

Original Research Article

The Developmental History of Space Configuration in the Last Hundred Year Houses of Najafabad

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Abstract

Problem statement: In the last hundred years, the houses of Najafabad in Isfahan, Iran changed from a central courtyard to four forms of the central hall, a riding-pedestrian hall, and the private and apartment hall during modernization. So far, no research has been conducted on this developmental history to introduce the past and its changes and inform contemporary researchers and designers about the background and history of house design in this city.

Research objective: This study aims to evaluate the developmental history of the architecture of Najafabad houses over the last hundred years and compare these houses based on the space syntax technique.

Research method: In the present descriptive and analytical study, the developmental history of houses was evaluated from the point of view of spatial configuration, in several categories with several indicators using library studies, field observations, and simulation with the specialized software of syntax and space, and behavioral patterns were analyzed in spatial categories of entrance space, motion path, and privacy with navigable depth index, the internal organization of main spaces with interconnectedness index and spaces of pause, motion, and spatial hierarchy with depth index. In addition, entrance space, motion path, and privacy with navigable depth index, the internal organization of main spaces with interconnection index, and spaces of pause, motion, and spatial hierarchy with depth index were investigated. SPSS software version 20 was used to prove the numerical results based on inferential statistics methods such as Pearson correlation test.

Conclusion: Based on the results, the spatial configuration of the houses changed over time and privacy decreased. There was a direct statistical correlation between integration, depth, and navigable depth of common spaces in all periods. A gradual change was evident in the relationship between the courtyard and the building and its role from active to passive, reducing privacy at the entrance, identifying multi-functional vertical communication routes, reducing hierarchy in horizontal routes, increasing the number of organizing elements, and changing the organization from central to linear. The results can be effective for researchers and contemporary housing designers to reflect on the spatial qualities of contemporary housing to reduce the above deficiencies.

Keywords: *Housing, Najafabad house, comparative comparison, developmental history, space syntax, spatial configuration.*

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Introduction

Najafabad is located 26 kilometers away from the west of Isfahan, Iran, whose foundation is related to the Safavid era according to numerous traditions¹. Significant narrations about the reasons for the establishment of the city by the order of Shah Abbas and the role of Sheikh Bahai, his famous minister, have been narrated, which show the value of physical and architectural studies about the architecture and urban planning of this city². The old houses of Najafabad are a part of its physical identity surrounded by dense gardens in the past and before the modern era. The dominant activity of the people was agriculture, husbandry, canvas weaving, knife industry, and making steel tools (Khalili, 2007). Most of the gardens dried up in the process of urban development and the importance of horticulture in the city decreased due to water shortages over the past few decades. Historically, valuable buildings have also turned into dilapidated buildings in terms of physical, biological, and social aspects. The architecture of today's cities has lost its previous coherence with the gradual influence of modern architecture, and the face of cities has become a daily record of architectural developments (Hojjat, 2005, 56) and is shedding its skin (Hojjat, 2012). Field observations also show this metamorphosis and the rapid growth of tall building construction. Recording the spatial characteristics of past and present housing and the developmental history of housing can improve the decisions of today's architects in the field of research and design. This study aims to evaluate the changes in Najafabad housing in the last hundred years regarding spatial configuration to identify the similarities, differences, and developmental history between them and compare them based on the spatial syntax technique.

Preliminary knowledge about the spatial configuration and syntax of the space along with the developmental history of housing over the past hundred years in Najafabad and searching for categories makes the review simpler and more structured.

Theoretical Foundations

The space syntax method is considered to be one of

the methods of space analysis proposed by Christopher Alexander and Philip Steadman in a form-oriented perspective to understand the invisible structures and systems behind the shapes and phenomena of architecture. This method was proposed in the book *Social Logic of Space* by Hillier et al. (1984) after years of efforts at the Bartlett School of Architecture and Design (University College London) to discover the effective factors and hidden patterns behind the forms of native housing spaces (Montello, 2007; Wineman, Peponis & Conreoy, 2006; Hillier & Hanson, 1984; Haq, Saif & Zimring, 2003; Dawson, 2002; Hillier, 1999). The spatial configuration of settlements provides a relatively accurate map of the economic, social, and ideological relations between their residents (Hanson, 1998, 13). According to Hillier, different spaces reflect different ways of living in them, and the cultural and social characteristics of their inhabitants can be understood using the space syntax method (Hillier & Sahbaz, 2005; Turner, 2007, 104; Hillier, 2007, 44).

Human behavior in this space, which is the result of communication and spatial exchange, becomes more relevant by believing in the definition of architecture as a container of human life (Hojjat, 2002). Therefore, human behavior is influenced by establishing spatial relationships and creating a coherent whole, and Hillier calls this a configuration of space. Spatial configuration focuses more on the formation of spatial relationships in a set compared to quality in a single space (Bafna, 2003, 17). Some believe that the way the spaces are related to each other or the spatial configuration affects the way of human spatial experience before any other feature of the space, such as form, shape, color, and texture, which are the individual features of each space (Hillier, 2007, 20). Therefore, the spatial configuration is the driving force of human activity in artificial environments and the foremost thing which affects and determines human spatial cognition (Jeong & Ban, 2011, 665). The spatial configuration of the house and its interior design, as well as the shape of the houses in an area, can support or hinder the culture of the inhabitants (Rapaport, 1969, 49-50). Therefore, the organization pattern of the space and its configuration are examined to understand the

relationship between the design of built spaces and subsequent cultural dimensions (Thungsakul, 2001, 81). The space syntax method examines the physical and socio-cultural characteristics of samples by using four indicators of connectivity³, control⁴, integration, and depth (Klarqvist, 1993; Lima, 2001; Jiang, Claramunt, & Klarqvist, 2000). This study examined integration, depth, and navigable depth indicators to evaluate entrance transformation, motion path and privacy, pause spaces, motion and spatial hierarchy, and internal organization of main spaces.

Integration is the most important factor in space syntax, which expresses spatial coherence, and higher integration in the degree of interconnection in space increases the coherence with other spaces. This feature also indicates the level of access to the desired space, and a greater connection increases the accessibility of the space (Yazdanfar, Mousavi, & Zargar Daghigh, 2009, 61). Integration in the space composition method is a relational concept rather than distance and metric (Turner, 2007, 31).

The depth of separation of a space is from the totality of spatial configuration. Spaces with greater depth separate themselves from the spatial configuration, which has a social meaning. Increasing the depth means the separation of public and private privacy, which also increases the degree of spatial privacy. The greater depth of the set of spaces creates a spatial hierarchy and reduces the access and penetration to some spaces, leading to greater control of the space. Therefore, the controllability of the space increases by raising depth and creating privacy (Memarian, 2002). On the other hand, decreasing the depth of the space reduces the spatial separation, and the space becomes more integrated, showing a higher integration value and the possibility of easier access to the space (Haq, 1999, 4). Depth is related to the number of spaces we pass through to reach the desired space. In addition, navigable depth means the visible area from a specific point to a set of points (Benedikt, 1979).

Research Background

Spatial configuration in the housing area is a subject

that has always been considered by researchers (Saatci, 2015; Eid, Shehayeb & Yaldiz, 2004; Karlen, 2009; Dursun, 2007; Mustafa, 2010). Some studies have been conducted in this field In Iran. Azadbakht and Nurtaghani (2017) examined the mutual relationship between the spatial configuration and the activity system at the scale of communal areas inside the house by categorizing communal activities and measuring syntactic data. Heydari Heydari, Ghasemian Asl & Kiaei (2017) revealed the cultural differences in different societies through the space syntax method and the analysis of different settlements. Madahi and Memarian (2018) used the spatial configuration method to investigate the native housing in Boshruyeh on an architectural scale to identify the continuity and change in the spatial configuration of the native houses of this region and analyze the consistency of the spatial configuration and organization of these houses and its changes with the native settlement culture and its control system. Tabatabai Molazi and Sabernjad (2016) utilized the space syntax analysis to understand the configuration of Qeshm native housing and highlight the necessity of coordinating the construction rapidly increasing today with the needs and social relations of the native people. Hamedani Golshan (2015) investigated to reread the principles and intellectual foundations of the theory of space syntax and update the developments that occurred in recent years in the concepts and tools of this theory. Kamalipour, Memarian, Fayazi & Mousavian (2012) studied the native housing of Kerman using the space syntax perspective to classify the shape composition of native housing and the spatial configuration regarding the arrangement of the guest space in the traditional houses of Kerman.

Based on the literature, historical and native houses have always been studied using the space syntax technique. In the present research, a wider variety of houses are discussed during the last hundred years. These studies have often shown that the spatial configuration of native and historical houses is functionally and culturally well-responsive to the needs of their residents. In addition, the configuration of native and historical houses has been introduced as a suitable model for

contemporary constructions in the research proposals without specifically examining contemporary housing. This study investigated a more diverse range of houses, from historical to contemporary houses, in Najafabad to evaluate the responsiveness of different configurations in these houses over time to design houses. Further, it aims to create a higher-quality architecture, more compatible with the activities, communications, and needs of users by compensating for the weak points and maintaining the strong points.

