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# Explaining the Dialectic of Discontinuity and Interconnection in Contemporary Residential Architecture of Tehran based on the Evolution of Open and Closed Spaces*

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## ABSTRACT

With the rise in land value and its commodification in the contemporary era, the area of houses has been gradually reduced, and the houses with courtyards have been turned into small apartments. Hence, the residents' relationship with nature in the yard and the outdoor space, as a public space, has faced substantial changes. The contemporary residential architecture of Iran has redefined its relationship with the outdoor space more than anything in the transition from tradition to modernity and has explored a new way of dialectic discontinuity and interconnection. Therefore, the research question is the relationship between the parameters of the discontinuity and interconnection and the prominent patterns of the contemporary housing of Tehran based on the role of the closed and opened spaces. The current research aimed to study the relationship between the parameters of the discontinuity and interconnection in the prominent patterns of the contemporary residential architecture of Tehran, including three patterns- traditional (courtyard at the early Qajar era), traditional-contemporary (villa houses with a courtyard in the first and second Pahlavi era), and contemporary (apartments after the Islamic revolution)- based on which the dialectic of discontinuity and interconnection in the open and closed spaces can be explained. Various parameters of the discontinuity and interconnection of the houses in Tehran and the space syntax features were identified using valid library studies and the qualitative descriptive research method. Then, the relationship between the various parameters of the discontinuity and interconnection and the indicators of the space syntax were studied using logical reasoning. The case studies in the experimental theorem of logical reasoning were analyzed using pairwise comparison in the analytical hierarchy process by Expert Choice. Also, the parameters of the discontinuity and interconnection on the three main patterns were evaluated using the space syntax method by DepthMap software in the analytical theorem. The results of analyzing the Iranian human's interaction with nature in the modernization processes show that the open and semi-open spaces in the residential units have lost their nature than in the past.

**Keywords:** Residential Architecture of Iran, Contemporary Architecture of Tehran, Dialectic of Discontinuity and Interconnection, Open and Closed Spaces, Internal and External Relations.



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## 1. INTRODUCTION

With the rise in the land value and its commodification in the contemporary area, the area of houses has been gradually reduced and the houses with courtyards have been turned into small apartments. Hence, the residents' relationship with nature in the yard and the outdoor space, as the public space, has experienced substantial changes. The relationship between the interior and exterior, which leads to the spatial continuity, is a feature applied in the structure of the space and the boundary between the exterior and interior and can be considered an architectural capability to develop a limited space and its relation with other adjacent spaces (Kiani Behjou & Rasiani, 2016, p. 54). Some scholars believe that the past architecture of Iran has released the space, unlike the contemporary architecture that captures it (Haeiri, 2009, p. 14). In other words, in the past, the built space has not dominated the human while the experience of creating the built space in contemporary Iran is otherwise and solid and hard walls, floors, and ceilings are the priority (Keramati, 1386, p. 2).

Since a house is a place where the maximum presence of the human in the space occurs, and a space that experienced the maximum pattern changes in its spatial organization, studying the dialectical relationship of the discontinuity and interconnection in the residential samples is of great importance. On the other hand, Tehran, as the capital of Iran in the contemporary era, is where the first western achievements entered to create the revolutionary and hasty changes in housing. The origin of the evolutions in housing in Tehran must be traced to the Qajar era when Naser al-Din Shah Qajar aimed to develop the city (Agha Latifi & Hojjat, 2019, p. 44). As a result, the applied changes gradually affected other cities as well. Thus, analyzing the evolutions in Tehran can pave the ground for understanding the general evolutions in other cities of Iran. By accepting the fact that the change in the pattern of the open and closed spaces and their interrelationship led to the change in the system of activities in the residential houses, analyzing the spatial connections in the house is one of the most important implications, which has been raised in the current research and is assumed that by a comparative study in the different patterns of the house, the evolutional trajectory of this concept can be analyzed in different formation periods of the architecture of the Iranian houses. Accordingly, after introducing the dialectic process and how the discontinuity and interconnection occur in the open and close spaces regarding the human-nature environment, the parameters of discontinuity and interconnection in the residential land use were extracted. Then, the changes were analyzed in three periods of Qajar, Pahlavi, and after the Islamic Revolution in three principal patterns of these periods each of which represents other numerous built buildings in Tehran, by establishing the relationship between the components of the space syntax method. Thus, the research questions are as follows: how is the dialectical relationship between the discontinuity and interconnection defined? What are the main contemporary housing patterns of Tehran? What is the relationship between the discontinuity and interconnection parameters and the prominent contemporary housing patterns of Tehran based on the role of the closed and open spaces?

## 2. RESEARCH BACKGROUND

Most research on housing is often conducted in typology. Typology is the classification of the works based on their prominent features and determining the different types. In the typology of housing, the spatial, functional, and social relations and aspects were the most significant factor in the formation of the various types. Some of the important studies on architecture were investigated in terms of the human-nature relationship presented in Table 1. In another class of the housing studies, the housing and home were considered in terms of sociology, phenomenology, or anthropology that are included in the qualitative studies. Table 2 presents the most important studies conducted in these two areas.

**Table 1. Analyzing the Previous Studies in the Architecture of Housing Regarding the Exterior and Interior Spaces**

| Researcher | Research Title | Results |
|---|---|---|
| (Memarian, 2008) | Introduction with the residential architecture of Iran: Introvert and extrovert typology | He studied the residential typology of the different houses in Iran based on the various features, including spatial relationship and formation. |
| (Haeiri Mazandarani, 2009) | House, culture, and nature | Different types of space organization on the micro and macro scales were studied regarding the analysis of the architectural and cultural features of the historical houses of Iran and their adaptation to contemporary architecture over the past fifty years. |
| (Khakpour, Ansari, & Taherian, 2010) | Typology of the historic houses of Rasht | Four types of historical houses are introduced by studying the physical components and elements of Rasht houses based on the elongation, function of the open and closed spaces, and form. |

