

**Research Article**

## **THE IMPACT OF DESIGN CLIMATE ON ENERGY EFFICIENCY (CASE STUDY: CLIMATE BUILDINGS IN YAZD)**

**\*Mehdi Zamanpour**

*Islamic Azad University of Shiraz, Rezameshksar, Shiraz Art University*

*\*Author for Correspondence*

### **ABSTRACT**

Since each region has its own climate, it is often thought that building designers with an understanding of the climate of a geographic area to other parts of the same design can be used to. In this article, similarities and contradictions in the climate of a region in two different geographical regions is studied. Throughout history man has always tried to provide a safe shelter for residence, harmonize with their surroundings in order to create favorable conditions for the rest of his life and in fact, climate, climate in shaping the biosphere, is directly involved. In Iran, due to having four different climate, hot and humid, hot and dry, mild, wet and cold, different architectures (especially in housing design native) coordinate with the spaces constructed in such a climate is created, using local materials that are least harmful to the environment. Using local materials and reduces energy consumption, thereby increasing the durability and environmental sustainability have been building. Therefore, in this article, we tried to design the impact of climate on energy saving considers and disadvantages of the new architecture in terms of climate, lack of energy savings and damage to the environment, we briefly examined. Finally, to summarize and provide strategies on energy savings in buildings is due to new technology and techniques.

### **INTRODUCTION**

Climate design method for reducing overall energy costs in buildings. Design is the first line of defense against the outside climatic factors. In all climates, buildings are built according to the principles of ecological design.

To minimize the need for heating and cooling and instead of natural energy around their buildings save money in the long run cause climatic design techniques is the best type of investment for building owners. They do not cost much at all.

And only requires knowledge about the design architect climate and of course the result is that the energy efficiency, especially fossil energy source has a considerable impact in this type design energy source, solar energy is eternal (Watson *et al.*, 1997). The purpose of this paper is to conserve fuel because it was trying to design buildings directed towards natural warming. Although it is a monument climate in all seasons should be responsive to the needs of residents but this short is accountable for all content and just what is followed in this paper how the supply of building heating by direct radiation of the sun. The use of equipment, installations, and materials, mechanical and electrical is only building construction. In other words, how can it be architecture or design only the building that we're living in there and without heaters they live in places that cannot be converted and cooling the need to minimize or eliminate heat. Since each region has its own climate refused, it is often thought that building designers by knowing the climate of a geographic area can be used for other parts of the same design. In this study, we aimed to reduce the climate impact design energy consumption on climate Egyptian city of Yazd in examine (Bahmani, 2007). How to deal with the nature and the architecture, reaction in different parts of the earth, and every man will be valuable architectural remains from the past overcoming his show as complete or incomplete based on factors such as climate, weather, etc. Hence, we see the local architecture and cultural diversity in different countries may be consistent with climate show that the specific characteristics of their region. Due to different conditions of climate and culture in Iran, has a special feature is consistent with its different architecture and the climate has been created.

## **Research Article**

### **Statement of Problem**

#### *A Review of the Research Literature*

In order to investigate the views of experts in the field of traditional architecture in connection with their agreement with the climatic conditions and building sustainable research have we have chosen a selection of comments will skip some of the presentations, in this section we discuss the theoretical framework, we will evaluate the issues raised. Darab and Shahriar: his architecture studies to assess the local Gilan "in the context of the study of traditional architecture, based on environmental conditions," explained at first, we designed and implemented housing in the territory of Gilan and according to the situation of environment in residential buildings housing several types of models have been evaluated. Then the interior spaces of traditional houses Gillan, architectural spaces are divided into three categories:

A) Room indoors

B) The semi-open spaces such as porches

C) Range of open spaces, including a courtyard around which the house is "important to the rest of the house."

