

# Improving Housing Security based on the Explanation of Visual Access Indicators in Historical Houses of Bushehr\*

Seyedeh Maryam Sajjadi<sup>a</sup>- Ahmad Danaeina<sup>b\*\*</sup> - Javad Divandari<sup>c</sup>

<sup>a</sup> M.A. of Architecture, Faculty of Architecture and Art, University of Kashan, Iran.

<sup>b</sup> Associate Professor of Architectural Engineering, Faculty of Architecture and Art, University of Kashan, Kashan, Iran (Corresponding Author).

<sup>c</sup> Assistant Professor of Architectural Engineering, Faculty of Architecture and Art, University of Kashan, Kashan, Iran.

Received 11 May 2021;

Revised 02 March 2022;

Accepted 03 April 2022;

Available Online 21 December 2022

## ABSTRACT

Providing spatial security through visual access in the home is one of the most important components of living in historical textures. This component is directly correlated with the concept of quality and can be influenced by social, economic, psychological, and physical factors. Despite its importance, analysis of the role of visual access in security inside the house from the perspective of spatial structure, configuration, and spatial location is among the top research that has received less attention. The present study deals with the investigation of the visual access indicator of the residential buildings in the historical texture of Bushehr based on the field study and using the space syntax technique in the UCL Depthmap 10 Software. An explanation of how visual access is created in the historical houses of Bushehr and its effectiveness in the improvement of security is the most important objective of the present study. It is qualitative research that is based on an analytical-survey approach in the psychological field. To that end, first, the visual access indicator and its connection with security have been investigated and in the field study section, the indicators have been examined in eleven historical houses. The findings indicate that the visual access indicator in the interior spaces behaves differently when associated with components such as metric depth, integration, and justified graphs. Based on the analysis of the justified graphs, the historical houses of Bushehr are not much complex regarding the access hierarchy and their justified graphs are chained, and access to the interior spaces of these houses is very easy. The results indicate that the highest visual access can be seen in low-depth spaces and with the clustering of the justified graph, the space depth is increased while the visual access is reduced. Also, with the increase in visual access, the security in other spaces is increased and their accessibility is reduced. As a result, in line with the type of space use, the role of visual access is also changed and the increase in this component in the semi-private spaces would guarantee the security of the private spaces.

**Keywords:** Housing, Historical Texture, Security, Visual Access.

\* This article is derived from the M.A. thesis of the first author entitled "Designing of Self-Contained Residential Units in Behbahani Historical Neighborhood of Bushehr with the Approach of Improving Security in Urban-Historical Spaces" under the guidance of the second author and advice of third author and the support of the research department of Kashan University.

\*\* E\_mail: danaeina@kashanu.ac.ir

## 1. INTRODUCTION

The ability to be seen and have a view of the environment are among the important factors in creating security. This component which is also called 'visual access' is among the top components lack of which creates numerous challenges for the residents' security. Regarding environmental control through seeing, Fisher & Naser have enumerated two factors of "vision" and "perspective" as solutions for crime reduction and believe that a wide view allows the person to better perceive his/her surroundings and he/she can decide more quickly when crimes are being committed. Generally, with reliance on the "access resolution" in the environment, since it highlights that part compared to other spaces that have less access resolution, the spatial control is increased that subsequently leads to the increase in environmental security. Vekrel and Vaytzman suggest three factors of "awareness of the environment, the ability to be seen by others, and easy access to help in case it is needed" for the increase in the security of the urban spaces (Asghari Zamani and Zadvali Khajeh 2014, 111). Control, access, and natural surveillance can also influence physical security. Contrary to the spaces that can be surveilled are those placed in the lost or blind spaces. These spaces are regions that are physically considered to be not-visible spaces. Such spaces, due to the lack of ability to be seen owing to lack of lighting and non-visibility of the form, are the first step to the creation of defenseless and insecure spaces (Taherkhani 2002, 94). One way to solve the problem of lost spaces is "natural surveillance" of the place. The surveillance of the urban areas by the residents or the police is made possible through the urban environment empowering, being seen, and/or so-called "natural surveillance". Therefore, it is possible to expose these areas to the public and prevent the creation of unsupervised areas (Asghari Zamani and Zadvali Khajeh 2014, 112-113).

The components of security and visual access in urban spaces are subjects that have been dealt with in some studies. However, the analysis of this subject in the interior space of the buildings has been less studied. The present study, using the "space syntax" technique, has dealt with the investigation of the relationship and the quality of space configuration in the housing and its connection with visual access, and subsequently, the grounds for the creation of security in the historical houses of Bushehr. In this regard, it seeks to answer two main questions. First, what is the relationship between visual access and security in the interior space and how is it realized? Second, how does the location of micro-spaces influence the security of the house's physical space?

## 2. RESEARCH BACKGROUND

Security includes a subjective dimension (sense of security) and an objective dimension (presence of

security) and can be discussed in three levels namely the micro (personal), mid (group), and macrolevels (urban area and beyond). Although there is no border between personal and social security, the demarcation provided by the related literature can be classified as follows.

