



# Assessing the Differences of Climatic-Temperamental Comfort Zone in Traditional Houses in Four Climates during Critical Temperature Days

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## Abstract

By looking at the traditional architecture of Iran and exploring it in any context we can discover mysteries and secrets which were the reasons for the success and survival of this architecture. While modern scientific developments in the climatic design field determine rules and regulations for providing comfort in any region, they do not consider physical and temperamental differences among people residing in different climates. While in the traditional architecture, the climatic rules for each region were shaped by the deep relation between the human population and the environment of the region. The main objective of the current study is to accurately assess the climatic-temperamental comfort level in traditional houses. Accordingly, four traditional houses in four different climates were selected and using EcoTech software application, the temperature in these traditional houses is analyzed and the Gioni chart method was analyzed for providing environmental comfort. Based on the findings about the studied houses, the conditions of the house provide a lower comfort level than Gioni comfort level and this is less because of technological shortages but more because of providing climatic-temperamental health temperature.

**Keywords:** Traditional architecture, climatic-temperamental comfort, health temperature

## 1- Introduction

Iranian contemporary architecture mimics the modern architectural patterns and neglects the climatic characteristics of each region to construct similar buildings in different climates, requiring utilization of fossil energy sources to adapt to human comfort conditions. The energy crisis and the environmental problems caused by unchecked consumption of fossil fuels have rendered the necessity for saving fuels and reevaluating construction methods, one of the most important pillars of planning and designing in this country. In order to simultaneously reach thermal comfort and reducing fuel consumption, we have to construct buildings which are consistent and homogeneous

with their climate by understanding the local climate and making use of the natural potential of the living area to counter climatic complications.

One of the most important human issues is environmental comfort and since human beings have different physiological (temperamental), spiritual, mental, and social needs, they have to interact with their fellow human beings. Therefore, creating suitable architecture is necessary for human beings.

Traditional architecture had at its core the internal and psychological desires of human beings in a way that different individuals in different regions considered their temperament and humors as they were constructing their architecture. They were very keen on maintaining the comfort and health of human beings. However, with the advent of the industrial revolution and the growth and development of modern architecture, gradually the attention and the structural foundation of architecture shifted towards reaching beauty and prosperity, so humors, temperaments, and psychological and physical health were neglected. This lack of attention, which may be considered insignificant, in the long-term can have negative impacts on the temperaments as well as physical health of human beings. So, considering the four characteristics of aesthetics, stability, comfort, and health (Figure 1), it can be seen that modern architecture is more involved with aesthetics and stability and a little comfort. Therefore, in this study, we are trying to consider comfort and health characteristics. Comfort can be generalized to include well-being which consists of mental, physiological, perceptive, protective, and environmental well-being.

The health characteristic can be sought after in the traditional medicine and humoristic rules of that tradition can be followed. In this medicine, the coordination between an individual's humors or temperaments and the environment will improve and reinforce human temperament.

While there have been many developments on the issue of determining the comfort range and many physiological factors are considered in these charts, the charts which are currently a reference for modern architectural designers are faced with some problems: (1) these charts consider comfort as an absolute phenomenon, (2) they do not consider the physical or temperamental differences of human beings residing in each climate, (3) an identical comfort level has been assigned for all the climates.

The main objective of the current study is to determine the comfort level more accurately by considering temperaments and humors as well as physiological variations. Moreover, it has been tried to design charts and curves which consider relative comfort as well as the humors and temperaments and the health of human beings.

## 2- Research Literature

Since centuries ago, there have been many studies regarding the climatic comfort of the human habitats. For instance, a researcher in his book called "the Scientific History of geography" argues that, "Aristotle divided the earth into several climatic regions and designated these areas as habitable and uninhabitable based on their climatic characteristics.

The scientific and accurate investigation of climatic conditions and comfort of human beings started during the 1950s and 1960s. In these years, scholars started trying to estimate the human comfort conditions using mathematical equations, statistics, curves and charts, as well as climatic parameters such as temperature, humidity, wind speed, and so on.

Determining the range of thermal comfort in the dry conditions of Yazd City was performed and using the Olgay model and correcting the boundaries of thermal comfort in this model based on latitude, climate data and field observations, the thermal comfort zone was calculated for the hot and cold seasons of the year [1].

A research study of the physical, mental, and environmental effects of environmental factors on thermal comfort in different climates was carried out using coupon classification. These studies are about the adaptability of human beings in different regions located in Bangladesh, Brazil, Cuba, India, Nigeria, and so on and they determined a comfort zone for each country. The ability of each individual to withstand thermal changes and the environmental temperature and the level of human beings' adaptability can affect the determination of the comfort zone and help save energy [1].

Moreover, a study in Brazil under the hot and humid climatic conditions was carried out that considered the air flow which is a very important factor in hot and humid regions. Based on the questionnaires gathered in this study, human comfort requires higher air flows and they defined a minimum temperature of the comfort zone which was higher than the standard level [1]. These studies define a comfort zone for each climate.

### **3- Methodology**

The current study uses an analytical-inferential method. The study first discusses the foundations of traditional medicine. Then, it considers temperamental comfort and its measures and characteristics. Next, it analyzes four different traditional houses in four different climates. The temperamental and thermal comfort zone in each house is determined using EcoTech software application.

### **4- Principles of Traditional Medicine**

#### **4-1- Location Temperament or Humor**

Location temperament is in agreement with human temperament and by studying location temperament; the human temperament is also studied. In other words, by observing the four physical elements in the surrounding environment we can understand the behavioral and ethical characteristics of human beings related to that same elements. For instance, humidity and water do not have a determined shape and they change shape based on their container and by changing the container, they change shape quickly. This element implies a human being who has a temperament close to humidity; he or she understands perceptions quickly and forgets them quickly, too. Or a hard object which requires a lot of effort to be shaped requires a lot of effort to change shape again, much like human behavioral and ethical characteristics which are very stagnant. These people take a lot of time to understand something, but when they understand, they will never forget. As humidity causes flexibility, heat causes movement, dynamic nature and kinetics in objects and phenomena. In other words, intensity and extreme nature are caused by a hot temperament and climate. In contrast, coldness reduces movement and the dynamic nature and causes humans and other animals with this temperament to become slow and stagnant. Therefore, human temperamental characteristics are in agreement with the natural environment [2].

