



## **Exploring Traditional Iranian house and culture using Space Syntax theory and methods, Case Study: Brojerdiha Mansion, Kashan, IRAN**

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### **Abstract**

The main aim of the current paper is to explore the Iranian traditional houses cultural properties by space syntax theory and methods, using spatial configuration most recent developments and computer based techniques. The paper initially took a brief introduction to the spatial configuration theory fundamentals and core ideas. It starts with the book by Bill Hillier and Julianne Hanson, the social logic of space and then proceed to the bible of the theory, Space is the Machine. More than that, recent publication and papers which has had a huge impact on the theory were cited wherever it was necessary. All the theory and methods are applied to a case study from Iranian traditional houses in order to demonstrate its hidden geometries and structures underpin its forms and functions. recent studies in space syntax proved the fact that Patterns of movement inside buildings are generated from the spatial configuration. Besides, it has been proven that Movement patterns are correlated with space syntax through measure of 'integration'. In order to show the cultural and social effects of a design, space syntax applies a graph representation on any kind of traditional house. This graph can be analyzed as a system of connections between spaces. The system of connections then appears to have effects on the movement patterns of the residences in a traditional house. Furthermore, the movement patterns affect the cultural values and the social relation in big families living in the traditional houses. With spatial configuration tools and methods, the causal links between the cultural and social factors and architectural design can be revealed. The method is definitely a strong method of advanced architectural analysis because of the fact that seeking the underpinned structures in architecture have not been so usual before the advent of computers and its developments. Although the axial and convex analysis were developed before computer and quantitative techniques, emerging technologies and computers analytical powers has a great influence on its further developments. The case study that will be presented in detail served as a proto-type for Iranian traditional houses to understand whether axial lines and convex maps could show the social and cultural effects of traditional house design in Iran or not. A graph has been applied on the ground floor plan of the house and then it has been simulated in depth map software. Depth map software capable the researcher in analyzing the graph. The causal links between the graph and the properties of the traditional house design have been clarified for further studies. Brojerdiha Mansion, Kashan has been selected as a case study to uncover the understructures that underpinned the traditional architecture in Iran. The reason to select the Mansion was firstly, its prestigious role in Iranian architecture, Qajar era in one hand, complexity and multi-use spaces in its plan, which makes it a suitable case study for analysis, on the other hand. The outcomes of simulations provide a ground for showing the causal links between design and the social and cultural aspects of the mansion. The integration value of the main movement corridors shows a high value of causal links with the social interaction locations of the residences.

**Keyword:** *Space Syntax, Brojerdiha Mansion, Integration, Segregation, Intelligibility*

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### **Introduction**

Among the logical systems exploring architecture and urban design, the space syntax theory, have attracted more attention rather than others, recently. The attraction is mainly due to the tangibility and objectivity of the theory and the availability of sources and the software. the open source software and the available books on the related websites, is the witness of these privileges. For instance, the inventor and theorists of this theory, in Bartlett school of architecture, University college London, have put most

of their tools and library resources available for public access researchers. At the same time, similar efforts are emerging around the globe to utilize the theory and method applications and to develop its new concepts. for example, at School of Architecture and Urban Planning in Georgia Institute of Technology and at the Massachusetts Institute of Technology, there are academics have been gathered around the topic and scientific research are being defined. none of the theories of structuralism, have influenced so much attention as the theory of Bill Hillier and Julia Hanson in the Schools of Architecture. Biennial symposiums of space syntax which has been held nine rounds become