In a part of their study identified eight characteristics of rural architecture in Gilan

Finally, modern buildings with state problems refer to "the new architecture should be used in place of conventional materials and limitations carefully consider climate (Darab and Shahriar, 1993). Ghazanfarpour: He: "Assessing the relationship between climate and housing in the province" refers to that "In recent years much attention has been operating climate and housing asymmetrically, problems and issues to be raised." Due to the warm climate, diverse province into two parts: and dry and somewhat warm and humid division and taking into account the effects of temperature and mode of exposure to sun and wind, criteria and principles for the construction of the plan form, color, materials and rose in the climate to maximize renewable energy use (Hosseini, 1995).

Saghafy and Asghar: The research was carried out by them, "the relationship with adjacent materials compatibility and savings in the buildings' studied in our studies suggest with regard to the "energy crisis in the world, no material adjustment and increased amortization of buildings, especially in certain environmental conditions "must be evaluated in this context. Hence the importance of choosing the correct cover, how to build monuments to the past that due to "weather conditions and situations used in heterogeneous structures" have been discussed.

The tables show the "incompatibility possibility of aggregation or juxtaposition of materials relating to response to chemical or physical" in a variety of ways to select materials appropriate to the building referred. At the end of the discussion, hooded walls as "direct thermal insulation on exterior walls will be installed" has been introduced and suggest that hooded walls cause the "whole structure of the building against changes in temperature and environmental protection and to prevent loss of heat (Mohammad and Asghar, 1992)

## **MATERIALS AND METHODS**

### **Methods**

The climate of the city of Yazd, the region is hot and dry, it is the construction of conditions in relation to climate and sustainability will be discussed. Because Typology building and housing in different regions, ie, show the influence of environmental factors including climate and culture. The disadvantages of the new architecture, climate, Yazd, the use of the material inconsistent with the terms of, poor building design and energy conservation, we briefly discuss finally, to summarize and provide strategies for building energy savings due to new technology and techniques. To conduct this research, analytical and research methods used based on library resources, documents and statistical data have been collected.

### **Hypothesis**

A) In order issues, assumptions regarding the desired content, are presented as follows:

B) In the past, local materials, the buildings used are correct and complete.

C) The optimal use of renewable energy such as air, sunlight, can be seen in construction in the past. The architecture fits with the least impact on the environment and climate affect ecosystems.

### **Research Article**

D) Considering the above factors, it can be concluded that traditional architecture is in line with sustainable construction.

E) And new architectural styles, and do not consider the above problems for residents of certain buildings in each zone is created.

The theoretical framework

Considering the numerous studies in the field of building design due to climatic conditions must be taken to point out that in these studies, construction of topics related to sustainable building traditions of a particular subject is not considered and always in accordance with the conditions surrounding the construction of the buildings in different regions is discussed. Some studies also point to the importance of energy in the building and how to use renewable energy perishable and non-use of energy mentioned or specifically to the points discussed. The studies collected in this study all comments and design in accordance with the ecological impact on reducing energy consumption will be analyzed.

### **Recognition Elements**

#### **Sunshine**

(Ultraviolet) electromagnetic beam is emitted from the sun. With the maximum intensity of solar radiation in the visible light but more than half of the thermal energy of the sun beat down on red.

Clouds plenty of outdoor space and atmosphere to reflect the sun's rays; but the rest of the earth is warming the Earth's natural.

#### **Temperatures**

The amount of solar energy that falls on the ground at any point during the year, depending on the severity and duration of sunshine in the area and the heat and the cold of the ground, the main factor determining the temperature of the air above it. The mean high water temperatures in summer than in winter the average temperature is lower than the air above the sea. Altitude also affects the temperature at a constant latitude areas are cold at higher altitudes than the lower.

#### **Humidity**

The humidity is the amount of water vapor in the air. The warmer air holds more water vapor. The maximum amount of moisture in the area of the equator with a motion of the poles decreased. Vapor pressure of the air layer near the ground is always more.

#### **Vapor Pressure**

Amount of air pressure that increases the vapor pressure of water vapor in the air caused by atmospheric pressure is different.

#### **Wind**

The main reason for the unbalanced air pressure belts sun's rays on the earth. It leads to temperature differences in different parts of the surface, which makes the wind blow. (Force, Coriolis) caused by Earth's rotation caused huge mass of high pressure areas to low pressure is moving to deflect this movement is clockwise in the Northern Hemisphere and counterclockwise in the southern hemisphere of hours. This force is zero at the equator and toward the poles increased.

