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A Comparative Study of the Qualities of Visual and Physical Accessibility in the Spatial Patterns of Contemporary and Traditional Houses Using the Space Syntax Technique

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ABSTRACT

Changes in people's lifestyles and culture over time have led to major changes in the spatial system of contemporary houses compared to traditional houses. These changes have sometimes resulted in different qualities in the spatial system of houses, one of the most important of which is the change in the (physical and visual) access qualities in contemporary houses compared to traditional houses. Therefore, the present study aims to compare the qualities of visual and physical accessibility in traditional and contemporary residential uses in Iran and to identify the factors affecting these changes. So, the main research question is: How do the qualities of visual and physical accessibility influence the structure of spaces and the connections between them? To answer the question, in the "Analysis" section, the Depthmap software is used, the outputs of which are used to analyze the intended patterns. The samples examined in this research include four traditional single-courtyard houses and four apartments, as contemporary samples, in Kashan City. For each of both traditional and contemporary groups, visual and physical accessibility is analyzed separately using the abovementioned software, and after extracting the characteristics of each of them from the software, the similarities and differences between them are described and analyzed. An important part of the results indicates that changes in different states of physical and visual accessibility in houses are one of the fundamental factors effective in the emergence of spatial qualities or changes in them and in general, the logic of spatial configuration in the interiors of houses. Therefore, the type of accessibility, either physical or visual, causes many differences and similarities between the characteristics of spatial configuration in houses, especially in traditional houses, which have more categorizable qualities.

Keywords: Visual Access, Physical Access, Contemporary Housing, Traditional Housing, Space Syntax.

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1. INTRODUCTION

Rapoport maintains that from the very distant past, the house was beyond a shelter for humans, and many cultural and social aspects are obvious in all steps, from its construction to settling in it and using it (Rapoport 1975). According to many researchers, some of these qualitative characteristics (sociocultural aspects) are influenced by types of access[1], such as physical and visual access, at the house level (Naganuma et al. 2015; Bellal et al. 2003; Peponis et al. 2014). For example, spatial hierarchy is one of the phenomena affecting the spatial quality of a house both physically and sometimes visually. However, "accessibility[2]" seems to be one of the spatial quality-related concepts that can be used to analyze all kinds of urban spaces and architectural interiors. Therefore, the present study aims to investigate physical and visual accessibility to explain the quality of space in traditional and contemporary houses. It seeks to answer the question of how changes in the qualities of visual and physical accessibility influence spatial relationships in houses. So, the present study analyzes and compares traditional and contemporary houses in the qualities of physical and visual accessibility by examining spatial configuration using the space syntax technique and its relevant tools. In this regard, the following questions are raised:

- Can the qualities of physical and visual accessibility in traditional and contemporary houses reflect the architectural characteristics of the space in them?
- How has the nature of visual and physical accessibility changed from traditional to contemporary houses?

2. METHOD

The present study attempts to compare the qualities of physical and visual accessibility in the interior of traditional and contemporary houses and to investigate its role in determining the architectural characteristics of the space in the houses. For this purpose, four traditional single-courtyard houses and four contemporary houses with different numbers of rooms were selected as case studies. Here, it should be noted that since the studied traditional and contemporary houses are different in the house area, they were compared by converting the obtained data to percentages and examining changes in graphs (minimum and maximum). Therefore, the difference in areas would not be effective in the spatial analysis of the samples. To compare the abovementioned qualities, it is necessary to use a strategy that is considered a powerful technique in examing obtained data. So, the space syntax technique was selected to analyze the data considering its nature as well as its solutions to interpret space. This technique can process many syntactic features in the configuration of the space by having a computer simulation tool (Depthmap software) used to evaluate the data, and its outputs allow for examining and discussing the quality of the environment[3].

After analyzing the case studies using computer tools and obtaining quantitative data, a qualitative strategy was used to analyze the results as follows. The reasons for the findings were investigated by observing the case studies, reviewing their related documents, and interviewing experts and sometimes the users of the case studies. So, the present study is considered mixed-method research since it uses a combination of quantitative (software analyses) and qualitative (logical reasoning) methods. Figure 1 shows the research process and how the visual and physical accessibility qualities are studied in the case studies.

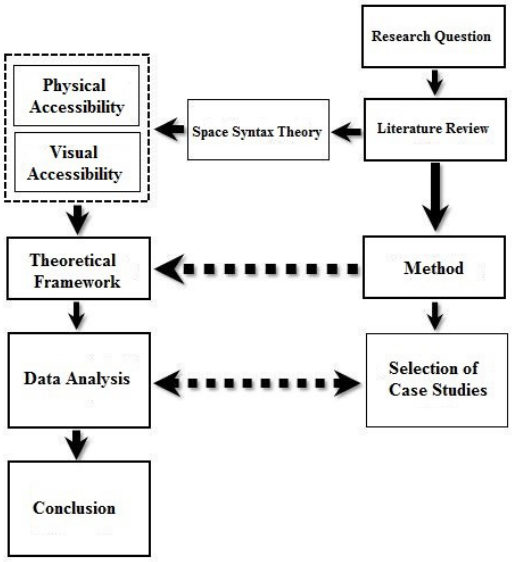


Fig. 1. Research Method

3. LITERATURE REVIEW

Many architects and theorists introduce spatial qualities as the criteria for assessing architectural works (Hillier 2007; Hillier et al. 1987). One of the most widely discussed topics in the field of assessing the quality of space is the space syntax technique and the quantitative and qualitative tools used in it for this purpose. In this regard, among the indicators that can be justified and analyzed by the components of this technique, one can refer to visual and physical accessibility. Thus, in this section, first, the space syntax technique and its tools are discussed. Next, the research that has analyzed spaces using this technique with an emphasis on the factors of visual and physical accessibility, and their results are reviewed.

