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ORIGINAL ARTICLE

Climate design and its role in reducing energy consumption management: A case study of Kerman city of Iran

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The impact of climate factors on biological complexes is one of the most important applications of climatology. Which has been attended by planners in recent decades. City and climate have a strong impact on each other. In the exploration of Iranian native urbanization, it is clearly established that traditional urban spaces are designed based on the principles of urban sustainability for maximizing the use of natural energies and combating heat and cold annoyance. The clear difference between urban texture integration in the hot and dry climate and urban tissue fracture of hot and humid climate is a proof of this claim. The old texture of cities such as Yazd and Kerman have made their inner city spaces entirely based on environmental elements for the comfort of the citizens. Compact construction, narrow shady alleys and even the color of buildings are affected by this consideration. Accordingly, the main focus of the discussion is to examine the impact of climatic conditions on indigenous urbanization in Iran and also the exploitation of these climatic principles in materials, architecture typology, urban space organization and urban elements. In this regard, as the elements and climatic elements in the formation of texture, orientation of buildings and urban spaces, the way of zoning and morphology of the old texture of Iranian cities has had a major impact, Optimal use and consideration of the valuable and indigenous principles in designing today urban spaces will also play a major role in realizing the principles of sustainability and spatial quality.

Keywords: Architecture; environment; area; Kerman; temperature

Introduction

Our country has different climatic regions. Different characteristics of each climate have a great influence on the formation of cities and the architectural composition of these areas. The traditional and indigenous architecture of Iran has been well suited to climate and has been able to invent appropriate architectural methods by relying on natural resources and clean and renewable energies such as flow of air light and sunshine (Watson, 1937).

Human beings are unwittingly under the climatic conditions of their surroundings, and this is the climate that determines the type of livelihood and the way in which its needs are met. For example, a person living in central Iran, for example, Yazd, has a different climate than a person living in the north and on the plains of Gilan and has to deal with the climate in his or her place of residence in a different way.

The livelihood and even the Physical characteristics of the two individuals will also be different. The first person will have to use the windbreaker to cool off his home in order to save himself from the severe summer. If the second person will have to use the ceiling roofs in his buildings to escape the heavy rainfall of Gilan. Climate is an agent that affects all human objects and activities. In return human beings must always have information about the climate in order to be able to make decisions in dealing with it. From the beginning, mankind was inevitably influenced by the climate, today, with the advances of human civilization, the need to study the effects of climate on human life is very sensitive.

Climatology and architecture climatology

Climatology is a science that seeks to explain the difference in the nature of the climate in different places and how it interconnects with the elements of the natural environment and human activities. Climatology is a scientific study of climate, that is, the description and display of climates, analysis of the factors of the difference between climates and the application of climatic information in solving community problems. In other words, climatology is the discovery and explanation of the natural behavior of the atmosphere and utilizing it for the benefits of mankind(Alijani, 2012).

Regarding the importance of architectural climatology, today it is important to pay attention to the climatic conditions in the design and construction of all buildings in two respects.

On the one hand, buildings in harmony with climates or climatological buildings are better in terms of human thermal comfort. Environmental conditions of these buildings are better, and the daily and seasonal variations in the temperature and flow of air in these buildings create varied and pleasant environments.

On the other hand, the coordination of a building with climatic conditions saves the energy needed to control the environmental conditions of these buildings. In some climates, the indoor climate of the buildings can be adjusted throughout the year naturally, without the need for mechanical thermal systems. In order to achieve comfortable conditions, utilization of the facilities in the buildings is the most important factor. Terms and conditions must be respected to continue the fight against the environment in the construction of buildings.

- Designing a suitable building for environment;
- Selection of materials in accordance with the environment.

Construction should be proportional and influenced by the climate of different regions and according to the traditional architecture of the region. Therefore, climatisters should understand the climate better and provide appropriate guidelines for comfort in buildings and living environments.

It is necessary to present the new design with the widest recognition of the past architectural features and their relationship with the climatic conditions of today and organize the present situation in a desirable manner, with regard to the past, present and the future. In designing urban, rural and industrial buildings, the climate of the site should be considered in its entirety and appropriate design should be made in relation to the latitudes and the topographic position of the slope in the geographical directions and the amount of solar energy in the summer and winter cold.

