

Deficiency of the Space Syntax Method as an Urban Design Tool in Designing Traditional Urban Space and the Need for Some Supplementary Methods

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Abstract

Urban design problems have become so complex that no single designer is able to address all aspects of a design area simultaneously. Lately the application of computerized and scientific methods has helped designers to analyze complex problems. One of these methods is Space Syntax. The purpose of this study is to first investigate the strengths and weaknesses of this method and then suggest some supplementary methods to cover its pitfalls. On the next step, Space Syntax and supplementary methods will be used to design a pedestrian pathway in the Imamzade Ghasem neighborhood as a traditional context. Space Syntax can identify the existing spatial structure and direct future changes toward its strengthening. The case study reveals that Space Syntax can be successfully used in the design of traditional spaces, but in order to successfully design a neighborhood in such a complex context, it involves logistical shortcomings which could be eliminated through supplementary methods.

Keywords Space Syntax, Urban Design, Traditional Neighborhoods, Imamzade Ghasem

1. Introduction

The most significant task of an urban designer is the design and shaping of public spaces in order to improve their quality. Following the industrial revolution, however, the forces shaping cities became so diverse and numerous that traditional artistic methods would no longer respond to the emerging needs of the contemporary city. This made the need for new urban design methods inevitable. Computers attracted designers' interests because they made it possible to consider multiple factors at the same time. Efforts were, then, made to find ways and means to use new technology in urban design. Among the results were models to predict the changes that would occur due to the implementation of different plans in cities. The models developed under Space Syntax are one of those models. Using this analytical method will pave the path for the realization of desired goals in urban design projects.

The emergence of modernism in Iran brought about the same problems European cities were facing during a significant part of the twentieth century. For centuries, architecture and urban design in Iran have relied on artistic and intuitive principles, which are no longer capable of solving present-day problems of cities. That is why the majority of urban design plans in the country are doomed to failure. It, therefore, seems that the application of scientific methods including Space Syntax can solve this problem and result in reducing the time and money spent on preparation and implementation of urban design plans.

While predicting the future is increasingly necessary for preparing any urban design plan, the forecasting and modeling tools developed and used in the Western world are not proven to be successful in the context of traditional cities of Iran. Under such circumstances the responsibility of urban designers, in the application of reliable analyzing and predicting methods to improve the quality of plans and to eventually promote the quality of life in cities, becomes more serious.

2. The reasons for selecting Imamzade Ghasem neighborhood

The design and intervention in the historical sites of cities, particularly in the ones with valuable and unique cores, is one of the critical and challenging issues in contemporary urban design. Imamzade Ghasem neighborhood is one of the oldest neighborhoods of the city of Tehran, located in the Shemiran area in North Tehran (Fig. 1).

Fig. 1. Location of district 3 in zone 1 in the city of Tehran
This neighborhood has been shaped around a specific element, which has resulted in cohesiveness, social and

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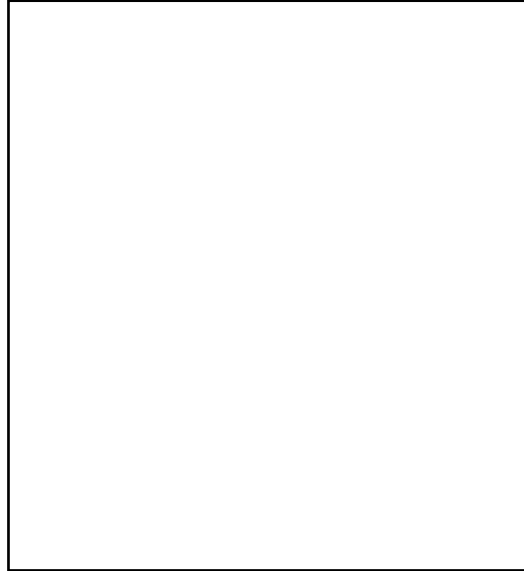


Fig. 2. Imamzade Ghaser neighborhood

cultural unity, family ties and close relationship among residents (Fig. 2).

A combination of the Imamzade Ghaser building and the cemetery, which are all located near the central square, form a strong tourism attraction in the neighborhood with a unique identity. The central square, Imamzade Square, has been acting as the service center for the neighborhood, which provides daily, weekly and in some cases, even monthly needs of the residents.

Some of the unique characteristics of the area are: steep slopes (as high as 50%), view to the mountains and the city, pleasant climate because of the mountain heights and orchards, and also the existence of one of the mountain climbing paths (the potential of sport tourism) nearby. Recently, however, due to unplanned and hasty developments, some of the orchards have undergone subdivisions and turned into high-rise residential apartments. Urgent actions therefore, are needed to protect the natural features since they are the unique and irreversible characters of the area.

3. Questions

- Does Space Syntax, in spite of its considerable potentials, involve any shortcoming and deficiency in the recognition and analysis of urban spaces that require the input of some supplementary methods, particularly when it is applied in the complex and traditional contexts?
- Can Space Syntax be used as an urban design tool to overcome the implementation problems of urban design plans which are due to inadequate recognition, analysis, and also unreal prediction of the future?

