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Formal Sustainability in Traditional Architecture of Iran According To Five Principles of Traditional Architecture of Iran

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ABSTRACT

Traditional architecture of Iran demonstrates its civilization grown over centuries and is based on five principles of "Introversion", "Autonomy", "Human- conformity", "Structure and Modulation" and "Purposefulness" The geographical position of Iran and its main types of climate have been among the major factors affecting this architecture. A cursory study of these principles in various climates reveals that Iranian architects have created monuments based on the principles of sustainable architecture. Sustainability is a complex concept that can be looked upon from different perspectives; examples of which are function, structure, facilities, adornment and landscape. In this article, traditional architecture of Iran is viewed from the standpoint of formal sustainability. The elements of formal sustainability in Iran are investigated and the associated changes at different regions, which are the result of the climate changes, are demonstrated. This article uses an interpretive-historical research method whereby the principles of Iranian traditional architecture and sustainable architecture are compared. Despite the diversity of society at different regions and the variety of climates, this study proves the conformity of both architectures (i.e. traditional and sustainable) in the field of architectural form.

KEYWORDS: sustainable architecture, formal sustainability, Iran traditional architecture, climatic architecture

1. INTRODUCTION

Now a day's, projecting local identity on built form is always the common debate on traditional and nation architecture. For achieving nation identity in contemporary era, the architecture uses significant of cultural elements and local artifacts to produce building as symbolic identity [1].

Historical buildings of any country are among the most important elements which form the identity of the residents of that country. Iran, as an example, is a country with well-known architectural history whose monuments and historical buildings demonstrate a great proof for the above statement. Abundance of buildings left scattered in every part of Iran's territory, has provided a rich field for inspecting its eminent art and architecture.

Traditional architecture of Iran, since long past, has been regarded by many researchers and accordingly numerous studies have been done about it. Sustainable architecture also is not new, but a topic of numerous investigations. Sustainable architecture, as an important part of the general topic of sustainability discusses the pressing economic and political issues of our world and seeks to minimize the noxious environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space [2].

The traditional architecture of Iran and its relationship with the principles of sustainable architecture have been less researched, so there are virtues in introducing sustainable aspect of vernacular architecture of this territory and its manifestation in the form of valuable buildings. These buildings were designed and then built by considering the major environmental concerns (including, but not limited to, heating issues), and therefore they can be scrutinized under the category of "sustainable architecture".

2. RESEARCH METHOD

This research is an interpretive- historical research. Its goal is studying and perceiving the past documents and finding the order details and organizing them by an analytical mind. This method in strategic level requires an epistemological viewpoint and a fundamental perspective to explain previous situations. In tactic level, this method requires reality finding, evaluating, organizing and reality analyzing [3].

3. Traditional architecture of Iran

According to Pirnia (2005), as a prominent scholar of traditional architecture of Iran, traditional architecture is based on five principles: 1- "Introversion" 2- "Autonomy" 3- "Human- conformity" 4- "Structure and Modulation" 5- "Purposefulness" [4]. Fig.1 is a diagram which depicts these principles.

In traditional architecture of Iran and based on geographical location, bio-ecology, climate and by choosing a special roof type, the exposure of the exterior surface were reduced to direct sunlight, creating a shade in

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accordance with the climate of each region, wind catcher, cellar, central courtyard and windows facing the sun is faced to environment to gain the best comfort in interior spaces without making use of polluting facilities. In the other word, ancestors of this territory were completely aware of solar passive systems and always used this functional method [5]. Besides, the performance and functional ability have been very important in designing and constructing the buildings. It has been tried to avoid creating unutilized space and in detail the whole space was engaged for special function. This subject even was followed in adornment and construction detail of buildings.

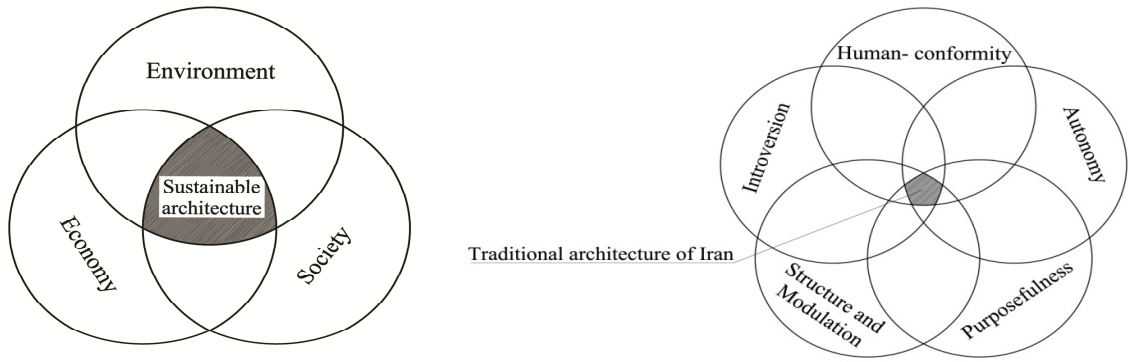


Fig.1.(a) Sustainable architecture diagram; (b) Traditional architecture of Iran diagram (source: author)

