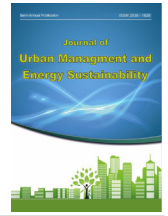# Journal of Urban Management and Energy Sustainability (JUMES)

ORIGINAL RESEARCH PAPER

Analytical evaluation of transparency in the spatial configuration system of Shahneshin Hall in the Garden-mansion of the Qajar period of Shiraz using the space syntax technique (Case studies: Eram, Afif Abad, Narenjestan-Qavam and Shapuri garden-mansion)

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ABSTRACT

Transparency is one of the qualities of the spatial structure in Iranian architecture, but it has less theoretical explanation, in order to investigate the concept of transparency, the aim of research is to evaluate the spatial structure of the particular marks of the Qajar period and the examples investigated in the city of Shiraz city. In this research, descriptive and analytical methods have been used to describe the characteristics of the research samples, and the "comparative study and analysis" method has been used to analyze the data in the evaluation of the spaces. This type of study deals with creating relationships between two or more phenomena, through analysis, explanation, explanation of their characteristics, differences, and possible similarities and after that Spatial structure analyzed using Depthmap software in four garden-mansion case such as Eram, Afif abad, Shapuri and Narenjestan Qavam to evaluating location of Shahneshin hall up to the transparency matter. The results show Shapuri Garden-Mansion has the highest amount of transparency, followed by Eram Garden-Mansion, then Narenjestan Qavam Garden-Mansion, and finally Afif Abad Mansion. Finally, it can be concluded that because the Shapuri Garden-Mansion has the highest quantitative value in the four indices of depth, visibility, coherence and legibility, it has more spatial transparency than other mansions.

Running Title: Transparency in the spatial configuration system in the Garden-mansion of the Qajar period

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
65	24	28

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INTRODUCTION

One of the most important architectural topics from the past until now has been the category of space. This word along with many suffixes such as mental space, public and private space, social space, cultural space, etc. Is used by both public and private. On the other hand, the concept of "space" is one of the most important architectural topics that have always been the focus of architects and researchers. Also, the concept of space has had a special importance in Iranian architectural studies. That is, what the architects organize by means of physical elements, and it has characteristics beyond its material elements. The success of an architectural work depends on the relationship between the materials that make up the space and the meanings issued from it. Architecture, as an art of space, unlike other arts, requires more effort from its observer. The mentioned studies have all emphasized the perception of space as a fundamental aspect of understanding architecture. In fact, spatial cognition is the most important aspect of our environmental experiences, and one of the most significant examples of these spatial experiences is the perception of a quality of space called "transparency". Although transparency is one of the qualities of the spatial structure of Iranian architecture, but it has less theoretical explanation, for this reason, in order to investigate the concept of transparency in Iranian architecture, this research examines and interprets the spatial structure of the landmark works of the Qajar period and the examples examined in the city of Shiraz with the use of space syntax technique. Considering that Iranian art during the Qajar era caused major differences in values, thoughts, tendencies and methods of architecture and urban planning due to the changes it had in various political and cultural fields. This diversity, which was largely influenced by the contrast of tradition and modernity in various fields, has been manifested most of all in the field of architecture of residential buildings. These differences have occurred in all the components of a house from the beginning to the other interior spaces, while the analysis of the shape and spatial structure and the analysis of the configuration of these buildings have been given less attention. Also, taking into account the theory proposed by Bill Hillier (1986), for the first time, referring to the space difference factor, he investigated different spatial values in a plan using quantitative methods (mathematical relationships of space syntax). Became. This is despite the fact that until now, in Rappaport's theories, the recognition of spatial value was only done using qualitative methods. Based on this theory, the present research tries to extract the differences and similarities in the spatial patterns used in the historical Qajar mansions in Shiraz city, which is to investigate and evaluate the spatial connections of the plan and the place of the Shahneshin space with the surrounding spaces in this Mansions using Depthmap software shows that the comparison of different graphs obtained to analyze the relationship between this space and the surrounding spaces in the historical Qajar mansions of Shiraz can be the foundation of a new perspective in this regard.

MATERIALS AND METHODS

Methodology

In this research, descriptive and analytical methods have been used to describe the characteristics of the research samples, and the "comparative study and analysis" method has been used to analyze the data in the evaluation of the spaces. This type of study deals with creating relationships between two or more phenomena, through analysis, explanation, explanation of their characteristics, differences, and possible similarities.

The first step: review and analysis of case samples, gathering the required information by using library studies by referring to the documents and first-hand sources in the relevant writings about the better understanding of the case samples in order to analyze the case samples that include the garden mansions. The history of Qajar is in the city of Shiraz.

Second step: Spatial structure analysis using Depthmap software, Depthmap software is one of the tools used to analyze different spaces from urban spaces to architectural spaces. Using this software, indicators such as depth of space, visibility, coherence and cone of vision are examined. This software has capabilities that can be used to check the functional efficiency of different spaces using the mentioned indicators (Van der Hoeven and Van Ness 2014, 71). Using the capabilities of this software and the main purpose of this research is to examine the aforementioned cases, the following 4 graphs were extracted: depth, correlation, visibility, readability, R2 index.

