

Vernacular houses in Yazd: Natural elements

¹Nafise Afshari Basir, ²Farah Habib, ³Seyed Majid Mofidi Shemirani

¹ Ph.D. candidate, Department of Art and Architecture, Science and Research Branch, Islamic Azad University, Tehran, Iran

² Professor, Department of Art and Architecture, Science and Research Branch, Islamic Azad University, Tehran, Iran

³ Assistant Professor, Department of Art and Architecture, Science and Technology University, Tehran, Iran

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ABSTRACT: Given more than seven thousand years of urbanization and highly diverse topographic and geographical conditions, Iran is one of the treasures through the world's architectural history. Climatic diversity, on the one hand, and long history of living, on the other hand, has led to noteworthy and valuable achievement in architecture and urbanization within this country. However, these elements are less utilized in today architecture. Urban life, technological advances and excessive economical demands have extremely made people apart from the nature and formed their mind within an iterative mechanized order. Furthermore, human being is a part of nature and his/her close relationship to the nature provides him/her with survival and longevity. In Iranian houses, a space indicating relationship between human and nature is courtyard. Central courtyards within vernacular houses in Yazd provided inhabitants with terrific living conditions and enhanced their living quality by utilizing natural elements such as water, wind, light, and plants. Today, due to providing more houses regardless of their quality, not only are natural elements ignored in human life; but also in many cases, buildings do not have essential features of living. This paper attempts to explore how to create and enter natural elements in apartments. This paper aims to investigate natural elements on vernacular houses in Yazd. A descriptive, analytic methodology along with a case study (vernacular houses in Yazd) were employed and data was collected through library and field research.

Keywords: Elements of nature, House, Vernacular houses, Yazd.

INTRODUCTION

In today's world, the excessive population growth of cities and on the other hand, the development of cities without rules as well as industrialization regardless of people's health and welfare in residential spaces make human societies face a crisis. While in recent years, appreciation of nature and its proximity to residential areas have been concerned in most of countries and a great attention has been paid to association between human-made space and its natural context. Attention to natural elements, particularly the nature formed within courtyards next to houses, can improve quality of life and make houses a better space for human growth and sublimity (Zare, et al., 2012, 50). Central courtyards within Iranian vernacular houses provided inhabitants with terrific living conditions and enhanced their living quality by utilizing natural elements such as water, wind, light, and plants. However, today, due to providing more houses regardless of their quality, not only are natural elements ignored in human life; but also in many cases, buildings do not have essential features of living. This paper attempts to explore how to create and enter natural elements in contemporary houses. This paper aims to investigate natural elements on vernacular houses in Yazd (see Fig1). The structure of research is shown below:

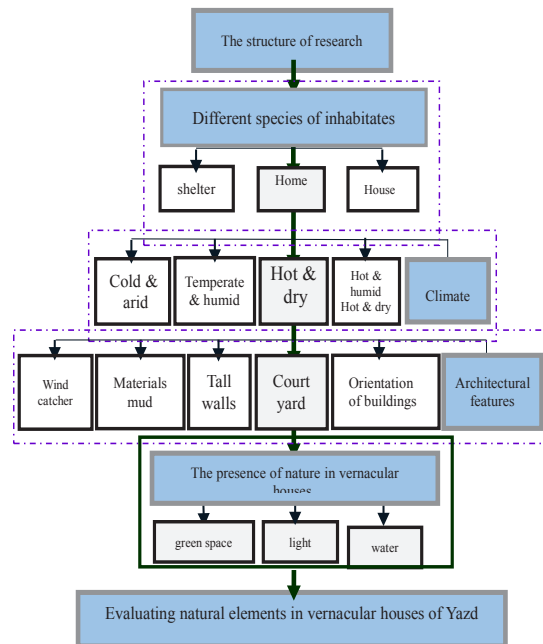


Fig1: The structure of research (source: Author)

