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Analysis of the Formal Features of Chaharsofe Houses and its Influence on the Formal Structure of Introverted Houses in the City of Isfahan *

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Abstract

Problem statement: Chaharsofe houses are considered to be one of the most valuable architectural buildings of Iran, such that some researchers consider the design of some monuments with different functions during the Islamic era to be derived from the Chaharsofe houses. Understanding the features of Chaharsofe houses will help maintaining and restoring these valuable buildings and will play an important role in identifying the influential characteristics in the formation of the spaces of the historical houses.

Research Purpose : This research is based on the fact that the characteristics of Chaharsofe houses have played a significant role in the micro and macro structures of the introverted historical houses. This research seeks to recognize the formal features of the texture of Chaharsofe houses and, accordingly, to analyze the formal features of the texture of the historic houses built in the city of Isfahan.

Research method: In this regard, this research explores the formal features of a recurring form in Chaharsofe houses for the first time and reveals their impact on the emergence of the plan of introverted houses spaces. In general, this research will be conducted to characterize the components of Chaharsofe houses and how they were used in the residential buildings constructed in the following periods. The research method used in this research is comparative, historical, and interpretive whose interpretation has been done inductively; the applied tools include collecting information with a library method, field method, and conducting structured interviews with experts and professors. The present research seeks to reveal the recurring formal features of Chaharsofe houses in creating the spaces in the plan of Isfahan's introverted houses.

Conclusion: The results showed that the characteristics of Chaharsofe houses on micro and macro scale have a significant role in the formation of the spaces in the plan of the introverted houses.

Keywords: *Chaharsofe houses, Introverted houses, Formal features of Iranian .houses, The city of Isfahan.*



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Introduction

In Iranian architecture, the quadri-sectional geometry with divisions in the form of a plan, have been used in various architectural manifestations. It is also possible to mention the four-porch systems in buildings such as schools, mosques, inns and the Chaharsofe system in the houses, baths, and even four chambers of the ancient period. Having shelter is one of the human physiological criteria that has been important to humans over the centuries. One of the oldest housing systems in Iran, four chambers or Chaharsofe has been introduced. This system has an intermediate space around which four vaults or porches have been built (Pirnia, 2013: 149). Due to the climatic, cultural and lifestyle characteristics of people, houses in Iran are categorized in two ways of introverted and extroverted. Introverted houses, based on features like privacy (Mahramiat) and climatic conditions, have central yards and their external appearance, and the element that affects the connection of these houses to exterior spaces, is simply limited to the entrance (Memarian, 1993: 16-8). Extroverted houses also have many facades based on the climatic features, and sometimes a porch or a passageway around their exterior facade have been designed for light and air-conditioning; also, they are usually without a central courtyard (Memarian, 2008: 21-12).

Extensive researches have been carried out on historic houses, but in this area limited studies have been conducted on Chaharsofe houses. The effect of the form of the plan of Chaharsofe houses, which represents a residential unit, is less perceptible in the houses of the general public. In the researches done, the categorizations have not been carried out thoroughly and comprehensively, and the effect of the physical features of Chaharsofe houses in the historic houses is not taken into account. The recognition of these features allows for fundamental restoration in both types of residential buildings (Chaharsofe and introverted).

This research seeks to answer the following questions

1. Based on the features of the Chaharsofe houses, what are the properties of these buildings? And to how many categories are they divided?
2. How has the plan's form of Chaharsofe houses been reflected in designing the spaces of the introverted historic houses of Isfahan?

Since the shape deals with the two-dimensional properties of the spaces and the form addresses their three-dimensional properties (Ching, 2006: 52,62), in this research, first the knowledge and typology of Chaharsofe houses will be evaluated in terms of their form. Then, by recognizing the spaces used in this research, the recognition and typology of Chaharsofe houses will be considered in terms of their form. Lastely, by recognizing the spaces used in the introverted historical houses of the city of Isfahan and selecting examples described in detail in the research methodology, we will try to understand the effect of the formal features of Chaharsofe houses. In this study, by analyzing the forms used in Chaharsofe houses and introverted houses in Isfahan, an attempt has been made to understand their common features.

Background

So far, a lot of research have been carried out on constructed houses in the history of Iran, so that some have focused on its archaeological aspects; some research have pointed to the typology of the introverted houses (Pirnia, 1993, 2013, Memarian 1993, 2008, Ghasemi & Memarian, 2010, Haeri Mazandarani, 2009); some research have considered the extroverted houses (Khakpour, Ansari & Tahanian, 2010; Memarian, 1997), and a few studies also introduced the structure and components of the structure and spatial organization in the houses of Iran (Ghezelbash & Aboozia; Pirnia, 1993, 2013; Soltanzadeh, 1993; Sartipi, 2005). Also, some have addressed the spiritual and philosophical aspects of these houses (Ardalan & Bakhtiar, 2001; Noghrehkar,

2008). Research have been carried out on the changes that have taken place in the past houses, especially during Qajar and Pahlavi periods, and examined their evolution in terms of structure, function, space and method of construction (GhilichKhani, Etesam & Mutafati Ameri, 2012); Research have also been done in the field of materials used in the construction of houses and traditional structures that have been used for them (Bozorgmehri, 1999; Ghobadian, 2006).