A group of studies considers security in the urban space to be an important component of residence and emphasizes its emergence in the urban space. Studies by Jacobs (1961), Newman (1972), Lucas et al. (2007), Ekblom et al. (2011), Schneider and Kitchen, (2013), and Sultani et al. (2016) are among such studies. Another group of studies has considered the significant correlation between security and analyzed environmental factors and the role of social and environmental factors to be effective alongside the physical, perceptual, and psychological components. Studies by Matlabi et al. (2016) and Montazir al-Hojjah et al. (2018) are among such studies or are emphasized based on preventive architectural policies or sociocultural relations such as view, increase in visual accessibility, creating a proportion between the population density and residential complexes, creating various and homogenous uses (Movaghar Pak, Faraji, and Ghorbani 2015). A group of studies regards the physical characteristics of the environment to be related to the occurrence of anti-social behaviors (Friedrich, Hillier, and Chiaradia 2009). From another point of view, security has been investigated in the historical textures, and observance of the spatial hierarchy, privacy, and center-oriented spaces have been enumerated as indicators of the place's security (Sheikh Bahaei 2019). In addition, security and physical space, and the relationship between the increase in land area and visual integrity have been introduced as important components for the improvement of security (Alal-Hesabi, Hosseini, and Nasabi 2012).

Another group has investigated the role of urban pathways in the improvement of security. Studies by Hoon (2003), Russ (2009), and Foster et al. (2014) are among such studies. The research by Maroofi et al. which deals with the investigation of the role of isolated pathways with less rate of use by pedestrians compared to connected roads with a low average depth value is among such studies. Also, in this study, the better flow of movement and surveillance by individuals (especially the pedestrians) on the pathways with a low average depth value (or better-integrated pathways) on the local scale have been defined as insecure places for the residents (Maroofi and Jafari Shamsabadi 20108). Or in the study by Hillier, the inappropriate structure of the modern hierarchical streets compared to the traditional streets has been enumerated as an effective factor in the outbreak of several types of crimes. This study has also considered the components of buildings connection, avoiding any secondary access, combining the entrance of houses with public spaces, and maximum direct visibility to the entrances to be the factors for

the increase in street security (Sajjadzadeh, Izadi, and Haghi 2017, 20).

Based on the background, the three environmental, social, and physical components influence the formation or effectiveness of security. Visual access, as an important physical indicator for the improvement of security, has been less considered. The present study seeks to investigate its effective dimensions so that in this way, besides paying attention to the integrity of interior spaces in the housing architecture and improvement of security, the way for continuity of living in the historical texture is paved.

### 3. THEORETICAL FOUNDATIONS

Understanding the visual access indicators requires awareness of the components whose manifestation leads to the improvement of housing security. The first subject that can be discussed is awareness of the whatness of security since people connect to space as much as they feel secure in it. In addition, the cognitive indicators of visual access can be also effective in the connection between the man and housing, and the type of his connection with the environment. Explanation of these subjects and the extent of their relationship and effectiveness on each other paves the way for the improvement of man's presence in the housing.

#### 3.1. Concept of Security

The word 'security' is derived from the Latin 'Secure' meaning 'to have no fear and anxiety'. In the Grand Larousse encyclopédique, security is explained as a thought based on which fear and loss are meaningless. From a positive dimension, it means providing the grounds to create tranquility, and from a negative dimension, it is the lack of any kind of threat. Therefore, as a basic need of human beings, and a factor for a healthy life, it plays an important role in personal and social health.

The extent of security the people feel when exposed to the environment is the most important factor in their tendency to be present in a space. As long as people are facing a dangerous environment, they naturally

fear for their security. Man's behavior might be the best indicator of fear. However, the behaviors through which the fear is recognized are not always easily detectable (Warr 2000, 459). When encountering these behaviors the more space is known as a destination and various uses are created in its surroundings, the more its security will be, and the more it is used as a place for passage, the lower its security (Karami et al. 2015, 162). For example, in the spaces of a residential building, if the living room is located at the end of the movement chain in an environment, it will be quiet. Therefore, its location in the movement hierarchy in space plays an important role in its silence and security. This functional hierarchy emerges in the center-based system. Thus, to solve this problem, we should go from the entrance to the room (pre-space), and from there, we should go to the living room to create a hierarchy of nested centers. The best condition is when the room is at the farthest end. A quiet place the individual uses for rest after passing through the house (Christopher 2015, 367). The easier the access to the destination, the higher the legibility of the environment, the lower the feeling of dear and anxiety of the person on his path, and subsequently, the lower the sense of insecurity. Besides legibility, society, body, and economy are also three important and effective elements in security. The component of environmental density increase can also have positive or negative effects on residents' security. The concentration and gathering of visitors, on the one hand, causes potential disturbances for the residents and on the other hand, it increases the possibility of care and control of the residents over abnormal social behaviors. To create security in residential buildings, methods compatible with the characteristics of these buildings are used. In general, two basic principles of protection include determining boundaries against the entry of unauthorized people and exercising control by guards, and designing defined spaces or using electronic methods to create surveillance opportunities for residents and people living in buildings. In Figure 1, the factors effective in security from the viewpoint of different people are presented.