#### **4-2- Home and Resident Temperament**

Where we live and spend our free time, some rays will affect the body and create an effect of coldness or warmth (hotness) in our bodies. These coldness or warmth must be consistent with the geographical location of the house construction and in order to create this coordination and consistency we have to build the house and our residents by using materials which adjust the geographical location temperament. For instance, in order to build a house in a cold and humid geographical location such as northern regions, the house must be made out of wood. While, if we use cement and plaster, since these materials are very cold, an individual residing in that house will suffer from intense cold and this coldness will cause diseases such as rheumatism, extremity pain, and fatigue. However, when constructing a building in a tropical region (hot and dry), we have to use materials such as cement and plaster in order to adjust the hot climate of that geographical location. Using metals and polished materials in the building will cause the building to start absorbing different rays and these rays will be absorbed into the body, so they change the mental conditions of human beings [3].

#### **4-3- General Foundations of Temperament and Humor**

Human temperaments are divided into outside the body and inside the body groups. Outside the body temperaments must be against the human temperament and inside body humors must be consistent with the human temperament. For instance, in the winter, an individual with cold temperament must breathe in the cold air (inside the body) but he or she must wear warm clothes (outside the body). Therefore, an individual must not act against his or her natural temperament just

because of thermal comfort since this will cause risks to his or her health. Therefore, striking a balance is required [3].

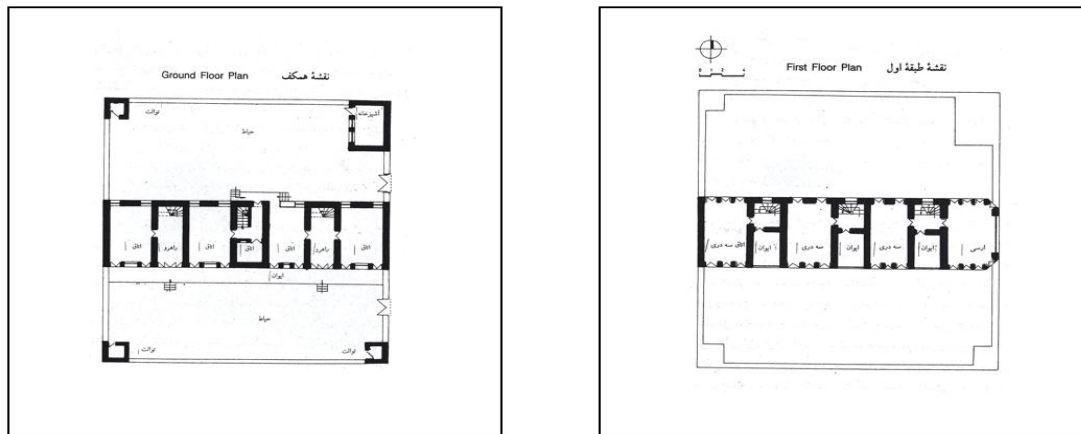
## 5- Analysis

### 5-1- Evaluating Traditional Houses in Four Climates with Traditional Measures

#### 5-1-1- Khaneh Shafahi Alizadeh, Amol (Mild and Humid)

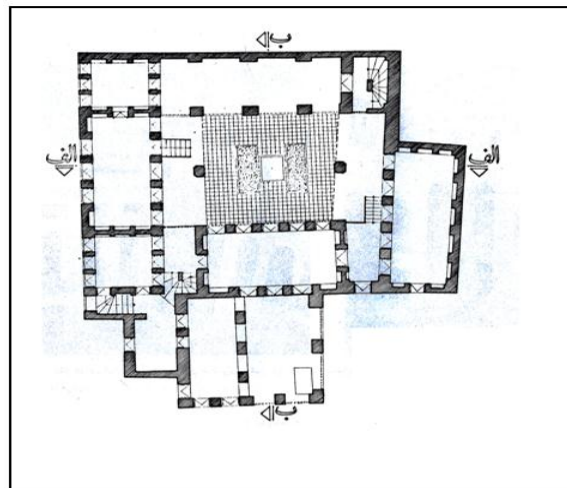
General characteristics of the building:

- a) Inclined roof
- b) Porch or patio around the building
- c) Building is shaped towards the outside space
- d) No basement
- e) The floor of the ground floor is higher than the natural earth level (the floor is raised)
- f) Using two-way air conditioning

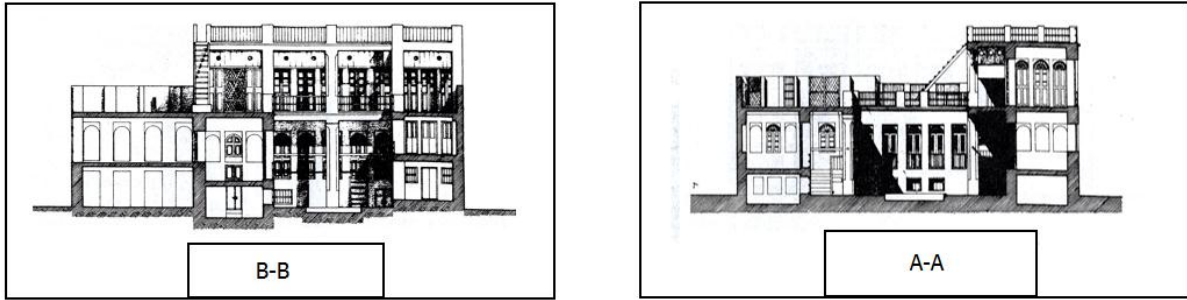


**Figure 1- The Plan for the Khaneh Shafahi Alizadeh, Niaki Neighborhood, Qajar Dynasty (two-way air conditioning is among the significant characteristics of the traditional buildings on the humid coast of the Caspian Sea)**