Previous studies on Najafabad are often limited to urban studies (Satari Najafabadi, 2012; Atai, 2011) or the introduction of its public buildings (Khalili, 2007; Nadi, 2002) and there are fewer sources to analyze or describe the residential architecture of this city. Hosseinpour Fard (2012) presented a typology for historical houses and models for house design after documenting and writing about ten historical houses belonging to the Qajar and sometimes Safavid periods. The book "Forty Houses: Body and Life in the Historical Houses of Najafabad" (Karbasi, 2019) described the architecture and the way of life in the forty historical houses of this city (before the last sixty years), which have not gone beyond the description. In this way, no research has been published on the subject of the present analysis of the architecture of the houses of Najafabad.

Research Method

First, the study archive of architecture offices and field studies, interviews, and observation of Najaf Abad houses (in the last hundred years) were categorized by referring to the map of the history of Najaf Abad buildings and logically compared with a combined and descriptive-analytical method. The combined method includes library research, field observations, simulation with space syntax software, and the comparative method. The characteristics of the houses in terms of spatial configuration were evaluated by the UCL Depth map space syntax software indicators after the software simulation. The categories of entry, motion, and privacy were analyzed with the index of navigable depth, the internal organization of the main spaces with the index of integration, and the spaces of pause, motion, and

spatial hierarchy with the index of depth. Inferential statistics methods with Pearson's correlation test were prepared by SPSS 20 software to prove the numerical results (Fig. 1).

Findings

Based on the field observations and physical evidence, attempts were made to determine some categories of houses over time by looking at the common characteristics of the houses of Najafabad in different periods from a hundred years ago up to now to measure them based on the selected categories. A total of 40 houses of different ages were examined in five areas of the city based on the map of the history of the buildings of Najafabad city⁵ (Archive of the Department of Cultural Heritage, Handicrafts and Tourism of Najafabad), along with a field study on 200 houses. In addition, an interview was also conducted with real estate offices in the city. The study archive with the oldest architectural design office in Najaf Abad city⁶ (archive of Pardis architectural design office) was referred to ensure the comprehensiveness of the statistical community in each region. These houses can be divided into five categories based on their distinctive features, including the internal organization of the main spaces, the flow of motion, and entry into the building, each of which was common in this city during certain periods. Houses placed in these five categories were frequent, and personalized houses such as the houses of wealthy people, which are less abundant, were omitted. The present study does not claim to have a complete typology of housing in Najafabad city and analyzes the developmental history of the configuration of its known types so far over time. Observation and semi-structured interview techniques were used by identifying these houses to achieve the connection between the body of these houses and the current life. In this section, the description of the body of each category and its relationship with the current performance was developed to provide the necessary preparations for the analysis of the connection in the plan.

• Category A houses

The oldest houses in Najafabad mostly belong to 50 to

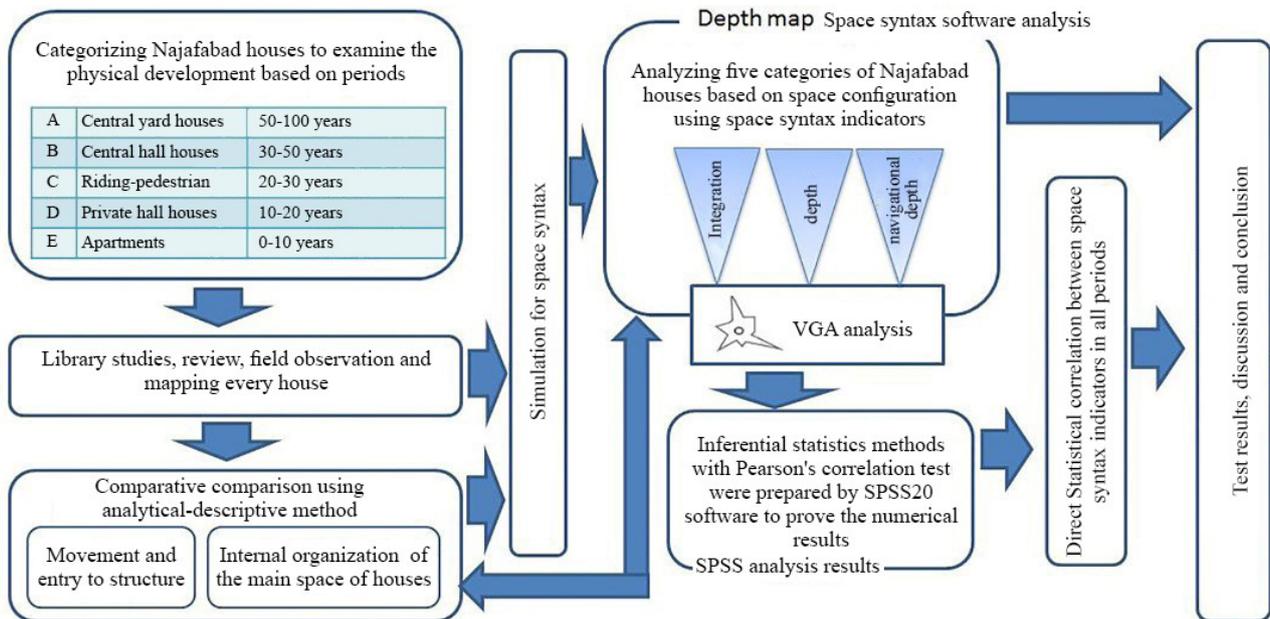


Fig. 1. Research steps. Source: Author.

100 hundred years ago, and the characteristic of these houses is the location of the open space in the middle of the closed space, in such a way that the closed spaces are placed around the central open space (Fig. 2).⁷ These houses, which are built at least on both sides of the yard, are called the central yard.

These houses, which are built at least on both sides of the yard, are called the “central yard”⁸ in the present study.

• **Category B houses**

Fifty thirty-year-old houses which are one-story and often have a central hall and a basement (Fig. 3) and the ground floor is a few steps higher than the courtyard level. The basement serves as a service space for the kitchen, which can be accessed from the kitchen in addition to the yard. Sometimes the parking lot (sometimes with a temporary roof) occupies a part of the yard.

• **Category C houses**

The second category of houses in Najafabad was formed between thirty and twenty years ago with the beginning of multi-story buildings and living at height (Fig. 4). In these houses, the car plays a dominant role, and a covered space adjacent to the closed spaces on the ground floor is dedicated to parking. In this way, a part of the spaces of the first floor, which are placed above

this low parking lot, is moved to a higher height. These houses are so-called riding-pedestrian.⁹

• **Category D houses**

Most of the houses built in Najafabad in the last twenty to ten years were one story and sometimes two or three stories¹⁰. In these houses, several families often live next to each other on separate floors, and the connection between the floors is a staircase that directly accesses the alley. The private sector is separated from the public spaces by a semi-private corridor or hall. The parking lot is located on the ground floor or basement and occupies an important part of the construction of the ground floor. This method became obsolete after some time and the number of two- to three-story constructions was reduced, and after that most of the houses of this category are built with one story¹¹. These houses were called “private halls” (Fig. 5).

• **Category E houses**

The beginning of the construction of high-rise apartment houses in Najafabad dates back about ten years ago (Fig. 6). These apartments have four to ten floors¹² and each unit has at least one parking space on the ground floor or basement¹³. Access to the units is provided through stairs and an elevator in the center of the closed area. The open space or the yard is inevitably allocated to the parking lot and sometimes to a small unit on this floor