4. Sustainability in traditional architecture of Iran

Sustainable development recognize the close relationship between social, economic and environmental results and emphasizes that they should be equally in harmony for making decisions process. The correct concept of Sustainability has followed a certainly and warranty of life satisfaction quality for everyone [6].

Very long time ago, before the development of the sustainable architecture concept in scientific societies or even among architects, principles of the architecture of Iran were established based on exact criteria. These principles would cover a wide variety of issues including environmental, architectural and energy-saving features. Iran's ancient architecture, based on the specific climate of the region had a special prescription for each of the problems, selection of materials, structure's type, general form of the building, facilities, landscaping, functionality etc.

By scrutinizing of these principles, it is clear that all of five principles of traditional architecture of Iran were adapted with principles of sustainable architecture. The principles of "Autonomy", "Structure and Modulation" and "Purposefulness" included in the category of economy, while the principles of "Introversion" and "Autonomy" were reflected by the environment and the principles of "Human-Conformity" and "Introversion" were included in the social issue category.

Introversion is an environmental factor that in hot climates of Iranian architecture and has shaped toward a courtyard inside of building so it architectural forms has tended to be internalized (effect of the environment). On the other hand, this factor has been originated from Iranians belief as a sign of sanctity of personal life and prominence of the privacy, veil and hierarchy in the Iranian architecture (community effect) and is not specific to a particular climate or particular function. Autonomy means independence, which primarily refers to the economy and secondly demonstrates an environmental friendly feature of the building and as well as the use of local materials. This shows that Iranian architects were always aware of the environmental impact of the buildings and have always accounted for the economic features of a building in designing the architectural space to be proportional to human dimension and its personal and social activities. (Fig.2)

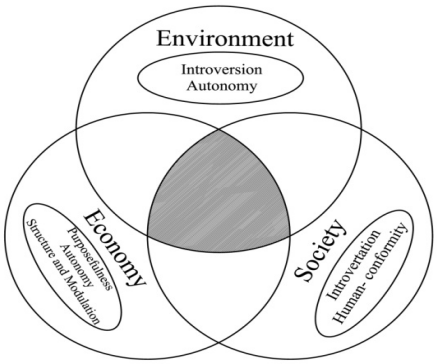


Fig.2. Adaptation of principles of Sustainable architecture and Traditional architecture of Iran(source: author)

This study conducts a comprehensive review of the sustainability aspect of traditional architecture of Iran according to the following classification. This classification is presented for the first time and covers architectural element perspectives including: 1- formal sustainability 2- functional sustainability 3- structure sustainability 4- facilities- sustainability 5- adornment sustainability. This classification surely probes the sustainable aspect of traditional architecture of Iran from a new perspective.

This classification investigates the sustainable aspect of traditional Iran architecture from a new viewpoint and because of the extensiveness of sustainable architecture subject; the formal sustainability in Iran architecture is exclusively excavated.

4.1. Formal sustainability

If a building architecture utilizes the forms that are in accordance with the economic and environmental factors and also human comfort then those forms qualify the sustainability, and the sustainable form is in fact imputed to it. In other words; a building has the formal sustainability if its efficiency is in share among the three categories of economy, environment and society.

The form of a building can be categorized based on the properties of its roof, walls and openings as well as orientation of general form. Studying these aspects, we can understand the differences and similarities of building forms and based on that, we can choose the form of the building with respect to environment, economy and society issues.

The present study reviews the forms characteristic of Iran traditional architecture in four different climates with respect to the type of roof, wall, opening and the general form to understand the concept of form sustainability in traditional architecture of Iran.

4.1.1 Environmental viewpoint

Architecture can be described from various perspectives. The environmentalists see architecture from the environmental and bio-climatic angles. If one traces the evolution of architecture of a country that includes change due to external influence, the architecture is still chiefly manifesting response to climate than the foreign cultural influence [7]. Traditional architecture cleverly appreciate climate which in turn become part of the cultural understanding in creating built form. The construction technology depicted the available technology at that time but somehow illustrated an accurate prediction of controlling, filtering and responding to outdoor climate.