Third step: conclusion

Analyzing and summarizing the comparisons made using the graphs obtained from the Depthmap software regarding selected case samples.

Spatial configuration

Spatial configuration deals with the way spaces are arranged next to each other and their mutual relationship with each other (Sajadzadeh et al., 2015: 16). In spatial configuration, the relationship between activity and space can be understood and defined in the existing relationships between spaces or the spatial organization, as well as the relationship between the users of the space, rather than in the characteristics of the space (Siadtan and Pour Jafar, 2013: 29). The form and function of the space, the way the spaces are placed in relation to each other, the spatial hierarchy, accessibility, etc. Are among the factors affecting the configuration of the space, each of which is based on criteria such as interconnectedness (the degree of access to the spaces), depth (spatial isolation)., isolated parts in the space), connection (connection of spaces with each other) and... Can be evaluated in different spaces based on the factors affecting the communication and interactions of the users of the spaces. Configuration is a set of relationships between spaces that exist in a special position in time, configuration may provide conditions to facilitate or limit visual and physical connections, while humans try to structure while using

the artificial environment. Giving these links and making them manageable. Based on the definition of this process, decision-making in the field of behavior, about what has been done in the artificial environment and how the location of spaces differs from each other, is called spatial cognition (Rappaport, 1977:246). From the point of view of space arrangement theory, configuration or spatial arrangement refers to the quality of the relationship between the elements of a system, in such a way that a change in a relationship affects the totality of relationships in the system (Hillier and Vaughan, 2007:207). Usually, a configuration, such as the complex construction of language, is described based on words such as (adjacent) and (between) that express the simplest forms of spatial relationships. Spatial configuration means the way spaces are arranged next to each other and their mutual relationship with each other. In this way, it can be concluded that any change in the arrangement of spaces will create changes in the overall level of spatial configuration (Sejadzadeh, 2015). Spatial configuration is a subject that has always been the focus of various researchers (Karlen 2009). Hiller and Hanson (1998 and 2001) believe that in addition to the physical elements of the building, spatial configuration is one of the important factors in shaping the architectural space, also "space layout" includes a set of techniques for modeling, quantifying and spatial organization in buildings and structures. It is proposed to study and find effective factors and hidden patterns beyond the form of settlements. By studying spatial organization, this theory deals with how it interacts with social structures and the behaviors and activities of users (Hosseini Ghiathund Vesahili 2015, 364).

Space Syntax

Analyzing the shape of the building and understanding the relationships between the spaces in each spatial configuration is a science that is referred to as the syntax of space in architectural discussions (Memamarian, 2008). This science, which is referred to as space

syntax technique, was founded by Bill Hillier (Hillier and et al, 2005). The importance of this method becomes more apparent from the fact that it can be used to understand the social and cultural logic of the formation of different spaces in each architectural configuration (Hillier, 1996:77). The location of the space in a spatial configuration system and its relationship with other neighboring spaces lead to the creation of a pattern of space organization. In such a situation, a hierarchical order governs the space, which is derived from the type of establishment of spaces in the general system of spatial configuration, and the most suitable method to investigate such a concept in spatial structures is the method of space syntax (Heidari et al., 2016: 22).

The most important central concepts of space arrangement technique are "connected", "depth", "co-connection", access", the definition of each of which is presented in table 1:

Table 1: Space syntax Indicator

Indicator	Equivalent in software	Description	Fundings and Analysis
Depth	Depth	* Metric depth: distance (number of steps) between two points. * Stage depth: the number of spaces that a person must travel from one point to reach another point (Mamarian, 2008). * As the depth of the space decreases, the separation and separation of the space are reduced and as a result, the space is more integrated, which indicates the higher value of integration and more accessibility of the space (Haq, 1999:4).	In addition to separation and separation, increasing the spatial depth also leads to an increase in the degree of spatial privacy. In the sense that the greater depth of the space complex causes the spatial hierarchy and the reduction of access and influence of some spaces, which leads to the control of the space more and more. Therefore, by increasing the depth, the controllability of the space increases and as a result, it leads to the creation of the privacy factor in the environment.
Cone of vision	Isovist	This index is measured from the perspective of visual access and physical access, which is referred to as visual access as isovist and physical access as metric depth.	
Integration	Integration	* The degree of continuity or separation of the space compared to other spaces in the configuration. A space has a lot of connections that have more integration with other spaces. * Conjunction has something to do with depth; * It is called a connected space when other spaces in the environment are located at a relatively small depth of it. In this way, to move from any space with a high correlation value to all other spaces in the system, less changes are formed in the person's orientation (Peponis & et al, 1990:765; Penn, 2003:45). * It has a direct and linear relationship with the connection index;	The greater the number of connections with a space from its neighboring spaces, the more connected that space is. From the analysis of two indicators of connection and co-connection, the readability value of the building is measured, which indicates the degree of complexity or ease of spatial relations.
Chart of Readability	R2	Readability or correlation depth chart or R2 index. The closeness of the obtained value to 0.5 indicates maximum readability and ease of access, and its closeness to 0 indicates the complexity and illegibility of the space. On the other hand, the degree of spatial privacy is related to the degree of their connection with the entire space and as a result, the ease of access to it. Accordingly, in addition to the general measurement of legibility or spatial complexity, the overall degree of privacy of the building can be evaluated using the legibility diagram. (Haidari, 2016:29).	The readability chart includes depth information and a link that increases the transparency of the R2 index obtained from the readability chart.