*Corresponding Author Email: f.habib@srbiau.ac.ir

MATERIAL AND METHODS

This paper aims to investigate natural elements on vernacular houses in Yazd. A descriptive, analytic methodology along with a case study (vernacular houses in Yazd) were employed and data was collected through library and field research. In this study, 22 vernacular houses in Yazd which including (Golshanhouse, malek house, Motaharian house, Baghizadeh house, Mortazvand house, Arab Mahmoudi house, Motaharyan house, Maserathouse, olumiha house, nazari house, olya house, Arabzade house, baradaran house, AkhavanTabrizi, house, farjami house, Akhavansigari house, Rasoulia house, Arab house, hoshmand house, rohanyan house, fateha house, Arab Kermani house) were examined but because of the limitation on the article pages number inevitably are selected 5 example of how to analyses these houses in each neighborhood and was shown. At the end of the analysis is expressed 22 samples in the form of a table. In this houses, quality of light, water, and green space are evaluated in courtyards of five houses located in Yazd including Golshan house, Malek house, Rasoulia house, Arabzadeh house, and Mortaz house. Ratio of glazing to whole façade, ratio of water area to whole area of courtyard, and ration of gardens area to whole area of courtyard are measured in order to examine quality of light, water and green space, respectively. The House

In regard with origin of the word “khaneh1” stated that the Aryan dug the earth to build a house and called it “kand”. This word gradually transformed to “kad”, “kadeh”, “kaneh”, and then “khane”; that is another form of “khaneh”(Rafizadeh & Ranjbarkermani, 2002, 194). In Moin dictionary, house means: 1. room; 2. settlement, dwelling, place; 3. somewhere to live in, home, shelter. In Dehkhoda dictionary, house means: where people live in, settlement, privacy, shelter, and rest (Dehkhoda, 1955, 193). Gaston Bachelard, a modern science theorist in Europe (new spirit of scientific and instrumental rationality), wrote that “ a house is like a homeland where a hierarchy of different functions related to residing or living at home gets engraved on human mind forever. A house is not only a shelter for days and nights, but also a case which repeatedly gets opened and closed to review our past memories (Hashemi, 1996, 14). Rappaport argued that “mainly, a house is not a structure, but an institution created for very complicated targets. Since a house is a cultural phenomenon, its form and spatial arrangement is intensively affected by culture”) Fig. 2(. Cooper Marcus (1995) evaluated symbolic concept of house via various experiences and examples and remarked that in human’s mind, there was a symbolic relationship between house and himself (Cooper & Sarkissian, 1986) so a house is something more than a dwelling (Hollander, 1993). A house is center of the universe in its inhabitants’ attitude; and within a neighborhood, it performs as the most evident structure in order to stabilize concept of place (Moore, et al., 1974) (Table 1). In fact, a house is a small sample of the universe by which we make ourselves (Norberg-Schulz, 1980). Therefore, organizing spatial principles imply relationship between people as they symbolize human’s general

condition (Tuan, 1977, 56).



Fig. 2: Houses designed in accordance with the climate and culture of each place (source: Armanshahr counselor Engineers, 2009, 46)

Table 1: The viewpoint of philosopher in relation to house

philosopher	The point of view
Rappaport	a house is not a structure, but an institution created for very complicated targets
Cooper Marcus	evaluated symbolic concept of house
Hollander	house is something more than a dwelling
Moore	A house is center of the universe in its inhabitants’ attitude
Norberg-Schulz	a house is a small sample of the universe

Vernacular Houses in Hot and Dry Climate

Vernacular architecture represents a strong relationship between human and nature by smoothing the nature and using natural elements (Alpagonovello, et al., 1990, 60). One of the most evident examples of harmony of human being and nature is vernacular houses in hot and dry areas of Iran. Unique climatic characteristics of hot and dry areas have led to formation of houses based on special principles and development of brilliant techniques such as qanat and wind tower (Dehghan, 2003, 66). In these areas, climatic comfort was supplied via three approaches: utilizing shadow and wind, utilizing water, and reducing impact of solar radiation (Golkar, 2001, 80). In addition, climate is one of the most influential key factors in formation of central courtyard in hot and arid areas cities and vernacular, vernacular architecture of Iran. Given hot and dry weather, solar radiation and particular climatic conditions, cities possess a compact and dense configuration in such areas (Zare, et al., 2012, 53).

Nature

Word of nature is traced to “natura” denoting nativity, which terms of “nation”, “national” and “native” are derived from. Nature and nation have not only same Latin roots, but also same history and they have been always explaining each other. Many countries have indicated nationalization via green space available in their land, like the role of jungles in Sweden or white desert in Canada (Macy & Bonnemasion, 2003).

