the idea that context and the vernacular features are the first criteria of successful urban design and as an appropriate

response and as a strategy, priority is given to the design which pays attention to the local context, or is nativistic in other words [21].

In vernacular architecture, through mutual interaction between the substrate and the indigenous architectural design, architectural harmony with the ecology has been created. The following aspects may be considered in the context of each project:

6-5-1- The Social and Cultural Aspect

For example, a central courtyard pattern is based on the culture of this land and is inextricably tied to past beliefs, personal and social behavior, economy and technology of the people who live in it[22].

6-5-2- The Historical Aspect

The inner part of the historical cities of Iran such as Kashan has a special physical structure which is the result of socio-cultural influences over the centuries. Old, inner part has been gradually and continually developed [23].

Undoubtedly, the richness of this model has given it sustainability, which reflects its attention to historical aspects of the site.

6-5-3- The Climatic Aspect

City and region are both manmade and natural systems which have great influence on each other. Climate, as far as it is related with human comfort, is the result of factors such as sunlight, temperature and humidity, wind and precipitation. The climate of each location has specific features which at the same time cause limitations in urban design. In designing urban spaces such as buildings, green spaces, streets in addition to paying attention to quality, performance, visual and aesthetic features, considering the climate of the city and regional planning is necessary and ignoring this issue creates special problems [24].

One of the reasons for the emergence of contemporary energy and environmental crisis is not paying attention to climatic differences. Open spaces with central courtyard in the vernacular architecture in Kashan have their own unique characteristics, which shows paying attention to the environmental aspects of the platform's architecture [25].

6-5-4- The Anatomical Aspect

Space-based architecture of deserts in Iran with a central courtyard, sunken garden and orangery has its special attention to the physical context. Site elements such as available resources, potentials and limitations, indigenous materials, neighborhood, a hierarchy of access, site geometry, orientation, landscape, vegetation condition, climatic advantages, and the landscape which are among physical aspects of the site are considered in the formation of the open spaces.

Weather and climate have always been a problem for people, and they have dealt with them during thousands of years. Harsh summers and cold winters of the desert and in some cases, hot, dry, adverse winds and storms have prompted people to think about alternatives and solutions [13].

6-6- Central Courtyard and Holism:

In traditional cities, the integration and interconnectedness of urban elements are in the way that makes their spatial separation difficult. The elements are not like a house with a courtyard which makes the whole structure; rather, the whole structure is part of the house with a courtyard. The interconnectedness of the whole structure is the highest manifestation of unity. In traditional cities, the buildings and their component part were looked upon collectively, not separately [23].

This interconnection created cities that possess an inner face. The core natural areas in the center and median strips each domain were formed in the central courtyard. The accumulation of physical quality of life has emerged as a new focus space in general not size [9].Gestalt psychology and the result of a general perception, however, knows more than their sum. Buildings with a central courtyard not only pay attention to sustainable architectural principles, but these principles in their expanding to urban fabric have created a sustainable city. It considers the nature and function of the entire system and all-round views [26].Wet and dry wind from the Crypt and the cooled ambient air and wastewater, sewage, having been reused in agriculture as well.

7- CONCLUSION

Kashan has been a native and traditional habitat in the distant past which has employed design and climatic factors as well as construction techniques to use natural resources and provide comfortable thermal conditions. However, in recent years, the traditional architecture of the city, like most cities in the country with inappropriate policy-making and using cheap, subsidized fossil fuel, faced many changes, and the role of climatic and environmental factors in making residential and non-residential spaces decreased. Traditional structure of the city, more than anything, proves applying native techniques in the face of the region's harsh climatic conditions. The design and dimensions of plans, constructions, distribution of spaces, spatial relationships, buildings' structures, materials all demonstrate this fact. For this reason, traditional structures in Kashan can be considered sustainable in terms of climate and architecture. Its construction practices and techniques can be used in reproducing new residential spaces. So the experiences of traditional architecture are still useful. While reducing dependence on fossil fuels, the experiences can contribute to improving the quality of the

residential environment in terms of comfort and hygiene. So the first step is to take advantage of natural conditions and compliance with environmental and climatic change.

