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AURUM MÜHENDİSLİK SİSTEMLERİ VE MİMARLIK DERGİSİ
AURUM JOURNAL OF ENGINEERING SYSTEMS AND ARCHITECTURE

Cilt 6, Sayı 2 | Kış 2022
Volume 6, No 2 | Winter 2022, 291-313

ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

EVALUATING SUSTAINABILITY ASPECTS OF HOUSING IN UNESCO WORLD HERITAGE CITY OF YAZD CASE STUDY: LARIHA HOUSE

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GELİŞ TARİHİ/RECEIVED DATE: 01.07.2022 KABUL TARİHİ/ACCEPTED DATE: 27.10.2022

Abstract

Nowadays, reducing energy consumption and coexistence with natural and climatic conditions in the region has become one of the most prominent architectural goals. As a result of the growing population and the crisis created by rising energy demand, managing energy consumption patterns has become an essential component of sustainability. The traditional architecture of Iran is derived from the culture, tradition, customs and is unique to the climate of that region, which has caused the least use of non-renewable energy in the design and construction of its structure. Besides, simple and logical methods have provided the most use of renewable energy. As a result, this study explores the method of optimizing energy consumption in the housing sector through current native pattern designing in hot and dry regions with a specific emphasis on the relevance of energy savings. The case study of this research is Lariha House. It can be observed in the design concept of this house, the details such as wall thickness, placement of the building, the height of the internal structure, and other elements including plants, porches, wind flow and etc., directly influence optimizing energy usage.

Keywords: Sustainability, City of Yazd, Houses, Vernacular Architecture

UNESCO DÜNYA MİRASI YEZD ŞEHRİNDE KONUTUN SÜRDÜRÜLEBİLİRLİK YÖNLERİNİN DEĞERLENDİRİLMESİ VAKA ÇALIŞMASI: LARİHA HOUSE

Özet

Günümüzde enerji tüketimini azaltmak ve bölgedeki doğal iklim koşulları ile bir arada yaşamak en önemli mimari hedeflerden biri haline gelmiştir. Artan nüfus ve artan enerji talebinin yarattığı kriz sonucunda, enerji tüketim kalıplarını yönetmek sürdürülebilirliğin önemli bir bileşeni haline gelmiştir. İran'ın geleneksel mimarisi, kültürü ve geleneklerinden türetilmiş olup ve o bölgenin iklimine özgüdür. Bu da yapısının tasarımında ve yapımında en az yenilenemez enerji kullanımına neden olmuştur. Ayrıca, basit ve mantıklı yöntemler yenilenebilir enerjinin en fazla kullanımını sağlamıştır. Sonuç olarak, bu

çalışma, enerji tasarrufunun önemine özel bir vurgu yaparak, sıcak ve kurak bölgelerde mevcut yerel tasarımı konsepti yoluyla konut sektöründe enerji tüketimini optimize etme yöntemini araştırmaktadır. Bu araştırmanın vaka çalışması, Lariha evidir. Bu evin tasarım konseptinde, duvar kalınlığı, binanın yerleşimi, iç yapı ögelerinin yüksekliği gibi detaylar ve bunun yanısıra, bitkiler, sundurmalar, rüzgar akışları gibi diğer unsurlar, enerji kullanımını optimize etmeyi doğrudan etkilemektedir

Anahtar kelimeler: Sürdürebilirlik, Yezd şehri, Evler, Vernaküler Mimari

1. INTRODUCTION

In recent decades, the energy crisis and climate change have been among the most important problems that mankind has faced. In developing countries, energy consumption has also risen up with the increasing population (Asquith, Vellinga, 2006). Nowadays, mechanical systems play the most important role in the thermal balance of the buildings and at least one third of the energy consumed in most countries is allocated to heating and cooling the buildings (Perez- Lombard, Ortizb, Poutb, 2008). As a result of the growing population and the crisis created by rising energy demand, managing energy consumption patterns has become an essential component of sustainability. In the present age, the issue of sustainability is a matter of concern based on climate-friendly design and the use of recyclable materials and energy reducers (Eicker, Tereci, Kesten, 2010). Sustainable architecture is an architectural response that prioritizes human life in the present and the future. In its structure, those materials are used that are homogeneous and compatible with their environment during production, use or even during destruction. In sustainable architecture, locally produced materials are used as much as possible. It is considered the minimum consumption of fuel energy sources, the maximum use of solar energy, heating systems with the highest efficiency, and the least environmental degradation for the quality of habitant's life. Eventually, all factors that enhance the level of physical and mental comfort of those who live in that environment (Zahedi, Najafi, 2006).

Historical research indicates that traditional Iranian architecture and urban planning have been beautifully and simply built and developed in an organic and environmentally friendly manner (Abdolhosseini, 2011). This native architecture is introverted and has been formed according to the material and spiritual needs of the people there. It means that, it is shaped by taking advantage of the conditions and abilities of the natural environment and culture of the specific geographical region, in order to provide physical and psychic tranquility to dwellers (Fergus and Roaf, 2007). The traditional architecture of Iran is derived from the culture, tradition, customs and is unique to the climate of that region, which has caused the least use of non-renewable energy in the design and construction of its structure (Maleki, 2011). Besides, simple and logical methods have provided the most use of renewable energy. As a result, this study explores the method of optimizing energy consumption in the housing sector through current native pattern designing in hot and dry regions with a specific emphasis on the relevance of energy savings (Bonner, 2006). In hot and dry zones, people in the past created solutions to deal with climate problems that have different appearances in diverse places. Due to harsh environmental conditions in summer, hot storms and winds carrying fine particles, here structures play an important role in thermal comfort. (Golany, 1978). One of these hot and dry region is Yazd province,

which has its own special climatic conditions and traditional architecture. In the traditional architecture of Yazd, some details of the four-season houses such as basement, central courtyard, wind catcher, domed roof, porch, eco-friendly materials, garden pit, windows, location of the building has various structure. The elements and factors of Yazd houses created thermal comfort and a suitable environment for living with the use of these templates and the structures adapted to the environment. Although, these forms and structures in the present age cannot be used directly due to differences in modern construction systems and materials. The vernacular architecture contains principles and elements that can be used in modern architecture, and it seems that these principles can meet the goals of sustainable architecture (Khalili, Amindeldar, 2014).

2. RESEARCH QUESTIONS

Traditional Iranian architecture has a strong and abundant support for various aspects of sustainability, and Iranian art and culture place a special value on this art and culture. Third-world countries, including Iran, consume nearly three times the amount of energy as the rest of the world. It conveys that with the construction industry accounting for more than 40% of this. This level of consumption suggests that the problem requires further attention. This study investigates the following research issues:

What is the concept of sustainability and its indicators in the traditional architecture of houses in Yazd city?

Can the manifestations of sustainable architecture be seen in the houses in Yazd city?

Energy conservation, which is one of the principles of sustainable architecture, how was it done in designing the houses of this climate?

To answer the main questions of this research, Lariha House has been chosen as the case study. In the continuation of this research, an attempt will be made to investigate the relationship between sustainable architecture and the concept of design and construction of Lariha house and its urban context.

3. RESEARCH METHODOLOGY

The vernacular architecture and design of residential dwellings was influenced by a variety of reasons. Iran has a variety of weather conditions, including warm and humid, hot and dry, hot and humid, mild semi-desert and cold climate, due to this fact, different areas employed various roof forms and building materials. This paper is tried to focused on central areas of Iran (Yazd city) with hot and dry climate.

