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IJAPAS

International Journal of Applied Arts Studies

IJAPAS 6(4) (2021) 31–44

Study and Analysis the Effect of Pond House in the Structural Formation of Houses in Hot and Dry Climate in Iran

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Received 06 January 2022; accepted 14 February 2022

Research Article

Abstract

Residential houses in the hot and dry climate of Iran are among the valuable and important buildings of this land. Recognition of the shape and physical structure of the hot and dry climates of Iran will not only preserve and restore this precious achievement in the past historical periods of Iran, it will also play an important and useful role in identifying the hidden features and potentials of this building.

The present study intends to identify the structural features of the pond in relation to other spaces of residential buildings, to study and analyze how and to what extent the pond is effective in forming the structure of residential houses in the hot and dry climate of Iran. In this regard, the researcher first extracts repetitive morphological features in the pool house space and its effect on the emergence of residential house plans from among ten samples of residential houses with basins that have been randomly selected from the samples of the existing statistical population. In this research, the research method is comparative, historical and interpretive, which have been interpreted inferentially. The tools used in this research include collecting research findings through library and field studies and interviews with experts and masters. The results show that although according to the climatic model, the physical structure of most residential buildings in the

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This article is taken from the doctoral dissertation of Abazar Mehrali entitled "The role of pond house in the spatial design of historic buildings in hot and dry climate of Iran" under the guidance of Dr. Hossein Soltanzadeh and advisor Dr. Kaveh Bazrafkan in the Faculty of Architecture and Urban Design, Islamic Azad University, Emeritus Branch.

hot and dry climate of Iran has a dominant north-south axis, but the location of the pool house is always along the dominant axis of the house; Even in cases where the main extension and the dominant axis of the house in this climate is defined as east-west.

Keywords: Pond House; Introverted Houses; Desert Housing; Climate and Housing

1. Introduction

The foundations of Iranian architecture are derived from nature and its power (light, water, wind and soil) and are strongly textual and contextual. The problem faced by the designers of new buildings is the relationship between the building and the natural environment. Therefore, a current of thought should be chosen that does not reject traditional technologies and new scientific methods in industry like traditionalists, does not criticize all concepts of traditional architecture as modernists, and does not favor moderate groups towards an eclectic architecture. Take a step. A stream of thought should be chosen in which something is not valued and important because it is modern or because it belongs to the past architecture, but it is the correctness and rigidity of design principles that are in the center of attention (Shahin and Takapumanesh Baqaei, 2006).

The structure of housing has always been evolving and evolving throughout history and has been influenced by thousands of environmental, social, economic, psychological and cultural phenomena and factors. Housing created in the direction of a complex set of purposes is not just a physical structure, but a comprehensive phenomenon and need that has found different meanings in different times, places and environments. Utilizing natural potentials to meet needs such as heat, cold and air conditioning to create human comfort in a residential space has been considered by architects for many years and the most important principles of residential architecture design are based on this. "Pool house" is one of the manifestations of peaceful coexistence of man with the dry nature of the desert in residential houses in Iran, which is based on climatic principles and rules. The research considers the role and position of this space in relation to other parts of residential houses in the hot and dry climate of Iran. The research question is based on the structural characteristics, ponds are divided into how many categories? 2) How does the pool house space affect the formation of the structure of residential houses in the hot and dry climate of Iran?

2. Research Background

The studies that have been done in this field are: A number of introverted residential houses have been typified (Memarian, 1993 and 2013; Ghasemi Sichani and Memarian, 2008; Pirnia, 1993 and 2013; Hairi Mazandarani, 2009); Some have also considered the extroverted residential houses (Memarian, 1997; Khakpour, Ansari and Tahernian, 2010); Some physical structures and components and the way spatial organization have been evaluated in residential houses in different regions of Iran (Ghezelbash and Abolzia, 1985; Pirnia, 1993 and 2013; Sultanzadeh, 1993; Sartipi, 2005; Eskandari, 2011); Some archaeological perspectives have studied Iranian residential houses (Malek Shahmirzadi, 1986) and some have made philosophical and spiritual evaluation of Iranian residential houses (Ardalan and Bakhtiar, 2001; Noghrekar 2008).