REFERENCES

1. Coch H (1996), "Bioclimatism in vernacular architecture. Renewable and Sustainable Energy Reviews; 2(1–2): 67–87
2. Pourdeihimi Sh. (1999). "Making Buildings which Match the Climate", Soffeh, 9(27), pp. 62-71.
3. Energy Saving. (2006). National Building Regulations, chapter 19. Ministry of Housing.
4. Soflaei F. (2003). Climatic Elements in Iranian Traditional Architecture. The 3rd Conference on Energy Optimization.
5. Vale, B. and Value R (1996) Green Architecture: Design for a Sustainable Future, London: Thames & Hudson Ltd.
6. Bahadorinezhad M, & Ya'qoubi M. (2006). Ventilation and natural Cooling in Iran's Traditional Buildings. Tehran: Markaz-e Nashr-e Daneshgahi.
7. KashanBoroujerdi House. (2000). Kashan Cultural Heritage Organization
8. http: //hamshahrionline.ir/news -22675.aspx, Retrieved May 24, 2007
9. Ahmadi F (2005). "City-House Central Courtyard", Soffeh, 41, pp. 90-113.
10. Pirnia K (2008). The Style of Iranian Architecture. Tehran: Soroush-e Danesh.
11. Kasmaee M (1984). Climate and Architecture. Tehran: Building and constructio corporation of Iran.
12. Ghaffari A (2002). "Architecture Form in Sustainable Development", Soffeh, 34.
13. Zomarshidi (2008). Iranian Architecture: Making a Building with Vernacular Materials. Tehran: Zomorrod.
14. Me'marian Gh (2007). Iranian Residential Architecture: An Introverted Approach. Tehran: SorousheDanesh.
15. Viseh S (2009). "Appropriate Methods for Using Local Materials". Journal of the Buildings and the Environment of Villages.
16. Noghrehkar A (2008). An Introduction to Islamic Identity. Tehran: Mimistry of Housing.
17. Eftekharzadeh S (2005). "Space Retrieval, Changing an Apartment to a House", Architecture and Buildings, 6.
18. Arwin AA, & Niyazi M (2006). "Historical Houses in Kashan: Climatic Features of Vernacular Architecture in Kashan", *Kashan-Shenakht*, *3*.
19. Falahat MS (2006). "The Concept of Belonging to a Place and its Component Parts", Fine Arts, 26, pp. 57-66.
20. Ahmadi Z (2009). "Contextualism and Sustainable Architecture", Sustainable Architecture Conference, Islamic Azad University, Hamedan Branch.
21. Carmona M, Healt T, Oc T, Tiesdell S, (2003) "public places, urban spaces,oxford, architectural press
22. Taqaddosi R (2002). "The Principles of Planning a Sustainable City", The First Student Conference on Architecture and Urban Planning.
23. Tavassoli M (2009). Urban Designing: The Art of Renewing the Structure of the City. Tehran.
24. Sheikhbeglou R, & Mohammadi J (2010). "The Analysis of Climatic Elements, Wind, and Rain with an Emphasis on Urban Designing: The Case of Isfahan", Geography and Environmental Planning, 21(3).
25. NoqsanMohammadi MR, Dehqan F, & Montazari M (2012). Vernacular Urban Designing in Developing New Cities: Reconciling Development and Sustainability with an Emphasis on vernacular Designing in Yazd Streets. Cities and Vernacular Architecture, 2.
26. Young K (2004). "Ecological or Green Designing in Architecture", trans. S. Zanganeh, Abadi, 42.

To cite this paper: Mojtabavi SM, Validad MT (2015) Investigating the Implications of Sustainable Architecture in the Native Architecture of Residential Areas in Iran (A Case Study of Warm and Dried Climate in Kashan City). *J Art Arch Stud*. 4(2): 45-50.
Journal homepage: http://jaas.science-line.com/

Journal of Art and Architecture Studies (JAAS)
ISSN: 2383-1553
Volume 4, No. 2: 45-50