In the first step, the principles and concepts of sustainable architecture are evaluated. Accordingly, it has been tried to review the sustainable environment concerned with precipitation, wind and sand storms, general urban patterns, and how the city has been developed. The structure of the city, compactness, dense texture, narrow, irregular streets, and covered streets were probed. Moreover, the importance of traditional architectural features of Yazd city region and to examine its features in terms of theory in scientific dimensions.

In the next step, Lariha House was evaluated in detail as a sample of typical housing architecture in the historical region of Yazd. The position of the house is examined in terms of the urban context, planning of the house, materials, walls and openings, courtyard, eivan wind catcher, and sardaab. In addition, the degree of conformity of the elements of Lariha's house with the principles of sustainable architecture is investigated. Yazd's traditional houses are an amazing example of how it may be handled difficult climates with the use of simple intelligent architectural solutions, natural energy, and climate adaptation.

4. THE CONCEPT OF SUSTAINABLE ARCHITECTURE

Sustainable architecture, which is a subset of sustainable design, is one of the most important modern movements which is a natural response to the concerns and problems of the industrial age (Tereci, 2017). Buildings, consume 50% of all fuel reserves, resulting in environmental catastrophes; hence, the necessity to design and produce more sustainable architecture is clear (Perez- Lombard L, Ortizb, Poutb, 2008). Sustainable architecture, like other architectural categories, has its own set of principles and guidelines. The following are the principles that must be met in order to classify a structure as a stable structure:

1. Energy conservation
2. Harmony with the climate
3. Reduce the use of new resources
4. Meet the needs of residents
5. Site coordination

Some buildings have specific features and characteristics that make them sustainable buildings. The principles that must be observed in order for a building to be classified as sustainable architecture are: conservation of energy, harmony with the climate, and accommodating the needs of inhabitants. (pleasing the mental and physical requirements of people is particularly important in sustainable architecture.) (Mani, 2010).

5. SUSTAINABLE AND TRADITIONAL ARCHITECTURE

Any country's cultural legacy plays a vital role in developing a sustainable environment. weather condition is one of the most important environmental factors that play an effective role in the climatic design of buildings and urban planning (Salighe, 2004). Despite climate change around the world and the problems caused by the consumption of fossil fuels, energy consumption in the world and in Iran is increasing every year (Konya, 2013). Due to the fact that Iran has different climatic regions, in this area for heating, cooling, and ventilation, a significant amount of energy is consumed. This volume of energy consumption should be considered in urban design and architecture compatible with the climate in order to provide comfort for people of that area (Rodrigo, Pérez-Higueras, 2012). Utilizing the indigenous and traditional architecture of each region is always one of the main architectural events and traditional Iranian architecture must be recognized as a complete representation of sustainable architecture (Oliver, 1973). On the other hand, many sources have studied passive techniques to enhance the energy use of buildings. Because of the significance of sustainability and heritage, numerous studies have been conducted in these areas, ranging from ancient building approaches to modern passive and active solutions to reduce the reliance of buildings on fossil fuel imports. In this context,

traditional courtyards in Yazd were investigated to determine the indoor thermal comfort conditions and effectiveness of natural ventilation systems, as well as other native thermal comfort design ideas (Memarian, 2000). Downdraught cooling (wind-catcher) is another well-known historic feature that is regarded as an energy-efficient and cost-effective alternative to conventional air-conditioning for new and existing buildings (Maleki, 2013).

6. CITY OF YAZD'S GEOGRAPHY AND CLIMATE

Yazd city, with an area of 76,469 square kilometers, is located in the center of Yazd province and on the Isfahan-Kerman road in coordinates up to 56° and 31° north latitudes and 23° and 54° east longitudes. The altitude of this city is 1230 meters above sea level and the air distance to Tehran is 508 kilometers. According to the 2016 national census, the province's population was 1,140,000 people (Kasmae, 1984). Being located in the central part of the Iranian plateau means being exposed to the most unsuitable natural factors that dominate the central plateau of Iran (Ghobadian, 1998). Slight opening with intense evaporation, being away from the sea, proximity to the vast dry desert of salt, low relative humidity with high heat, are some of the factors that make Yazd one of the driest regions in Iran. However, this special geographical and weather situation, along with the intelligence of the past of this land in using the natural energies, created a unique architecture (Nazem, 2015).

Moreover, the weather of this region in the book " Islamic Architecture of Iran" written by Professor Mohammad Karim Pirnia (1992) about the climate of Yazd has mentioned that summers are very hot and exhausting. The intense and dry summer and desert winds in these places combined with storms is terrible. It is one of the prominent features of summers in Yazd province. In addition, winters are usually extremely cold and unbearable, so being outside the city in January and February may be dangerous and deadly, especially early in the morning. These issues related to climate and other issues can be considered as a result of drought and dehydration in this city.

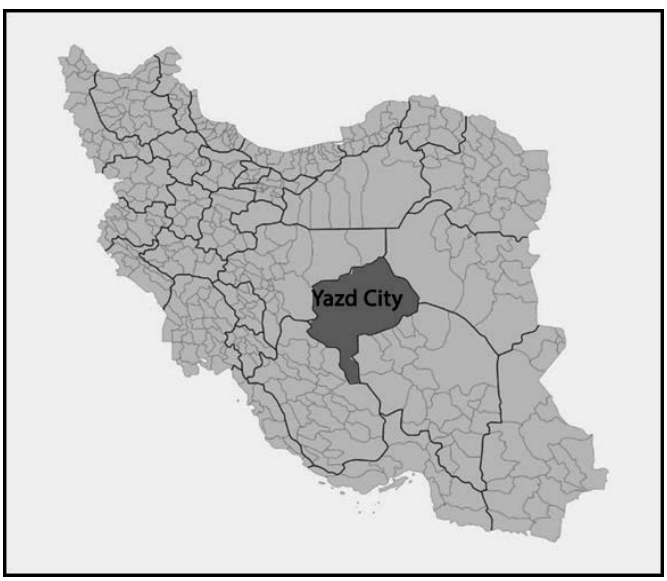

Figure 1. The location of Yazd city in the country of Iran map (Location of the province of Yazd and Yazd city [map])

7. THE LARIHA HOUSE (CASE STUDY)

The construction of this valuable building dates back to the Qajar period and the year 1286 AH and it was commissioned around 150 years ago. The area of this house is about 1700 square meters and its infrastructure is about 1200 square meters. The Lariha house is located in the heart of the historical context of the Fahadan neighborhood in Yazd city, which is also a major tourist attraction within the city. This district is made up of various courtyard houses, ancient structures, and bazaars that are all connected by narrow, shady valleys. The Lariha house is one of several historical houses in this neighborhood that are listed on the Iranian Culture and Heritage organization's list of significant buildings for preservation and conservation. A decade ago, this house received intervention and restoration, and it is now used as a museum (Figure 2).

Figure 2. Location of Lariha house within the Fahadan district

7.1. The urban contex of the house location

The location of the house is in a dense, low-rise neighborhood with winding, narrow alleyways. In terms of environmental and cultural values, the design of the urban context is just as essential as the design of the structure itself, and the entire system works together to create ideal living conditions both inside and outside the home (Figure 3). The passive climatic aspects of these vernacular residences, as well as the architecture of the buildings themselves, are heavily influenced by city planning and urban design. One of the reasons for the narrow alleys, which is sometimes enough for only two people to cross, is to provide better climatic conditions in the passages (Figure 4). The presence of high walls along the passages has a great effect on creating shade against the sun and also protecting the passages against rush desert winds. The winding roads in hot and dry weather are due to the fact that on straight and wide routes, desert winds can flow quickly and cause air circulation.