In relation to Chaharsofe houses, studies have also been carried out and some have introduced these houses in Zavareh and Boshruyah (Ghaffari, 2004; Pirnia, 2013). Studies have also been carried out on the evolution of the Chaharsofe form in historical buildings and their functional characteristics (Gholami & Kaviani, 2000). A few research have been done on the typology of historical houses, and some scholars have studied the typology of historical buildings in Mashhad based on elements such as porch, vestibule, corridor, courtyard and the type of decorating; their method has been a descriptive-interpretive one. Based on the results of this study, the houses have been divided into three categories. Two types that have been formed during Qajar period, the first and second ones, and are introverted; and the third types formed in the first Pahlavi era and are of extroverted types (Farahbakhsh, Hanachy & Ghanai, Masoomah, 2016). Also, some scholars have dealt with the type of the houses of Rasht, which were built in the old fabrics. The factors studied in this paper are based on the general orientation of the building and the physical elements and the research method is descriptive and experimental (Khakpour, Ansari & Tahanian, 2010); Some considered the physical changes in houses during Qajar period in Gorgan city; The research method of this survey is historical commentary and the results of this research indicate that architectural developments in this period have been driven by extraversion and increased communication with the environment (GhilichKhani, Etesam & Mutafati Ameri, 2012).

A research on the typology of houses in Isfahan during Qajar period has shown that the houses of Isfahan during this period were built on the basis of the region's climate in an introvert formal; also, based on factors such as architecture, structure and decoration, these buildings can be classified into three categories (Ghasemi & Memarian, 2010).

Based on the conducted research, this paper tries to analyze the effect of the pattern of Chaharsofe houses on the historical houses of Isfahan by identification and typology of Chaharsofe houses as the oldest system for designing housing, as well as categorizing the main spaces of historical buildings in Isfahan and comparing these two systems with each other. Therefore, the research method of the present article is different from the methods of the research, and will be done in a comparative, historical and exploratory way.

In this research, first, the plans of Chaharsofe houses from will be categorized in terms of form. Then, according to the selected samples from within the statistical population, the spaces of the historic houses of Isfahan will be examined, in such a way that the formal characteristics and their adjacent spaces have been taken into consideration. Finally, based on the comparison between the categories carried out in Chaharsofe houses and historic houses of Isfahan (based on the study samples) the results of the research will be extracted.

Theoretical Framework of Research

According to research carried out about houses, especially Iranian houses, only a few theorists can be mentioned in this area. Theorists have analyzed their theories either in terms of physical characteristics or on the basis of spiritual characteristics. In the field of theories that have been done in accordance to physical dimension, a few researchers dealt with the classification of the form of primary houses (Cataldi, 1989). Some have pointed to the geometric characteristics of houses based on

Peyman (Pirnia, 1993 & 2013); Some researchers have also focused on categorizing Iranian houses based on introversion (construction method, type of spaces and typology) and extroversion. In some studies, there has been a widespread look at courtyard houses in Iran and Islamic lands, and ultimately the central courtyard and building and extroverted cities of Bushehr, the Shiraz cities' introversion, Yazd and Chaharsofe of Zavareh have been typologically identified (Memarian, 2008). Some have categorized and extracted the open, semi-open, and covered spaces patterns in the architecture of the past houses and described descriptively the path of movement in the houses (Haeri Mazandarani, 2009). Theories have also been carried out on the climatic characteristics of houses and their impact on materials, their shapes and forms (Ghobadian, 2006). Based on the items presented in the background and theoretical foundations of the research, the present research will benefit from the comments of theorists such as Pirnia, Memarian and Haeri Mazandarani about the typology of the spaces of historical houses and their functional features in this study.

Methodology

The research method is comparative, historical and interpretive. First, the considered houses in the statistical population (Chaharsofe and introverted) were extracted and samples were taken using field studies; and then the formal features (properties that exist in the plan of spaces) of Chaharsofe houses were dealt, and formal characteristics of the introverted houses of the city of Isfahan, the type of layout and the number of their construction materials were analyzed and finally eight houses of the statistical society as samples of study have been selected. The selection of samples was done using written and oral documents, and attempts have been made to select the samples that can be generalized to the entire statistical society; the reasons for choosing Chaharsofe and historic houses and analyzing their common formal characteristics have been the spatial

range of houses and the same function of habitation of both (Chaharsofe and historic houses). On the other hand, the formal structure of Chaharsofe houses is one of the formal features of the ancient architecture in Iran, so that in several periods, architects used them in order to form the plans of palaces and even in Islamic eras, in mosques and schools. The limitations studied in this research were the extensiveness of statistical population and the entry into each of the two group of houses (the Chaharsofe and introverted) for surveying them since most of the houses have a private owner and some people live in them, and by the permission of the relevant organizations and the dwellers, it was possible to survey these houses.