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a place for scholars and thinkers of architecture. several advantages are changed the theory and methods into a popular way among common methods of researches in architecture. First, the essence of the theory on space has doubled the importance and its achievements for architects. As we know, space is the essence of architectural design. The significance that is due the functionality of the method in everyday experience architects in shaping the space. Better interpretation, architects in their Experience architecture and urban design, are used from the research results directly and are applied it in the design of their own. Second, the comprehensive and inclusive approach on a large range of architectural and urban design. For example, in the field of architecture, design, morphological architecture, historical evolution architecture, modeling, spatial analysis, spatial behavior and understanding space are the issues that this method could create worthy and profound researches. In the field of urban design, most researcher's activities in this field are on the basis of the relationship between layout and a range of socio-economic and environmental changes. Some of These phenomena can be named such as movement patterns, information and interaction, density, land use, security and the distribution of crime, the value of land, urban development and social differences. The importance of doctrine that is formed today on the basis of the theory of "space syntax" is obvious for theorists of architecture and urban design. More than the schools of architecture and design, this theory is wider spread in many faculties of Humanities, School of Psychology and archeological. The present article tries to apply the ideas and thoughts of this theory on Iranian traditional houses. The main goal of the study is to recognize the capabilities that underpinned the historic architectures of Iran.

### **1. exploring social logic of space**

The Theory "space syntax" is an attempt to make a causal relationship between human society and physical architecture [1]. In a sense, it is the characteristics of the visual and motion of human in an architectural space that forms architectural space and simultaneously building and forming Social relationships. The First basis of the theory that is space, as the inherent feature of human activity, emanate of this attitude. In contrast to this view, space is as a basis for activity. For more explanation, should be said that, in view of this theory, space and human activity do not have two independent and different essences. But that they have univalent nature that emerge in two different flaunt. This nature is hidden in the nature of man and his visual and motional characteristics. In fact, the essence of the emerging of space and human relations, both are the man and his visual and motional characteristics. Thus, with priority to the human characteristics in fact, we lead to the creation of a

unique architectural space and social relations. This concept, is forming unit and the default theme that space is an inherent essence of human activity and not a platform for it. The second basis of the theory is on the configuration of the space and its distinct role in shaping human activities. Simply put, the characteristics of the configuration space, in contrast to the physical properties of space are more important role in shaping human activities [2]. On a larger urban scale, this theory tries to restore the man-made space in theory of spatial organization of the city. This man-made space encompasses all its aspects, including buildings, biological collection, the cities and perspectives. In other words, human population uses urban space as a resource and director to organize for their own. This involves creating a configuration space in biological collection."Spatial configuration" in this discourse is expressive and emphasized the relationship between the spaces of the space on its own. The more appropriate term, the spatial configuration is emphasized on the formation of spatial relationships in a series compared with the space quality of the unit. Strengthening and highlighting the role of spatial association, will be able to create a social, economic or behavioral relation to any space or for tiny urban spaces, assumed different signs and characters. This feature, in fact figures out the prominence of the theory and its special ability to deal with the relationship between human activity and the built environment marks [1]. Finally, the fundamental purpose of formation of the space syntax theory, is seeking approaches for describing the configuration space. A description that can detect hidden social logic in underneath layers and a basis for secondary theories that cover social and cultural events (Grout, 1384). As stated earlier, the configuration space role and the development of its processes and its social different meanings are ultimate goal of all these efforts. That how the phenomena of social, cultural and economic are defined and go along in direct relationship with configuration space, illuminates the crucial role of this system among architecture and urban planning research logical systems [4].

### **2.Approaches and strategies, practical methods**

Spatial Configuration can be considered the beginning of space syntax analysis, usually, applies on building plan or urban areas plan. But the starting point for analysis, is graph network (topology), which represent abstract of the configuration space. The fact is that abstract pattern of social relations in space is better understood by the topological network. Or in other words, basically the social relations are imaged by the graph, and the relationship between the components implies the presence or absence of these relations. In addition, the network topology, is created a background for beyond calculation that display the complexity of social relations and decode the