4. Purpose of the study

The purpose of this study is to test the applicability of Space Syntax, recognize its deficiencies, and suggest

some supplementary methods for the design of urban spaces in a different context than England—the context of traditional urban space in Iran.

5. The Space Syntax Method

5.1. Background (The Space Syntax method strengths)

A review of the history indicates that form-oriented theory of architecture has been increasingly explored to understand the existing, but invisible structures and organizations which are behind the architectural forms and phenomena. One of the methods developed in the framework of the formal view is Space Syntax, which is known as one of the important methods of space morphology today. The initiators of this method intended to, contrary to the common procedure, promote the general knowledge by working on the applied knowledge. One of the principles of Space Syntax is a mutual relationship between space and socio-cultural patterns. Space Syntax applies the concept of configuration in urban spaces to discover those social patterns and structures. In this sense the form of cities are reflections of residents' life style. In other words, cities may be regarded as factual manifestations of historical, economic, social, and cultural forces which work in society. The purpose of application of Space Syntax is to discover these social relationships in space (Hillier 1996). This method is looking for a definition of space and reason for its independence (Hillier 2005). This could be regarded as one of the positive points of the method.

Space Syntax is capable of using integration radius to predict the pedestrian movement at the local and larger scales. This criterion is known as "movement potential" (Radford & Ragland 2003, Penn 2003, Hillier 1996). Therefore, the more the integration radius degree on a street, the more the movement potential of pedestrians,

and the more pleasant the space would be for users. Beside the concept of movement potential, there is another concept called "natural movement", suggesting the relationship between the structure of the city and the way urban spaces are located in relation to each other and to intensity of pedestrian movement. Natural movement brings still another concept into mind known as "movement economy". Natural movement and subsequent urban network affect land use patterns through attracting movement, and land use patterns will intensify natural movement. In this respect, acts of exacerbate effects is formed which shapes urban pattern (Hillier 1996).

On the other hand, one of the main challenges for urban designers, traffic engineers and supporters of pedestrians' safety is the lack of precise data on "pedestrian exposure". Rford and Ragland (2003) believe that Space Syntax software is able to fill this vacuum. Careful calculation of the mentioned measurement may decrease the degree of risk exposure in the hot spots. This will increase people's interest for walking, which will lead to a safer and healthier community, and a reduction in the use of motor vehicles, which is a significant factor in reducing air pollution in the metropolitan areas.

Another analysis of the integration map is to determine to what extent space is public or private by using depth criterion in the justified graph. An increase in the degree of integration in a space would result in an increase in how much public is a space. By using integration degree criterion, we can design different spaces according to the respected land uses as required public or private spaces (Hillier 2005). This analysis can be applied in recognizing remote areas of cities.

The Space Syntax method is applicable for measuring the legibility of a space. Legibility is defined as the relationship between characteristics of a local graph, namely "connectivity", and its global feature, namely "integration" (Penn 2003). It can be said that in an integration map, the more integrated a space, the more legible it will be and vice versa.

The Space Syntax method and computerized analyses performed by it can, based upon integration or depth criterion, identify the main structure of a city (Hillier 2003). This method will increase the rationality, as well as, the creativity of the design process (Hillier & Penn 2004).

One of the strengths of the Space Syntax method is its ability to describe graphically the compound features (Hillier 1996). Lynch (1981) believes that if we ever decide to develop a particular language for cities, this language will probably be visual, because in order to describe complex spatial patterns, illustrative presentation is preferred to words. Perhaps it can be said that the Space Syntax method, by presenting the results of analyses graphically and in the form of map or diagram, makes it possible to understand the complex phenomenon of the city more than before. This is the first step to achieve the visual language of urban design. On the other hand, Space Syntax modeling may greatly impact the quality of the

urban design process. Graphic presentations make it easily understandable to all interest groups. Therefore, it can be used as an effective tool for participatory and collaborative decision making to involve different political groups and citizens in the planning and design process, in order to reflect their diverse needs and desires. This software can, in fact, solve one of the main problems encountered by urban designers, namely the gap between expert and non-expert languages. Application of this software in countries like Iran, where public participation in the design process is faced with many problems, may pave the way for a more active participation of people in making decisions about their environment. Finally, the abstraction of urban spaces by the Space Syntax method provides the possibility of morphology to illustrate order and discipline in the form of similarities and dissimilarities and to make it possible to compare different spaces (Hillier et al. 1976).

Space Syntax has found many diverse applications, including: discovering and analyzing the city's main structure, investigating the volume of pedestrian movement, locating urban land uses, designing special urban land uses such as subways (see: Ünlü&Edgü 2007), examining segregation in citiesii, analyzing the dynamic process of urban development through history (Hillier 2005, see also: Crompton & Brown 2007 & Wang et al. 2007), measuring the probability of delinquencyiii (see: López&Nes 2007), analyzing the building on individual floors or vertically (see: Brösamle, Hölscher&vrachliotis 2007), presenting the characteristics and configurations of spatial patterns of communities, and also the relationships between spatial and social patterns (Hillier et al. 1976), discovering urban characteristics (see: Read 1999), and, most important of all, stating that even the most complex patterns may be recognized by identifying a few number of concepts and initial performances (Hillier et al. 1976).