#### 5-1-2- A Traditional House with a Central Yard in Bushehr Port (Hot and Humid)



**Figure2- The Plan for the First Floor of a House in Bushehr [4]**

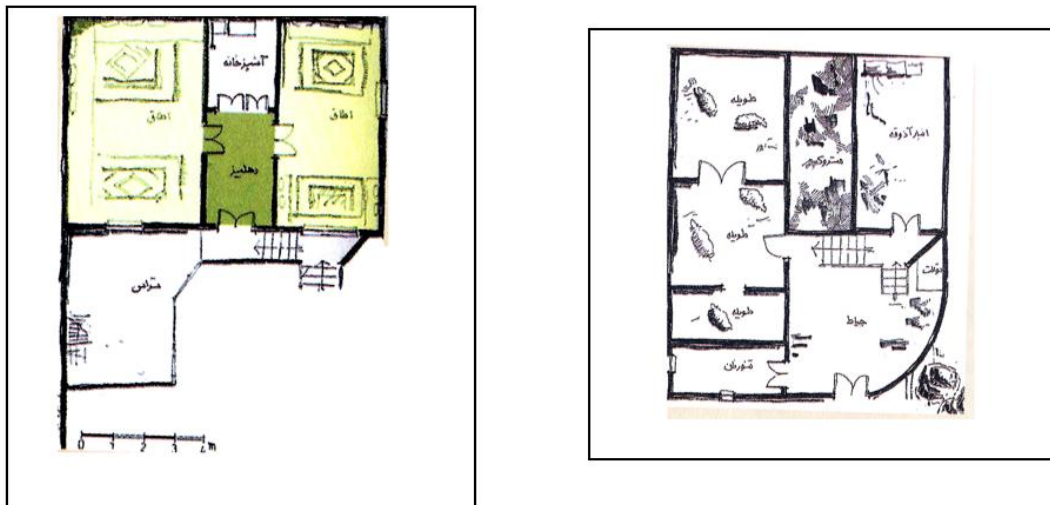


**Figure 3- Cross Section A-A:** Notice the difference in heights of the rooms in different floors. The ground floor has a functional role (storage, kitchen, and water reservoir) and the first and second floors are residential. High and perforated turrets on the roof create shadows and protect the privacy of residents, and protect against air drafts [4]. **Cross Section B-B:** the ratio of height to the length of these yards in hot and humid climates is much higher than those in similar central yards in the central plateau of Iran with a hot and dry climate [4].

#### General Characteristics of the Building

- a) Buildings have a central yard and they are relatively inside-oriented
- b) Maximum utilization of shadows and air drafts
- c) The heights of the rooms are very high and the windows are long
- d) Wide and raised porches
- e) No basement
- f) Rooms are mostly leveled

#### 5-1-3- A Rural House in Ardebil (Cold and Dry)



**Figure 4-The Plan for the Ground and First Floor of a Rural house in Ardebil** (the yard area is small compared to the substructure; the first floor is a place for livestock and services and the upper floor has a small terrace and the rooms) [5]

#### General Characteristics of the Building

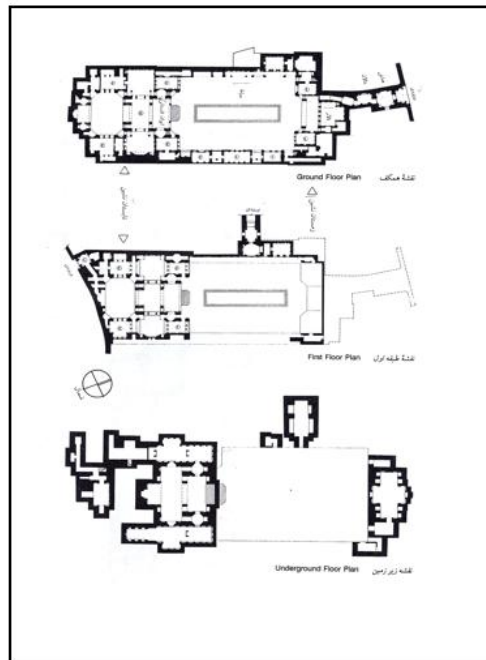
- a) The building has a central yard and it has an inward nature
- b) The ratio of the external wall of the building to the volume of the building is very low
- c) The height of the rooms is very low
- d) The roofs are often leveled
- e) Small openings
- f) Small yards and porches

g) Walls are relatively thick

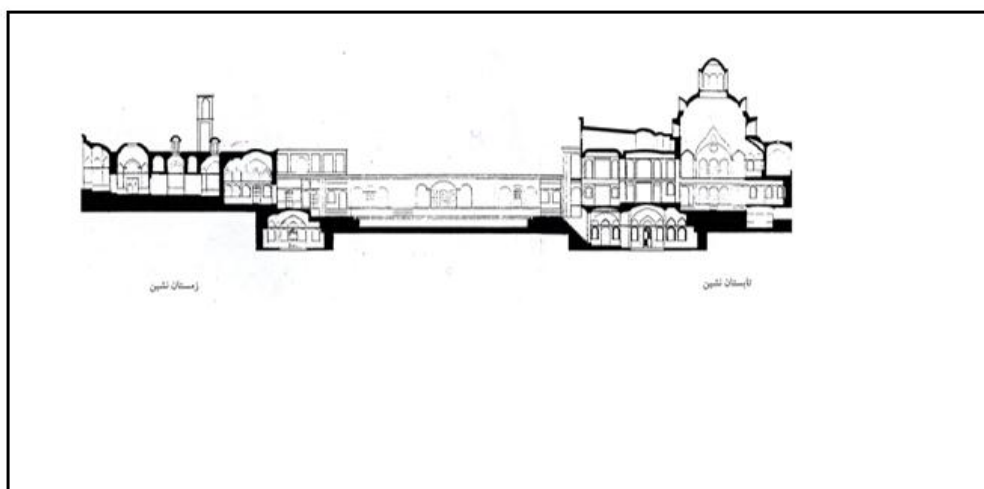
**5-1-4- Borujerdis House in Kashan (Hot and Dry)**

**General Characteristics of the Building**

- a) The building has a central yard and it has an inward nature
- b) The ratio of the external wall of the building to the volume of the building is very low
- c) The height of the rooms is very low
- d) The roofs are often leveled
- e) Small openings
- f) Small yards and porches
- g) Walls are relatively thick



**Figure 5- Plans for the Floors of Borujerdis House (External Yard) in Mir Ahmad Neighborhood of Kashan (considering these plans it is evident that the summer section, the basement and then the winter section have more significance and area compared to other sections) [4]**



**Figure 6- The Longitudinal Section of the Borujerdis House (notice the height difference of the summer and winter sections as well as the height difference of the yard compared to the alley, the sunlight angle at June, 22 is 79.5 degrees and at December, 22, it is 32.5 degrees) [4]**