Transparency of spatial structure

The concept of "space" is one of the most important topics in architecture, and spatial awareness is considered the most important aspect of our environmental experiences. One of the types of these spatial experiences is the perception of a quality of space called "transparency" (Row & Slutzky, 1963:44). Transparency is one of the basic aspects of space (Memarian, 2017: 357).

Nader Ardalan defined transparency as the concept of continuity of positive spaces, and emphasized it as one of the important concepts in understanding Iranian architecture (Ardalan, 1973:45). Architecture, with greatly depending on the continuity of positive space, does not create any interruptions and obstacles in the flow of human movement. Man, continuously moves in the undulating and unfolding space, which remains unified forever (Ardalan and Bakhtiar, 1390:47). The positive space connection system creates an order of relationships that makes the forms assemble correctly. As a result, the separate forms become one and make a whole and maintain the rhythm. (Ibid.: 97). Therefore, in Persian, transparency means something that can be seen from the outside, what is inside; (Dehkhoda, 1349). After extensive investigations on the transparency component and its investigation in the spatial structure system of Iranian architecture, it can be stated that these concepts and principles, while they have differences with each other, also have common points, so before addressing the issue and examining the principle Transparency in the buildings of the Qajar period in Shiraz, it is necessary to provide a precise definition of this principle in architecture from the point of view of different experts, therefore, some of the most important concepts are given in table no. and readable from the principle of transparency in this research. (Tab 2)

According to the definitions expressed from the point of view of the experts, some elements about the concepts of transparency were extracted, which are shown in diagram Fig 1 and 2.
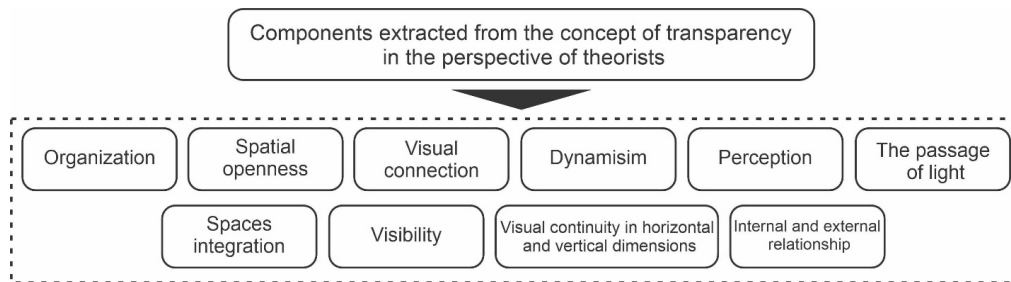

Figure 1: Components extracted from the concept of transparency in the eyes of architectural experts
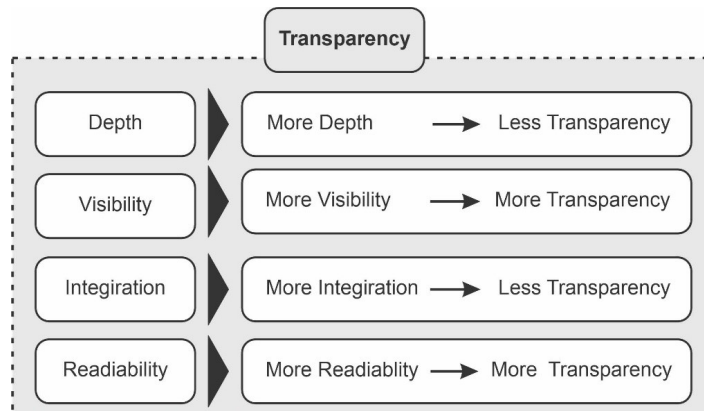

Figure 2: The relationship between space syntax indexes and the transparency component

Table. 2: Examining the concept and definitions of transparency from the perspective of architectural experts