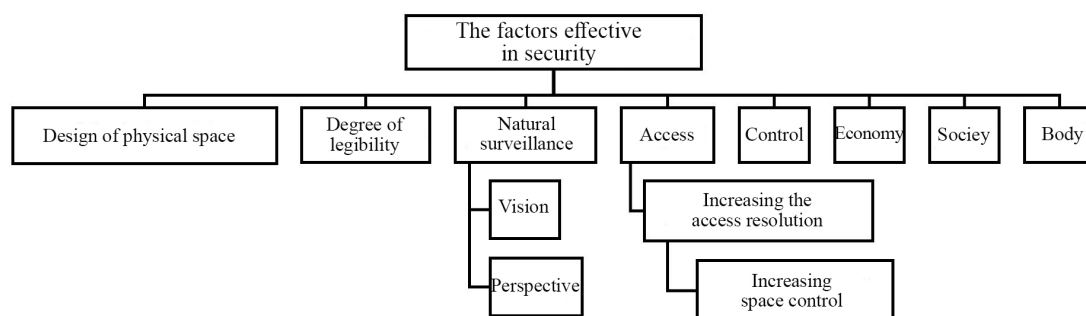
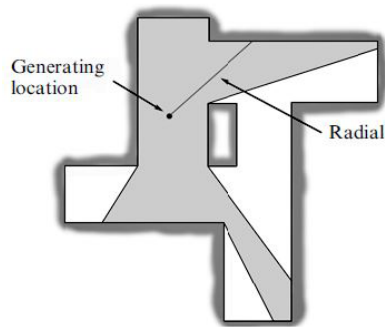


Fig. 1. The Factors Effective in Security

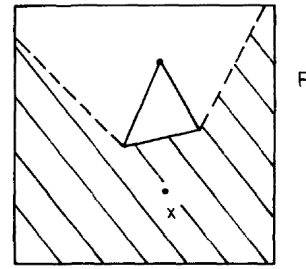
### 3.2. Cognitive Indicators of Visual Access

The visual and dynamic characteristics of men in the space simultaneously form the architectural space and the social relationships. The space is a platform for activity. Space and human activity are not two independent and different natures. But they have a unit nature with two different manifestations. Man and his visual and dynamic characteristics are the essences of the formation of space and human relationships (Hamedani Golshani 2015, 87). In the visual access, since the sight capabilities are used for environment examination, and the viewers are also present on the floors, the criminals are less inclined to commit crimes in such a space. As a result, there are some spaces in the environment that despite not being physically accessible by man, are detectable by the eyes (Heidari, Peyvategar, and Kiaei 2016, 93). At the neighborhood level, there are various tools to consider the two-dimensional spatial aspects. One of these tools is the Isovist. According to Benedikt, the Isovist is a set of all visible points from a specified point in space and it is defined based on the surrounding environment. He has provided a set of analytical measurements of the Isovist which are used to obtain the quantitative features of spatial environments. Benedikt starts by considering the visible volume of a place and then, he shows this presentation more simply, with the application of a horizontal cut of the Isovist polyhedron (Fig. 2) (Turner et al. 2001, 103).



**Fig. 2. The Isovist Polyhedron Containing the Visible Area from a Hold Point**  
(Turner et al. 2001, 103)

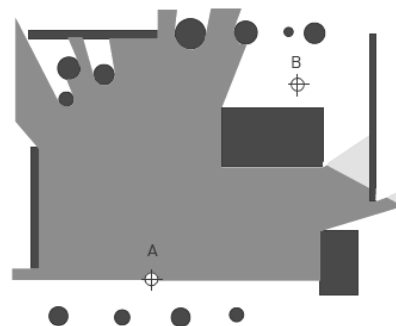
This tool provides the person with a panoramic view of a specific point in space. The Isovists are also used for navigation or pathfinding in an urban texture (Fig. 3). In the past, this task was done manually, however, today, by the use of the Depthmap Software, multi-point analyses can be also done as well as single-point analyses. The interesting point about the concept of Isovist is that it is an attractive visual method for thinking about the spatial environment in a way that it describes the “interior” space, people’s view, whatever they perceive, interact with, and move through it (Turner et al. 2001, 103).



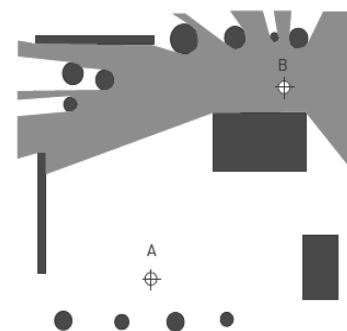
**Fig. 3. The Isovist**

It provides a panoramic view of space.

The Isovist visualizes a panoptical view from the viewer and a specific point in the environment. The boundary of the panoptical view is defined by the walls and existing standing and vertical elements such as trees. The shape and size of the isovist also change by moving around in the environment. Therefore, it is possible to visualize the sequence of panoptical scenes or views from specific points along the movement paths. As shown in figure 4 and 5, the isovist field of view can be 180 degrees (what a person sees when he enters an open space) or 360 degrees (indicating the state of a person who stands at a point and turns around from the same point and watches the environment) (Van Ness 2011, 174). Table 1 shows the various types of access and their functions.