3.1. "Visual Accessibility" Feature in Space Syntax

In his book "The Ecological Approach to Visual Perception", James Gibson assumes that visual

perception is not achieved through inference and interpretation but through direct interaction between the user and the adjustment of the required information of his surroundings by him (Gibson 1979). Benedikt took advantage of this theory to develop the Isovist theory to analyze the visual quality of the environment (Benedikt 1979). He defines it as a tool for visualizing the visual information of the environment, or in other words, to perceive the limits of the visibility polygon. He introduces this concept as the cone of vision and defines it as the visual range of a person from one point to all visible points in space (Ibid, 47). Isovist theory is also used in the space syntax technique and it represents a kind of experimental data obtained from the investigation of mutual influence of placement of people in space and their visual perception of its quality considering the elements placed in the environment. The analysis of images and isovist diagrams provides detailed properties of the geometry of the environment, which help to examine the quality and visibility of the environment (Emo 2015, 121-123). Since previous research has introduced Depthmap software as a tool for assessing the quality of visual access (Turner 2001; Varoudis et al. 2014), the present study also applies this software to assess the quality of visual access in the case studies. In the space syntax technique, isovist refers to "the perimeters and areas of spaces, as well as the farthest and closest visual access, etc. from a specific point". It is used to explain the quality of visual perception, and there are specific definitions for each of them, which are selected and used based on the needs of the analysis. In the present research, isovist is used to examine the visible fields (isovist area) in the analyzed house. In fact, isovist analysis is considered a way to quantify the visual quality of space, and its best presentation is included in isovist area analysis.

3.2. "Physical Accessibility" Feature in Space Syntax[4]

Most differences between different spaces in the accessibility indicator are due to the changes that have occurred in people's lifestyles[5] in different periods. The access is created only between two adjacent spaces and only through the movement between them, and this connection is formed by penetrating the border shared by them (Steadman 1983). This type of access is not related to the convexity or concavity of the space, and the user of the space may have direct visual access to parts of the environment, but for having physical access, he must pass through several spaces to reach the end of the visible space. These features are among the differences between these two types of access (Fig. 2) (Griz and Amorim 2015, 3-6).

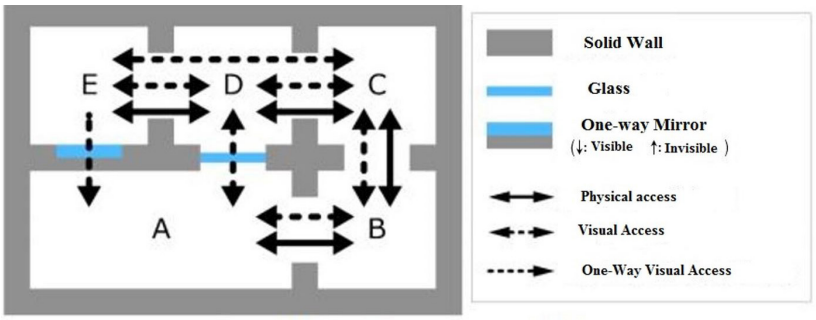


Fig. 2. Access to Spaces to which There is Visual Access but no Direct Physical Access
(Naganuma and Kishimoto 2015, 150-153)

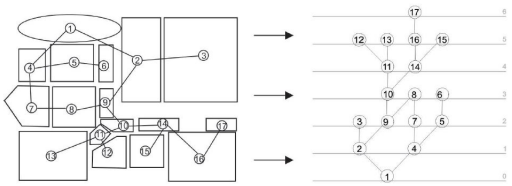


Fig. 3. The Justified Graph of Physical Accessibility in a Residential House
(Ibid, 150-155)

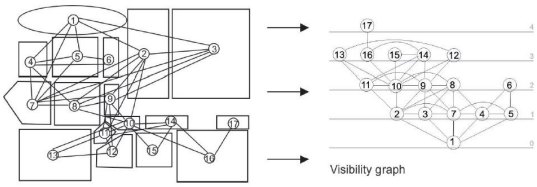


Fig. 4. The Justified Graph of Visual Access in a Residential House
(Ibid, 150-153)

The level of access to each part of the building directly affects the quality of the space. For example, access to space through several entrances reduces control over that space and increases the amount of movement in it. Therefore, it increases the permeability of that space. On the other hand, the single connection between spaces limits access and increases control over them. Therefore, it seems that according to the social logic of the space syntax theory, the most efficient way to analyze the relationship between spatial organization

and social meanings is to examine the spatial patterns or inequality genotype or space syntax graphs in the interior of houses (Hillier et al. 1987). Due to some problems and limitations of the graph analysis method, the space syntax software or the same Depthmap software is used in the new research. In the present study, the physical accessibility in case studies is also assessed by the capabilities of Depthmap software. For this purpose, Visibility Graph Analysis (VGA)[6], including step depth (without considering the metric distance and only by changing the space), and metric depth (considering the metric distance), is used. With these two indicators, physical access analyses can be performed[7]. Varoudis et al., in their study, tested this issue and explained the effects of various types of visual and physical access on the quality and structure of the space and the social relations governing it (Varoudis et al. 2015, 152-155). In the space syntax approach, various axial[8], convex, and concave spaces[9] (Fig. 5) are among the most effective factors in understanding the geometry of space or, for example, recording cognitive maps in people's minds (Hillier et al. 1984; 2007; Turner et al. 2001).

