



Simulations of urban pedestrians and pedestrian impact analysis on creating sense of belonging to place using space syntax method (Case study: Rasht urban pedestrian)

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ABSTRACT

The existence of urban open spaces that have a quality of meaning in their bodies; reinforces social and cultural encounters among society and thus creates a sense of belonging to the place. The main objective of this research is the pedestrian impact analysis on people's sense of belonging using simulation method. To achieve this, the research strategy is quantitative-qualitative. Data analysis has been done using the Space Syntax method in the Rasht urban pedestrian. In this method, the city map has been analyzed in the UCL Depth Map 10 software. The data have shown that the sense of belonging in simulating the urban pedestrian pathway, a legibility factor that influences the formation of a sense of security and ultimately reinforcing the sense of belonging has correlation coefficient below 0.4 and also in the context of analyzing whole-part integration (radius of 3 km) correlation coefficient (R2) is 0.46 indicating the moderate presence of these parameters within the scope of the study. As a result, to enhance conceptual quality of this route requires attention and review in the design of this pedestrian.

Key words: *simulation, sense of belonging, space syntax, urban pedestrian, Rasht city.*

Introduction

In the present era, due to the separation from ancestor's culture and heritage, Places had been formed without any difference in quality and mystery that as a result of which factors such as variety, vitality, mobility and vivacity were lost from urban spaces (Taban and et. al, 2011, 80). Non-identity and placeless crisis is the result

of these changes (Iak and Gholampour, 2014, 38). According to Norberg-Schulz, Human beings are abandoned placeless in urban territory. Undoubtedly, this loss of place creates a poor sense of belonging and participation in human. In the modern time, scholars by emphasizing human spatial requirements in the life

environment have recognized the importance of many things, such as spatial security, social relations, legibility, sense of belonging and identity (Einifar and Aghalatif, 2011: 18). Traditionally, urban open spaces cause to address the need for face-to-face communication. In recent decades, given to the advancement of communications, using these places has been reduced in terms of their functional requirement, but there is still psychological, cultural-social need to this type of communication (Abdaszadegan, 2002: 65). Human observes the places and activities on foot, therefore one's feelings are being provoked and values inherent in urban setting can be perceptible for individuals. In the other hand, walking allows one to interpret the environment and reminisce it. This phenomenon is of great importance in terms of perception of spatial identity, sense of belonging to the environment and understanding beauty (Ghorbani and Jam-e Kasra, 2010: 60).

Knowing that the existence of unmotivated, low-quality and non-sense urban spaces is one characteristic of modern cities (Sajjadzadeh, 2013: 70), the present article emphasizes on the sense of belonging as one pillar in the formation of meaning and identity in the environment in order to improve the quality of urban space. This research describes the importance of sense of belonging and of giving meaning to the place within a social, cultural and public space. Rasht central pedestrian situated in the Shahr-dari square as a place having meaning and sensory concepts and also with valuable activity, physical and social characteristics has been examined in order to analyze affecting in the formation of sense of belonging to the place. It appears that changing physical tissue of this square and its surrounding streets into urban pedestrian has increased the sense of belonging to this place. Thus, the article seeks to address this question that to what extent the pedestrian has been successful in shaping sense of belonging in Rasht city residents? Approach of this research has been examined based on the space syntax theory which

can analyze spatial structure based on the physical features (karimi, 2007: 3). In this respect, the available social interactions and behaviors have been investigated in urban pedestrian using space syntax by means of Depth Map software from the point of view of factors such as legibility, urban tissue dispersion, availability and choice and duration of presence in this tissue, the most important factors realizing the sense of belonging.

Research background

A great deal of researches has been done on the theory of space syntax under Hillier's supervision that display the integration parameter influenced by the degree of using urban spaces. The severity of this factor is due to the daily routes traveled by individuals and the travel density from one point to another (Vaughan, 2007; hillier, 1996). In most cases, there is a direct relationship between the integration equivalent and the density used. Finally, the research found that the greatest value of road integration is related with a high density of travelers in this particular path (Penn, et. Al, 1998). Having investigating the immigrant-dwelling and marginalized neighbors in the city of London, Vaughan has found that these neighbors are usually formed in a neighborhood with a high degree of integration. Giannopoulou et al. (2016), also analyzed and predicted pedestrian movement in Athens using this method. This article considers three general objectives including 1) interpret and predict densities of pedestrian movement 2) identify inconsistencies and limitation in the pedestrian movement 3) propose a methodological framework to overcome these limitations. Baran et al., (2008) during studies performed in two neighborhoods with traditional and New Urbanism features showed that higher universal integration and top space connections in each passage have a positive effect on the number of pedestrians. Due to the novelty of this method in the scientific community, little number of researches has been performed centered on the space syntax method.

