Explaining the Role of Diversity in Creating Life in Iranian House Based on Christopher Alexander's Opinion and Focusing on Boundary Spaces

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Abstract- Iranian house is an interior space filled with cozy and beautiful corners and open and closed spaces that are nested and mysterious, and the human being can discover soul with it. This nested and loved organization that allows everyone to create coherent realm and corners is created through the boundary spaces, by which the human being, within the small world (in the words of Islamic and Christian worldview), discovers and experiences the space and creates his own memories. The interior of the Iranian house has been created through purely simple geometry, and it has found complex compounds through boundary spaces that create the spatial diversity and many details that cause life in it. This paper examines the role of diversity in the creation of life in Iranian house through boundary spaces through a qualitative and descriptive-interpretive approach and a phenomenological approach, which is based on the fifteen characteristics of Christopher Alexander proposed in his book of the nature of order In order to carry out the research, diversities in Iranian house (spatial variation and details) have been studied. Then, by introducing and evaluating Alexander's views and boundary spaces (its different types in the Iranian house and how to establish their relationship with them), a theoretical framework that diversification resulted from simple geometry and complex compoundsin its own cultural context implies the creation of life in the Iranian house is developed. The research is conducted with a sample of cases and in accordance with the developed theoretical framework and ends with the final conclusions.

Keywords-Diversity, Life, Boundary Spaces, Iranian house, Christopher Alexander.

I. INTRODUCTION

Attending the Iranian house offers an unprecedented experience of spatial and aesthetic perception. In the interaction with space, life is felt as if it is person's childhood home. Nested spaces and constant discovery of the new space leads to a lot of vitality and triggers the emergence of individual and collective behaviors within the family and makes life more effective. The space in the Iranian house has a fluidity and soul and is constantly being discovered by the audience. In fact, the wonder and discovery of spatial diversity and details (in all aspects) is the source of life in the Iranian home. Unity between space and detail in this direction will strengthen life. Three types of space are observed in the composition of the spatial organization of Iranian house. The closed space, the open space, and the space between the two, which is described as the boundary space in this paper, have a dual characteristic of enclosure while opening, closing, and connecting, causing the space to be curtailed. "Space starts its presence from curtails."[1] Thus, the inner-to-outer relationship, which forms the core of the architecture, is created through boundary spaces. The occurrence of diversity is generally evident in these spaces, and it creates identity for space, and space is filled with soul and life goes on.

An American researcher, Arthur Pope, considers the combination of excitement and tranquility as one of the most important features of the Iranian aesthetic experience, and this feature from the scale of space to the details has always been of interest to Iranian architects, and especially in the boundary spaces, has caused a lot of variation that has been very effective in the creation of life at the Iranian home.

Christopher Alexander raised the issue of life in his book "the nature of order" and described fifteen fundamental properties that accompany the presence of life in a building or system, which (most of them) are related to diversity, and this signifies the importance of the role diversity in the creation of life in architecture. According to the above discussion, the greatest probability of the emergence of diversity is in boundary spaces and through them. As a result, the present paper specifies various forms of diversity in these spaces and studies and analyzes its role in creating a vital structure based on the fifteen properties proposed by Alexander.

II. RESEARCH METHODOLOGY

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[1] Soul of the place, p.25

The present study has a qualitative approach and is descriptive-interpretive to explain the role of diversity in life creation through a phenomenological approach. In this regard, focus of the study is on the types and forms of diversity in the boundary spaces in Iranian houses that have been introduced through field studies and library resources and studied by Christopher Alexander's fifteen criteria. In order to avoid increasing the volume of contents, it is tried to summarize these contents in the form of a table. The sample of the studied houses generally belongs to the Qajar period, because most of the remains belong to this period and also the highest growth in the architecture of the house is based on the views of Mohammad Karim Pirnia in the same period.