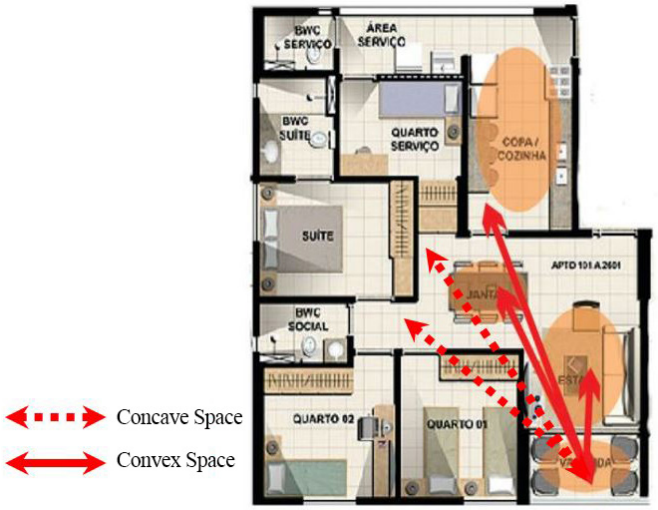


Fig. 5. Convex (without Obstacles and with Direct Visual Access) and Concave (with Obstacles and without Direct Visual Access) Spaces in the Interior of a House

(Griz and Amorim 2015, 6-9)

4. THEORETICAL FRAMEWORK

The present research process includes the examination of the types of accessibility to explain the quality of space in various types of traditional and contemporary houses. Therefore, the space syntax tool is used to explain this matter. In the present study, physical accessibility is analyzed with "Visibility", "Step Depth", and "Metric Depth" indicators, and visual accessibility with the "Isovist" indicator. The selected samples included four contemporary houses with one to four bedrooms, and four traditional courtyard houses in the desert areas (Fig. 6). In the computer simulation of both traditional and contemporary samples, the characteristics influenced by physical and visual access in the interior of the houses are analyzed.

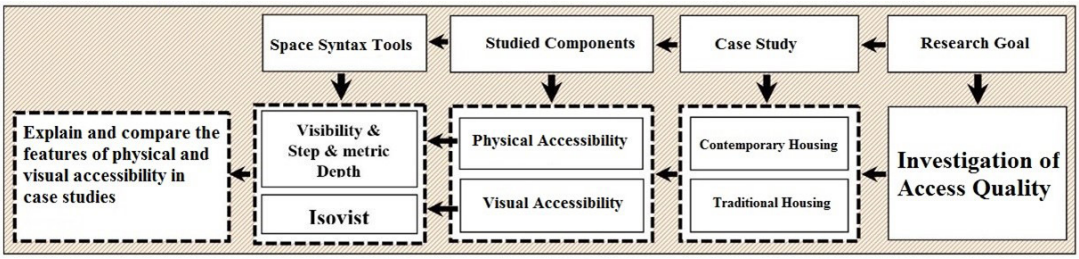


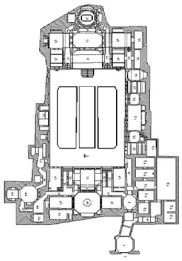
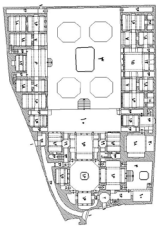
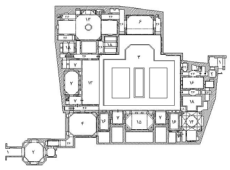
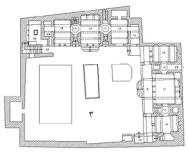
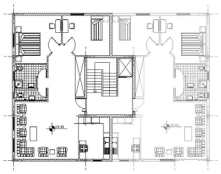
Fig. 6. The Diagram of the Theoretical Framework

5. INVESTIGATION OF CASE STUDIES

Since, in the present research, movability at the house level (to assess physical accessibility) and a person's field of vision to different parts of the house (to assess visual accessibility) are investigated, the case studies were selected according to their built-up areas and visual qualities. Accordingly, contemporary houses were selected based on variables such as area (number

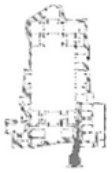
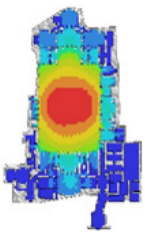
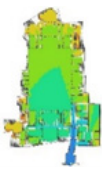
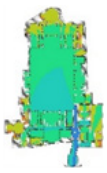
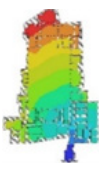
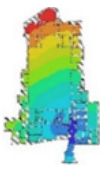
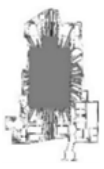
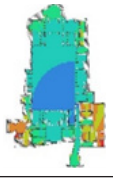
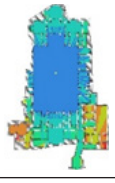
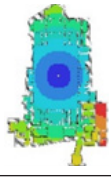
of bedrooms) and geometry, and traditional houses were also selected based on their built-up areas. In the present study, contemporary houses refer to the common apartments with a built-up area ranging from 83 to 145 m^2 in Kashan City and a different number of rooms, and traditional houses refer to central-courtyard houses in the old fabric of Kashan City. So, four contemporary houses with one to four bedrooms were selected as contemporary samples, and four single-yard houses[10] were selected as traditional samples (Table 1). Also, to compare various spatial configurations and analyze visibility from the entrance to the interior, it was noticed that the four traditional samples had different entrance geometry and depth. Regarding contemporary samples, they were selected in such a way that in some of them, the entrance was placed on the corner, and in others, the entrance was placed in the middle of one of the sides. It should be noted that in the Isovist analysis, in each house, visibility was assessed in four steps from the entrance to the middle of the space. Also, in step and metric depth analyses, four and three steps of movement in space were considered to analyze the visual and physical qualities, respectively.