Among these researches, one can mention the research carried out in Yazd and Narmak neighborhood, Tehran, where the results of studying pedestrian movement show that there is high correlation between the pedestrian movement and the spatial characteristics of neighbors (Abbaszadegan, 2000). Also, in Tehran's Khazaneh neighborhood, pedestrian movement and universal integration have been shown (Abbaszadegan & Azari, 2012: 60). Moreover, in the research performed by Abbaszadegan et al., (2012), the best route for constructing urban pedestrian has been evaluated through space syntax method.

Research theoretical literature

Formation of pedestrian construction

Certainly after increasing criticism of car domination in cities, loss of quality of urban centers was the subject of pedestrians, at the same time, there has been a great deal of researches on the pedestrian subject (Haqqi et al., 2015: 19, Shi'a et al., 2013:20; Abbaszadegan and Azari, 2012: 56, Cawn, 2005; Ewing et al., 2006). In general, pedestrians are considered as roads that are far from the passageways and a wide range of users including pedestrians, runners, and cyclists use them (San Diego Regional Planning Organization, 2009). In the case of pedestrian constructing, it must also be said that pedestrianism consist of creating streets or spaces without rider traffic (Shia et al., 2013: 21). In our country, different researches have been performed in recent years including Akbarzadeh et al., (2016) in the field of urban pedestrian desirability evaluation on the basis of qualitative components. In this study, part of pedestrian in Rasht city in the Alamolhoda Street has been evaluated, and their results showed that the street width, protecting the street against atmospheric factors and noise pollution is effective on the quality of the pedestrian pathway. Researches in the Ferdowsi Street of Sanandaj have also shown that pedestrians have an impact on improving the identity of citizen behavior (Akbari and Davoudi, 2015).

Space syntax theory

Space syntax is a convenient method of urban analysis based on which computer techniques have been employed in the formulation of urban analysis (Giannopoulou, 2012). This method has been shaped based on the display and definition of the environment and the traits of its construction with the aim of exploiting it in the field of statistical analysis as well as the use of observation that relies on the behavior of samples, such as roads and pathways (Penn, 2003). In the beginning, this theory was initiated by Christopher Alexander and later by Philippe Stadtmann. Further, its theoretical idea was presented by Hillier (1984) in a book entitled social logic of space. In their view, in cities and in buildings, there is a meaningful relationship between form and function in the spaces (Hillier and Hanson, 1984). The main idea of this theory is related with the concept of spatial configuration in which the connections of the elements are important to each other (Rismanchian and Bell, 2010: 50). Given that the fundamental hypothesis of this theory has been generated based on the human knowledge and behavior, it can be used in the field of studies on the environment and human behavior (Abbaszadegan et al., 2012: 49). Hillier (2007) believed that movement generated from spatial configuration has great potential in shaping socio-economic qualities (Hillier & Vaughan, 2007: 223). This theory is a useful methodology for understanding the role of the environmental form from the point of view of topological relations in the study of environmental recognition and human routing behavior (Didehban et al., 2013). This method analyzes all spatial communications as mathematical and graphical parameters (Abbaszadegan, 2002: 66).

Spatial Analysis Parameters in Space Syntax

Integration

Integration is one of the most important concepts in space syntax theory. This concept means the value of integration level of each line (space), the average

number of intermediate lines or spaces that can be reached all areas of the city. Accordingly, integration in the space syntax approach has a relational meaning, not distance one (Abbaszadegan, 2012: 50). In fact, integration of an urban space shows the degree of its integrity with the whole city. Integration map is an important tool in understanding how the city components behave. Studies showed that dispersion of integration value in city level has strong correlation to the movement of pedestrians (Turner, 2007: 542).

Choice

The streets that have the highest payloads play a greater role in the pedestrian flow having a higher degree of choice (Haciomeroglu et al., 2007).