III. REVIEW OF THE LITERATURE

Christopher Alexander believes that structures and systems that are of order have life in them, but his definition of order is different from the mechanical and Cartesian one. He believes that in order to understand this order, there should be a dissident view of the world. A look that "sees the entities of the world not in separate parts but in their wholeness."[2] This new perspective discusses the relative degrees of life and seeks to establish a new relationship between performance, decoration and beauty. Understanding and analyzing performance in the current architecture is a Cartesian one. But ornament is not understandable and analyzed based on Cartesian view, and we just might like it. In the new look, Alexander treats order the same as ornament and performance, and introduces the functional order and ornamental order, adding that these are two different aspects of one type of order in which the human structure is emphasized by Alexander.

Today, the need to address the life of the earth, the cities and the environment is an issue of importance to various scientific and global planning groups, but when we look at a traditional home, a life beyond the definition of these organizations and institutions that is often ecological is seen, which is the same as life proposed by Alexander that is considered in this article. The definition of life is different from the perspective of Alexander and is not limited to mechanisms of environmental reproductive devices. "Life is the quality inherent in space, and it is used for every brick, every stone, every person, and every kind of physical structure that appears in space. Everything has its own life."[3] Alexander considers a single pattern of life, which includes the life of living and non-living beings, and this sense of life is constructible and measurable. In the traditional architecture and especially the Iranian architecture, which is a kind of emancipation of matter, this sense of life is of a diverse structure in its wholeness and details that is due to geometry. Also, Alexander considers the idea of an integrated wholeness as life-giving and describes it as an

"overlapping system of entities"[4] and introduces entities as center and adds that each wholeness is composed of strong centers. Indeed, the center is used to describe a structured domain in space and is not a geometric core but part of a domain that defines a wider pattern of functionality of components and their coherence.

In the field of diversity, different researches have been conducted that are not specifically related to diversity, including research titled House, Culture, Nature (Hayeri Mazandarani, 2009), the combination of contrasts in architecture (Afshar Naderi, 1995). This studies demonstrate the important role of diversity in the expression of architecture and the construction and organization of space.

Boundary spaces are a very extensive and important topic in architecture, which require a thorough study. There are no independent researches in this field, but a lot of research has been done on it, such as: boundary-bound space (Mirshahzadeh, 2011), joint (Reza Khani, 2013), house architecture (Nilander, 2002), in which semantic and functional discussions are explored.

IV. DIVERSITY AND ITS DIFFRENT TYPES

Diversity means versatility and is one of the most important features of Iranian architecture. Iran's architecture is diverse in some aspects, and is uniform in others. But investigation of Iranian architecture shows the unity in the plurality and diversity in unity. This means that the principles of organizing space and structure are uniform, but the finishes are very diverse. Climate, culture, economics and housing are among the factors that make up diversity. One of the factors of creating diversity in residential space is life in a non-distinctive space, and space is not differentiated or used on the basis of a particular function, but is combines, separated and used tailored to the needs, and furniture is flexible and this causes spatial and functional diversity. Spatial diversity through shaping nested spaces relies on pausing and passing with the possibility of expanding the composition of spaces together through in-between spaces creating the limits of the public to the private scale and creating individual and group behaviors within families and children have the most diverse spatial and behavioral experiences.

Diversity is emerging in two parts in the Iranian home:

1. Spatial diversity

2. Detail diversity

Spatial diversity in Iranian residential architecture, due to various residential typology including four-story types, central courtyard, sundeck, etc., which within themselves are much more diverse, has led to an infinite number of unique homes that are very effective in creating life and identity. Diversity in details (ornaments and building

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[2] The nature of order, p. 21

[3] Ibid, p. 30

[4] Ibid, p. 67

elements) is very high given that there is no limitation in their size, and also in the Iranian architecture, the most complex forms come from the simplest geometric combinations. The method of defining space in Iranian architecture is such that open space is combined and separated by the boundary space. This definition of space is not interrupted, but space changes slowly and gradually. This method creates a high spatial diversity. In addition, boundary spaces that make it possible to differentiate and, at the same time, combine spaces through gradual change, provide the highest degree of diversity in human detail and states.