5.2. Space Syntax application in Iran

In Iran, Space Syntax has been adopted mostly in the area of theoretical studies and the method has not been put into practice yet.

5.3. The Space Syntax method deficiencies

In the Space Syntax methodology analytical study on the compositional space is conducted by emphasis on abstract description of that space topology. Presupposition for this abstract process in analyzing compositional space demonstrates that the sociological aspects in spatial composition can be perceived by topological descriptions. The point is that researchers in this area have tried to substantiate the possibility of discovering sociological aspects of spatial compositions through topologic descriptions to common sense rather than theoretical basis (Bafna 2003). This will decrease the creditability of the method.

Another issue is related to VGA, which is the basis of

numerous analyses in the Space Syntax method. The success of VGA analysis in describing the manner of interaction among people in space is not fully documented. In fact, the findings of this analysis are under question even by its founders (Turner 2004 & Turner et al. 2001). In other words, Space Syntax analyses which are derived from such a map are based on an assumption that even in some cases its inaccuracy has been proven. It seems that after about 30 years from the advent of Space Syntax (1980), it is now necessary to end such debates and come up with a more definitive conclusion.

The Space Syntax method claims that it is creating a theory based on experience (Hillier & Hanson 1997). Researchers in this area use inductive methods to prove their hypotheses (see: Hillier 2001 & Hillier et al. 1987). When such methods are used to prove a case, only a contradicting example is enough to suspect all findings. This contradiction exists about some Space Syntax hypotheses. That is why Space Syntax may not be used as a theory. The application of the Space Syntax method should also be done with caution. Of the cases in which Space Syntax hypotheses were under question, we can refer to a research conducted in Brazil:

Findings of the Space Syntax suggest that it is the global features of cities, and not the local ones, that should be identified (Hillier et al. 1993). In rejection of this claim in an experimental example in Brazil (Holanda 2007), lack of correspondence of some cities with these findings is documented. This has been verified in another research on Iranian bazaars (see: Masoudinejad 2005). Another example in rejection of the findings of Space Syntax is related to integration radius. According to the findings of the Space Syntax method, radii between 5- 7 are suitable for integrating the main routes and a radius of 3 is appropriate for measuring integration on local streets (Penn 2003). While Karimi (1997) proves that due to some specific features of the context, integration degree of a radius of 3 is not enough for investigating local integration in Iran; he instead suggests a radius of 5. In addition to these contradictory examples which question the findings of Space Syntax, they have been accepted with low precision and accuracy, even in its developmental stage. This will increase the probability of error in the results of analyses to a large extent. In this respect, one problem regarding the Space Syntax method is arbitrariness of the axial map. Ratti (2004) believes that the generation process of this map seems doubtful and random regarding some facts about urban built-up areas. In response, Hillier and Penn, point to a research project. In this project, the length of axial errors related to 36 cities was investigated among which 28 cases had satisfactory results. They consider the calculated error insignificant and consider the results of this research a proof for precision and accuracy of the axial map (Hillier & Penn 2004). This situation occurs when in today's world, everything is moving toward more precision with the help of novel tools and computers. 33% error is

somewhat more than what could be negligible.

In another case, the issue of two dimensional maps as the input data in Space Syntax software is raised. According to Turner (2004), the maps which contain circle configurations are based on approximate calculation. This will eventually reduce the findings' precision. In cases where a significant number of architectural and urban spaces are designed using singular configurations or pieces of circles, Space Syntax software has failed to precisely analyze and calculate these configurations. Another problem in the application of Space Syntax and the precision of its results is in the agent-based analysis (Turner & Penn 2002, Penn & Turner 2002 cited in: Turner 2004). Turner calculates the approximate accuracy of this analysis for interior environment about 0.77 and for urban environment about 0.68. The question is whether such approximations can be considered the basis of analysis in urban environments. Urban design is a very complex field with multiple variables, and, therefore, needs the kind of tools to make the existing conditions more clear and simple, rather than the ones that are subject to uncertainty. It seems essential to carefully and cautiously use this method and to measure the results of the analyses with the local components and terms to prevent any inaccurate variables from entering into the urban design process.

Lack of attention to the physical elements may also be considered a problem. Examples in the case of urban design are as follows:

1. In the justified graph, the dimensions, proportions and their impacts on users' perception of spaces are not considered important.
2. Although every spatial form has its unique characteristics, which motivate a specific reaction from the viewer, space configuration has almost been neglected in drawing the justified graph.
3. The type of materials used in the walls and floors, either in architectural or urban spaces, plays an important role in the interests of people in using the related spaces. In space abstraction to the justified graph, however, these differences have been removed.
4. The kind of ornaments applied over a building or urban space has a great influence on the manner of communication of people with that space. The significance of this issue is to the extent that elimination of ornaments and applying certain materials will lead to a different architectural style, implying even different ideological principles. This issue has also been neglected in the justified graph.
5. Based on experience, the manner of calculating the starting point in a building with multiple separate entrances, depending on which entrances are considered results in the formation of different justified graphs (Memarian 2007). In

cases where residents have not moved, so that we could relate graph changes to alterations in residents' socio-cultural conditions, changes in the configuration of the justified graph reduces its reliability. Such cases lead us to question the extent of creditability of data from this method in the field of social relations.