Connectivity

In space syntax, access is defined with integration, so that the nearest center is determined from origin to destination. This calculation shows the frequency of pedestrian movement. At the point where it has the greatest access, there is greater correlation and the highest flow of pedestrian movement is seen at that point, and low access means low flow of pedestrians (Law et al., 2012). The degree of connectivity means the number of streets that are connected to a certain street.

Total Depth

Total depth is the number of nodes that need to be traversed so that we can reach a certain node in the map after passing all the nodes. This concept is closely related to the factor of access to space and displacement in the urban texture and if this value is high, this parameter represents the ease of access to points in urban texture.

Urban Texture Dispersion Scheme

This scheme introduces measurement spatial integration status in each urban texture between two general and local situations in the degree of guidance

of individuals in urban space. In other words, this parameter represents the capability of synergy by individuals (Hanson & Hillier, 1984; Hillier & Penn, 1996).

The degree of presence in space

Measuring the degree of urban texture and its integration reflects the use of individuals from space as well as the presence in urban space. In other words, the correlation between street payload and the integration of each space reflects the presence and use of individuals at each urban segment.

Legibility

Among the factors that are considered in the design of urban texture is the ability to understand the space by individuals (intelligibility). Accordingly, a degree of perception in an environment is obtained that has meaningful relation to the legibility. The correlation between integration and connectivity in urban texture reflects the intelligibility or the legibility of the urban texture. Accordingly, the higher the degree of correlation between the integration and connectivity, the more legibility is the urban texture (karimi, 2012).

2-4 Sense of belonging to place

Belonging to place is in a level higher than a sense of place and the continuity of human presence in the environment plays a decisive role in its formation and strengthening. According to this sense, people envisage their experiences of symptoms, the meanings of functions and personality a role for the place in their mind and place is respected for him. From the point of environmental psychology, the place belonging is referred to the person's cognitive relation with an environment or a certain space (Sarmast & Motavasseli, 2010: 138). In sociology perspective, the sense of belonging to a place does means primarily to be specific and distinct, constant and stable and belonging to community (Pourmand et al., 2010: 83). Among the factors enhancing the sense of belonging to place is the interaction of individuals with each other

that by making attractive spaces, the presence of dwellers can be more pronounced in the public sphere of neighborhood through the prediction of space, equipment and furniture for using different social groups and encouraging them to sedentary activities, such as sitting, standing and reducing their speed (Ghasemi, 2015: 145). Also, researches performed in the context of the impact of the city scale on the sense of belonging have shown that the sense of belonging to the place is related to factors such as perception and

appreciation of others from that place, antiquity and background, the degree of dwelling individual in that place, common experiences and memories of that Place, amount of community and social activities and the level of security in the public spaces of the city (Sarmast & Motavasseli, 2010). Due to the research literature and physical influence of the architecture on the sense of belonging, table 1 was set up.

Table 1: Factors affecting the sense of belonging

	<i>Factor</i>	<i>Reference</i>		<i>Factor</i>	<i>Reference</i>
1	Density and number of stories	(Kashfi et al, 2012)	9	Physical clarity, association of meanings	(Falahat, 2006)
2	Equilibrium between open and made space	(Lewicka, 2011)	10	Physical quality and facilities	(Ujang, 2010)
3	Identity, symptoms, historical, cultural and natural symbols	(Bahrapour & Modiri, 2015)	11	Multi-functional public spheres	(Sadrian et al, 2014)
4	Security, legibility, zoning, neighborhood monitoring	(Newman, 2008)	12	Memorable elements, gathering places	(Sarmast & Motavessli, 2010)
5	transparency	(Ghasemi, 2015)	13	Zoning	(Shi'a, 2010)
6	Satisfaction, equality on the use of public arenas of the neighborhood	(Rafian et al, 2012)	14	Participation in preserving public spheres	(Forouzandeh & Motallebi, 2011)
7	Vitality and visual quality	(Ge & Hakao, 2006)	15	Green space	(Daeipour, 2014)
8	access	(Zebardast & Baniamerian, 2010)	16	Comfort	(Khaef & Zebardast, 2015)

In the following, according to the objective of the research, the environmental (physical) and mental factors affecting the sense of belonging have been investigated. Due to the architectural design issues, one

can influence the physical and mental factors affecting the sense of belonging. According to what has been stated so far; Table 2 was set up.

