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A Critical Approach to the Experience of Home Attachment in Assessing Spatiality of Contemporary Iranian Housing

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Abstract

Place, as one of the basic concepts in architecture, is an area for habitation, relief, and tranquility. In other words, man chooses to live in a place and through a place. On the other hand, attachment to housing is an emotional bond between human beings and housing, which leads to a feeling of trust, security, and satisfaction. Therefore, the spatiality of housing is the subject of the present study, which aims to rethink the concept of dwelling and promote the experience of attachment in contemporary houses to evaluate the components that shape the spatiality and the physical approaches affecting it in study samples. The main research question is How are the shaping spatiality components in contemporary Iranian houses evaluated? The research method includes a combination of qualitative approach (descriptive-analytical method) to analyze and interpret library information about theories of spatiality and place attachment as well as quantitative/qualitative approach (logical reasoning method) and software based on the case study that is observed and analyzed with Depthmap computer simulator to study the spatial arrangement of five contemporary housing types in hot and dry climate cities. The samples include 10 outstanding residential buildings from 5 types of garden villas, single-unit attached houses, multi-unit attached houses, apartment houses, and residential complexes in 4 cities with hot and dry climates. The comparison of housing types shows that courtyard houses have a better situation in terms of spatiality indicators, which are mainly related to the role of distribution areas such as courtyards and porches. In this way, removing the distributing role of the yard leads to a decrease in spatial coherence. Also, soft structures, obstacles, and physical interface elements play a major role in determining visibility level and people following and, accordingly, visual and physical enclosure.

Keywords: Iranian Housing; Spatiality; Place Attachment; Contemporary Housing; Space Syntax.

1. Introduction

According to Tadao Ando, the home is the most immediate environment related to the human being (Habibi et al., 2020: 228) and is an institution and structure to respond to a complex set of goals. Among the places types that make sense of human activities and continue them, the home is the most important place where put the flow of everyday life into itself. Therefore, the interest in the home and the sense of belonging to the residence place and its identity that provide trust and comfort to the residents is of great importance. "Home is one of the important topics of the phenomenological approach and the attitude of cultural paradigms that, like many other human-made complexes, has a dual nature of effectiveness and impressionability from culture" (Varmaghani, 2022). Today, human life is defined in houses that neglect the individual and social needs of users in their design and construction. So, there are many problems such as a lack of attachment and belonging and even peace and comfort (Rashid Kolvir et al., 2020: 196). Given the importance of the residence concept and the necessity of strengthening emotional bonds with housing, efforts to enhance the optimal quality within the architectural framework are remarkable. "What is emerging is that human-made environments, and especially contemporary housing in recent decades, have been distant from the indices of the inhabitants' fundamental needs provision and are incapable of responding to them" (Mirzamohammadi et al., 2020: 106). This study seeks to investigate the role of physical factors of housing on the spatiality and attachment experience; it has begun with the hypothesis that the study of spatial quality in different types of contemporary housing reveals differences and similarities in the way influence the spatiality indicators; that can be considered in the design of contemporary housing patterns. The purpose of the research is to investigate physical approaches to creating spatiality and place attachment in contemporary Iranian houses. It is also trying to evaluate the components that form spatiality in contemporary Iranian houses. The present study has used two quantitative and qualitative strategies. So the descriptive-analytical method and deductive and logical reasoning methods as well as library and documentary studies have been used to collect and analyze data. Depthmap and Agraph and Excel software have been used to analyze. Finally, after the evaluation process of analytical cases, the share of each building in terms of impressibility from the research indicators specified; and the reasons and causes of the creation or lack of it in the configuration of houses' plans are analyzed and deduced. The research questions are "Which physical approaches are involved in the creation of contemporary Iranian houses spatiality?" and "How are

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the components of spatiality evaluated in contemporary Iranian houses?"

2. Research Background

There has been a lot of research on the sense of belonging to the place and at the higher level of that, place attachment and in particular housing. Many of these researches, relying on the results of the questionnaire have categorized the indices of belonging sense to place; or, based on existing theories, they have explained the indicators related to the place. Table 1 offers the most important findings of some recent research related to the present study approach.