**Fig. 4. An Example of a 180-Degree Isovist**  
(Ibid, 174)



**Fig. 5. An Example of a 360-Degree Isovist**  
(Ibid, 174)



**Table 1. Various Types of Access and their Functions**

Types of Access	Descriptions
Visual Access	It is the amount of space that can be perceived by vision.
Physical Access (Metric Depth)	Investigating a part of the environment that can be evaluated and seen by people through physical movement in space.
Local Access	The ability to access the environment with a certain radius (for example, a radius of 3 meters). The amount of physical and visual accessibility of spaces is examined in this area
Comprehensive Access	The capability of the space is related to the access (physical and visual) to the entire environment.

#### 4. SPACE SYNTAX AND ITS MANIFESTATION IN SPACE SECURITY

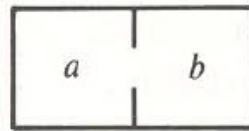
Spatial organizations shape the behaviors of their inhabitants and govern individual behaviors and relationships. The space syntax is used in constructions and to check settlement scales so that the inter-space relationships and spatial indicators are analyzed. The focus of both scales is on examining the principles related to the organization and functional relations that can be seen in similar systems formed by houses, streets, squares or rooms, halls, yards, etc. (Arslan and Koken 2016, 90).

From the social point of view, "art", and "architecture" in particular, are considered the same as a social art, and "building" is considered as a social entity, and the social relations of people and users of the environment can be understood by recognition of the spatial connections. In 1984, Hillier, in collaboration with Hanson, expressed a new theory of space as an aspect of social life in a book entitled "The Logic of Social Space". In this book, by emphasizing the concept of "space syntax", he tried to discover the rules that could be obtained from the examination of various arrangement patterns in different spaces. He believed that different spaces reflect the different ways of life of their users, and by using this method, it is possible to understand the cultural and social characteristics of the residents that influence the formation of different spatial patterns. The architectural "space syntax" is among the methods that have been used in the analysis and interpretation of various buildings (Heidari, Ghasemian Asl, and Kiaei 1396, 23). The most important goal of researchers with this approach is to investigate social relations in space, such as the creation of privacy and the extent of privacy and publicness of spaces. A space that is not connected to another space cannot be used. There is no such space. Space is made with its borders, and communication patterns are also made with borders and gaps. These patterns form social relations and life values such as culture and become more understandable with the help of spatial forms (Erman 2017, 168). So here, "syntax" means examining the relationship of each spatial unit in a neighboring set, like examining a word in a text and its relationship with other words. If a building is considered as something composed of a spatial communication system, the emergence of this

communication system will be in the form of a pattern, and knowing these patterns means understanding social relations in space, and understanding the hidden pattern in the body of the building means knowing social relations which happen within spaces (Bashirzadeh 2014, 2). Space syntax is an attempt to identify the quality of expression of social or cultural meaning and how spatial configuration creates social interactions in the built environment (Dursun 2007, 4).

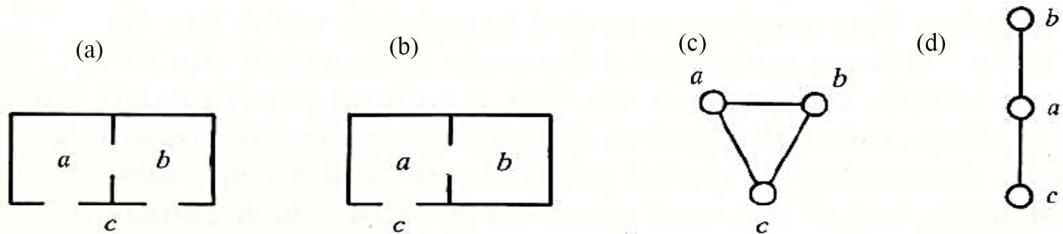
Human societies use the urban space as a source to organize themselves, and this requires the creation of a spatial configuration in the human habitat. Strengthening and highlighting the role of spatial communication allows for giving a social, economic, or behavioral attribution to each space, or it can assume different signs and characters for urban micro-spaces. Also, space has a unified and continuous nature in its organization, which is reduced to discrete and discontinuous components in most rational systems. To put it more simply, in the real world, the boundaries of space do not exist separately from each other, but it is these spatial characteristics that transform them into different spaces (Hamdani Golshan 2015, 88).

The configuration relationship between two spaces cannot be understood and defined without the third space. The relationship between two spaces is simple and helps to understand the relationships of the whole (Erman 2017, 168). The configuration is not prioritized only in the social logic of the space and originates from the logic of the space itself, and this issue can be shown easily. Figure 6 shows a partitioned cell that can connect space a to space b through a gap. This gap creates a "relation" (which can be called "permeability") between two spaces, but as long as we know the relationship of each to at least one other space, i.e., until we know the position of each based on the configuration. For example, Figure 7 (a and b), shows two possible relationships for spaces a and b. In Figure 7(a), both spaces are directly connected to space c, but in Figure 7(b), only space a is connected to the outside. So, to get from space b to space c, you must pass through space a. In other words, the relationship between spaces a and b changes when we consider space c. In one case (b), a controls the access path from c to b, and in another case (a), it does not (Hillier, Hanson, and Graham 1987, 363).