Theorist	Year	Description
Barker	1997	Scientific and technical glossary: the ability of an object to transmit light or different wavelengths, transparent, transparent, smooth
Oxford	-	It is referring to a situation that makes it easy to understand something.
Mohammad Taghi Jafari	2006	The principle of transparency in the world of art works to make a diagram of the abstraction of unity from the gradual transformation of darkness into lightness and reduction of quantities.
Darab Diba	1999	Transparency has concepts such as internal and external communication, continuity, integration. The concept of transparency and continuity is against a closed and finished space. In such a space, the path of human movement or his gaze is continuous, so that spatial openings on horizontal and vertical lines cause transparency in the walls and columns, and the perspective and the final view in an infinite horizon, again life and expression. It just takes over.
Titus Burckhardt	2001	According to the spiritual vision of the world, the beauty of a thing is the transparency of the existential and material coverings of that thing. The effect is its interior and its content or the manifestation of the kingdom of the world in its material existence.)
Noghre kar	2008	* This principle can be called the organization of vision or the organization of perspective rather than transparency; Because it is more compatible with the principle of space independence. Transparency, in a better sense, is the lightness and purity of architectural spaces in the Islamic era, which has the characteristic of reducing the mass and mass of the building and increasing its empty space. * In the wisdom of Islamic art, transparency is the breadth of vision, and since the main vision of man is his spiritual vision; Transparency is the possibility of penetration from the appearance of the work to its interior and content, or the manifestation of the universe in its material existence. In a general classification, transparency has two characteristics: 1-reducing the mass and mass of the building and increasing the empty space, 2-manifesting the inner and divine aspects of materials and materials with various methods using light and its reflection in patterns and colors.
Row and Stale ski	1963	Transparency leads to clarity, and in contrast, there is ambiguity
Canavan	2010	The literal meaning of transparency refers to the physical expression of matter and its practical meaning refers to the quality of the organization of spaces.
Forty	2009	In the dictionary of modern architecture, transparency is one of the key words of the 20th century. An expression used for transparency in the architecture of most parts of the world; It is attractive in creating a sequence of spaces inside and outside the building
Misra	2010	In architecture, transparency is a quality of space that is created in the relationship between the interior and exterior surfaces of the space, and in fact, its rigidity is reduced and it becomes transparent. In understanding transparency from the perception of space, the connection between inside and outside is extended to the concepts of continuity, integration, and wholeness.
Collin Row		Transparency always happens where there are places in space with two or more levels of meaning; That is, there is a great variety of communication between vertical and horizontal levels, and each of these cases creates a kind of spatial transparency.
Shultz	2014	Transparency is one of the manifestations of open plan and open form.
Dandies	2009	In the book Basics of Visual Literacy, transparency is a technique and is the opposite of opaque, and in graphic and visual works it is defined as follows: In this technique, the details of visual elements can be seen behind the main element.
Roast	2008	Transparency can be seen as a factor in achieving the internal and external continuity of the building

Continuity of spaces is one of the most important features of the spatial structure of architecture, which, while determining and defining certain boundaries of each space, makes the spatial structure continuous and continuous. Such a spatial experience can be explained in the form of perceptual-movement transparency, which has been evaluated for the purpose of this research with the spaces in the investigated samples such as Shahneshin Hall and its surrounding spaces. As a result, Iranian architecture forms a transparent and continuous relationship between inside and outside. Iranian architecture is transparent and continuous, and at the same time it has privacy, confinement and definition. Based on the definitions of transparency and the indicators that were analyzed in the Depthmap software, the close relationship between these two issues can be seen in Fig 2:

Architecture of the Qajar period

Iran's architecture in the past has always had a clear and consistent trend, which often had a logical relationship with the previous and subsequent periods, but in the Qajar and Pahlavi eras, we see a break in Iranian architecture. What has caused this transformation and rupture in Iranian architecture is the intellectual and cultural transformation of Iranian society that began in the Safavid period and reached its peak in the Qajar period. The Safavid era was born, but since these changes had not yet had much effect on architecture, the beginning of the transitional period in Iranian architecture should be considered the Qajar period (Akbarian, 2013). At the beginning of the Qajar dynasty and the selection of Tehran as the capital, the architecture related to the ruling class, according to the political power and economic strength of the statesmen in various historical periods, a variety of architectural works emerged, mostly with names such as Qasr, Kushk, Throne, mansion and words like this were known. These buildings, while enjoying the artistic achievements of the previous period in all types of architecture, including royal and folk architecture, include features in terms of architectural structure and array that

stand out from other structures of their own and previous periods.