The rate of heat transfer depends on thermal resistance of the building materials. In the warm climates, indoor air is affected by heat transferred from the roof and walls. This effect depends on the details of building design. In traditional Iran architecture roof and walls of buildings in hot climates were designed in such a way to minimize their heating transfer thus keep the indoor temperature constant. In rainy and humid regions, humidity plays the main role. Roof is the most important architectural aspect of a building in regions with high rainfall. The roofs are usually designed with a special slope to control the drainage of water and the materials employed in both roof and buildings are usually natural and have some native names such as ”Gaalipoush“(Fig. 8) and ”Latesar“. For example in the coastal regions of Persian Gulf, because of high humidity, the buildings have ”Ivaan“ which cause natural ventilation and would help maintain the indoor air cool and fresh [8].

Sun light and air temperature fluctuations influences on external surfaces of the roof and some parts of walls (southern, western and / or eastern walls). The influence value largely depends on the type of the roof and wall, thickness and its material kinds and outer surface color.

4.1.2. Economic viewpoint

In Iran’s traditional architecture, affordability is an important factor which greatly influences the design of a building. Expensive materials have no place in Iran traditional architecture. This means that for a building which has appropriate form and design and is resistant to negative climatic impacts, the employed materials should be available, inexpensive and affordable. Therefore, in order to remove the material delivery costs, vernacular architects have employed locally-available materials to create a safe shelter against atmospheric agents. Using materials such as wood in northern Iran or brick and clay in central and southern regions of Iran prove this claim.

Basically one of the fundamental motivations for making the vaulted and domed roof was that the appropriate woods were not presents everywhere. However, fabricate of adobe and brick was simple. Hence, by architects’ creativity with adobe and brick, large spans can be covered. Perhaps the fundamental incentive to construct the arch and dome is the belief of ”self-efficiency“ principle in construction [4].

4.1.3. Social viewpoint:

The word of “sustainability” is derived from Latin word, "Subtenir", which means hold in higher or keeps in basic. Every society must be support and protect basically by their present and future peoples. In some countries people are provoked by meaningful combination of physical, cultural, and moral features to support and care of their community. In fact these places are those in which sustainment is established in the best way [9].

One of the two important aspects of the building form is the building acts as a shield against atmospheric agents for residents comfort; therefore, it should be preparedly designed and built for human activities and

second, as a symbol of showing that there is a place for group or special group, plays a social role. This issue is more pronounced in the political, administrative and religious buildings. In mosque architecture for example, social aspect and symbolization are more important, thus mosque in urban system, according to its situation, have a glorious portal and façade and it seemed grandeur from the outside although from the inside the stillness and quiescence is important. Therefore, to create glorious façade, roof is built in city proportion and appears raised by portal and dome Although, the intellectual architects of this territory, by making a shorter roof inside, according to human proportions, created a space for seclusion ,“human self-reflection” and “thinking about his God”. (Fig.6)

Because of the presence of different climates in different regions of Iran, this study divides the climate of Iran into four different categories and inspects each one separately.

These four climates are as follow:

• Hot and dry climate (Central plateau of Iran)
• Hot and humid climate (Coasts of Persian Gulf)
• Cold and mountain climate (Western Mountains of Iran)
• Temperate and humid climate (Coasts of Caspian Sea) [4] See Fig.3

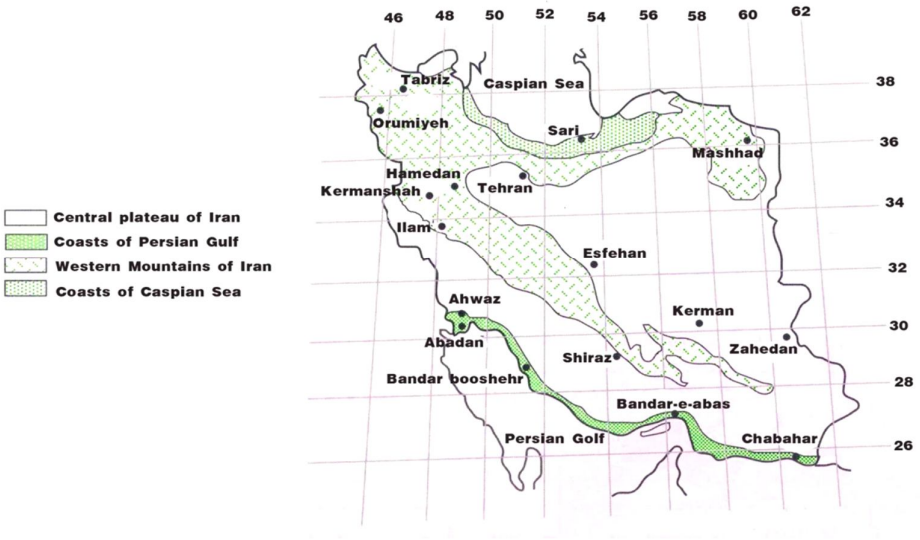


Fig.3. Climatic Map of Iran (source: M. Kasmae)