Table 1
Investigating previous research according to the research approach

Researcher	Year	The most important findings
Keshavarz Ghadimi, Tabibian & Moinifar	2022	There are differences between the components of a sense of place in real places and virtual spaces including indirect but powerful interactions and experiences, removal of temporal/spatial constraints, immersion instead of physical presence, and free and limitless communication in virtual media.
Moztarzadeh & Nikounam Nezami	2022	The physical component serves as a grounding criterion that affects the component of social sustainability. Social interactions, security and safety, place attachment, and sense of place have higher rankings that are effective in improving the physical quality of residential complexes.
Mirzamohammadi, Bagherzadeh & Zeynaly	2020	There is a significant relationship between the design of the sustainable residential complex with the emphasis on environmental psychology and the sense of belonging to the place. In other words, paying attention to the sense of belonging in design will lead to the sustainability of residential complexes.
Rashid Kolvir, Abbaszadeh, Akbari & Shahroudi	2020	Physical factors such as form and size, privacy, material type, and decorations are the most important indicators of a sense of belonging to independent houses, and access and spatial layout have more appearance in apartment houses. Non-physical factors such as activity and comfort, social and individual dimensions in apartment houses, and meanings and symbols in independent houses play an important role in increasing the sense of belonging to a place.
Soltani, Feyzi, Falamaki & Mahmoudizarandi	2020	The most important criterion in raising a sense of belonging to housing from the perspective of residents is the convenience and fondness for space, cultural signs, vitality, and visual quality. But from the designers' viewpoint, hierarchy and access are more important in the formation of a belonging sense.
Habibi, Fallahi & Karmirad	2020	The architecture of the Iranian house, by modeling traditional houses and recreation of central courtyard components, vestibule, and increasing efficient interface spaces, can increase the physical belonging sense of the residents.
Hojat, Mozafar & Saadati	2017	Being anchor, social dignity indicator, sweet memories bed, and the behavioral bed are the traits that offer guidelines for their creation and promotion increase the housing attachment likelihood.
Cheung & Hui	2018	The place shape is effective in creating the identity and perdurability of the place and provision of users' needs to places. The place shape influences attachment to it relying on the symbolic importance of the place as a container of emotions and communication and giving one's life a purpose and meaning.
Stedman et al	2017	The body, activity, and meaning and also compatibility of these three dimensions comprise the main formative elements of place identity.
Scannell & Gifford	2017	Enclosure and creating boundaries mean a process that forms the identity of the individual and the place, during which one's relationship with others is regulated and the experience of understanding oneself is provided.
Ujang & Zakariya	2015	The compatibility of shape, activity, and meaning is effective in creating the place identity and perdurability and providing users' needs to places.

The innovation aspect of the present study is to evaluate the indices of place attachment by focusing on the formal and spatial components in the organization and layout of different species of contemporary houses in a special climate. It uses specialized architectural software and quantitative/qualitative methods to measure the realization of the research approach in contemporary housing.

3. Theoretical Framework

Since the research approach is place attachment and spatiality, the theoretical framework is presented in three separate and hierarchical parts, including place, dimensions of spatiality, and then housing attachment indicators. These are also presented in four sub-sections and then their relationship with space syntax indicators is explained.

3.1 Place

The place is an important source of identity and community with severe emotional and psychological relationships between them (person-place) and the most effective identity factor. Phenomenologists consider place as a part of space has been given meaning, it is considered a place for events and happenings in life (Shahcheraghi & Bandar Abad, 2015: 260). The place belonging comprises a wide range of placelessness to severe Identification (Haghparast et al., 2019: 304). Heidegger (1971) believes that space takes its existence from the place and this is the place that gives existence to space. The place identity means specifying or distinguishing the place and its recognition basis that can cause trying to preserve and restore it (Ralph, 2017: 57). This concept is in relationship with people's emotions and affections about the place that

is different depending on the users' conditions, and the failure to confirm it will follow a type of non-place characteristic (Norberg Schultz, 2013: 40). Thus, experienced spaces are considered to be an aspect of existence and part of individual identity that is the result of a set of cognitions including memories, emotions, attitudes and values, preferences and ideals of behavioral concerning a variety of environments that shape individual experience.