V. SPACE AND LIFE

As explained earlier, life is a comprehensive phenomenon and is not merely a mechanism for life. Alexander believes in a level of life in all systems and buildings, but some are more and some less likely to have this life. The constituent elements of space from the public's perspective include walls, ceilings and floors, which together are constructive of the wholeness, and act as centers that support each other and are constructors of a degree of life. In the architecture of Iran, wall is not merely a physical separator element, but part of the whole, which is connected to the patio floor and sometimes forms the podium, and sometimes it is the position of emergence of plant and material motifs, as if the wall of the garden continues, it sometimes form a vault, and it is sometimes finished as a living space. "In Kashan, the walls that are in this way are called the living wall."[5] This is the life that Alexander points out and is considered in this article. Floors and ceilings are also the same, and are ultimately, constituent of space that create strong centers with a variety of functions and finishes to make the wholeness to have life as strong and seamless. We feel the life when encounter with space, and space is stated to be interesting, rich, and of spirit. The walls, floors and ceilings, as the center and the space between them, are not just adjacent space, but dependent and interdependent. The greater the complementary parts of them (including decorations, behaviors in space, and its functions) act as centers, more different and transformative structure will be and more life will be felt in it.

VI. LIFE FROM THE POINT OF VIEW OF CHRISTOPHER ALEXANDER

Christopher Alexander considers structures with life to have certain qualities that make them feel alive. He introduced 15 characteristics for structures that have life that are summarized briefly in Table 1. "These fifteen characteristics all determine the nature and essence of living systems. The range of space that can include such living entities is incredibly diverse."[6] Life in old structures is greater, and the Iranian house is one of the strongest living structures that has these characteristics,

[5] Haeri Mazandarani, p. 110
[6] The nature of order, p. 198

and diversity (space and detail) plays a vital role in the creation of vivacity, which is absent in contemporary structures. These characteristics are interrelated and reflect a deep structure that they are all seen and do not work alone, and more important than themselves, they are the context of the centers, and these characteristics help properly understand the function of this field.

Table 1: fifteen characteristics identified by Christopher Alexander

	Characteristics of living structures	Description
1	Level of scale	Diversity on a scale with hierarchy and proportionality (large - medium - small - very small).
2	Strong centers	The system of symmetry, the focal point, the hierarchy of domains (from public to private) toward the center or focus.
3	Boundaries	The nature of connecting and separating, the center defining and having the central features that form it.
4	Alternating repetition	Creating a beautiful and subtle diversity with a rigorous repetition and, of course, a distinct modification to create the wholeness.
5	Positive space	Every space is complete in detail and wholeness. The nature of the determination in the open, close, and especially the boundary space that has the shape and meaning, and is not remaining.
6	Good shape	Having a simple and original geometry and shape in details that can create a very complex shapes. Two-way symmetry, inner symmetry, positive space and qualitative residual space, continuity and cohesion, confinement and perfection.
7	Local symmetries	Simple and geometric shapes and irregular spreading in the components and break down of the first dry geometry, the use of localized symmetry in general to create a diverse wholeness.
8	Deep interlock	The use of boundary spaces to create strong and inseparable centers, belonging to both inside and

		outside that bring about coherence.
9	Contrast	Creating unity through differentiation in order to create diversity and diverse use of recognizable contrasts. Creating a sense of discriminating in performance. Contradiction creates differences and accepts distinctions.
10	Graded variation	A gradual change from one limit to the other, creating variety and mild variation in size, distance, intensity and characteristics.
11	Roughness	Unconsciousness and unplanned heterogeneity, so that its beauty is unmasked and not artificial.
12	Echoes	The geometry is similar to the change in angles and centers and the deep inner similarity.
13	The void	Free space, silence and peace, not in the heart of space, but designed and organizing other centers.
14	Inner calm	Remove all unnecessary elements.
15	Not-separateness	Not-separateness depends on the state of the boundaries, including: discontinuity, grading, scale crushing, softness, gradual change, and boundary inaccuracy.