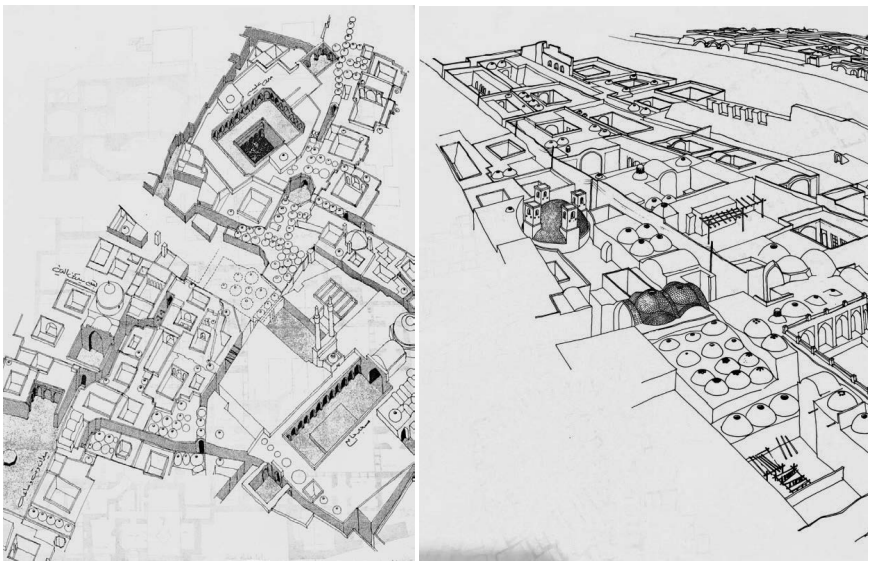

Figure 3. Sketches of the dense urban environment from where the house is located

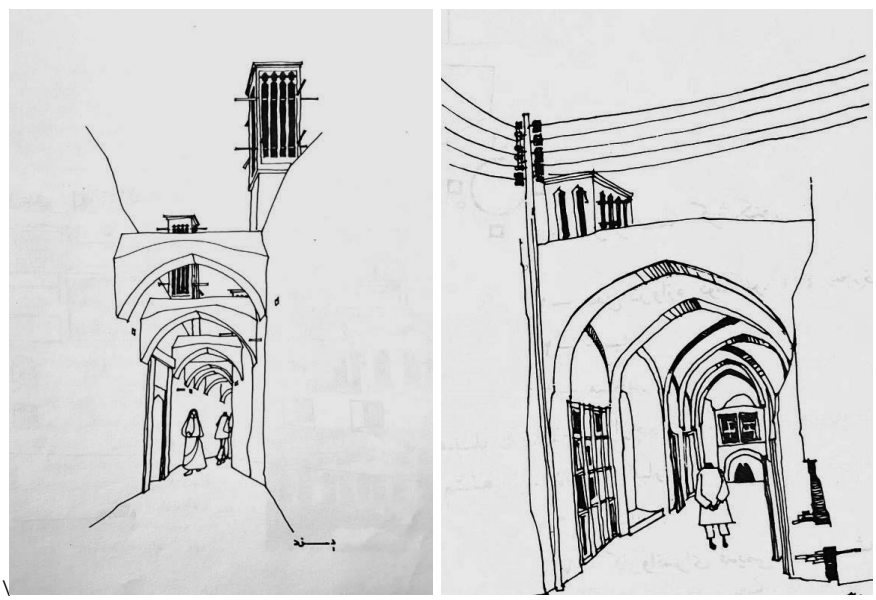

Figure 4. Yuzdaran pass, hight of wind catchers (a sample of four-season house in Fahadan district)

Climate has a significant impact on the architectural forms that are immediately recognized. For example, when one approaches the equator line and enters a more desert-like climate, the proportion of window area to wall area becomes less (Tavassoli, 1974). These environmental characteristics and responses are often overlooked today, as architects are more inclined and motivated to produce contemporary architecture utilizing high-tech and expensive approaches that have little practical benefit for the structure (Fathy, 1986).

7.2. Planning of House

The house is oriented along a northwest-southeast axis in order to create separate winter and summer areas. There is one main entrance to the house, which is located on the north side. This beautiful house has two large and small courtyards, two pools, Eivan (loggia,) halls, doors and many rooms. The entrance consists of a portico, vestibule and a corridor, leading onto a Hashti (vestibule), which serves as a lobby. The hashti ensured that guests couldn't see straight through the house as they entered because culture and privacy were important considerations. They had to turn a corner and proceed through hallways to reach the main section of the house, which was the courtyard. The hashti is located between the two courtyards and has equal access to both. Some service spaces, such as stables, kitchens and warehouses, have separate connections to the outside by the detached door. In addition to the mentioned components, the building has a separate section in the northeast corner, which includes a room and a small yard. There is a main courtyard in a rectangular shape and its elongation is approximately along the northeast-southwest. The main courtyard is large and detailed and porches, halls, and rooms all occupy the center of each side of the courtyard with a strong relationship to it, to benefit from its environmental and aesthetic qualities. In the middle of this side, there is a tall and high Eivan (loggia). The location of this semi-open space, the most important and largest space in the house, at the top of the yard has a great impact on the quality of the yard space. The Eivan is mainly used on summer evenings when the sun starts to set and is usually elevated about two to three steps above courtyard level (Keshtkaran, 2011).

This house, like many other Yazd vernacular dwellings, has a summer and winter area. For a more suitable living environment, families were obliged to relocate to different parts of the house throughout different seasons. The wind catcher, Sardaab (water reservoir), and basement are all positioned on the south side of the house, which is also known as the summer area. This space receives only solar light from north during the summer because the windows all face the courtyard. The walls on this side are a little higher than the rest of the house and cause a high floor-to-the ceiling height, which reduces the amount of heat and keeps the space cool (Akhtarkavan, 2011).

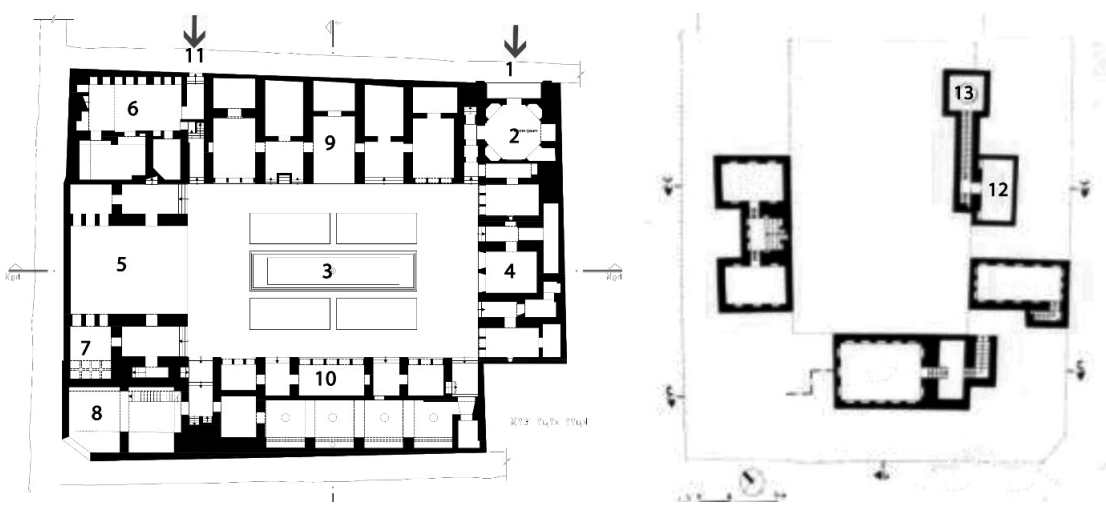

Figure 5. Spatial arrangement of rooms (Ground floor plan and Basement)