4.2. General form of building

The building form has a key role in the building harmonization with the climate and can reduce costs of the harmful environmental impacts and control operating expenses. The best building form is that loses the minimum heat in winter as well as receiving minimum heat from sunlight and the surrounding environment in summer. Next subparts review the effective factors in the design and selection of a general form of building according to the results of the studies on traditional architecture of Iran in all four climates.

4.2.1. Hot and dry climate (Central plateau of Iran)

In this region, with very hot summers and dry air, a closed cubic form with a courtyard in the center of building has been selected. Planting trees that produce shade and moisture softens the air of the building. Furthermore, a pool house or fountain helps the cooling of the surrounded air through the evaporation of water [5].So the building has a free plan around the yard and the windows and doors are facing to it, thus the general form of building is introverted. See Fig.4

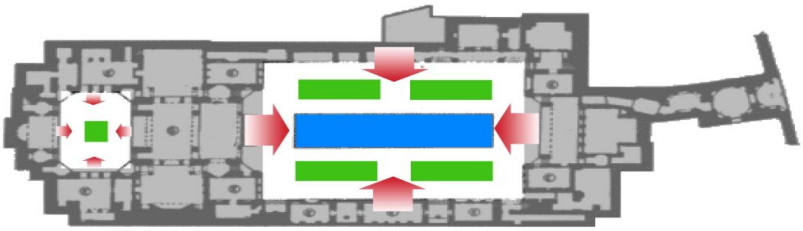


Fig.4. Central courtyard and Introversion Architecture in Hot and dry climate of Iran (source: M. Pirnia)

4.2.2. Hot and humid climate (Coasts of Persian Gulf)

In hot and humid areas due to high intense sunlight in the east and west, the building form has been extended and has a rectangular shape along the east– west axis. This form of building is very effective with respect to inducing air current to reduce interior space moisture.

4.2.3. Cold and mountain climate (Western Mountains of Iran)

For this region due to its extreme cold weather in winter and because the sun rises in the east and sets in the west, the side of the building that is utilized for solar gain needs to be facing the south to take maximum advantage of the sun's potential energy. If the building's axis is located on the east-west direction with its longest dimension facing the south, more of the building is situated to absorb the sun's heat energy. Passive solar buildings are typically rectangular with the long side of the building facing south. The distance from the source of incoming heat (south) to where it is absorbed (typically a northern wall) has been minimized. The resulting shape is a rectangle. The two-storey buildings form, similar to the cubic form, is the best type from viewpoint of inner space temperature control during winter.

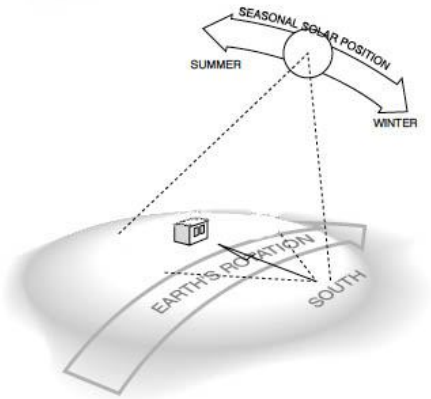


Fig.5. If the building in Cold and mountain climate were longer, stretching toward the east-west axis, more of its mass would be ideally situated to absorb and radiate heat in the winter (source: author)

As the degree difference from true south expands, the overall potential solar efficiency of the structure decreases. Put another way, the greater the degree variation from true south will decrease the amount of the building's solar gain. As a result, larger amounts of supplementary energy may be needed to heat the building in the winter. (Fig. 5)

Traditional architecture in the Zagros region were applying these principles in constructions of their buildings and therefore building form and urban and rural plans in Western Mountains of Iran are compact and dense. (Fig. 10)

4.2.4. Temperate and humid climate (Coasts of Caspian Sea)

Although air temperature makes the general form somewhat flexible, it appears the expansion of the plans along the east–west axis is necessary to induce air current for reducing interior space moisture, because of the high humidity of the air. The processing of the building's form in these areas is more freely than other areas, due to the low intensity of sunlight and its low effect on the temperature of the inside space of the building.