Natural Elements in Vernacular Houses

In vernacular houses, nature was always presented in terms

of three appearances: primary, secondary, and abstract form. In regard with definition of primary and secondary nature, Spirn declares that “In attitude of authors from Cicero to Marx, primary nature refers to the nature not transformed to secondary nature by human” (Spirn, 2008, 41). In vernacular houses, sky, soil, water, wind and different living figures such as domestic plants and pets all were available in terms of primary nature and they interacted to each other and to human. Considering activities to meet material and functional needs (food, subsistence, temperature adjustment) and mental needs (beauty, helping other creatures to live), human has limitedly and non-destructively transformed primary nature to secondary natural elements like construction materials, farmed plants, etc. Third appearance was abstract nature. In abstraction, nature was represented in terms of a human definition via simplifying, characteristic detachment, and geometrizing shapes. Nature abstraction can be observed throughout vernacular houses in various ranges; from arabesque motifs inspired by plants as patterns on carpets and plasterwork on walls to vaults and domes symbolizing blue sky, from abstract petals of goljam to its round shape which generally visualized a colorful sun on the wall between inside the room and the courtyard. To summarize, a natural element was concerned through three different approaches in the same place and time so that its impacts were emphasized (Table 2) (Daeipour, 2014, 52).

Table 2: Natural elements in vernacular houses

natural elements in vernacular houses	primary	primary nature refers to the nature not transformed to secondary nature by human
	secondary	limitedly and non-destructively transformed primary nature to secondary natural elements
	abstract	In abstraction, nature was represented in terms of a human definition via simplifying, characteristic detachment, and geometrizing shapes

Case Study

Yazd lies at longitude 54 degrees east and latitude 32 degrees north and at an altitude of 1220 meters above sea level. Yazd is located in arid and semi-arid belt of the northern hemisphere. Yazd city lies in a vast and arid valley surrounded by Shirkooh and Kharanq mountain ranges. More than 84.5% of Yazd province area is arid and only less than 16% of its land is not arid. In Yazd, just 23 days a year are precipitated to be rainy; the sun shines 3052 hours on average and there are about 60 non-sunny days a year. According to Koppen’s climatic classification, Yazd is located in hot and dry climate. Unique climatic characteristics of hot and dry areas have led to formation of houses based on special principles and development of brilliant techniques such as qanat and wind tower (Dehghan, 2003). In these areas, climatic comfort was supplied via three approaches: utilizing shadow and wind, utilizing water, and reducing

impact of solar radiation (Fig. 3) (Golkar, 2001).



Fig. 3: Position of Yazd city in map Iran (source: Wikipedia, 2016)

In addition, climate is one of the most influential key factors in formation of central courtyard in hot and arid areas cities and vernacular, vernacular architecture of Iran. Given hot and dry weather, solar radiation and particular climatic conditions, cities possess a compact and dense configuration in such areas) Fig.4 ((Zare, et al., 2012, 53). Climatic impacts have affected formation process of central courtyard by two aspects: first aspect is that orientation of buildings was noticed in order to create better climatic conditions; and second one is that buildings had no specific visual connection and opening to the outside path in such introverted architecture to confront climatic circumstances (ibid,53). In introverted architecture, interior spaces could not be seen from the outside urban space; and if there was an opening, it was embedded above a height to prevent from direct sight (Deilmann, et al., 1987, 46). Main structure of Iranian vernacular houses in hot and arid areas was made of adobe and clay. Thermal characteristics of adobe and clay were one of affective factors in house comfort. Adobe buildings having thick walls act like insulation (Dehghan, 2003, 70). Building orientation was one of important issues in constructing vernacular houses in hot and dry areas of Iran. The orientation was based on quality of solar radiation and wind flows (Pirnia, 1992, 155). Orientation of old houses climatically resulted in logical arrangement of summer and winter rooms around the courtyard. In fact, such building orientation has led to multifunctional interior spaces including summer spaces and winter spaces and it has created an internal migration within the house (Memarian, 1994, 347). A courtyard with small gardens and central pool was another scheme to reduce heat intensity. Courtyard, usually located at a lower level than urban street, acted as temperature adjustment in addition to providing light for rooms. In summer nights when inhabitants were slept on the roof, cool airstream freely flows from flat roof of house through courtyard; and in day hours, the cool airstream preserved on yard floor chilled