Chaharsofe houses

Sofe or Chafteh (vault) means a roofed and vaulted space with a form of cross around which rooms were built (Pirnia, 2013: 165); these types of houses have a long history in Iran and in their central space, Domical¹ vaults were used and four porches or vaults were built on their four sides (Pirnia, 2013: 150-152; Rafiee sereshki, Rafizadeh & Ranjbar Kermani, 2004: 184). Generally, these houses are found in Zavareh, Meibod, Ardakan and Boshruieh in provinces of Yazd, Isfahan and Khorasan (Gholami & Kaviani, 2000: 154). The history of these houses goes back to pre-Islamic era. In history books, these houses have been mentioned in the books such as "history of Yazd" and "new history of Yazd": "In the mentioned neighborhood, adjacent to the mentioned house, the beautiful house and the four vaults and the water pot and the springhead, in which the water of Narsuabad flows were built, and it is absolutely a great house" (Jafari, 2005: 12). "I came to the basement and went down about 60 zineh²; four sofeh were appeared; as I entered, I noticed that every sofeh is 20 Zar³ in length and height in which Zar³ candles were lighting" (Kermanshahi, 1995: 296). Also, some palaces of kings in different eras, like Bishaboor palace, buildings and Summerhouses in Eram garden in Shiraz and Hasht Behesht garden in Isfahan have followed the Chaharsofe pattern

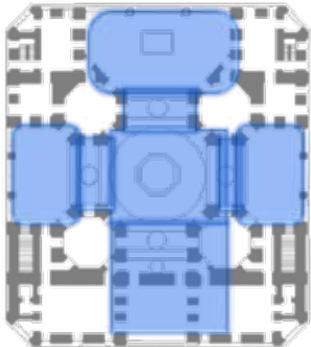
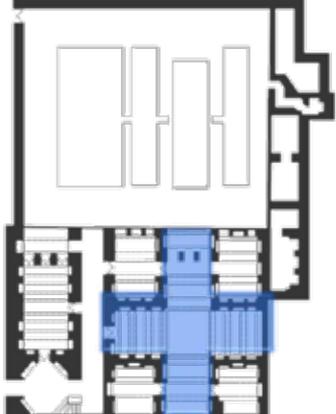
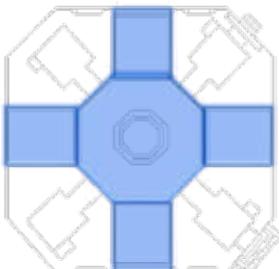
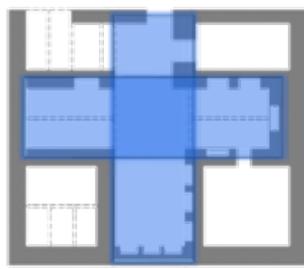
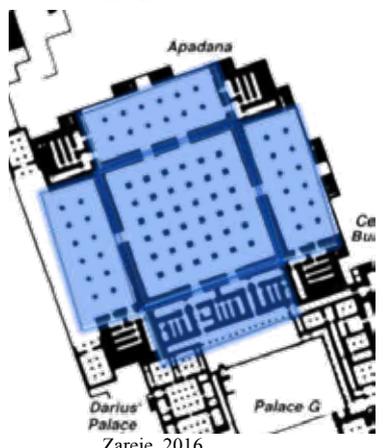
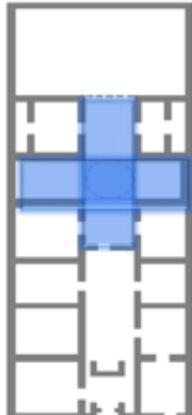
(Pirnia, 1993, 166); and this fact shows that this system were used for designing houses whether in small and rural scale or in large scale of government buildings by designers and famous architects (Table 1).

Classification of Chaharsofe houses

Generally, Chaharsofe houses have two different types. The houses placed in the city of Zavareh

which have a cross plan and the central section of this cross is vaulted and has a cover of domical vault; and, by means of combination with other spaces, are related to the outside of the building; the houses placed in Boshruieh and the southern parts of Khorasan province have also a cross shaped spaces in the central section, but unlike the houses placed in Zavareh ,their central part lacks

Table 1. Samples of plans of Chaharsofe houses in cities of Zavareh, Meibod and Bashrooyeh. Source: Cultural heritage, handicrafts and tourism industries, Ghafari, 2010; Pirnia, 2013; Gholami & Kaviani, 2000.

Samples of chaharsofe	
Macro scale	Micro scale (rural)
 <p>Culture Heritage, Handicrafts and tourism organization in Isfahan</p>	 <p>Ghafari, 2000,53</p>
 <p>Pirnia 2008: 178</p>	 <p>Jahani House In Boshroyeh, Cholami And Kavyani, 2017: 155</p>
 <p>Zareie, 2016</p>	 <p>A Haouse In Yazd, Hemat Abad (Pimia 2009: 178)</p>
	<p>Zavareh in Isfahan</p> <p>Bashroyeh in Khorasan Province</p> <p>Hemat abad in yazd province</p>

any coverage and this system reminds us of the introverted buildings and the royal houses built in the formal of extroverted ones had openings through which access to outer spaces and gardens was possible (Tables 1&2).