VII.   BOUNDARY SPACES

It has already been mentioned that space in the architecture of Iranian house is threefold: open, close, and boundary spaces. A boundary space is between the two, and even convertible into two others, which requires separate research. But the boundary space has the roles that give rise to the appearance of diversity in itself. Some of the roles of the boundary spaces, according to Pierre-Von Meiss, are "1. Utilitarian, 2. Protective, 3. Semantic." Factors affecting it include: "1. Functional-behavioral factors, 2. Physical-environmental factors, 3. Perceptual-semantic factors."[7] These spaces are not remaining of other spaces, but they themselves are of shapes and geometry and unlike other spaces, as mentioned above, they have many roles that have the potential for diversity much more than other spaces. Boundary spaces help residents create territory and also guide visits in the relationship between the home and the city. These spaces are places where diverse, mutual, and sometimes opposite phenomena interchange with each other and cause duality.

[7] Einifar and Aliniay Motlagh, p. 58

Duality arises between their independent existence and the other main spaces that they explain, and give them follower and secondary character. The attention to these spaces leads to the creation of space, a matter which has been neglected in contemporary architecture and contemporary housing. The following chart illustrates a part of boundary spaces in Iranian homes and how they relate to the main sections of the house and their explanation.
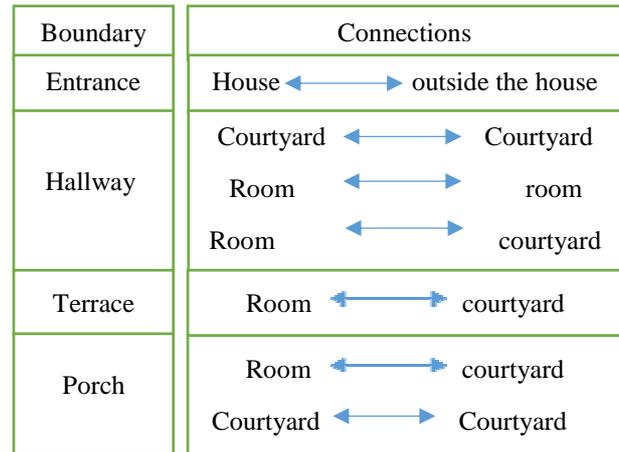

Figure 1: Boundary spaces in Iranian house and the how of connecting spaces.

VIII.   THEORETICAL FARMEWORK

Iran's residential architecture has used simple and original geometric elements in space and detail and has been able to create a great spatial and detail diversity and make quality spaces through its focus on the boundary space. In Iranian architecture, especially Iranian housing, geometry has a technical and religious background. Man is the creature of God and the architecture is the creature of man. The human is of size and limit and architecture is the same. Any object that has a size will also have proportionality, which is an important issue in aesthetics. Almighty Allah, in the Holy Quran, spoke about the decline of magnanimity in the creation of the world. "Magnitude in the divine word is the same as geometry, and geometry is of magnitude."[8] With this definition, it can be stated that the creation of the world is based on order and geometry, and since God breathed his soul in man, gave him the power of creation. Human work is in fact a godly work, and therefore, the living space and any space created by humankind is a minority world, and it is God's counsel and a sacred space. "Geometry is referring to what is the nature of phenomena. Therefore, geometry is inherent in quality before being quantitative quantity."[9] When a person performs the work of architecture as an act of God and forms it through geometry (the quality which utilizes the essence of divine practice), he actually presents a form of kingdom to the tangible world, the result of this action will be alive and stable. The fifteenth characteristics of Alexander about the living architecture

[8] Holly Quran, Al-Hijr Surah, 21st Ayat
[9] Nadimi, p. 84

put emphasis on geometry and its role, and this reflects the importance of the role of geometry in the life of systems and architectures. The diversity resulted from original and simple geometry that has complex compounds in the rich Iranian-Islamic cultural context is the source of the life of the Iranian home, as shown in the following figure.
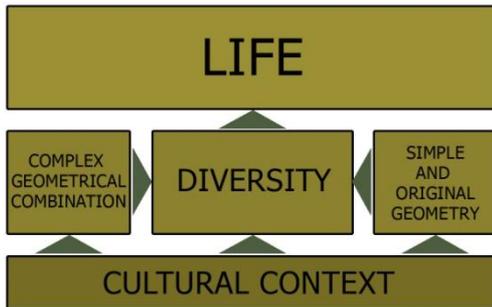