Table 1. Guide table of Lariha house (Adopted and modified by author)

Number	Spaces
1	Main entrance
2	Hashti (vestibule)
3	Central courtyards
4	Winter area
5	Eivan (loggia)
6	Bedroom
7	Wind catchers
8	Room under the wind catcher
9	Spring area
10	Fall area
11	Secondry entrance
12	Sardaab (basment)
13	Ganat system (Aqueduct system)

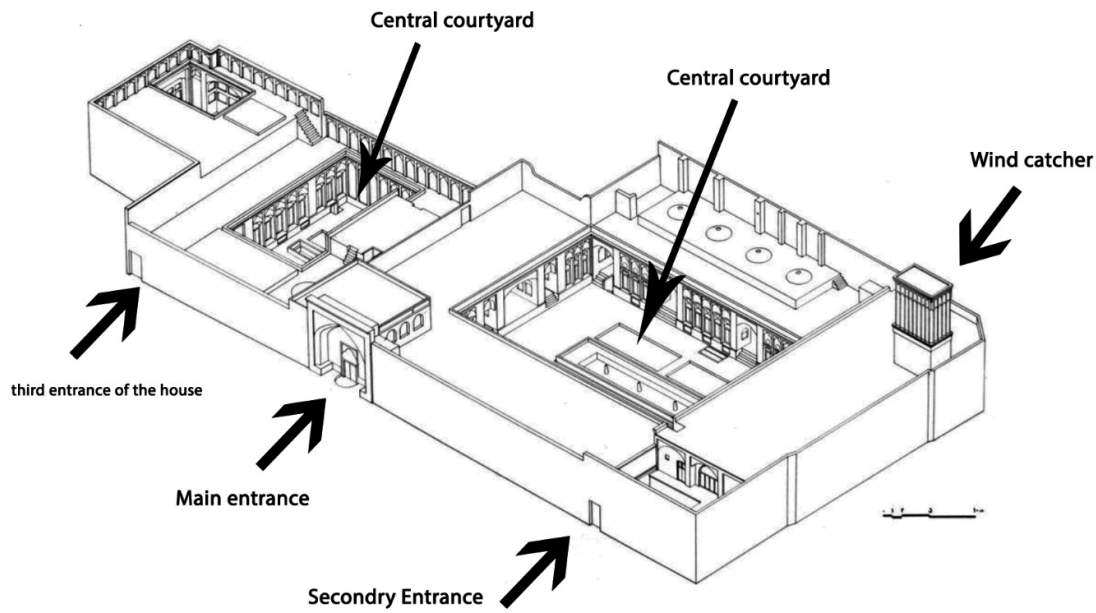

Figure 6. Bird view from the Lariha house

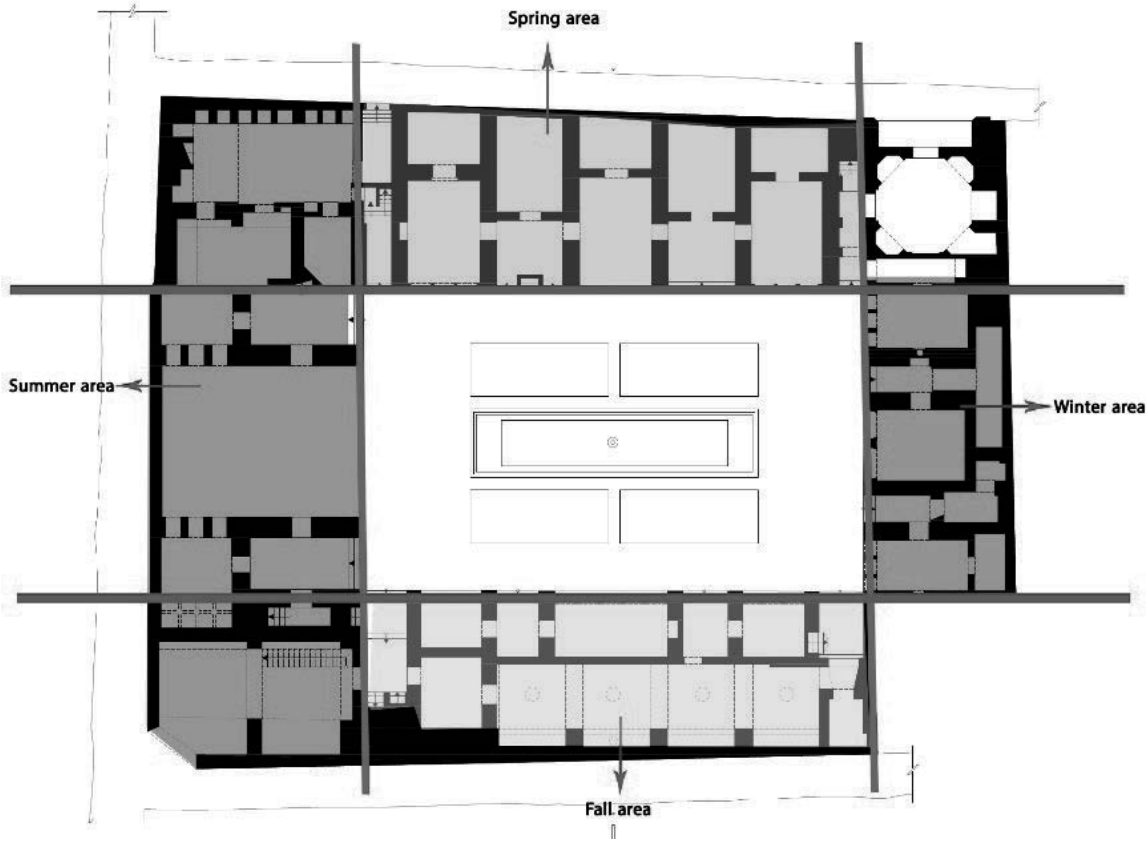

Figure 7. Seasonal areas within the house

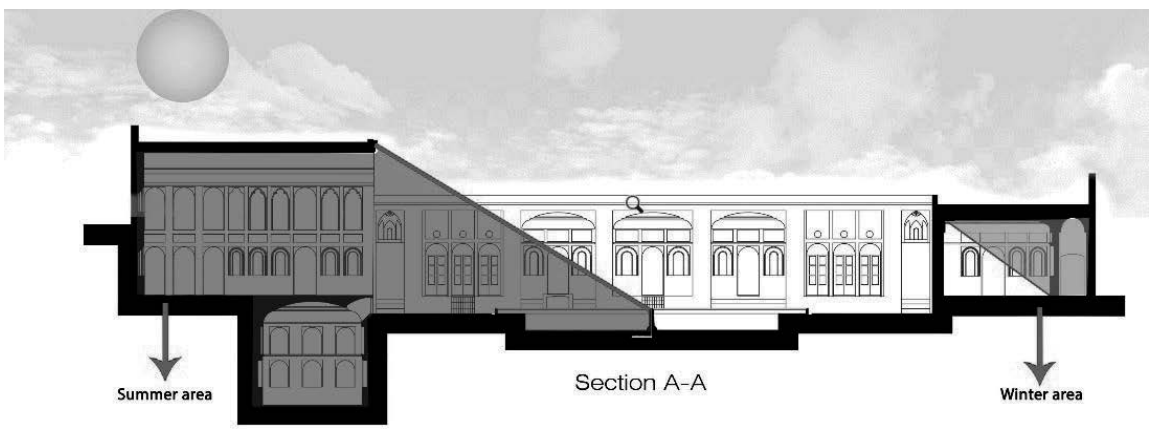

Figure 8. Shading provision in summer and winter parts

7.3. Materials, Walls and openings

Mud and adobe were the most common building materials in hot and dry areas (Figure 9). The climatic condition of Yazd have created its own architectural style. The mud and adobe are elements with high thermal resistance and heat capacity, the outer surface of which absorbs the sun's rays. Indigenous materials also made the construction cost of the building more affordable. The surfaces of the buildings were often whitewashed to reduce the heat generated in the walls by sunlight. In the construction of Lariha house, like other historical buildings in the city, local materials such as brick, mud, and adobe have been used (Keshtkaran, 2011).