Chaharsofe houses can be classified in different ways but the nature of emergence of Chaharsofe houses based on spatial layouts, took place around a center, so the specifications of central parts of the building can be used as a suitable factor for classification of Chaharsofe houses. On the other hand, the investigations showed that one of the most influential factors in formability is the elements around the central part, were built in two ways of covered and uncovered. Also, the location of the building and the yard were also important; in some examples, expansion has been to such an extent that the structure of the Chaharsofe houses has not changed (Table 2, row 1);

however, over time, due to the increase in the required applications in the house, two solutions have been used: 1- expansion of the central space (expansion from inside) that led to the enlargement of middle space in such a way that the ability to cover space by making a vault without columns was simply not feasible so the space has become an unroofed structure (Table 2, row 2). In some cases, climatic conditions, such as prevailing winds, have made the climatic comfort in unroofed areas undesirable, especially in desert areas; in some cases, the house has had a large area and the possibility of opening the middle space could not happen and as a result the house was spread outwardly so that the middle space remained roofed and from the two or four sides overlooking the surrounding area, these houses are located in a palace between the open spaces (Table 2, row 3).

Table 2. Classification of four-story houses in terms of shape, type of roof and direction of expansion. Source: authors.

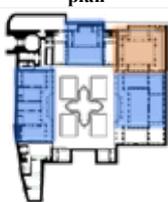
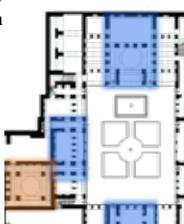
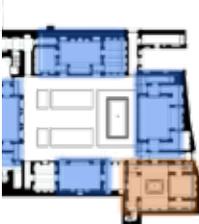
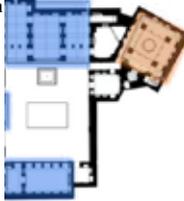
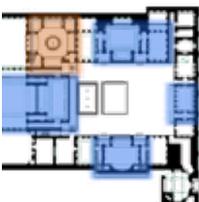
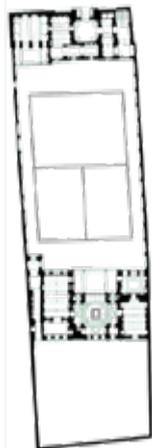
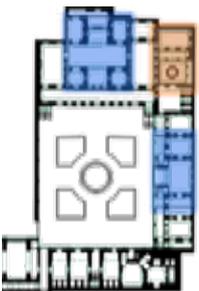
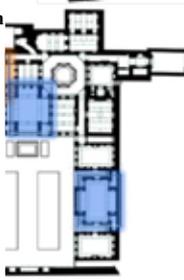
Chaharsofe houses classification over time	plan	Roof Type	Plan Type	Extension	Samole
Chaharsofe space yard Spaces around chaharsofe		Roofed	House with central space	Without extension	Zavareh houses
		Yard	House with court yard	Internal extension	Boshroyeh house
		Roofed	house with central building (house between two open spaces)	External extension	Hashtbehesht palace & sokias House

The place of main spaces (Tehrani, Talar, autumn living room, spring living room, water pot) in historic houses

There are two vertical axes in historic, introverted houses of Isfahan which one is introduced as the main axis with much length and the other one is the by-axis with shorter length which both pass through the center of the angles of the courtyard;

also, the main spaces (Tehrani and Talar) and the by-spaces (Autumn and Spring room) are formed along these axes (Table 3). Tehrani is a space that in comparison to other spaces has a much higher value and has been built more than other spaces in the houses of Isfahan. Tehrani used to serve guests and is placed along the length axis which passes through the center of the angles of the yard which

Table 3. Map of examples of historical buildings studied in Isfahan city (source: Gangnameh; 1999. Cultural Heritage, Handicrafts and Tourism organization, 2017. Source: authors.

Isfahan Historical House			
House	plan	Image	
Charmi			
Dehdashti			
Mosavarrual Maliki			
Harani			
Vasigh Ansari			
Sokiasian			
Labaf			
Karimi			

pond
 Vertical space

is located based on the direction of the elongation of the land and the north or west of the yard.