4.3. Roof

In this section, roof and ceiling construction has been scrutinized from environmental, social and economic perspectives.

Roof is the most critical component of a building against climatic factors. Sunshine, rain and snow are the three most important factors influencing the form of roof of a building. In winter, the roof in comparison with the walls at night with the long wavelength rays emitted from itself, faster and more loses its heat. Therefore, in cold region in winter, the building roof is the major cause of heat loss. In very hot areas, there is the belief that the roof is the main cause of warming the indoor air. This statement of course is absolutely correct, but in most cases, the reason of that is the roof has been constructed from non-indigenous materials and has a non-climatic form.

4.3.1. Hot and dry climate (Central plateau of Iran)

In this climate the roof form in response to hot weather and intense sun radiation has been shaped and hence vaulted and domed roof as a climatic form has been selected [8].

An important feature of a domed roof is that at most times of the day-in solar radiation exposure- a part is in the shadow and away of sun radiation and always remains cool. These roofs, beside structural benefits cause the light absorption and heating from sunlight adjusted during the day by different temperature of vaulted surfaces. [10]

In this climate, the temperature difference between day and night is high. Therefore, use of materials with high thermal mass helps to moderate the temperature fluctuations. It reduces temperature fluctuations by absorbing heat when the ambient temperature is hotter than the mass, and then releasing the heat when the ambient temperature falls below the temperature of the mass. When used effectively, this results in improving indoor comfort.

Materials that have been used have good quality (e.g. mud, mud-brick and brick) which were developed and evolved during millenniums and centuries of traditional fabrication [11]. As the thickness of the roof rises, temperature moderation is done efficiently. Consequently, in traditional architecture, in construction of the roof, thickness of roof was as high as possible. To collate with the ceiling load resulted from the high thickness roof, the vault with sharp elliptical arc or double layer roof is used. Using double layer dome is an efficient response to this climate condition because of reducing the roof weight and the possibility of heat exchange with air insulation between two shells was very low. Furthermore, the interior space volume declined, so cooling and heating it was easily possible. (See Fig.6)

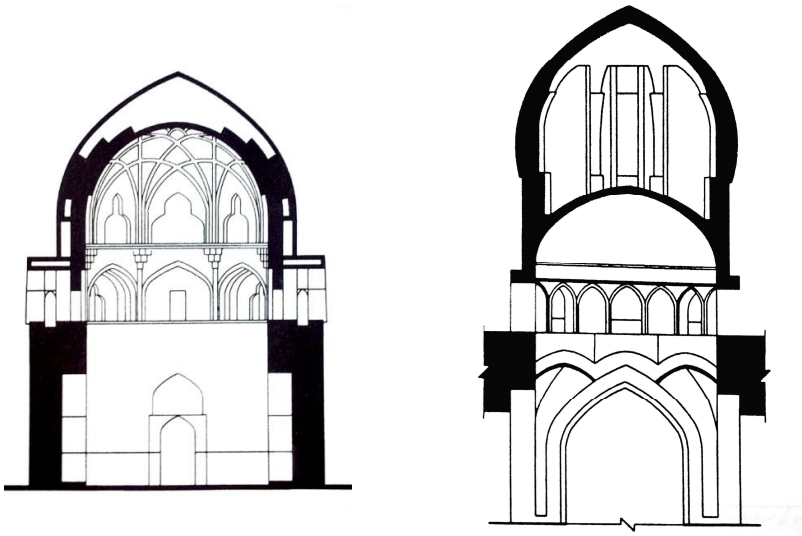


Fig.6. Use of double layer dome for Climatic and Human- conformity Aims (source: M. Pirnia)

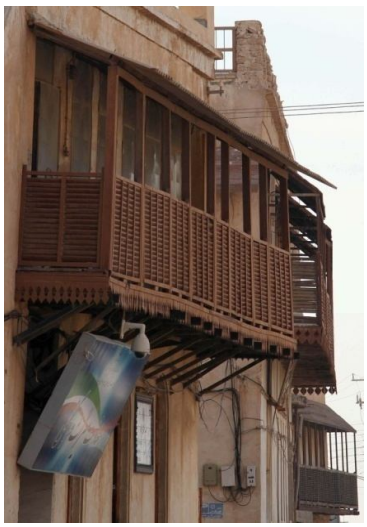
Accordingly social and psychological aims have been reached. That means, by the second interior cover, the building was close to human proportions and the relationship between humans and space was more intimate. In addition, in this region's traditional architecture roof has been constructed from indigenous materials and brick usually is the final coating which in comparison with clay has a lighter color and hence that is the cause of the reflection and less absorption of heat from solar radiation [12].