#### **Winds Types**

Trade winds and polar westerly monsoon winds that dry local winds and sea breeze to comment some of them:

#### **Monsoon Winds**

These winds are caused by differences in the mean annual air temperature of Earth's surface on land and sea, causing winds of winter and summer winds on the sea.

#### **Dry Sea Breeze**

On the coast the air is warmer than the sea (from land to sea) at night and the water colder than the sea breeze from the sea toward the land.

#### **Local Winds**

In mountainous areas the temperature will cause local winds. Warmer air near the mountains during the day levels of atmospheric air moves upwards, but at night the reverse action takes place. To this day light winds from bottom to top and from top to bottom at night.

## Research Article

### Precipitation

The warmer air holds more moisture is if they say it's cool relative humidity (RH) of the air is increased it is called the dew point temperature and the relative humidity reaches 100% if the weather gets colder it cannot hold all the moisture out. The excess water vapor or water droplets on the surface temperature are lower than the dew point is formed. If the outside air temperature in winter because of cold surfaces below the dew point of the air inside the glass window is water droplets formed on the windows (Gholamhossein, 1992).

### Climate and Building

Note that, although the elements are all affected buildings and principles outlined in this section applies to all of them, but the result was that particular buildings may influence some elements of the impact of domestic factors (such as heat due to the presence of people, lamps and lighting devices exothermic) very few, and no decisive role. Architecture warm and dry area investigation and study of climatology in the architecture of this type of housing architecture can be used in many other cities of the central plateau of Iran introverted architecture that is consistent with the type of climate. This section examines the housing architecture; Yazd is an example of introverted architecture.

### Climate Yazd

Climatic characteristics of the region are "Drought, extreme heat in the summer" with sand storms in some cases. And the wind blowing in different directions, as well as is "severe cold in winter".

### Indigenous Architectural Features of Yazd

A) The spatial structure of the building: main index indigenous architecture of Yazd, which is introversion. This type of architecture has a central courtyard and rooms are located on all four sides and internal space for ventilation, louver side of the building is constructed (Fig. 3). Outside form usually acted (in some cases, flat) respectively. The sunken garden is a space that is located in the basement room and such a combination, creates cool spaces in the lower chambers and causes the air flow to the correct way, and shows the need for artificial cooling systems are not and hence the energy consumption is reduced (Fig. 4) (Gholamhossein and Memarian, 1992).