relationship between them. The network graph, removes the calculation from complexity of the architecture and urban plan that in its relations with the adjacent space does not have a direct effect and thinks pure and unaffected by the relationship between the components. This causes the surrounding space, with differentiated geometries, according to the network to be judged and are considered part of the same value. The best way to describe the story, providing a tangible example of architecture. For this purpose, Boroujerdiha Mansion in Kashan has been rummaged studied as a case study (Figure 1). This case therefore is selected, which is primarily display an outstanding example of traditional architecture of Iran. Secondly, samples of traditional architecture, due to they have numerous openings of architectural spaces to each other, provide acceptable and treatable samples for space syntax theory. A theory that developed on relationship among architectural spaces and is a believer in the primacy and originality of the communication of spaces. Boroujerdiha Mansion, like most of his contemporary houses include multi-storey that have been contemplated only ground level in this case. Following the discussion in order to clarify the procedure space syntax, linear plans in multistep is implemented on Boroujerdiha Mansion plan and convex space and configuration space can be extracted from it. In the meantime, methods and techniques will be discussed in detail.

### **3. Analytical techniques, convex space and axial maps**

Space itself is integrated nature; and the nature in the more logical systems, is reduced into discrete and torn components [5]. In other words, the boundaries of space in the real world are not discrete and separate, but these spatial features that can be converted into different spaces. Arrangement of these spaces together made a configuration space and the main problem in applying space syntax, is changing a configuration space into a graph. Turn a continuous space to a discrete and separate symbol, means splitting the continuous spatial relationships and replace them with discrete components and is an emphasis on the aspect of the relationship between these components with each other. An architectural or urban context plan, with strong and solid lines has been surrounded and blocked as the boundaries of a confined space. However, in reality, space is unlimited and continuous nature and borders and edges in the areas of communication space, is not certain definition [5]. Drawing Convex space and axial maps are two strategies that the space syntax theory selects to transform continuous space to Discontinuous components and separated from each other. Convex space in Geometric definition indeed is a space that its edges forms a convex polygon. Polygon convex is a polygon that does not have no angle greater than one hundred and eighty degrees and this makes

the lines are drawn inside the polygon and connected the edges to each other would never have crossed edges (Figure 2). The equivalent term in architectural space, is a space that standing in it providing the ability to control and monitor all of its surrounding space [5]. Mapping the convex space is an Introduction to axial maps that prepare space syntax studies. This method as architectural space that forming a convex space is considered to be a separate and independent unit of collection. (Figure 4). The relationship between the convex spaces form a graph that represents the internal relations of spaces. In changing the convex space to axial maps, some continuous convex spaces that have a more complete viewing angle to each other, are combined and constitute a single line thus, a single space. This on the one hand due to the fundamental differences of mapping technique of the convex space and linear space map and on the other hand disadvantages and damages that still exists in drawing axial maps [6].

### **4. Measurements and descriptive concepts**

Choosing between drawing the convex space and axial maps depends on several factors. For that computer programming spaces or generating spaces are desired, usually convex space is used. Where the environmental behavior indicators have concerned axial maps, are more effective. The main reason for this problem is a significant relationship between population distribution and the degree of integration in an urban context. In other words, the relative distribution of the population has always been associated with the integration space [7]. The integration of asymmetry or relative of a space (whether a convex space or an axial map) is the mathematical ratio of a configuration space in relation to other spaces. For more explanation, must be said that of the basis calculation of the number is the average depth of a node in the graph network of an architectural or urban texture [8]. Simply the average depth is the division of the maximum number of nodes that are located in any direction from the source node into the number a space connection. Similarly, the relative average depth is calculated by ratio of the number to maximum depth of a node in a graph. Since depth is always a positive number and the number of maximum depth is always greater than the number of average depth, the relative average depth value or relative asymmetry is always a number between zero and one. This number can be the basis for comparing the relative graphs with distinctive features, such as the number of different nodes, different depth and different organization. Real relative asymmetry, in fact is the ratio between the relative asymmetry graphs to a reference graph called a diamond that has a similar number of head. Diamond graph characteristic, is the same distribution of nodes between its levels, so it is an appropriate basis to measure the regularity of establishment of an asymmetrical graph. The

integration, which is used frequently in the study of space syntax is real relative asymmetry reverse number. The integration of more nodes is referring to the lower depth of nodes and their involvement with the graph spatial network. Most of space syntax researches are on numerical correlation between a human factor and space integration.