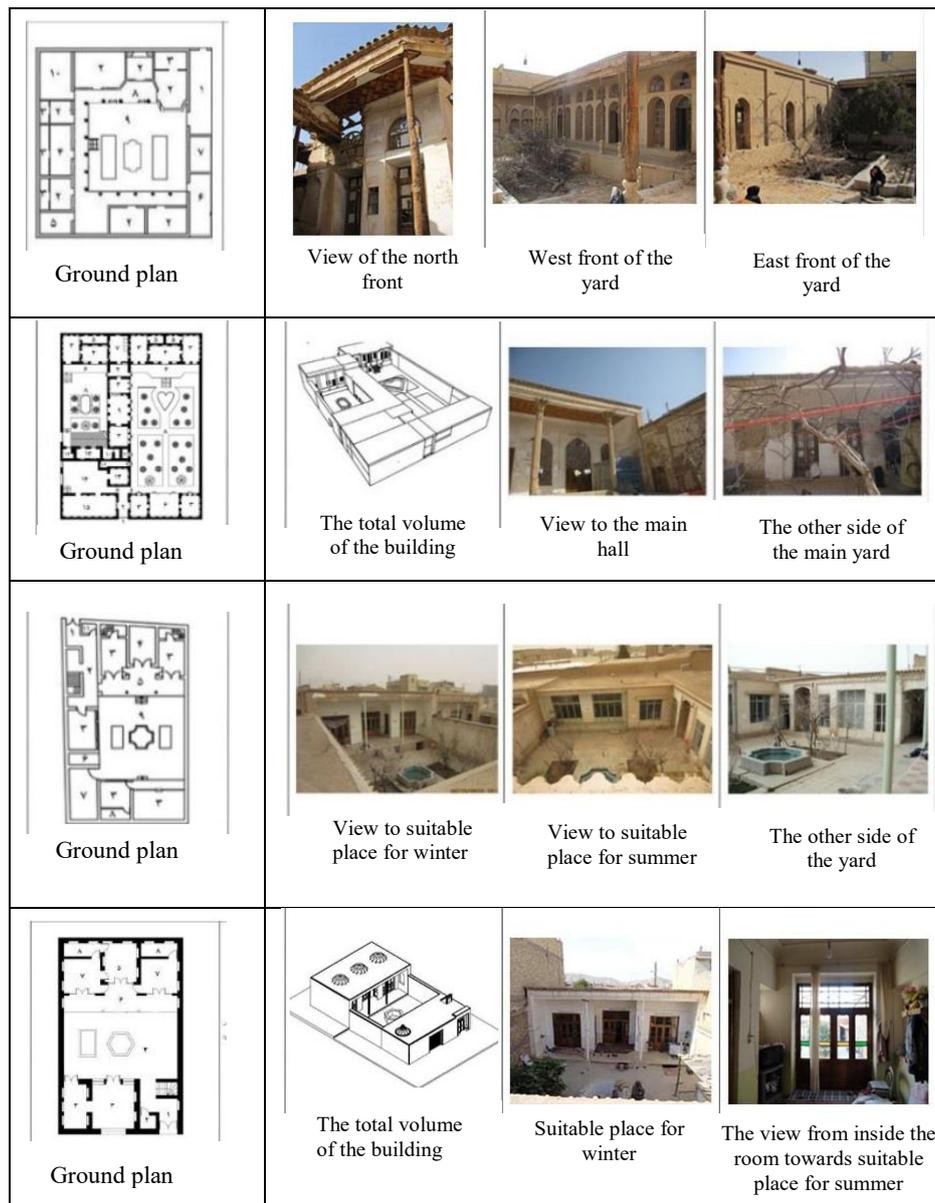


Fig. 2. Types fifty and one-hundred-year-old houses in Najafabad. Source: Hosseinpour Fard, 2012.

due to the necessity of allocating the entire closed space of the ground floor to the parking lot, the units on the higher floors only have access to the semi-open space of the terrace. However, this terrace is not located along the daily activities of life and is only for drying clothes and storing things.

A special type of housing with different characteristics was available to a significant number of people in Najaf-Abad city in certain periods, as different physical characteristics can be seen in each period and five categories of houses with significant differences in architectural form can be distinguished (Table 1).

Discussion: Comparison of configuration in five categories of houses in Najafabad

Comparison of the internal organization of the main spaces: Patterns describe the relative position of the components to organize the internal spaces of a building. In other words, the terms which describe these basic patterns are central, linear, set, co-center, co-family, bi-center, and nuclear organization (Kelark & Paz, 2008, 232). Therefore, two central and linear patterns can be identified in the five categories of houses in Najafabad (Fig. 7).

The comparison of entrance and motion course: The



Fig. 3. Yusufan's house is one of the thirty- to fifty-year-old houses. Source: Author.

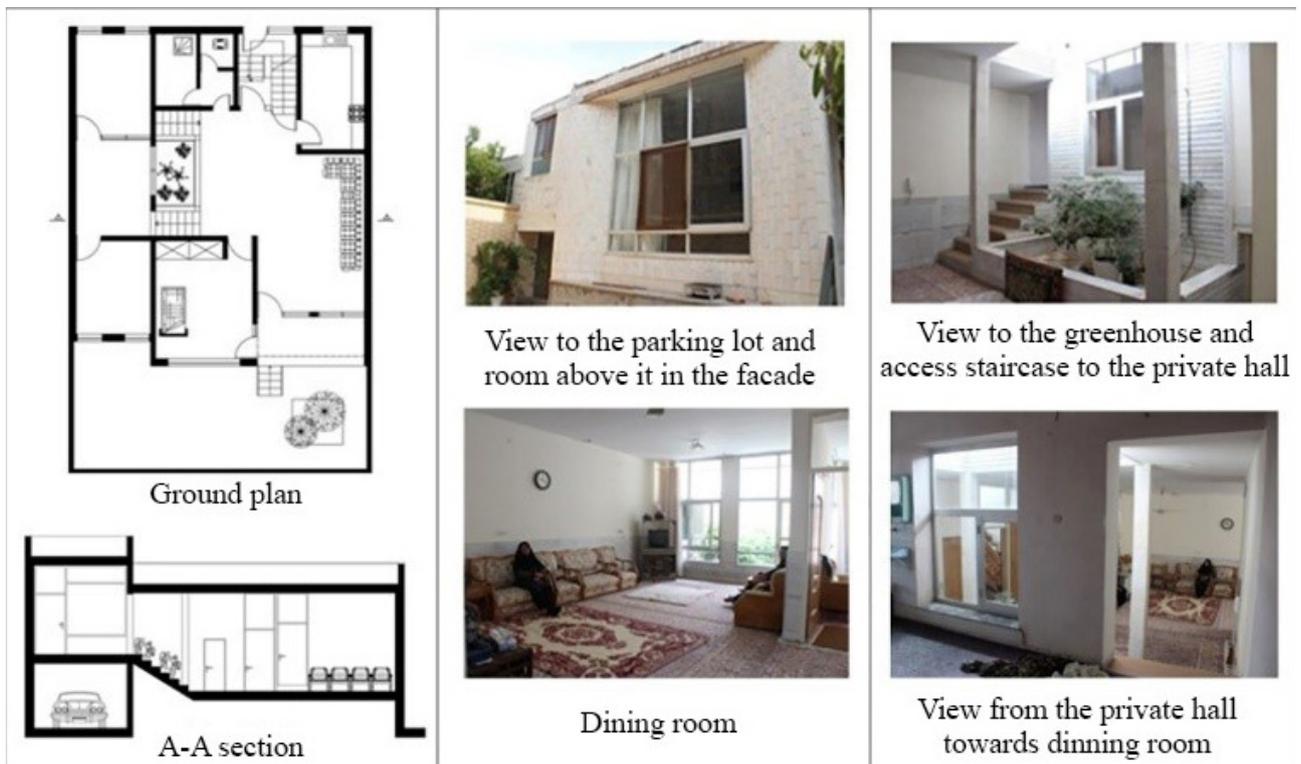


Fig. 4. Salehi's house (one of the twenty- to thirty-year-old houses). Source: Author.

general changes of the houses in the motion course of the entrance and inside the house are examined in two

parts of the entrance and horizontal and vertical motion course in the height¹⁴ (Fig. 8).

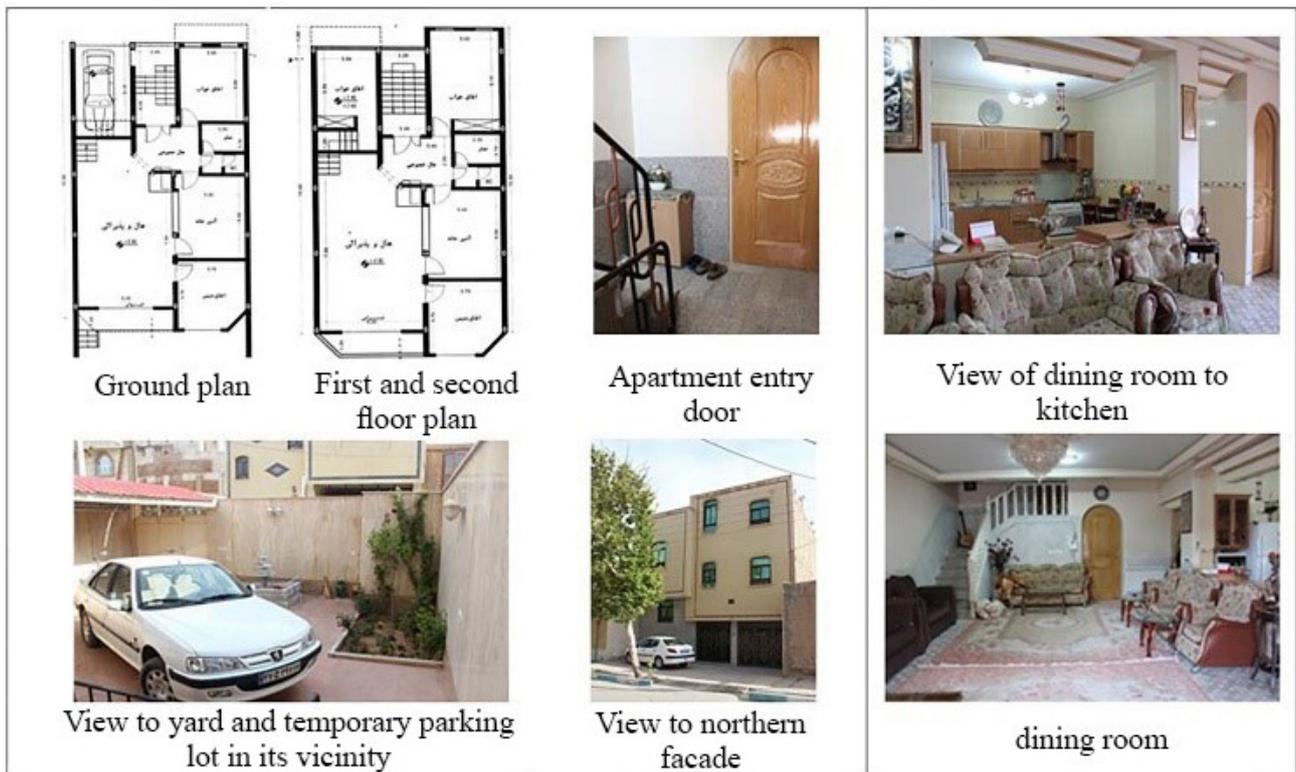


Fig. 5. Zainli's house (one of the ten- to twenty-year-old houses). Source: Author.