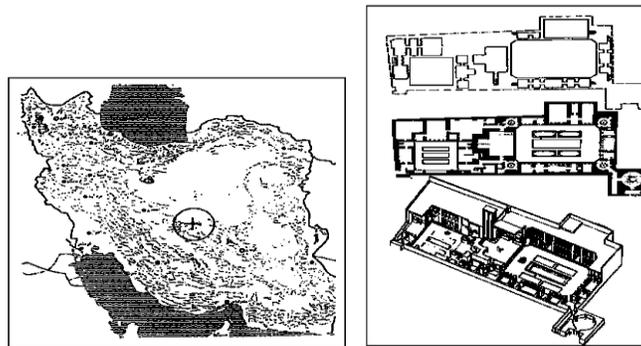


Figure 3: House of Nematullahi

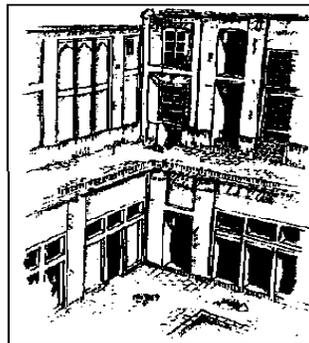


Figure 4: Shows a sketch of the life of a house with a sunken garden

### **Research Article**

B) The effect of air flow and sunlight in hot, dry climates such as Yazd, with severe storms with sand and high temperatures in the summer and intense cold in the winter, harmony with nature and the environment becomes necessary, for example, the Climate Action Plan form must be compressed to a smaller surface exposed to sunlight. As it was explained is due to excessive exposure to sunlight in the summer and too cold in winter, the placement of the building on the south and southeast in order to receive the maximum amount of energy in the winter. In order to use the right winds, the architects used the wind up this way, the flow of air into the room transfer and polluted air and sent out. The wind suction work to be done, the wind carrying the hot and dry parts of the region due to regional climate and wind direction varies, for example, "in Yazd, the wind in different directions, Learn the four-way constructed and is usually too high" (Vahid, 1992). According to the above, the architecture of the houses in Yazd form of renewable energy such as air and sunlight in a well-ordered way and optimal use this reduces the use of fossil fuels by thus has guaranteed the sustainability of the environment (Gholamhossein, 1992).

C) Building materials, building materials in any kind of weather conditions to operate, the weather is hot and dry the study of materials used in the comfort level of occupants in the building's impact. In this climate, building materials should be selected in such a way the frequency of resistance to heat and thermal capacity are high. Including materials that builders use if the flower and its derivatives are used in the building are stone or wood, it with soil and flowers are mixed because this type of material does not comply with dry weather in Yazd. It is worth noting that a floral requirements, from the soil after application of the vector field is obtained this leads to the use of local materials, reduced energy consumption why you no longer need to spend more energy to transport materials from other parts of the site have not, the construction materials during production, use discarding it will not adversely impact the environment. Another important point in the construction, the materials used are thick, wall thickness shall be able to withstand exposure to prolonged sunlight, the materials used in the building should be light in color to reflect large amounts of solar energy, brightly colored soil materials, the best color choice in the region is hot and dry.

### **Features a New Architecture of Yazd**

Unfortunately, such an architecture conscious side, we are witnessing the emergence of a new architecture that is completely inconsistent with the climatic conditions. Row houses are made of concrete, steel and brick built the courtyard where the walls are short, on the one hand cannot fit and cannot be built on site, severe wind and solar protection against bright light, and create conditions inhospitable to residents, the thickness of the walls and ceilings using the special situation of the region, there is no resistance and the use of black tar on the roof of bluish color due to increases in summer temperature and the direction of heat transfer through the roof reduces the temperature inside the house in winter finally, the use of heating with fossil energy consumption and cooling systems due to improper temperature of interior spaces are used in different seasons, generally, it should be said that the new architecture building approach imbalance caused by a lack of comfort climates, on the one hand, residents on the other hand the use of inappropriate materials and increased use of fossil energy, sustainable architecture that existed in the past is not considered. Factors that may affect the building design to reduce energy consumption

### **Location of Buildings**

Factors that can affect a site's environmental features include:

Topography, the nobility is high hills or in valleys around it. In building location must be considered in design of their work taken seriously. Additionally, both natural and constructed surface permeability, and soil temperature are important genus. For use in the construction of solar radiation, it is necessary to place it on the ground will be designed so that the maximum amount of solar radiation between the hours of 9 to 15 solar operation so you need to identify and locate the site determines that the south has seen the game down south in the winter and there is a veil over the light (solar diagram for detection mask that prevents the entry of sunlight on their website). In addition to the problem of urban sites the possibility of ghosting, especially around tall buildings on the south side is very high. During the design stage of the building, should lower the radiation angle of latitude site) December (and barriers such as tall buildings or trees around and pay attention. According to delineate sensitive areas should be protected from the

### Research Article

analysis. The location of the building is better than the open tops of hills, valleys floor sensitive areas which are subject to prevailing winter wind is generally avoided. There were bumps and trees umbrella term barrier to wind. In addition, the artificial barriers such as embankments and walls can also be helpful.

Behind the building is suitable for wind gradient, for protection against the wind. As the winter winds blowing from the north and northwest, located on the southern slope of shade from the sun and wind more often, so it should look for when selecting a site tour of the area and finally, "continued the space of a space with the assurance that the sun is otherwise, it is not no use except in desert areas.