Table 1. Plans of Contemporary (Classified by the Number of Bedrooms) and Traditional (Classified by the Type of Entrance and Area) Houses

Traditional Houses				
	Sharifian House Area: 1958.28 m^2	Al-Yasin House Area: 1510.78 m^2	Abbassian House Area: 1264.90 m^2	Karkhanechi House Area: 843.80 m^2
Contemporary Houses				
	Four-bedroom House Area: 215.60 m^2	Three-bedroom House Area: 139.60 m^2	Double-bedroom House Area: 112.70 m^2	Single-bedroom House Area: 93 m^2

(derived from Hajghasemi 1996)

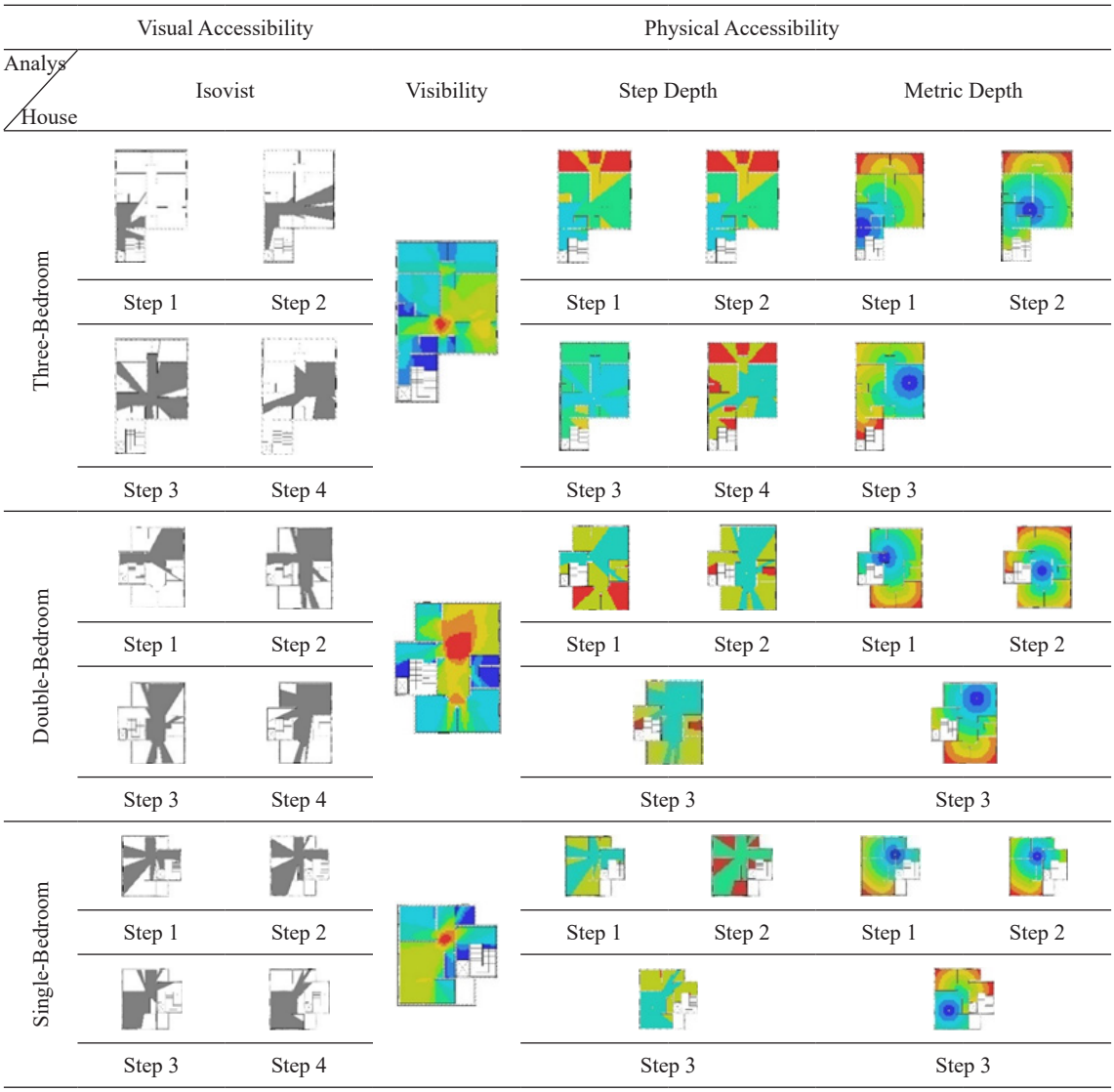
Table 2. Software Analysis of Traditional Houses

Analysis / House	Visual Accessibility			Physical Accessibility			
	Isovist		Visibility	Step Depth		Metric Depth	
Sharifian							
	Step 1	Step 2		Step 1	Step 2	Step 1	Step 2
							