Figure 2: theoretical framework, the relationship between diversity and life in cultural context

IX. CASE STUDY

As previously described, diversity in the boundary spaces of Iranian house will be studied in two spatial and detail diversities. According to Figure 1, there are four types of boundary spaces that will be explored in two spatial and detail parts by presenting images and analyzing them with the views of Christopher Alexander. Boundary spaces in Iranian houses are based on the ability to combine and separate spaces cause diversity in open and close space, floor and ceiling and wall, shadow and bright, cover and finish. Effective factors in this area are scale, perspective, territory, function, light, heat and materials.

In order to avoid word of mouth, houses are selected as examples from three cities of Kashan, Isfahan and Yazd, which belong to the Safavid and Qajar periods. For the two spatial and detail sections, a table is presented according to Table 1, presenting a summary of each characteristic in the homes under study.

A. SPATIAL DIVERSITY (open and close space)

The simple and original geometry that arranges the Iranian house and its organization reflects Alexander's characteristics, and almost all of the above features are emerging through geometry, and more importantly, space and components are of a completely simple geometry possessing complex compounds that commonly occur through boundaries and boundary spaces and create an inseparable wholeness.

Figure 3 shows Abbasian house of Kashan. As it is seen, there is an empty space with simple and legible geometry in the heart of the house by the corridor and junctions with closed spaces connected with precise grading and boundaries. The characteristic of determination is evident in all spaces, and the single spaces all have simple and legible geometry. The gradual shift from space to space is

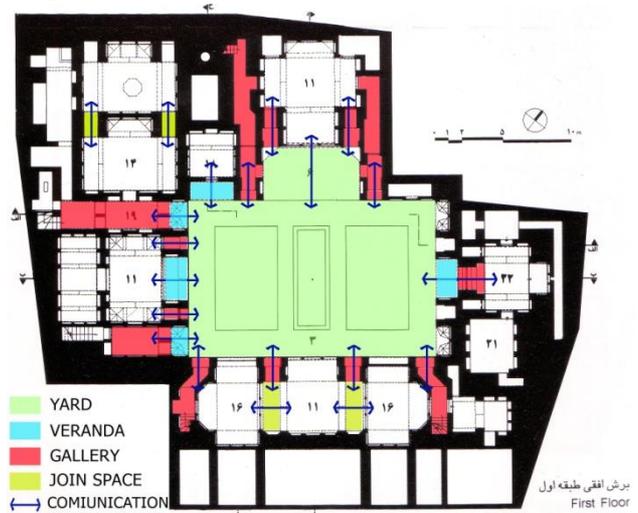evident in the creation of the wholeness and inseparability.

Figure 3: plan of Abbasian house, Kashan (source: Ganjnameh, Kashan houses)

Figure 4 shows Gerami house of Yazd that has simple and original geometry and spatial sequencing has created a good shape, and geometric echoes by changing scales has created a distinct and diverse space that can be separated and combined to define diverse territories, and this results in a variety of individual and group behaviors and function within the family and the ability to memorize in space increases, and as a result, the sense of belonging appears to be strong over time.
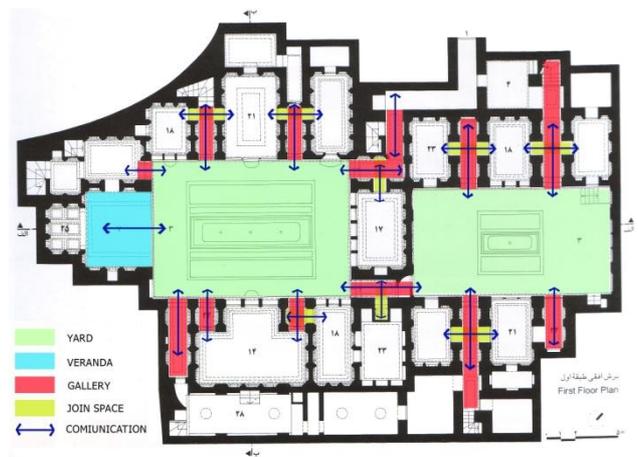