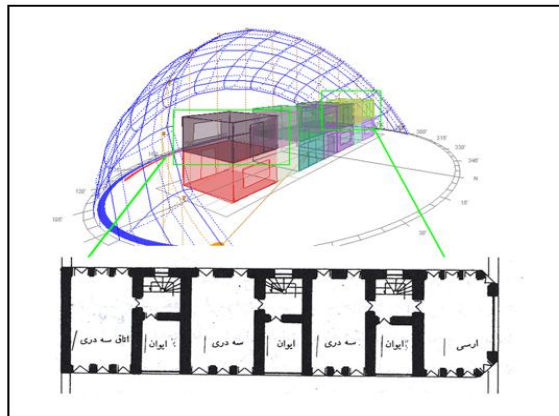
**Table 1-Evaluating Traditional Houses Using Architectural Characteristics**

|                     | Mild and Humid                                      | Hot and Humid                                  | Cold and Dry                              | Hot and Dry   |
|---------------------|---|--|---|---|
| Material            | Plant<br>(humid and hot temperament)                | Wood<br>(humid temperament)                    | Stone<br>(cold temperament)               | Mud, clay, bricks<br>(hot and dry temperament)                      |
| Thickness of walls  | Average   | Average<br>(low thermal mass)                  | Thick                                     | Relatively thick  |
| Texture compression | Open and wide gravel                                | Semi-dense                                     | Dense                                     | Very dense  |
| Ceiling height      | Several rooms, low external walls                   | Higher heights                                 | Lower heights                             | Higher heights  |
| Type of ceiling     | Inclined  | Leveled  | Leveled                                   | Leveled   |
| Color and ornaments | Free, few ornaments                                 | Light colors, few ornaments                    | Light colors,<br>a lot of ornaments       |   |
| Openings            | Several wide openings                               | Very high and long                             | Small                                     | Small   |
| Type of arrangement | Outward bound- two-way<br>air conditioning and open | Having a central yard and<br>semi inward bound | Having a central yard<br>and inward bound | Having central yard and<br>basement,<br>inward bound and restricted |
| Semi-open spaces    | Having a porch                                      | Having wide and<br>raised porches              | Small porches                             | Having summer halls   |

**5-2- Analyzing the Temperature of Selected Traditional Houses in the Hottest and Coldest Days of the Year Using EcoTech Software Application**

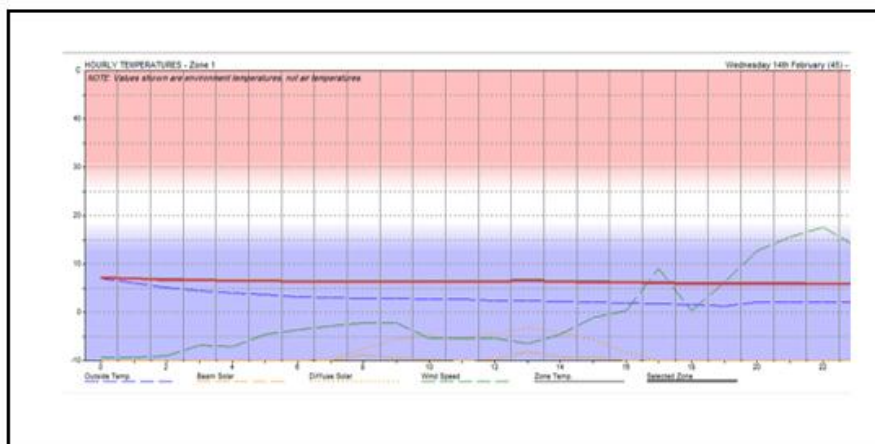
The traditional houses are modeled and after defining the materials, significant spaces in the house are selected and the thermal analysis for the hottest and the coldest days of the year is performed.

**5-2-1- Evaluating the Temperature of Khaneh Shafahi Alizadeh, Amol (Mild and Humid)**



**Figure 7- Khaneh Shafahi Alizadeh, Amol**

✓ **Assessing the Temperature of the Three-Door Room**



**Figure 8- Minimum Temperature of the Three-Door Room in December**

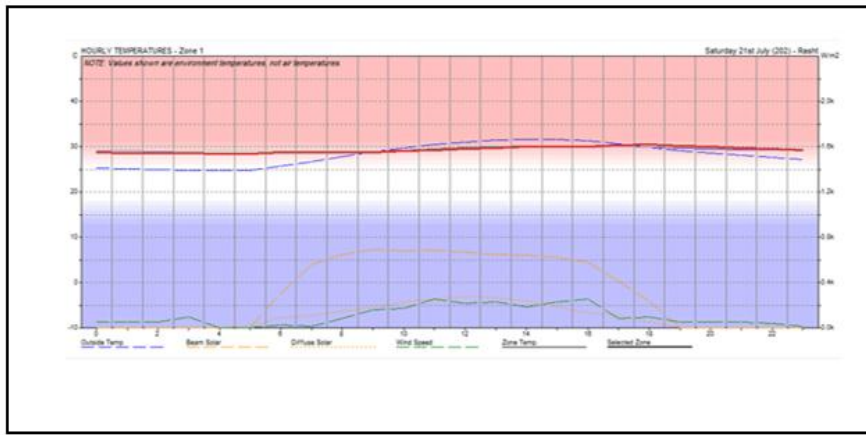


Figure 9- Maximum Temperature of the Three-Door Room in July

The coldest day of the year in Amol is January, 10, when the temperature is 3.7 degrees Celsius, while the temperature in the three-door room in this day is about 7.5 degrees Celsius. The hottest day of the year in Amol is August, 7, when the temperature is 31.2 degrees Celsius while the temperature inside this room on that same day is about 28.5 degrees Celsius.