	Step 3	Step 4		Step 3	Step 4	Step 3	

Analys / House	Visual Accessibility: Isovist	Visual Accessibility: Visibility	Physical Accessibility: Step Depth	Physical Accessibility: Metric Depth
Al-Yasin	Step 1, Step 2, Step 3, Step 4		Step 1, Step 2, Step 3, Step 4	Step 1, Step 2, Step 3
Abbassian	Step 1, Step 2, Step 3, Step 4		Step 1, Step 2, Step 3, Step 4	Step 1, Step 2, Step 3
Karkhanechi	Step 1, Step 2, Step 3, Step 4		Step 1, Step 2, Step 3, Step 4	Step 1, Step 2, Step 3

Table 3. Software Analysis of Contemporary Houses

Analys / House	Visual Accessibility: Isovist	Visual Accessibility: Visibility	Physical Accessibility: Step Depth	Physical Accessibility: Metric Depth
Four-Bedroom	Step 1, Step 2, Step 3, Step 4		Step 1, Step 2, Step 3, Step 4	Step 1, Step 2, Step 3



In the following, Tables 4 and 5 (contemporary and traditional sample houses, respectively) present quantitative and numerical analyses of the above software findings to evaluate the data logically and accurately.

Table 4. Numerical Analysis of Software Findings for Traditional Houses

House	Isovist Area (m^2)	Isovist Area/Total Area Ratio (%)	Visibility (Connectivity)	The Shortest Distance to the Farthest Point (Metric Depth)	Total Area (m^2)
Sharifian	Step1-47.46 Step2-52.52 Step3-306.53 Step4-827.2	2.4% 2.6% 15.6% 42.2%	Max= 1535 Min= 3	Step1-from Entrance:72.02 Step2-from Vestibule:58.2 Step3-from Courtyard:55.72	1958.28
Al-Yasin	Step1-6.09 Step2-78.22 Step3-448.27 Step4-727.90	0.0% 5.1% 29.6% 48.1%	Max= 2891 Min= 7	Step1-from Entrance:65.53 Step2-from Vestibule:43.47 Step3-from Courtyard:39.24	1510.78

House	Isovist Area (m^2)	Isovist Area/Total Area Ratio (%)	Visibility (Connectivity)	The Shortest Distance to the Farthest Point (Metric Depth)	Total Area (m^2)
Abbassian	Step1-31.30 Step2-43.89 Step3-245.76 Step4-572.11	2.4% 3.3% 18.9% 44.1%	Max= 2209 Min= 7	Step1-from Entrance:69.98 Step2-from Vestibule:62.96 Step3-from Courtyard:28.23	1294.90
Karkhanechi	Step1-81.02 Step2-151.37 Step3-335.21 Step4-543.87	9.6% 17.9% 39.7% 64.4%	Max= 6157 Min= 44	Step1-from Entrance:39.83 Step2-from Vestibule:36.65 Step3-from Courtyard:20.02	843.80

Table 5. Numerical Analysis of Software Findings for Contemporary Houses

House	Isovist Area (m^2)	Isovist Area/Total Area Ratio (%)	Visibility (Connectivity)	The Shortest Distance to the Farthest Point (Metric Depth)	Total Area (m^2)
Four-bedroom	Step1-41.36 Step2-56.83 Step3-65.98 Step4-61.13	19.1% 26.3% 30.6% 28.3%	Max= 1906 Min= 87	Step1- from Entrance: 15.04 Step2- from Partitioning Space:13.00 Step3- from Hall:16.46	145.60
Three-bedroom	Step1-17.96 Step2-32.99 Step3-54.98 Step4-40.77	12.8% 23.6% 39.3% 29.2%	Max= 1531 Min= 59	Step1- from Entrance:15.01 Step2- from Partitioning Space:10.93 Step3- from Hall:12.08	130.60
Double-bedroom	Step1-35.33 Step2-54.69 Step3-45.76 Step4-53.02	28.5% 44.2% 36.9% 42.8%	Max= 2209 Min= 7	Step1- from Entrance:10.16 Step2- from Partitioning Space:8.09 Step3- from Hall:11.86	108.7
Single-bedroom	Step1-38.05 Step2-46.29 Step3-37.53 Step4-35.28	40.9% 49.7% 40.3% 37.9%	Max= 6157 Min= 44	Step1- from Entrance:8.80 Step2- from Partitioning Space:8.04 Step3- from Hall:8.95	83

6. DATA ANALYSIS AND DISCUSSION

As mentioned earlier, considering the difference between traditional and contemporary housing in the area, relative data graphs and variations in data (minimum-maximum and ascending-descending) were used to make correct comparisons between numerical data, meaning that in all steps of isovist analysis of all houses, the isovist area/total area ratio, instead of the isovist area, was considered.

6.1. Quality of Visual Accessibility

In the present study, the software images from Isovist analyses were used to assess the quality of visual accessibility. The graphic images from this analysis for traditional samples, presented in Table 2, indicate that by moving from the entrance to the middle of the space, the Isovist area gradually increases (an ascending curve for all four samples). These curves show that despite different types of access hierarchy, from the entrance to the courtyard, in these four samples, one can a relatively similar variation trend in all four samples. This process can be understood by analyzing the values and images in the above tables.