6. According to Rob Krier (1979), location of building entrances affects the type of the emerging urban spaces, but in the drawn justified graph for urban spaces, this issue has not been seriously taken into consideration.
7. Justified graphs do not consider two- or three-dimensional geometries of spaces so that it may be said that justified graphs neglect the impact of configurational and geometrical factors on choosing the movement direction within the space by users (Memarian 2007).
8. The degree of space enclosure affects the manner of users' movement, which is not accounted for in the justified graph.
9. In the justified graph, the size, characteristics and type of spaces are not addressed, and only the relationships between spaces are considered important; although, one can expect that space quality may be significantly influenced by those factors.
10. Space Syntax does not pay attention to the color factor while experts consider color as a significant part of Iranian art and architecture (Nasr 1971). The design process cannot be considered as complete without paying adequate attention to the colors.

Now the question is regarding the circumstances where the basis of all calculations in the Space Syntax method is on the justified graph and this graph suffers from such deficiencies. To what extent can we rely on the results of analyses of this method for design? In the subsequent sections, some other factors and cases which have not been adequately dealt with analyses of Space Syntax are addressed:

Land-use: According to Space Syntax movement, patterns within an urban environment are largely intended to be formed on the basis of road network topology. Other factor such as land-use distribution, which plays a determinant role in traffic movement, has not been considered in this method (Steadman 2004). Ratti (2004) also believes that Space Syntax is largely negligent about land use and this factor has not been considered in the drawing of axial map. He (see: Hillier 1999 cited in: Ratti 2004) further calls Hillier's suggestion regarding adding land pieces as spatial elements in suitable locations, an ambiguous process. In response to Ratti's argument, Hillier and Penn present some reasons: one of the most important is the dependency of land use factor to space configuration and movement flow (see: Hillier and Penn 2004). Although, these researchers themselves believe that this issue still remains a hypothesis and needs to be

verified (Hillier 1999, Hillier et al. 2000, Hillier & Penn 2004). Ratti's argument seems to be some extent plausible; because the manner of adding an interior space to an axial map as an urban street may be somewhat illogical. In analyses conducted by this method, land use factor has not been considered important. This is in spite of its significance in determining the configuration of cities and as a result its impact on social life in that city, and also despite its emphasis on the identification of compound factors, affects social life. Therefore, it is essential that urban designers take the mentioned issues into account and measure the results of their research regarding the land use factor. In addition to what was stated about land use factor it further seems that the software analyses in the case of locational analysis and land use proposal are not capable of providing an applicable design tool.

Height and width of pedestrian pathways: Space Syntax is a simulation and a simple illustration of the urban texture only in two dimensions and disregards many important features of streets, such as building height and street width. Ratti (2004) believes that defining the natural movement raises many questions about Space Syntax findings. In a definition presented by Hillier about natural movement, there is no trace of the impact of these factors on movement patterns, while both of the building height and street width are among the generators or inhibitors of movement. Hillier and Penn in response to this doubt state that investigation of variables such as building height is conducted mostly in the regression model rather than the spatial one. Since the main goal of Space Syntax is to understand the impact of spatial configuration on social life, the inclusion of other factors, therefore, would de-emphasize the impact of the main factor (see: Penn et al. 1998a, 1998b cited in: Hillier & Penn 2004). Hillier's claim, regarding the possibility of eliminating all variables, and assigning the highest importance to the configuration, is based only on an experimental research carried out in the city of London; the results, of which, cannot be generalized to be applicable to other environments.

Climate: The effect of some other factors on the movement pattern, such as climate, has also been disregarded in the Space Syntax method (Memarian 2007). It is obvious that the housing pattern on the mountainous areas, with small and few entrances, and the resultant hill-towns are mainly due to the climatic and topographical conditions. Excluding this determinant factor, which could significantly change housing and urban patterns, would, undoubtedly, lead to a lack of accuracy in the findings.

Topographic factors: Space Syntax ignores topographic factors and height differences, and solely relies on visibility, which does not seem to be realistic. Now in case of such an error in the justified graph, to what extent this

deviation will be reflected in the analytical data? Would this invalidate the results of the analyses?

Metric information: Another question raised against the axial analysis is related to topologic representation of a city, which is performed without any kind of metric information (Ratti 2004). This issue is especially important when we assume that pedestrians decide their direction based upon the minimum metric distance, and the compositional features of the city which do not play any role on this decision.

Travel objective: Penn (2003) believes that what should be evaluated in the design process is the effect of plan geometry, and any kind of evaluation on the basis of people's motivation toward travel proves wrong in most cases. The role of the travel objective on the movement pattern has also been disregarded in the axial analysis. Differences in travel purposes will, undoubtedly, affect route selection in urban areas.

Pedestrian facilities: Pathway width and the existing facilities for pedestrians' movements are other factors eliminated in the axial map. Although it may be said that pathway width has been indirectly included in the drawing of the convex map, the route quality, pedestrian or vehicle use, and movement speed are not adequately taken into consideration.