the house (Costello, 1992, 40). In vernacular houses, there was a pool of water in the middle of courtyard which absorbed solar energy. In addition to providing purity, shadow and beauty, low water trees compensated for lack of ambient moisture. In other words, entire constituents of vernacular houses helped to create a habitable microclimate for human being. There was a basement in most of houses in hot and arid areas. Associated with wind tower, courtyard, pool and garden, basement was designed in such a way that could provide a quiet and pleasant environment to relax in hot summer of that area. Entrance of basement is better to be opened toward the north; because in addition to enjoying gentle north winds, it would remain safe from intense sun exposure (Dehghan, 2003, 72).



Fig. 4: A plan of houses planes in Yazd (source: Armanshahr counselor Engineers, 2009, 26)

RESULTS AND DISCUSSION

Vernacular architecture represents a strong relationship between human and nature by smoothing the nature and using natural elements (Alpagonovello, et al., 1990). One of the most evident examples of harmony of human being and nature is vernacular houses in hot and dry areas of Iran. In historical houses of Yazd, the house was not separated from nature and there should be some natural representatives inside spatial configuration of house (Haeri, 2008, 184). In this paper, primary natural elements such as water, light, and vegetation are considered. These three elements are of importance because:

Water

Water signifies numerous concepts like light, life, purity, and fluidity. Water played a key role in many ceremonies. The concept of "life inside the courtyard" was suggested in culture of vernacular architecture and the life was realized by water. So the courtyard is a suitable place for mankind to connect with natural elements such as water. In vernacular Iranian architecture, both pool and water are the elements which accentuate sensual quality of such place (Soltanzadeh & Sadatzade, 2013, 4). (Fig. 5)

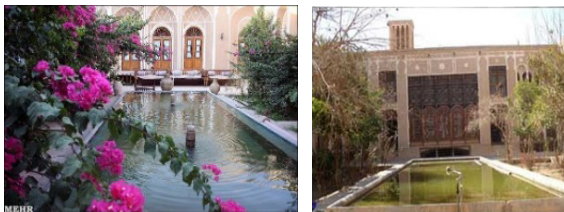


Fig. 5: Water in vernacular houses of Yazd (Source: Hajighasemi, 2004, 68)

Vegetation

Green space and plants are so important in vernacular architecture. In central courtyards, there were some gardens to grow variety of flowers and trees; so that in addition to beauty, ghosting and increasing relative humidity have helped to comfort courtyard space and Natural cooling system are considered of the main elements in this type of houses (Fig. 6). The green space for the following reasons is very impressive in the microclimate surrounding of the building (Mehri, 2013, 3).

- Effective reduction of direct solar radiation and reflection;
- Shading roofs, walls, windows, and courtyard space;
- Decrease in dust around the building;
- Decrease in temperature around the building;
- Improving humidity in arid climates;
- Conducting wind flow and increasing its speed into desired direction.

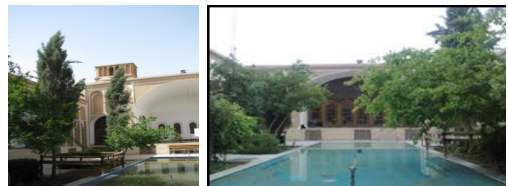


Fig. 6: Green space in vernacular houses of Yazd (source: Hajighasemi, 2004, 72)

Light

As a key element in architecture of houses, light has been a leading factor in architecture of buildings and even cities. In Iranian vernacular architecture, light has been concerned as main element along with other features (Fig. 7). Light is employed via protective components such as portico, tabeshband², sunshade, sabat³, jamkhaneh⁴, rozan⁵, roshandan⁶, and shabak⁷ (Gholami, 2001, 3).

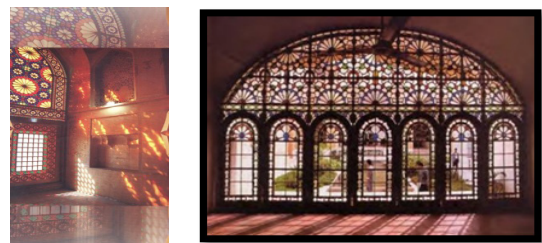


Fig. 7: light in vernacular houses of Yazd (source: Hajighasemi, 2004, 56)

Evaluating Natural Elements in Houses of Yazd

In this section, quality of light, water, and green space are evaluated in courtyards of several houses located in Yazd including Golshan house, Malek house, Rasoulilian house, Arabzadeh house, and Mortaz house. Ratio of glazing to whole façade, ratio of water area to whole area of courtyard, and ration of gardens area to whole area of courtyard are measured in order to examine quality of light, water and green space, respectively.

