Assessment of Climate Comfort in Vernacular and Contemporary Houses Of Iran

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Abstract

Technology development causes a human oriented design to be forgotten all over the world. In housing design, one of the important factors for human-oriented design is Climate comfort. Today similar architectural patterns in different climate regions in Iran, can't provide residents comfort. While vernacular housing architecture of Iran had different patterns for providing climate comfort in different regions. The aim of this paper is to suggest some solutions to enhance the level of comfort in today's housing of Iran. This paper compares contemporary and vernacular houses of Iran in terms of climate comfort by using description and case study analysis methods.

Keywords: comfort; climate comfort; contemporary housing; vernacular housing

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1. Introduction

Built environment has direct effects on human's satisfaction and well-being. Therefore for attaining the physical satisfaction, the human body should be in a comfort level that achieving this depends on accommodation of building design with the outdoor climate. Accordingly climate is one of the most important factors, which can have an effect on human comfort. Hence, due to the differences of climate in a different part of the world, each region needs its designs and construction techniques in its buildings that can provide human comfort

In Iran, the same techniques are used in different zones for designing contemporary houses. While vernacular housing in Iran was well adapted to its climate by using different strategies in different climates.

As Iran has rich vernacular architecture, scientists can analyze the positive features of the past architecture (not just imitate them) and make an attempt in order to build environmentally compatible structures using the new construction materials and advanced technologies. Consequently, the main objective of this study is to explore the possible means and ways of increasing climate comfort in contemporary houses by realizing the climate comfort building and the characteristics of the vernacular houses.

2. Literature Review

2.1 Climate and climate comfort in architecture

"One of the effective factors in the human life, health and comfort are climatic conditions. A human being, directly and indirectly, has been affected by this condition" (Ramezani1, Maghsodi & Shafaghati, 2013). Jahan Bakhsh (1998) presented climate comfort conditions which in the aspect of temperature is suitable for 80percent of people, or in other words, human beings under those conditions, neither feeling the heat, nor cold and neutral state is its other word.

Considering climatic comfort in architectural and building design is the subject matter of many researches that clarifies its significance. The climatic design is looking after providing climatic comfort for human in buildings (Shakor, 2011). Gioni presented a bioclimatic chart of a building, and Elgi presented humidity and heating conditions in relation with human needs and climate design and drew bioclimatic chart (Kasmaei, 2008). In Iran, various studies were done in the field of climate role in architecture and urban design. Most studies pay attention to architecture survey consistent with a climate in various climates of the country.

As a result, a climate is highly associated with the built environment. Moreover, according to the climate characteristics, there are different classifications in architecture, such as the cold, temperate, warm-humid and hot-dry climates. We can use this classification for achieving climate comfort level in building in different climates.

2.2 Vernacular architecture and climate comfort

Different climates require different architectural responses. To satisfy the various necessities, vernacular architectures that developed through the centuries has much original and interesting design practices and technologies (Singh, 2009). It sets a harmony between dwellings, dwellers, and the physical environment. These kinds of structure evolve over time to reflect the environmental, cultural and historical context in which they exist (Helena, 1998).

Iranian vernacular architecture achieved the climate comfort conditions in interior spaces by using of intelligent strategies and adapted to the natural and social conditions of a specific location in which it exists. However, it may not be appropriate to adopt these models as readymade solutions for modern architecture. But we can learn a lesson from the approach of the builders who acknowledged the interdependence of human beings, buildings and physical environment (Helena, 1998).

3. Methodology

This study analyzed climate comfort in contemporary and vernacular houses by considering the design principles for each different climate in Iran. The aim of this is to investigate the climate comfort differences between vernacular and contemporary houses and explore the effects of the climate to enhance the level of human comfort.

24 vernacular and contemporary houses in Yazd, Rasht, Bushehr and Urmia cities were selected. These cities are located in the four important and different climatic part of Iran (Fig1). These cities were selected to find out the parameters of human-oriented design at different climatic regions.

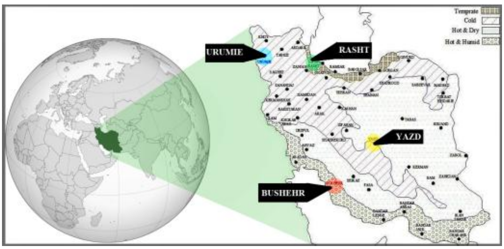

Fig. 1. Climatic division of Iran and location of Urmia, Rasht, Bushehr, Yazd city in this country.'