| Researcher | Research Title | Results |
|---|---|---|
| (Ghasemi Sichani & Memarian, 2010) | Typology of the houses of Qajar Period in Isfahan | The results showed that the houses of Isfahan have been built extrovert using the components of the hot and arid climate, and can be divided into three types of first, second, and third Qajar periods in terms of the features of the architectural space, structure, and decorations. |
| (Soltanzadeh, 2011) | The role of geography in the formation of different types of courtyard in the traditional houses of Iran | The results showed that the formation of the open spaces or courtyard in the traditional houses of Iran was affected by the geographical phenomena. |
| (Hariri, Zare, & Naghizadeh, 2012) | Nature-courtyard relationship (with a review on the Iranian housing architecture, Kashan) | The houses with central courtyards in Kashan were studied, and the ratios of the coverage lot and different elements, such as the fountain, green space, and yard of the house, were analyzed to each other, and a pattern for the formation of the yard in the new houses was proposed. |
| (Kamalipour, Memairan, Feyzi, & Mousavian, 2012) | The formal combination and spatial configuration in the vernacular housing | The study classified the vernacular housing in terms of form in a case study in Kerman and studied the spatial configuration regarding the zoning of the guest space in the traditional houses in Kerman. |
| (Nikghadam, 2013) | The pattern of the semi-open spaces in the vernacular houses of Dezfoul, Boushehr, and Bandar Lengeh | This study considered the open and semi-open spaces the influential factors in the formation of the climate patterns of the vernacular houses in terms of local climate components and revealed that the application of these patterns in the design of the contemporary housing of this climate could lead to the improvement of the thermal comfort. |
| (Asefi & Imani, 2016) | Redefining the design patterns of the desirable Iranian-Islamic housing: a qualitative evaluation of the traditional houses | The results of this study showed that there is a significant relationship between the quality of the traditional houses, architecture, and the past lifestyle, which originates from the original values and traditions. |
| (Khameneh Zadeh, 2017) | The concept if privacy and its realization in the life-world of the Iranian house | The results show that the one-dimensional approach to the spectra nature of the privacy in each group of houses understudy has led to the removal of part of the territories and has led to the more manifestation of the individual and collective identity of the residents of each house in each group of these houses. |
| (Agha Latifi & Hojjat, 2018) | Investigating effectiveness of the physical changes on the concept of the house in the contemporary eras | This research described the changes in the concept of the house in the contemporary era from the Tehrani residents' point of view and stated that the meaning of the house was a manifestation of the semantic meaning rather than material or physical meaning. Also, the qualities of the house have been declined in the past decades based on the residents' opinions, and the concept of the house has relied on quantities than qualities. |
| (Tabatabei & Fazli, 2018) | Narration of the house: a method to understand and represent the desirability of the lived experience in the house | The results show that the features, such as the continuity of the interior and exterior time in the lived experience, its tangibility and being imaginary, results in introducing the narrative understanding as a proper ground to study the desirable lived experience in the house. |
| (Kiyayi, Soltan Zadeh, & Heidari, 2019) | Investigating the flexibility of the spatial system of the houses in Qazvin | This study showed that the effect of the spatial system on creating the flexibility of the traditional houses was evaluated to be more than in the traditional-contemporary and contemporary houses using the space syntax method. Also, most of the contemporary houses with any area have the same flexibility in their spatial system. |

**Table 2. Investigating the Previous Studies of the Different Sciences on House and Exterior and Interior Relationship**

| Scholar | Scientific Branch | Research Title | Results |
|---|---|---|---|
| (Fakouhi & Ghaznavian, 2012) | Anthropology | Anthropological investigation of the desirable spatial diversity from urban residents' opinions of Tehran, Alborz, and Qazvin | The result was proposing a cultural model for spatial diversity and variety, indicating that the built houses between 1970-1990 meet the residents' needs culturally. However, the built houses in the recent decade that are designed based on engineering and have design plans have relatively lower desirability. |
| (Schulz, 2013) | Architect and Theorist | The concept of dwelling; towards the Allegorical architecture | He presents philosophical perceptions and profound analysis of the relationship between human, built space, and nature in this book. He knows the love of place and earth as part of being-in-the-world and prefers it to technical matters. |
| (Bachelard, 2013) | Philosopher | The poetics of space | In the phenomenology of illusion and imagination, he introduces the house as a tool to analyze the human spirit and seeks to show how the non-material parts attached to the material and objective parts of the space function. |
| (Hayward, 1975) | Psychology | The house as an environmental and psychological concept | He presents a list of the meanings attributed to the house, including the physical structure, territory, and a specific place in the world, self, and identity. |
| (Marcus, 2006) | Architect | The house as a symbol of self | He introduces the house as a symbol of self and reflection of the inner world, thoughts, values, and world view of the residents. |
| (Rapoport, 1969) | Theorist in Behavior and Environment | Culture and form of the house | He states that the aspects of the culture of the house are twice as important as other aspects. |

The stated research that is a part of the conducted foreign and domestic studies on the house show that the house is of significant importance and can be studied from different aspects and with various approaches. Extracting the parameters of the discontinuity and interconnection based on the users' criteria for using the space and their perception of the environment in the interdisciplinary area of architecture and social sciences makes the current research necessary to complete the previous research. Furthermore, in analyzing its relationship with the components of the space syntax, the current research reads the structural and physical evolutions of the house in the contemporary area by relying on the human's presence in the space and his/her lived experience, as well the dialectical matter of the evolution of the discontinuity and interconnection.

## 3. RESEARCH METHOD

The current research was based on logical reasoning and a case study using a qualitative approach. Most of the studies that used logical reasoning tend to a series of the existing knowledge, known or factors that have been neglected and integrate them in a unit frameworks that have a remarkable and novel expletory capability (Groat & Wang, 2013, p. 341). The current study also attempted to explain some of the principles ruling the space layout in the architecture of Iran from its particular perspective. In this regard, the subject was studied by selecting the samples of the housing that can well represent the historical periods of the architecture of Iran. Groat and Wang know the main components of logical reasoning, including the definition, relationship, and expression, that the current study also follows the same system. In the theoretical foundations of the research, the definitions were provided. Then, using logical reasoning, the parameters of the discontinuity and spatial interconnection were identified and extracted from the valid resources, as presented in Table 3. Also, the relationship of the parameters with the considered patterns was analyzed in pairwise comparison using the Analytic Hierarchy process in Expert Choice Software as presented in Figure 9. The relationship between the parameters of the discontinuity and interconnection and the qualitative criteria in the spatial arrangement of the selected patterns was investigated by analyzing the maps of the selected residential buildings in Depth Map software using the Space Syntax method as presented in Table 8. Thus, the total of the conducted analyses could explain the dialectic of the discontinuity and interconnection in the case studies based on the relationship between the open and closed spaces. Figure 1 presents the research process.