It is also worth noting that the thickness of the walls should resist long-term sunlight, especially since the external walls are about 1-1.5 meters thick which increases its thermal capacity. Walls facing winter winds, as well as those that are exposed to high levels of radiation, should be thick. All these specifications can be seen in the Lariha house (Figure 12).

To reduce the amount of solar radiation that enters the house, there are no openings on the exterior walls. This was also partly due to cultural and social aspects; as privacy was a major consideration in the house design, there were no windows facing the street or alleyways. The courtyard is visible from every room in the building, and the rooms on the corner are roof-lit. The materials of doors, windows, porches, and horizontal beams inside the roof are made of wood (Memarian, 1999) (figure 11).

the majority of the windows are brilliantly colored in order to diminish direct sunlight into the houseThe colors also prevent mosquitoes from entering the house through openings, which is a common trouble in hot climates (Figure 10).

Figure 9. Traditional wooden window facing the courtyard (Orsi)

Figure 10. Colored window

Figure 11. Adobe

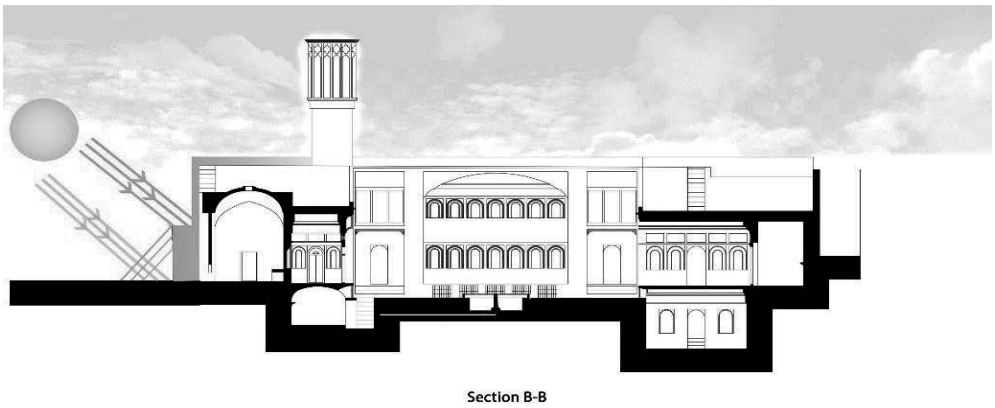

Figure 12. Thick external walls

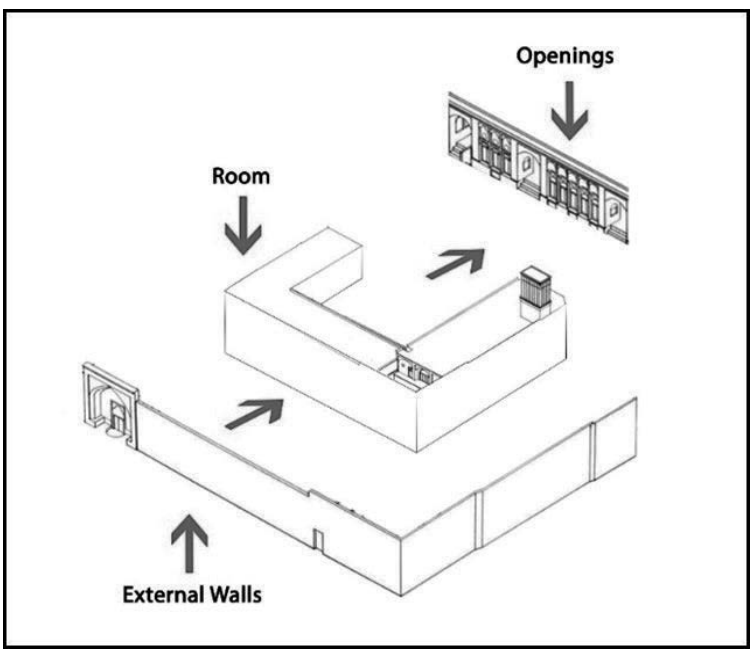

Figure 13. Openings

7.4. Courtyard

The main courtyard is one of the most important parts of Lariha house because its four sides are surrounded by other spaces of the house. The rooms of the house were used seasonally. The halls of this part of the house are large and mirrored and have wooden doors and stained glass, which indicates that the parties were held in this part. The courtyard is rectangular in shape and stretches along the northeast-southwest. The southwestern side of the courtyard is more important than the other side, in the middle of which a tall porch has been built. The location of this porch (eivan) as a semi-open and significant space of the house at the top of the yard has given another effect on the house space. The

northeastern side of the courtyard, unlike this side, has a small and short porch (eivan) in its center and other spaces.

One of the factors that balanced the ambient temperature in summer was the pool in the middle of the yards. The pool of the Lariha house also had the same purpose. In desert cities, water-deficient trees and plants such as pomegranates, grapes, figures, etc. were often planted next to ponds and in gardens in order to provide shade and to compensate for the lack of ambient moisture with the help of ponds. In the past, house ponds were almost always full of water, so at night in this house, the image of a five-door room was reflected on the pond water. In the pond, there is a large wooden bed with a few steps above the ground and the pond. This prevented annoying insects from getting on the bed. In the summer, residents lie on the carpet and spend time on the bed to cool off and enjoy the space (A'zami, Yasrebi, Salehipoor, 2005) (Figure 14). The main and secondary courtyards of the Lariha house are located along the southwest-northeast axis. Having many courtyards was a way for the family to flaunt their riches and added to their social status. The women and female visitors used the secondary courtyard; which was called Andarouni. (Figure 15), and was more secluded. While, the main courtyard was for other male visitors and men; was called Birouni (Figure 16).