4.3.2. Hot and humid climate (Coasts of Persian Gulf)

This region is near to the coastal line so it is always humid and very hot, especially during the spring and summer. In this region, like central plateau of Iran, indoor air cooling is the basement of the design, but the high humidity of air should be paid enough attention. Shadow and ventilation are two main factors in sustainable design in this region. Furthermore, wind speeding up the amount of moisture that evaporates from surfaces and hence the environment temperature is declined. In the other hand ventilation is useful for passive cooling, where it should be considered along with other passive design features such as location, orientation and layout, window size and placement, and thermal mass. Reaping the benefit of these factors" Taareme", "Shanaashil" (Fig. 7) and wind catcher as three sustainable systems have been designed and employed in this region [13].

In this climate, use of special terrace that surrounds the building facing the sea, as called Taareme, Shanaashil for utilize of free sea breeze has been common.

It is important to consider further the cooling solution for the afternoon times where the roof design may need to be reviewed and experimented [14].



Taareme Shanaashil

Fig.7. Use of Taareme, Shanaashil for utilizing of free sea breeze (source: author)

Wind catcher systems are operated by the power of wind coming through the holes designed on it. Air circulation at various points in the building is adjusted by opening or closing the various ducts at the bottom of the wind catcher. The wind catcher operates according to the condition of the wind and sun radiation in the region. By this system, a building will use the natural energy and works like today modern coolers to be cooled without using expensive resources. (Fig.8)

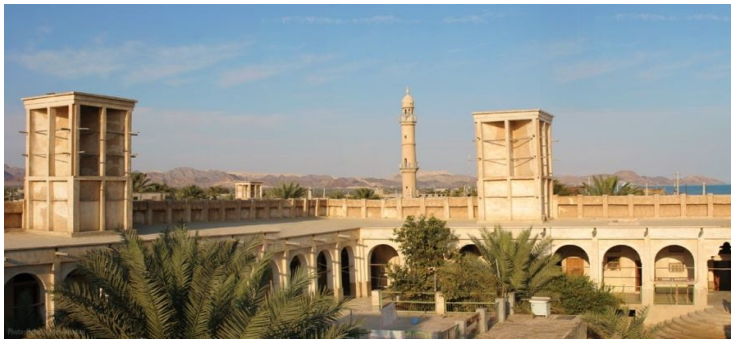


Fig.8. Wind catchers for utilizing of free sea breeze in Hot and humid climate of Iran (source: author)

In this climate, because of proximity to the sea and not much difference between the day and night temperatures, low thermal mass materials such as wood is used and hence the roof form is mostly flat. The accessibility to the open seas in this area facilitates the delivery of the materials such as woods by ship.

4.3.3. Cold and mountain climate (Western Mountains of Iran)

Long cold winter and short temperate summer are the main features of this climate. Therefore, the goal of a sustainable design in this region is creating and protecting of warm indoor air and all of the climatic systems based on this goal have been designed. As the wind and water play the main role in Hot and dry climate, the sun and solar energy play the main role here. In this region, for maximum solar gain, buildings have been located, oriented and designed to maximize window area facing south. However, this has been depended on the site's shape, orientation and topography.

The ceiling has a flat shape and its height is low to help faster and easier heating of the internal space as well as reducing the exchange heat with the external environment.

Flat roof is a climatic alternative in this region, because of accumulated snow on the roof acts as a high thermal barrier against outside cold air that its temperature is several degrees lower than snow.

4.3.4. Temperate and humid climate (Coasts of Caspian Sea)

This climate has several features. The most important of them included abundant rainfall, high humidity and low difference of temperature between day and night. Due to the high volume of rainfall, the general form is

sloping roof. The cover has been made of the stem of rice and Gaalipoush [8] (Fig.9). Ceiling height of the buildings near the sea is higher than those buildings situated farther away the sea and consequently, its slope is more intense because the rain fall due to nearing the sea, is intensified.

Fig.9. Gaalipoush roof in Temperate and humid climate of Iran (source: MehrNews.com)

4.4. Wall

Main purpose of building walls in traditional architecture is to support roofs and ceilings. But this building element has other main purposes that Iranian architects exactly have considered them. The amount of sunshine affecting indoors temperature depends on the type and kind of materials used in the exterior walls. Regarding the fact that the air temperature in the traditional architecture of Iran is not controlled by building's mechanical systems, type and kind of materials used in the wall, have great impact on the welfare of its inhabitants. In this regard, we investigate the wall and its structure in the traditional architecture of Iran in different climates based on environmental, economic and social perspectives.