Qajar period architecture in Shiraz

After the Zandiye government came to power and Shiraz was chosen as the capital, Karimkhan Zand built buildings in this city that are suitable for the capital. From Karimkhan Citadel, which was the residence of him and his family, to Divan Khaneh, the city's commercial complexes such as the bazaar and even religious centers such as the Vakil Mosque and public buildings such as the bathhouse and water storage, were built purposefully and systematically. This caused the establishment of residential buildings in the city according to the existing situation. But in the Qajar period, due to the influence of foreign relations, architecture and house building in some cases resulted in pure imitation of Western works, which is mostly seen in the decorations and sometimes in structural and architectural forms and elements. In the Qajar period (1170-1304 AH), we are faced with various events, including the rule of numerous Qajar princes, the formation of a dual group of the Qashqai clan and allied tribes, the increase in the role of religious scholars in politics, the entry of more western goods, as well as the continuation of the local autonomy of the influential khans and landowners and the relative independence of the urban nobles, he pointed out that this important thing caused Shiraz to have many ups and downs in many parts during this period, so in the Qajar period, three families of All of them were more powerful and often engaged in government work and competed with each other. These three families were the Qavam family, descendants of Haj Mirza Ibrahim Khan Sheriff, who mostly held the post of Shiraz Sheriff and lived in Balakoft neighborhood. The elders of this family, who often had the title of Qawam al-Mulki, built various buildings in the western part of Bala Kaft neighborhood, most of which have remained to this day, and the most famous of these buildings are Diwankhaneh Ya Qawam (Naranjestan) and Andron Qawam (Zinat al-Mulk House), which Both are located
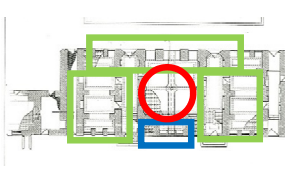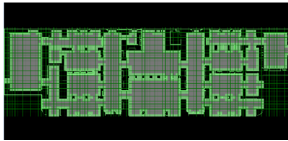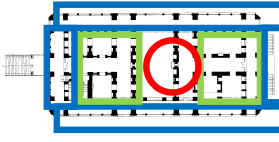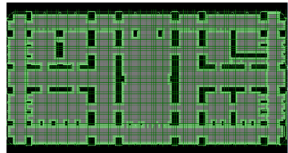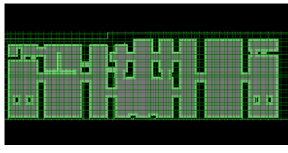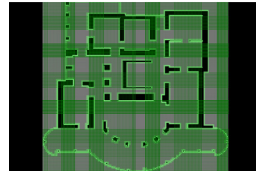
at a distance of one alley next to Lotfo Ali Khan Zand Street. Hasina Qavam is located next to the south side of the same street. The second family is the Moshir family, who often held the position of the Ministry of Fars. The most famous member of this family is Haji Mirza Abul Hasan Khan Moshir al-Mulk. The residence of this family was in the Seng Siah neighborhood, and the buildings they built in this neighborhood where the mosque, Hosseiniyeh, and Moshir House, which is still standing. The third family is the family of Qashqai clan leaders who lived on the west side of the Maidan Shah neighborhood. The complex of their buildings, which is known as the mosque, the garden, the Hosseiniyeh and the Ilkhani bath, is located in this neighborhood. (Afsar, 1995). (Tab. 3)

Case Studies

In the current research, the method of selecting the samples is to select the historical mansions of Shiraz gardens of the Qajar period, firstly, there are sufficient documents and information about their architecture and construction, and secondly, the building itself and its decorations exist in order to collect correct and sound field information. And thirdly, have the most coordination with the preparation of the obtained data. Therefore, the statistical population of the research is a number of historical mansions of the gardens of the Qajar era,

Table 3: Statistical population of the research

Mansion Name	Construction Year	Facade	Plan — Porch / Shahne shin / Surrounding spaces	Plan in software DepthmapXnet 0/35
Eram Garden-mansion	1818-1897			
Afif abad Garden-mansion	1867			
Narenjestan Qavam Garden-mansion	1873 – 1887			
Shapuri Garden-mansion	1926			

which are complete in terms of architecture and decorations and have been restored, and traces of the influence of art, architecture and western culture are evident in them. These mansions are: Aram Garden-Mansion, Narenjestan Qavam Garden-Mansion, Afif Abad Garden-Mansion, and Shapuri Garden-Mansion. In table 2, explanations about the name of the building and the year of construction and the image of the facade, as well as the location of the royal hall and the porch and the spaces around it, as well as a picture of the plan of the mentioned buildings in the software environment were presented. Are shown in Fig. 3.

DISSCOUSION AND FINDINGS

In this section, the configuration of the buildings is analyzed using Syntax of Space software. In this research, this software was analyzed in order to analyze the depth, visibility (isovist), coherence and readability index Physical access check was done with metric depth. Metric depth can be extracted using Depthmap software. As the depth of the space decreases, the separation and separation of space are reduced, and as a result, the space is more integrated, which indicates the value of higher integration and more accessible space (Haq. 1999:4). In the space syntax technique, visual accessibility refers to as isovist. Visual accessibility means the amount of space that can be perceived by the sight. (Lazaridou, 2013: 2). isovist is examined step-by-step in software; This means that at this stage, like a photographic camera, the exact limit of normal human vision (120 degree viewing angle) is determined. Using this analysis, it is possible to examine the amount of space that can be seen by the observer at each stage. In this research, according to the type of buildings and their common spatial characteristics, including the Shahneshin hall and its surrounding spaces, a stage was chosen for isovist, which includes a view from the point of the Shahneshin hall to the surrounding spaces. The physical access component in this software was evaluated with metric depth and finally the clarity or readability of each building was checked with the R2 connection diagram. The proximity of the obtained value of correlation and the index to the number 0.5 indicates the maximum readability and ease of access, and its proximity to the number 0 indicates the complexity and illegibility of the spaces. The images and numbers related to the software analyzes of these four buildings are shown in Tab. 4.