Golshan House

The house is located next to Golshan water reservoir, butchers gate alley, 10th Farvardin Street, Tal neighborhood. The building dates back to Qajar dynasty (about 126 years ago). The house was belonged to Haj Ali Akbar Mahalli Tali; and since he devoted the house to his daughter, Bibi Fatima, and her husband, Haj Hossein Golshan, it has been known as Gulshan house. The house possesses three courtyards and various roofed and semi-open spaces, two entrances, and several supplementary spaces. East and west courtyards and large open spaces of the complex are important parts of the house. Both rectangular courtyards are established approximately on north east-south west direction. West yard is larger than east courtyard and it is connected to main entrance of the house. Second entrance, located in southwest of the complex, is connected to main courtyards by corridors. Third courtyard, a beautiful part of the house, is smaller. This courtyard is located in northeast corner of larger courtyard, which had a small entrance. In larger courtyard, there is a semi-open space in the middle of each northwest, southwest, and southeast facade; and there are two eyvans in east courtyard: one on southwest facade and the other in the middle of southeast facade. In third courtyard, whole southeast facade and most part of northeast facade are dedicated to eyvans. Excluding basements, most spaces of the house are one-story; except southwest parts of two larger courtyards where there are high eyvan on both sides and two subsidiary chambers⁸ on second floor. So these two facades are higher than the others and that is why shadowed facades of these two courtyards are different from other facades (Hajighasemi, 2004). According to the calculations, ratio of windows area to whole area of facade is 15% for north facade and 25% for south facade. Windows constitute 15% of whole area of west facade. About 26% of west courtyard area is dedicated to a pool of water. Approximately, 17% of east courtyard and 16% of small courtyard is dedicated to pool of water. Around 13% of west courtyard is dedicated to green space; this value is about 17% for east courtyard while that amounts to 4% in small courtyard (Fig 8).

Malek House

This building is located next to Chehel-Mehrab mosque in the Fahadan neighborhood. This house is a tremendous complex extending over northwest-southeast direction. A roofed path passes through the complex which divides it into two parts. Smaller part is located in northwest of the complex and it consists of a courtyard in the middle and two roofed spaces on either side. This courtyard and its surrounding spaces are secondary parts of the complex. Larger part is in southeast of the path and it has three courtyards. Located at the center, main large courtyard has a rectangular plan and the most important spaces of the house are organized around it. In the southeast of this part, there is a beautiful courtyard based on an octagonal plan. There is a hall between this courtyard and the larger one, which is connected to smaller courtyard on one side and to the

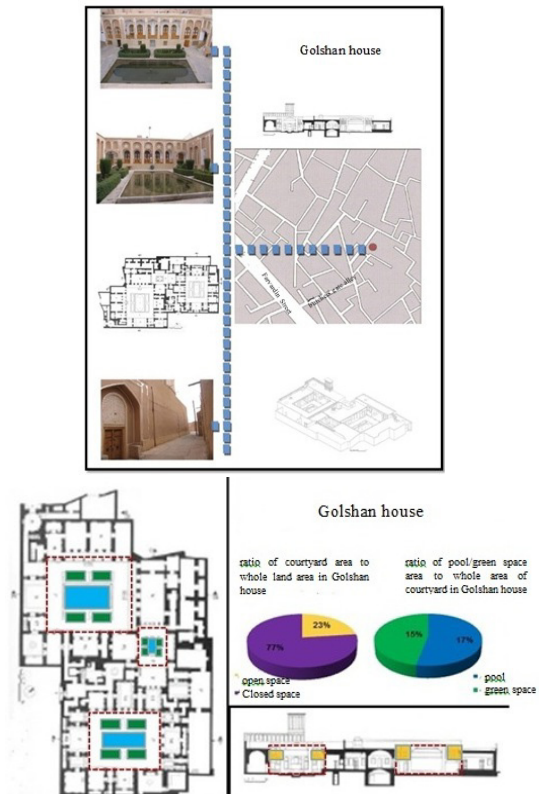


Fig 8: Analyses of Golshan house (source: Author)