### Building Form

The building forms an important role in creating the right conditions for energy conservation plays. The exterior of the building, in direct contact with the outside air and energy is valuable, the outside air pass. Design must ensure that the smallest possible amount of surface in proportion to the volume of external air in contact with the surface. The butter is ideal given that only one globe-shaped building is the best and how the layout of the buildings next to each other can change the amount of heat loss. But in the case of buildings with the same shape as the shape of the structure is more compact and less loss of heat energy.

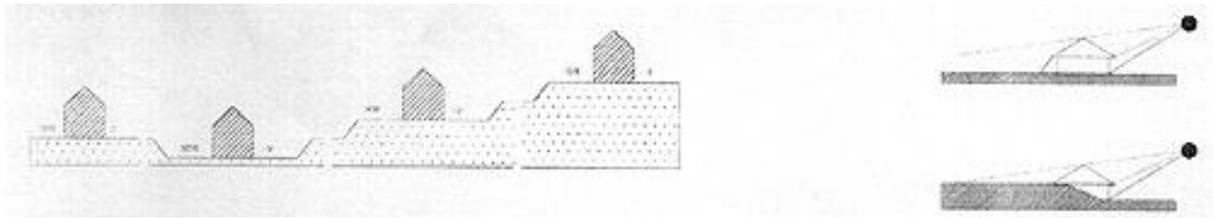


**Figure 2: Optimization of heat loss in a pro rata reduction in the level**

The overall form of the building should be designed the two main goals of greater energy absorption and low heat dissipation to provide. The hull form of a building, it is a form of heat loss in winter and minimum in summer heat absorption is minimal. Optimum form for this purpose in any form and in any climate gives the best results. Form is stretched in the east-west direction. In all geographic latitude and longitude, east-west oriented buildings that will be pulled over are more efficient. In hot and dry climates, form drag is more efficient because it reduces surface contact with the harsh environment. In temperate climates the form of a building is more freedom. In hot and humid climates and can be driven without restrictions in the optimal design the building. In general, buildings that are adjacent to each other East and west walls are common have had much better results. One of the most important factors in the form of the building reduces its height.

The best solution against winter winds, low slope roof and reduce the total height of the wind and relatively smooth passage of air to help. The ideal shape curved domed building can be reduced by increasing the air pressure. Similarly, levels of integration and the smooth walls of the least resistance to air flow of the show. Resulting in a minimum amount of air pressure will remain. One of the solutions is that the northern part of the roof slopes away. The house is built on the Southern slope and north facade of or behind the embankment prepared to call out the view with less. By reducing the height of the north wall, the shadow of a building on land or less disappears completely (portions of land in the winter, people are constantly in the shade, these parts are usually empty and not used. (Such embankment on the north wall, above the earth brings and it gives light and heat loss in winter reduces the Northern Wall and summer heat intake leads to zero. In fact, the surface temperature of the outside air temperature is greater than the cold seasons. And outside air temperature is below the heating season. With the winning territory north wall, the cold front structure of northern winds in winter is protected.

**Research Article**



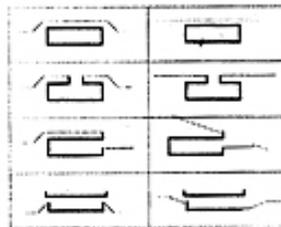
**Figure 4 and 5: Heat loss and temperature difference is as a function of the position.**

When the northern facade of soil removal is not possible, North facade would be designed so that an adequate amount of sunlight to reach the northern parts of the building. Residential areas, it is better to keep the internal temperature Non-residential space that they would be less likely to visit and do not require heating comfort. Such as warehouses, corridors, etc. in the vicinity of the outer space to act as a buffer for heat shield and prevent heat loss through the building shell.

Room under the sloping roof is as a buffer space between the parts of the temperature control or part of the building shell) roof (which bear the scorching sun in summer and winter pressures used (Jahanbakhsh-Saeed, 1998).

