The way of saving energy in the traditional houses of Iran’s arid zone regions

Faranak Zaimi

Design office, Iran

ABSTRACT

Formation of urban and urban texture in compatibility with natural environments and factors and using those factors in severely unfavourable hot and dry climatic conditions that cover a major part of Iran is an interesting phenomenon. One of the very important achievements in Iranian traditional architecture lies in the very conformity and providing suitable life environment in those dry and hot regions.

In this paper, a brief explanation is given on climatic conditions of the zones and climatic measures taken for those cities are discussed. The scope of those approaches covers the urban sites and settlement places as well as four season houses in those regions.

Keywords: Iran, hot and dry climate, traditional architecture, four season houses.

Introduction

Energy is one of the highly important issues in today’s life. Through proper design of urban and residential spaces, energy consumption could be minimized and at the same time, maximum use could be made of climatic factors. The importance of this issue could be seen in difficult climatic conditions. The central Plateau of Iran with its hot and dry climate is one of those zones.

The climatic design in traditional texture of those cities and their traditional buildings are one of the valuable examples in studies. In continuation of the paper, a brief review is made on the history of the research, starting from urban texture to the internal spaces of houses.

Hot and dry climate of Central Plateau of Iran

High drought, low moisture and lack of clouds in sky are among special climates of those zones, causing great ranges of temperature changes in those zones. The temperature fluctuations sometimes reach 20 centigrade degrees in 24 hours.

Local architecture of hot and dry climate of Iran:

Local architecture in the aforementioned region is executed with construction materials such as adobe and mud since they have suitable thermal capacity. In very hot climatic conditions, the retardation is reached to infinity by constructing houses inside the hills or basements and by using this measure, the balanced thermal conditions of the depth of land are used; (1) such as Meymand underground village in Kerman.

Urban texture

In starting this study from urban texture, it should be said that urban texture in those regions is dense and very compact. Urban spaces are completely enclosed and buildings are closely stuck so thermal loss is lowered. Alleys are narrow and with many turns, surrounded by tall walls; for, wide and direct alleys receive sunshine for long hours of day; however, in alleys constructed in broken lines, there is always a shadow side. In addition, the desert winds could have direct flows in allies, causing disorders in routine life. In those paths, there are pause places that directs in lower level in three steps. This difference in height causes suction of cool air to down. On the other hand, most alleys in Iran have roofs, sabot and ribs that in addition to resisting earthquake, they make shelters for passersby ‘Fig 1’. In addition, in the desert alleys, except the entrance of the buildings, there are seldom any windows opened to the alley from houses and if there are any windows, it is very small and in height to prevent rays reflected from surface. Therefore, presence of elements such as half shelters (ribs) or difference in height, the alleys are saved from boring feature and give them special beauty.

Freezing places and cisterns (water reservoirs) are among other urban elements which are often seen in desert cities. Major parts of structures of the cisterns are: (2)

1. Water reservoirs, all or a part of them are built underground; because, it first adds to the resistance of walls and second, soil as the natural insulation around the reservoirs, prevents the temperature penetration.

2. Reservoirs coating: Major coating of cisterns is dome shape so the heat ascends and the reservoir side is kept cool. On the other hand, in most hours of day, one side of the dome is in the shadow.
3. Ventilation and wind catcher: They discharge the hot water below cisterns dome and establish air flow to keep the water healthy and cool.

4. Staircase and water foots

5. Decorative threshold

Building form

After passing the passages, we reach the houses of this climate. Those houses are known as four season houses (3) from the structure to the decorations are designed to meet the climate of this region. The two north and south fronts, as the most suitable directions for buildings are allocated for summer and winter dwelling. The northern front or “Panah” that opens to the winter sun is the sitting room of family. In another front “Nesar” backs sunshine and essentially, it is a veranda with tall roof and wind catcher as the sitting place of family (4) and most often, the “basement” is built below it. In hot seasons, the temperature of cellar- being underground- is less than other parts. For example, in “the Broujerdis” house in Kashan, at 11:30 AM of September 25th, the temperature in alley is 36 centigrade degree, 32 centigrade degree in yard and 24 centigrade degree cellar. The height of summer sitting places in the houses is high so the hot air could ascend (3). In some buildings, a dome is established in two-shell form on the ceiling in order to insulate it against sunshine.