larger one on another side. In north corner of the house, there is another small, square courtyard surrounded by supplementary spaces. The house has two entrances, one in northeast and another one in east part. Similar to other vernacular houses of Yazd, there is an vestibule behind the entrance which connects to main and subsidiary courtyards, basement or other parts through corridors. Main courtyard and octagonal courtyard are the most considerable spaces of the house; so this highlights their importance. Another point is that there is a five-door room on one side of main courtyard and a three-door room on the opposite side; while the tripartite facade has got a similar layout to five-door facade due to niches on either side and repeated pointed arches over them. There are eyvans on other two sides. The most significant space of the entire complex is a hall located between two main courtyards. Cross-shaped plan of hall has created alcoves on each side. The alcoves and domed roof have turned the hall into a perfect, centripetal and independent space (Hajighasemi, 2004). According to measurements based on available data and code map, windows constitute 26% of the whole southwest facade in the house. About 17% of the entire courtyard is dedicated to gardens and about 16% of the entire courtyard area is occupied by pool (Fig. 9).

Rasoulia House

Rasoulia house is located in Sahl-ibn-Ali neighborhood of Yazd and consists of two distinct external and internal parts.

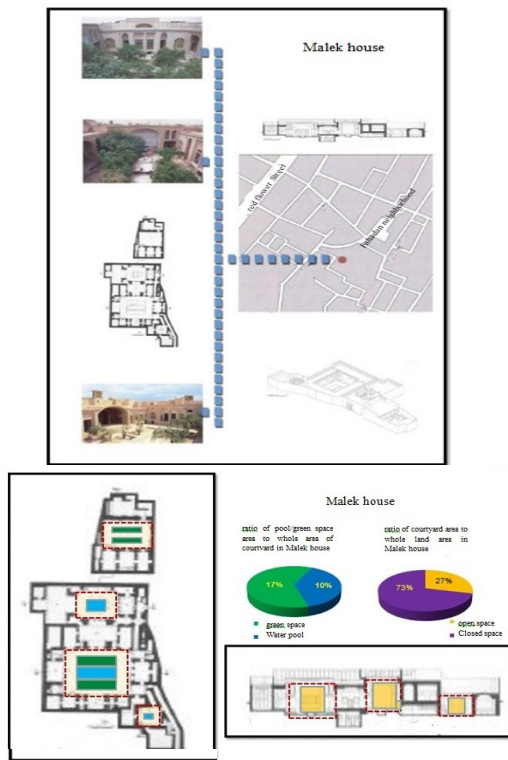


Fig. 9: Analyses of Malek house (source: Author)

Main spaces of external part include a large sash-room with colored pieces of glass, a hoz-khaneh, a hall, a basement and a wind tower. Inner courtyard is entirely private part of the house and includes three-door chambers, five-door chambers, sashes, a hall, a pavilion and a wind tower all organized around a large vegetated courtyard with a pool in the middle. Basements and a qanat are beneath the rooms, the hall and pavilion. Rasouljan house has a vernacular bath located between the inner and outer courtyards. In 1989, this house was devoted to Yazd University. Today, the house is used as Faculty of Architecture, Yazd University (Hajjighasemi, 2004). In this building, 25% of each façade is dedicated to windows and 16% of west courtyard and 26% of west courtyard is made up of pool. 13% of courtyard area is allocated to gardens (Fig. 10).

Arabzadeh House

This house dates back to Qajar dynasty and is located in Fahadan historical neighborhood. Its entrance is embedded in southeast part of the complex, which is connected to a vestibule named “karbas” by Yazdian people. There is a way to access the roof on left side of karbas and stables are placed beneath it. Karnas is connected to the courtyard on right side. A plasterwork based on rasmi-bandi⁹ method can be observed above the karbas in which there is skylight to supply light for entrance space. The courtyard is organized in a south-north direction and there is a big pool in the middle of it. Five-door and three-door rooms are connected to entrance hall. Guest rooms above five-door rooms and the basement make this