4.4.1. Hot and dry climate (Central plateau of Iran)

Generally, in hot and dry climate, buildings have been built from high thermal capacity materials such as mud and brick. In areas with very severe weather conditions, by constructing the building in foothills or under the earth surface, the equilibrium thermal conditions of underground have been used. Building exterior surface to its volume ratio is low; consequently the rate of heat exchange through the outer wall is minimized. To further reduce the temperature caused by solar radiation, the outer surface has been whitened [10].

In respect to both material and thickness walls have been designed according to the climate. For example, in hot and dry climates the walls are very thick, sometimes one meter thick. This high thickness is accompanied with some benefits: first it increases the delay (the time between absorbing the heat from one side of the wall and passed through it and leave it from the other side), and second; it decreases the temperature swing between day and night since the heat absorbed during the day is released at night. Third, thick walls lose heat at night through transformation, therefore during the day the walls are cooler than human skin. Human body will radiate on it even if the temperature is high. These walls will provide the most comfort during the day and at night will bring the necessary cold through transformation. [15]

4.4.2 Hot and humid climate (Coasts of Persian Gulf)

In this climate, the walls have been made from low thermal capacity materials. Using a wide Ivaan, the walls are located under the full shadow and they also prevent to rain penetrating through building.

4.4.3. Cold and mountain climate (Western Mountains of Iran)

In architecture of this region, the following points have been considered: First, materials with high thermal capacity and also has good insulation have been utilized. Second, the vernacular architects by minimizing the surface area to the volume of building ratio, have saved a lot of required heat. For utilizing solar energy, the dark colors for outer surfaces of building have been selected [5] (Fig. 10). In addition, in this region, because of the long duration of freezing period in the winter, buildings have deep stone foundations to be resistant against erosion caused by freezing. For protection against cold weather and preventing heat loss, buildings have been built so close to each other and narrow alleys have been considered.

Fig.10. Use of high thermal capacity material and minimized outer surface with windows facing to southern light in Cold and mountain climate of Iran (source: www. MehrNews.com)

4.4.4. Temperate and humid climate (Coasts of Caspian Sea)

In very wet areas near the sea shore, to protect buildings from abundant land moisture, houses have been built on wooden base, but in the foothills where the moisture content is lower, the stone base or in some cases catwalk has been used for protection against moisture. Walls have been made from materials with low thermal capacity and in the case of using materials with high thermal capacity, their thickness have been maintained at the minimum level of possibility.

4.5. Window

Light and its importance in a building space, in viewpoint of its relationship with the human activity in building and its direct effect on the mind, body and soul is obvious. Window is a transparent or translucent opening in a wall or door that allows the passage of light and, if not closed or sealed, air and sound. Window has a special place in traditional architecture of Iran. In addition to providing daylight in internal space, ventilation is an important function of the window in this architecture. Sunshine on windows of buildings has a great impact in increasing the inside air temperature, especially when the sun directly lights into the inside of building, the thermal effect of window is much higher than walls. Consequently, the internal space becomes warm immediately after receiving the direct sun lights. If the building is made from lightweight construction materials, the heat increase is more tangible. [5]. Number and size of windows is dependent on the climate and the culture of region. In dessert areas opening are small and located under the ceiling. They are mostly on north and east side of the structure. In cold areas openings are generally bigger and located in southern side of the structure to get benefit from the sun light. In temperate areas openings have been placed along the wind path to purify the air entering the inside of the structure. [10]

Window orientation and canopy status are important factors through affecting the amount of light entering the building and consequently the inside temperature. The following section reviews the window role in the Iran four climates.

4.5.1. Hot and dry climate (Central plateau of Iran)

Direct sunlight in these regions is severe. In addition, low humidity broadens the temperature range. In summer, the air temperature reaches 50 °C in day and to 15 °C or less in night. In these regions, the number and place of the windows have been reduced and to prevent the penetration of reflected radiation from the surrounding surfaces, the windows have been built on the upper parts of walls. The numbers of windows that are opened to the sidewalks are minimized to avoid unfavorable climate penetrating into the indoor area. Most of the windows are opened to the protected central courtyard area, which generally has less harsh conditions and a more favorable environment than exist on the outside of the buildings. [13]

To prevent eye exposure to intense sunlight, “Orosi” -a special type of window like sash window-has been created that in addition to its unique design, modified the amount of light passages the opening. The Orosi with structure of small pieces of wood and colored glass and in a special eye-catching geometry have been built skillfully.