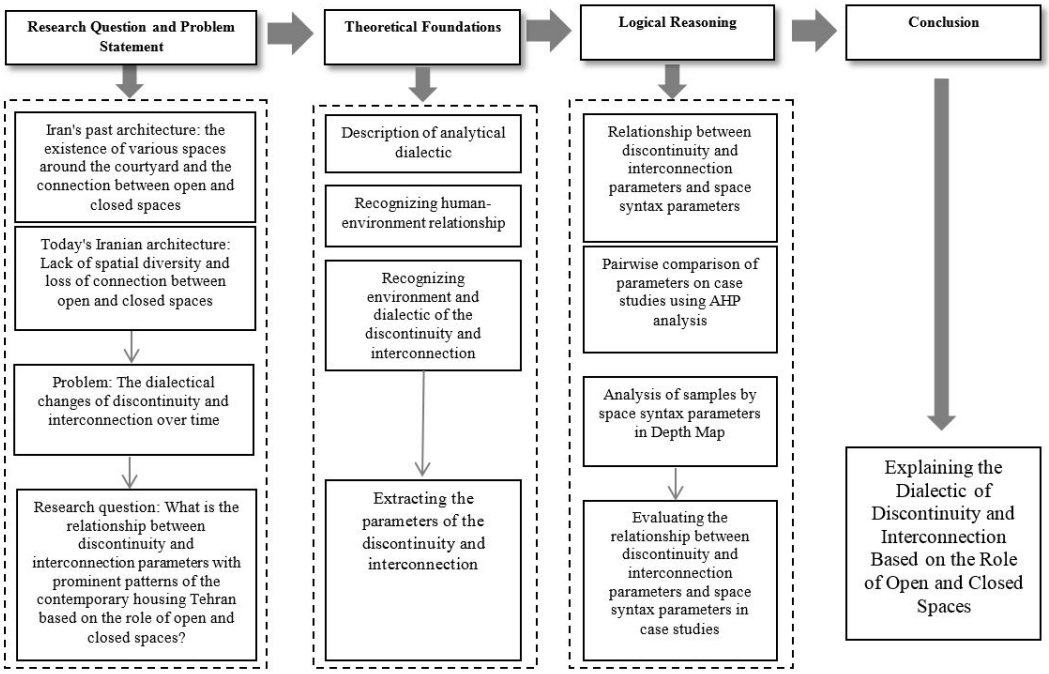



**Fig. 1. Model of Research Method and Process**

## 4. THEORETICAL FOUNDATIONS

This section explained the analytical dialectic. Then, the human-environment relationship was studied. In the following, the environment and the dialectic of the discontinuity and interconnection of the human and environment regarding the open and closed spaces (interior and exterior) have been described. Finally, the parameters of the evaluation of the discontinuity and interconnection dialectic and the analytical indicators of the structure of the space in the space syntax method and the relationship with the parameters of the discontinuity and interconnection were presented from authors' opinions.

### 4.1. Analytical Dialectic

Dialectic has several constituent and principal elements. First of all, dialectic has always been based on the process and cannot be considered without it. Dialectic is a movement of being; thus, conceptualizing is a part of implicit and natural meanings in the dialectic discourse (Tanhaei, 2015). Dialecticians believe that the elements of life are born from each other. Having this perspective, dialectic does not consider anything stable, and all the elements are moving, and evolution occurs by encountering these elements with each other. Therefore, the dialectic is not a specific form of the movement in which the elements are not necessarily in contrast to each other but, it is any kind of movement which is in contrast with each other, and this contrast is one of the principal concepts of the dialectic. This contrast leads to establishing the interaction between the elements. Therefore, action somewhat leads to the changes, resulting in the evolution; finally, all these elements have the totality. These are the four features of the main analytical concepts of dialectic.

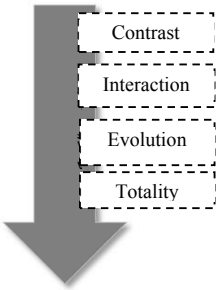



**Fig. 2. The Main Cconcepts in the Analytical Dialectic Process**

### 4.2. Human-Environment Relationship

Human perception and recognition of the environment are formed due to establishing a relationship between the surrounding environments (interaction). However, the surrounding environment means a combination of the natural environment and built environment that have interaction with each other. The result of

the interaction between three components, human, natural environment, and built environment, forms the human's life. Therefore, there must always be an interaction between these three elements to establish the balance in the form and function of the living space (Keramati, 2007, p. 6). The desirable situation is when these three elements are simultaneously in the same place to be able to be continuously in a proper dialectic.

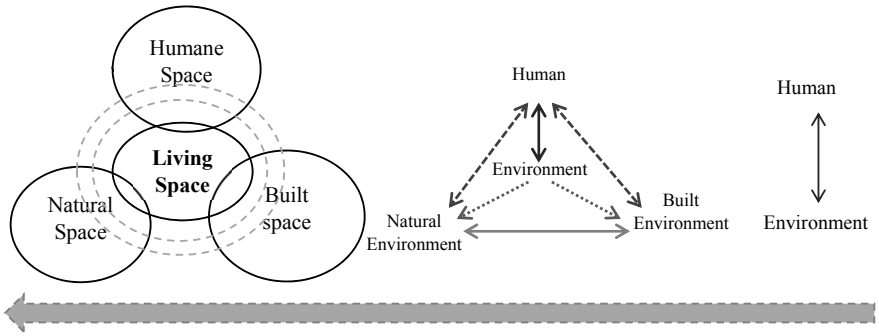



**Fig. 3. The Role of the Living Space in the Human-Environment Interaction**

The human being's relationship with his/her surrounding environment is subject to a set of five senses. The environment is also recognized by elements each of which creates different perceptual feelings in the human. Therefore, as the first factor of relationship with the environment, the human being's sense plays a significant role. Thus, it can be said that feeling is a stage that helps the human perceive the information from the environment, which is the first step towards perceiving the environment and entering the process of connection. If the human being or a space perceiver is considered the subjectivity and surrounding environment and the perceived space are considered the objectivity, the subjectivity-objectivity relationship is dialectic (Nasir Eslami & Sohangir, 2013, p. 86). The human-environment relationship also includes three main stages: feeling, perception, and recognition. Indeed, the human being can perceive the form based on the perceived information (feeling) and analyzes it, and the landscape is formed in his/her mind (perception). Then, the human evaluates based on complicated mental processes, and a mental image is formed in his/her mind (recognition) based on which, behaves in a particular way (Pakzad & Bozorg, 2016, p. 54). Figure 4 displays the principal stages of the human-environment relationship process.

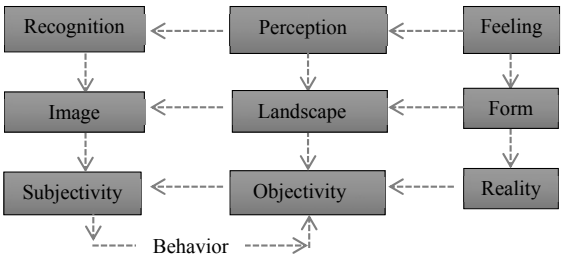



**Fig. 4. Process of Human-Environment Relationship**
(Pakzad & Bozorg, 2016)

### 4.3. Environment and the Dialectic of the Discontinuity and Interconnection of the Human and Environment Regarding Closed and Open Spaces (Interior and Exterior)

The dialectic forms of the discontinuity and interconnection in the residential buildings can be classified into four groups: between the indoor and outdoor space, between the interior spaces, in an interior space, in the exterior space of the building. Since the current research investigates the relationship between closed and open spaces, the first form of the dialectic forms of the relationship between the spaces is considered that will be explained in the following.

The dialectic between the interior and exterior spaces: in this form, the dialectic induces being inside to the human besides providing the development of the landscape and the optical opening. Some believe that no spatial issue is as inherent in the architect's work as the fact that he must see the inside and the outside as related. That is, he must consider the two as parts of a concept (Arnheim, 2013, p. 123). The human being needs both interior and exterior space, as well as the possibility to move between these spaces. The fundamental condition for human settlement is his proper definition of the exterior and interior. The cultural definitions, beliefs, and world view of humans lead to different perspectives on the interior and exterior (Schultz, 2013). Various architectural styles and cultural traditions might express the dialectic between the interior and exterior through various degrees of openness and enclosure (For example,

the impenetrable walls of medieval military castles against the window-filled walls of Renaissance castles) (Partovi, 2013, p. 94). Regardless of cultural or style description, the walls, floorings, and ceilings provide the conditions through which an interior area is formed between the exterior area the result of which is the settlement of the people and groups.