Fig. 6. Apartments from the category of houses dating from the past ten years until now. Source: Author.

• **Analysis of Category A houses (central yard)**

The internal organization of the main spaces of the central yard houses: The integration of the yard is more

than other spaces as a safe place for people's solitude and peace due to its spatial enclosure from the outside and its spatial privacy (Table 3). According to Haeri, in

Table 1. Categorization table of houses in Najafabad during the last hundred years over time. Source: Author.

| Category | The age of the buildings | The title assigned after observing the structural features |
|----------|------------------------------|--|
| A | One hundred to fifty years | Central yard |
| B | Fifty to thirty years | Central hall |
| C | Thirty to twenty years | Riding- pedestrian |
| D | Twenty to ten years | Private Hall |
| E | The last ten years until now | Apartment |

central yard houses, the yard is the central organizing element as an example of an open space enclosed in more than one way, including all kinds of daily, weekly, monthly and yearly activities and is placed in the center of the three-dimensional network (Haeri Mazandarani, 2008).

Entering the house and the motion course of the houses in the central yard: The navigable depth decreased due to the number of pre-spaces (Table 2), indicating the creation of privacy in the courtyard space and greater entrance depth¹⁵. In most historical houses in hot and dry regions, the path from the alley to the yard is often a broken and indirect path, and the entrance is designed as an interface between the outside and the inside to maintain the distinction between the two parts and connect each other (Navai & Haji Ghasemi, 2012).

The vertical motion course in houses with a central yard: The stairs to access the roof are usually without skylights with a high rise in the corner of the yard or in the entrance corridor of the house along with a secondary and underused space.

• **Analysis of category B houses (central hall)**

The internal organization of the main spaces of the central hall houses: While entering the houses of the central hall, the range of closed spaces with an organizing and dividing space is located in the heart of the house, where all the paths end and the rooms are located around. This space is the central private hall, which was shown with the letter B regarding integration (Table 3). Integration of this space is more than other spaces, which is not far from expected because of its location and function, which has a different character and dignity compared to other spaces. From this period onwards, the yard is located on one side and the

building on the other side, and the connection between closed and open spaces becomes less.

Entering the house and the motion course of the central hall houses: After passing through the entrance door, we immediately enter the yard. As shown in Table 3, there is little navigable depth in the yard. In this era, the input is defined regardless of hierarchy and confidentiality. In some early examples of this category, which has more traditional residents, the privacy of the yard is preserved by hanging a curtain in front of the entrance of the yard so that the yard and the building behind it are protected from the sight of passers-by when the door is opened.

As shown in the integration map, the integration of the central hall (space B in Table 3) has the highest value after the yard (space A in Table 3). In the closed space of these houses, it is possible to move in the interior through the remaining spaces between the spaces or the main rooms. The corridor leading to the hall, which is usually placed in the center or middle of the spaces, provides access to other spaces. Less navigable depth in the reception space as a public space compared to more private spaces such as bedrooms, bathrooms and kitchens is noteworthy due to the presence of a reception area in the vicinity of the yard. The guest enters the reception room directly from the porch without passing through the corridor and hall and without any hierarchy. The vertical motion course in the central hall houses: First, the double ceiling (false ceiling) of the bathroom is accessible by a ladder, and then the roof from the double ceiling can be reached with a row of stairs, which are just a few pieces of wood sunk into the wall. The staircase next to the toilet and bathroom leads to the roof. This staircase often has a large and tall window in the facade of the building, which has large

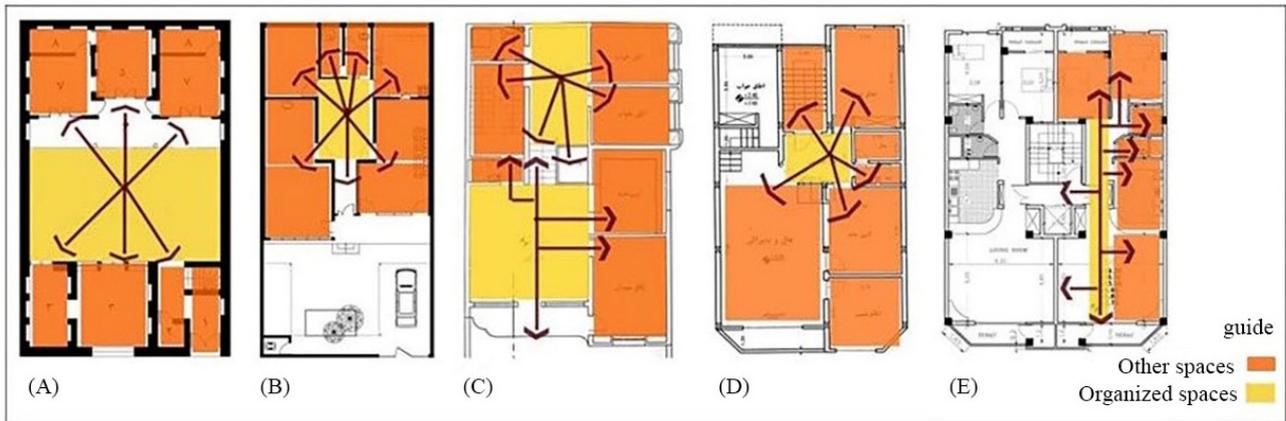


Fig. 7. The comparison of the internal organization of main spaces in five categories of houses in Najafabad. Source: Author.

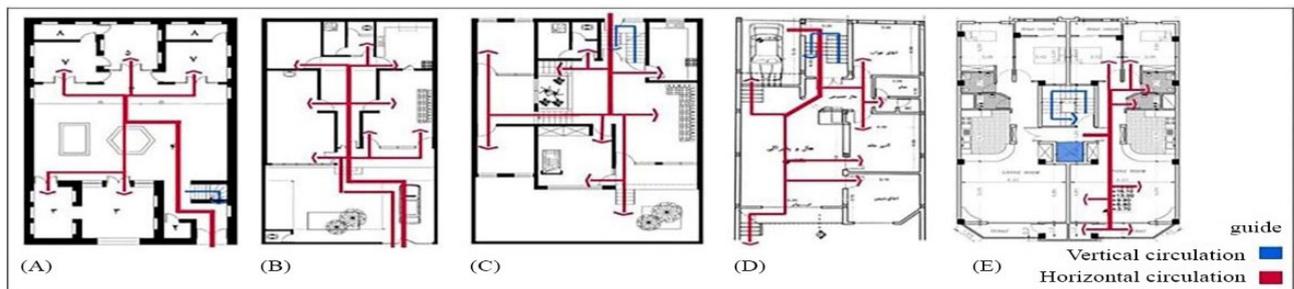
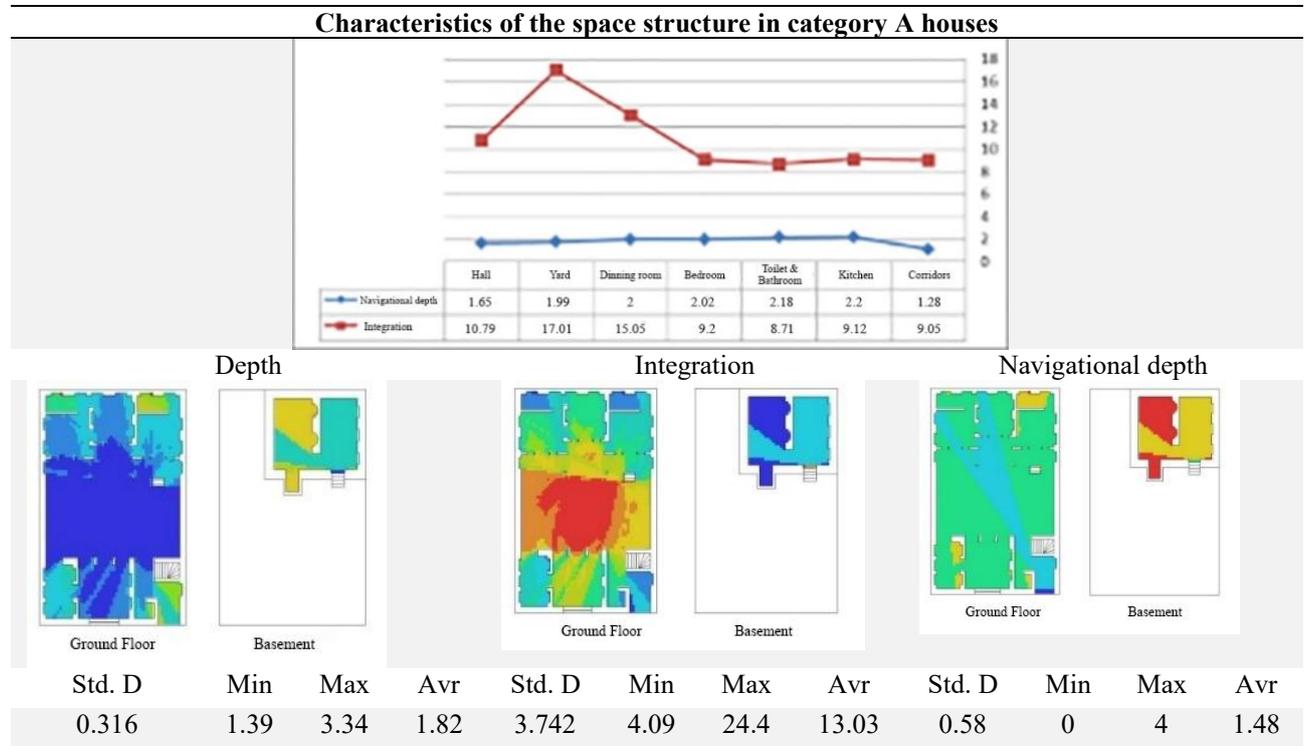


Fig. 8. The comparison of vertical and horizontal motion in five types of houses in Najafabad. Source: Author.