Station location: Another factor affecting movement patterns is the location of bus stops, and subway or bicycle stations. These locations which are gathering places and, therefore, a significant factor in attracting pedestrians have not been included in the axial map.

Identity, temporal dimension, etc.: All analyses of Space Syntax are based upon a two-dimensional map approaching the third dimension by drawing the "convex spaces". Other critical features such as people's perceptions, sense of place, and collective memories, which constitute the identity of a place, do not play any role in drawing such maps. In addition, time dimension, which leads to operational changes in a structure or a fixed form of the city, has been neglected. In other words, a fixed urban element-- a building or a space—could be the host of several activities over different times of the day and night, and also in different seasons of the year. This issue has not been reflected in a two-dimensional map. A critical question to be raised is whether the omission of an integral part of urban design—urban activities (see: Bahrainy 1998)—could be justified. On the other hand, it seems that Space Syntax does not address the cultural factors properly and people's perception of forms and spaces in investigating and analyzing urban spaces, while many differences observed in urban design result from these differences among cultures. In response to this question, preparing a convex map is somewhat convincing, but this is realized only when

activities performed in a space do not change over time; however, many urban spaces are assigned to different or even conflicting activities during various time periods. Even in some cases these spaces remain empty or useless, and within some other time periods, they attract many people. This could be regarded as one of the Space Syntax deficiencies.

Input data to Space Syntax software lacks some other important information such as public/ private space, the direction of buildings, sound effect in attracting population, accessibility to alternative modes of transportation, land and property value, technology and public transportation cost, impact of different cultures in using different forms of transportation, city management, different classes of population, traffic volume, activity type, lighting, mental map, people's personality, space control (ownership, management, accessibility right, and use), the effect of a suitable view on attracting people, and residents' economic characteristics. Surely disregarding any of these elements may lead to biased results.

Although the Space Syntax method has been effective in several different situations, many contradicting cases and shortcomings have also been documented. It seems possible to utilize this method's strengths as well as try to cover its pitfalls using supplementary methods.

6. Supplementary methods suggestion

Since the Space Syntax method is, on the one hand, located in the general category of composition /configuration subject, and on the other hand, it is closely related to linguistics, therefore addressing these issues as the roots of Space Syntax is important to be able to remove the deficiencies of this method. It will also help to the development of the design criteria on the local and national scales. It should be noted that these criterion are value free and universal, and should be interpreted in any location according to local circumstances. Design criteria at the global scale result from investigating the following theories as supplementary methods:

Linguistics (Chomsky 1986): Urban design has a language similar to the spoken language including words (content) and grammar (procedure). Therefore, we can use linguistic approach in urban design. One of the shortcomings of the Space Syntax method is its disregard to the local characteristics and consideration of universal features, as its basis. It seems that the application of the linguistic approach in urban design may facilitate the application of local language in the design of urban spaces.

A pattern language (Alexander 1979, Alexander et al 1977): It seems that the application of Alexander's pattern language may remove some of the deficiencies of Space Syntax when addressing the global scale. On this basis, religious spaces may be investigated as one type of urban space and their fixed characteristics could be determined

based on the different regions where they appear.

The image of the city (Lynch 1960): Space Syntax does not pay enough attention to the third dimension. It seems that the application of Lynch's method in consolidating the identity of the Ghasem neighborhood, which is the purpose of the present research, strengthens the element as a landmark and a pathway leading to the landmark and the pathway are considered to be two effective factors in the mental maps of residents and tourists.

Urban units' configuration (Marshall 2009): Considering a building as a basic urban unit in the third dimension may eliminate some deficiencies of the Space Syntax method arising from focusing on 2D maps and neglecting the third dimension of urban spaces.

Urban space typology (Krier 1979): Application of Krier's "urban space typology" reminds us to focus on the historical course and evolutionary trend of this area. In this sense, it seems that with regard to structure recognition of the neighborhood, which is formed over a historical core, application of Space Syntax will be useful. Krier also maintains all urban spaces result from one of the two elements of street and square, or both. On this basis, the existing urban spaces in the Imamzade Ghasem neighborhood will be defined in the form of a combination of squares and streets.

The effective forces on city composition (Bacon 1974): Bacon believes that if the designer wishes that his/her plan entails unity and cohesion and to sustain over time, it is necessary to present a general aspect or a structure of the city. With the application of Bacon's idea, the original structure of the city is recognized by the Space Syntax

method, and then this structure will be consolidated in the proposal.

7. Theoretical framework

It appears that Space Syntax cannot be applied in urban design practice as the sole method to respond to all needs in every situation. Therefore, it is necessary to use supplementary methods to remove existing deficiencies; the most important of these deficiencies are the cultural aspects of the local environment. On this basis, the design criteria of this research are adopted from some supplementary methods. There is no doubt that such supplementary concepts and methods need to be adapted to the local condition in order to be effective in filling the so-called gap.

The theoretical framework is also based upon the design process at the global, national and local scales. At the global scale, the Space Syntax method provides a set of general design criteria. These criteria, in harmony with the local situation may be, then, translated into the native language at the national and local scales through supplementary methods.

