# Sustainability in Iranian Traditional architecture
## In the case of Isfahan-central Iran

*Rafooneh Mokhtarshahi Sani*

*rafooneh@gmail.com*

***Abstract:***

Iranian architecture like the architecture of almost all other developing countries is in the middle of big transformation and change. Through last centuries, Iranian traditional and vernacular architecture demonstrated distinctive characteristics of sustainability. Today in Iranian contemporary architecture, however, such characteristics either completely demolished and forgot or misused frequently. During the recent years, Iran also has faced energy crisis. Then, sustainable buildings are demanded more than ever specially in Iranian large cities. Related statistics show most of spent energy is using by urbanized areas and residential buildings. Consequently, in order to find the proper way of adaptation with immediate environment, investigating traditional architecture and it's harmonize relationship with nature appear to be a useful way. On the other hand, Iran is a large country with diverse climatically conditions and as a result different vernacular and traditional architectures. In this variety, central part of Iran and its old capital city: *Isfahan* has had an essential role in Iranian culture and architecture. This city locates in the arid and semi arid part of Iran, however, the most important river of central Iran is divided the city in two parts. Therefore, the traditional architecture of this city contained the characteristics of both arid regions and riverside cities. The aim of present paper is to give an overview of vernacular/ traditional architecture in central part of Iran in the perspective of sustainability. Also investigating the unique architectural characteristics of *Isfahan* city is the other focus of study. In this inquiry, revision of this traditional architecture has been divided in two categories: urban layout in general and traditional housing in specific focus.

***Keywords: sustainability, traditional architecture, central Iran, Isfahan,***

## Introduction:

The architecture style and building types at least in historical periods somewhat was depending on environment and climate condition. According to Reza Shabani [5]there is a relatively famous theory of Climate, which discuss about relationship between identity and natural environment. Based on this theory, some natural environmental elements like climate, geography, and geology are the main reasons for creating various identities of different nations and ethnics.

[5] translation of : Shabani, Reza, Iranians and national identity, SAZEMANE ENTESHARAT, Tehran, 2006, P150

This matter at least about Iranian culture and architecture is more highlighted due to the historical respect for natural environment in this culture. For instance, Iranian New Year is in the first day of spring. Also, festival of fire at the last Wednesday before New Year, festival of Yalda at the first night of winter, or spending the 13$^{th}$ day of spring in the nature and many other examples are popular national celebrations, which are directly related to the nature.

Perhaps the first image of environmental character of Iran will remind everybody, hot and arid zone with architectural characteristics of such environments. However, Iran is a vast country with various climatic situations, different topography, and as a result diverse solutions in terms of environmental architecture. West and North West of Iran with long, very cold winters, north and south with very high humidity, center, and east of Iran with hot, arid and semi arid weather, through history forced the traditional architects to find a way for adaptation with such unfriendly conditions.

In contrary, in Iranian modern architecture seems such necessary combination of built and natural environment has been neglected. This ignorance has had various reasons which lack of enough information about traditional environmental architecture is one of them. It seems traditional architecture and its sustainable solutions to some degree, is unknown for even local architects. Then reviewing main environmental architectural characteristics might be useful for contemporary architecture too.

Among Iranian historical cities, Isfahan is one of the most important cities in terms of keeping main characteristics of its traditional environment. This city, which was the popular capital of Safavid rulers in the 17th and 18th centuries, lies in central Iran, with arid and semi-arid weather. Such environments generally do not have enough water. This city, however, is an exceptional case. A big river divides this city in two parts, which provide enough water not only for this city but also for the other peripheral regions.

Accordingly, environmental architecture characteristics of this city appear to be interesting due to such combination.

## The local climate:

Covering an area of 105,937 square kilometers, Isfahan province is located in the central part of Iran. According to the latest divisions of the country, Isfahan province includes 17 townships which Isfahan town is the capital of the province and the most populated city in the province. Due to its vastness, Isfahan province consists of several mountainous and plain areas. Regarding this natural and topographical situation, the climate of the province is changeable as well. Although the province usually enjoys a dry and temperate climate, but it can be classified as three climatic regions depending on the distance with western mountainous area and desert (Kavir) plain in the east and south-east. These climatic regions are[6]:

1. Arid weather: which is located in eastern part, near to central desert. The average annual rainfall stands at 70 millimeters.