The definition of the space in Iranian architecture is based on the degree of coverage (to be limited). The degree of coverage or enclosure relates to the ceiling, flooring, and walls in determining the boundaries. The definition of the boundary of the architectural space is of significant importance. The boundaries create spatial order. Eventually, they determine the spatial quality, which is created by them. Meanwhile, the clearer the boundaries of the architectural space, i.e., the floor, wall, and ceiling, are defined, the better the space is understood (Kiani, Behjoo, & Rasitani, 2016, p. 54). Iranian architecture included three types of main open, semi-open, and closed spaces based on the definition of the boundaries. The combination of the three groups of open, closed, and covered spaces in this architecture are in such a way that they define each other, i.e., the open spaces define the closed space and vice versa. Meanwhile, the covered spaces are responsible for the transition space located between the open and closed spaces. It was common in most climate regions that the closed spaces are indirectly and generally related to the yard through covered spaces (Farrokhzad & Modiri, 2014, p. 86), and the spatial dialectic is established through this space.

### 4.4. Evaluation Parameters of Discontinuity and Interconnection Dialectic

By reviewing the resources of Table 1 and 2 and studying the opinions of scholars who investigated the architecture of the houses in terms of the spatial qualities, to investigate the spatial connection, leading to the dialectic of the discontinuity and interconnection of the human and environment through the open, semi-open, and closed spaces, we see terms that were used in the existing resources more than others. Terms, such as continuity, transparency, rhythm, axis, the extension of the activities, and in-between spaces, as presented in Table 3, were considered the parameters of the evaluation of the interconnection and discontinuity dialectic in the current study due to the maximum reparation in the resources. By reviewing these parameters in the case studies, the role of the open and closed spaces in explaining the dialectic of the discontinuity and interconnection of the human and environment in the selected buildings, each of which represented the sample of their period, was studied.

**Table 3. The Parameters of the Discontinuity and Interconnection Regarding the Open and Closed Spaces**

| Parameters of the Discontinuity and Interconnection | Description |
|---|---|
| Transparency of the Walls | The most significant factor in establishing the dialectic between two spaces is the transparency of their limiting surfaces. The transparency of the surfaces can be provided by installing openings, doors, and windows. If there is no opening in the surfaces that close the area, visual and spatial continuity will not be possible between the adjacent spaces. Simultaneously with establishing the relationship with the adjacent spaces, these openings can weaken the closeness of the space based on the dimensions, number, and layout. Furthermore, the openings can affect the orientation and continuity of the space, the light-absorbing quality, views, and the form of the function and movement in the space. |
| Axis | Axes show the directions and connect different elements. Hence, they are considered the reason for integration and spatial continuity. In a simpler sense, the axis connects and relates the spaces like a string. The axes can be defined in various directions. However, since the human's sense of direction is based on the vertical and horizontal directions, these two are often stronger and used by architects. Axis can be used to increase the different types of dialectic, including interior-interior and interior-exterior. Finally, it must be said that the axes are not necessarily direct rather they can change their direction along the way. |
| Rhythm and Repetition | Continuity is based on persistence and repetition. Repetition, as rhythm in the music or architecture, is a very simple principle of composition, trying to create a sense of integration and continuity. |
| Continuity of the Surfaces | The existence of the common elements between two spaces induces a sense of integration to the viewer. When the flooring, wall, or ceiling extend from a space to another, consequently, the two spaces continue in each other. |
| Thee Extension of the Activities | The extension of the activities has a sensory effect on the spatial integration in the audience's mind, which is not necessarily related to the physical extension of the spaces. Considering the similar activities for the adjacent spaces helps this phenomenon occur. |
| In-between Space | In-between space is one of the main factors of the integration, sequence, and spatial zoning of the architectural and urban elements through which plays a significant role in spatial organization. The existence of such space between the main spaces connects two spaces while separating two spaces among two interior spaces or interior and exterior spaces. |

### 4.5. Indicators of Analyzing the Space Structure in the Space Syntax and its Relationship with the Parameters of the Discontinuity and Interconnection

Analyzing the structure of each spatial configuration in the space syntax is conducted using the indicators by Visibility graphs, including connectivity, integration, and isovist. Each indicator in the space syntax method was first explained in Table 4, and then, their relationship with the indicators of the discontinuity and interconnection was described.

**Table 4. Indicators of Analyzing the Space Structure in the Space Syntax Method**

| Indicators of the Space Structure in the Space Syntax | Descriptions |
|---|---|
| Isovist | This indicator is evaluated in terms of physical and visual accesses. Visual access is called isovist, and physical access is named metric depth. |
| Integration | It is the degree of integration or separation of a space to other spaces in the configuration. |
| Connectivity | The connectivity means the number of links that are directly established between each space with other spaces. |

As presented in Table 4, there are three main indicators in the space syntax to analyze the spatial configuration. Visual access is one of the main indicators, which can be divided into physical and visual accesses. Visual access is called isovist in the space syntax, which is directly related to the transparency of the walls and movement axes, as the subclasses of the discontinuity and spatial link parameters. In space syntax software, isovist is studied in several stages. That is, the visual field of the ordinary human is precisely determined in each space, like a camera. The spatial area, which can be viewed by each viewer in each stage, can be analyzed using this indicator. The metric depth has a direct relationship with the parameters of axes under the parameters of the discontinuity and interconnection in the software; because the axes connect the spaces like strings and have different lengths. Furthermore, they can be defined in various directions. Integration, which determines the connectivity or the separation of each space to other available spaces in that configuration, has a direct relationship with the in-between spaces and continuity of the surfaces as subclasses of the interconnection and discontinuity. The in-between spaces, such as semi-open spaces and continuity of the surfaces in the ceiling, flooring, and walls, are the factors of linking the spaces. Therefore, integration is related to the indicators of the space syntax. Connectivity refers to the number of the links directly established between space and other spaces, and it has a direct relationship with the parameters of the extension of the activities, rhythm, and repetition; since establishing a direct link between the spaces provides the possibility of extending the activity, and such direct link can be established by the created repetition and rhythm in the space design so that such rhythm and repetition prevent from the separation of the spaces and link them directly. Quantitative components in the space syntax were used to analyze and evaluate the qualitative components of the discontinuity and interconnection in the current research, and the interrelationship between these components was explained in Figure 5.