A study has also studied the role of the mansion pool house in the desert region of Yazd and convergence with the principles of sustainable architecture (Redai, 2014). Research has been done in the field of materials used in the formation of residential houses in Iran (Ghobadian, 2006;

Bozorgmehri, 1999). Also, research has been done on the developments taken place in traditional houses, especially in the Pahlavi and Qajar period (Qelichkhani, Etesam and Mokhtabadi, 2012).

Studies have also been done on the historical houses of Mashhad based on the components such as entrance, porch, corridor, courtyard and type of decorations in which the houses have been divided into three general categories (Farahbakhsh, Hanachi and Ghanaei, 2017). In Khakpour, Ansari and Tahernian (2010) research, traditional texture houses of Rasht have been identified. This article has been defined based on the orientation of the building and physical elements. Gorgan houses have also been evaluated in a study in terms of developments in the Qajar period. The results of this study indicate that architectural developments in the Qajar period in Gorgan have been formed based on extraversion and increasing interaction with the environment (Qelichkhani, Etesam and Mokhtabadi, 2012).

Based on the research, in this article, the author has made an attempt to study the effect of the pool house in the formation of the pool house by correctly recognizing the components of houses located in hot and dry climates of Iran and also identifying accurately the structure and body of the pool house space. Therefore, the research method in this article is different from the mentioned research methods and will be done comparatively, historically and interpretively. In this study, first, the plan of a number of houses with pool houses has been studied, then, based on the selected samples from the statistical population, the pool house space in relation to adjacent spaces will be evaluated. Finally, based on the comparison between the classification made in the houses with basins, the results of the research will be extracted.

3. Theoretical Foundations

3.1. Residential House

The house is one of the most important topics in architecture which is less addressed. Unfortunately, this topic has not been studied in architecture schools. The need for a house is very much felt at this time and this need must be met by recognizing the architecture of the past and adapting it to contemporary architecture. The word house, which is a term today, used to refer to a room in the past.

From the economic point of view, a house is a kind of "commodity", from an artistic point of view, a "symbol", from a sociological point of view, an "institution", from an engineering and architectural point of view, a "building", from an urban point of view, a "space" and from an anthropological point of view, is a "culture" which includes all the mentioned dimensions. Understanding the house and its place in the system of social relations between people and society is also possible by considering all the symbolic, institutional, material and aesthetic aspects of the house or the "culture house" (Fazeli, 2008).

House is a broad and complex concept with different dimensions and components that in different cultures and societies cannot provide a comprehensive and complete definition. Professor Pirnia believes that the house is a place where the residents do not feel uncomfortable, the inside of the house is a place where family member live and they should not feel tired.

In the search to find the definition of a house cannot be a comprehensive definition for it, in general we can say: "Of all the architectural functions, the house is the most immediate and important space related to man and is the first space in which concepts such as spatial quality and spatial belonging are experienced" (Farhadi, 2014).

Home is a place where one achieves complete peace and belonging. Peace is not simply a matter of physical comfort for the individual and family and a sense of security in the face of external

threats. In addition, it results from the inner peace that pervades family members and the relationships between them. The home is a place to rest, reflection, and processing the environmental experiences. Home is a place to be alone with yourself and find yourself. The quiet interior of the house should also be manifested in its appearance (Pakzad, 2007).

Crystalline state and regular geometric design of each traditional house space, pair and geometric construction of these crystal units around the yard based on environmental considerations and observance of very public to very private areas that make up the whole house. To classify these crystals, which are located in the layers of light and darkness while maintaining the hierarchy relative to the courtyard, we define each:

Courtyard: The central core is a space with a geometric order, introspective, independent, axial and central, open to the sky.