✓ Assessing the Temperature of the Sash Room

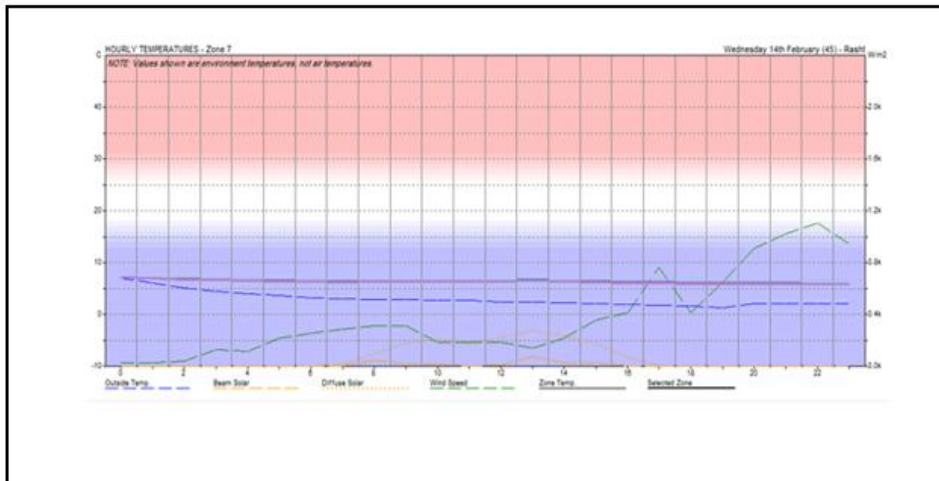


Figure 10- Minimum Temperature of the Sash Room in December

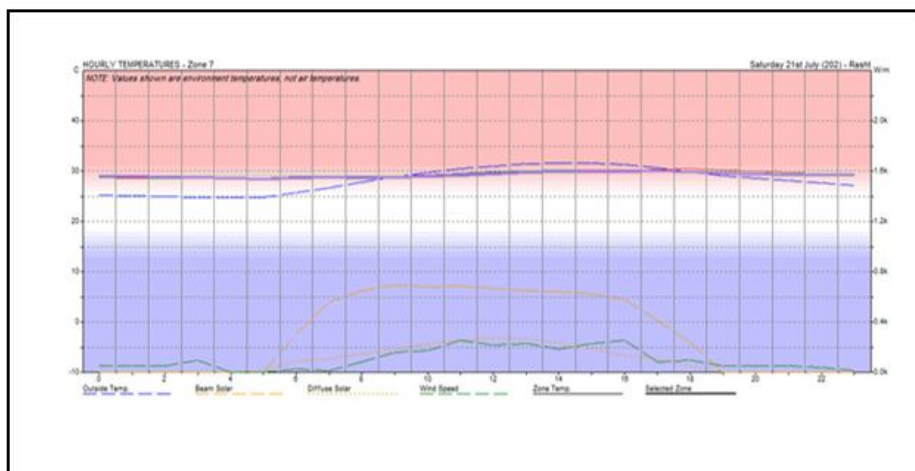


Figure 11- Maximum Temperature of the Sash Room



Considering the minimum temperature, the temperature of the sash room was not very different from that of the three-door room and this temperature in the sash room was about 8 degrees Celsius. The maximum temperature of this room is a little higher than the three-door room, i.e. about 30 degrees Celsius.

5-2-2- Analyzing the Temperature of the Traditional House with Central Yard in Bushehr (Hot and Humid)

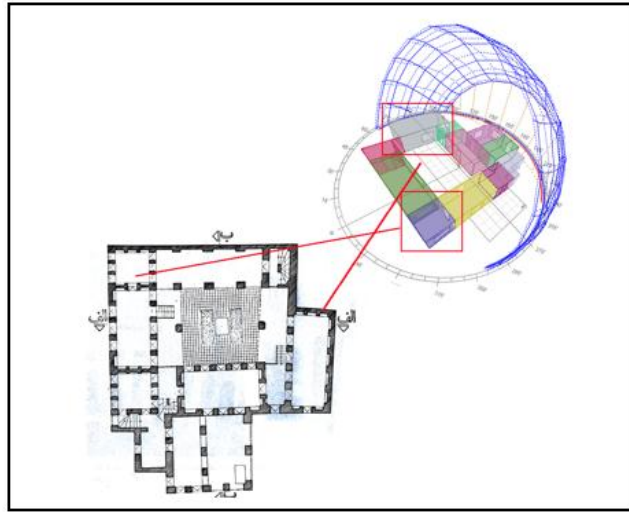


Figure 12-Traditional House in Bushehr

✓ Analyzing the Temperature of the Guest Room (Five Doors)

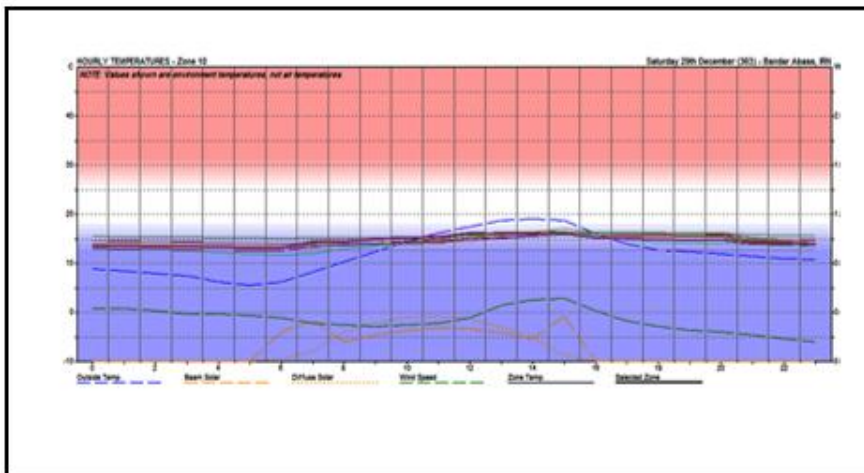


Figure 13- Minimum Temperature of the Guest Room in December

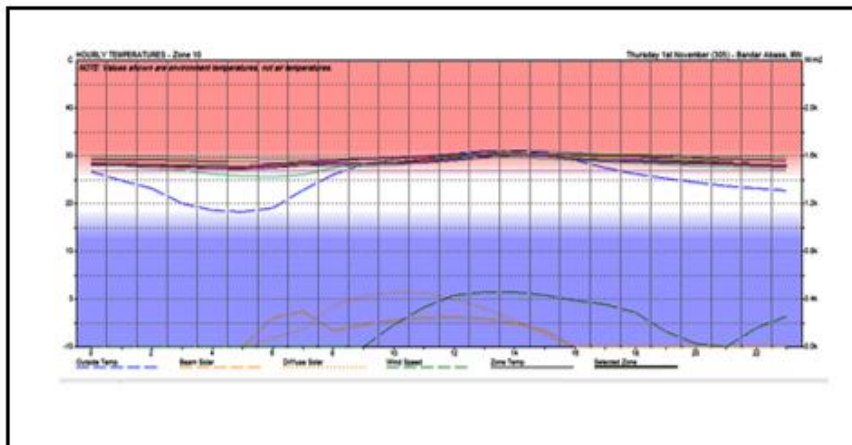


Figure 14- Maximum Temperature of the Guest Room in August

The coldest day of the year in Bushehr is January, 18, when the temperature is  $9.9^{\circ}\text{C}$ , while the temperature inside this room at the same day is about  $14.5^{\circ}\text{C}$ .

The hottest day of the year in Bushehr is August, 12, when the temperature is  $38.8^{\circ}\text{C}$  and the temperature of this room at that same day is about  $30^{\circ}\text{C}$ .