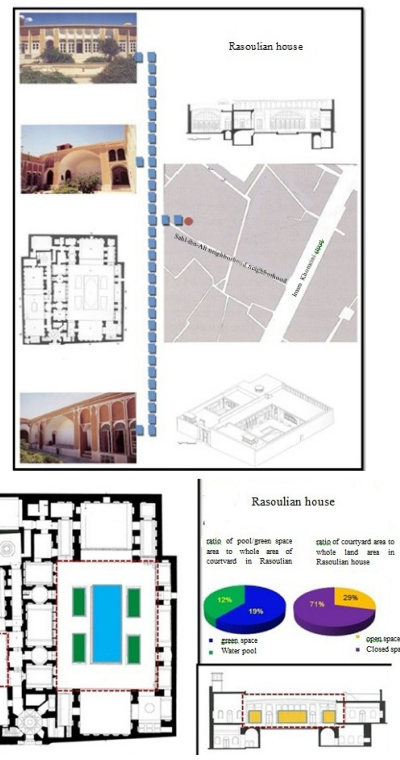


Fig. 10: Analyses of Rasouljan house (source: Author)

house more beautiful and spread. This house is now used as museum of coins and anthropology. It is known as Heidarzadeh museum of coins and anthropology due to objects devoted by him (Hajjighasemi, 2004). In this house, windows make up 25% of northwest façade and 26% of northeast façade. Around 15% of the courtyard is allocated for pool and 26% for gardens (Fig. 11).

Mortaz House

Mortaz house is located on Mortaziun Street in Yazd. This house was built by Ali Shirazi in the late Qajar dynasty. The house was recently devoted to Faculty of Architecture and Urban Studies, Yazd University; and it is now used by Department of Urban Studies. The house is 1526 m² and consists of basement, ground floor, and first floor. The building has two main parts; larger part was utilized for private spaces and smaller one was used for general spaces. (Hajjighasemi, 2004). In this house, 36% -about one third- of whole land is allocated to courtyard. Windows make up around 28% of all facades; and pool and gardens account for 15% and 16% of whole courtyard area, respectively (Fig. 12).

Given analyses based on investigation of light, water, and green space in courtyards of houses in Yazd, it was found that these buildings are designed totally associated with nature. Utilizing vernacular natural elements as well as nuances of implementation indicate a complete compatibility of this architecture with its surrounding nature. The results of investigations on vernacular houses of Yazd showed that

about one third of area of houses is allocated for courtyards and also about 15-25% of each wall is made up of windows, about 10-15% of courtyards is made up of gardens, and around 5-10% of courtyards is allocated for pool; and all these results are listed in the table below)Table 1(. Therefore, these three elements have been employed in all houses of Yazd and results of the study can be considered in design of modern houses. It should be noted that the values cited in the table are calculated by $\pm 2\%$ error. For example, in the range of 15-20%, figures 23% and 24% are calculated 25% and figures 21% and 22% are calculated 20%.

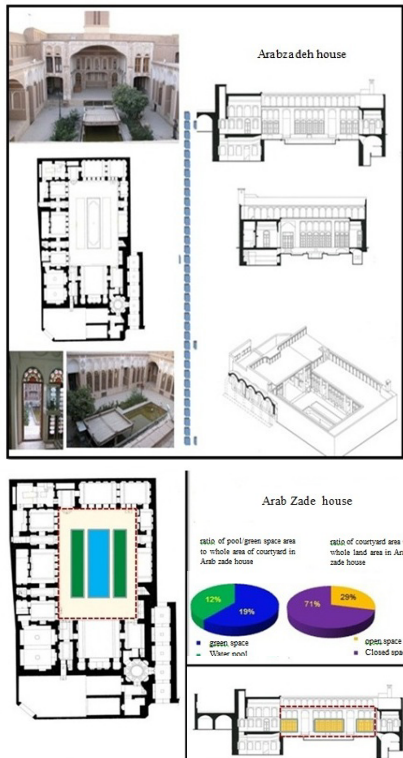


Fig. 11: Analyses of Arabzadeh house (source: Author)