At this stage of the research, using the numbers extracted from the software for each of the mansions and presented in Table. 4, the mansions can be expressed in the following four components by comparing the numerical average of each one. Of course, in the following, the connection between these four indicators and the transparency component will be fully investigated:

Depth

By comparing the numbers extracted in Table No. 4, it was found that Bagh Shapuri Garden-Mansion has the lowest depth with the number 305/132. And also, Afif Abad Garden-Mansion with the number of 688/186 has the highest amount of depth and this is due to the arrangement of Shahneshin Hall space and its location in the plan, as can be seen in Afif Abad Garden Mansion, Shahneshin Hall is more central than Shapuri Garden-Mansion. Is more, in such a way that the marking of the royal hall of the Afif Abad Garden-Mansion can be seen completely in the middle of the plan, in other words, it can be clearly said that this space is connected with more spaces around it, of course, the dimensions and the plan form of Shahneshin Hall also has a significant impact on the analysis of the numbers obtained in the software. In Table No. 5, this information about the examined samples is stated. (Tab. 5)

According to the comparison of the numbers in table number 5, it can be concluded that the hall of the Shapuri Garden-mansion has a shape closer to a square due to the ratio of the plan dimensions, therefore it has less depth, also the hall of the Afif Abad Garden-mansion has a rectangular shape according to the dimensions of the plan. So, it has more depth.

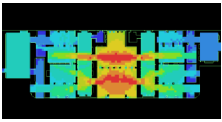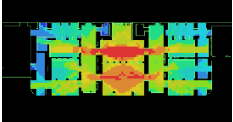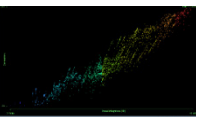Table 4: Software analyzes (shape) in space syntax theory
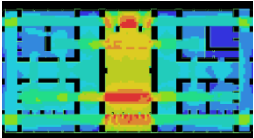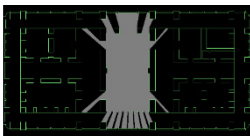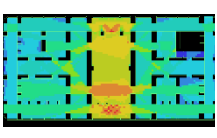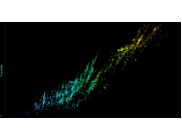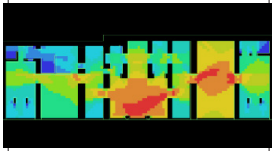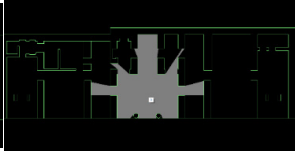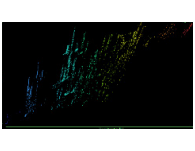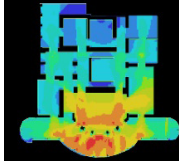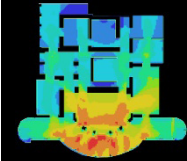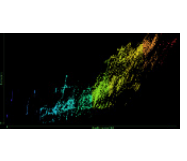
Mansion Name	((Visibility Graph			Isovist))			Integration			R2 (Visibility Graph Analysis (VGA)
Realm										
	Min.	Mid.	Max.	Min.	Mid.	Max.	Min.	Mid.	Max.	Index R2
	20	382.623	682	131.596	131.596	131.596	20	332.893	690	0.818
Afif abad										
	Min.	Mid.	Max.	Min.	Mid.	Max.	Min.	Mid.	Max.	Index R2
	11	688.186	1801	101.956	101.956	101.956	11	47/700	1801	0.522
Narenjestan qavam										
	Min.	Mid.	Max.	Min.	Mid.	Max.	Min.	Mid.	Max.	Index R2
	20	317.613	690	126.419	126.419	126.419	20	705/319	690	0.541
Shapuri										
	Min.	Mid.	Max.	Min.	Mid.	Max.	Min.	Mid.	Max.	Index R2
	20	305.132	672	199.697	199.697	199.697	20	297.132	672	0.894

Table. 5: Details of the plan of Shahneshin Hall

Index	Eram Gra-den-Mansion	Afif abad Graden-Mansion	Narenjestan Qavam Graden-Mansion	Shapuri Graden-Man-sion
Plan dimension	10.5*8.10	8.17 * 16.69	9.20 * 8.10	* 6.70 8.28
Area	85.5	136.35	74.52	47/55
Plan form	Rectangle close to square	elongated rectangle	Rectangle close to square	square

Isovist

Isovist in these buildings, despite having general common features, but also has differences. By observing the values obtained from the Isovist of the Shahneshin Hall in each of the mansions in question in Table No. 4, it is clear that the values obtained for all four mansions investigated in Shiraz are that Shapuri Garden-mansion due to the plan form of the Shahneshin Hall which is curved and radial, has the maximum numerical average of the visual cone (199/697). Afif Abad Garden-mansion with the number of view cone equal to 101/956, due to the shape of Shahneshin hall plan which is elongated, has the minimum value.