Table 2: Final classified factors

<i>Personal variables (mental)</i>	<i>Environmental variables (physical)</i>
Sense of security	Physical clarity (zoning and separation of public, semi-public, private, semi-private spheres, public sphere visibility and specifying riding and pedestrian paths, access and entrances)
Sense of ownership and responsibility	Multifunctional public sphere and shaping the presence and interaction in environment
Sense of identity and recognition	Symbols, memorial signs (natural, historical and cultural) Preserve and reinforce memorable elements
Sense of satisfaction and positive perceptions	Urban furniture Green space and environmental natural elements

In the research to achieve the objective, which includes analyzing the impact of urban pedestrians on the sense of belonging in urban residents. According to the factors shaping the sense of belonging: sense of security, sense of identity, sense of satisfaction and sense of ownership as well as measureable issues by simulation in the Depth Map software options such as:

Pedestrian legibility in relation to security formation, the degree of presence and route choice and access in relation to sense of satisfaction have been assessed and evaluated. Accordingly, the framework for achieving this is shown in Figure 1 and the main objective of the research i.e. investigating the impact of urban

pedestrians on the sense of belonging has been analysed.

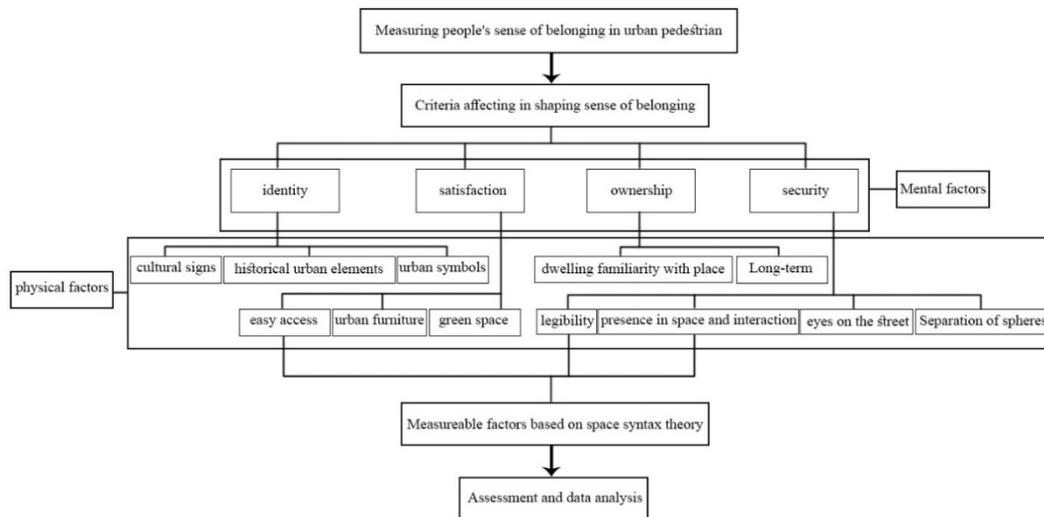


Figure 1: Framework for achieving the sense of belonging (Suorce: Edited by author, 2018)

Methodology

In general, the research method is quantitative - qualitative. Data collection has been performed in two sections of librarian study and analysis by the theory of space syntax. The basis of these studies is using the Auto Cad software for map processing and providing it for analysis in the Depth Map10 software. In the present study, achieving the objective through extracting data from a case study analysis of the Depth Map Software is carried out using space syntax theory and, finally, classification and analysis and data selection and their integration. In addition, through the observation and method (Gate), some points are specified in the map and visual inspection is performed in order to test the validity of the research theoretically. Among a variety of combination analysis methods of space syntax, such as: visibility & axial line, isovist, convex, axial line analysis has been selected as a proper method for the research. In this way, the basic features of the system of spaces will be available in the artificial environment as simulation. In order to allow this method to be used, space is redrawn by straight lines termed as axial lines and the generated product is called axial map. In sum, the space to be measured is modelled by the minimum and longest straight lines

that covers all convex spaces (Hillier and Hanson, 1984).