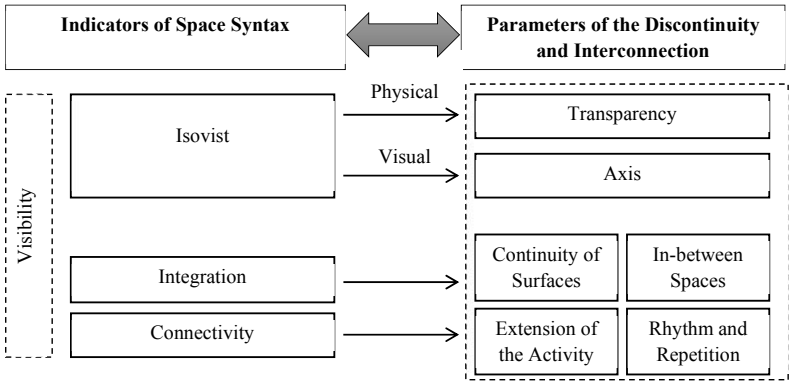


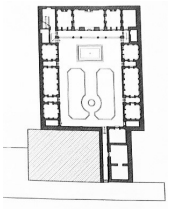
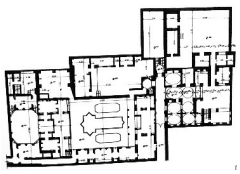
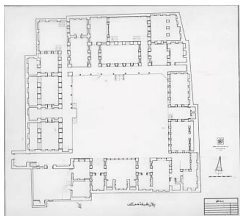
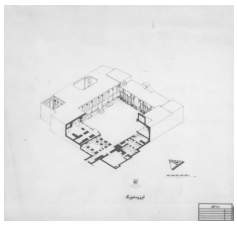
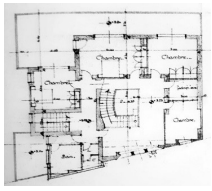
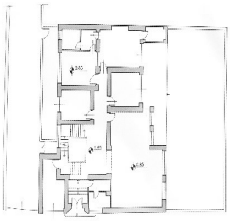

**Fig. 5. Explaining the Relationship between the Indicators of Analyzing the Space Structure in the Space Syntax and the Parameters of the Discontinuity and Interconnection**

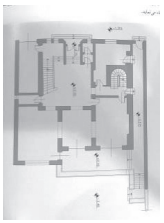
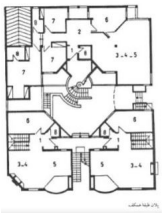
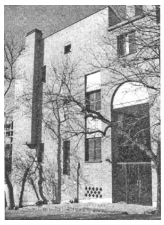
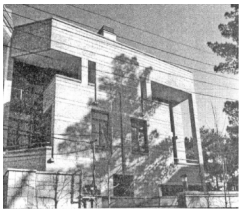
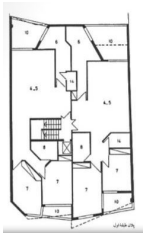
## 5. THE CASE STUDIES IN THREE COMMON TYPES OF CONTEMPORARY HOUSING IN TEHRAN (QAJAR, PAHLAVI, AFTER REVOLUTION)

In the current research, the contemporary era of Tehran includes the time of the last century. Reviewing the types of houses built during this century shows that Tehran experiences three main types of housing. The first type included the houses with central courtyards following the traditional architecture principles and has been called traditional type in the current study.

The second type was the transition from tradition to modernity, which gained a different form and is a combination of the past buildings with the western architectural principles, leading to creating relatively low-rise buildings with a one-sided yard. This type of housing has been called traditional-contemporary in the current research. The last type, which is called contemporary in this research, includes buildings built after the revolution in the form of apartments in plots of land with a 60% coverage lot that has continued to this day. Tehran experienced the first hasty evolutions of the last century due to its position as the capital of Iran. Numerous Qajar historic houses in the old neighborhoods of Tehran have been on the list of the case studies some of which were not available due to the loss of the required evidence. However, based on the information of the Organization of Cultural Heritage of Tehran, the Oudlajan neighborhood includes the maximum historic houses in the status quo. The case studies related to the Qajar period included in the traditional class of the current research were selected from this neighborhood. The case studies of the First Pahlavi and Second Pahlavi eras were also numerous selected among Paul Abkar's works; because the evolution period in Tehran was formed under the influence of his works and some other architects, such as Vartan and Gorakian, and alike. These case studies were included in the contemporary-architectural class. Finally, with the beginning of the construction of residential neighborhoods and apartments, the villas of the Pahlavi period were also considered dilapidated houses, or in the new replotting of the lands based on the 60% regulation, the new apartments were built that were included in the contemporary houses. Due to selecting the works of the Pahlavi era among the designed works by the architects of that period, the case studies after the revolution were also selected among the works of the architects of this period. Table 5 presents the considered case studies.

**Table 5. Introducing the Case Studies of the Research**

| Type | Name of the House | Description | Plan | Image |
|---|---|---|---|---|
| Traditional | Motamen House | Period: Qajar<br>Location: Oudlajan<br>Construction Year: 1883<br>Architect: Unknown |  |  |
| | Modarres House | Period: Qajar<br>Location: Oudlajan<br>Construction Year: NA<br>Architect: NA |  |  |
| | Dardashti House | Period: Qajar<br>Location: Middle Oudlajan<br>Construction Year: NA<br>Architect: NA |  |  |
| Traditional-contemporary | Mirdamadi House | Period: Pahlavi<br>Location: Taleghani Street<br>Construction Year: 1951<br>Architect: Paul Abkar |  |  |
| | Dr.Mosaddegh House | Period: Pahlavi<br>Location: Intersection of Felestin Street and Azerbaijan Street<br>Construction Year: 1951<br>Architect: Paul Abkar |  |  |

| Type | Name of the House | Description | Plan | Image |
|---|---|---|---|---|
| | Boulevard House | Period: Pahlavi<br>Location: Keshavarz Boulevard<br>Construction year: 1953<br>Architect: Paul Abkar |  |  |
| Contemporary | Kamraniyeh Residential Complex | Period: Islamic Revolution<br>Location: Kamraniyeh<br>Construction Year: 1991<br>Architect: Faramarz Sharifi |  |  |
| | Dibaji Residential Complex | Period: Islamic Revolution<br>Location: Dibaji<br>Construction Year: 1992<br>Architect: Faramarz Sharifi |  |  |
| | Shafaq Residential Complex | Period: Islamic Revolution<br>Location: Yousef Abad<br>Construction Year: 1981<br>Architect: Yousef Shari'at Zadeh |  |  |

## 6. DATA ANALYSIS

In the section, the data were analyzed using pairwise comparison. Then, by weighing and selecting the most preferred criterion, the criteria were ranked. In the next step, the criteria were analyzed on the houses understudy.

### 6.1. Analyzing Pairwise Comparisons

As previously mentioned in the research method, the analysis was conducted using two different analytical tools. First, analysis was conducted using pairwise comparison in this section. The obtained results from the pairwise comparison of the criteria and items were analyzed and extracted using Expert Choice software. In this research, the hierarchical design of the tree diagram used in the software is as shown in Figure 6.

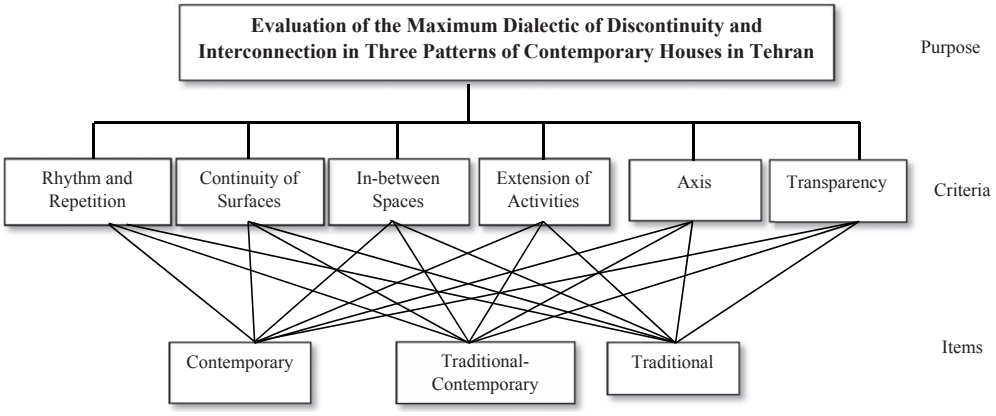



**Fig. 6. Tree Diagram of the Pairwise Comparison of the Criteria and Sub-Criteria**

## 6.2. Calculating the Weight and Selecting the Most Preferred Criterion

Given scoring through the elites' questionnaire among the 15 statistical population, including the architecture professors, six main indicators that obtained a score from 1-9 were compared. Considering the output of Expect Choice, a pairwise comparisons matrix of the main criteria was obtained as explained in Table 6 (Inconsistency Rate: 0.01).