Climate design

Climatological design means a plan that can match natural environment around it and make more use of the natural forces available locally So that they can create a Suitable natural environment for users (Kasmaei ,2006).

The term "climate design" is said to the specific constructional methods aimed at reducing the cost of heating and cooling using natural energy streams In order to create well-being in buildings (Jafarpour, 2002).

Two things must be done to achieve this goal.

- To study the climate conditions of the place From the point of human comfort;
- Design of the building's body (the design of the building's structure is something such as the dimensions of the building and the area of the wall, the size of the windows, etc.) (Alijani, 2012).

Climatic design is a method for reducing the overall energy consumption of a building and the first line of defense against climatic factors. In all climates buildings constructed in accordance with the principles of climatological design, the necessity of heating and cooling are decreased to the lowest level and they use natural energy in return.

The methods for reaching the main objectives of climatic design are as follows.

- Reducing heat dissipation in the building,
- Reducing the effect of wind on the heat loss of the building,
- Use of solar energy for building heating,
- Protecting the building against extreme sunlight in hot weather.

Climatic elements affecting architecture

Human comfort is the result of the interaction of climatic elements such as solar radiation, temperature, humidity, wind, and rainfall (Darab,1993).

- Solar radiation,
- The temperature,
- Humidity,
- Wind,
- Rainfall (Figure 1).

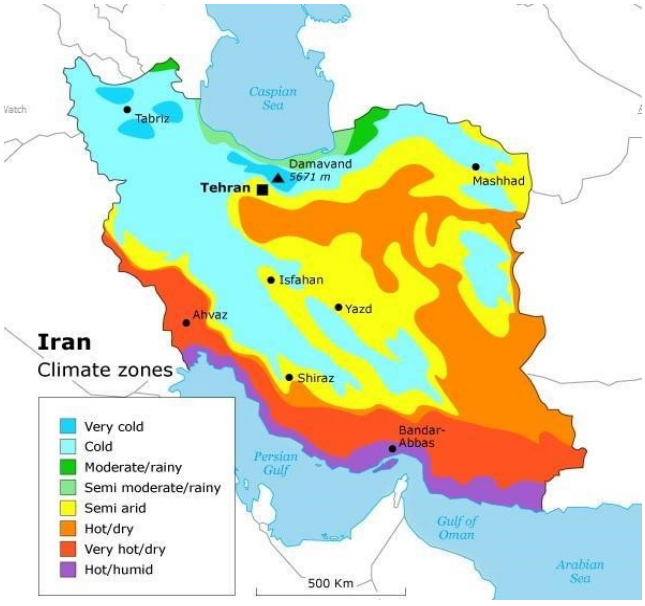

Figure 1. Climate zones of Iran.

Study of traditional climatic design in four climates of Iran

Architecture of the temperate and humid region: This area includes heavy rainy areas of northern Iran, with high humidity and air temperatures in the summer. Therefore, continuous rain and high relative humidity are the main factors in the

formation of architecture in this land. The formation of the native architecture of these areas is based on the modules of the square, which has been developed linearly along the east-west and perpendicular to the wind flow, this kind of formation is an example of extraterritorial architecture. One of its characteristics is the direct physical connection with the outside of the house, the lack of a yard and expansion in height, and the buildings are located in open green spaces.

The skeleton of the building is in fact the building's stack of wood, which is used in the frames too, and the final cover is clay and other materials such as stone, clay and pottery are also used in conjunction with all-wood buildings (Memarian,1997).

The architecture of the warm and dry area: In the study of architecture of this type of climates, it is possible to point out the housing architecture of many of the cities of Central Plateau of Iran which has an intrinsic architecture coordinated with this type of climate. The climatic features of these areas are drought, dehydration, severe heat in the summer, along with sandy storms in in some cases of the year and winds in different directions, as well as extreme cold in the winter.