8. The Imamzade Ghasem neighborhood

8.1. Cognition and analysis

Based on the aforementioned information, application of Space Syntax for the purpose of analysis and cognition at the global scale is plausible. In order to identify the original structure of the Imamzade Ghasem neighborhood on the same scale, design principles, standards and guidelines are developed according to Christopher Alexander's suggestion (A pattern language) to design holy and religious spaces (Fig. 3).



Fig. 3. Imamzade Ghasem Shrine, a northwestern view

The second scale to be considered is the national scale. The Imamzade Ghasem neighborhood has the characteristics of Iranian culture. Therefore, the national scale includes the Iranian cultural values. In addition, the form and configuration of this neighborhood is different from those of other surrounding ones. This area has unique characteristics and conditions, which are based on the climatic, topographic, historical and cultural aspects, and, therefore, may be regarded as local characteristics of

the area. It is essential to state the Iranian principles to the local scale, providing a sense of place in the area. For this reason, the design criteria of the national scale are expected to be translated and reflected in the local scale.

Thus, the third scale to be considered is the local scale, urban design dialect. According to the linguistic view, words and grammar in each locale are specific to that area and can't be generalized to other areas. If we could

recognize the structural units of the language in the Imamzade Ghasem neighborhood, we could remove the deficiency of the Space Syntax method in addressing the native characteristics. What is important at this stage is the translation of the principles and criteria, obtained from supplementary methods, to the local language. As it was stated earlier, the findings of Krier, Lynch, Marshall, and Bacon are all value-free so that they form a universal language. But if local or regional values were added to these methods, and these methods were interpreted with regard to a specific design subject, each method could have the potential to be applied to the previously mentioned scales to form the language of urban, regional or local design. To reach this goal, these methods, which have become native by adding local values, will be used as supplementary methods for the Space Syntax method at

the local scale.

8.2. Application of the Space Syntax method at the global scale

With this research, an attempt is made to come up with a design solution based on the existing spatial structure of the Imamzade Ghasem neighborhood. This is because any attempt to make plans without considering the existing structure, which functions in a mutual relationship with the social system, will lead to a complete failure and the eventual destruction of the structure. The first step in this regard is the recognition of the spatial structure, for which the Space Syntax method is used. In order to identify the original structure of the neighborhood, a broader area than the main study area is considered (Fig. 4).

Fig. 4. Study area on global scale

Space Syntax analysis is performed using depth map software and drawing the axial map to give integration analysis (Fig. 5).

Fig.5. Integration analysis, Imamzade Ghasem neighborhood

It indicates that the route started from Golparvar Street, passing through Mamzade Ghasem square and Miri Street, with the integration value of 2.83673, which is the highest integration value. Current and observed conditions in the site suggest that the Space Syntax finding in identifying the most integrated pathway is correct, and that most pedestrian traffic takes place in the same route. Since the results of the Space Syntax analysis correspond with the existing situation, this analysis may, thus, be regarded as reliable. We may, therefore, conclude that the respected route will form the main structure of the area.

This route is the main element of the historical skeleton of this texture and is called the "historical axis". After this route, the route of Golabdare Street, Mamzade square-Astaneh Alley has the highest integration value and will be called "cultural-tourism axis".

8.3. Application of SWOT at the local scale

On this scale, cognition and analysis processes are conducted by collecting data and base maps and preparing the SWOT table (Table 1) (Fig. 6).

Fig. 6. Design area on local scale

9. Design

9.1. Objectives and criteria

The design process went through the global and local scales and the design objectives and criteria are drawn from Space Syntax and supplementary methods (Table 2).

9.2. Proposed alternatives

Regarding the findings of the area's cognition and analysis

stages, three alternatives are proposed:

- Alternative 1: Creating a wide green space and dedicating the square and surrounding streets to pedestrian pathways (Fig. 7)
- Alternative 2: Creating urban spaces and establishing new pathways (Fig. 8)
- Alternative 3: Creating garden pathways and increasing commercial uses and green spaces (Fig. 9)

Fig. 7. First alternative

Fig. 8. Second alternative

Fig. 9. Third alternative

9.3. Evaluating the proposed alternatives

9.3.1. Evaluation based on the Space Syntax method

Evaluation is performed by the Space Syntax method to indicate the impact of the proposed plan on the historical

axis integration value and the cultural-tourism axis. It is observed that the first alternative increases the role of the cultural-tourism axis and its accessibility without destroying the historical structure (Fig. 10).

Fig. 10. Integration analysis, Alternative 1

The second option also has increased the integration value of the historical axis. The degree of increase in this option is greater than the first one. In this option, the integration value of cultural-tourism axis is increased, again a higher increase is observed compared to the first option. So it can

be said that the second alternative compared to the first one has been more successful in consolidating the historical and cultural-tourism axes (Fig. 11).

Fig. 11. Integration analysis, Alternative 2

In the third alternative, the integration value of the historical axis is increased. The increase is more than that of the first alternative, but not very different from that of the second alternative. It can be said that the third

alternative has increased its importance and accessibility to the historical axis but not very successful about cultural-tourism axis, compared to other alternatives (Fig. 12) (Table 3).

Fig. 12. Integration analysis, Alternative 3

Therefore, according to the Space Syntax method the second alternative may be considered as the most successful one in achieving the intended goals.