3.2 Dimensions of Spatiality

In general, the body, activity, and meanings have been considered the main formative elements of place identity (Stedman et al., 2017: 52). Some researchers account only for the role of the place shape (Cheung & Hui, 2018) and others (Ujang & Zakariya, 2015; Stedman et al., 2017) account compatibility of shape, activity, and meaning, effective in creating place identity and its perdurability and providing users' needs to places. Punter believes that the physical criteria for evaluating the place's shape are perspective, constructing manner, and furniture (Punter, 2007: 168-170), and Castello accounts for forming factors such as nature (water, plant, sky) and activity factors such as private and public function and ownership effective in creating the place meaning (Its personality and authenticity) (Castello, 2016: 110-118). Indicators such as space order and cohesion, enclosure degree, and privacy have also been inferred as the most important figural factors (Steele, 1981). Stedman's studies on the physical dimension role of the place refer to its direct role in satisfaction and its indirect role in place attachment in the individuals' mentality, which are also influenced by the symbolic meanings of the place (Stedman et al., 2017: 52). In describing the place structure, Schultz introduces the first layer as physical characteristics in terms of being natural or artificial (natural landscape and artificial landscape) (Partovi, 2008: 80).

3.3 Housing attachment indicators

Housing attachment is the sense of one's symbolic relationship with her/his residence and includes the emotional and sentimental meanings that the inhabitants give to it (Simon, 2019: 123). The concept of place is often also emphasized on emotional dependence and is overshadowed by meanings. This concept, unlike space, is not abstract but full of current meanings and activities in it (Pakzad and Bozorg, 2015: 183). Users' attachment to the place is associated with their consciousness, memories, thoughts, and informed and unconscious beliefs about the shape and physical characteristics of the place. The physical attachment has been subjected by Riger and Lavrakas as being rooted and by Taylor as physical interaction (Sakurai et al., 2015: 423). Proshansky also described it as part of the individual and social identity of each person (Proshansky, 1978: 152). As a result, the physical space of the housing acts as a space system that affects users' interactions (Habibi et al., 2020, 231). In addition, attachment is crystallized in places with distinct definitions and personalities, and all the constituent elements of the environment, house structure, and landscape characteristics are considered (Altman & Low, 2012). The causer indicators of housing attachment include a wide range of physical factors that are categorized in the present study relying on the literature review in general in four subdivisions, including order and cohesion of space, spatial enclosure, nature perspective, and privacy. Theories about each of these four indicators and how it relates to the concept of place attachment are briefly presented.

3.3.1 Space Order and Cohesion

"Spatial Cohesion" is the hidden geometry that regularizes physical and non-physical architectural structure and gives meaning to the multilateral connection of the spaces with each other and also enables various experiences for human presence based on the definition and composition of space (Rapaport, 2019: 102). This indicator contains the sequence, spatial orientation, and succession of the areas that create order in the spatial structure of the housing (Ibid: 148-148). Space cohesion is the intermediary between the tangible and intangible aspects of architecture and will lead to the organization and formation of a structural pattern that has a concept beyond mere functionalism (Taghizadeh & Taghvaei, 2019: 96-95).

3.3.2 Spatial enclosure

The important point of the place has been known as its enclosure (Castello, 2016: 95). In Heidegger's expression, each space essence is defined by the presence of boundaries and converts to place (Khamenehzadeh, 2017: 33). In other words, the enclosure is the factor of defining the place and the sense of identity, and a sense of establishment within the defined space that induces security and convenience and follows attachment to it. The realization of the enclosure is in both shape and conceptual mode in terms of giving meaning to the place. Thus, the place form is effective in its attachment based on the symbolic importance of the place as a container of emotions and communications and gives one's life a purpose (Cheung & Hui, 2018: 40). This understanding of space is related to the place and human experience; so that Ralph also enumerate space to provide a platform for the place (Ralph, 2017: 11). The place ability for having boundary and being restricted make the sense of distinction, stability, and belonging to the public for the residents and gain the security and peace for life. A sense of distinction and stability requires the establishment of lasting boundaries and some non-penetrable; That is, more boundaries' transparency will lead to a better distinction.