Figure 4: Plan of Gerami house, Yazd (source: Ganjnameh, Yazd houses)

Sharifian's house plan is similar to other houses with simple geometry and the complex combination of boundary spaces creates diverse spaces that can be used to enter a space from several paths and this spatial complexity is a very important point for children's playing and is life-giving. This spatial complexity for entering the house form the alley is also a valuable element that generates deep coherence and ambiguity in the architecture of the house, while also providing a strong control and definition of the territories.
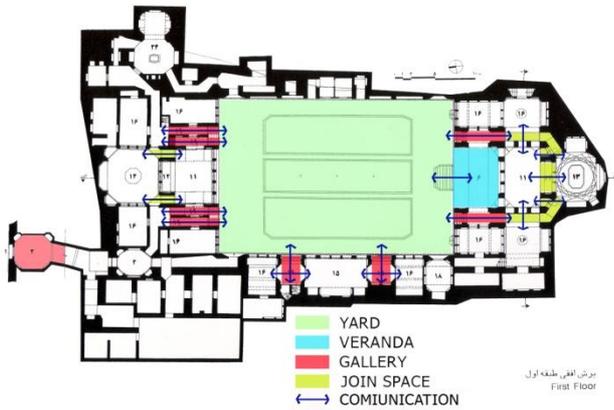
Figure 5: plan of Sharifian house, Kashan (source: Ganjnameh, Kashan houses)

Strong boundaries with nice topical symmetry in plan and walls inside and outside of the house as well as simple geometry in the plan with high diversity in closed spaces in terms of shape and thus contrast, spatial hierarchy and how to access are the architectural features of the Vasigh Ansari house in Figure 6 that has created diverse perspectives with a change in the scale of closed and open spaces.
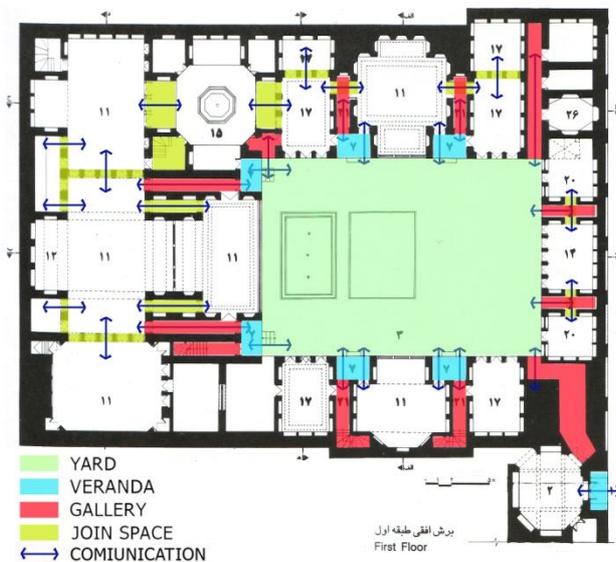

Figure 6: plan of Vasigh Ansari house, Isfahan (source: Ganjnameh, Isfahan houses)

The introduced examples have a distinct structure in spatial organization. The main spaces are of simple geometry, and the wholeness of complex compounds, which are formed through boundary spaces, and in detail are formed through the boundaries and covering and finishes.