✓ Evaluating the Temperature of the Bedroom (Three Doors)

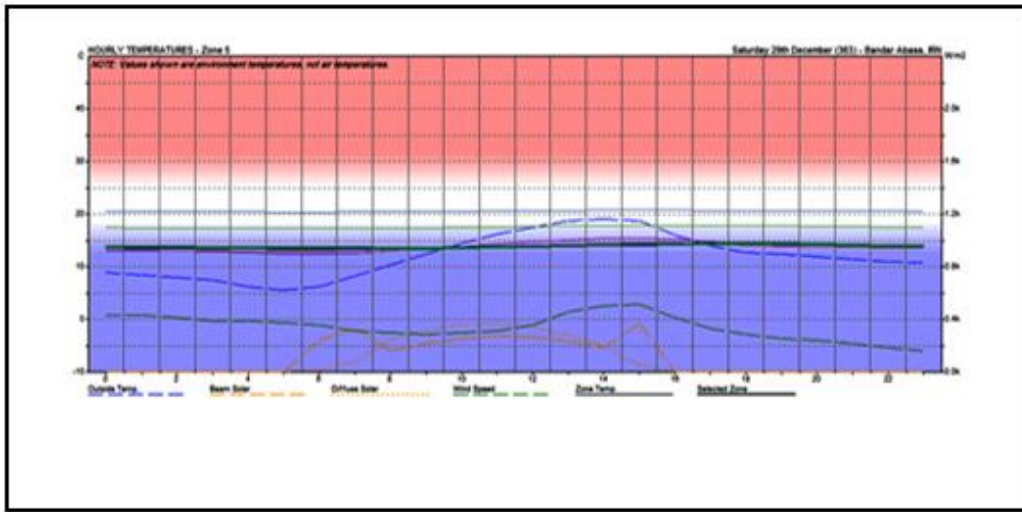


Figure 15- Minimum Temperature of the Bedroom in December

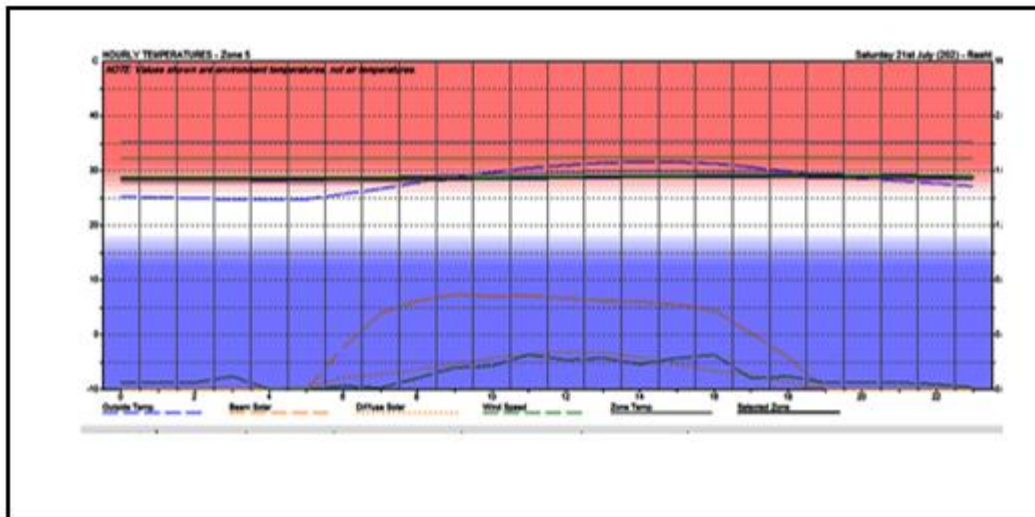


Figure 16- Maximum Temperature of the Bedroom in August

The minimum temperature of this room is  $15^{\circ}\text{C}$  and the maximum temperature of this room is  $29.9^{\circ}\text{C}$ .

5-2-3- Evaluating the Temperature of the Rural House in Ardebil (Cold and Dry)