**Basement**

Many of the buildings on the land meets the needs and problems related to climate, including, preventing heat exchange, protection from wind and heat exchange. Underground buildings are often thought to be incompatible with the use of direct solar energy is like houses that are built on the ground. Solar energy is also a significant issue for the construction of underground it is important that the design should and deployment of these houses are to be respected. Home about solar energy being above or below ground assumes a crucial role. Dirt cheap thermal storage building adjacent to buildings are in the proper orientation relative to the sun. Little change in soil temperature changes in temperature. Prevents heat loss in buildings and it is a good insulator.



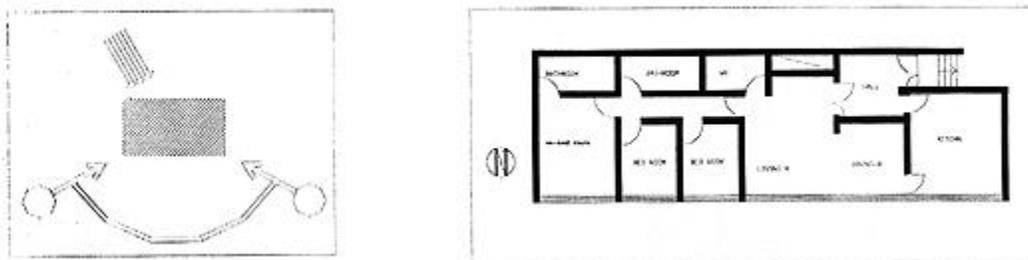
**Figure 6: Different ways of building on the land.**

**Building Plans**

Climatic conditions that prevail around a building in the winter, we will assist in determining the relative interior spaces. The north side of a building in the winter because it does not receive direct solar radiation, will stay cooler. It cannot live without heat. East and west facades should be an amount equal to one in the morning and one in the afternoon, and receive solar radiation. Because the path of the sun across the sky towards the North - South is symmetric. Within a day, the temperatures observed in most of the eastern facade of the western façade caused by dust in the morning and the weather is warmer in the afternoon. South facade of the building because it is for sunshine, sunny warmest and most of the buildings in the winter (even the roof) so have spaces that need more sunlight. Along the southern facade of the building be deployed. South side of building the best place to rooms is used within days. The rooms are in dire need of light and heat.

The southern facade is three times the size of the eastern and western facades can benefit from the sun. The resulting spaces are located on the south side of most of the solar radiation. So it seems natural that the South façade for solar radiation are open and transparent. To take advantage of solar heat or in other words the only way to absorb direct solar energy systems, solar heat gain through windows is that are exposed to sunlight.

**Research Article**



**Figure 7 and 8: View the sun and wind in winter**

On the other hand, this problem can be investigated. The best orientation for most building surfaces, direction that the maximum sunlight in winter and minimum in summer it gets.

In summer, on the contrary, the southern facade and roof less than east and west facades, solar radiation it receives.

**Because in winter**

The sun is low in the sky and shining at an angle less and radiation to treat the southern facade is nearly perpendicular to the facade. More radiation in summer is nearly perpendicular to the roof. However, almost all minorities, heat absorbing glass walls facing south in winter through most of the heat loss through the glass front. To plan a monument to important areas using the sun are more exposed to the south. In addition, to improve the walls and windows facing south to make the building more solar energy can be increased. One way design building greenhouses are climate in addition to gardening often used in heating the house. Greenhouse, the air inside the shell is completely transparent to solar radiation warms the day. Sabeti (1969) the air is conveyed into the building and maintained by absorbent material (Stone sink) and at night the stored heat is released (indirect method (the greenhouses are hard and difficult to run. And in our country and most of the least developed countries is a welcome bit. The results can be used instead of traditional Iranian architecture. For example, a small central courtyard with a glass roof, which in this day and age have become Pasyhyay in the living room or hall spaces. Can be very useful and effortlessly. The patio is predominantly located in the center space. If the roof is covered with glass and tilt it toward the south. On the patio when the sun warms the air by Bright ceiling. Course also sheds light on the surrounding walls absorb heat. Patio windows open during the day and warm air inside into space. At night, when the valves are closed cold air is trapped with carbon dioxide that the plants produce. The following are full of energy and heat. This method is more reasonable than the southern greenhouse we have the vision and perspective and to exclude direct solar radiation. In addition to being in our country are too hot southern heat required is generated. That is not needed. In the central patio windows double glazing or insulation and night. The window is associated with low free space (Sabeti, 1969).