The main index of native architecture of the warm and dry areas is its introversion. This type of architecture has a central courtyard and the rooms are usually located on four sides. The courtyard form is usually a garden pit (in some cases flat). In fact, the garden pit is a space surrounded by rooms in the underground, and this combination creates cool spaces in the lower chambers and makes the flow of air in the correct way, and no longer requires synthetic cooling devices and as a result, energy consumption is reduced (Pourjafar, 1995).

Architecture of the warm and wet area: In analyzing the architecture of this climate, which includes the coastline of southern Iran, it should be stated that the architecture of this region is the ring of interconnection between the two types of intrinsic architecture of the warm and dry region and the outward-looking architecture of the mild and humid region because It has the features of both introverted and outward-looking architecture in combination.

The general profile of the climate in this area can be expressed in terms of having a very hot summers with high and constant humidity in all seasons. Remarkable thing in this climate is the slight difference in the temperature of day and night (Iran Gazette, 2018). The native architecture of this climate is a combination of introspective and outsourcing architecture. In order to cope with the heat and create an air flow in the interior, in addition to the covered verandahs, windows in opposite directions in the north and south are used to create internal airflow in the rooms.

Architecture of the cold region: In exploring and studying the architecture of this type of climate, we refer to the architecture of housing in Tabriz, it is worth noting that the architectural form of this type of climate is like the intrinsic architecture of the dry and warm area. But with the differences that are necessary for the cold weather.

Methods

Kerman climate

Kerman has a cold desert climate (according to the Koppen climate classification), with hot summers and cool to cold winters. Precipitation is scarce throughout the year. The city's many districts are surrounded by mountains that bring variety to Kerman's year-round weather pattern. The northern part of the city is located in an arid desert area, while the highland of the southern part of the city enjoys a more moderate climate. The mean elevation of the city is about 1,755 m (5,758 ft) above sea level. The city of Kerman has a moderate climate. The average annual rainfall is 142 mm. Otherwise, its climate is relatively cool (by Iranian standards) (Iran Chamber Society, 2013) (Tables 1 and 2; Figure 2).

Table 1. Climate data for Kerman.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	11.8	14.2	18.6	23.8	29.8	34.8	35.5	34.0	31.0	25.7	19.2	14.1	24.4
	(53.2)	(57.6)	(65.5)	(74.8)	(85.6)	(94.6)	(95.9)	(93.2)	(87.8)	(78.3)	(66.6)	(57.4)	(75.9)
Daily mean °C (°F)	4.4	7.1	12.1	17.2	22.9	28	28.9	26.9	23.3	17.4	10.8	6.2	17.1
	(39.9)	(44.8)	(53.8)	(63)	(73.2)	(82.4)	(84)	(80.4)	(73.9)	(63.3)	(51.4)	(43.2)	(62.8)
Average low °C (°F)	-4.0	-1.1	3.4	7.9	12.0	15.6	17.0	14.2	9.8	4.8	−0.7	−3.6	6.3
	(24.8)	(30)	(38.1)	(46.2)	(53.6)	(60.1)	(62.6)	(57.6)	(49.6)	(40.6)	(30.7)	(25.5)	(43.3)
Average precipitation mm (inches)	29.0	26.7	32.0	19.5	8.6	0.5	0.7	0.6	0.3	0.7	5.1	18.4	142.1
	(1.142)	(1.051)	(1.26)	(0.768)	(0.339)	(0.02)	(0.028)	(0.024)	(0.012)	(0.028)	(0.201)	(0.724)	(5.597)

Table 2. Climatic zones of Kerman province, their code and temperature and moisture characteristics.

Number	Climates Codes	Moisture	Winter	Summer
1	A-C-VW	Aride	Cool	Very Warm
2	A-C-W	Aride	Cool	Warm
3	A-K-M	Aride	Cold	Mild
4	A-K-W	Aride	Cold	Warm
5	A-M-VW	Aride	Mild	Very Warm
6	A-M-W	Aride	Mild	Warm
7	HA-C-VW	Hyper Aride	Cool	Very Warm
8	HA-M-VW	Hyper Aride	Mild	Very Warm
9	SA-C-W	Semi Aride	Cool	Warm
10	SA-K-M	Semi Aride	Cold	Mild
11	SA-K-W	Semi Aride	Cold	Warm