Table 2. Characteristics of the space structure in category A houses: The central yard. Source: Author.



In the plans, red and blue colors indicate the highest and lowest degrees of integration and depth, respectively.

or small pieces of colorless or colored tempered glass, preventing the inside of the building from being seen

from the outside and providing light for the staircase. From this period, the staircase gradually becomes an

important us element in Najafabad houses (space C in Table 3).

• **Analysis of category C (riding-pedestrian) and D houses (private hall)**

The internal organization of the main spaces of riding-pedestrian houses: The organizing space expands into two larger spaces, with different features including the organizer of the privacy of the house is the private hall, and the organizer of the public privacy and the permeable area of the guest, i.e., the living room. The high level of integration in these two spaces (Table 4) introduces them as an organizing space.

The internal organization of the main spaces of private hall houses: In private hall houses, organizer space comes in many forms. In some cases, the living space is the organizer of privacy and has places to sit, and the dining space is the organizer of the public privacy of the house (space A in the integration section of Table 5). In some cases, the private hall is the organizer of privacy and does not have a pause space, and dining is also the organizer of public privacy (space B in the integration map of Table 5). In this category, the main spaces of the house are involved in the organization and often there is no independent and detailed organizer space.

Entering the house, the motion course of riding-pedestrian houses, and private halls: The definition of entry in these two categories is two ways:

Entrance from the yard (in northern houses): The entrance is directly from the yard, as in the houses of category B, without respecting privacy and creating a hierarchy.

• **Entrance from the building (in the southern houses)**

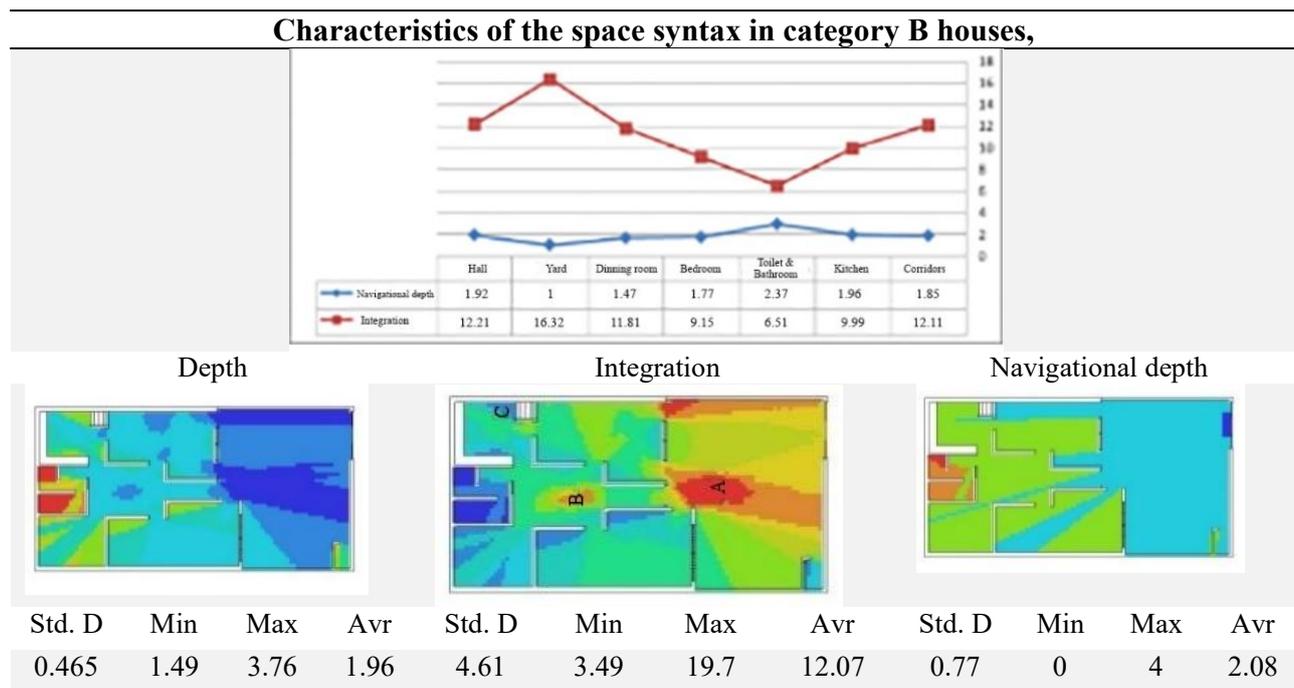
After entering and climbing a few steps from the main door, it leads to closed spaces. As shown in Table 4, this way of entering to some extent limits the navigable depth and direct view into the room and creates more privacy than before.

The vertical motion course in private houses and private halls: the horizontal and vertical motion course starts from one point and a staircase provides access from the basement to the roof. This staircase has two doors in the hall, one to enter the hall and the other to go to the upper floors.

• **Analysis of category E houses (apartments)**

The internal organization of the main spaces of apartment houses: The organizing element of spaces in apartment houses is a corridor or a linear path that

Table 3. Characteristics of the space syntax in category B houses, Central Hall. Source: Author.



In the plans, red and blue colors indicate the highest and lowest degrees of integration and depth, respectively.

Table 4. Characteristics of space syntax in category C houses, riding-pedestrian. Source: Author.