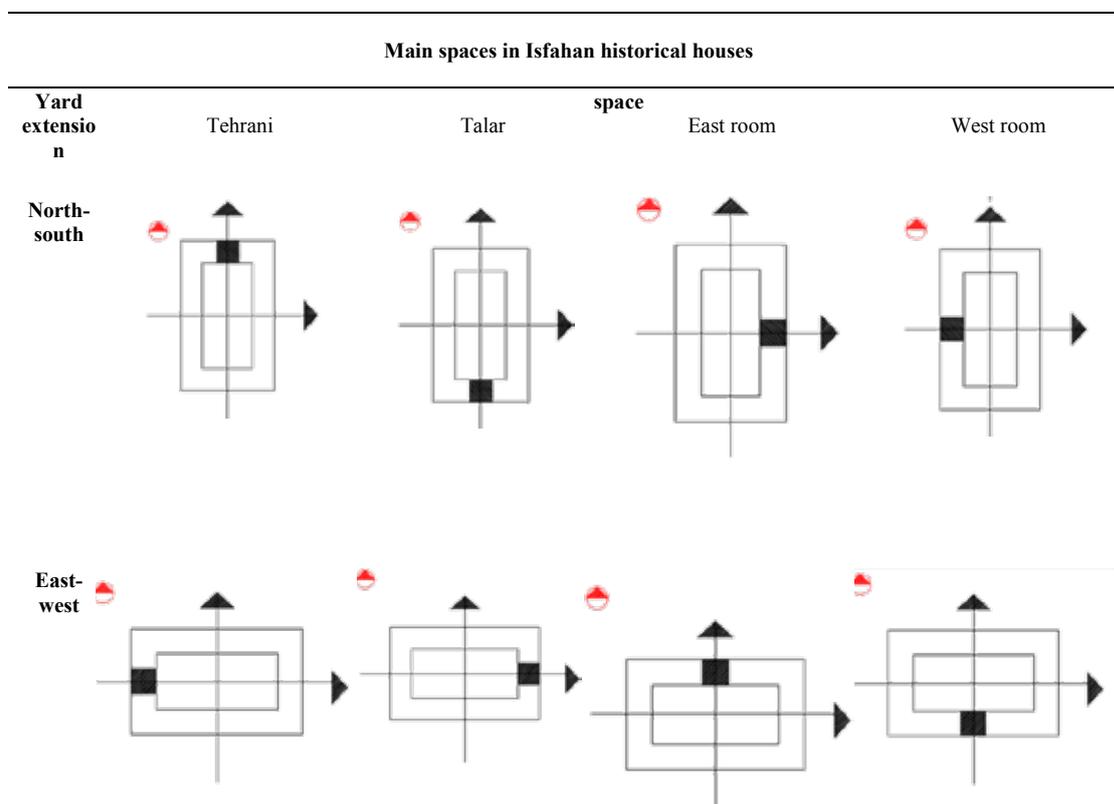
The other space is called Tallar (Talar) which was a place for sitting and sleeping and located opposite side of Tehrani; and, it was built in a place with less sunlight which is located based on the elongation of the land form and its orientation (south and east). The other rooms are the autumn and spring rooms that were used based on sunlight and climatic conditions in autumn and spring, respectively. Talar, the autumn and spring rooms were important after Tehrani, respectively and were not built in some houses (Table 4).

Apart from the main spaces in the houses under study, there is a space called the basin (Hoozkhan: This room is a porch and a basement with a pond (Rafiee sereshki, Rafizadeh & Ranjbar Kermani, 2004: 190). An indoor space where the pool is located and there are rooms on the four or three sides, and it is a summer porch (Soltanzadeh, 1993: 49). This space in the houses of the city of

Isfahan is generally located on the north side. In contrary to the written sources, which have pointed out that this space was used on the (south) side in the summer, the placement of this space has been in places where the depth of construction sides of this area was large and the back spaces did not have the ability to use daylight, and by building the space of the pond (Hoozkhaneh) those spaces benefit from light; in fact, through the openings created at the roof of the pool houses, there was the possibility of lighting in this space (Fig. 1).

Various and different spaces were designed and built in the houses of Isfahan so that each of the spaces has different formal features (Tables 5 to 9). Tehranis are designed and built into three categories: (Squared, Chalipa and Rectangular). These forms vary according to the dimensions of the land in each house, so that if the depth of the construction space is high, Chalipa form was used (Dehdashty, Karimi, and Labaf). If the length of this aspect was high in the yard the

Table 4. The location of the main rooms in direction of the yard's elongation. Source: authors.



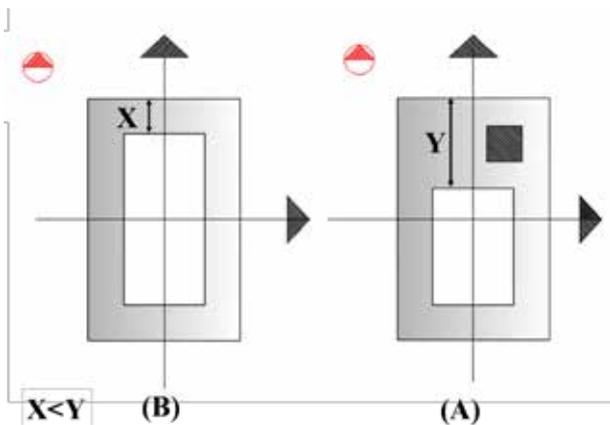


Fig. 1. Placement of the pool in part of the construction with a high depth. Source: authors.

Shekamdarideh pattern (the Charmi house and the cross: Dehdashti, Karimi and Labaf) were applied, and if the length of this aspect of the courtyard was low, they would use the rectangular pattern (Mosavarual Al-Maliki's house). Also, the use of cross and squared (Shekamdarideh) has caused the formation of Shahneshin in this space (Table 1). The Tehrani Chalipa (cross) pattern is taken from the formal of the Chaharsofe type of the primary type (roofed and introverted); (Table 2).

The Talars are in the second priority compared to the Tehrani Rooms built in historic houses and they were not built in some houses in Isfahan (Labaf and Karimi's houses). On the other hand, the Talars in two shapes of Shekamdarideh (squared) (Dehdashti and Mosavarolmali's houses) and rectangular (Sheikh Harand house) have been made in case examples (Table 6). In the studied cases, the Shekamdarideh⁴ houses have also benefited from the formal characteristics of the first-class Chaharsofe sample houses. However, because of the low depth of this part of the yard for construction, the architects of the traditional architecture have made changes to it using their knowledge and creativity and designed and constructed it in the form of Shekamdarideh in such a way that instead of the four vaults, three vaults are replaced around the central space (Table 6).