3.3.3 Privacy

Privacy means separating from anything and extrication of perimeter environment (Khamenehzadeh, 2017) and means a process in which one's relationship with others is regulated and the self-awareness experience is provided (Scannell & Gifford, 2017). The result of privacy is a stayer around a person that is formed in response to the influence and the power of others and occurs more than any other place in the housing structure (Rapaport, 2019:

125). Privacy will lead to understanding the spatial differences of the place, which are the factors of place distinction and attachment to it (Counted, 2016). Privacy sense is achieved by controlling the private living environment and being empowered for social interactions. Therefore, the environment that is organized at different and controlled levels enables the process of achieving privacy. The separation of public and private areas and the continuity of movement sequences to facilitate the perception hierarchies of space are among the factors of emerging privacy.

3.3.4 Nature perspective

Place attachment and harmony with nature have been considered necessary for each other. In other words, the link with nature based on experience and practice will reduce the alienation feeling in the living complexes (Bell, 2008: 97). Phenomenologists such as Schultz and Pallasmaa, to promote the concept of residence, consider the presence of nature to be effective in place attachment of residence (Norberg Schultz, 2013; Shirazi, 2012: 63). Chermayeff and Alexander, referring to the separation of nature from contemporary human life and its consequent vacuity, describe intimate contact with nature as unparalleled joys (Chermayeff & Alexander, 2015: 54-43). In this regard, some scholars have dealt with indirect signs of nature, such as diversity and complexity, and have attempted to provide identity patterns to human-made places, inspired by natural processes (Proshansky, 1978: 160). Seeing a variety of natural landscapes will create a special sense of place and its impact; In contrast, restricting the landscape can cause a feeling of stenosis and discomfort that is against the spatial attachment (Simon, 2019: 45). Therefore, natural spaces, as the most beautiful and original, housing tangible product, in addition to maintaining residents' peace and tranquility, demonstrates their identity and appreciates redolence, dreams, and hope of residents to the best way through numerous components.

3.4 Syntactic Indicators of attachment assessment

Each of the creator indices of housing attachment is compatible and measuring with the indicators in space syntax theory. Thus, the "order and cohesion of space" is measurable with the "integration" indicator in Depthmap, which means "the limit of the relationship and connection of each point to the general system and the amount of access to it. More amount of integration has higher access "(Montello, 2007: 8). Space Syntax is capable of predicting the user's passage path with the help of "integration radius". A convex space map is used to measure the amount of integration in the Depthmap software. "There is no obstacle in a convex space and can be seen its all characteristics from any point in it (Hillier & Hanson, 1984: 104). The "space enclosure" can be examined in both subdivisions of the physical and visual enclosure. So that the "physical enclosure" is measured by the "gate count and people following" indicator, and "visual enclosure" can be measured with the "visibility" indicator in the Depthmap. Space traffic means the movement pattern in space and the possibility of crossing any space gate. "In the theory of natural movement, configuration alone by itself is the main factor of user guidance and can affect the spatial absorbent points' distribution pattern" (Hillier et al, 1993: 30). The visibility is directly related to the concept of forming the whole space in the mind and layout of adjacent parts (Hillier & Hanson, 1984). Therefore, a place that has high visibility is suitable for the establishment of spaces that need to be observed by the audience. "Privacy" will be measured through the "space depth" indicator concerning "number and connection of space" and ultimately the "nature perspective" is evaluable with the use of the "Isovist" tool and examining the visual field area of the specified spatial steps and simulated plan of the cone of vision. Depth in space syntax means the number of steps needed to get from one point to the other points. "Less spatial depth represents the value of higher integration and space accessibility" (Haq, 2001, 4). Also, Isovist represents the visual field area to analyze environmental visual efficiency (Gibson, 2014); So that in each space stage, the exact range of observer vision is determined. The indicators of each of these factors are presented in Figure 1.

4. Research Methodology

The research method includes a combination of a qualitative approach to analyze and interpret library information on spatiality and place attachment theories, as well as a quantitative/qualitative approach and software based on the case study. It has been observed and analyzed with a computer simulator as well as Agraph software to investigate the spatial layout of five contemporary housing species in hot and dry climate cities. Then, through a comparative study and logical reasoning, the factors affecting the spatiality of contemporary housing have been evaluated and deduced. Thus, the present study has used two methods consisting of "descriptive analytical" and "deductive logical reasoning".