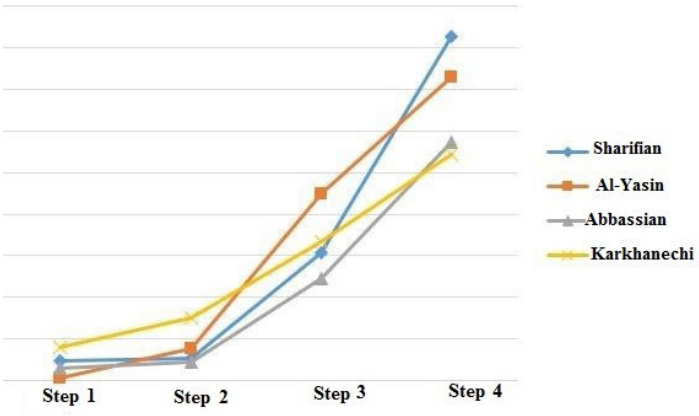


Fig. 7. The Graph of Variations in the Isovist Area (Cone of Vision), from the Entrance to the Middle of the Space, for Four Traditional Samples

Regarding contemporary samples, the results seem a little different. The Isovist analyses of these houses show no specific trend (Table 3). As seen in Figure 8, for contemporary houses, the Isovist areas in the four steps show no specific trend. For example, in the single-bedroom house, due to the small scale of the space, 40.9% of the total interior area can be seen from the entrance, and unlike traditional samples, visibility decreases in the next step (step 2). Therefore, it is not possible to consider a perfect ascending or descending trend for the entire interior of the house, and the variations in the Isovist area do not follow a relatively specific trend. Moreover, considering the Isovist area/total area ratios obtained for the Isovist steps in all eight houses, one can find that in contemporary houses, in the first two steps, a significant part of the space is visible to the user while in traditional samples (except for Step 2 in Karkhanechi House), below 10% of the total space is visible. Such conditions in traditional houses have reduced overlooking and privacy from the entrance as a public space to the living room as a semi-public area, while in contemporary houses, this issue is less important. The reason for this is that in contemporary houses, the desire to visually integrate the house has resulted in the removal of many fixed elements (such as doors and walls) in many parts of the house such as the living room, kitchen, and drawing room. Moreover, in contemporary houses, especially in apartment models, there are rigid barriers such as walls and doors only for bedrooms and restrooms, and other parts of the house are separated from each other using semi-fixed elements (such as furniture, wardrobes, and half walls). While in traditional houses, all spaces have their own specific spatial character and are separated from other parts using completely fixed and rigid elements. This causes various parts of the house to be spatially independent and to which there is limited physical-visual access.

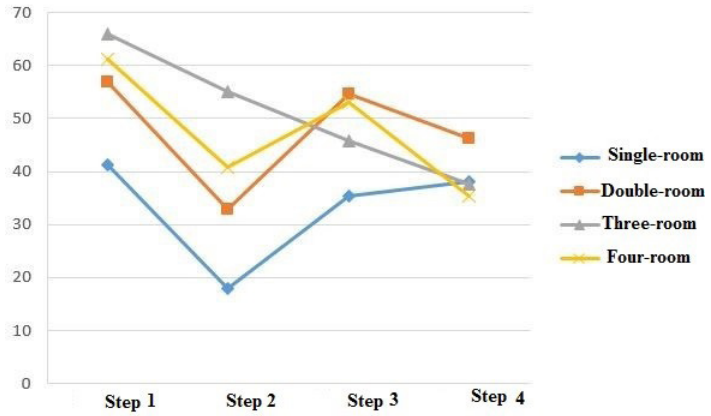


Fig 8. The Graph of Variations in the Isovist Area (Cone of Vision), from the Entrance to the Middle of the Space, for Four Contemporary Samples

6.2. Quality of Physical Accessibility

In this section, to assess the quality of physical accessibility, two depth and visibility (connectivity) analyses were used. Regarding connectivity, in all the eight houses studied, one can see that the maximum connectivity gradually increases as the area (from four-bedroom to single-bedroom in contemporary houses and from Sharifian to Karkhanechi in traditional houses) decreases. The reasons for this are the shrinking of the space and thereby, the integration and increased physical permeability of the environment. Moreover, software images clearly indicate that in all traditional houses, connectivity follows a specific and similar trend, and one can see that there is the highest connectivity (the highest level of integration) in the middle of the entire space (or the courtyard), which is marked in red. While the four contemporary samples show four different types of connectivity and one can see no the same pattern. The reason for this disparity is that in traditional houses, there is an opening [called the central courtyard] in the house while in contemporary houses, the middle space is made of a solid mass with no opening and it is generally a corridor or a partitioning space called a hall, which cannot connect directly to all the spaces of the house. In other words, it can be claimed that in traditional houses, the courtyard, as a central partitioning space, directly connects to most of the spaces in the house, and the pattern of access is radial in traditional houses while in contemporary houses, the access pattern is linear and the spaces are located along each other.

Regarding step depth and metric depth, in traditional samples, by moving from the entrance to the middle of the space, the metric depth gradually decreases (descending graph) while in contemporary houses, by moving from the entrance to the hall, the metric depth is variable and doesn't follow a specific trend (ascending-descending graph). These results imply that in traditional houses, the depth gradually decreases from the entrance to the middle of the house due to the central spatial distribution while in contemporary houses, due to the scattering of spaces and the different locations of the entrance space in different contemporary house models, the depth doesn't decrease by moving from the entrance to the middle of the house space (Fig. 9). Also, one of the other important reasons for the emergence of more physical access in the early steps of entering contemporary houses is the existence of more convex and axial spaces in this part compared to traditional samples. In fact, in traditional houses, to create privacy and access hierarchy, more concave spaces were used in the entrance part, the maximum convexity is in the courtyard part, and almost all other parts are covered by concave spaces. This is while the open plan model, which was noticed by architects during the arrival of modernity onwards, has led to the increase of convex spaces, resulting in reduced concave spaces in the entire environment of contemporary houses.