**Fig. 6. A Partitioned Cell**

(Hillier, Hanson and Graham 1987, 363)

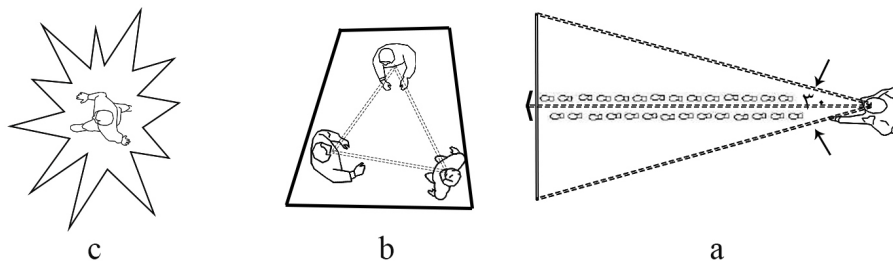


**Fig. 7. (a) and (b) Two Possible Relationships between Spaces a and b and the Outside (space c). (c) and (d) Corresponding Justified Graphs**

(Ibid, 363)

Another feature of the space is that it is impossible to talk about a space in which behavior has not been observed. Moving between spaces has a reason. It is goal-oriented and a sign through which the movement is created and shows the connection between space and other spaces in the whole area. To understand spatial configuration, it is necessary to consider all spatial

relations as a whole instead of examining spaces individually (Erman 2017, 167). And it should be noted that the characteristics of space configuration, compared to the physical characteristics of space, play a more important role in shaping human activities (Hamdani Golshan 2015, 87).



**Fig. 8. Visual and Dynamic Characteristics of Man**

- a) It is the movement in a linear path, and man's visual field is limited to the visual axis in the form of a cone with a 15-degree view of the surroundings
- b) Social interactions are formed in a convex and closed space
- c) Man sees different visual fields by moving in the environment (Figure 8) (Hamedani Golshan, 2015, 87)

One of the applications of the space syntax method is the extraction and analysis of crime-prone points in an artificial environment. In this method, by using a series of syntactic tools, it is possible to predict the behavior of people, especially criminals, in an environment and based on that, and the relevant theories, implement solutions to prevent the occurrence of such criminal acts. Experts, relying on the principles of space syntax, believe that in this method, due to the lack of emotional involvement of residents towards their living environment and simply by relying on the spatial characteristics of that environment, it is possible to easily identify the points where crime is most likely to occur. In this view, a

component such as "accessibility to the environment" can have the greatest effect in achieving this goal<sup>1</sup> (Heidari, Peyvastegar, and Kiaei 2016, 93). Many parameters such as legibility, accessibility, integrity, connection, etc. are used in spatial analysis, some of which are being investigated in the present study.

#### 4.1. Depth

The concept of depth is defined as the number of steps between two points and has a social meaning. Increasing depth means separating the public from the private. That is, if a stranger wants to enter the building, he must pass through the origin of one space, to get one degree closer to the private space.

The depth indicator means social hierarchy or a social function (Bashirzadeh 2014, 77). Depth is formed when you have to cross several intersecting spaces to reach your destination. If the desired destination has a small change in direction, it is "shallow" and if it has a higher value, it is "deep". The important point is the ability to show the value of the relationship of each space with other spaces in the system (Arslan and Koken 2016, 90). As the depth of the space decreases, the separation of the space decreases, which indicates that the space is more accessible. It is also necessary to state that the result of increasing the spatial depth, in addition to separation, is also an increase in spatial privacy, i.e., with the increase in the depth of the space complex, the amount of access and permeation to some spaces decreases, which is a factor to control the space as much as possible (Heidari, Ghasemian Asl and Kiaei 2016, 24).

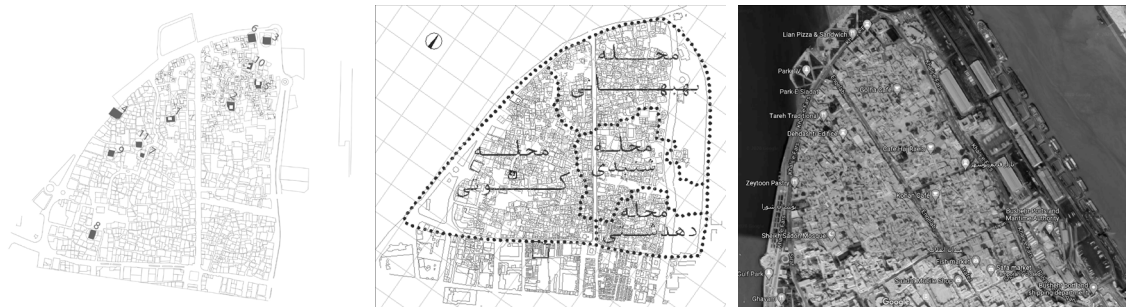
## 5. RESEARCH METHODOLOGY

There are various methods for the analysis of the spatial structure. Some of these methods are qualitative and some others are quantitative. All results of these tools explain the space function and each can lead to unique social interpretations of each space. One of these methods is the space syntax technique. The results of the present study are based on this technique. The space syntax consists of a collection of techniques for analysis and investigation of any

type of spatial configuration, especially when this spatial configuration includes a significant dimension of human affairs such as buildings and cities. Based on the architectural research classification, the space syntax is logical reasoning (Groat and Wang 2019). And based on this approach, "the defined social and cultural patterns are embedded in configuration". The space syntax analysis consists of the numerical representation and analysis of a spatial configuration. In the present study, eleven historical buildings were chosen as samples. To create an equal opportunity for the samples and avoid prejudice, the buildings have been chosen based on the formal typology, and with the help of justified graphs, the metric depth and visual accessibility of each space, the interior configuration of the houses in this area as well as the social and cultural patterns derived from them have been logically and numerically investigated.

