# Environmentally Friendly and Sustainable Patterns of the Traditional Architecture employed in the Arid Hot Desert Climate of Iran

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Environmentally friendly architecture or sustainable architecture is an approach that focuses on minimizing negative effects both to human and the environment. Architectures and designers who pursue this perspective aim protecting the water, soil and air by using environmentally friendly material in the construction of the buildings. Three major characteristics of sustainable architecture include:

1- Sustainable site design, conserving water resources, energy and environment,

2- Improving the quality of the life space of the building,

3- Protection of the materials and the resources.

But the question is: Can the patterns and materials of traditional sustainable architecture be applied in today's modern residential architecture?

In this short article, following three dimensions approach has been employed to study the potential environmentally friendly elements of Iran traditional architecture. Iran's central desert has been selected as a case study of the article and the results can be helpful for both policy makers and public opinion, architects and designers.

## Case study:

Iran's central desert, also known as Dasht-e Kavir, is considered as one of the driest and warmest regions of the world. Despite the difficulties of living in these areas, throughout the course of history some significant cities have been formed and developed on the verge of this desert. This was only possible by exploiting the natural resources wisely to moderate and balance the weather. Some of the challenges the people in these areas have had to face and find solution for

include: water deficiency, sandstorms, extreme heat in summer and extreme cold in winter as well as the excessive temperature difference of the day and the night.

## Environmentally friendly patterns of the traditional architecture

1. Preserving resources

One of the main objectives of the sustainable architecture is to increase the efficiency of the structure and reduce the energy consumptions through optimal utilization of the spatial and structural capacities.

In the traditional architecture of Iran, energy efficiency had played a significant role. In that context the designing of the overall structure of the building, the distribution of different spaces and the construction materials were all measured on the basis of energy efficiency optimization. In the desert areas of Iran, a central courtyard along with a small garden are usually located in the middle of the building and they increase the humidity of the living space of the building.

Given that the courtyard is located in a lower level compared to the surrounding environment, therefore it absorbs the nearby surface waters easier and facilitates the access to the groundwater as well. In addition, by placing the basement underground, the external and internal thermal exchange of the structure is reduced and the temperature fluctuation in these areas could be managed.

Alternative method of energy consumption reduction is to decrease the surface that is directly exposed to sunlight. This can be made possible by creating density. density is defined as the division of the amount of the overall surface level by the amount of the built structure. For instance, a one-floor building has a lower density compared to the same building built in two floors. This criteria had been followed in the desert cities of Iran by densifying residential units so that some residential units were connected to others from four sides.

Another factor that serve the purpose of saving energy in the desert cities is to benefit from the systems that the environment has to offer to minimize the energy and electricity spending. These systems include windcatcher, Ab anbar, windmill and watermill.

The materials that were used for the construction of the buildings usually included clay and bricks that had been collected from the excavation process and were mixed with the straw which was derived from agricultural activities. Therefore, not only these materials were supplied from the natural resources but also they had facilitated energy saving by delaying the warming up of the building during the day and keeping the heat at night.

2. Designing to return to life cycle

Sustainable architecture studies shows that the traditional architectural patterns of the Middle Eastern cities have substantial compliance with the environmental features of their lands.

Another architectural and urban tradition of Iran included the adaptive reuse and re-utilization of the buildings even during the significant socio-cultural changes. For instance, upon the arrival of the Islam to Iran, some modifications were applied to the religious buildings including Fire Templates and they were preserved and used as mosques. Therefore, the desirable features of the traditional architectural of Iran in that respect include preservation, maintenance, restoration, and adaptive reuse and re-utilization of the buildings.

3. Human at core

One of the most significant factors in designing the structure that can serve human is to focus on climatic comfort in different areas. Researchers believe that the main purpose of the urban design and architecture within the warm and dry environment should be the reduction of the effects of the weather on the people and for doing so three methods are available that includes the utilization of the shadow, wind, water and minimizing the impact of the sun's rays.

The studies of the desert cities of Iran shows that they have also benefited from the same factors. In the residential units shadow was created by benefiting from the central courtyard with high side walls. The role of water in these spaces was noted by building Howz (pool) in the courtyard to naturally cool the air and reduce the air dryness.

Another feature of the traditional architecture of the desert areas is to take the cultural issues and needs into considerations and design the residential units in such a way that urban texture meet

all the needs of its residents. The residential units in the traditional urban texture of Iran represented the city the neighborhood and the city in which they were located in the sense that it was divided into inner[i] and outer parts and the administrative, social and economic activities that were related to them were predefined. For instance, the outer area of the house was devoted to the man of the house to do its activities and it was also a reception area for the guests and the inner parts was where the private quarters were established and it included living area, court, bedrooms as well as kitchen. These spaces were connected through the vestibule. Vestibule were small covered spaces that connected the door to indoor space. In front of the door usually two platforms were built that could be used by residents of house and could be used as a shelter from rain and sun for the passers-by.

## Eco-friendly Construction Materials employed for arid hot desert climate of Iran

The common construction materials in the hot and dry regions of Iran included mud, clay, brick and Sarooj which have high thermal resistance capacities. Although these materials absorb the heat of the sun on their outer surface but prevented the heat from penetrating inside. These materials are of natural origin and prevent thermal exchange due to its their thermal capacities. As these materials are natural, they can be easily returned to nature and they wont harm or pollute the nature.