4.1 Method of selecting cases

The range of the case selection is outstanding residential buildings in the solar 90s, in various cities of hot and dry climates. The selection criterion is the highest variety in the plans' organization, as well as the feasibility of measuring the spatiality indices deriving from the literature review in the spatial configuration of analytical cases. Another criterion was the availability of maps and design ideas and the possibility of photographing houses, and the other was the relative differences in the way they deal with space so that the use of different design elements and different ways of creating space could be evaluated and compared with each other. And recognized their positive and negative results in the ability to emerge housing attachment indicators. Given the importance of climate and habitat in the design method, this factor was considered constant. Also, the outstanding cities of the hot and dry climate, including Yazd, Isfahan, Shiraz, and Tehran were considered in the cases selection. Thus, 103 outstanding buildings were identified in 4 selected cities

(4 in Yazd, 8 in Shiraz, 26 in Isfahan, and 65 in Tehran). And among them, the plans were identified and selected with different types of spatial layouts. So that in Yazd, despite the small number of outstanding cases that were built in the 90's, 3 buildings were selected in 3 modes (1. Central courtyard 2. Introverted 3. L -shaped); And in Isfahan, due to the approximate similarity of many cases and accordingly receiving the same results, among 26 existing cases 4 in 3 modes (1. Porous 2. Lengthy 3. Stepped with multiple terraces 4. Minimal with two units per level) were selected. To achieve more accurate results, houses were categorized into 5 species of garden-villas, single-unit connected to the urban context, multi-unit connected to the urban context, and apartment and residential complexes. And according to the above criteria, two samples were selected from each group, including 3 in Yazd, 4 in Isfahan, 2 in Tehran, and 1 in Shiraz.

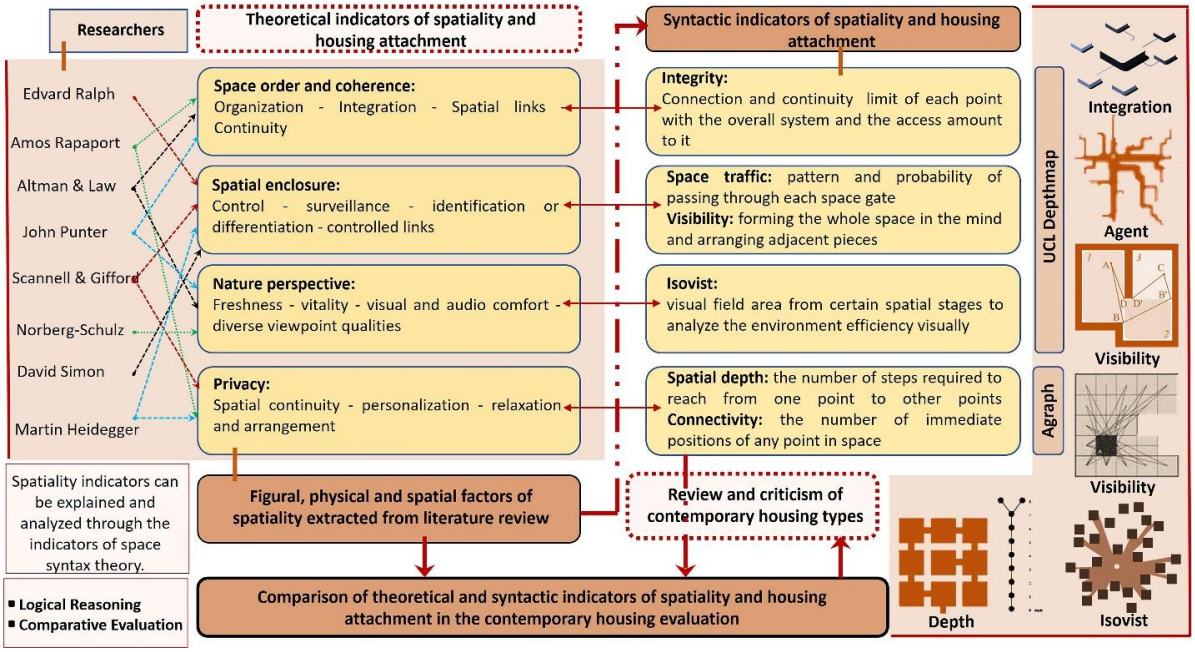


Fig. 1. Physical indicators of evaluating spatiality and housing attachment based on literature review