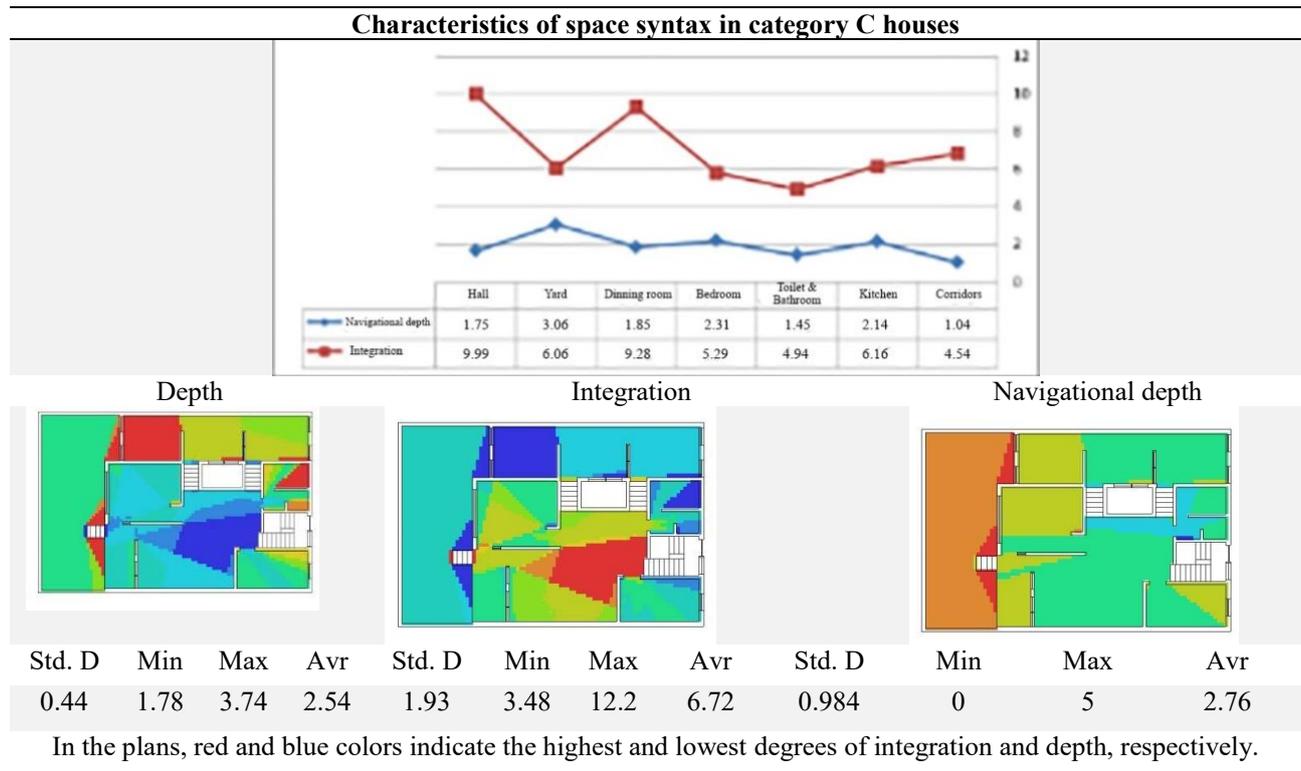
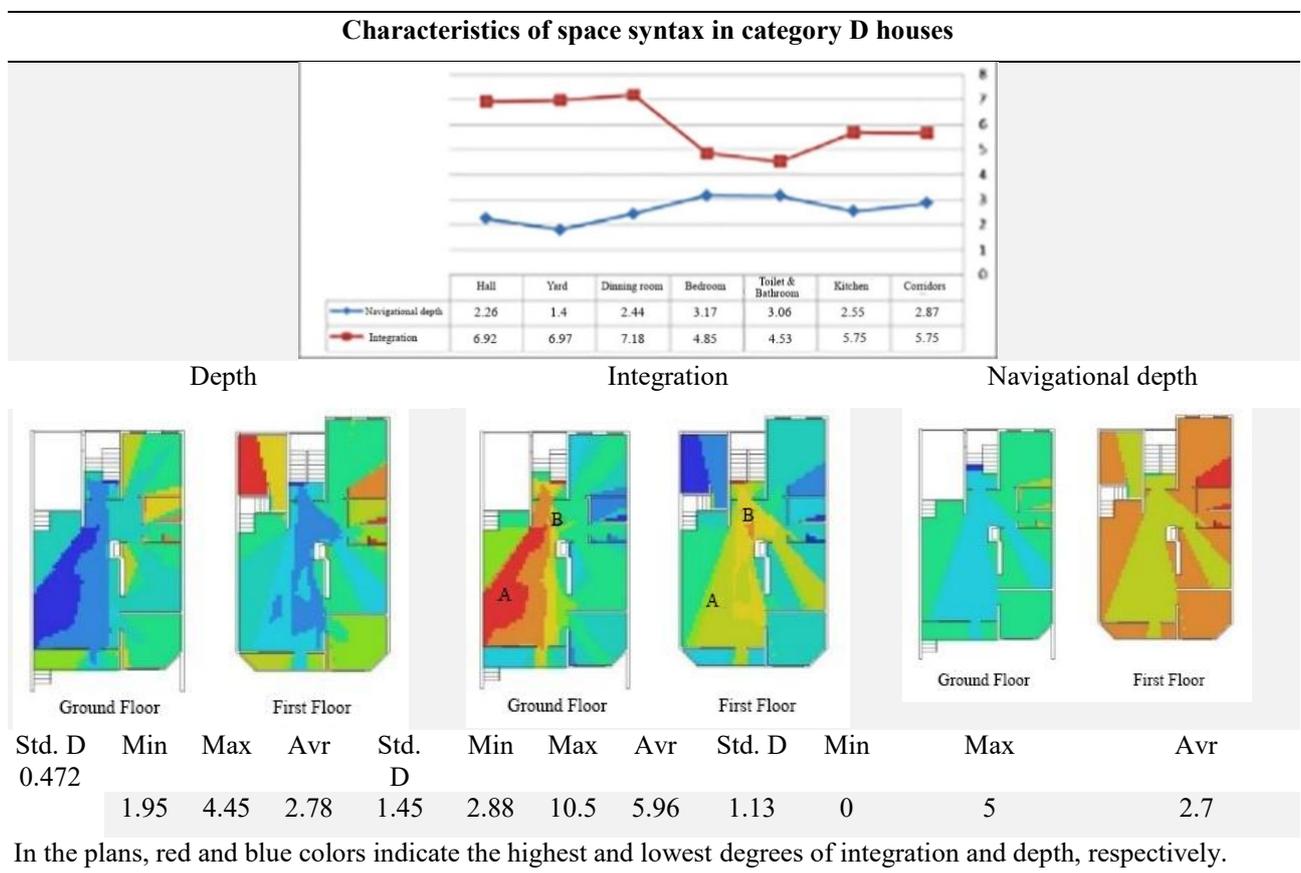


Table 5. Characteristics of space syntax in category D houses, private hall. Source: Author.



connects the private sector to the public sector. The open space or yard is inevitably assigned to the parking lot and sometimes to a small unit on this floor due to the necessity of allocating the entire surface of the closed ground floor space to the parking lot, and the units on the higher floors only have access to the semi-open space of the terrace.

The corridor is a path with a gap in the living space in the north-south direction, which connects the terrace on one side of the house to the entrance area of the bedrooms on the other side of the house. According to Clark and Puzzle, this organization pattern focuses on line and motion, which is created by the path and direction of passage (Kelark & Paz, 2008, 233). An increase in integration can be observed in the space of corridors, staircases, and elevators (Table 6), which is the result of the spatial organization of this category, unlike other categories with a horizontal arrangement.

Table 6 presents the developmental history of the internal organization of the main spaces. In the interior space of each unit, a part of this linear path is usually shared with the main spaces such as the living room and reception, imposing the load of its motion performance on their special functions.

Entering the house and motion course of apartment houses: It is possible to enter each unit through the door on the landing (semi-private privacy) and there is a direct view into the residential unit upon entering. In other words, an increase in integration in the staircase representing the frequent passing of residents and the placement of this space in the vicinity of internal spaces such as the kitchen has caused the loss of privacy which confirms navigable depth in this space. In the interior space of these units, a linear axis as a horizontal organizing element connects the reception and the terrace on one side to the rooms and the private yard of the house on the other side.

The vertical motion course in contemporary houses: There is the entrance door of a house on each landing, and the landing of the stairs often turns into a messy shoe accumulation place in examples of more than one floor. The staircase in these examples gradually turns into a dead space, with poor quality, and without light,

despite its important role in people's daily access and transportation. In the best case, it has a small window facing the street, and there is no trace of the large and serious windows of the previous periods in the houses of this period. Stairs and elevators are the most serious elements of vertical access used daily and permanently in apartment houses, and the staircase is still used as a shoe accumulation place for the houses on that floor on each floor. The poor quality of the staircase space in category D continued in the houses of this category. In addition to the length of the stairs of the E-stairs and its location in the heart of the structure, the little light of the D-stairs has taken away from it and added to the problem of its poor quality (Table 6).

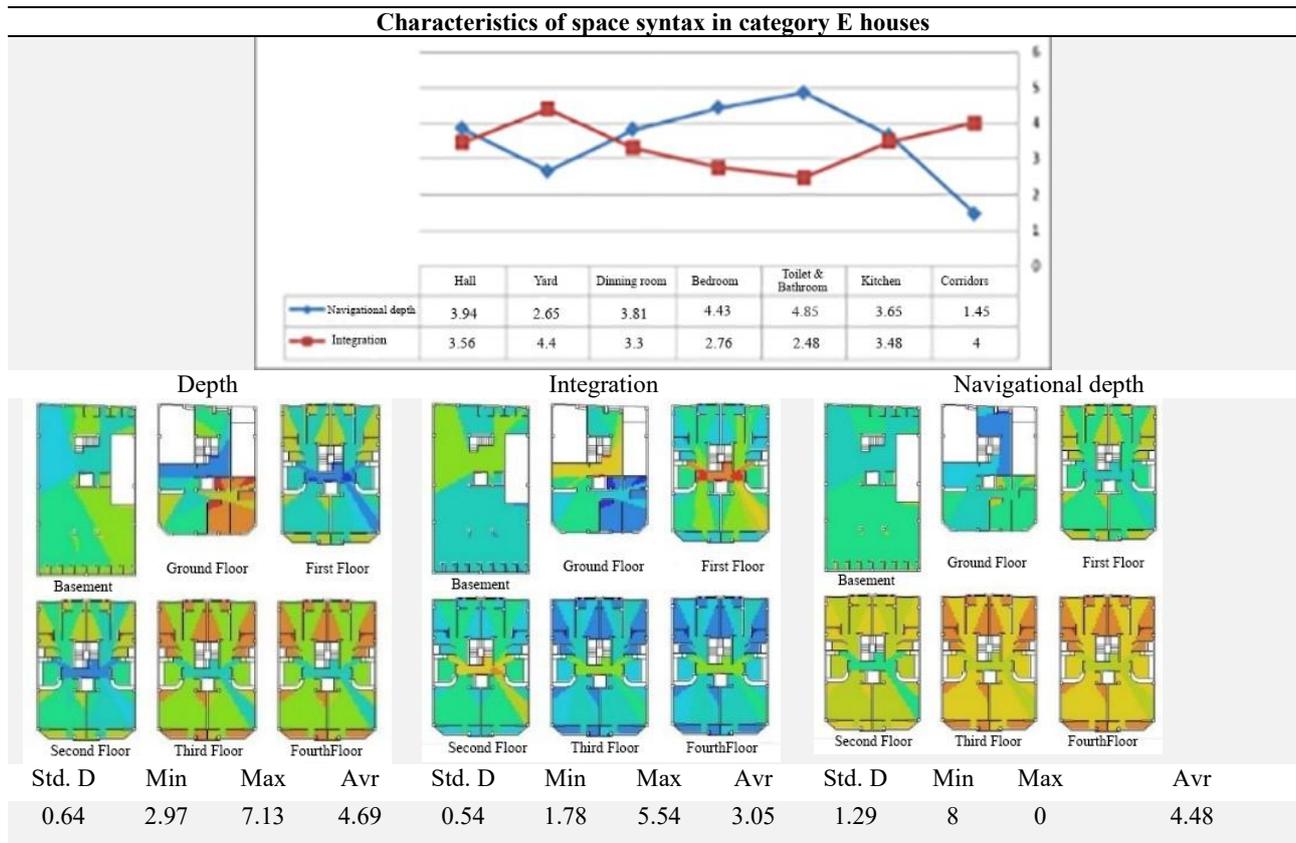
The Relationship and Correlation Between the Characteristics of Space Syntax in Five Categories of Houses

The Pearson correlation test was used for data analysis. Table 7 shows the relationship between the parameters of the space between the pairs of components in five categories of houses in Najafabad. In addition, there is a significant relationship between all components and the significance level is less than 0.05. The amount of correlation between categories of the house with navigable depth, integration, and depth is 0.932, 0.971, and 0.901, respectively. The correlation between integration and navigable depth is 0.921, showing a high level of correlation among all of the mentioned variables. The correlation between the depth with navigable depth and integration is 0.629, indicating a significant relationship in the houses of all five categories. Therefore, there is a direct correlation between shared spaces with navigable depth, integration, and depth.