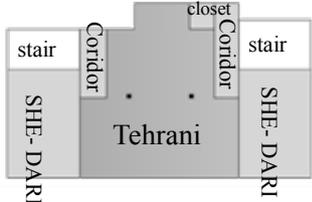
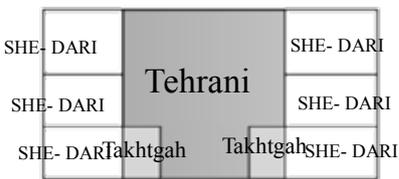
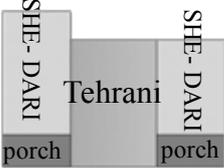
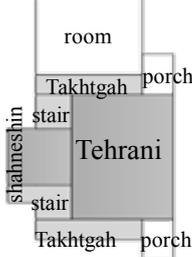
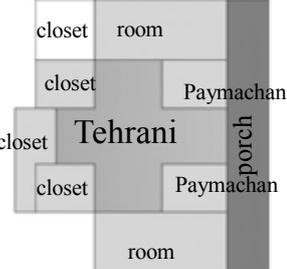
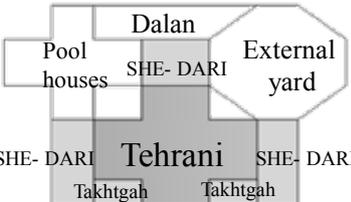
Autumn rooms are also designed and made in a

variety of shapes, so that the rooms of the autumn settled in three shapes (rectangular, cross and Shekamdarideh) have been built. In chalipa (cross) form (Karimi's house), formal features of the Chaharsofe house spaces (indoor and introverted) are used to design this room. In Shekamdarideh mode (Mosavarolmaleki's house), the form of the Chaharsofe type of the first type has been used, but due to its low depth, it was not possible to create a cross shape, and the craftsmen changed it into a Shekamdarideh plan or three vaulted by their own creativity (Table 7).

According to the classification of the cases (Table 8), the spring rooms have been also categorized into two shapes (rectangular and Shekamdarideh), the form of the abdominal cavity (Shekamdarideh) has been made in houses whose depth of space in spring room were more (Mosavarolmaleki's house). Also, if the length of this aspect is low, in the middle of the side, bed ware (takhtgah) has been made which were used as a wide corridor and there is no room in the middle of this side (Charmi's house). In these spaces, the form of the first Chaharsofe (roofed and introverted) is improved, but since the depth of space on this front is low, the form has changed from four to three vaults (Mosavarolmaleki's house).

The pool houses are also made in different forms, (rectangular and octagonal) with blunt corners (and octagonal). With curved corners; also, in some cases, these spaces are separated from around vaults by columns (Dehdatih, Sheikh, Harandi, and Charmi's houses); The plan's from of this space is also derived from the features of the Chaharsofe form of the first type, and in one case, it was derived from the formal of the four-dimensional houses of the third type (the Slokian house), so that the vaults are located around the place of the pool. The space of pool houses in the city of Isfahan is roofed and introverted in all cases, except the Sukksian house, which is located in the middle of the garden and is extroverted and the area of the pool in this house is different from

Table 5. Formal classification of Tehrani part in Historic Houses of Isfahan. Source: authors.

Tehrani Typology in historical houses					
House	Position of Tehrani	Tehrani form and grade 1 & 2 spaces around Tehrani and entrance direction	House	Position of Tehrani	Tehrani form and grade 1 & 2 spaces around Tehrani and entrance direction
Charmi	North side		Dehdashti	North side	
Sheikh Harandi	North side		Sokisian	North	Hashti is in the main axis of building
Labfaf	North side		Mosavarua I Al-Maliki	East side	
Karimi	North side				

■ Tehrani □ Grade 1 Access To Tehrani

■ porch ■ Grade 2 Access To Tehrani

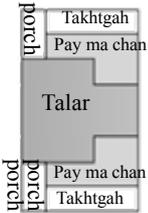
the rest of the house due to the area of the land; In this building, the pool of the house also played the role of the Talar, because it is located on the southern side of the garden, and because of being extrovert, it directs light from two directions to the space (Table 9).

Discussion and analysis

With regard to what mentioned before, the process of changing the formal features of the spaces of Chaharsofe houses (form, function, and shaping axes) can be discussed and analyzed so that, based

on the features of the form, Chaharsofe houses have a big central space in the middle, four vaults around its four sides and small spaces in the corners that act as service aspects. In the cross state, the middle space is in the form of a cross, and on the four sides there are four very small service spaces, and in the third case, which is in the form of Shekamdarih, its formal is like a defective cross, and on its both sides, the service spaces have been built. From the viewpoint of the shaping axes, Chaharsofe houses are formed from the intersection of four horizontal axes and four

Table 6. The typology of Talar in Historical houses of Isfahan. Source: authors.