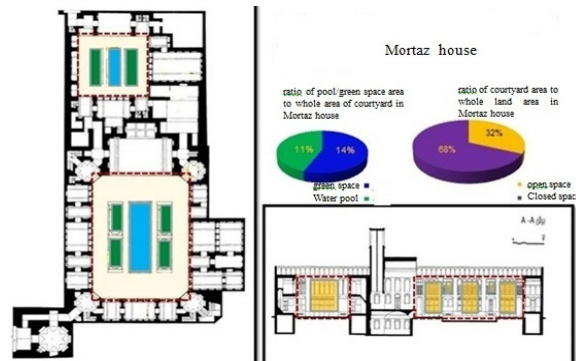
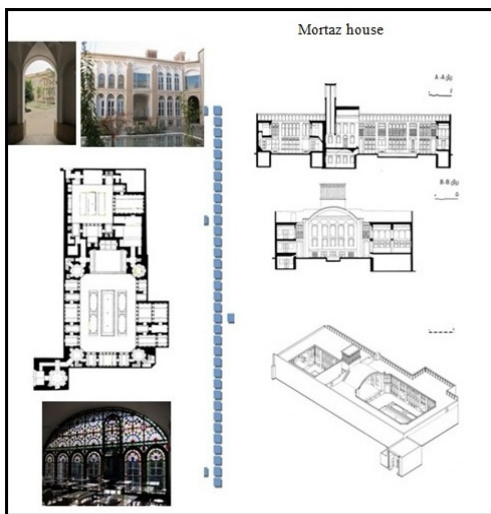


Fig. 12: Analyses of Mortaz house (source: Author)

Table 1: ratio of pool area and green space area to whole area of courtyard and ratio of window area to facade area (%) (source: author)

name of building	number of courtyards	ratio of courtyard area to whole land area (%)	ratio of pool area to whole area of courtyard (%)	ratio of green space area to whole area of courtyard (%)	ratio of window area to facade area (%)
Golshan house	3	25%	15%	15%	20%
Malek house	4	25%	10%	15%	20%
Mortaz house	2	30%	15%	10%	25%
Arabzadeh house	2	30%	15%	20%	20%
Rasoulia house	2	30%	20%	10%	25%

CONCLUSION

In general, it can be declared that it is necessary to employ environmental psychology in design of residential buildings. This knowledge will not only help us in physical design, but also will guide us in conceptual and functional design. Today, design of various forms of built environment rely on planners' and particularly residents' knowledge rather than their feelings and attitudes. However, perception and needs of people supposed to be living in such dwellings are ignored. While designers' knowledge about expertise directly and indirectly useful for professional design makes it possible to propose designs better adapted to the user's needs, styles, cultures and climate; and subsequently, the environments designed by them would meet human demands. Nevertheless, familiarity with environmental psychology plays a key role along with other behavioral sciences. Because by understanding human's perception of the environment and particularly the nature and natural elements such as water, light and vegetation, this science helps designers to design spaces based on their needs. Undoubtedly, natural elements examined in this paper have a deep influence on the human psyche so that many problems in which today's

Iranian society, particularly large cities, are involved can be solved through utilizing the elements in design of dwellings and inspiration from Iranian vernacular houses along with learning perceptual and behavioral sciences. While in ancestral residential spaces in this country, concept of house referred not only to a place for meeting primary demands, but also a space where mankind found its individual identity; houses built by skilled Iranian architects in accordance with vernacular design principles based on climate specific to each region. Obvious examples of such houses are located in hot and arid climate of Iran; houses which were designed according to residents' needs in regard with social, cultural, economic, environmental, and climatic aspects. Such houses responded to mental and physical human needs through pleasing courtyards and sunken courtyards, pool of water and short and high wind towers by means of wind, water and solar energy. Natural elements like water, plants and green space, and efficient light not only responded to human requirements but also affected them psychologically. Such worthwhile elements, provided residents with mental peace, are totally eliminated and forgotten in today's dwellings called houses, whose their target is just providing a shelter. Elimination of these elements has led not only to failure in physical connection between man and nature but also to mental and emotional turmoil.

ENDNOTES

1. Persian word which means house or home
2. Some kind of horizontal sunshade around windows in Iranian architecture
3. A roofed vaulted path to provide shadow in Iranian architecture
4. Some kind of opening used above domes and vaulted roofs in Iranian architecture
5. Some kind of small window in Iranian architecture
6. Some kind of niche inside the wall to provide light in Iranian architecture
7. Some kind of grid curtain in Iranian architecture
8. Known as "goushvareh" in Iranian architecture
9. Some method of plasterwork based on intersection of arches

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