Room: It is a space with a geometric order and relies on the courtyard. Although the room is an independent space in itself, which is justified by a geometric foundation, but from one side it depends on light, water, air and plants in the courtyard. Thus, the room is defined as a dependent geometric space.

Hall and windcatcher: Congregational room and religious ceremonies, summer residence.

Three doors: study, bedroom, fasting, lunch and fall and winter living.

Five doors: family gathering, party, family dining room, spring and autumn and winter.

Arsi: party, dining room, congregation of elders, payer and winter residence.

Tanabi: Sleep, rest (room located between the windcatcher room), summer residence (Ghezelbash and Abolzia, 1985).

3.2. Hot and Dry Climate

Hot and dry climate is a major part of our country, the main features are:

a) Hot and dry weather in summer and cold and dry in winter.

b) Rainfall and very low humidity (less rainfall than annual evaporation).

c) Very low vegetation and there is a shortage of wood in this area.

d) The temperature difference between day and night temperatures is very high (Akhtarkavan, 2012).

Winds with dust, due to low humidity and distance from the sea, the difference in air temperature during the day and night is high. In these areas, temperature fluctuations in the region are very high and the amount of humidity is less than human comfort. Also, the sun and its heat in summer create a hot and scorching environment, and the dusty winds of the desert, which flows many days of the year, which are disturbing to comfort. Therefore, by creating a central courtyard in the middle of the building and installing a water pond and constructing a garden, increases the humidity in the living space of the building and brick walls that are built with relatively high thickness in terms of bearing the heavy load of arches and domes. Like a thermal condenser, they reduce temperature fluctuations during the day and night, and finally by placing all the openings in a relatively humid and temperate space of the courtyard and blocking the outer wall of the building (except at the entrance). The connection between indoor and outdoor space has been cut off as much as possible and a small and suitable climate for human comfort has been established in the hot and dry climate of the region (Ghobadian, 2006).

3.3. Pool House

The pool house is an indoor space in which the pool is located and around it there are rooms on four or three sides (Sultanzadeh, 2017). The pool house is an indoor space with a pool in the middle, which is usually high and receives light from the ceiling (Haji Ghasemi, 2004). The pool house is a small porch located at the end of the summer rooms of each mansion. A spatial link between the courtyard and the summer rooms. In the middle of this space, a small pond has been built, which is usually octagonal in shape, and the reason for naming it is due to the existence of this pond in the middle of this space. In some pool houses, by constructing a high windcatcher at the back of the building, cool air enters the interior of the pool house (Mahmoudi, 2009).

Innovation and construction of ponds in hot and dry areas due to the relief from the intensity of drought and heat in summer and the result of the initiative of local experts (Aminian, 1999). There is a space called the pool house; this space is a room, porch and basement in which there is a reservoir (Rafiei Sarshaki, Rafizadeh and Ranjbar Kermani, 2004). In the mansion of Iranian gardens, by establishing a pond under the dome, features such as: coolness, humidity and reflection of various images are created. This space is called "pond house" (Haeri Mazandarani, 2009).

4. Research Method

In this research, the research method is comparative, historical and interpretive. First, several residential houses were extracted from the statistical population (pond houses with hot and dry climate of Iran) and harvested using field studies. Then, considering the structural features and the arrangement of the spaces around the pool house, they were studied and analyzed. At the end, ten houses from the entire statistical population were selected as the study sample. The selection of samples was done using written documents and the researcher's efforts were focused on selecting samples that can be generalized to the entire statistical population. The limitations studied in this study were the impossibility of access to many residential spaces with pool houses, which were often privately owned and some people lived in them. Also, many of these spaces could not be evaluated and analyzed by the researcher due to being abandoned and destroyed over time. In some cases, with the permission of relevant organizations and centers, it was possible to collect information and collect the building.