In order to analyze the spatial structure of Rasht city, at first, the axial map of the city including the visual-motion lines has been provided through the space syntax method. In fact, this map includes the city's visual and motorized sub-systems and systematically displays the relation among these systems (Abbaszadegan et al., 2012). Given the theory of space syntax, among all the objective space properties, only the ones are maintained that related with relative position of the vertices, the distance and dependence between them and finally generates the possibility of video and graphical analysis of these connections and the components continuity is examined. In analyzing this sample to produce meaning, analyzing the effects of urban pedestrians on creating sense of belonging has been considered (Safari, 2016).

Scope of the study

The city of Rasht is located in the center of the province of Gilan and in Figure 2, city map is provided. This city is located in northern part of the country and there is a great deal of varieties in its urban texture (Rasht city comprehensive plan, 2007). Given

to the implementation of an urban pedestrian in the center of city, in Shahr-dari square (Sarepol-e Zahab martyrs) and considering the fact that in the space syntax theory, spatial parameters in this theory are calculated in each period and compared with each other, and these parameters will be calculated and evaluated in terms of analyzing urban space configuration in two general (Rn) and local (R1, R2, R3) scales. Accordingly, R1 is one kilometers to the

center of urban pedestrian and R2, R3 are 2 kilometers and 3 kilometers to the center of urban pedestrian. Accordingly, a range of 3 kilometer radius has been drawn from the center of urban pedestrian and has been analyzed. In addition, according to performed studies by researchers, a person can move without feeling of tiredness for 3 K and this radius is being used in this method (Hillier and Hanson, 1984).



Figure 2: Map of study section in Rasht city & Rasht linear map with its spatial sub- systems

Analysis of information and data

One of the basic issues in this research is the use of a city map to accurately understand the urban spatial structure and valuation on urban roads and shaping urban spatial structure. With this aim, at first the map of city is provided and entered into the software and then through related techniques, linear maps are obtained for analyzing the structure of Rasht city.

colors in one spectrum and the number which is called the correlation coefficient of and the equation of regression line obtained are used for analyzing each factor. In fact, these colors and numbers represent the severity or weakness of each factor in the study area.

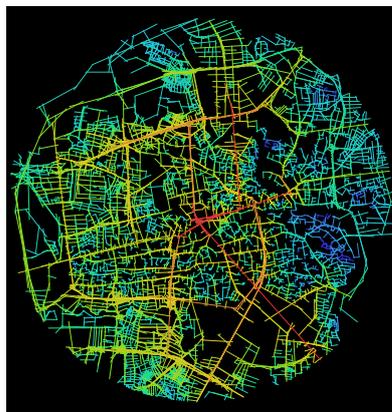
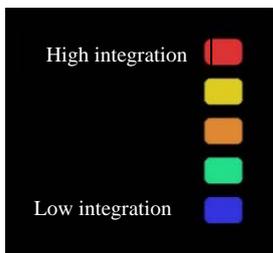


Figure 3: Map of study section in Rasht city & Rasht linearmap with its spatial sub- systems

Finally after analyzing data, a graph is obtained in accordance with Fig. 3, in which the intensity of

In this map, the factor of access and the degree of integration and its role in the expansion of the spatial structure have been considered. This map is read such

that each line represents a motor-visual canal that passes through from one or a few urban spaces, including the network of passageways. In this map, the more the integration in the whole city the more dark its red color and the less the integration, the lower role in shaping the spatial structure of the city and the lighter the blue red. Thus, this map shows that the Imam Khomeini road is the most important path in the urban Selection of 22 points in the studied area by the Gate method have been considered (Major, 1997-98).

In the following, according to Table 3, the degree of integration of the same points in the analysis carried out by the program has been evaluated and compared. Considering the results obtained in table 4 in places such as Motahhari Street and connecting this,

spatial structure of Rasht and plays the most role in shaping the spatial structure of Rasht city.

On this basis, in recognition of city and verification the validity of the research according to Figure 4, observation and have shown that the density the street observations of is greater street to Hajiabad and Imam Khomeini streets than the extent of integration analyzed by the program and the presence of peddlers in this area and the markets of the day in these streets are the reason for this contradiction. There is also a taxi station and access passageways have been instrumental in determining the extent of the presence of people in these points.