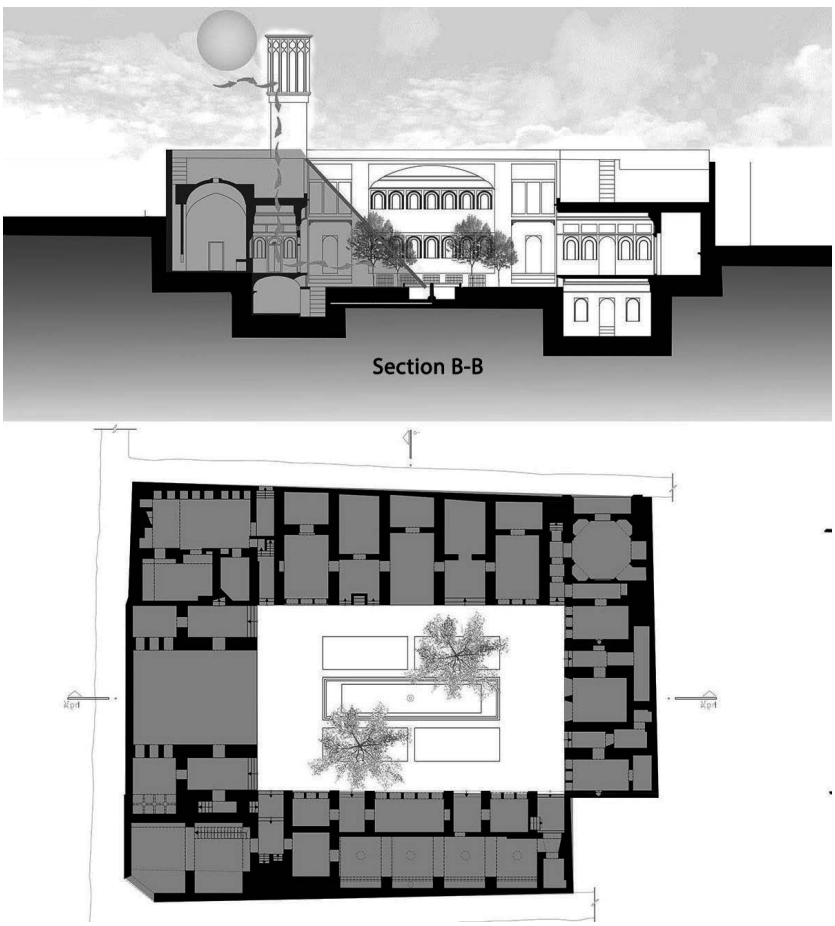

Figure 14. The central courtyard provides a desirable microclimate for inhabitants.

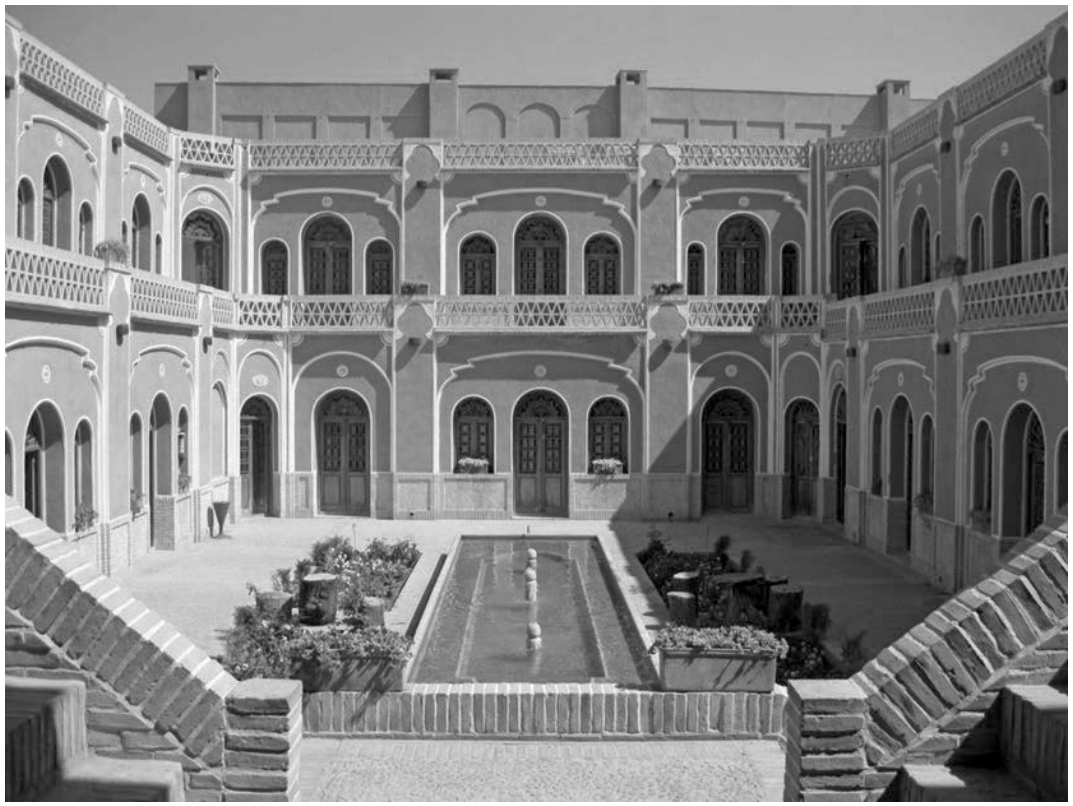

Figure 15. The secendory courtyard was called Andarouni.

Figure 16. The main courtyard was called Birouni.

7.5. Porch (Eivan)

The first thing that can be seen when somebody enters the southern part of Lariha house courtyard, is its very large porch. On hot summer days, residents took refuge in the shade of the porch and spent time there. The height of the porch is very large and its opening is wide. As if, the courtyard has expanded into it and has made a connection between them. The inner bodies of the porch are thick, and it seems that the walls of the yard have continued into the porch. All this makes the porch an important part of the courtyard that overlooks other places and has become a safe space with walls and ceilings. Another element that raises the status of the porch is the rooms and earrings (rooms on both sides of the royal residence). These elements are built around it on two floors, and their doors and windows open into it. The tall windcatcher of the house is located behind the porch, and can be enjoyed watching the grandeur of it from inside the yard (Haghparast, Niroumand, 2007) (Figure 17).

In this part of the house, there is a porch that is taller than the other views and has a wide opening in the center of the southwest front. On the other hand, the contrast between the two facades can be seen in this house. On the northeastern side, there is a five-door room and a seven-door room have been built across the adjacent facade, which beautifies the courtyard. On the northeastern side, five-door and three-door rooms have created arches. On the wall of the east side of the courtyard, frames such as a seven-door room have been carved. The same similarities and repetitions on different sides of the courtyard have made the porch of the southwestern side different from other sides (Bahadori, 1958) (Figure 18).