4.2 Data analysis method

Data analysis was performed by comparing the spatiality indicators (space order and cohesion- enclosure- privacy- nature perspective) with space syntax indicators (integration-visibility- spatial traffic- mean depth- Isovist). Thus, the order and cohesion of space with integration measurement, visual enclosure by using visibility indicator, physical enclosure with space traffic indicator, privacy with mean depth and number of connections, as well as the number of space and ultimately the nature perspective with the Isovist tool were evaluated in two spatial steps in analytical cases. To compare the samples in terms of the four indicators of spatiality and housing attachment, the software output values were first normalized and then compared in the bar chart. And the share of each building was determined in terms of the research indicators' influence and the reasons and factors for creating or not creating it in the configuration of the houses' plans were analyzed and deduced.

4.3 Introducing the case studies

Yazd Home (Year 2012) with an area of 950 m2 with L -shaped plan is established on part of the old family's house garden in the Mehdiabad area. Creating privacy and separation of private and public territories, the viewpoint of the old garden, and considering to climate are the main ideas of building formation. The pomegranate garden house of the grandfather (2014-2017), with an area of 945 square meters in one of the 17 old neighborhoods of Taft city, is designed using the architectural patterns of the area, which is the second home and a place for family gathering. Yast Khaneh (2015-2016) with an area of 1300 square meters with an introverted design in the new context of Yazd City is a reconstruction project. The House of Numerous Yards with an area of 600 square meters (2017-2019) was built in Najafabad, Isfahan, with numerous courtyards to remind the houses of Safavid garden city. Nazar Mansion (2016-2019) with an area of 1150 square meters in the vicinity of Zayandehrood River has a river landscape and green spaces around that as well as noise pollution. Therefore, at different levels of the house, the courtyards are created in the heart of the building. One house, Two Generations, Three Units (2018), with an area of 1169 square meters, was built as three duplexes for three units and two generations of one family (mother, father, and two sons). These three volumes are involved from the inside so that the boys' duplex is directly related to the mother and father's duplex. The house uses traditional houses elements such as wooden shutters, ponds, and domes. Malek Residential Building (2013-2016) is located in the Malek neighborhood of Isfahan with an area of 850 square

meters with 90- and 180-meter units. The plan was designed to reduce individualism and eliminate the definitive separation of private and public realms. 144 House Apartment (2015) on a land of 268 square meters, was built in the Golshan garden area of Shiraz with different plans for each floor and used native materials and native architectural elements such as Badkhan. Khab-e-Aram Residential Complex (2014-2017) with a staircase design is located on a triangular plot with an area of 380 square meters. The staircase design plan with cellular structure and variation of even and odd floors has resulted in the formation of terraces facing the Zayandehrood River and the direct connection of all the microspaces of the house with the open space. Earrings Residential Building (2012-2016) was established on a land of 1281 square meters with the influence of Earrings novel and the use of nature, inspired by the simplicity and security of traditional houses. Numerous wooden terraces and balconies form the empty spaces of the building volume as a family living area. Figure 2 introduces the cases of study.