**Openings**

In winter, the input and also with each opening and closing, is always plenty of cold air into the building. Air infiltration through all the input fields do will replace the cold air outside and warm air inside it instead. This influence is stronger when opening. In a typical home, the influence of cold air from the inlet and thermal losses due to heat transfer through the thickness can be up to 10% of total heat loss of the house is formed. This value is higher than in a store or an office. Built a porch and entrance hall, significantly reduces the loss of heat by conduction and infiltration of cold air. Both are on the inside and another one outside source. The volume of air is trapped. Whatever the weather is settled inside the entrance, the warm air is less. Moreover, the outdoors, only a small amount of heated air inlet placed in contact with the cold weather outside. Provided that inside the entrance is closed at the moment. So every time someone enters or exits the building, during cold weather will not be exposed to air. In addition, it should be available outside the entrance to the winds of winter and the frame is well insulated to reduce heat loss. In most climates, the entrance to which is located on the southern facade against winds and storms are safe, but if the opposition is the Winds must be protected with vegetation and trees Badshknhay or you go out the front entrance or shows also completely open and seam (Nouifert, 2006).

### **Research Article**

The combination of interior spaces south side of a building is the best place to rooms within days of them being used. The rooms are in dire need of light and heat. The main space than they need to be in direct sunlight and in accordance with the schedule in the southern part, southeast and southwest of the contract. Or the path of the sun in the direction adapted to the building. In a house, where the breakfast is better which is in the southeastern part of the early morning sun exposure is important. Or the living room to the south is the largest space in the day it used. Southwestern rooms or work because most of their time in the evening (Vahid, 1992). To provide comfort for indoor subjects can be divided into two parts hot and cold. Some parts of the building are less or seasonal use. The parts can be separated from the hot areas of the building and therefore to spend less energy and improve comfort. Even the parts that do not need permanent housing are all having a temperature. For example, a winter bedroom can be a bit cooler than other rooms. The walls that are resistant to heat transfer. And doors that are sealed to separate the hot and cold sides of the building are necessary.

The rooms that are used less. Must be on the same side of the building act as a buffer space duplex homes prevent air movement between classes is necessary to provide comfort conditions. If space is not completely closed off stairs, this space will displace warm air from downstairs to Top resulting in a very heated up and cooled down. It is more important, especially during the day. Therefore, at this time most of the activity is on the ground floor.

Put a lid on the bottom or top of the stairs on the bottom floor heating will keep and, if necessary, at night it can be opened in hot weather bottom chambers has spread to the top floor. In the space of two floors to the ceiling heat it up and residential space on the first floor and a hundred and eighty centimeters would be pretty cool. Although GPA temperature as well as space may be part of it will be too hot, cool it down. Such spatial segmentation by moving or glass panels can prevent the movement of air. The house is divided into spaces that are closed motion and prevents air from inside the building. What seals the deal with the wind and at the back to prevent the wind from outside air infiltration? It must be the vertical displacement of air in the house (Bahmani, 2007).

### **Conclusion**

This study was an attempt to influence the design of buildings in accordance with the Region of Yazd design to reduce energy consumption and the impact on energy consumption evaluation thus the relationship of climate to design the optimal use of energy in Yazd. Study of local structures in Yazd, the optimal use of renewable energy sources are such as air, sunlight, etc. The construction is concerned, and we are all creators to build the least impact on the environment. The most important point in the new architecture, excessive use of energy from non-renewable (fossil) is due to the use of inappropriate materials and transportation and use of heating and cooling building design mistakes due to climatic conditions. The proper use of native materials and combining them with the new construction and benefiting from the experience of experts in energy efficiency and renewable energies such as solar energy can be wind for cooling, heating and ventilation utilized within the context of this requires cooperation between architects and energy experts using new technologies to be compatible with modern architecture to create a climate of each region.

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