Urmia city (37°40'N, 45°03'E) has cold climate conditions. Rasht city (37°19'N, 49°37'E) has Temperate and humid climate conditions. Bushehr city (28°57'N, 50°49'E) has insufferable heat and humidity climate conditions. Yazd city (31°53'N, 54°16'E) has hot and dry climate conditions.

The study identifies the dominating bioclimatic design strategies for the four main climate zones using Givoni's Psychrometric chart (Fig2). In this chart, the combination of monthly temperature and relative humidity indicates the recommended passive design strategy for each month (Givoni, 1969).

For comparison between vernacular and contemporary houses, first, principles of climatic design were analyzed from Givoni's Psychrometric chart. Then we categorized climate comfort design parameters of each region. We selected 24 houses (6 houses for each climate region) and rated the level of having climate comfort design parameters on a 5-point Likert scale. As the nonparametric test, we used the Mann-Whitney U test to analyze the data. All the statistical analyzes performed in SPSS version18.

4. Results and Discussions

Following design recommendation are identified by using Givoni's charts for four climates, which are drawn in Fig3 by extracting meteorological data effective on climate a comfort such as a temperature and relative humidity from the synoptic station of Iran's cities.

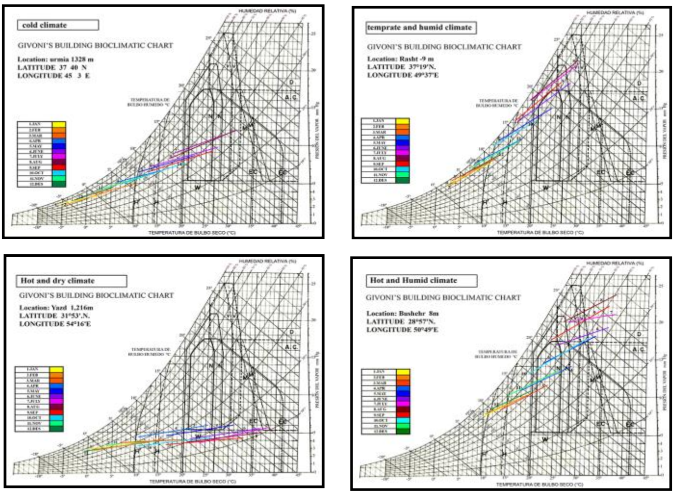

Fig.2.(a)Urmia Bioclimatic Chart, (b)Rasht Bioclimatic chart, (c)Bushehr Bioclimatic Chart, (d)Yazd Bioclimatic

Table 1 shows the principles of climate design for Urmia city from Givoni's psychrometric chart (Fig.2, a). In this city, the weather is very cold during more than six months of the year. Therefore for achieving the climate comfort, introverted building with a compact layout, small openings, veranda with Low height and small central courtyard located according to the sun radiation are recommended. Heavy external and internal walls are dominant climate-responsive design strategies to enhance solar passive heating effect for great temperatures swing between day and night. Active solar or artificial heating is required during long winter periods.

In summer days, comfort level can be achieved by temporary provision for humid air movement and use thermal mass can store enough heat from solar radiation during the day for the nights

Table 1. Analyzing bioclimatic chart of Urmia

Month	TIME	ZONE	DESCRIPTION
Dec, Jan, Feb, March		Under heated	Require heat sources, minimum heat exchange with the outside, Using solar heat
Nov	Day	Cold, H'	Materials with high thermal capacity, Using solar heat
	Night	Under heated	Require heat sources, mechanical equipment
Apr, Oct	Day	H	Using solar heat, Suitable building materials
	Night	Cold, H'	Materials with high thermal capacity
May	Day	H, N'	Using solar heat, Materials with high thermal capacity
	Night	H', H	Materials with high thermal capacity, minimum heat exchange
June, Sep	Day	N', N	Comfort zone
	Night	H', H	Materials with high thermal capacity, minimum heat exchange
July, Aug	Day	M, V, N'	Need for natural ventilation, Tolerable thermal condition with Suitable materials
	Night	N, H	Tolerable thermal condition, minimum heat exchange