B. DIVERSITY IN DETAILS

In the Iranian house, details and ornaments, just like

space, follow the geometry, and, according to Alexander, geometry is simple in its components, but complex in composition. Difference of decorations and arrays in Iran with other parts of the world is due to the religious and

spiritual attitude that has a natural spirit and uses vegetarian and arabesque and geometric shapes. In this section, the light and its role in the construction and life of space is very important. Figure 7 shows the view of the Abbasian house, referring to the entrance of the corridors as one of the boundary spaces where arches, arabesque, Muqarnas, Rasmibandi, door and window details are all of simple geometry that by gradual change of scale and with its alternating repetition has formed a good shape whose echoes are affected by a gradual change, while offering symmetry, simplicity, void and calmness to mankind, leading to the creation of a strong center that itself has smaller centers and is part of the larger centers creating the conditions for wholeness and leads to a sense of lif.

Figure 7 : Abbasian house, the façade of the first half floor (www.tishineh.com)

Figure 8 shows the southern facade of the Abbasian house, which shows the complex and diverse combination of boundary spaces and their communication with the courtyard space. Scale change and retreatment and yachts create diverse combinations so that different types of prospects and temperature variations are possible and create a non-separating combination of space and details by bringing in open spaces.

Figure 8: Southern facade of Abbasian house (www.hamshahrionline.ir)

In Iranian houses, light is as important as space. Stanches that direct light, such as ceiling and wall, are not used solely for the purpose of lighting, but the spiritual aspect of light is targeted, and the light is decorated and arranged with color and geometry, and then entered into space. As a result, walls, floor and ceiling are echoed from the design and color of the window in different hours, and this leads to the inseparability, unity, and wholeness and makes the walls as beautiful boards at home (figure 9).

Gradual change in boundary points, like boundary spaces, is done by a very diverse range of details such as arches, Muqarnas, Rasmibandi, sliders, etc., which indicates the ability to create strong centers through these spaces and points in order to create a sense of life that is generally done by geometry and echo, and gradual change and scale changes and depth. This detail includes the edge of the window or niche to the very large spaces.

Figure 9: Tabatabae house, Isfahan(www.tripyar.com)

Figure 10 shows finishes in two sections of the niche to the main hall of the pool house at the border point of the change of the edge of the wall and ceiling. Muqarnas and Rasmibandi are two form of finishes used in this figure and have simple geometry detail and complex components in general.
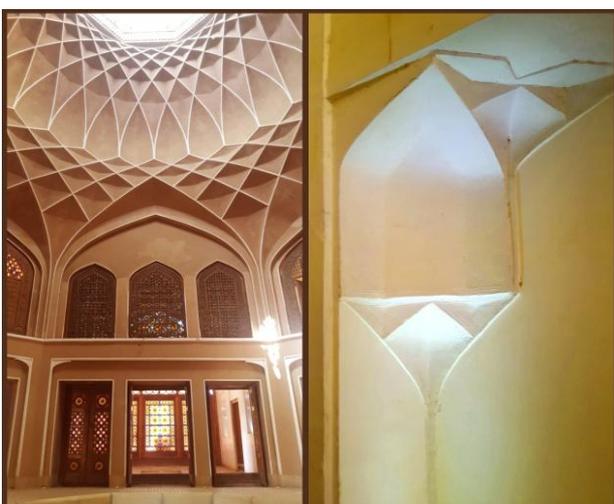

Figure 10: Muqarnas at the edge of the niche (right) and Rasmibandi (left) in the dock of Dolatabad Garden, Yazd (Source: Writer, 2016)

CONCLUSION

Case study showed that the architecture of Iranian homes is of life relying on Alexander's views, and human beings experience a sense of life living in such spaces. Table 2 shows the summary of the survey done.

Table 2: summary of investigating Iranian houses relying on fifteen characteristics identified by Christopher Alexander according to table 1

	Characteristics of living structures	Description
1	Level of scale	The scale in these houses is of hierarchy and has a dimensional relationship, and changes in scale are based on standards.
2	Strong centers	The houses have many strong centers. The main spaces and even the boundary spaces are of the symmetry system, and symmetry emphasizes the focus, which is not necessarily a geometric center, but generally also helps to centralize geometry (central courtyard and closed spaces at focal points of symmetries). We also see the hierarchy of territories from the general to the private that separate and connect with the boundary spaces.
3	Boundaries	The boundaries in the studied houses have a restrictive and defining character, focusing attention on the center they define, they have the most intrusiveness and scale change in their walls and their entrances, and are at the centers they are building.
4	Alternating repetition	Creating a beautiful and subtle diversity with a rigorous and hierarchical repetition in details and ornaments of studies houses are important characteristics of finish.
5	Positive space	Every space in the Iranian house is complete in detail and whole. The characteristic of determination in the space of these homes is a very evident characteristic created with their simple geometry and geometric finish, and more importantly, people have created it over time and have emotional dependency on home, and in the long run, the house is the heirs of their memories.