9.3.2. Evaluation based on supplementary methods

Based on suggested supplementary criteria, each proposed alternative is evaluated and its advantages and disadvantages are recognized (Table 4).

9.4. Developing the selected alternative

The final alternative is the result of incorporating the three proposed alternatives. To successfully design the pedestrian pathway of the Imamzade Ghasem neighborhood, the final solution will be presented in three steps: long-term, medium-term, and short-term. The long-term solution requires dedication of the whole square, the cultural-tourism axis, and a part of Miri Street and

Golparvar Street to pedestrians, and ownership of the lands at the southeastern corner of the square to change them into green spaces. The medium-term solution is taking ownership of the existing residential garden on the southeastern corner of the square and dedicating it into green space and building a path-garden along this route. The short-term solution proposes the implementation of: the proposed pathways in the second alternative, the cemeteries in the third alternative, the parking lots in the first alternative, urban spaces on the vacant in the second alternative, purchasing plots of land and changing their uses from residential to commercial in the third alternative, the proposed step pathway in the first alternative, and a cultural-sport complex on the northeastern side of the square. In this solution, Golabdare Street and Astaneh alley are dedicated to pedestrians. Also three pieces of land next to the path-garden are transformed into green spaces or commercial uses (Figs. 13 to 18).

Fig. 13. Proposed land uses

Fig. 14. Proposed paths, nodes and landmarks to increase the neighborhood legibility

Fig. 15. Proposed paths to increase Ghasebzadeh pathway integration

Fig. 16. Imamzade Ghasepathway

Fig. 17. A view of the eastern side of Imamzade Ghase square

Fig. 18. A view of the southern side of Imamzade Ghase

10. Conclusion

The Space Syntax method was first developed in England, and then spread to other parts of the world, including developing countries. What encourages us to apply the method in Iran is that all of its analyses are based on a convex map, which itself is based on the definition of view range. The most important issue in the generalization of a method is the extent of its inclusive principles. View range as a universal concept is considered an important criterion in all countries and cultures in leading people to move within buildings and cities. Therefore we may claim that the Space Syntax method is applicable to a variety of conditions, since its basic principle is inclusive. However, based on reasons mentioned above, it seems essential to apply this method with caution in the design of spaces which are less similar to the western cultural conditions. A review of the weaknesses and strengths of the Space Syntax method reveals certain shortcomings of the method; these should be considered along with its potentials. It is necessary to apply the method in different contexts to test its adequacy and prevent any misuse in the contexts where the

complexity does not allow for a straightforward application. Our study confirms previous experiences that at the global scale, the Space Syntax method is capable of presenting useful and reliable analyses, but at the local scale, it may face some difficulties which are supposed to be eliminated through supplementary methods. Therefore, the answer to the first question does Space Syntax involve some deficiencies that require the input of some supplementary methods is that the application of the Space Syntax method will, on the one hand, help solve some of the problems urban design practice has been facing in complex and traditional contexts. But, on the other hand, it may also lead to failure due to certain incorrect data which might enter into the design process. The answer to the second question can Space Syntax be used as an effective urban design tool is positive; i.e. we can benefit from the significant capabilities of the Space Syntax method in cognition and analysis of urban spaces. However, in some other cases it has certain shortcomings that should be dealt with in each specific site, location and condition through the use of supplementary methods.

Table. 1
Analysis of the neighborhood at the local scale

	Strengths	Weaknesses	Opportunities	Threats
Environmental and natural	Unique topography, moderate climate, lower air and noise pollution, appropriate distribution and diversity of green space	Frost during 4 months of the year, heavy snow fall during cold seasons, private and enclosed green spaces	Creation of urban spaces around the river, transforming the gardens into public urban spaces	Possibility of river overflow; earthquake risk, land use changes to replace gardens with urban development, and the green spaces around the river with waste disposal
Visual	View to the heights, river as a determinant factor in the spatial structure, the Imamzade building as the distinctive built element	Sharp slopes in the pathways, lack of harmony in architectural forms of new developments with the ones in the historical part	Creating urban spaces around single ancient trees, creating urban spaces around the rivers	New development might block the views to the heights, and also disregards the local and historical facades of buildings
Physical	Organic structure and transportation network distinction, the Imamzade building as a focal point, existence of a neighborhood center in Imamzade Ghasem square, the relative uniform height of buildings, lack of incompatible land uses	Limited access of vehicular traffic and parking, shortage of pedestrian pathways, mix of pedestrians and vehicles, lack of designed public spaces, weak connection of the Imamzade building to the river, shortage of educational, sport and cultural uses	Using step pathways as a historical element and identity, creating urban spaces related to green spaces, promoting river-based tourism, transforming the Imamzade building into a local landmark, formation of a tourism axis connecting the Imamzade building to the river, encouraging the traditional structure patterns	Limiting the access, especially during the cold seasons, changing the spaces around the river to waste collection places
Economic	Active gardening activities, existence of commercial uses at the local level	Shortage of commercial uses, lack of tourism activities and services	Encouraging tourism activities through a park	Land use change of gardens threatens social and ecological life of the area
Social	Old residents' strong sense of belonging to the area, integration and cohesion of the neighborhood.	Lack of freedom for some activities resulted from specific conditions of the area	Seniors may act as 'watch-dog'; maintaining residents' social identity and cohesion through the Imamzade	Inflow of new residents, residing the low-income groups in old buildings