## 6. INTRODUCTION OF THE CASE STUDY

The historical texture of Bushehr is located at the northernmost point of Bushehr city. This triangular texture is connected to the sea on two sides and the land on one side and includes four neighborhoods named Dehdashti, Shenbadi, Behbahani, and Kuti (Fig. 9).



**Fig. 9. Right: Bushehr's Historical Texture (Google Map), Middle: Division of the Neighborhoods in the Historical Texture, Left: Location of the Studied Buildings in the Historical Texture**

## 7. INDICATORS OF VISUAL ACCESS IN THE PHYSICAL SPACE

Surveilling the space and place cannot always be realized through human physical abilities, and in this situation, surveilling and accessing the environment through seeing naturally, i.e. by humans, or in an unnatural way, such as monitoring through CCTV cameras, can be the best option and solution. In urban spaces, this component is affected by spatial configuration indicators, depth, integration, and the degree of connection. The more complex, winding, and compact the passages are, and also the end of the passages is not visible to the passerby, in fact, the lower the visual access and subsequently, the lower the feeling of security by the space user (Fig. 10). But

the visual accessibility in the interior of the house behaves differently and unlike urban spaces, the greater the depth of the space and the more clustered the building justified graph is, the lower the visual accessibility, and as a result, the higher the security of that space.

In the architecture of the interior spaces of Bushehr historical houses, the central courtyard is the most important and effective element in creating or strengthening security, in such a way that the courtyard is defined in the middle and the rooms are placed around it. In the houses in this area, the rooms are located on several levels. The lower rooms, which are service spaces, serve functions such as warehouse or crew room. The kitchen, the reservoir, the janitor's room, and the bathroom are also located on this level.

The rooms on the upper floor are the living quarters of the residents and are considered the main space of

the house and include the summer and winter rooms (Maamori 2017, 109-110).



Fig. 10. Visual Limitation Due to the Dense Alleys and Complex Structure

## 8. FINDINGS

Various factors influence the human's feeling of security and tranquility in space. The possibility of direct and indirect surveillance of space and architectural bodies is one of these components. This component which means space control through observation tools is considered visual access in the present study. In this study, eleven historical buildings in Bushehr are chosen and the visual access component in all parts of these spaces has been investigated. the amount of visual access<sup>2</sup> in each space has been examined using the UCL Depthmap Ver.10 and based on the space syntax components. Tables 2 and

3 are extracted based on the investigation of these characteristics. To investigate the components of visual access more precisely, its correlation with the depth and justified graph has been also investigated. For a more coherent evaluation of visual access, the spaces of each building have been divided into three categories of semi-public (entrance), semi-private (courtyard, division spaces, semi-open spaces such as Mashrabiya, Tarmeh, and steps), and private spaces. The physical access indicator is measured by the metric depth in the space syntax software, and for this indicator, the shortest distance to the farthest point from the main entrance in the plan is considered (Tables 2 and 3).

Table 2. Analysis of the Metric Depth based on Space Syntax Software


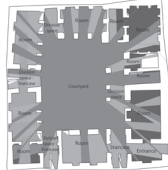
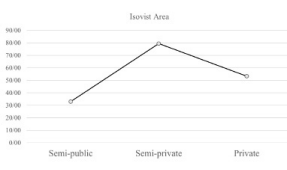
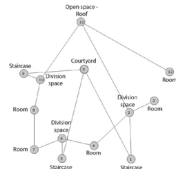
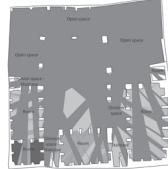
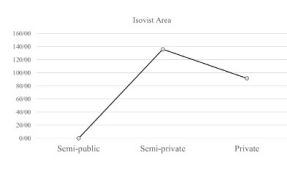
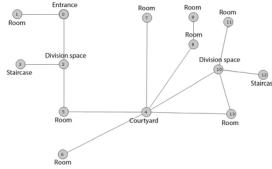
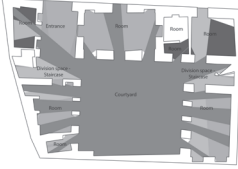
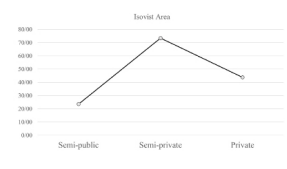
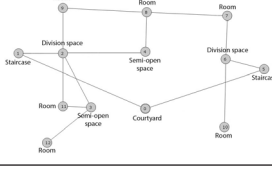
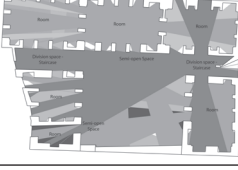
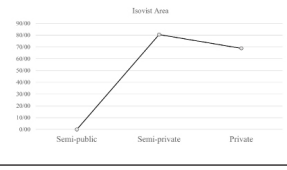
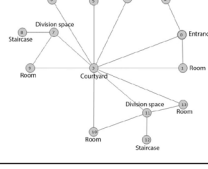
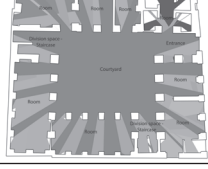
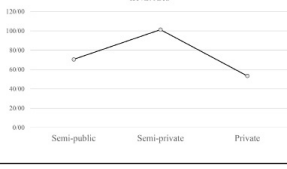