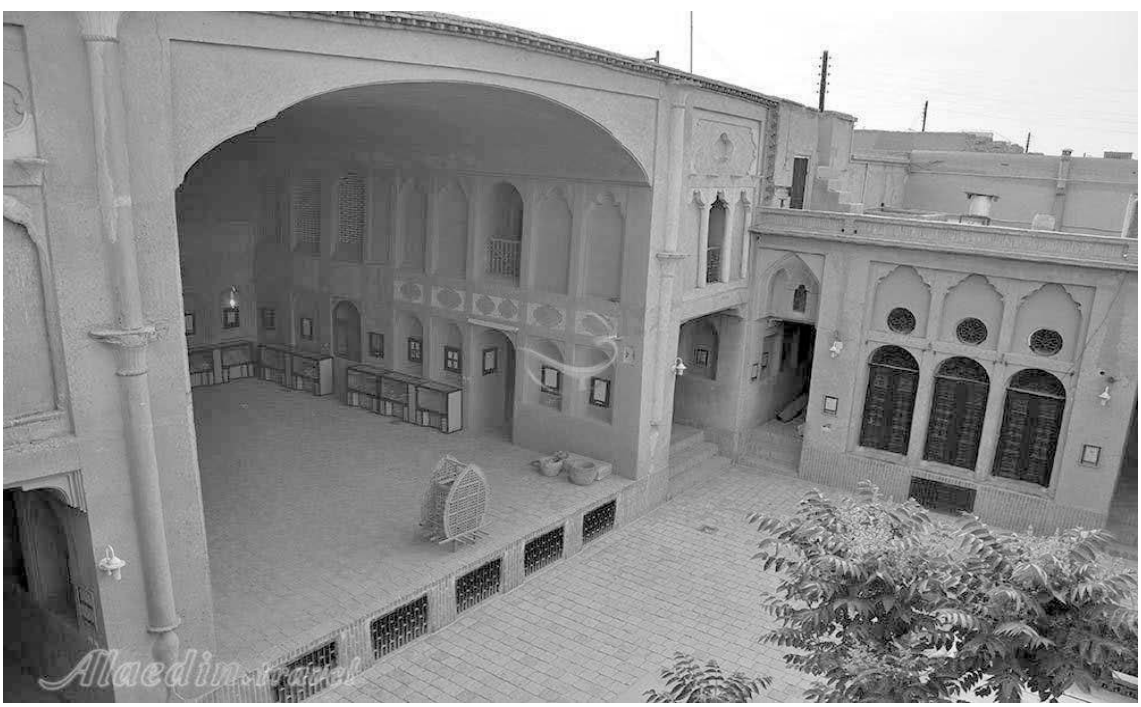

Figure 17. The large porch of the Lariha house

Figure 18. The small porch of the Lariha house

7.6. Wind Catcher

In the historical buildings of Yazd, in order to ventilate the air naturally, there is a tall structure with vents on top of it. This element has been built on top of the building to direct the wind into the interior spaces, which cools the air inside the house. The wind from the wind catchers compensated for the lack of humidity in the house by entering the hall, the house pool, and the basement. Wind catchers made in residential houses, not only is it essential for their main function, but also, showed the social status of the house owner, which was greatly influenced by its height and type of decoration (Ghobadian, 2011) (Figure 19).

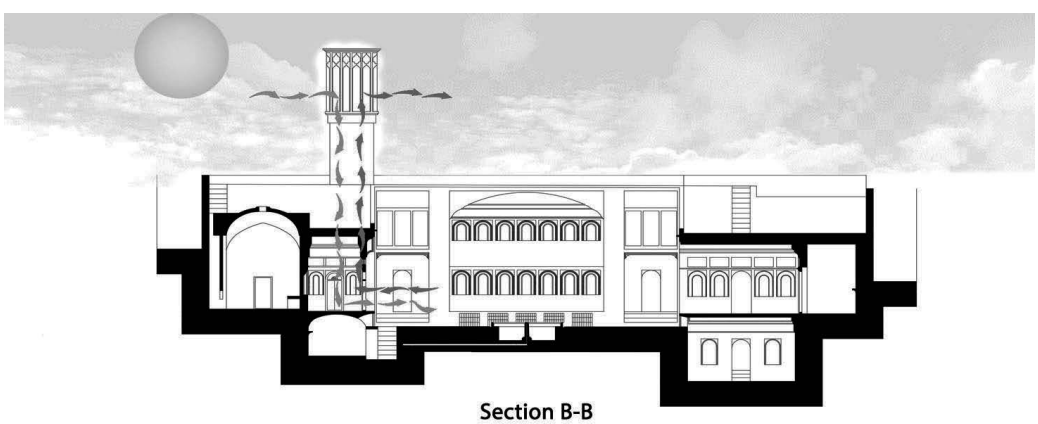

Figure 19. wind catcher system of Lariha house

The main door of the Lariha house is built next to the large porch of the main courtyard. Other smaller wind catchers are built into other parts of the building. The difference between the main wind catcher of this building and the wind catcher of other houses is that instead of being located on the main axis of the courtyard, it was created in the corner of the porch (Figure 20).

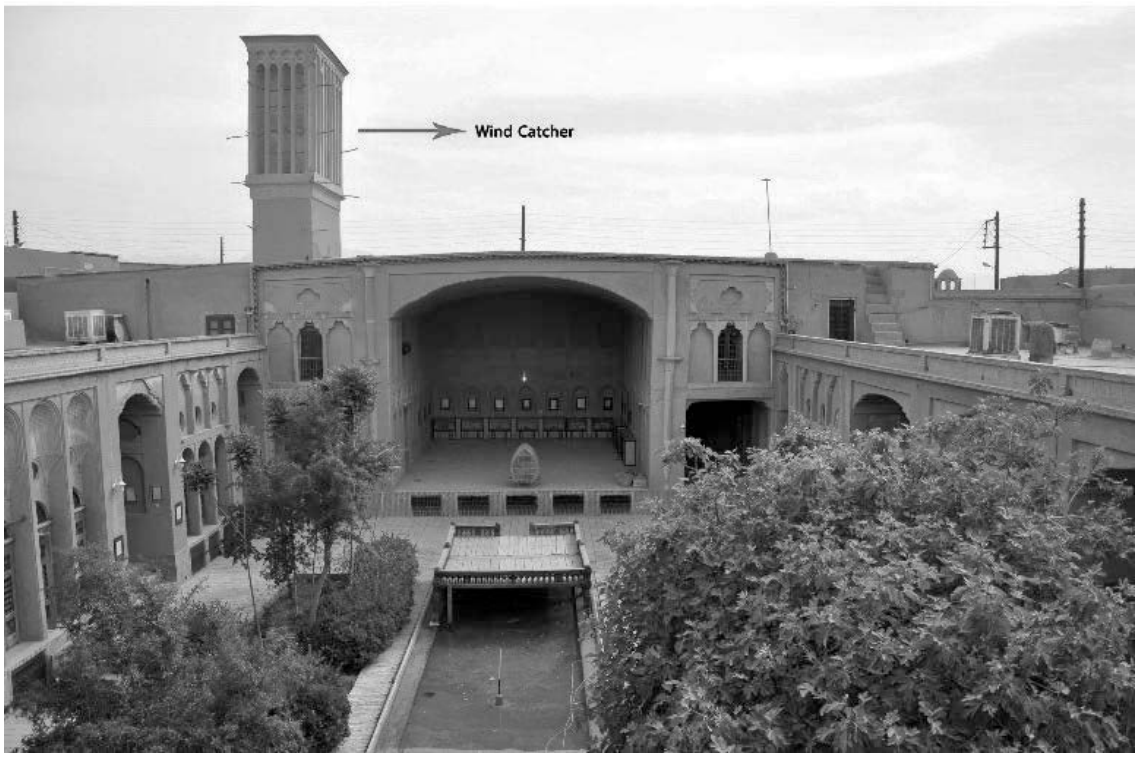

Figure 20. Wind catcher on the roof of Lariha house.

7.7. Sardaab (Water cellar)

Buildings such as reservoirs and underground spaces that are submerged in the ground gradually absorb heat and cold, and thus retain strong daily and annual fluctuations and adjust the air temperature (Eiraji, Akbari Namdar, 2011). The main sardaab of the house is located near the porch of the Lariha house in the large courtyard. Its depth is about 6 meters, and it reached the sardaab by walking 38 steps from the floor of the yard to the basement. This cold space was used to store meat, legumes, and other perishable foods. A smaller sardaab was also built in the western part of the building, which was not used much.

In the Lariha House, sardaabs or barns led to the courtyards through stairs or corridors. In the basement of the house, the spaces are created separately and scattered, and some of them are interconnected in a limited way. These spaces cannot be considered as a separate floor, as if they are part of their upper spaces, which then end up underground (Figure 21)(Figure 22).