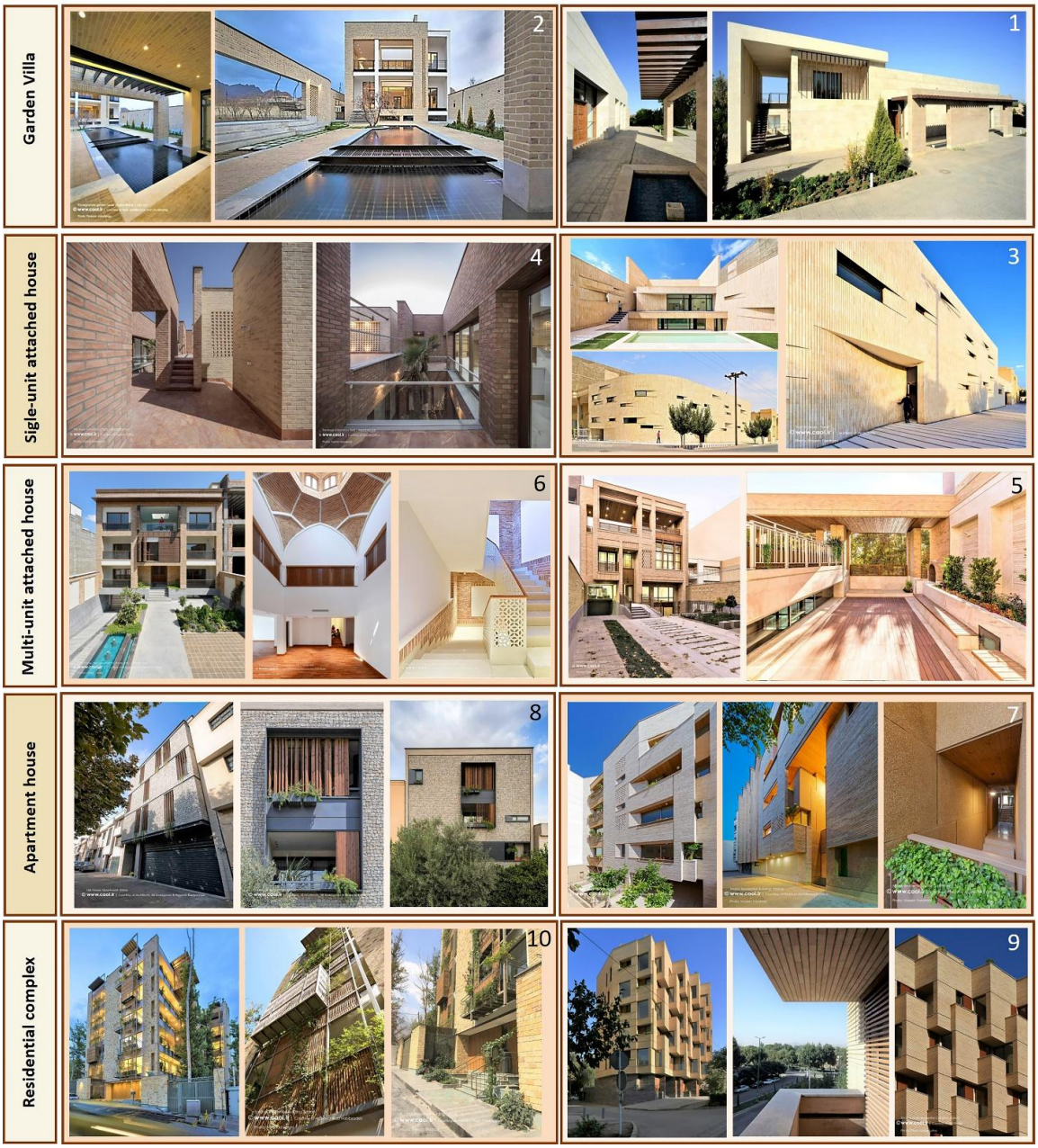


Fig. 2. 1. Yazd Home 2. Pomegranate garden house of grandfather 3. Yast Khaneh 4. The House of Numerous Yards 5. Nazar Mansion 6. One house, Two Generations, Three units 7. Malek Residential Building 8. 144 House Apartment in Shiraz 9. Khab-e-Aram Residential Complex 10. Earrings Residential Building
(Source: Author; http: //www.caoi.ir)

5. Results and Discussion

UCL Depthmap and Agraph software were used to measure spatiality indicators. Integration, visibility, and

possibility of circulation in the space (in Depthmap software) were chosen to respectively check the order and coherence of the space, visual enclosure, and physical enclosure. The isovist indicator was selected to evaluate the nature perspective and depth and connection indices (in Agraph software) were selected to evaluate privacy. Tables 2,3,4 show the degree of local and global integration based on the convex space map, the pattern of the probability of circulation in the space, and the visibility of the spaces on the analytical maps, and Table 5 contains the numerical values of the software output concerning each of these indicators.