2. Semi-arid weather: It covers the town of Isfahan.

3. Cold semi-humid weather: As we move on to the west and south-west, the height reduces, the rainfall rises and the temperature drops. Average annual rainfall of the region is 329 millimeters.

According to the reports of Meteorological Organization[7], maximum temperature of Isfahan province is 40.6 centigrade, minimum temperature is 10.6 centigrade, and average annual temperature is 16.7 centigrade. The annual freezing days of thå province are 76 days ad average annual precipitation is 116.9mm. Isfahan is situated between two mountain ranges and has relatively regular seasons. Flowing through Isfahan city,

[6] Zendehdel, Hasan ,Persia other than history, IranGarden Publication, 2006
[7] Iran chamber of commerce, industrial& mines website, http://www.iccim.org

Zayandeh Rood River is the most important river of the province and one of important rivers in Iran.

## Traditional architecture and environmental factors:

The environmental architecture of this city can be studied in two category: urban layout and traditional houses:

- **Urban layout:**
  - Organic street's pattern
  - Bazaar
  - *Sabat*
  - *Chahar bagh*
  - open public spaces
  - *Madi*
  - Bridges
- **Traditional houses**
  - Compact buildings
  - Building materials
  - Winter-summer rooms
  - Openings
  - Courtyard

## Urban layout

*Organic streets' pattern:*

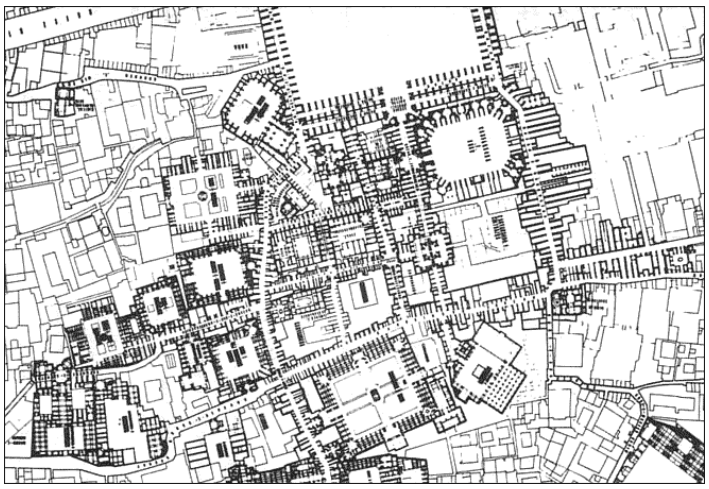
Most of traditional streets in Isfahan had an organic organization. These narrow twisting streets, which were surrounded by high walls, could provide enough shadow. In fact, for arid and semi-arid weather, there is high temperature's difference between shade and sunny areas. Generally, shading area is cool enough during the hot seasons.

Such organic layout, which was supported by surrounding compact buildings, could protect buildings from occasionally summers' sand storms. Winters' cold dry winds also could not break in the buildings through such design. These narrow streets were also the best place for people, specially women and children to socialize. The width of streets was only allowed pedestrians and small load-carrying animals to pass. All these considerations could provide a sense of belonging in addition to enough safety feeling.

(The general view of streets in the old part of Isfahan, Photo: Mohammad Gharipor, http://www.iranchamber.com)

*Bazaar*:

Bazaar was the heart of such organic network. Bazaar was connected two main focal points: old Friday mosque and Naghshe-Jahan square with its new Friday mosque and palaces. Most of the Bazaar's passage had covered by vaulted brick roofs. In fact, the Bazaar of Isfahan is the longest roofed market in the world.[8] This long covered Bazaar not only acted as main movement network within the city, but also it was the heart of all social and business activities. There were many *madrasa*, mosques, *hammams,* water stores, warehouses, and stables in the Bazaar. Even nowadays, still bazaar has kept its central role in this city people's life. Bazaar because of its structure as covered passage usually was cool enough in summers and warm in winters. It had natural light and good ventilation through some small openings in the roof. All these factors were helped Bazaar to be the primary place for social interaction.