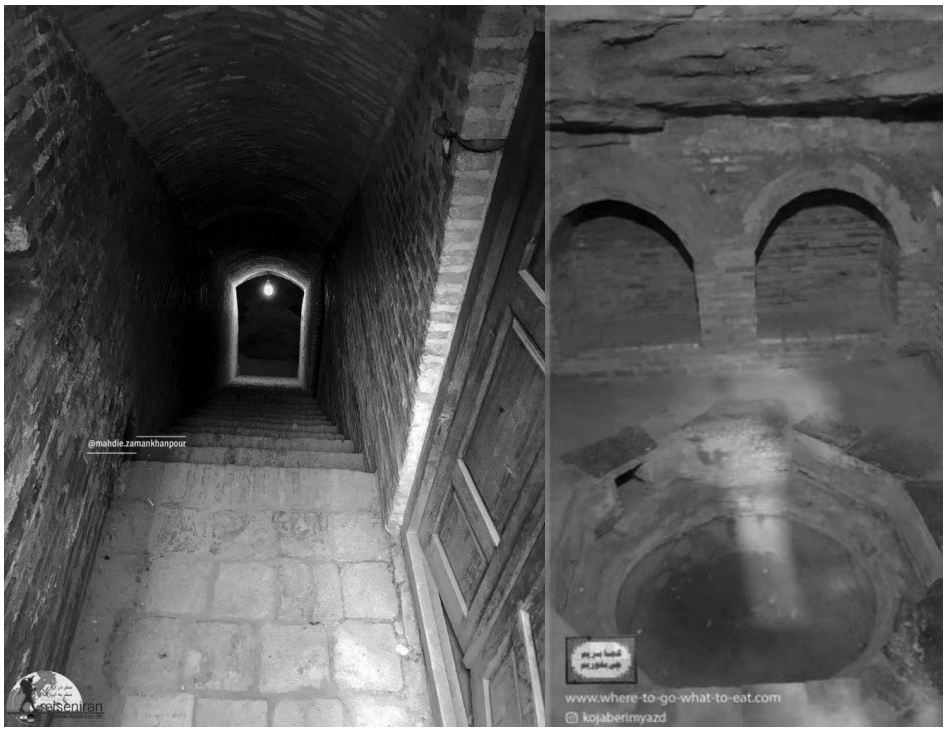

Figure 21. Sardaab (Water cellar) of Lariha houses

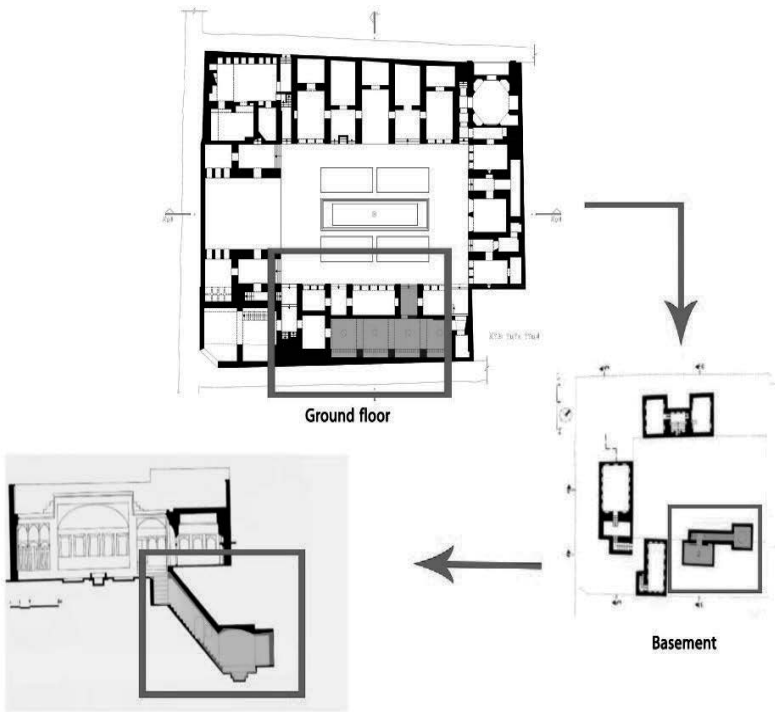

Figure 22. Location of the sardaab (Water cellar) in plan and section

7.8. Princple of Sustainable Architecture and Elements of Lariha House

According to Table 2, the elements of the Lariha house, including introversion, four seasons, wind catcher, house pond, materials, construction, porch, windows, and shades (radiations), with four groups of sustainability elements including construction, energy, consumer and culture of society, environment, and nature, are compatible and coordinated. Thus, it can be concluded that Lariha House has stability in all elements and is considered a stable structure.

Table 2: The degree of compliance of the elements of the Lariha house with the principles of sustainable architecture (Adopted and modified by author)

		ENERGY					CONSTRUCTİON									CONSUMER/CULTURE				ENVIROMENT/NATURE			
		Sustainable site design	Conservation of water resources and its quality	Maximum use of renewable energy	Building energy management	Climatic design	according to the life cycle of the building in the design	Recycled or reused materials	Minimal production of harmful gases by materials	Minimal toxicity of materials	Stability	Frequent renewability of materials	Long life	Local production of materials	Pay attention to native forms	Quality and stability of the building in terms of quality of execution and materials	Safe design for users	Internal environmental quality	Pay attention to the culture and past experiences in construction	Harmony with culture	Perception of ecosystem values and constraints	Do not impose the building on the environment	Avoid producing pollution and waste	Design based on zero carbon production
Main element of Vernacular architecture of Iran	Constraction Materials				✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
	Eivan (Porch)			✓	✓	✓	✓						✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
	WindCatcher		✓	✓	✓	✓	✓						✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
	Sardab	✓	✓	✓	✓	✓	✓						✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
	Four Season House	✓	✓	✓	✓	✓	✓						✓		✓		✓	✓	✓		✓	✓	✓	✓
	Central courtyard	✓	✓	✓	✓	✓	✓						✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Window			✓	✓	✓	✓						✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
	Wall thickness				✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

8. CONCLUSION

Sustainable architecture, as the most important approach known in recent years for all countries seeking to save on non-renewable energy consumption, prevent air pollution, and coexist with climatic conditions, has become one of the most significant measures in architecture and urban planning. While, Iran's past and its vernacular architecture is a clear example of sustainable architecture. This research was created to recount and remind us of the values of traditional Iranian architecture. After many years, rich and prolific architecture still has something to say because it is an example of sustainable architecture and it meets all its needs in relation to the environment and climatic and energy conditions within itself, without occupying the environment or causing pollution to it.

In the current study, the characteristics of traditional architecture in Yazd (with the case study of Lariha house) were studied to point out the relationship between Iranian traditional architecture and optimal use of energy and environmental sustainability. In the study of architectural rules and techniques used in the Lariha house, there are some important elements that can be investigated. The use of materials with a high capacity of heat resistance, the maximum use of solar energy, and the elements such as wind catchers to utilize renewable energy such as wind, water conservation, and the Sardaab to supply the water needed by the building were discussed. The climatic arrangements of the Lariha house are the key elements that show its relation with sustainable architecture. As being located in a dense urban context, proper orientation is according to the climate. The other factors like central courtyard usage, garden pit, basement, and waterfront in the yard, use of summer and winter areas, all indicate the manifestation and compliance of the principles of sustainable architecture in this house. This is the result of examining the principles of sustainable architecture with the rules used in the architecture of Lariha house.

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