6	Good shape	The simple and original geometry used with topical symmetries resulted in full and regular forms with finishes influenced by the Iranian visual culture, creating very complex systems, of which the most striking examples are Muqarnas and arabesque.
7	Local symmetries	Simple and geometric shapes and irregular spreading in the components and break down of the first dry geometry in the plan and ornaments, the use of topical symmetry in the whole and detail to create a diverse wholeness causing unity in plurality are evident features of Iranian houses.
8	Deep interlock	Boundary spaces to create strong and indivisible centers that belong to both inside and outside, including the verandahs that bring about coherence. Sophisticated and nested spatial communications increase ambiguity in space. The combination of excitement and tranquility, which is one of the original features of Iranian architecture, is evident through this trait at the Iranian home.
9	Contrast	Creating unity through differentiation has taken place through boundary spaces in order to create diversity. A sense of differentiation in performance and at the same time the ability to combine the functions are the boundary space facilities in the houses studied. Contrast (in ornament, materials, geometry, light and shades and brightness and the experience of different temperatures) makes a difference and accepts distinctions.
10	Graded variation	A gradual change from one limit to the other in the space and ornaments (the boundary between courtyard and room and ceiling with wall), creating diversity and mild variation in size, distance, intensity, material, and characteristics create life in Iranian houses.
11	Roughness	Coordination with a site that is not generally geometric, is designed in-house and based on work capabilities with the help of finishes in details and ornaments, as is clear in the plans, especially in accessing the house from alley,

		corridors and heterogeneous angle variations are seen, which allow for the prosperity of diverse and beautiful landscapes.
12	Echoes	The nature of the same geometry and shapes of the same family with changes in the angles and arches, and the repetition and similarity in general have contributed to this important feature in Iranian homes and, in spite of similarity, has made a considerable difference.
13	The void	Void, both in space and in the architecture of Iran and especially the house, has a special place. The central courtyard is one of the voids, and limits are very important in the plan and the skyline. Silence and tranquility are in the heart of space, not in a remaining space, but designed and organizing other centers.
14	Inner calm	Since geometry is the reflection of the spirit of the building, it creates life as much as it is simple, pure, and original. Iranian house is a geometric space with various combinations. Of course, the simplicity and purity of the makers who regard creation as a godly action also play an important role in the creation of life.
15	Not-separateness	Iranian house is an integral part of the environment. The gradual change of form and space and decorations from the boundaries and boundary spaces, the coherence in the whole and the parts, the crushing of scales in detail and space, which leads to the creation of realms from the public to the private, and defines the functions and behaviors and regulates them.

The purpose of the present research was to provide a theoretical framework to examine the role of diversity in creating the areas of the creation of life in accordance with the view of Christopher Alexander in the Iranian house. The present study suggests that Iranian houses are based on simple geometry in the main spaces and details that cause the creation of a variety of combinations due to complex compounds and, of course, systematic through the boundary spaces and border points in detail, and through the gradual change, which have led to individual and group behaviors within the family with the possibility of control of the realms in their cultural context and

therefore, a pleasing sense of space is created for man. As Gaston Bachelard says, man in the spaces of these houses can drown for hours in his own imagination and experience the calmness away from the excitement and record his memories. The resulting diversity through the boundary spaces makes it possible to reveal the main (open and closed) spaces, develop the wholeness, and symbolism, and to convert simple components to complex and coherent wholeness. By moving from these spaces, humans experience gradually another space and retrieve a new place.

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