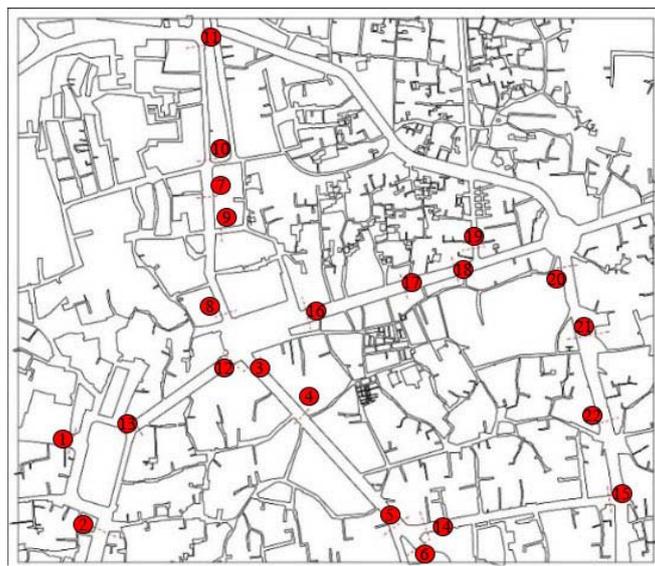


Figure 4: The city integration map and Gate place in city level and studied area

Table 3: Gate table

<i>Street name</i>	<i>Point number</i>	<i>Visit number</i>	<i>integration</i>
Bistoon street	1	102	1/8713
Lakani street	2	59	1/80065
Imam Khomeini street	3	92	1/9703
	4	49	1/75791
	5	53	1/76965
Sadi street	6	29	1/76943
	7	96	1/80864
	8	115	1/9725
	9	22	1/5345
	10	71	1/81416
	11	37	1/69562

Alamolhoda street	12	123	2/05129
	13	137	2/06745
Hajiabad street	14	32	1/6583
	15	31	1/6583
Shariati street	16	120	2/06745
	17	169	1/74999
Takhti street	18	98	1/74967
	19	49	1/69158
Motahhari street	20	133	2/12086
	21	86	1/87521
	22	100	1/87521

On the basis of the research carried out, there is an appreciable relationship between the intelligibility and the legibility factor in space. In addition, previous researches have shown that legibility of urban texture plays an important role by increasing the sense of security in shaping sense of belonging in individuals. Based on the intelligibility diagram in table 5, the correlation coefficient is approximately 0.16. In

general, however, the measurements of integration in urban texture in the local (radius 3) and local areas have been studied. Based on earlier studies, this diagram describes the integrity of urban texture. In table 5 and based on correlation diagram of urban texture dispersion, correlation degree is estimated to be 0.46. On this basis, urban texture integrity shows greater number compared to legibility in this area.

Table 4: Comparison of observation-evaluation in Gate method with degree of integration.

<i>Street name</i>	<i>Point number</i>	<i>Visit number</i>	<i>integration</i>	<i>Point image</i>
Imam Khomeini street	6	29	1/76943	
Sadi street	10	71	1/81416	
Shariati street	17	169	1/74999	
Motahhari street	21	86	1/87521	

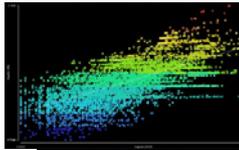
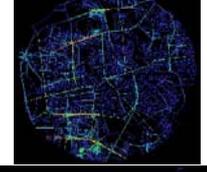
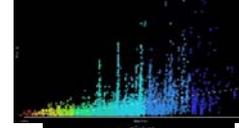
Research has shown that there is a significant relationship between the number of people presence, the time spent in each space, and choice factor; hence,

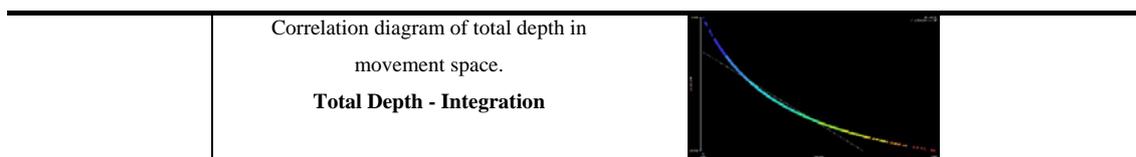
the space presence has increased, indicating higher interaction with others compared to relatively low traffic spaces. According to this, the continuity of