Conclusion

Analyses of the developmental history of Najafabad houses, both in terms of space and field, indicated a decrease in privacy and confidentiality over time. The way of arranging the spaces in the central courtyard houses, which had the most integration and the least depth in the organizer space (central courtyard)

Table 6. Characteristics of space syntax in category E houses, apartments. Source: Author.



In the plans, red and blue colors indicate the highest and lowest degrees of integration and depth, respectively.

Table 7. Statistical correlation between integration, depth, and navigable depth of common spaces in houses of each category. Source: Author.

| | Correlation coefficient | House category | Navigable Depth | Integration | Depth |
|-----------------|---------------------------------|----------------|-----------------|-------------|--------|
| House category | Pearson correlation coefficient | 1 | .932* | .971** | .901* |
| | (2-tailed) Sig. | | 021.5 | 006.5 | 037.5 |
| Navigable Depth | Pearson correlation coefficient | .932* | 1 | .921* | .980** |
| | (2-tailed) Sig. | 021.5 | | 027.5 | 003.5 |
| Integration | Pearson correlation coefficient | .971** | .921* | 1 | .885* |
| | (2-tailed) Sig. | 006.5 | 027.5 | | 046.5 |
| Depth | Pearson correlation coefficient | .901* | .980** | .885* | 1 |
| | (2-tailed) Sig. | 037.5 | 003.5 | 046.5 | |

provided more definition of spatial privacy compared to the private hall houses and then apartments. Figure 9 shows the reduction of integration and an increase of depth in the general state, as the result of the central organization becoming linear over time. The organization of spaces changes from a central to a linear state closer to the present, and the number of organizer

spaces increases with the creation of the hall space. The important difference between these houses is the change of function and relationship between open, closed, and semi-open spaces and the way of the presence of open space and its relationship with closed spaces. This difference in the private hall houses separated the three spaces from each other and disrupted the life process.

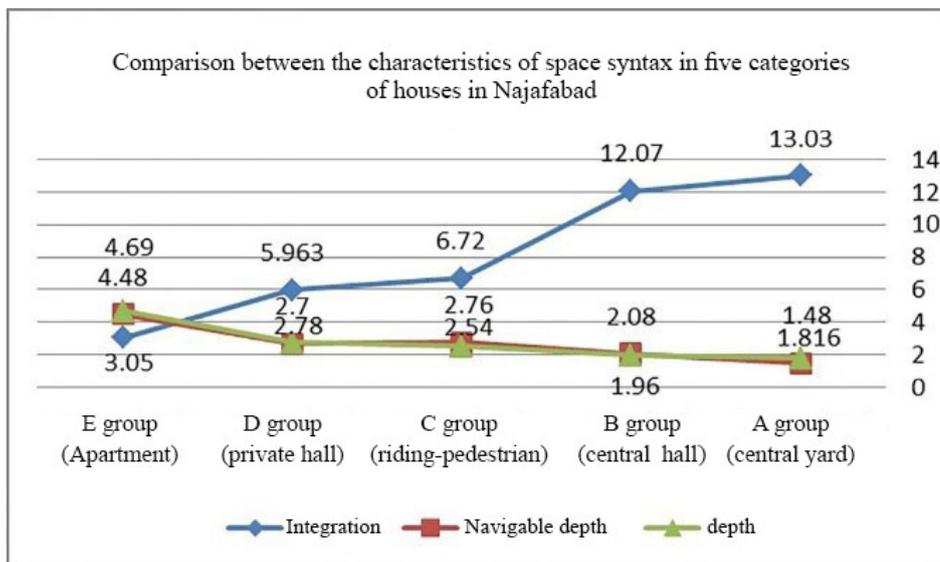


Fig. 9. Comparison between the characteristics of space syntax in five categories of houses in Najafabad. Source: Author.

There is a direct statistical correlation between integration, depth, and navigable depth of common spaces in all periods in houses. Table 8 represents a comparison between the houses of each period.

A gradual change in Najafabad houses can be recognized in the following cases with the help of the space syntax method along with field observations and shape analysis from the last hundred years until now:

1. Reducing the relationship between the yard and the building and changing its role from active to passive
2. Fading privacy at the entrance
3. Identification and multifunctionalization of vertical communication paths
4. Diminishing hierarchy in horizontal paths
5. The multiplicity of organizing elements and changing the way of the organization from central to linear.

The effectiveness of the main functional spaces such as living and dining decreased when organized and the definition of the entrance as a space to maintain privacy inside and create hierarchy was weakened. Vertical communication paths were identified, and the hierarchy of horizontal communication paths of the houses faded. The interference of the areas of pause and movement increased and damaged the performance of the main spaces. The combination of all these factors indicates the decline in the spatial quality of these houses from the past until now. It is necessary to take steps towards

higher quality architecture and make it more compatible with the activities and needs of users with the foresight of contemporary architects in designing new houses in this city by compensating for the above weaknesses.

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Footnotes

1. Some references consider the construction of this city by Sheikh Bahai as a policy to create economic support for the Safavid capital (Ismaili, 2006, 38).
2. Regarding the foundation of Najafabad, the design and idea of creating the city of Najafabad, thirty kilometers west of Isfahan, came from Sheikh Bahai. It is said that when a caravan was transporting wealth and goods from the endowments of Astan Alavi to Najaf, Sheikh Bahai had a dream at the first stop of the caravan, which was in the current location of the city of Najafabad, that the Imam of the Shiites have said to remove the burden of the road from the feet of the caravans and build a city in this place from the wealth of endowments, and the sheikh did the same (Ismaili, 2005, 38).
3. Connectivity: The number of points that a point directly communicates with.
4. Control: It determines the degree of authority of a point from the points to which it is connected.
5. Maps related to the dating of the existing buildings of the city
6. Available information about the dominant examples of housing designed in Najafabad during the last thirty years
7. It is placed in four cases around two inner and outer yards, all around, in a (U) shape, on both sides of the mass yard, north and south. The yard in the middle of the house is surrounded by at least two and at most four sides. Among these houses, which are mostly one-story, there are also two-story examples where living spaces are located on the ground floor and service spaces for hay storage and fruit drying are placed on the first floor.
8. Means the presence of a yard in the middle or between closed spaces not on one side. In these houses, the closed spaces include the open space as is a room without a roof, and one of the main spaces of the house. The open space

Table 8. Comparison of the houses in each period. Source: Author.

| House Group | Construction time | Organizing elements and spaces | Motion course | |
|---|--|---|---|--|
| | | | Horizontal | Vertical |
| Group A: Central yard houses | The last 50 to 100 years | The yard, the central organizing element for the whole house | Maintaining privacy at the entrance to the house with the entrance twist Yard; The central element that divides the paths | Placement of the secondary staircase in the corner of the yard Staircase, possible access to the ceiling |
| Group B: Central hall houses | Last 30 to 50 years | Central hall, the central organizing element for the entire closed space | Approximate privacy when entering the house Central hall, path divider element | The identification of the staircase in the building Having large skylight windows Staircase, access to the ceiling |
| Group C: riding-pedestrian houses | The last 20 to 30 years | Dining and private hall; Two organizing elements in privacy and publicity of closed space | Creating privacy at the entrance to the house by hanging the curtain after the entrance in some cases private hall and a part of the hall and dining; Path dividing elements | Staircase, access to the ground floor, and then the ceiling Making the staircase an indicator in the building and having large skylight windows in some cases |
| Group D: Private hall houses | Last 10 to 20 years | Dining, living and private hall, living and dining, are both residential and organizing spaces. | Creating a direct and non-hierarchical path in entering the house and not maintaining privacy at the entrance Diversification of the element that divides and organizes routes | The greater functional importance of the staircase to access the floors, reduce light, and its spatial quality Staircase, access to the ceiling and floors |
| Group E: Apartment houses | The last 10 years until now | Corridor, linear element-organizer | Absence of hierarchy in the entry of units and lack of privacy Linear element corridor, route organizer | Poor quality staircase and often completely without light, less use of stairs due to the presence of an elevator Elevators and stairs, access to the ceiling and floors |
| Summary: Developmental history of the studied cases | Change of organization from central to linear by increasing the number of organizing elements, entering the main functional grains such as living and dining into the game of organizing, and reducing the efficiency of these spaces. | | Fading the definition of the entrance, trivializing the maintenance of hierarchy, and privacy inside the house through designing the entrance, identification, and multi-functionality of vertical communication paths (The functional and physical importance of the stairs of the floors and then the reduction of spatial quality at the same time as its functional importance) | |

is well defined by closed and semi-open spaces.