Historical and cultural	Historical and cultural identity of the region due to the Imamzade Ghasem	Lack of view to the Imamzade building from many locations, lack of supportive activities	Existence of the Imamzade results in collective memories, the Imamzade building acts as a historical landmark, tourists make urban spaces lively and attractive	New developments damage the historical identity of region, rushing of tourists into the area
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Table. 2
Design objectives and criteria

Goals	Theme	Design criteria	
		Global scale	Local scale
Reinforcement of Imamzade Ghasem's traditional identity	Historical	Recognition and strengthening the main structure (Bacon 1974, Karimi 2000), minimum control and intervention, using mosque as the focal point of city center (Bahrainy 1996), recognizing and following the historical trends (Krier 1979, Bahrainy 1996), preserving cultural heritage (Barati, Taghizade and Aminzade 1988), consolidation of historical elements, using the traditional configuration of buildings and blocks (Marshall 2009)	Consolidation of historical axis, promoting the role of the Imamzade as a historical element and identity-creating factor, adding streams to the pathways as an traditional form using water along the pathways, following the organic character, complex and granulated composition of buildings within the historical texture
	Cultural	Include cultural, social and commercial activities and spaces into the square, but at the same time include residential use around the square, the mix of activities in central square should make it a 24 hour live space (Krier 1979), defining the pathway as an effective element in the mental map (Bacon 1974), promoting the cultural-tourism identity of the neighborhood, integrating cultural activities with mosques, balancing natural environment with the built environment (Bahrainy 1996), creating the necessary space for residents' physical fitness (Barati, Taghizade and Aminzade 1988)	Increase commercial, recreational and cultural uses around the squares, defining the cultural-tourism axis, considering cultural activities around mosques, and Imamzade Ghasem incorporating gardens and green spaces with urban life and built spaces, increasing sport uses
	Religious	Strengthening the existing landmarks and designing new ones to facilitate the formation of mental map (Lynch 1960), provide indirect access to holy places, provide view to the holy place, provide enclosure for the pathways leading to the Imamzade in order to direct pedestrians, considering places for rest and pleasure, provide access to the water, considering public pathway along water, paying attention to life cycle, connecting the cemetery with neighborhoods (Alexander 1977), provide connection with time (Barati, Taghizade and Aminzade 1988)	Consolidation of the Imamzade building as a religious landmarks, considering religious spaces and uses around the Imamzade building, provide visibility of the Imamzade building from special points in the area, provide a pathway leading to the Imamzade provide gates and entrances in order to direct visitors toward the Imamzade building, designing urban spaces for rest and social activities along the river, using water in designing the pathways, designing a pedestrian pathway along the river, dedicating a piece of land to the cemetery

Table. 3
Comparison of integration value of the proposed alternatives

	Before design	alternative 1	alternative 2	alternative 3
Historic axis integration	2.83673	2.84282	2.85137	2.85924
Cultural-tourism axis integration	2.23673	2.41599	2.41842	2.25760

Table. 4
Evaluation of alternatives based on supplementary methods

	Advantages	Disadvantages
Alternative 1	Consolidating the Imamzade building as a religious landmark, increasing green spaces and cultural-sports uses, dedicating the square and two historical and cultural-tourism axes to pedestrians	Purchasing a large area of residential uses, restricting vehicular access to the neighborhood, lack of commercial and cultural-sport uses
Alternative 2	Increasing urban spaces, consolidating the connection between the built environment and natural environment through integration of cultural-tourism axis and the river, strengthening the mental map by defining the pathway map	Vehicular traffic around the square, the incompatibility of proposed vast open spaces surrounding cultural-tourism axis, lack of commercial uses
Alternative 3	Maintaining balance between the built and natural environments, connecting the cemetery to the neighborhood, and increasing commercial uses	Vehicular traffic around the square, steep slope of the proposed pathways (north-south direction)

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ⁱThe number of nodes which are directly connected to one specific node. The higher a node's connectivity, the better its access to other nodes and it will result in using that node more and more (Raford & Ragland 2003).

ⁱⁱ Using Space Syntax software, it is possible to find some hidden segregations throughout the city for some social groups and even recognize some of its reasons.

ⁱⁱⁱ There are several examples like what López and Nes have done. On this survey they tried to recognize spatial characteristics of built environment which increase delinquency (see: López & Nes 2007). There is similar example in Democracy Park in Mecca (see: Kaya & Kubat 2007).

^{iv} The reversal examples will be mentioned.

^v The issue that happened in Modern age.

^{vi} Street width factor is somehow considered in pursuit of sight lines in order to draw axial map (Ratti 2004).

^{vii} Like Kandovan in Iran.

^{viii} Like Masooleh in Iran.

^{ix} Such destructions have happened in Iran several times in Mashhad, Kermanshah, Yazd, Hamadan, etc.

^x As it was stated in section "8.2. Cognition and analysis", national characteristics are expected to be reflected in the local scale