human presence in the environment plays a decisive role in shaping and strengthening the sense of belonging to place. In table 5 and in the correlation diagram of the choice and presence of people in urban context, research has shown that the correlation coefficient is 0.06. Given to the centrality of this range, the low presence in the central texture of the city has been observed in analysis, despite the high payload of this route and the value of its pedestrian, it does not

seem to play a great role in urban aggregation and dispersion, but considering the colors obtained in graph, the value of aggregation and dispersion of Imam Khomeini Street seems incomparable in urban level. Measurement of the depth of the map in the study area indicating the ease of access and displacement in this range is a correlation coefficient 0.92 which represents the ease of displacement and achieving this point of urban texture.

Table 5: Examining factors affecting in shaping the sense of belonging.

<i>Examined factors</i>			<i>Regression line equation R²</i>
Integration	Integration plan of urban texture in 3 km radius		$Y = 0/1x + 0/8$ $R^2 = 0/46$
	Correlation diagram of urban texture dispersion. Integration (HH) - Integration R3		
Choice	Choice plan of urban texture in 3 km radius		$Y = 29x - 32$ $R^2 = 0/06$
	Correlation diagram of choice and presence of individual in urban texture. Choice - Integration		
Connectivity	Connectivity plan of urban texture in 3 km radius		$Y = 17/5x - 13/3$ $R^2 = 0/16$
	Correlation diagram of understanding movement space. Connectivity - Integration		
Total depth	Total depth plan of urban texture in study area in 3 km radius		$Y = -2E-05x + 2/4$ $R^2 = 0/92$



Discussion

Previously, the data have shown that the presence of factors such as legibility, security, access, comfort causing the formation of a dynamic and vivacious path (Shi'a et al, 2013). In addition, the dynamics of the route and the presence of such factors increase social interactions and passion of life (Akbarzadeh et al, 2016). As a result of this presence inside urban pedestrian, urban environment can be recognized, on this basis, the coherent interpretation and memorization of place of life is formed, thereby the sense of place is strengthened and sense of belonging to place is generated (Ghorbani and Jam-e Kasra, 2010). In this research, urban texture dispersion correlation measurements and total depth correlation which indicates the degree of access in the range studied, shows a number above 0.4 indicating the ease of access at the city level. On the contrary, intelligibility measurement that is related to urban texture legibility is 0.16 which indicates the low quality of this factor in the study area. Haqqi et al (2015) stated that some drawbacks in generating pedestrian include peripheral texture weakness, wide streets, poor physical conditions and crime areas and this cause the failure of numerous pedestrians. In the present case, the weakness of the legibility factor is evident based on the obtained data and in the field of security and avoidance of crime areas according to the analyzed choice factor indicating the presence of individuals in this area is estimated to be 0.06 which shows low quality such as legibility within the scope of the study.

Conclusion.

In the urban design process, there is a need for a tool that can simulate and provide effective steps and consistent with the design objective systematically and present the results of these measures before the implementation. Nowadays, also new ways have been

introduced in order to meet this need that the space syntax method is one of the safe methods to achieve this. The present study also shows that the development process can be interpreted in this way. In sum, the present data don't show acceptable degree of the impact of this pedestrian in the formation of sense of belonging to place among dwellers of Rasht city. In the present study, the following recommendations have been suggested to provide solutions to improve the conditions of urban pedestrian and to enhance the impact of this path in reinforcing the sense of belonging to place:

1. Factors such as shaping urban furniture, in order to achieve interactive and discursive spaces and semi-open spaces for use in the different seasons considering the weather conditions of this region.
2. Due to the widespread use of urban pedestrian to shape this route and organize the human scale in this pedestrian, symbolic elements and urban elements such as flags and statues rooted in the history and culture of this country must be paid attention.
3. Lighting at night and organizing off-trade texture on the pedestrian path due to the multiple obsolete historical buildings in this path can be an important factor in increasing the sense of security and hence the sense of belonging to the pedestrian.
4. Another important factor in achieving the sense of belonging is to use vegetation cover and water element in the design of this urban space.

It is hoped that by expanding this knowledge and taking advantage of it in the context of designing urban texture, efficient spaces and responsible to human needs can be achieved.

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