Integration

As stated in Table No. 1, co-linking is somehow related to depth. Therefore, by comparing the numbers in Table No. 4, it can be said that Bagh Shapuri Garden-mansion with the number of 297/132 has the lowest correlation. And Bagh Afif Abad Garden-mansion with the number of 700.47 has the highest number of connections.

Readability

By evaluating the shape and numbers of the tables related to the graphs extracted from the software, it can be concluded that in all 4 buildings, the average readability index graph R2 of the Shahneshin hall is more than 0.5 compared to the surrounding spaces, and this indicates acceptable readability for It has all the buildings. But as can be seen, due to the spatial configuration of the mansions in Shapuri and Eram Garden-mansion, these numbers are more than the mansions in Narenjestan Qavam and Afif Abad Garden-mansion. The reason for this can be considered to be the lesser depth of the royal hall in these spaces. On the other hand, due to the location of Shahneshin Hall in the plan, it is more possible to access the hall from other spaces, so it can be said that because the access to the hall in the two mansions of Shapuri and Eram is easier compared to Narenjestan and Afif Abad, more numbers in the field are assigned R2 index.

The relationship between the four indexes of the space syntax software with the transparency component:

By summarizing the mentioned materials about the quantitative values extracted from the software and taking into account the analyzes that were mentioned as well as examining the explanations about the issue of transparency, it can be concluded that based on the mentioned indicators, the relationship between depth and spatial transparency is a relationship. It is reversed. According to Table No. 5, based on the comparison of the index of depth and coherence, the Shapuri Garden-mansion has the least depth, the least coherence and the most spatial transparency in the configuration of Shahneshin Hall. Based on the visibility index according to diagram number 3, which stated the direct relationship between the visibility cone and spatial transparency, it can be said that the Shapuri Garden-mansion has the highest visibility cone due to the curved shape of the plan and the number and dimensions of all-round windows compared to other buildings. The royal hall faces the surrounding spaces, as a result, it has the highest amount of spatial transparency, and the Afif Abad Garden-mansion is due to its rectangular plan and the enclosing of this space by two T-shaped corridors on both sides of the hall. The placement of the window on the small side (width) of the hall has the lowest amount of vision cone and as a result the lowest amount of spatial transparency among the investigated buildings. Based on the readability index, it can be concluded that the Shapuri Garden-mansion, due to the symmetry of the plan and the lesser depth of the royal hall, as well as the continuity formed in the layout and spatial relationships of the plan, as well as the location of the hall, which is in a place that makes it easy to access and the length of the path It is less than the entrance to Shahneshin Hall, so it has maximum legibility and greater spatial clarity.

But in the Afif Abad mansion, we experience this issue on the contrary, due to the complexity of the arrangement and spatial relationships of the

plan compared to the Shapouri Garden-mansion, as well as the need to access the hall space after passing through the T-shaped corridor and the many surrounding rooms, which makes it complicated. The lack of access to the space of the Shahneshin Hall has made it possible to say that the Shahneshin Hall in the Afif Abad Garden-mansion has less spatial transparency. (tab.6)

CONCLUSION AND RESULTS

Spatial transparency in architecture has been one of the characteristics of Iranian architecture, and accordingly, the main goal of this research is to analyze the transparency of the spatial structure and compare the structure and unique architectural features of the Qajar period historical mansions in Shiraz city. The mansions of these four gardens, despite having many similarities in appearance, have differences that have finally affected the spatial relationships between these mansions. In order to achieve this goal, the space syntax technique and the analysis of graphs and diagrams extracted by this software have been used to evaluate the spatial location of Shahneshin Hall with its surrounding spaces, and to examine the spatial transparency component in case examples. Using the diagrams available in Syntax of Space software and quantitative data related to each of the selected samples, the spatial structure of Shahneshin Hall and its surrounding spaces, as well as the relationship of each index with the transparency component, were investigated. Based on the findings of the research, the results obtained include those that were classified based on the type of indicators, one of the indicators is the spatial depth, and the findings related to this indicator are expressed as follows:

• The dimensions and location of "Royal Hall" in the samples studied are different from each other in terms of depth.

• Due to the ratio of the plan dimensions, the hall of the Shapuri Garden-Mansion has a square shape, therefore it has less depth, and the hall of Afif Abad Garden-Mansion has a rectangular shape according to the dimensions of the plan, so it has more depth.