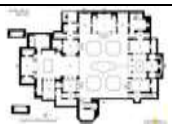
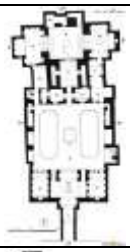
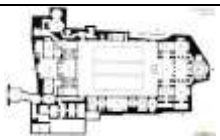
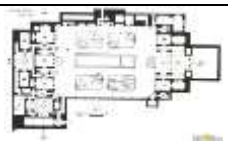
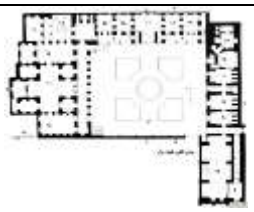
5. Research Findings

5.1. Introducing the Studied Residential Houses

Although the passage of time makes a change in needs and concepts inevitable, but some human needs, which are related to his psychological and personal characteristics, have the basis of stability and over time may formally change (Architects, 2006). The pool house is an example of the indigenous architecture of hot and dry areas, which shows the customs, spirit and feelings, thoughts and ideas, tastes and art of the people. Functional and spatial diversity, spaces such as pool house, three doors, etc. were tailored to the needs of the family and the use of each space at different times (Einifar, 2005). According to studies conducted in hot and dry climates of Iran, in addition to creating a pleasant environment in summer, the pool house can play the role of dividing the space in the summer so that all summer spaces have access to it. Considering the needs of users with regard to the need for privacy and security, considering the human scale and dimensions and dimensions of human beings in the design and formation of spaces based on cultural characteristics, social and behavioral patterns of desert people flexibility in building design in order to increase its

life and reduce the need to create new spaces, paying attention to the semantic features of nature in design in order to make the environment meaningful, optimizing energy consumption and maximizing the use of various forms of renewable energy to adjust the temperature and increase the desirability of environmental conditions are among the cases in which desert architects have tried to meet the needs of residents by creating indigenous elements such as ponds. In the Table 1, the names of ten residential houses in the hot and dry climate of Iran, which have been selected as samples for conducting the research process, along with the plan and the photo related to it, are mentioned (Table 1).

Table 1 Introduction of the studied residential houses

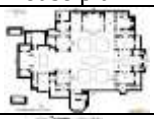
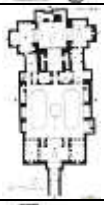
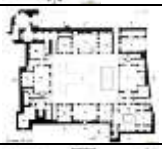
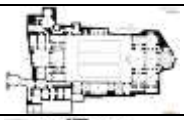
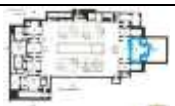
House	Plan	Image	House name	Plan	Image
Sajjadi House			Dehdashti House		
Bakuchi House			Sharifian House		
Masurmaleki house			Bani Kazemi House		
Karimi House			Labaf House		
Charmi House			Sheikh Harandi House		

5.2. Location of the Pool House in the Studied Samples

By reviewing Table 1, it can be seen that all the samples are introverted houses located in the hot and dry climate of Iran, which is equipped with a pool house, but the way the pool house is located

in their plan is different from each other. The Table 2, shows the location of the basin space in relation to the whole structure of the relevant residential house plan (Table 2).

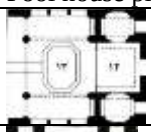
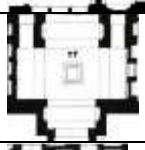
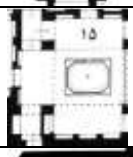
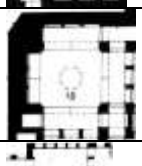
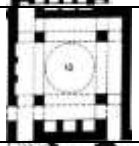
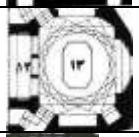
Table 2 Location of the pond house and introduction of the front of the pond house in the plan.