Talar typology in historical houses					
Tehrani's Form and the one and two grades of spaces located around the Talar and the direction of entering it	Talar's position	House Name	Tehrani's Form and the one and two grades of spaces located around the Talar and the direction of entering it	Talar's position	House Name
	Southern Side	Dehdashti	House has one yard & three built sides; no Talar in south side		Charmi
This room is like a palace inside a garden and its appearance is different from other introverted houses		Sokisian		Southern Side	Sheikh Harandi
	Western side	Mosavarual Al-Maliki	In the southern side of the room, Talar is not built.		Labfaf
<ul style="list-style-type: none">  Talar  Grade 1 Access To Talar  porch  Grade 2 Access To Talar 			In the southern side of the room, Talar is not built.		Karimi

vertical axis which have formed nine spaces. To form the formal cross, the four horizontal and the four vertical axes intersect in such a way that it forms five spaces in this shape, and in the formal of Shekamdarideh, three horizontal and four vertical axes collided and formed three spaces (Table 10).

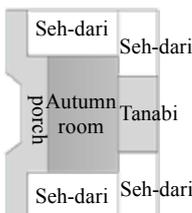
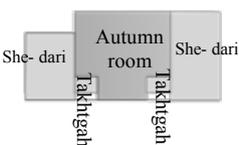
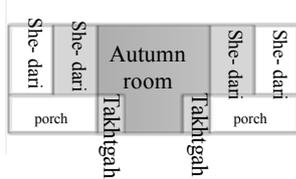
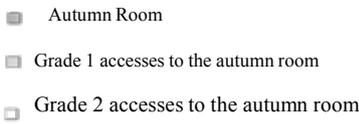
In the results and research which have been done, some scholars have addressed the physical features in the form of shape and the method of layout of the spaces; in some of these research, the classification of shapes, instruments and decorations in the houses of certain historical periods (Qatar) has been elucidated (Ghasemi & Memarian, 2010); (Table 11). Some have pointed to the general categorization of the

Chaharsofe houses in Zavareh so that the results of this research categorized these houses into four categories (simple four-vaulted, pool housed, three sectioned and combinational); (Ghaffari, 2004).

Conclusion

In the present study, at first, the properties of Chaharsofe houses are analyzed in terms of form and structure; and then, based on the study samples of this study, the physical features of the spaces of historical houses of Isfahan have been analyzed and spaces such as (Talar and Tehrani, autumn and spring rooms and pools) are classified. From the classifications performed and their adaptation to the characteristics of Chaharsofe houses, the adherence of these spaces to the characteristics

Table 7. The typology of Autumn Rooms in Historic houses of Isfahan City. Source: authors.

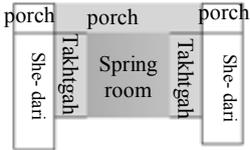
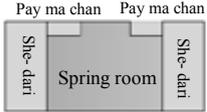
Autumn room typology in historical houses					
The form of room is west with grade 1 & 2 spaces around the room and entrance The position of Autumn Room	The position of Autumn Room	House Name	The form of room is west with grade 1 & 2 spaces around the room and entrance	The position of Autumn Room	House Name
This side of the house doesn't have room and there is only a porch.		Dehdashti		Eastern Side	Charmi
This house does not have any side.		Sokisian	The eastern side of this house is semi-constructed and has three 3-doors room which is not in the direction of the eastern-western axis which crosses the yard		Sheikh Harandi
	Northern Side	Mosavarual Al-Maliki		Eastern Side	Labfaf
				Eastern Side	Karimi

of the Chaharsofe houses has been reviewed. With the way that this adherence is carried out in historic houses on a small and large scale, on a large scale, the arrangement of spaces around the courtyard are unroofed space and on a small scale (Tehrani rooms, Talar, autumn and spring rooms, and pool) Chaharsofe houses are roofed central area.

Generally, Chaharsofe houses are classified into three types: First type: central space and four-vaults around it, second type: uncovered central part and four-vaults around it (houses with middle yard) and the third type: A house with an intermediate space where the building is between two open spaces and its central space

is covered. The pre-Islamic form in Iran has been transmitted to traditional Islamic schools by traditional architects and the changes in the formal and dimensions of houses have brought about dramatic changes in the needs of family members, in such a way that the past houses of the city of Isfahan (ordinary people houses not the palaces) were built introverted. Accordingly, the design of formal features of the houses on the whole scale has the characteristics of the form of the Chaharsofe house of the second type. That is, the open-air courtyard (without a roof) made on four, three or two sides of the building construction, and is generally introverted. In detail, these buildings have made use of a four-

Table 8. The typology of of spring rooms in Historic Houses of Isfahan City. Source: authors.

Spring room typology in historical houses					
The form of room is west with grade 1 & 2 spaces around the room and entrance	Position of room	House Name	The form of room is west with grade 1 & 2 spaces around the room and entrance	Position of room	House Name
	West side	Dehdashti		West side	Charmi
No construction in this direction		Sokisian		West side	Sheikh Harandi
	South side	Mosavarual Al-Maliki	Three sides of this house are built and no built space in west side		Labbaf
<ul style="list-style-type: none"> Autumn Room Grade 1 accesses to the autumn room Grade 2 accesses to the autumn room 			Two sides of this house are built and no built space in west side	West side	Karimi