(Part of Isfahan bazaar, Photo: Mohammad Gharipor, http://www.iranchamber.com)

[8] Mohammad Gharipour, http://www.iranchamber.com/architecture/bazaar_of_isfahan1.php

*Sabat:*

Traditional streets generally were covered in some parts to increase the shading zone of streets. This covered part, sometimes was a single arch and the other time it could be a room belonged to one of nearby houses. In addition to extra shading, which was provided by sabat the other advantage was better wind circulation. In arid and semi-arid weather, the temperature difference between shade and sunny area is high then this difference could provide a little breeze in the passage. The combination of this added shade area and breeze could provide relatively more comfortable environment.

Sometimes, under this covered area (sabat), there were some small sitting places on two sides of the passage. Thus, people could stay for having chat and socialize in these more comfortable urban places. Sometimes the entrances of several houses were opened to this area. It was also another chance for socializing in a neighborhood.

(Sabat, Photo: http://farm2.static.flickr.com)

*Chahar bagh:*

Chahar bagh is the name of famous historical street of Isfahan. It is a long, straight street, which is in contrary with common organic layout of traditional streets in this city. In historical period this street connected Si-o-se Pol Bridge to the royal palaces. Here it seems traditional architects were giving another solution for environmental architecture of this city. For reducing the heat in such wide street, they divided this street in four parallel sections. Then by planting lush tall trees on two sides and putting a stream in the middle of street, enough shadow had been provided. Today, that tall tree has been replaced to the short ones, but still this street is cool in summer time. Subsequently, it shows traditional architects could find a solution for straight wide street which has many similarities with modern ones.

New and old view of Chahar bagh street in Isfahan (photo: www.dejcam.com)

**Open public spaces:**

One of the most impressive environmental architecture factors of this city is its famous open public place: Naghsh-e-Jahan square. Designing such huge public open areas is somewhat rare in Islamic traditional cities. During Safavid period, however, king Abass the magnificent gave a new shape to the urban structure of Isfahan by making this rectangular square. Its length is 500m from North to South and has a width of approximately 165m. The square has been surrounded by two story arcades and historical buildings. This square had been used as a playground for polo games and horseracing, festivities, military parades and so on.

In arid and semi-arid weather, designing such enclosure is one of the best solutions for protecting the open area from hot dry winds during summer time and cold dry winds of winter. Later by adding a vast pool and planting trees all over the periphery of square, the comfort area of this place has been increased.

This new square through main Bazaar was connected to the old Friday mosque. In fact, during Safavid period, the old Friday mosque and its square were used mostly for religious purposes. However, this new square, and its mosque, were used more for official ceremony or playing and entertainment. These two important open public places were linked to each other through another public space: Bazaar. Therefore, possibly one can say that open public spaces were shaped the skeleton of this city.

(Nghshe-Jahan square, Photo: Erich F.Schmidt, FLIGHTS OVER ANCIENT CITIES OF IRAN)

**Madi:**

One of the especial characteristics of this city is some narrow streams that are called Madi. These streams are divided from the main river (Zayande-rood) and continue their way towards outside of the city, by running between some residential areas. Generally, streets were made on two sides of these streams, which with numerous trees and organic shape of passages, could provide cool, shadowy area, and increased the humidity of semi-arid weather.

**Bridges:**

Isfahan is one of the rare cities, which in spite of its semi-arid weather, has many historical bridges over Zayandeh-rood River. Although these bridges were important parts of city movement network, they could provide livable open public spaces too. These bridges had (and still have) an essential role in people's social life. Most of these bridges have arched supporting walls, which can give enough shade area in daytime. Generally, in the afternoons, people are coming to spend time with their families or meet their friends around these bridges.

Khajo bridge, (Photo: Persia other than history)

## Traditional houses

### Compact buildings:

One of the major challenges for architects in hot regions is finding proper solution for decreasing the heat. One way of decreasing heat is protecting buildings from direct sun light effect by making them as compact complexes. In this approach, not only buildings but also the entire city had been made as a full mass. The only openings of such mass, was the courtyards and narrow twisting streets. Even these narrow streets from time to time were covered by “Sabat” or dome roofs. The common construction material of this region was brick and mud brick. That is why such compact layout in addition to using of a single material, has been given a unify image to the traditional part of this city.