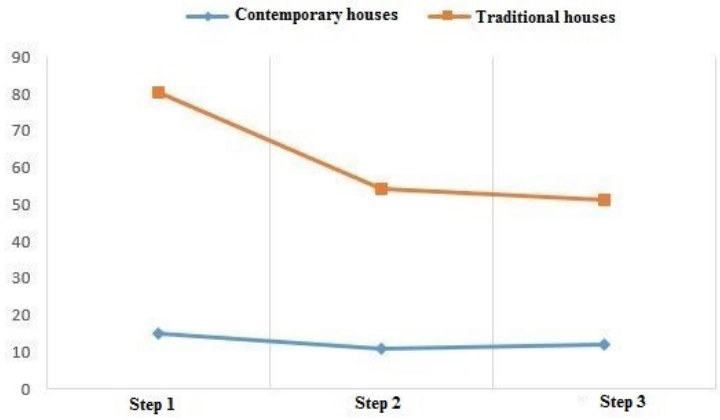


Fig. 9. Comparison of Traditional and Contemporary Houses in Changes in the Quality of Metric Depth from the Entrance to the Middle of the Space.

According to the analyses presented in the previous sections and the investigation of the reasons for the difference between traditional and contemporary houses in the qualities of visual and physical accessibility in the spatial configuration, Table 6 compares traditional and contemporary houses in terms of physical and visual accessibility.

Table 6. Comparison of Traditional and Contemporary Houses in Terms of Various Types of Accessibility

	Traditional House		Contemporary House	
	Space Quality	Cause	Space Quality	Cause
Visual Accessibility	- An increase in visual accessibility by moving from the entrance to the middle of the house;	- Step by step increase in the space area by moving from the entrance to the middle of the space;	- Irregularity in visual accessibility by moving from the entrance to the middle of the house;	- The space area changes by moving from the entrance to the middle of the space
	- The largest visible area in the middle of space;	- The presence of an opening (central courtyard) in the middle of the house, which increases visual access to it.	-Irregularity in the visible area in the middle of space;	-The existence of a corridor with a linear geometry as a partitioning space;
	- Lack of direct view of the courtyard from the entrance ;	- The use of turns in the corridors and the establishment of a vestibule in the entrance part; - The existence of more concave and non-axial spaces in the entrance part;	-The presence of a direct view of the interior from the entrance door	- Absence of a rigid obstacle in the entrance part of the house and the combination of entrance and hall; - The existence of more convex and axial spaces in the entrance part;
	Visual Accessibility Improvement Solutions			
Visual Accessibility	- Establishing the courtyard in the center of the building and arranging spaces around it; - Using pre-entrance (joint) before entering any space; - Using corridors with twisted geometries to limit the view of the inside from the outside; - Using vegetation to reduce the view of the house; - Using a curtain in the room door to reduce the view of the room when the door is open; - Using girih patterns and stained glass in the windows and sash windows of the rooms; - Using curtains to cover the windows of the rooms facing the courtyard to obstruct the view of the room from the courtyard; - Creating a joint before entering different spaces of the house; - Establishing a vestibule and a corridor at the entrance; - Using arabesque motifs and stained glass to obstruct the view of the rooms from the courtyard;		- Using a curtain in the open kitchen part to reduce the guests' view of the kitchen; - Turning the entrance of the bedrooms to reduce the direct view of them; - Turning the entrance of the toilet to reduce the direct view of it from the drawing room; - Using curtains to cover the windows to reduce the direct view of the interior from the opposite buildings; - Using prefabricated concrete and plaster molds in the terraces (sometimes with arabesque motifs) to reduce outside-in visibility;	
	Traditional House		Contemporary House	
	Space Quality	Cause	Space Quality	Cause
Physical Accessibility	- Gradual increase in connectivity as the area decreases (the highest connectivity is observed in Karkhanechi House);	- Increase in spatial integration and permeability due to the shrinking of space;	- Gradual increase in connectivity as the area decreases (the highest connectivity is observed in the single-bedroom house);	- Removal of fixed elements (rigid obstacles) and the use of semi-fixed elements and half walls to increase the integrity of spaces;
	- The presence of the highest connectivity in the courtyard and the lowest connectivity in the rooms;	- The establishment of the courtyard in the center of the house and the establishment of the rooms at the deepest depth from the entrance;	- Absence of a specific rule in spatial connections;	- Diversity in the space layout, the absence of a specific system in the space layout, and the existence of a linear pattern in the spatial system of the house;
	- A reduction in the depth by moving from the entrance to the middle of the space;	- The presence of the principle of hierarchy in the establishment of spaces in the configuration system; - Conformity of the spatial configuration of the house to a centripetal system as the dominant space layout pattern in houses;	- The variability of the step depth and metric depth of the spaces relative to the entrance in different models;	- The scattering of spaces and different placement of the entrance space in contemporary housing; - Absence of spatial hierarchy in the space layout; - In the cases where the entrance is placed on one of the sides, the use of a linear pattern increases the depth of the bedrooms relative to the entrance, and as a result, reduces the visual access to this part.