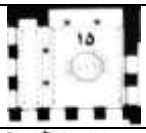
House	City	House plan	Pool house location	Pool house direction
Sajadi	Kashan			South
Bakuchi	Kashan			South
Masurmaleki	Isfahan			Southeast
Karimi	Isfahan			North West
Charmi	Isfahan			North East
Dehdashti	Isfahan			South West
Sharifian	Kashan			South
Bani Kazemi	Kashan			South
Labaf	Isfahan			North East
Sheikh Harandi	Isfahan			North East

5.3. Investigation of the Morphological Characteristics of the Pool House Space in the Studied Samples

With a reflection on the plans of the studied residential houses, it can be seen that in addition to the location of the pond space in the plan, the shape and structure of the pond space and even the pond shape in each plan may differ with other plans. These changes and their diversity can be considered separately. Formally, in a general category, pool houses can be divided into three general categories, which are: torn abdomen, crucifix and square. These shapes vary based on the dimensions of the land and the location of the pool house in the plan. In such a way that if the depth of the building is high from the cruciform pattern (Bakuchi, Karimi and Charm houses), if it is directly adjacent to the main courtyard of the building (Sajjadi, Musour Al-Molki, Bani Kazemi and Sharifian houses) it is torn from the belly pattern. And if they are located at a distance from the edge of the courtyard (Dehdashti, Labaf and Sheikh Harandi houses), they have followed the rectangular pattern (Table 3).

Table 3 Study of the diversity governing the plan of the pond house and the shape of the pond.

House	Pool house plan	Pool house shape	Pool shape
Sajjadi		Torn abdomen	Octagonal
Bakuchi		Crucifix	Square
Masurmaleki		Torn abdomen	Rectangular
Karimi		Crucifix	Octagonal
Charmi		Crucifix	Octagonal
Dehdashti		Square	Circular
Sharifian		Torn abdomen	Octagonal
Bani Kazemi		Torn abdomen	Octagonal

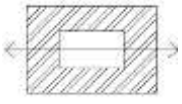
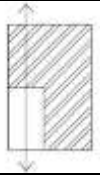
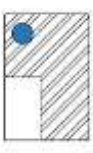
Labaf		Square	Octagonal
Sheikh Harandi		Square	Octagonal

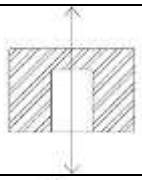
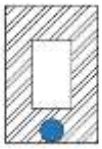
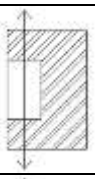
5.4. Checking the Position of the Pool House in Relation to the Main Axis of the Courtyard

If we consider the main axis of the courtyard as the dominant axis, i.e. the hypothetical line that passes through the middle of the courtyard and has a longer extension, then according to the Table 2 content, it can be seen that among the ten samples studied, (Sajjadi, Bakuchi and Musour Al-Maleki houses) the main axis of the courtyard is east-west and the rest of the examples (Karimi, Charmi, Dehdashti, Sharifian, Bani Kazemi, Labaf and Sheikh Harandi houses) the main axis of the courtyard is north-south.

However, the location of the pool house in front of the main axis of the courtyard in all samples will be according to Table 4. In other words, in houses where the main axis of the courtyard is located along the north-south (Karimi, Charmi, Dehdashti, Sharifian, Bani Kazemi, Labaf and Sheikh Harandi houses), the location of the pool house is located along the main axis of the courtyard. While in cases where the main axis of the courtyard is located in the east-west direction (Sajjadi, Bakuchi and Mosour Al-Maleki houses), the location of the pool house space is located along the axis opposite the main axis of the courtyard.

Table 4 Introducing the pool house position in front of the main axis of the courtyard.

House	Courtyard main axis	Pool house location in relation to courtyard axis	Pool house located along the courtyard main axis
Sajjadi house			×
Bakuchi			×
Masurmaleki			×
Karimi house			✓

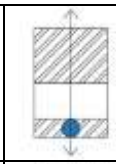
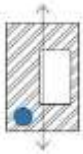
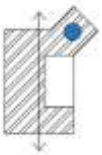
Charmi house			✓
Dehdashti house			✓
Sharifian house			✓
Bani kazemi house			✓
Labaf house			✓
Sheikh Harandi house			✓

5.5. Position of the Pool House in Relation to the Dominant Axis of the Courtyard

As can be seen in Table 1, the predominant axis of hot and dry climate residential houses in Iran is based on climatic issues and to be more compatible with local conditions and climate, mainly in the north-south direction. However, the general construction pattern (schematic plan) of the studied samples can be a good proof of this claim, which is shown in Table 5 along with the location of the pond relative to the dominant axis of the house.