In addition, the buildings are lower from alley surface (for cool air suction) with entrance door the only opening with outdoor that connects the outdoor to the yard through corridor and Hashti (vestibule). The entrance doors are made of wood and have no threshold and if there is any door with threshold, it has grooves to prevent air block. The house corridor is connected to the central yard with few steps down. In this yard, a water pool and many trees are planted so in addition to increasing the moisture and lowering heat, the winter winds and sand storms are prevented. All spaces of the house are opened to this yard.

In the summer sitting section, a large veranda does not make it possible to have warm sunshine into the house.

Windows were vertical and most part of their surfaces were wooden decorated to prevent heat inside. They never used large glasses and most of the time, they used colour glasses so in addition to beauty, heat and light entry could be controlled ‘Fig 2’. In addition, in the façade, the ray wall with almost thin sunshine cut blades with 6 to 15 centimetres thickness are used, around which, windows and holes would be worked for shadows. Those who worked on top of threshold or window were called horizontal wall or shadow top. In addition, on top of threshold, the bar walls, in form of two small shelves with two oblique coat were made. Wall ray and bar walls were able to prevent severe sunshine (5). ‘Fig 3’

Howz khaneh (impluvium) is among other designed spaces in home where many rooms are opened to it. The existence of Howz khaneh has necessary moisture for those spaces and sometimes, Khishkhan ( mud shelves) are built and by putting water soaked mat on it, the cool of the pool house would be increased (5) ‘Fig 4’. The history of Khishkhan in Iran goes back to the ancient time. One of the examples of the Khishkhan( mud shelf or wind whirl) is Firouzabad fire- temple in Firouzabad (Fars), built for flow of air inside walls (6).

However, wind catchers are the most important characteristics of houses in hot regions of Iran. Yazd is famous as the city of wind catchers and there are many cities like it. The tallest wind catcher in Iran is Dolatabad Garden in Yazd with 34 meters height. The wind catcher functions as follows: It takes moisture air and directs it to the major rooms of building, water reservoirs or cellar. Some of the wind catchers cool the inside building through convection and some others do so through air displacement and evaporation. The cooling system of Dolatabad Garden wind catcher works in second method. That is, the air flows inside building and passes through a small rocky pool and water jet and is directed to other rooms ‘Fig 5’. To improve the cooling function of the wind catcher and using evaporation cooling, other methods are used as well. As an example, in the city of Bam, there is a wind catcher with 50 meters distance from the building and is connected through an underground canal. On top of the canal, there is a garden. After irrigating the garden, the moisture penetrates to the canal walls and the wind that flows to the building from wind catcher, cools the building (3).

All cases mentioned above and many other delicate points show that traditional architects have made the climate favourable.

Summary

The traditional method of design in hot and dry climate is an evidence of meeting the routine needs of people and people of those regions have used simple and natural methods or in another word, biological climatic conditions. Those approaches have been meeting the climatic demands of people in best shape and least expenses; although, all cases, which have been mentioned, do not match modern life; with small changes (needing study) could be useful in today’s houses as well.
Panel Presentation: Habitat
Author: Faranak Zaimi
Institution: Design Office, Iran

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Figure 1: Sabot and ribs
Figure 2: Wooden decorated windows with colour glasses
Figure 3: Ray wall (Tabesh band)
Figure 4: Khishkhan

Figure 5: The cross section of veranda and balcony of Dolatabad Garden in Yazd. Notice the water current network form reservoirs to below wind catcher, hall floor, veranda floor and ultimately garden site.(source: Climatic Analysis of the Traditional Iranian Buildings)