**Table 6. The Output of the Weighing the Criteria**

| | transparency | Axis | Continuity of activities | Intermediate spaces | connectivity of surfaces | Rhythm and repetition |
|---|---|---|---|---|---|---|
| transparency | | 3.0 | 3.0 | 2.0 | 2.0 | 3.0 |
| Axis | | | 2.0 | 6.0 | 3.0 | 1.0 |
| Continuity of activities | | | | 4.0 | 2.0 | 2.0 |
| Intermediate spaces | | | | | 2.0 | 5.0 |
| connectivity of surfaces | | | | | | 3.0 |
| Rhythm and repetition | Incon: 0.01 | | | | | |

The values of Figure 6 show that the priority of the row index to the corresponding column index. The underlined numbers are the reverse situation, i.e., indicating the priority of the column to the row. Therefore, the main indicators were presented in Figure 7 in terms of preference (significance).


**Fig. 7. The Output Graph of the Results of Weighing the Criteria**

Figure 7 shows that the criterion of in-between spaces has had the maximum weight value and ranked the first in the comparisons among the selected criteria in the current research and based on the answers received from the questionnaires. Then, the criteria of transparency, continuity of the surfaces, extension of the activities, rhythm, and repetition, and axis ranked the second to the sixth, respectively. Table 7 shows the weight value of each criterion based on the numerical comparison.

**Table 7. Ranking the Weight Value of the Criteria**

| Row | Criterion | Weight Value | Rank |
|---|---|---|---|
| 1 | In-between Space | 0.371 | 1 |
| 2 | Transparency | 0.235 | 2 |
| 3 | Continuity of Surfaces | 0.171 | 3 |
| 4 | Extension of Activities | 0.099 | 4 |
| 5 | Rhythm and Repetition | 0.063 | 5 |
| 6 | Axis | 0.061 | 6 |

Based on determining the weighing of the indicators in the result of the pairwise comparison among the items, the pattern of the traditional houses with the value number of 0.556 obtained the maximum dialectic of the discontinuity and interconnection among the three main patterns with the acceptable inconsistency rate of 0.03 as presented in Figure 8.

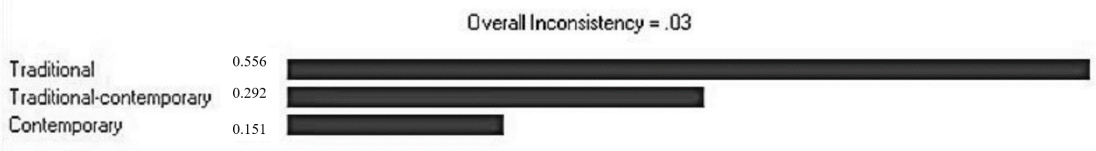



**Fig. 8. The Final Comparison between the Three Patterns of the Contemporary Houses of Tehran Based on the Criteria**

In the sensitivity graph in Figure 9 obtained from the software, the position of the patterns can be compared regarding the indicators.

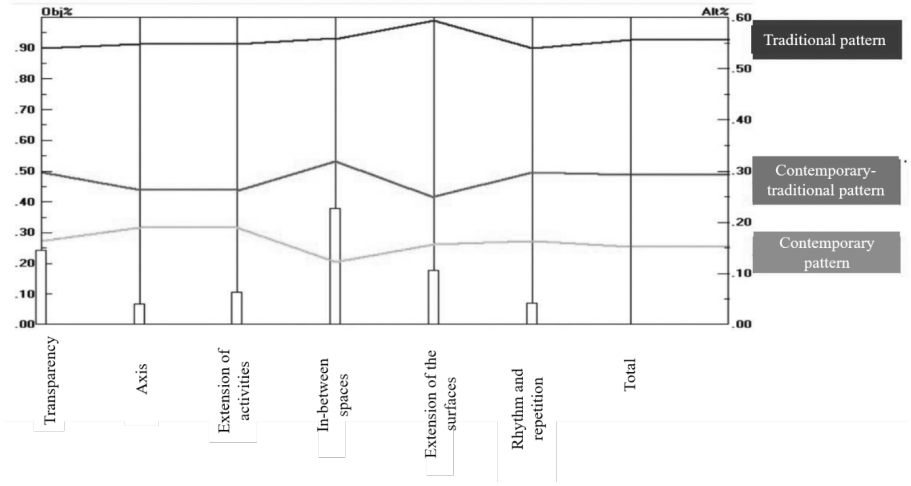
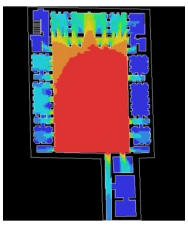
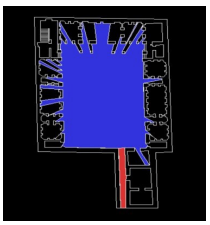
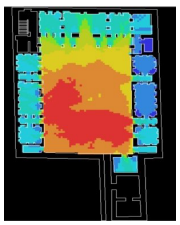
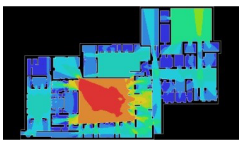
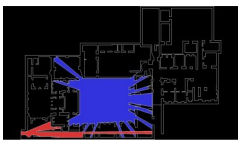
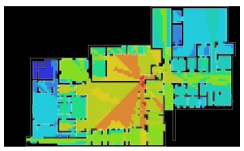
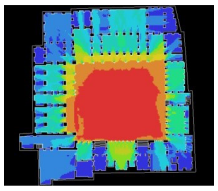
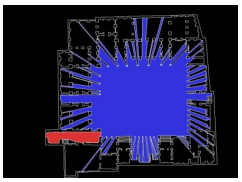
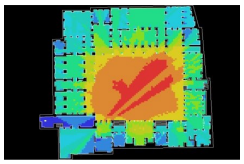
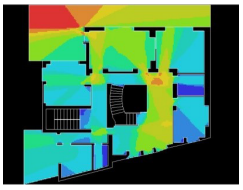
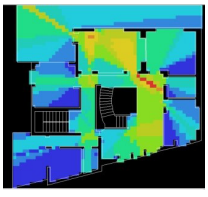
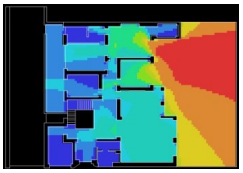
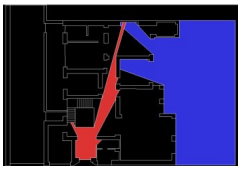
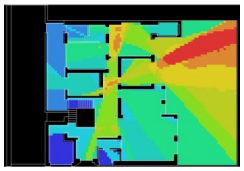