9. 19. In these houses, the private and public parts are separated from each other by the difference in floor level. The remaining public part of the ground floor is located next to the parking lot and the private part is located on the parking lot. The access staircase to the private part passes by a greenhouse with a skylight and connects the dining room to the private hall of the bedrooms on the parking lot. Dining on the ground floor and a private hall on the parking lot are two elements that organize closed spaces in these houses.

10. They are often formed and popularized with the intention of married male children living with their parents.

11. Wealthier employers provide a separate house for their children due to the preference of the new generation to live in an independent building.

12. The primary applicants for these apartments are young and middle-class couples who cannot afford to own a non-apartment house.

13. The basement, which in the past was a warehouse or a place to rest in hot seasons, has been turned into a parking lot and separate storage rooms for each unit.

14. This range of vision in the present research is taken from the entrance with regard to the focus on privacy, and other spaces are also measured hierarchically and spatial steps relative to the entrance.

15. In some examples, residents enter the yard after passing through two ninety-

degree turns, which increases the navigable depth of the yard from the entrance.

Reference list

- Atai, H. R. (2012). *Analyzing the role of physical form in improving visual qualities (case example: central part of Najaf Abad city)*. (Unpublished master’s thesis in urban design). Faculty of Architecture and Urban Planning, University of Isfahan, Iran.
- Azadbakht, J. & Nurtaqani, A. M. (2017). The relationship between the system of collective activities and the configuration of Kuhdasht houses with the approach of space syntax. *HONAR-HAYE-ZIBA*, 22 (1), 64-74.
- Bafna, S. (2003). Space Syntax A Brief Introduction to Its Logic and Analytical Techniques, *Environment and Behaviour*, 35(1), 17-29..
- Benedikt, M. (1979). To take hold of space: isovists and

- isovist fields. In: *Environment and Planning B: Planning and Design*, 47-65.
- Dawson, P. C. (2002). Space syntax analysis of Central Inuit snow houses. *Journal of Anthropological Archaeology*, 21, 464-480.
 - Dursun, P. (2007). *Space Syntax in Architectural Design*. In: 6th International Space Syntax Symposium, 1-56.
 - Eid, D. K., Shehayeb, D. & Yaldiz, Y. (2004). *Determinants of Activity Patterns in Egyptian Homes: A space syntax analysis of use*, Paper to be presented at the ENHR Conference July 2nd-6th 2004, Cambridge, UK..
 - Haeri Mazandarani, M. R. (2008). *Home, culture, nature. First edition*. Tehran: Urban Planning & Architecture Study and Research Center.
 - Hamedani Golshan, H. (2015). Rethinking the theory of “space syntax”, an approach in architecture & urban design; Case study: House of Borujerdi Kashan. *HONAR-HA-YE-ZIBA*, 20 (1), 85-92.
 - Haq, S. (1999). *Can Space Syntax Predict Environmental Cognition*. In F. Holanda (Ed.), *Space Syntax Second International Symposium*. Brasilia, Brazil: Fundacao de Apoio a Pesquisa do Distrito Federal.
 - Haq, S. & Zimring. (2003). Craig Just down the road a piece :The development of topological knowledge of building layouts. In: *Environment and Behavior*, 35, 132-160.
 - Haq, S. & Zimring, C. (2003). Craig Just down the road a piece: The development of topological knowledge of building layouts. *Environment and Behavior*, (35), 132-160.
 - Heydari, A. A., Ghasemian Asl, I. & Kiaei, M. (2017). Analysis of the spatial structure of traditional Iranian houses using the space syntax method (case study: comparison of houses in Yazd, Kashan & Isfahan. *Iranian Islamic City Studies Quarterly*, 7(28), 21-34.
 - Hillier, B. & Hanson, J. (1984). *The Social Logic of space*. Cambridge, Uk: Cambridge University Press.
 - Hillier, B. & Sahbaz, O. (2005) High Resolution Analysis of Crime Patterns in Urban Street Networks: an initial statistical sketch from an ongoing study of a London borough. University College London, UK.
 - Hillier, B. (2007) *Space is the machine: a configurational theory of architecture*. London: Space Syntax.
 - Hojjat, M. (2002). *An introduction to the book “Architecture and the Secret of Immortality”*, (M. Qayyomi Bidhendi, Trans.). Tehran: Shahid Beheshti University.
 - Hojjat, I. (2005). Man-made identity, identity maker (a reflection on the relationship between identity and architecture). *Fine Arts*, (24), 55-62.
 - Hojjat, I. (2012). *Hojjat’s speech in architecture class, master of architecture*. Faculty of Architecture and Urban Planning, Isfahan University.
 - Hosseinpour Fard, M. A. (2012). *Housing typology as an architectural design process* (case example: Najaf Abad city). (Unpublished Master Thesis in Architecture). Islamic Azad University, Department of Science and Research, Tehran, Iran.
 - Ismaili, M. (2005). *Najafabad education in the context of history*, Isfahan: Ghazal.
 - Jeong, S.H & Ban, Y. (2011) computational algorithms to evaluate design solutions using space syntax. *Computer-Aided Design*, 43, 664-676.
 - Jiang, B., Claramunt, C. & Klarqvist, B. (2000). Integration of space syntax into GIS for modeling urban spaces. *International Journal of Applied Earth Observation and Geoinformation*, 2(3 & 4), 161-171.
 - Kamalipour, H., Memarian, Gh. H., Fayazi, M. & Mousavian, M. F. (2012). Form composition & spatial configuration in native housing: Comparative comparison of guest space arena in traditional houses of Kerman. *Housing and Rural Environment Quarterly*, 31(138), 3-316.
 - Karbasi, A. (2019). *Forty houses: Body and life in forty historical houses of Najaf-Abad*. Tehran: Publications of the Organization of Cultural Heritage and Tourism.
 - Karlen, M. (2009). *Space Planning Basics*, 3rd Edn, John Wiley and Sons. New Jersey: Inc.
 - Kelark, R. & Paz, M. (2008). *Examples of architecture*. Tehran: Saede.
 - Klarqvist, B. (1993). A space syntax glossary. *Nordisk Arkitekturforskning*, 2.
 - Khalili, F. (2007). *Canals and irrigation network in Najafabad city*. Isfahan: Golban.
 - Lima, J. J. (2001). Socio-spatial segregation and urban form: Belém at the end of the 1990s. *Geoforum*, 32(4), 493-507.
 - Madahi, S. M. & Memarian, Gh. H. (2018). Reading the link between the spatial organization of the house & the way of life in native architecture (case study: Beshravieh city). *Housing and Rural Environment Quarterly*, 37(164), 69-84.
 - Memarian, Gh. H. (2002). Syntax of architectural space. *Soffeh*, 12(35), 75-83.
 - Montello, D. R. (2007). *The Contribution Of Space Syntax To A Comprehensive Theory Of Enviromental Psychology*. Proceedings of the 6th International Space Syntax Symposium, _I stanbul, iv-1-12. Retrieved from http://www.spacesyntaxistanbul.itu.edu.tr/papers/invitedpapers/daniel_montello.pdf.
 - Mustafa, F.A. (2010). Using space syntax analysis in detecting privacy: A comparative study of traditional and modern house layouts in Erbil city. Iraq. *Asian Soc. Sci*, 6,

157-166.

- Nadi, M. R. (2002). *Traditional houses of Najafabad. Unpublished bachelor's thesis in photography*. Faculty of Fine Arts, University of Tehran, Iran.
- Navai, K. & Haji Ghasemi, K. (2012). *Clay and fantasy*, Tehran: Shahid Beheshti University, Soroush.
- Thungsakul, N. (2001). *A syntactic analysis of spatial configuration towards the understanding of continuity & change in vernacular living space: A case study in the upper northeast of Thailand*. Bell & Howell Information and Learning Company.
- Rapaport, A. (1969). *House form and Culture, United State America*. Milwaukee: University of Wisconsin.
- Saatci, M. (2015). *Spatial hierarchy on vernacular houses in Eastern Black Sea Region*. Turkey, Proceedings of the 10th International Space Syntax Symposium , pp: 101-117 .
- Satari Najafabadi, Z. (2012). *Improving the quality of the network of open spaces in Najaf Abad city with the approach of landscape ecology and the design of the central axis of the city*. (Unpublished master's thesis in urban design). Faculty of Fine Arts, University of Tehran, Iran.
- Tabatabai Molazi, F. & Saber Nejad, J. (2016). Analytical approach of the syntax (arrangement) of space in the perception of the spatial configuration of native housing in Qeshm (a case study of Laft village). *Housing and Rural Environment Quarterly*, 35(154), 75-88.
- Turner, A. (2007). from axial to road-centre lines: A new representation for space syntax and a new model of route choice for transport network analysis. *Environment and Planning B: Planning and Design* , 34(3), 539-555.
- Wineman, J., Peponis, J. & Conreoy Dalton, R. (2006). Exploring, Engaging, Understanding in Museums. In C. Hölscher, R. C. Dalton, & A. Turner, *Space Syntax and Spatial Cognition –Proceedings of the Workshop held in Bremen 24th September 2006* (pp. 33-53). Bremen: Universität Bremen.
- Yazdanfar, S. A., Mousavi, M. & Zargar Daghigh, H. (2009). Analysis of the spatial structure of the city of Tabriz in the bar area and using the Space Syntax technique. *Road and Construction Monthly*, (76), 19-58.

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