Natural sunlight passes through Orosi prism and paves heart of the parlor after radiation to water surface inside the pond. In hot summers, Ivaan becomes Orosi canopy and, in cold winters, sunlight goes into depth of house and sprays color. In fact, an architect prevents direct entrance of light into Tanabi by putting the Ivaan in front of this space and throws colorful lights on walls and roof so that motion of water causes light dance in this space which is fascinating [16]. In other climate of Iran where sunlight is intensive, this kind of window is also used and results in a shining exquisite gem in the building façade (Fig.11)

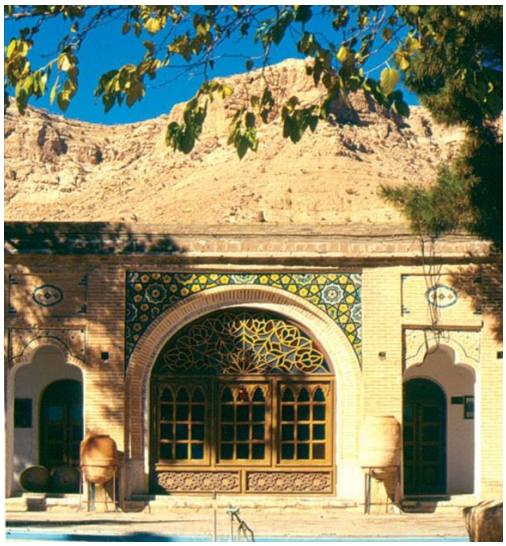


Fig.11. Orosi in southern façade of building for preventing eye irritation and with aesthetic aim
(source: www.ilam-miras.ir)

4.5.2. Hot and humid climate (Coasts of Persian Gulf)

This climate has a very hot and humid summers and temperate winters.

Maximum temperature can reach up to 40 °C and humidity, usually is 70 percent.

Considering the importance of natural ventilation and air current in buildings in this climate, the building has several large openings facing toward natural air flow. In front of these windows, wide and long Ivaans are built for efficient use of natural air flows. Furthermore, in regions close to the sea, for utilizing the cool sea breeze large wind catchers have been built. (Fig.8)

In this climate opening type and size should be chosen in accordance with the building passive cooling (lesser than outdoor temperature) for diurnal building operations. Small opening are advisable for night operation while for the building day operation, louver opening type should be adopted. This issue in traditional Architecture of Iran has been respected [1].

4.5.3. Cold and mountain climate (Western Mountains of Iran)

Although the air temperature and its duration in cold regions are different, in most areas it reached to 30 degrees below zero in winter. The only difference between this region and warm and dry region`s architecture is the necessity of using of heat from sunlight and solar energy in most times of years. Use of solar energy, is the important point in this region architecture. Thus, the construction of south-facing windows has been expanded and except in urgent cases and just with controlled dimensions, the construction of north-facing windows has been prevented.

4.5.4. Temperate and humid climate (Coasts of Caspian Sea)

In this climate, because of the need for natural ventilation, buildings have been constructed with large windows situated along beach, facing to the sea breeze flow. To prevent rain penetration of building in cold and rainy seasons, the Ivaans has been traditionally used in front of the windows [5].

5. Conclusion

In this article, the traditional architecture of Iran was studied in four different climates, from the sustainable architecture perspective. According to Pirnia (2005) - prominent scholar of traditional architecture of Iran- traditional architecture of Iran is based on five principles: 1- Introversion 2- Autonomy 3- Human-conformity 4- Structure and Modulation 5- Purposefulness. After analyzing the concept and meaning of these principles, it was determined that all of these five principles are adapted with principle of sustainable architecture. By study of the elements of traditional architecture Iran, in four climatic-base regions, the adaptation of these principles with the principles of sustainable architecture from perspective of “formal sustainability”- that was distinct from other aspect of sustainability in architecture such as “functional sustainability”, “structure sustainability”, “facilities sustainability” and “adornment sustainability”- was evident. Because of subject extensiveness, in this article, just formal sustainability in Iran architecture was excavated. Then form components including “roof and the ceiling”, “walls”, “windows”, “general form and its orientation”

in relation to the environment, economy and society was studied. In all these studies, it became clear that the principles of sustainable architecture in traditional architecture of Iran were confirmed.
Sustainability is a complex concept that can be looked upon from different perspectives; function, structure, facilities, adornment and landscape and other new point of views can be studied and scrutinized in other researches.

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