The output of topological model of an architectural-urban complex prepare it for an experimental study. In addition to, these simulations and models when formed on the basis of axial maps, are ready to match with the sociological or economic issues.

Especially when social issues directly, indicating the number of people who would present be in a collection. For example, the number of people in a particular social class, or the number of crime is located in an urban area, the number of people with a single socio-economic characteristic. This results in different cultural contexts and at different scales and in different habitats usually contributed to the understanding of urban structures take shape [9].

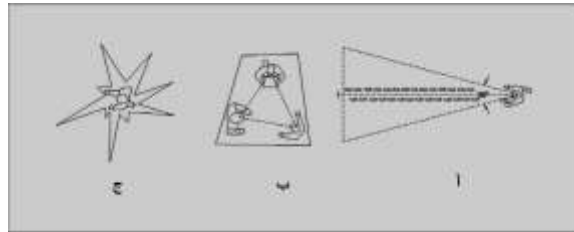


Figure 1 the human movement and visual characteristics (Vaghaun, 2007:208).  
 a. Man moves in a linear direction and his field of vision is limited to vision and cone with fifteen degrees around it. b. Social interactions are formed within a convex space. c. Human with movement in the built environment, can see a different vision. [3]

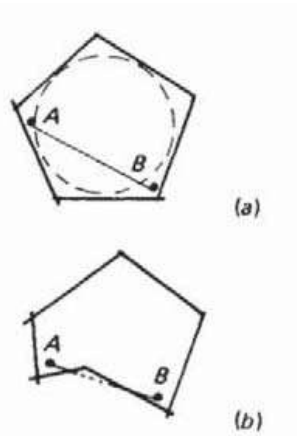


Figure 2-a convex space: the lines between points A and B are always located within the perimeter of polygons (Hillier et al 1984:98)  
 Figure 2-b Concave space: the lines between points A and B, overlap with the environment surrounding polygons

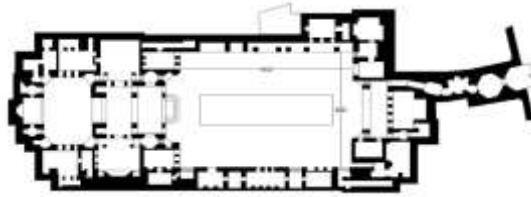


Figure 3-a Ground plan, Boroujerdi Mansion in Kashan (Hajighasemi, 1375)

