CLIMATIC ANALYSIS OF NEIGHBORHOODS IN A TRADITIONAL CITY (CASE STUDY: HAMEDAN)

Seyedeh Faezeh Etemad Sheykholeslami[1]*, Mansoreh Tahbaz**
*Art and architecture, Bu-Ali Sina, Hamedan, Iran,**Architecture & Urban planning, Shahid Beheshti,Tehran,Iran

Abstract

This article aims at discovering the climatic factors, as the fundamental one, in shaping human dwelling, on urban neighborhoods. Natural environment and climate have been of great importance in the architecture and city construction of Iran, to the extent that they were regarded as the influential factors. Based on field research, life basics in urban neighborhoods, which are still alive, are identified and climatic factors are scrutinized to recognize the adaptation extend.
To achieve the urban principle based on city studies, this research is performed in case. Therefore, Hamedan as one of the most compact zones of Iran with a mountainous cold climate is examined locally. The focus of research is on urban neighborhoods, passages and residentials, and general features of formation, orientation, settlement and establishment, full and empty combination along with material and construction system. The adaptation extent with climatic factors, radiation, wind flow, slope are examined, too.
Key words: thermal comfort, vernacular city, neighborhood spaces

1. INTRODUCTION

Human tendency is continual in every time to climatic design, because he or she wants to have comfort in habitancy spaces. Thermal comfort emanates from thermal equilibrium between human body and environment. Therefore suitable design of buildings and neighborhood spaces on the basis of climate conditions is so important. Natural and mechanical methods are used to achieve comfort climate. Because energy sources that can refresh are limited, cities are polluted and environment is irreparably damaged of fossil fuel, natural energy must be used. This kind of energy is healthy and able to refresh. There are two methods to use natural energy. One of them is passive method isn't used energy transformer. Human societies have achieved it based on their experience and used vernacular methods in design of building and cities, for example in mass and space, orientation and settlement of building. This method is noteworthy in this research.

2. CLIMATE STUDY OF HAMEDAN CITY

Hamedan city is in the Alvand mountain zone in Iran and in high mountainous climate [1]. It is located at 1741.5 M and 34 52 N and 48 32 E. Climatological data for the period 1994-2003 from Hamedan Forodgah station of Iran meteorological Organization [2] is seen Air temperature, relative humidity, wind direction and the days with sunshine rain and snow. The study of heating and cooling degree days (related to 18 and 21) and the comparison of their ratio in Hamedan show 92% of heating need against 8% of cooling need. On the other hand, heating is the most important problem in this cold city.
Generally, suggestive principle on the basis of Hamedan climate analysis [3] is (1) Maximum absorption of sun, (2) Minimum heat wasting, (3) Avoidance of winter coldness existing in majority of a year, (4) Resistance against long-time freezing, (5)Protection of building against cold wind (west south). Therefore, heat exchange must be decreased to minimum from walls, roof and openings in buildings so that heat waste can be prevented. Also sun radiation must be used maximum for heating, penetration of cold wind to building must be prevented, the problem of snow and freezing must be decreased, cross ventilation must be used necessary time and shadow must be controlled. [4]

3. CLIMATIC SURVEY OF VERNACULAR DWELLING IN HAMEDAN

Climatic dwellings in Hamedan are analyzed in two sections. At first vernacular dwelling are studied and then climatic analysis of vernacular dwelling complete. Activities and behaviors, which happen in every place, determine dominant structures on the place. Hamedan old houses that existed are 50 types, including native houses.
There are important differences between native houses in Hamedan and houses with well known pattern seen in most cities in Iran, nowadays. Vernacular houses in every city are old houses that fallow the pattern of Islamic (traditional architecture in Iran). This main pattern changes in every place based on climate and culture in that place. Native dwellings in Hamedan are 70 or even 100 years old.
Generally the most important principles in old houses are:

[1] -f_ ete@yahoo.com. [11,Shahin alley, PArasto street, Motekhasesin, Hamedan. Iran]

✓ Dwelling spaces are arranged and built around the yard and take view, ventilation and access by the yard.
✓ Yard and interior facade are built orderly and geometrically and irregularities are solved in closed spaces.
✓ Dwelling spaces in an internally-directed are generally divided into main zones of winter house and summer house.
✓ Bio spaces (main spaces) such as chamber, porch and rooms are built around the yard and service spaces such as lavatory are set behind main spaces.
✓ Bio-service spaces are set in the lowest level (basement or ground floor) and are used as bio spaces in very cold or very hot time.
✓ Service spaces like kitchen and lavatory are set in ground floor or corner of the yard. These spaces are one-function and the other spaces are multi- functions.
✓ Spaces are without furniture and fixed equipment. It helps the spaces to be multi- functional.
✓ Structure is carrier wall and major usage materials are brick, stone, wood and thatch. Wood hank is seen in some houses. [5]
✓ Climatic requirements of Hamedan were suggested by identifying and determine the aspects of wellbeing in this cold region. Attaining the strategies of climatic design from suggested assertions aren't independent of architectural type; therefore the available dwelling of Hamedan was examined. The architecture of each era is in influenced by some factors, one of which is recon climate. Amongst these influencibility is the general orientation of context toward east-south (Fig. 2). The existence of low depth balconies in ancient houses which allowed the maximum absorption of sun light in winter while preventing summer sun light is another sign of computability with region climate. (Fig. 3) These factors necessitate the examination of available samples so that the posed strategies can be used.