Table 2. Analyzing bioclimatic chart of Rasht

MONTH	TIME	ZONE	DESCRIPTION
Jan, Feb		Under heated	Dehumidifying, Require heat sources, minimum heat exchange with the outside, Using solar heat
Dec, March,	Day	Cold, H'	Selecting suitable building materials, Sometimes requiring heat sources
	Night	Under heated	Dehumidifying, Require heat sources, minimum heat exchange with the outside
Apr, Nov	Day	H, H'	Using solar heat, minimum heat exchange with the outside
	Night	Cold, H'	Selecting suitable materials, Sometimes requiring heat source, Using solar heat
May, Oct	Day	N, H	minimum heat exchange
	Night	H, H'	Using solar heat, minimum heat exchange
June, Sep	Day	N, N'	Comfort zone
	Night	N', H	minimum heat exchange, Dress appropriately
July, Aug	Day Night	V, N'	Tolerable thermal condition, need for natural ventilation

Tables 2 shows the principles of climate design for Rasht city from Givoni's psychrometric chart (Fig.2, b). According to the Givoni's chart, for achieving the climate comfort, cross ventilation is required therefore settlement pattern should be spread open and wide and buildings with deep continuous balcony and extending gable roofs are recommended. Furthermore, buildings should be orientated with their bigger façade toward the south in order to gain solar heat in the winter when the sun angle is low. Because of heavy rains, the ground floors slab should be upper than the ground level. And wood with minimum thermal capacity can be used as structural and covering material which is widely available in this area.

Table 3 shows the principles of climate design for Bushehr city from Givoni's psychrometric chart (Fig.2, C). The buildings should be built with complete shade, and they also have extensive deep verandas. For preventing excessive absorption of heat, using indigenous materials with low thermal capacity and bright colors for exteriors of buildings are recommended.

Orientation towards the prevailing wind from the sea, having minimum joints walls with neighbors, central courtyard and windows on both sides of single-banked rooms, high ceiling and wide windows enhance the air circulation to provide comfort during summer.

Table 3. Analyzing bioclimatic chart of Bushehr

Month	TIME	ZONE	DESCRIPTION
Dec, Jan, Feb	Day	H	Using solar heat, suitable building materials
	Night	H'	Using solar heat, minimum heat exchange with the outside
March, Apr, Nov	Day	N	Comfort zone
	Night	H	suitable building materials, Using solar heat,
May, Oct	Day	M, V, V'	Use of materials with low thermal capacity, need for natural ventilation
	Night	N	Comfort zone
June, Sep	Day	V', D	air conditioner, dehumidifier, a device is required
	Night	V, N'	natural ventilation , Tolerable thermal condition,
July, Aug	Day	D	Natural methods are not sufficient, dehumidifier device is required
	Night	V, V'	conditioning is a more serious problem, need for natural ventilation

Table 4 shows the principles of climate design for Yazd city from Givoni's psychrometric chart (Fig.2, C). It has dry summers with cold winters and has a high difference of the temperature between day and night in summers. Therefore, having a dense settlement pattern with central courtyards, orienting towards the sunlight and using earth sheltered constructions and wind towers are recommended. Heavy external and internal walls with high thermal capacity materials can reduce the need for conventional heating and minimize the temperature fluctuations between day and night.

Table 4. Analyzing bioclimatic chart of Yazd

Month	TIME	ZONE	DESCRIPTION
Dec, Jan, Feb,	Day	Cold, H'	Materials with high thermal capacity, Using solar heat
	Night	Under heated	Require heat sources and mechanical equipment, minimum heat exchange
Nov, March	Day	H', H	Materials with high thermal capacity, Using solar heat, minimum heat exchange
	Night	Cold, H'	Materials with high thermal capacity, Sometimes requiring heat sources
Apr, Oct	Day	N, W	Need to Increase humidity
	Night	H', H	Materials with high thermal capacity, minimum heat exchange with the outside
May,	Day	N, V	Need to natural ventilation
	Night	W, H	Materials with high thermal capacity, Need to Increase humidity
Sep	Day	EC	Need to natural ventilation and Increasing humidity
	Night	W, H	Materials with high thermal capacity, Need to Increase humidity
June, July, Aug	Day	EC	Need to natural ventilation and Increasing humidity
	Night	W	Need to Increase humidity

5. Conclusion

Comparison of vernacular and contemporary houses of Iran revealed that vernacular houses could provide a higher level of climate comfort.

Vernacular architecture approach is coordinating between human beings, buildings, and physical environment in order to achieve comfort in Energy efficient buildings. While these factors are not significant in contemporary houses of Iran and using similar design patterns based on technology can't provide human comfort.

To enhance the level of comfort, especially climate comfort in today's housing of Iran, it is recommended using the climate-responsive design strategies retrieved from Givoni's Psychrometric chart, identified for each region, with using technology in a proper way.

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