	Traditional House		Contemporary House	
	Space Quality	Cause	Space Quality	Cause
	Physical Accessibility Improvement Solutions			
Physical Accessibility	-Using hierarchy in entering different areas of the house; - Using multiple yards to completely separate the area of family life from social life; - Blocking the view of the interior from the entrance to reduce the possibility of overlooking it; - Limiting the number of entrances to the interior to reduce its permeability; - Using the pre-entrance space (joint) to avoid entering different spaces at once;		- Establishing bedrooms in one part and the drawing room in another part, as well as the kitchen as a connecting space; - Using a variety of furniture to separate the drawing room from the living room; - Using special furniture to determine the scope of the guest's presence and prevent entering other parts;	

7. SUMMARY AND CONCLUSION

According to the analysis, the general and generalizable conclusions and results related to the qualities of visual accessibility and physical accessibility in traditional and contemporary houses are as follows:

- The space integration is higher in contemporary houses while there is a higher level of spatial separation in traditional houses. One of the reasons for this is the reduced built-up area and the changed geometry of the environment in traditional houses compared to contemporary houses.
- In traditional houses, public spaces (guest-related spaces) and private spaces (bedrooms, guest room, and the interior) are separated from each other by physical access and with emphasis, and they almost have no visual access to each other (these spaces sometimes are defined by two separate courtyards and are located in two completely separate areas). While in contemporary houses, public and private spaces are separated from each other by physical access (by creating a corridor or partitioning space), and they have visual access to each other.
- In general, there is a significantly greater number of connecting spaces for physical access, such as corridors, partitioning spaces, etc., in traditional houses than in contemporary examples. Such a space layout is the reason for the reduced visual accessibility in traditional houses. In general, the level of visual accessibility has increased in contemporary houses due to the removal of many walls, and corridors and changing the geometry of the space from convex to concave.
- In general, there is more spatial circulation in traditional houses due to higher physical accessibility than in contemporary houses. In other words, in contemporary houses, spaces have an end, while in traditional houses, spaces usually have at least two entrances. Accordingly, the change of area in traditional samples compared to contemporary ones seems a reason for such a phenomenon. However, it should be noted that if the contemporary 1500-m villas are considered and compared with the traditional houses of the same area, the relationships between the spaces and especially, the visual and physical accessibility are still the same as those in contemporary models. For example, one can refer to the presence of an open kitchen, the smaller number of corridors, the absence of additional parts to separate spaces, the presence of dead ends and single-lane rooms, and the presence of furniture as a tool defining a large part of the spaces and separating them, all of which are observed in contemporary housing models with different scales.
- In traditional houses, there are more concave spaces while contemporary houses have more convex spaces. The presence of more convex spaces in contemporary houses implies the presence of higher visual and physical accessibility. While in traditional houses, reducing direct visual accessibility resulted in an increased number of concave spaces. Therefore, due to the mentioned conditions, it is more possible to create a private space, silence, and an access hierarchy in traditional houses than in contemporary ones.

Therefore, in general, due to the absence of cultural, environmental, social, climatic, technical, etc. limitations in contemporary houses, there is more diverse space configuration in them and they don't basically have the unity and order governing the spatial structure in traditional houses from the perspective of access types. Despite such conditions, some common features among the interior spaces in contemporary houses (the presence of more convex spaces compared to traditional houses and the use of the open plan model) have caused the emergence of common situations among these houses.

Finally, it should be noted that, in general, the present study didn't seek to prove that visual and physical accessibility alone caused architectural and behavioral changes in the space. In fact, this research only sought to show how visual accessibility influences the architectural features of the space and is effective in changing the residents' behaviors in houses. There are definitely other things that can influence the residents' behavior in houses, and the present study doesn't deny other indicators showing the change in behaviors in houses.

ENDNOTE

1. There are other types of accessibility, such as auditory and olfactory accessibility, which have not been introduced in the present study since they are irrelevant to the research topic, and the tools used in this study cannot investigate the sensory dimensions of the space.
2. Accessibility means a space's ability to connect with other spaces. It includes physical, visual, olfactory, and auditory connections.
3. It should be noted that the space syntax software is set in such a way that it provides images and values related to each analysis considering the human dimensions of the space and human visual and movement capabilities such as the field of vision and physical access. Therefore, only the software method was used in the present research.
4. In space syntax research, this capability is called "accessibility". However, in the present research, to distinguish it from visual accessibility in the interpretation of space, the term "physical" is also used with the term accessibility.
5. The way of life, lifestyle, or mode of life is one of the aspects reflecting certain groups of people's ways of developing internal activities of living (Lawrence 1987; Rapoport 1985).
6. In the Depthmap software, VGA determined the connectivity of the space and the integrity of its different parts.
7. In the analysis of two indicators of visibility and depth, Depthmap software provides the results from the view of a person with the ability to move in the environment and examine it.
8. They refer to spaces where there is no obstacle in the direct view of them in a linear form.
9. A convex space refers to a space where no obstacles are obstructing the observer's vision. This space can be formed in a polygonal area or any other similar area. A concave space refers to a space where there is an obstacle obstructing the observer's vision, such as a wall or furniture, and it limit the access to the entire space.
10. A single-courtyard house refers to a house with a main courtyard and secondary open spaces such as the backyard in it are not considered part of the courtyard. Therefore, houses with more than one main yard (interior and exterior) are not included in the present research.

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