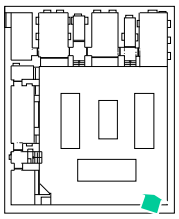

Fig 1.The old period house

Fig2.Airy figure of old texture Hamedan

3.1. THE RELATIONSHIP OF MASS AND SPACES IN DWELLING

The ancient texture of Hamedan is dense and the settlement of full and empty spaces is such that full spaces are built behind each other (Fig 8). Because there are full spaces in two north and south fronts. This play a vital role in reducing heath exchange of building with open space and the walls attached to open spaces are decreased.
Organization of open and closed spaces in Hamedan houses are of great important. The relationship of court with living space is indirect, established through filter with spaces of balcony and corridor. Generally, balcony is the intermediate space between open and closed spaces and ropy is the intermediate space between half open and closed spaces.
Nowadays, full and empty spaces in houses are placed in one row so that the passage becomes suitable for cars and the texture compression is reduced. Therefore in new and middle periods, there are two fronts which cause the heat exchange to increase, while in ancient houses the utility house was a heat filter for the back house.
Most of the houses in Hamedan have small yard and a small pond with a plant average over to prevent the pond from freezing in cold nights. The trees planted are of fall ones to let the winter sunlight in.
The most alive part of the old houses is the yard in which utilizing and living behaviors. In modern houses, open spaces were making a distance between the building to provide light and ventilation while making heat loss. (Fig.4) Frost and cold wind in the east-west passage causes the neighbor house temperature to decrease.

Fig 3, Traditional shade

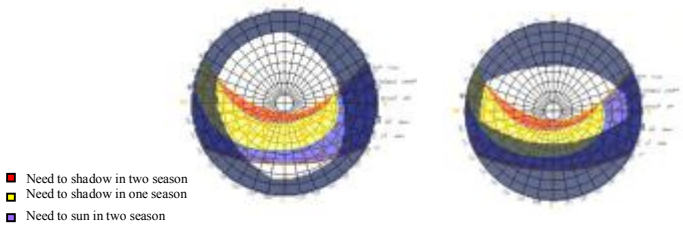

Fig 4.Yard shade mask in modern and old houses

3.2. THE BUILDING SATTLEMENT

The floor of most ancient houses was about 40 to 80 cm lower than the street level which fades into a series of steps or ramp in entrance. (Fig. 5) Therefore the ground surrounds the houses as heat insulation and reduces the heat transfer inside and outside the house. On the other hand, the reduction of building volume to the passage

causes the passage to have more sunlight. Ancient houses consist of one floor or two with base. Winter living space, located in the base, is subjacent to the first floor orthogonally to be enclosed with a closed space when it is cold. The base is lower than the earth level from 50 to 100 cm. The base floor is adjacent to the ground while it uses the heat of earth depth (heat fluctuation decreases with the depth increase).The walls of base are thick having little openings. These provided the minimum waste of heat in horizontal and normal surfaces. In new houses the yard floor and street are at the same level while there is no living space for base, therefore using geothermal energy is removed. The bases of new houses include parking and storage which reduce the temperature of the first floor due to adjacency with half cold space.

3.3. THE BUILDING ORIENTATION

The examination of ancient houses shows that, in houses with central yard, main orientation was towards south or east south. In some samples with denser texture, we can see orientation towards west south. In L. shaped houses, the main orientation is towards southwest and south east and the undesirable wind doesn't make any problem as the yard is small.

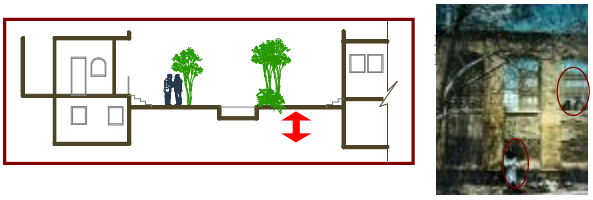

Fig 5.Going down of building to the earth

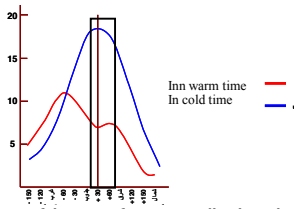

Fig 6.Obsorbtion of heat of sun radiation in walls [7]

To identify the most suitable location of main front of building, we pay attention to sun direction and wind current. This orientation allows the house to have the least and the most warmth in summer and winter, respectively. While prevents the house from being damage by unsuitable winds. The best orientation of building is one towards south with a 30 degree turn to south (the range of 20-45 degrees) so that the building takes the least and the most warmth in summer and warmth from the sun, respectively.(Fig. 6) The front toward east is the second most suitable with respect to sun energy. [6]
If the temperature in degree 21 (the border of shadow and sunlight requirement) is aligned on the sun revolution map with Hamedan Latitude (36 degrees of north, there will be obtained three ranges of requiring the shadow in two seasons and in one season and requiring sunlight in two season which determine the suitable orientation of building in Hamedan.