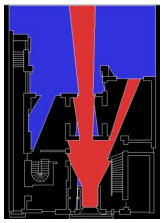
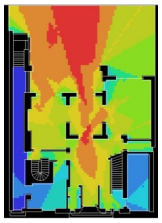
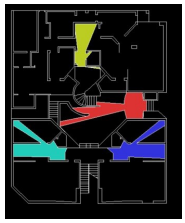
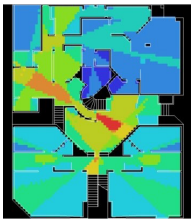
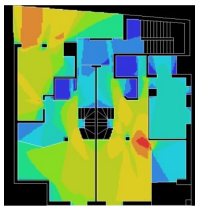
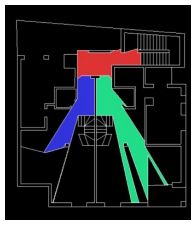
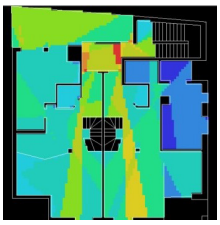
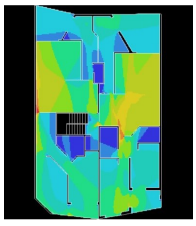
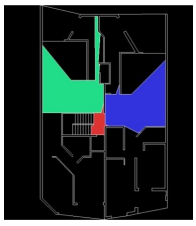
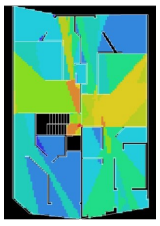

**Fig. 9. Ranking of the Dialectic of the Discontinuity and Interconnection in Three Main Patterns of the Contemporary Houses Based on the Weight of the Criteria**

### 6.3. Analyzing the Indicators of Space Syntax

In this section, the main indicators of the space syntax in Space Syntax Software and their relationship with the criteria of the discontinuity and interconnection as previously explained were studied in the case studies displayed in Table 8.

**Table 8. Analyzing the Indicators of Space Syntax**

| Characteristics of Samples | | Indicators of Space Syntax | | |
|---|---|---|---|---|
| **Pattern** | **House** | **Connectivity** | **Isovist** | **Integration** |
| Traditional | Motamen House |  |  |  |
| | Modarres House |  |  |  |
| | Dardashti House |  |  |  |
| Traditional-contemporary | Mirdamadi House |  |  |  |
| | Dr. Mosaddgh House |  |  |  |

| Characteristics of Samples | | Indicators of Space Syntax | | |
|---|---|---|---|---|
| **Pattern** | **House** | **Connectivity** | **Isovist** | **Integration** |
| Contemporary | Boulevard House |  |  |  |
| | Kamraniyeh Residential Complex |  |  |  |
| | Dibaji Complex |  |  |  |
| | Shafaq Residential Complex |  |  |  |

In the analyses obtained from the software, in the sub-set of the connectivity, by comparing the three selected patterns, it can be said that the courtyard and surrounding semi-open spaces in the housing pattern of the Qajar era were the reason for extending the activities to the centrality of the courtyard until diminishing this possibility in the private spaces. The spaces specified by red indicate the maximum connectivity and those with a blue spectrum have the weaker connection. Therefore, the mixture of the activities was possible due to the open space of the courtyard in the mass of the plan. Furthermore, the rhythm and repetition played a significant role in this connectivity; because as it is evident in the plans of this period, the spaces around the courtyard did not have a diversity in terms of form and were repeated around the yard. The decline in the area of the red surfaces in the housing pattern of the next period indicates the decline in the spatial connection in the patterns of this period due to the shrinking and declining courtyard. Such spatial connection was slightly more in the houses of the contemporary-traditional pattern due to the relatively large porches than the contemporary pattern. However, in the contemporary pattern, these connections have become either too small or transferred inside the single units; so that the connection between the neighborhood units is to be established, indicating the poor presence of the common activities between the neighborhood units in terms of human interactions. Reviewing the presented analyses obtained from isovist explicitly shows the transparency of the space and movement axes in the triple patterns; so that the possibility of the vast visual view to the surrounding space of the yard has been possible by a visual field of the 360-degree rotation of the human around himself in the courtyard of the traditional pattern and does not block the viewers' view. This analysis was evaluated at the two points in the center of the plans (in traditional-contemporary pattern, contemporary pattern, and division space) and the entrance of the building. Blue in the traditional pattern shows the view from the center of the space, and red indicates the view from the entrance of the building. In the traditional-contemporary pattern and contemporary pattern, the red color shows the view from the division space in the plan, and green, blue, or yellow colors indicate the view from the entrance of the residential units. Comparing these three patterns shows that in the traditional pattern, the view from the entrance is accurately limited and does not intrude on the private spaces; however, in the traditional-

contemporary and contemporary patterns, sometimes, we see that there is a great view to the plan, indicating the undefined axes that have neglected the spatial privacy at the entrance and provide an undesirable view to the depth of the semi-private spaces, such as hall and guest room.

The final indicator of the sub-set of the resulted graphs indicates the spatial integrity, which is directly related to the parameters of the in-between spaces and continuity of the surfaces. This indicator shown in red displays the spaces establishing the maximum number of visual links with the adjacent spaces. In the traditional pattern, this link can be seen inside the courtyard that is a public space. Also, in the contemporary-traditional pattern and contemporary pattern, these spots can be seen in the division space between the units or their entrances, indicating the loss of integration inside the units so that the red spot in the two former patterns has not been shown in any unit, indicating the decline of integration between the interior spaces of the units. The spots of the yellow and orange spectra in the patterns, such as the Shafaq residential complex in the contemporary pattern, present the integration between the spaces. However, its diminished color compared to the red spots in the traditional pattern indicates the weakening of this link yet its broadness on the surface. Based on the given descriptions regarding the relationship between this indicator and the parameters of the in-between spaces and continuity of the surfaces, it can be said that the in-between spaces were limited to the division space between the units in the traditional-contemporary pattern and contemporary pattern, and the lack of such spaces inside the residential spaces of these two patterns indicates the decline in the integration of the spaces.

## 7. DISCUSSION AND CONCLUSION

Given two quantitative analyses on the qualitative parameters in the dialectic of the discontinuity and interconnection, both analyses emphasized the importance of the role of the in-between spaces in establishing the proper dialectic between the environment and humans. In the first analysis, which addressed the pairwise comparison of the parameters, considering determining the weighing of the indicators in the result obtained from the elites' questionnaire, in-between spaces obtained the maximum weight. As a result, selecting among three items of the selected residential patterns of Tehran, including the traditional pattern of the Qajar period, the traditional-contemporary pattern of the Pahlavi period, and contemporary pattern of the era after the Islamic revolution, the pattern of the traditional houses with the weight of the 0.556 obtained the maximum dialectical relationship of the discontinuity and interconnection between three main patterns with acceptable inconsistency rate of 0.03. It indicates that this pattern has properly functioned due to using the broad open-space as the courtyard and semi-open spaces as porch, which is the mediation in establishing the relationship with the closed spaces of the rooms; so that, it has gained the maximum dialectic of the discontinuity and interconnection.