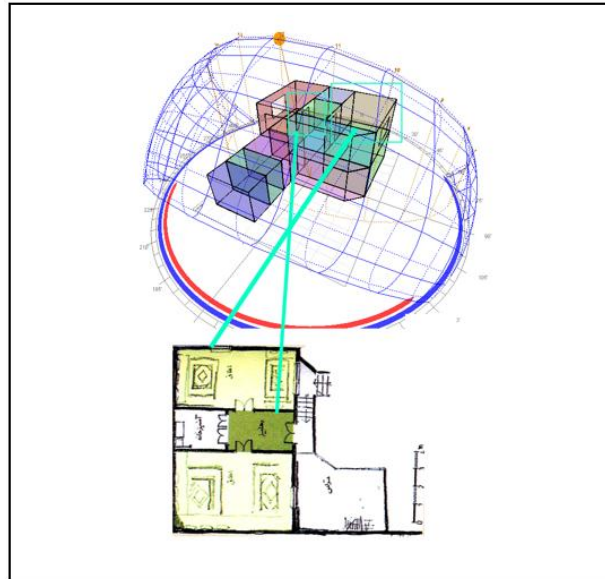


Figure 17- A Rural House in Ardebil

✓ Evaluating the Temperature of the Main Room

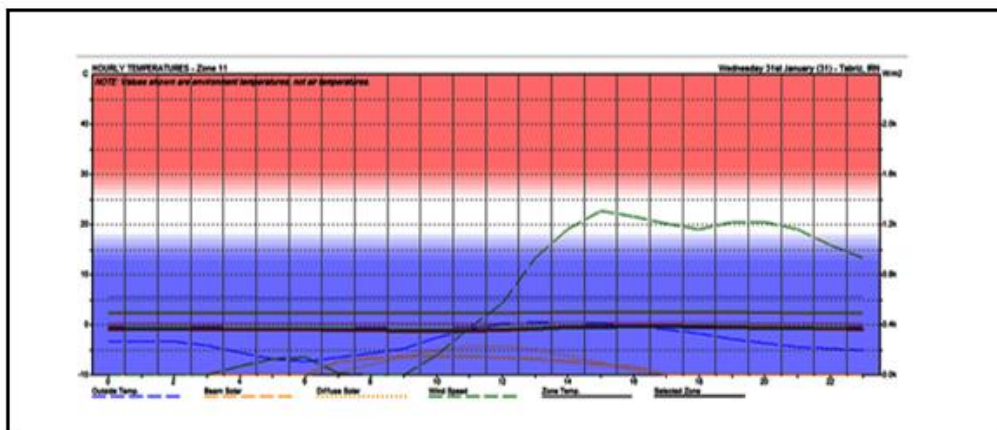


Figure 18- Minimum Temperature of the Main Room in December

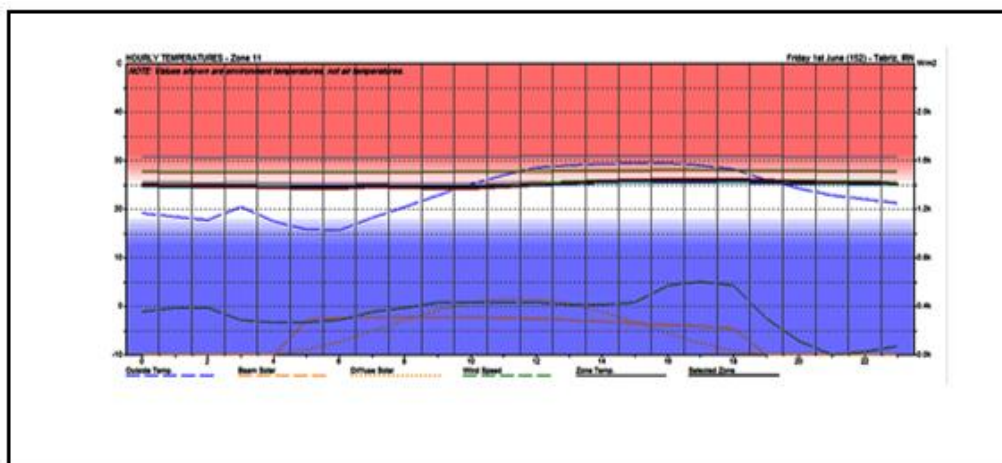


Figure 19- Maximum Temperature of the Main Room in July

The coldest day of the year is January, 7, when the temperature is  $-8.6^{\circ}\text{C}$  and the temperature of the main room at that day is  $0^{\circ}\text{C}$ .

The hottest day of the year is July, 19, when the temperature is  $31^{\circ}\text{C}$  and the temperature of the main room is  $25^{\circ}\text{C}$ .

✓ Evaluating the Temperature of the Corridor Room

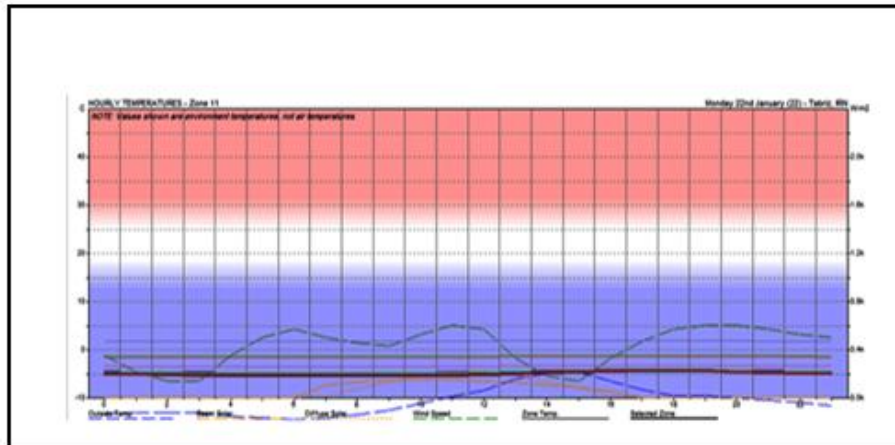


Figure 20- Minimum Temperature of the Corridor Room in July

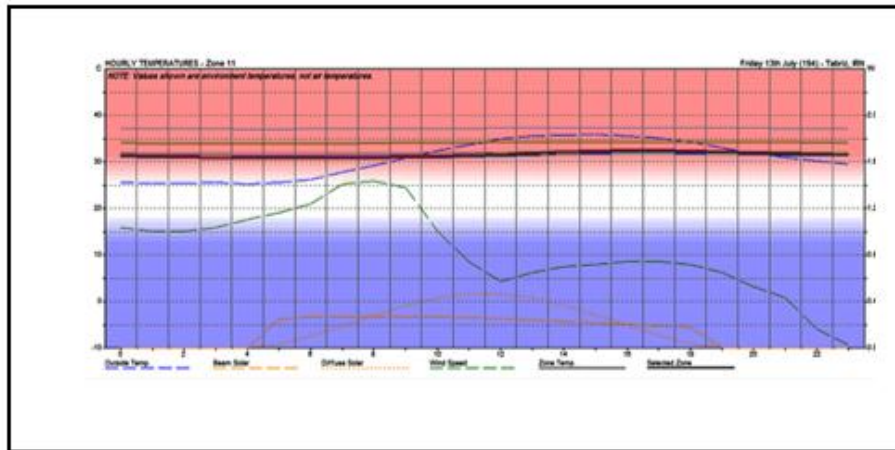


Figure 21- Maximum Temperature of the Corridor Room in January

The maximum temperature of this room is  $-5^{\circ}\text{C}$  and the maximum temperature of this room is  $30^{\circ}\text{C}$ .

5-2-4- Evaluating the Temperature of Borujerdis House in Kashan (Hot and Dry)