• The relationship between depth and spatial clarity is an inverse relationship. Based on the comparison of the depth index, Shapuri Garden-Mansion has the least depth and the most spatial transparency in the configuration of Shahneshin hall.

• After quantitatively comparing the numbers obtained in the space syntax software regarding the depth index, and examining its relationship with the spatial transparency component in the architectural structure of the Shahneshin Hall of the case examples, it is possible to order the amount of the spatial transparency component in the Shahneshin Hall of the buildings from the highest to the lowest amount, as follows:

Shapuri Garden-Mansion has the highest level of transparency, followed by Narenjestan Qavam mansion, then Bagh Eram mansion and finally Afif Abad Garden-Mansion.

Table 6: The relationship between the four indexes of the space syntax software with the transparency component

Index	Eram Garden-Mansion	Afif abad Garden-Mansion	Narenjestan Qavam Garden-Mansion	Shapuri Garden-Mansion	The order of the ranking of the Garden-Mansion in terms of greater degree of transparency
Depth	382.623	688.186	317.613	305.132	1- Shapuri 2-N. qavam 3-Eram 4-A. abad
Isovist	131.596	101.956	126.419	199.697	1- Shapuri 2-Eram 3- N. qavam 4- A. abad
Integration	332.893	700.47	319.705	297.132	1- Shapuri 2- N. Qavam 3- Eram 4- A. abad
Readability R2	0.818	0.522	0.541	0.894	1- Shapuri 2- Eram 3- N. qavam 4- A. abad

Due to the close relationship that two indices of depth and co-linkage have with each other, the conclusion expressed from the examination of the depth index also applies to the index of co-linkage.

Based on the cone of vision index, the obtained results include the following:

- Due to the plan form of Shahneshin Hall, which is curved and radial, the Shapuri mansion has the maximum numerical average of the viewing cone. Afif Abad mansion also has the minimum amount due to the shape of the Shahneshin hall plan, which is elongated in a rectangular shape.

- Based on the direct relationship between the field of view and spatial transparency, it can be said that the Shapuri Garden-Mansion has the largest amount of field of view from the Shahneshin Hall to the surrounding spaces due to the curved shape of the plan and the number and dimensions of the windows throughout, and as a result, it has the highest amount of spatial transparency. Be and Afif Abad Garden-Mansion due to the plan form which is elongated and also the enclosing of this space by two similar T-shaped corridors that exist on both sides of the hall and also the location of the windows on the small (width) side of the hall, has the lowest amount of vision cone and As a result, the spatial transparency is the lowest among the examined buildings.

- After quantitatively comparing the numbers obtained in the space syntax software about the cone of vision index and examining its relationship with the spatial transparency component in the architectural structure of the Shahneshin Hall of the case examples, it is possible to order the amount of the cone of vision component in the Shahneshin Hall of the mansions from the highest to the lowest amount, as follows:

Shapuri Garden-Mansion has the highest amount of transparency, followed by Eram Mansion, then Narenjestan Qavam Garden-Mansion, and finally Afif Abad Garden-Mansion.

Based on the readability index, the obtained results include the following:

- In the spatial configuration of the plan of the mansions in Shapuri and Eram Garden-Mansion, the readability index numbers are more than those of Narenjestan Qavam and Afif Abad Garden-Mansion, the reason for this can be the larger plan dimensions of the Shahneshin space and in other words, the deeper these spaces are. considered

Considering that the greater the readability, the greater the ease of access in the spatial relationships of the plan. Therefore, because the Shahneshin Hall is located in the center of the plan in the Shapuri and Eram Garden-Mansion, it is possible to access the hall from other spaces, so it is possible to He said that because it is easier to access the hall in Shapuri and Eram Garden-Mansion compared to Narenjestan, Qavam and Afif Abad, they have more numbers in the readability index.

- Based on the direct relationship between legibility index and spatial transparency, it can be concluded that the Shapuri Garden-Mansion is important due to the symmetry of the plan, as well as the continuity formed in the layout and spatial relationships, as well as the location of the hall in a place that makes it easy to access and the length of the path is less than the entrance to Shahneshin Hall, in other words, it has less depth, so it has more spatial transparency.

- After quantitatively comparing the numbers obtained in the Syntax of Space software regarding the readability index and the effect of the spatial transparency component in the architectural structure of the Shahneshin Hall of the case examples, it is possible to order the amount of the readability component in the Shahneshin Hall of the buildings from the highest to the lowest value. He stated the following:

Shapuri Garden-Mansion has the highest amount of transparency, followed by Eram Garden-Mansion, then Narenjestan Qavam

Garden-Mansion, and finally Afif Abad Mansion. Finally, it can be concluded that because the Shapuri Garden-Mansion has the highest quantitative value in the four indices of depth, visibility, coherence and legibility, it has more spatial transparency than other mansions.

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