### Four Season House

In the local architecture of Iran, people built houses that were designed for different seasons. As the southern part of the house was located in the shadow during the summer this part was usually used in that time and the basement was also located in that part. When the temperature was extremely high, people went to basement to escape from the heat. The northern part of the house was used during the winter as it was exposed to the sunlight and absorb the sun. By this process, people would adapt their lifestyle with the environmental climate. In the four-season homes, people adapt themselves to seasons, supplying their energy needs according to seasons in different sectors, and by doing so they used to control and manage energy consumption in buildings.

**Iwan**[1]

Iwan is a semi-open space that connect the indoor space to the outer space. This semi-open faces the central courtyard and the small garden and it has two semi-open walls and another side is attached to the alcove.

Iwans are usually located in the summer-stay area and face the north and in the afternoons they do not get sun rays. Therefore, the temperature of this area is usually less than the other parts and even the central courtyard, which results in the internal wind flow and makes the Iwan's atmosphere more pleasant.

By creating shadow, Iwan controls the temperature and avoids the heat and direct sunlight to from entering inside the building and by doing so the energy consumption is reduced yet the internal climate condition is improved.

[1] rectangular hall or space, usually vaulted, walled on three sides, with one end entirely open

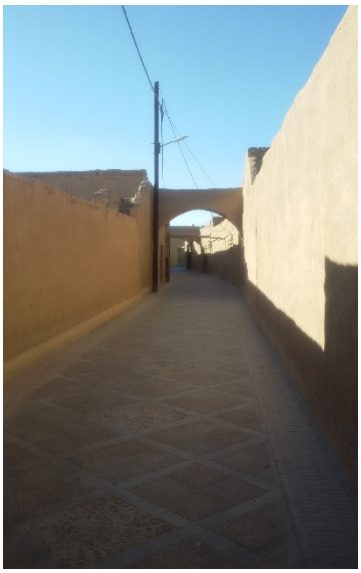
**Sunken Courtyard**

In tropical areas, sunken courtyard has been used for a long time. Along with security issues and the cultural role of the sunken courtyards, they create a cool and micro-humid atmosphere inside the building and therefore reduce the amount of needed energy to cool the building. Instead of opening the windows and doors to the outside environment, they are usually opened to the sunken courtyard and they avoid the contact of the inside area of the building with the outside. Throughout the day, the courtyard creates a cool environment and during the night, the cold weather settles inside the courtyard which is lower than the rest of environment and that is because cold weather is heavier than the hot weather. The vegetation in the sunken courtyard humidifies the air and increase the cooling of the airflow and leads the cooler air to the home

**Windows and Awnings**

The least windows and awnings can do is to prevent the unpleasant outside air to get inside. Windows are located at high altitudes or under the ceiling and are opened to central courtyard that has a more favorable environment and airwings were thin blades that were connected to the top of windows and doors horizontally and the other type of it were placed between the windows vertically and were 61 to 81 centimeters wide. In these warm and dry atmospheres, instead of having large glasses, windows had small, colorful glasses to control the light inside. It is possible

to control the light that gets inside building with windows, awnings and by doing so reduce the required energy for the thermal equilibrium.



**Walls**

Within the elements of the local buildings in the hot and dry areas of Iran, walls is considered as an important climatic element. The thickness of the walls in these areas usually were usually reached one meter and they act as thermal insulation due to its unique texture.

During the nighttime, the walls exchange their heat with the environment and absorb the available thermal energy throughout the day and by doing so keep the ambient temperature at the low level.

**Howz-khane**

In the tropical areas of Iran, there is a place called Howz,khane and one of the windcatcher's doors opens to it. In this area, there is a pond full of water and the airflow created by the windcatcher moves over it and by evaporating the water cools the environment.

This space is located in the summer-section of the building. By employing evaporative cooling, Howz-khane reduces the temperature. Howz-khane is considered as a sustainable system in the traditional architecture of Iran which does not cause pollution and solely works with renewable energy of the wind.

**Windcatcher**

Natural ventilation has played a significant role in the structure of the traditional buildings. In the traditional architecture of the desert areas of Iran, the role of ventilation was carried out by windcatcher. The windcatcher initiates working once the airflow was absorbs from its openings and the air flow is distributed between the spaces through the outputs that are embedded in the downwind opening. The windcatcher initiates to work once it is affected by the wind flow or

sunlight. Windcatcher absorbs the hot air from its upper valves under the ceiling and distribute the cool air through the open doors and windows.

Also, given that windcatcher works with environmental air flow and the natural energy, therefore it does not require manufactured energy and therefore this reduces the need for the modern energies.

**Conclusions:**

This study indicates that the traditional and the historical textures of the desert cities of Iran have followed some kind of sustainable and eco-friendly principles. The sustainable environmental and structural coordination of these desert cities are the outcome of a long process of trial and error over the time and the review of its features can be of service for planning, designing and constructing sustainable structures for the present time. In this regard, based on the principles of the sustainable development, the sustainability features of the texture of the structures in the desert areas will be discussed. Iran's traditional architecture in fact is the best example of the optimization of the energy consumption. And from environmental perspective, the four elements of the nature including earth, water, air, sun and sun play significant roles in Iran's civilization and architecture

On the other hand, Sustainable architecture approach requires localization. Despite the fact that to address the modern needs of the present time, the traditional architectural methods cannot be applied lonely, but some of its main features and values can be employed and extended to the sustainable architecture of the current time such as preserving resources, returning to life cycle and considering the human at the center of the design.

Original Photo taken by the Author

**Reference for further studies:**

Ahmad Fathi Najaf Abadi e Mina Pakdaman Tirani, *Lessons from Old Iranian Climate Architecture for Modern Architects*, European Online Journal of Natural and Social Sciences 2014, Vol.3, No.3: http://european-science.com/eojnss/article/view/2883/pdf

[i] Andaruni