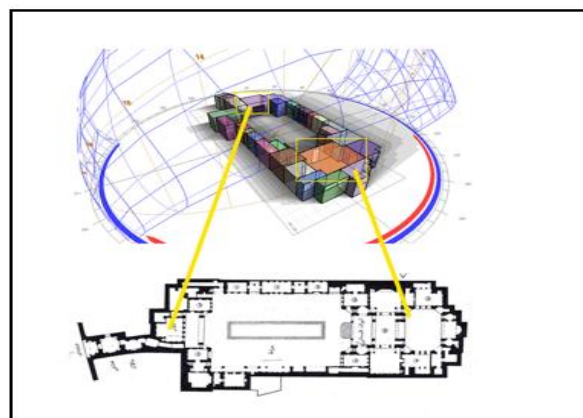


Figure 22- Borujerdis House in Kashan

✓ Evaluating the Temperature of the King Room

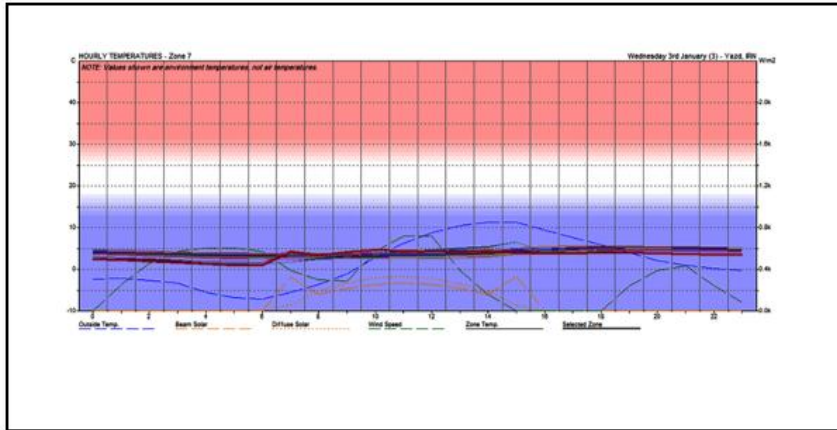


Figure 23- Minimum Temperature of the King Room in January

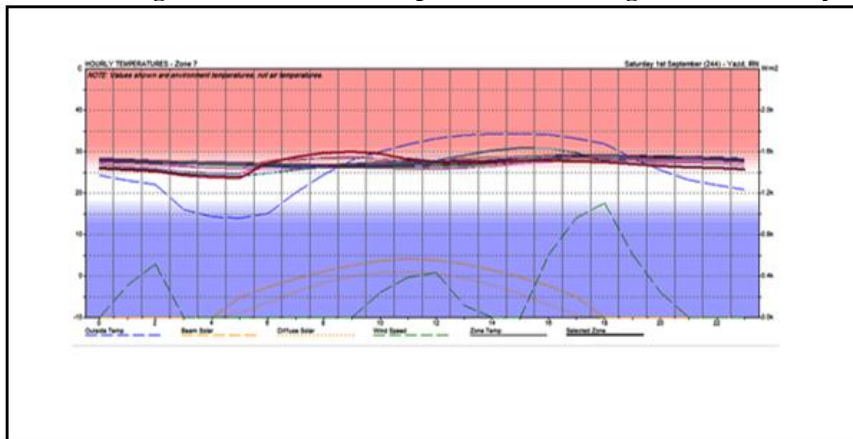


Figure 24- Maximum Temperature of the King Room in July

The coldest day of the year is January, 13, when the temperature is  $-0.8^{\circ}\text{C}$  while the temperature of the king room at that same day is about  $5^{\circ}\text{C}$ .

The hottest day of the year is July, 17, when the temperature is  $40.5^{\circ}\text{C}$  while the temperature of the king room (which is also known as the summer room) at that same day is about  $29.5^{\circ}\text{C}$ .

✓ Evaluating the Temperature of the Hall or the Winter Room

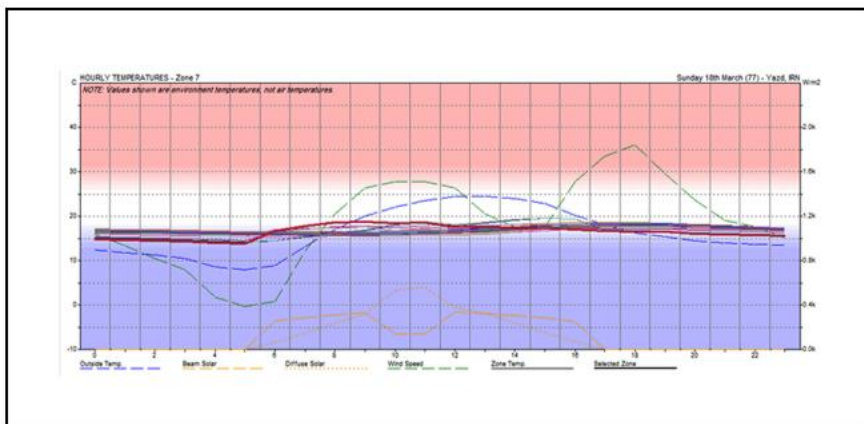
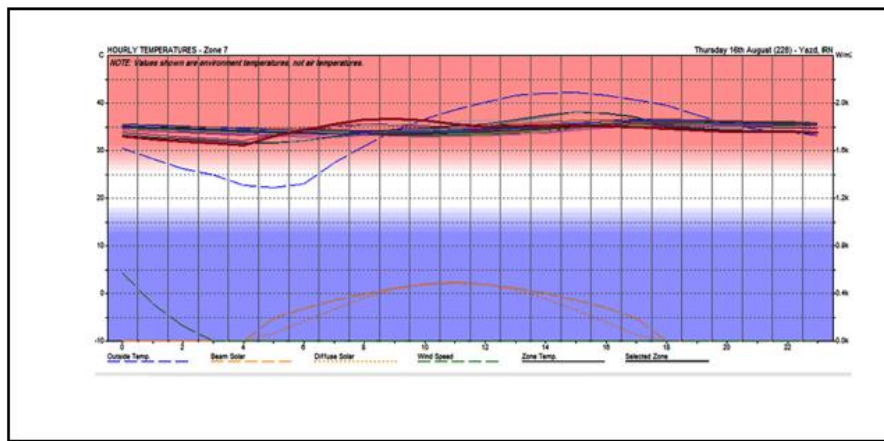


Figure 25- Minimum temperature of the Hall in January



**Figure 26- maximum temperature of the Hall in July**

The minimum temperature of this room (winter room) is  $15^{\circ}\text{C}$  while the maximum temperature of this room is  $33^{\circ}\text{C}$ .

## 6- Summary

One of the most important factors affecting residential construction for human beings is the environmental comfort. In order to reach this comfort zone, understanding climate is of utmost importance.

In the traditional architecture by evaluating nine characteristics in four traditional houses in four different cities as well as the thermal analysis using EcoTech software application, it was evident that the majority of seasons are in the acceptable range of comfort zone and the months which are outside this acceptable zone can be alleviated using architectural elements. In the traditional architecture, the different temperaments used in each climate are locally determined and consistent with the temperament of that climate. For instance, in dry and hot regions, bricks which have a hot temperament are used and in the cold climates, stones which have a cold temperament are used.

The localized nature of the material and the adaptation of materials in each climate with the temperament may seem against the thermal comfort but based on the principles of traditional medicine, reaching a coordination between human temperament and the environment will improve and reinforce the temperament and the capability of human beings. Hence, this is very important for temperamental health which is one of the four main characteristics of architecture.

## 7- Conclusions

Based on the principles of traditional medicine, each individual has its own unique temperaments and humors and based on the temperament of the person, that person will be able to withstand the same temperament and will have more consistency with the environment which has that same humor. However, a person with a humor will temporarily feel comfortable in an environment with another temperament. However, this will not last long and it is not appropriate for the mental and physical health of human beings. By investigating and evaluating traditional houses and thermal analysis of these houses we find out that the thermal comfort zone in cold regions can be lower and in hot regions it can be higher than the comfort level defined in different charts such as the Gioni chart. For instance, when the summer room in Borujerdis House in Kashan was thermally analyzed, in the most critical temperature (the hottest day) when the temperature is  $40^{\circ}\text{C}$ , this part of the house has a temperature of about  $29.5^{\circ}\text{C}$ . this is while in the available charts such as the Gioni chart, this temperature is completely outside the range of the comfort zone and only by utilizing mechanical tools we can reach the comfort zone. If the temperature is a little higher than the comfort zone, based on the principles of traditional medicine, this higher temperature is useful for the residents in this region and it is consistent with temperamental health. Hence, it can be concluded that using appropriate architectural designs which are consistent with the climate and the temperament, we can reach an acceptable range for the comfort zone.

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