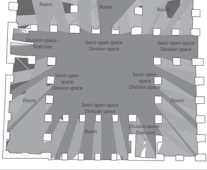
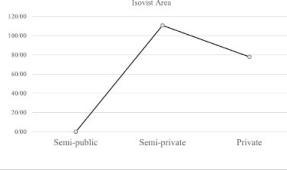
Building Name	Metric Depth from the Entrance	Building Name	Metric Depth from the Entrance	Building Name	Metric Depth from the Entrance	Building Name	Metric Depth from the Entrance
Dehdashti Building (1)		Kamandi Building (2)		Golshan Building (3)		Amirieh Building (4)	
Alamol-Hoda Baladi Building (5)		Tabib Building (6)		Rafei Building (7)		Nozari Building (8)	
Eskafi Building (9)		Hosseini Building (10)		Rashidi Building (11)			



Table 3. Isovist of Case Studies

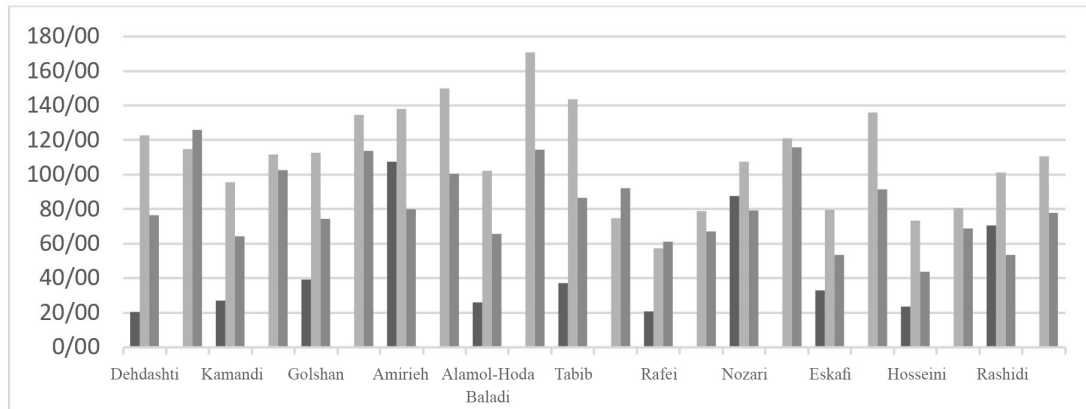
Building Name	Justified Graph of the Ground Floor	Isovist of Ground Floor	Comparative Graph of Ground Floor Isovist
Dehdashti Building (1)			
Kamandi Building (2)			
Golshan Building (3)			
Amirieh Building (4)			

Building Name	Justified Graph of the Ground Floor	Isovist of Ground Floor	Comparative Graph of Ground Floor Isovist
Alamol-Hoda Baladi Building (5)			
	<b>Justified Graph of the First Floor</b>	<b>Isovist of the First Floor</b>	<b>Comparative Graph of First Floor Isovist</b>
Tabib Building (6)	<b>Justified Graph of the Ground Floor</b>	<b>Isovist of Ground Floor</b>	<b>Comparative Graph of Ground Floor Isovist</b>
	<b>Justified Graph of the First Floor</b>	<b>Isovist of the First Floor</b>	<b>Comparative Graph of First Floor Isovist</b>
Rafiei Building (7)	<b>Justified Graph of the Ground Floor</b>	<b>Isovist of Ground Floor</b>	<b>Comparative Graph of Ground Floor Isovist</b>
	<b>Justified Graph of the First Floor</b>	<b>Isovist of the First Floor</b>	<b>Comparative Graph of First Floor Isovist</b>
Nozari Building (8)	<b>Justified Graph of the Ground Floor</b>	<b>Isovist of Ground Floor</b>	<b>Comparative Graph of Ground Floor Isovist</b>
	<b>Justified Graph of the First Floor</b>	<b>Isovist of the First Floor</b>	<b>Comparative Graph of First Floor Isovist</b>

Building Name	Justified Graph of the Ground Floor	Isovist of Ground Floor	Comparative Graph of Ground Floor Isovist
Eskafi Building (9)			
			
Hosseini Building (10)			
			
Rashidi Building (11)			
			

The private spaces of the house which are places for family members to rest and gather have various levels of visual access based on their location and function. Compared to spaces such as courtyards and terraces, these spaces are more enclosed and isolated. Spaces such as gathering rooms (winter or summer rooms) which had the highest number of openings and were

placed in a lower depth with the lowest hierarchy needed to access them, have the highest visual access. These spaces in the building are more public than other spaces. On the contrary, spaces such as closets for access to which more hierarchies should be passed, are deeper and have lower openings, are more private, and access to them is harder.