vaulted form in the design of spaces (Tehran, Talar, autumn and spring rooms and pool). In the spaces of Tehrani, the Talar autumn and spring rooms, the cross shape and Shekamdarideh, which were in Chaharsofe houses, have been adapted. In places with high depth of space, the form of the cross was used, and if the depth of space was less, the abdominal (Shekamdarideh) form was applied and the spaces were also covered. The pool houses in a part of a building that was more in depth were used for lighting, because the pool houses generally were built in the northern part (northeast and west) in Isfahan; this faction was used in winter. So, the traditional architects have designed and constructed pool houses in Isfahan in a roofed form in order to create the possibility of light into the lateral spaces using the windows embedded on top of it. Also among the houses analyzed, Sokiasian's

house based on the third type can be explained this way: the palace has been built extroverted and in the middle, there is a pool house based on the characteristics of the Chaharsofe type one houses. Therefore, in designing the features of historical buildings of the city of Isfahan, the formal features of Chaharsofe houses have been used so that in the macro state it is of the second type features (introverted and uncovered) and in micro mode the formal features of the first type (roofed and introverted) and the third (roofed and extroverted) have been used.

In future research, the development of Chaharsofe houses in religious and educational buildings can be dealt.

Note: The terms used in this article are from the books of Islamic architecture and Iranian architecture (which are the words of the late Pirnia and the writings of Dr. Gholam Hossein

Table 9. The typology of the pool houses in the historic houses of Isfahan. Source: authors.

House	Pool house position in house	roof	Pool house form	Pool form	Spaces around pool (direct access)	Spaces around pool (grade 2 access)
Charmi	North-east	roofed				
Mosavvanal Al-Maiki	South-west	roofed				
Vasigh ansari	North-west	roofed				
Labhaf	North-east	roofed				
Dehdashir	South-west	roofed				
Sheikh Harandi	North-east	roofed				
Sokhsian	south	roofed				

The typology of the pool houses in one-yard houses

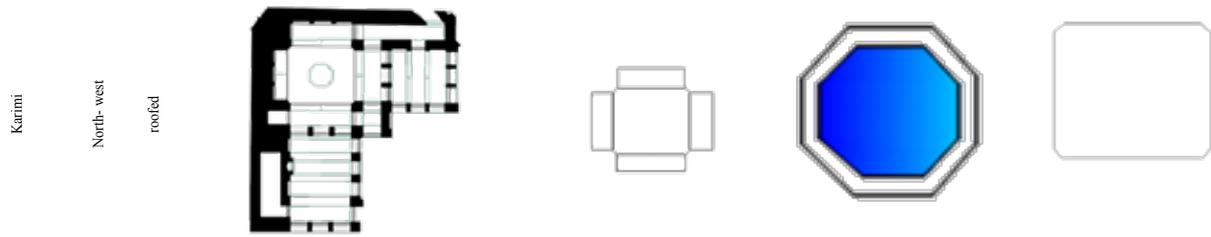


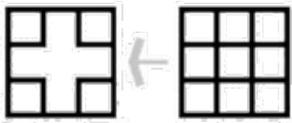
Table 10. Changes in shape, function and axis of the Chaharsofe houses and the formation of cross and abdominal cavities (Shekamdarideh). Source: authors.

	Chaharsofe houses	Chalipa form	shekamdarideh
cahrecteris			
Formal features			
Functional features			
Forming axes			
	<p><u>Chaharsofe</u> </p>	<p>(main)central space </p> <p>service spaces related to central spaces </p>	

Table 11. Results for the typology of Qajar houses in Isfahan city. Source: Ghasemi & Memarian 2010: 93.

Historical period	Architecture	Structure	Decorations	Samples	
Qajar	First (Safavid, Isfahan method)	Introverted Smooth skyline, cross-form central <i>Talar</i> , access with two corridors, rectangular yard, two-part door & window, trivial vertical connection	Vaulted	Using bright colors, shadows, perspective	Sheikhuleslam & Haghighi
	Second	Introverted (central yard) /extraverted	Smooth	Influenced by Rococo art, using less volume decorations, realistic wall-painting, colored glasses	Historical attractions of Isfahan like Molabashi, malek Angoorestan
	Third (Kordi)	Introverted/extraverted	Broken skyline (semi-circle), balcony with height from earth, stairs,	Smooth with wooden beams	Geometrical consisted of western furniture Dr. Alam house, Amin

Table 12. The Advantages of designing Chaharsofe Spaces. Source: Gholami & Kaviani, 2000.

Advantages of Chaharsofe spaces	Creating balances space in hot & dry climate	Enters some sunlight to space and provides a suitable combination of sun and shadow in different times in a year in houses
	Extending space in low central yard area	Small yard provided defected visual field in the space and balconies in four sides increase visual field and extend the space
	 <p>Geometrical pattern with cross-form arrangement</p>	
	Function of Chaharsofeh space	These spaces act as home workshops
	Transferring <i>Chaharsofe</i> from total to partial in space	In Yazd houses, <i>Chaharsofe</i> pattern is used in balconies and south <i>Talar</i> ; in Isfahan, this pattern is in pool in north side

Memarian, and also the physical alphabet of the houses of Yazd (Ghezelbash & Aboozia, 1985).

Endnote

1. Domical Vault or "Colanbuh" is a kind of vault built on columns or walls on a square cross section.
2. Zineh in Persian means stairs.
3. Zar': length unit which one Zar' is equal to 104 cm.
4. The Shekam darideh: refers to a room which is used in summer and connected the room to the other parts of the house like pond or garden through a window or sash.

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