General view from old Friday mosque and the surrounding houses

### Building material:

Finding construction materials is the other problem in the central part of Iran. In this broad region, which is surrounded by deserts, finding building material except soil is too difficult. Moreover, if even the few existing wood were applied in structure, termites after a while would have demolished it. Therefore, the common usable material was brick, mud, and mud-brick. These structures after the useful period age of building could

come back to their environment without any harm to it and they could be used repeatedly as construction material too.

The other advantage of using such building material, is laid in its' high potential for saving energy. Brick and mud can keep energy for a long time. In hot seasons, during the daytime, brick absorbs most of the sun heat without letting it to enter indoor spaces. While these gained heat exudes gradually during night time. In wintertime, the same procedure happens. The outside coldness absorbs by brick while the inside warmth would not waste too. This quality of brick is getting more effective by adding to the thickness of walls. Openings' frames had been made from wood. This natural material can keep energy in itself too. Usually thick canvas curtains were shaded windows. By this way, wooden windows were supported from direct sunlight, which could ruin them gradually. In addition, more shade was providing for indoor spaces.

A traditional house in Isfahan

(photo: www.Iranmiras.org)

**Winter and summer rooms:**

Typically, traditional Iranian houses had two different sections for summer and winter. The northern face of houses, which had minimum sun light, was used in summers and southern face with maximum sun light was used in winters. Kitchen and service rooms were located in eastern or western faces, therefore in both season they were used

by reasonable distance of main spaces. Therefore, by dividing indoor spaces to winter and summer rooms, the need for heat and cold was being minimized.

**Openings:**

Typical traditional Iranian house in central regions did not have any opening toward outside of house. All openings were just looking through inner courtyard. The high walls of courtyard, except mid-day which sun is raising perpendicular, could provide plenty amount of shade. Therefore, most of times there were not any direct sun light toward windows. In spite of this, the windows surfaces were divided in many small colorful pieces. That means, even if sunlight could enter inner spaces, these small colorful glasses would filtered the sun light to provide coolness and beauty in rooms.

A traditional window (Photo: Persia other than history)

**Court yard:**

If we could look at the Isfahan from the top, the general view of old part of city is like a huge massive form with numerous holes. These holes, which are making the courtyards, are the only open areas in the most parts of city. In other words, most of times, courtyards were the only breeze points. These deep courtyards had an essential role in energy efficiency of buildings. All indoor spaces were opened to the courtyard. Because of surrounding tall walls of courtyard, most of times there was enough shadow in

it. This shade in combination to greenery and pool, which typically were existed in courtyards, could provide a pleasant cool weather in hot seasons.

Generally, the roof of basement was made upper than ground floor. Basement was colder and had more humid than other spaces. Therefore, by putting some openings for the basement, such cool weather could come to the courtyard. Then, this more or less pleasant breeze was accompanying by humid of pool and coolness of greenery. Finally, this weather conditions would transfer to the indoor spaces.

Although Isfahan has semi-arid weather and keeping buildings cool is the main problem, it is getting too cold, in winters as well. Therefore, as much as sun light is unpleasant in summers, in winters it is demanded. For this reason, trees, which were planting in the courtyard, were chosen from the types that were loosing their leaves in winter. Therefore, sunlight could enter courtyard and bring heat to the indoor spaces.

## Conclusion:

To design buildings in harmony with the environment, it is better to have a look to the traditional architecture as a valuable source of learning and at the same time have another look toward the future. Investigating in traditional architecture of different

regions will be useful to find such proper considerations and perhaps re-apply them in the contemporary designs.

In this case study three types of solutions might be offered: In the first group, there are some qualities, which still can be efficient in terms of sustainability in the contemporary buildings even with the same format as traditional architecture, such as designing livable *open public spaces*, and designing *compact buildings*.

In second group, there are other characteristics, which by some changes and adaptation can be used again. For instance, use of *local building material* still can be a good solution for resource and energy efficiency. Especially in some regions, use of these local materials is easier and cheaper than concrete or other new materials. Or for instance although we cannot make courtyard houses with the same arrangement, the idea of *courtyard* can transform to the other related energy efficient ideas. Dividing a window surface to smaller pieces and use of *colorful glasses* is also can be used again easily in modern buildings.

In the last group, there are some traditional architectural characteristics, which are not applicable in modern architecture and societies anymore, like separating houses to *winter and summer rooms*.

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