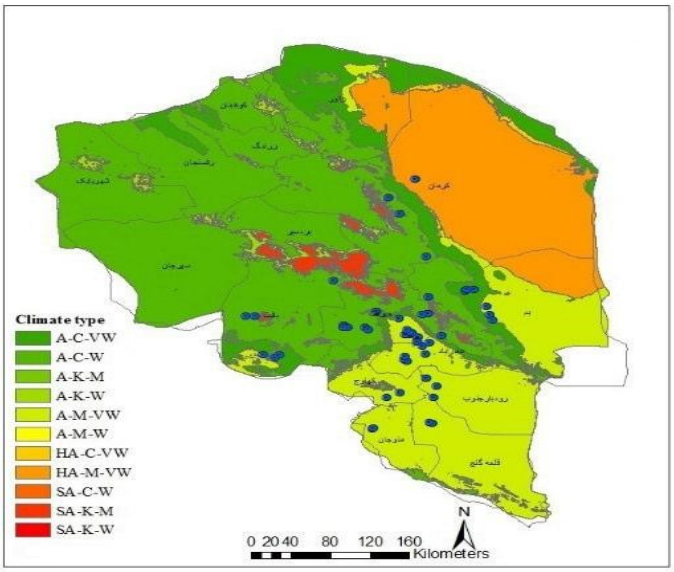

Figure 2. The climate map of Kerman province. For climate codes see Table 2.

Kerman's Native Architecture Features:

- Having special building components such as basements and cellar, porch, windproof and central courtyard.
- Frequently arched domes with relatively high height and relatively thick walls.
- Lower floor of the building and courtyards from the surface of the road.
- Construction of buildings in the central courtyard and semi-introverted ,
- Use bright colors,
- Dense tissue,
- High heat capacity materials,
- Use the Windproof (Sharieat, 1995). (Figure 3).

Figure 3. Examples of Kerman's native architecture.

Kerman's new architecture features

Unfortunately, alongside the conscious native architecture of Kerman, we are witnessing the emergence of a new architecture that is completely contradictory to the climatic conditions of this city (Iran Chamber Society,2013). Row houses made of concrete, iron and brick, with courtyards that because of their short walls are not able to create a suitable shade, and they can not protect the building against strong winds and high sunlight, and create unfavorable conditions for residents, on the other hand, the use of walls and ceilings of low thickness, which is not resistant to the specific situation in this area and Also, the use of black bitumen on the roofs that increases the temperature in the summer and decreases the temperature in the winter and finally, the use of heating appliances with fossil energy and also cooling devices are the Features of this new architecture.

In general, it should be stated that the new architecture, in a way that does not harmonize with the climate on the one hand causes discomfort to the inhabitants and, on the other hand, by inappropriate use of materials and increased fossil energy consumption, does not address the sustainability architecture that existed in the past.

Results

As we know, the native architecture of the entire world has always been designed with the aim of integrating with the surrounding environment and utilizing more of the natural resources. The traditional architecture of Iran, which has been shaped differently in different climates, is itself an indication of this, and the available solutions that helped more in comfort have been many in Iranian native architecture. How to deal with nature and architecture is the reaction that every human being has and will have in different parts of the world, and the remaining architecture of the past has been indicative of overcoming it entirely or incompletely on factors such as climate. This is where we see a variety of indigenous architecture in different countries of the world consistent with the climate and culture that show the specific features of their region.

Conclusion

In Iran, due to the various conditions of climate and culture, it has a special feature and different architectures are in harmony with the climate. But when the availability of fossil fuels was possible, and the technology also advanced, and the heating and cooling installation was upgraded, it provided cooling and heating needs regardless of the architecture of the building.

Modern architecture, which is a typical example for the impact of technology on architecture, was a major development in architecture, and the technology used was not just in the area of modern construction that transformed architecture, but modern facilities, along with other advances in architecture, created fundamental changes that The most important of them was to forget about architectural patterns that were created to adapt to the climate.

Today, architects and urban planners should not forget that inspiration from our traditional architecture as an existing model can be a guide to climate design goals, and before creating or providing mechanical solutions, first, traditional solutions in local architecture should be evaluated, then these methods should be accepted.

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