Table 5 Schematic plan with the location of the pond relative to the dominant axis of the house.

House	Dominant axis of the house	Pool house position in relation to house dominant axis	Schematic plan	Pool house located along the house main axis
Sajjadi house	North-south			✓

Bakuchi house	North-south			✓
Masurmaleki house	East-West			✓
Karimi house	North-south			✓
Charmi house	East-West			✓
Dehdashti house	North-south			✓
Sharifian house	North-south			✓
Bani kazemi house	North-south			✓
Labaf house	North-south			✓
Sheikh Harandi house	North-south			✓

6. Discussion on Research Results and Findings

According to the above-mentioned topics, the formal features and dominant axis of the courtyard and the general structure (schematic plan) of residential houses located in the hot and dry climate of Iran can be discussed in relation to the shape and location of the pool house. Although the shape of the pool house is one of the three modes of the cross, the torn abdomen and rectangle, but mainly on one of the southern fronts (Sajjadi, Bakuchi, Sharifian and Bani Kazemi houses). Or the northeastern front (Charmi, Labaf and Sheikh Harandi houses) and rarely on other fronts, for example, the southeastern front (the house of the illustrator) or the southwestern front (Dehdashti house) or the northwestern front (Karimi house). In these studies, the shape of the pond inside is mainly octagonal (Sajjadi, Karimi, Charmi, Sharifian, Bani-Kazemi, Labaf and Sheikh Harandi

houses) and less square (Bakuchi house), rectangular (Mosur-Molki house) and circular, (Dehdashti house) is remarkable. In the study of the pool house location in relation to the main axis of the courtyard, the studies show that except for Sajjadi, Bakuchi and Mosurolmaleki houses in which the main axis or axis of the courtyard is east-west and the location of the pool house in them is not along the main axis of the courtyard. In other studied houses (Karimi, Charmi, Dehdashti, Sharifian, Bani Kazemi, Labaf and Sheikh Harandi houses) where the main axis of the courtyard is defined in north-south direction, the location of the pool house space along the main axis is always defined.

Also, in the study of the condition of the pool house in relation to the dominant axis of residential houses in the hot and dry climate of Iran, among the studied samples, it was found that the location of the pool house has always been along the axis of most residential houses. The samples evaluated were different. In other words, both in the samples with the dominant east-west axis (Charmi house) or in the samples with the dominant north-south axis (Sajjadi, Bakuchi, Karimi, Dehdashti, Sharifian, Bani Kazemi, Labaf and Sheikh Harandi) are always located in the basin space in line with the dominant axis of the house.

7. Conclusion

In general, based on structural and formal characteristics, pool houses are classified into three general categories, which are:

a) Cross b) Torn abdomen c) Rectangular

If the depth of the building is high at the location of the pool house space, it has followed the cross pattern and whenever the pool house space is directly adjacent to the courtyard, it has followed the torn abdomen pattern. On the other hand, if the space of the pool house was far from the edge of the courtyard and was not deep, it is always defined as a rectangle.

The extent and manner of influencing the pool house space in the formation of the structure of hot and dry climate houses in Iran is as follows:

Although according to the climatic model, most of the residential buildings located in the hot and dry climate of Iran have a dominant north-south axis, but what is very interesting and important in this study is that the recognizing the location of the pool house is always along the dominant axis of the house. In some cases, the main extension and the dominant axis of the residential house is defined as east-west.

Another noteworthy point is that except in rare cases in which the main axis of the courtyard is defined as east-west extension, in most cases, especially those in which the main axis of the courtyard has a north-south extension is always the location of the pool house located along the main axis of the courtyard.

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