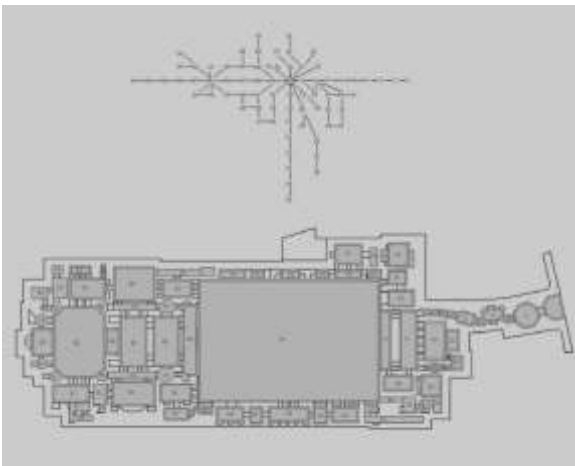


Figure 4 Convex space and corresponding Graph

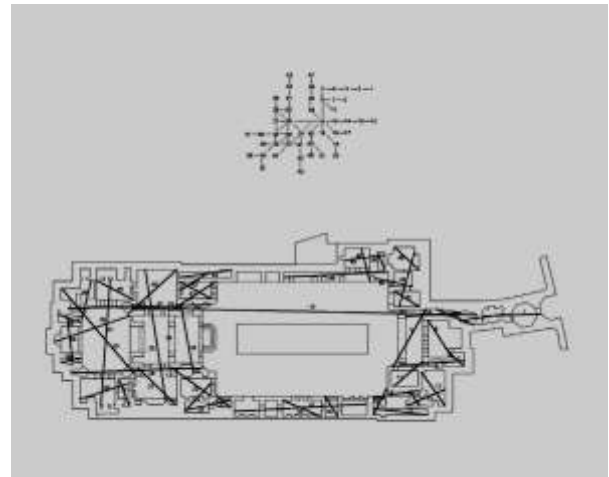


Figure 5 Axial map and its graph

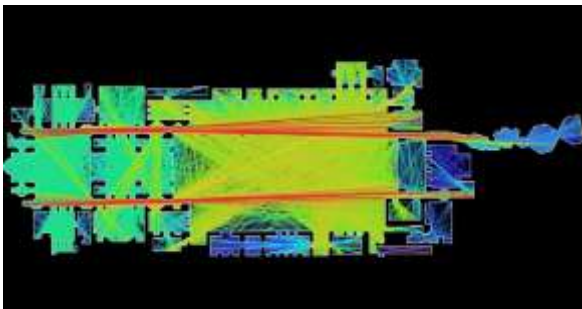


Figure 6- an axial map, Boroujerdi's Mansion, Kashan, drawn by the Depth Map Software

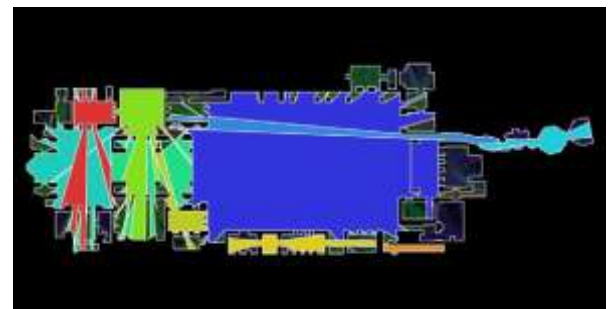


Figure 7- a convex space map, Boroujerdi's Mansion, Kashan, drawn by the Depth Map Software

Table 1. The results obtained from the analysis of the spatial configuration of Boroujerdi's Mansion;

Ref	Connectivity	Entropy	Integration [HH]	Intensity	Line Length	Mean Depth
412	1969	1.4142025	15.33045	2.3186069	51.399853	1.6103466
2100	1849	1.4597056	14.280992	2.2293169	40.331013	1.6551988
1074	945	1.417094	9.9800024	1.5122604	19.839134	1.9375637
3435	675	1.7290437	7.7232709	1.4278343	9.4010286	2.2115188
3612	414	1.7018751	6.8925152	1.2541982	3.775835	2.3575432

## 5. Conclusion and summary

Methods and analytical techniques of space syntax in schools of architecture and urban planning has become as a common tool [10]. Continuous development of its software and theory at the Bartlett School and elsewhere is an inevitable need to be updating the theory and practice. This process requires rethinking the first basics and then look at its development and finally its implementation on the basis of the new case. The aim of this article is to review basic concepts and considered its implementation on a traditional architecture.

Based study of the paper focuses on an architecture single building, and rethinking of methods and happened developments in the theory of Bill Hillier, is in it. Since most studies of this method is related to the research and urban contemporary architecture reflection in a traditional building of Iranian can reveal realities lies at the heart of Iranian valuable architecture; reanalyze Spatial and social structures in it and ultimately help us to understand the thought and life of the past [11]. The past that can be the identity of architecture of Iran today. These results have been extracted from the current study:

The main corridor of the traditional houses and their extension to the court yards are still the most capable space for social interaction and family face to face relations. As we can see in the axial maps, the highest value of the integration is dedicated to the space which is shaped from the extensions of the both side corridors on the court yards. This analysis demonstrates the vulnerability of the space.

Although the courtyard level is one meter deeper than the other parts, the extension of the visual fields on both sides of the building still makes the continuous visual fields, the most capable parts of the architecture for gathering users and family members.

Centrality and the interactions between the family members demonstrate a high correlation and the space in the middle of the graph are more prone to social encounters.

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