**Fig. 11. Isovist of Semi-Public, Semi-Private, and Private Spaces in the Buildings**

Blue bars indicate semi-public spaces, orange bars indicate semi-private spaces, and gray bars indicate private spaces

It can be inferred from the investigation of the Isovists that the entrance (semi-public spaces) of the houses have low visual access due to their duty of creating or strengthening privacy and enclosed areas. To increase the security level, some spaces are placed beside each other with the courtyard at the center, and therefore, these spaces have the highest visual access. In the whole building, the courtyard, semi-open spaces, and/or Mashrabiya (semi-private spaces) enjoy the highest visual access which is in line with the communicative role they play in the building.

In most buildings, and on the ground floor, the private spaces have the lowest visual access after the entrance, especially the spaces on one corner of the building. These spaces which also have the highest metric depth and based on the justified graph, more hierarchies should be passed to reach them, are the most secure spaces in the building. People enter the house space after passing through a controlled space with limited access such as the entrance, and after passing the hierarchy and passing through spaces that are highly controlled, access these spaces in the house. After the courtyard, those private spaces that are in the spatial structure of the building are the place to receive guests or the gathering place of family members and are also located at a small depth in the building, having the highest level of visual access.

## 9. CONCLUSION

Space configuration is indicative of defined sociocultural patterns and an important factor in the creation and control of security. By investigating this component through visual access, the sociocultural patterns and their manifestation in indigenous housing can be obtained, and accordingly, some solutions can be provided for improvement of the housing security. Visual access in urban spaces leads to an increase in surveillance of the environment and paves the way for security improvement. With the increase in legibility and visual access, individuals feel more attached when facing the passages and the environment. This

indicator in the interior space, when associated with components such as the metric depth, integrity, and justified graphs, behaves differently compared to the urban spaces.

Based on the analysis of visual access graphs, the metric depth, and justified graphs, the historical houses in Bushehr are not much complex regarding the access hierarchy, and their interior spaces can be easily accessed. On the ground floor, semi-private spaces have the highest level of visual access regarding the structure and location of the entrance. On the first floor also, the highest level of visual access belongs to communication and semi-open (semi-private) space, and the lowest level of visual access and the most isolated spaces belong to private spaces such as the rooms. Therefore, based on the public or private being of the spaces, visual access is also increased or decreased.

Answering the first research question (what is the relationship between visual access and security in the interior space and how is it realized?), it is noteworthy that the higher the visual access to the space within the house is, the higher the space control capability. In other words, with the increase in visual access to spaces such as the courtyard and semi-private spaces, the security level of other spaces is also increased while their accessibility is decreased. As a result, besides the change in the role of visual access based on space use, with the increase in this component in semi-private spaces, security of the semi-private spaces is guaranteed. Answering the second research question (how does the location of micro-spaces influence the security of the house's physical space?), the position of each space is considered based on the use, level of privacy, tranquility, and accessibility of the space in line with the function. For example, spaces such as living rooms (summer rooms) as spaces for the gathering of family members, which is an accessible space with high control capability, are placed in the lowest depth and the first layers of the house. On the contrary, the bedrooms and closets (sometimes warehouse) is located on the farthest



layers of access in the house. Therefore, through this space syntax and configuration, security in the physical spaces is created.

## 10. SUGGESTIONS FOR FURTHER STUDIES

Visual access, Isovist, cohesion, and integrity, investigated in the present study, are among the top research analyzed regarding the spatial security of historical houses. Undoubtedly, many intervening

factors are effective in the improvement of physical security. Regarding the wide scope of this issue, the investigation of all effective dimensions in a single study is not possible. Regarding the role of the climate in the formation of the architectural structure of the housing as well as strengthening the security in the interior space, this subject can be considered as complementary research in further studies so that security indicators in the house can be investigated and the results of the present study can also be more effective.

## ENDNOTE

1. It should be noted that the physical access which is tracked by the pedestrian in urban spaces can only be investigated in the parts that are on the ground. As a result, by evaluating the ground plan in two dimensions, its environmental characteristics can be understood.
2. Visual access has been investigated based on the level of natural human vision at an angle of 120 degrees. Warm colors (red) in the software outputs mean the most visible area and cold colors (green and blue) mean the least amount of visibility. Features of the visual graph are strongly related to manifestations of spatial perception, such as navigation, movement, and use of space. In this research, the amount of Isovist Area components have been measured.

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#### HOW TO CITE THIS ARTICLE

Sajjadi, Seyedeh Maryam, Ahmad Danaeina, and Javad Divandari. 2022. Improving Housing Security based on the Explanation of Visual Access Indicators in Historical Houses of Bushehr. *Armanshahr Architecture & Urban Development Journal* 15(40): 83-97.

DOI: 10.22034/AAUD.2022.269651.2406

URL: [http://www.armanshahrjournal.com/article\\_163866.html](http://www.armanshahrjournal.com/article_163866.html)



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