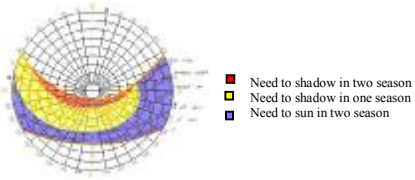

Fig 7.Time of needing to sun or shadow

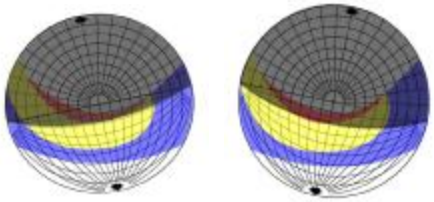

Fig 8.South east and south west orientation

Overlapping the shadow finder compass and the obtained graph, we obtained the best orientation of building as 12 degree to east-south with shadow mask of 72 degree. (Fig. 8) In south-west orientation there is a warmer fall in the afternoon but in the morning of cold winters we have less sunlight. We need a deeper shadow marker in this front (83 degree for the front to south or 12 degree to west).
On the other hand, the building surrounding must be so designed so that it is protected from winter winds. [7] The wind slowing in Hamedan is dominantly to east south and for the cold wind it is west-south suitable wind blows from south-west and east. Therefore, the most suitable building orientation is east to south east of 45 degree to south. Eastern front is at the second.
Generally, the best building orientation, based on absorbed radiation heat by the walls in different months, shadow maker design and wind blowing direction is south of 30 degree to east, 12 degree to east south and east to east south of 45 degree, respectively. Now, two acceptable fronts are compared, east south and west south, to obtain the suitable orientation of dwelling texture. The south west orientation blocks the cold wind to the passages and works more efficiently.

4. CLIMATIC SURVEY OF PASSAGES IN HAMEDAN NEIBORHOOD

The texture of Hamedan neighborhoods is a continuous one in terms of setting of anatomical spaces along with each other, making a unified body in which each dwelling is connected to other units from two or three fronts. [8] In this compact texture, the neighborhoods are located as non geometrical oil spots while having a gradual growth, and organic passages along with dwelling units have formed the city. The width of these passages has changed in proportion with the increase or decrease of accessibility .his has been concomitant with an accessibility hierarchy.

4.1. THE FIGURE AND SATLEMENT OF PUBLIC OPEN SPACES

Public open spaces of city, the main function of which is communication are consisted of two parts: (1) urban passages (2) neighborhood centers. Urban passages are referred to the streets and neighborhood open spaces which are the communication highway are referred to as square. Neighborhood center is located in a place with the best accessibility to other ports. Formal survey of neighborhood centers and the location of passages general composition of traditional textures consist of open space in the formation of which the building bodies play a vital role. Schultz has called this the principle of creation of open space by building body saying that these principles can produce suitable definitions for open spaces.
These open spaces, named neighborhood centers, are seen in two forms in traditional texture of Hamedan.

1. Linear centers: They are located along the passages or bazaars consisting of some shops and some open spaces like mosques and public bath, usually located in the passage intersections.
2. Neighborhood centers as little squares: In the intersection of main passages or next to the most important passage and public buildings and trade spaces which are in rectangular form.

The existence of green spaces and trees seen in the center of neighborhoods, named as Chaman, cause the environment to have a climatic moderation, to be dehumidize and to have shades in summer and to prevent from disturbing winds. The level of houses and courtyards has become lower than of alley so that the sun can shed light on the passages as and they are out of building dominancy.

4.2. THE PUBLIC OPEN SPACES ORIENTATION

Having recognized the form and the foundation of neighborhood centers and the passages, we turn our attention to their orientation and climatic analysis. The orientation of neighborhood centers is linear and the elongation of little squares is northwest-east south, east north-west south, or north-south, the second one is the most common. This orientation prevents the west winds from damaging the houses and lets the houses to provide suitable light. The west-east passages have always one side of shade; therefore they are built low and sometimes roofed. The length of western-eastern passage is short and dead end alleys, the least wide passages, while having the role of accessibility to one or more dwelling spaces.

5. CONCLUSION

For achieving climatic dwelling and neighborhood that uses natural energy to achieve thermal comfort, Hamedan city has analysed in two sections after recognizing climate Hamedan: (1) Climatic survey of Hamedan vernacular dwelling and (2) Climatic survey of vernacular passages in Hamedan neighborhood. These are studied to determine the climatic strategies of climatic design in Hamedan dwelling.
The climatic strategies have been using in native architecture for a long time. Theses are helped to decrease of thermal wasting of roof, walls and openings; to maximum use of sun radiation in winter; to decrease the influence of wind in thermal wasting; to control of long- snoozing and shading mask and also to use of cool wind in hot days. This strategise are grammar of climatic design and lead researches and designer to achieve principles and patterns of climatic design in dwellings, after they would be adopted with nowadays needs. This method is usage for other cities and the other climate zones.

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