Furthermore, by formal analysis of the plans using space syntax method in Depth Map software, it was revealed that in the pattern of the Qajar period in the case studies, connectivity, isovist, and integration are at a higher level than the other two patterns by showing broader red spots than other patterns. The reason was the central courtyard and the possibility of integrating the spaces through open, semi-open, and closed spaces. In the traditional pattern, the spectrum of red to blue can be seen from the center of the plan to its surrounding in the sub-set of the connectivity, as one of the indicators of the space syntax. This spectrum shows that the connectivity of the spaces has also been established through in-between spaces from the public areas to the private spaces. In the traditional-contemporary pattern, this spectrum has been displaced, and the open spaces have been relocated to the one side due to removing the central courtyards that generally have lost their previous function in the traditional pattern. Also, the semi-open spaces of the porch have turned into sleeping porches with a view towards the alley and street rather than to the plan. Due to transferring these spaces to the bodies of the buildings, the red can be seen as the connecting surfaces in this area. Also, the color spectrum of this connectivity, which was seen in the previous pattern, cannot be observed in the plan of these patterns where the red color is in the center. In the sub-set of the isovist, due to the in-between spaces connecting the open and closed spaces in the traditional pattern, the view from the entrance, displayed by the red color, was limited. It indicates the isovist of the 360-degree view of the viewer from the entrance of the building. Also, this view does not intrude on any of the private spaces. However, in other patterns, this level of view could intrude on the private and semi-private spaces. In the traditional-contemporary and contemporary patterns, red was displayed as the view from the division space of the units, and yellow, green, and blue show the view from the entrance of each residential unit. In the sub-set of the integration, as one of the indicators of the space syntax, it can be seen that the red spots in the traditional pattern have the maximum area. Its reason is again the central courtyards, which facilitated the integration between the spaces. These sports have been faded or lost in the second and third patterns.

## 5. FEATURES OF SAFAVID AND QAJAR ARCHITECTURE AND ART

By the advent of Shah Abbas monarchy, the authority of the central government increased, the safety of the roads increased and the rich businessmen demanded for houses

with high-quality materials. The portal of the houses was the symbol of owner's richness. The pool is one of the most important elements of Safavid architecture which was commonly used for ablution in Muslims' houses. Existence of plant and water makes the place more pleasant. The pool is located in front of the alcove to rarefy the air before entering into the alcove. The alcove has a cross plan and is covered with vault. In this period, the decorations were generally brick marquetry, Sashes, Gereh, Plastering and Graffiti. These graffiti were used in the period of Shah Abbas in order to compete with the European palaces. In Muslims' houses, the plant motifs were used while in non-Muslims' houses, including Armenian houses, human motifs were used (Chehrazi, 2015, p. 5). The motif of flowers and bushes was developed in the Safavid period and paintings on pen-cases, the mirror frames, pictures and oiled covers had gradually become popular. In this period, trees (place of birds) were painted out of the symmetrical axis and composition of motifs was active and animated. Another feature of Safavid motifs is the use of various birds.

## 8. CONCLUSION

Finally, it can be concluded that establishing different dialectics of the discontinuity and interconnection was affected by the diversity in the mass-space relationship in three types of the stated contemporary houses resulted from the relationship between the open, semi-open, and closed spaces. The central courtyard in the traditional pattern leads to creating the spatial diversity in the formation of the open, semi-open, and closed spaces, which was diminished by the transition from the tradition to modernity, and the human-environment relationship was gradually turned into the discontinuity between the human and environment. The best way of human-environment relationship is the two-way relationship so that the human can affect the environment and vice versa, the result of which is creating the sense of the presence for the space user, which is twice more important in the residential land use. The discontinuity of the human and the environment leads to incomplete and inappropriate human perception of space, as a result of which housing, in the sense of dwelling, has become merely a house and is merely a shelter with no attachment and sense of belonging for human, as it has been in the past. Hence, the result of the research shows that the connection between the human and the environment depends on the proper use of open and closed spaces and the importance of semi-open spaces. Providing solutions to strengthen the discrete relationship between the human and the environment through the role of open and semi-open and closed spaces or investigating why and how the concept of housing has transformed into a home under the influence of the dialectical change of discontinuity and interconnection can be suggested as future research.

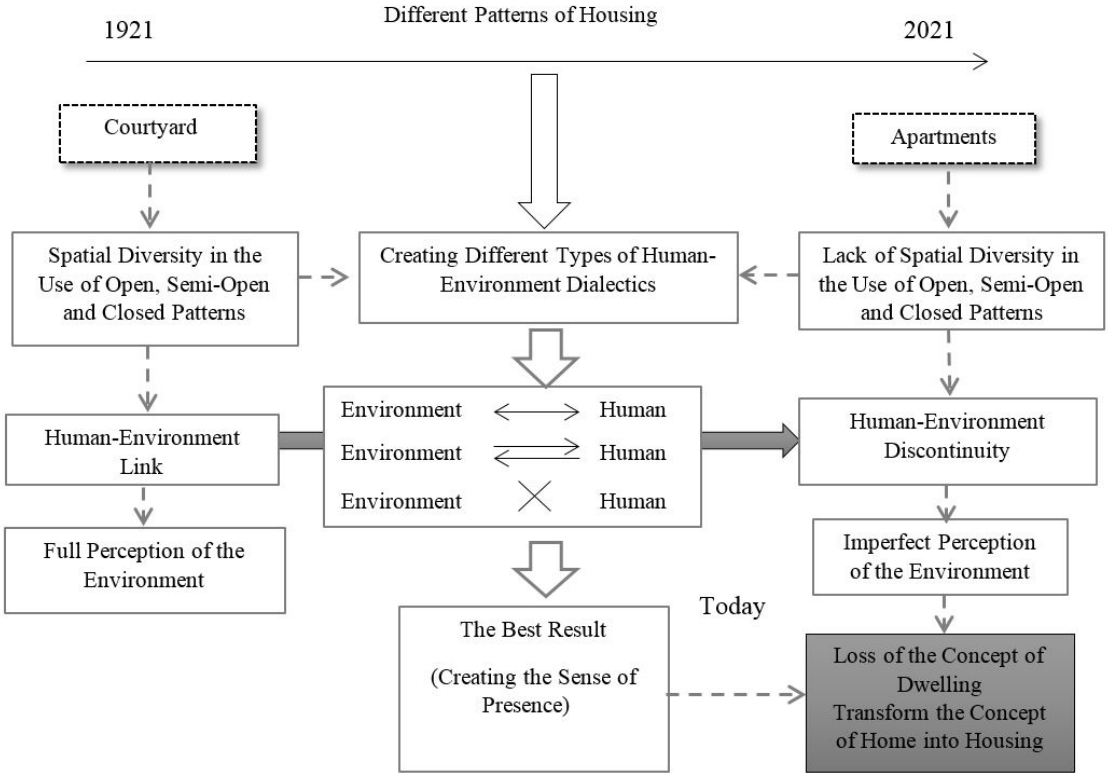



**Fig. 10. The Raised Hypothesis for the Future Studies**

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