Table 2
Comparison of order and coherence values of space based on local and global integration on the convex space map

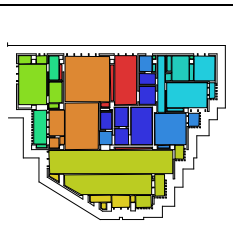
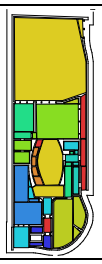
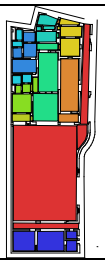
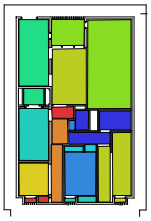
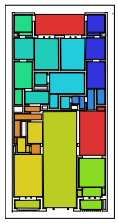
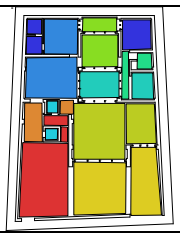
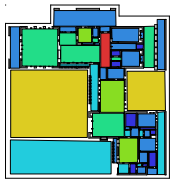
Residential complex	Apartment house	Multi-unit attached house	Single-unit attached house	Garden Villa
				
Khab-e-Aram Residential Complex / Isfahan	Malek Residential Building / Isfahan	Nazar Mansion / Isfahan	Yast Khaneh / Yazd	Pomegranate garden house of grandfather / Yazd
				
Earrings Residential Building / Tehran	144 House Apartment/Shiraz	Two Generations/ Tehran	The House of Numerous Yards/ Isfahan	Yazd Home house garden / Yazd

Table 3
Comparison of the physical enclosure amount in the movement pattern and the possibility of circulation in space (gate count indicator and people following)

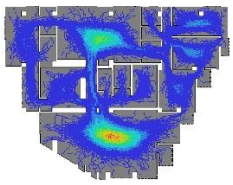
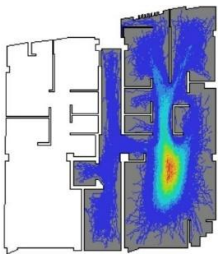
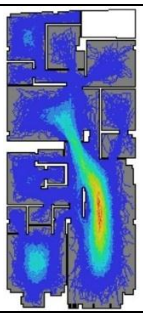
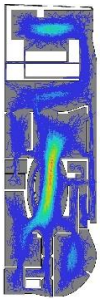
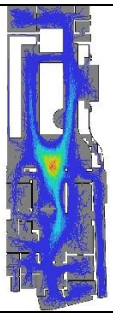
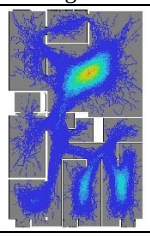
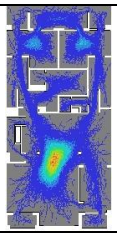
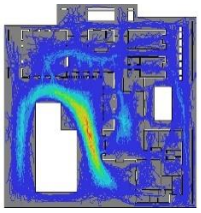
Residential complex	Apartment house	Multi-unit attached house	Single-unit attached house	Garden Villa
				
Khab-e-Aram Residential Complex	Malek Residential Building/ Isfahan	Nazar Mansion/ Isfahan	Yast Khaneh / Yazd	Pomegranate garden house of grandfather
				
Earrings Residential Building/ Tehran	144 House Apartment Shiraz	Two Generations/ Tehran	The House of Numerous Yards	Yazd Home

Table 4
Comparison of the visual enclosure amount based on the visibility measurement map

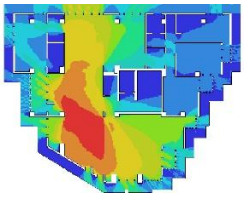
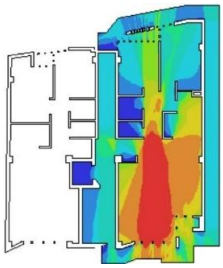
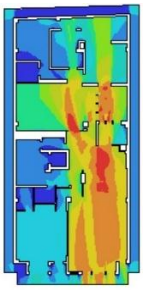
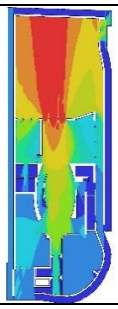
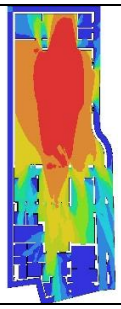
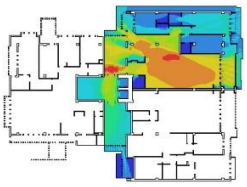
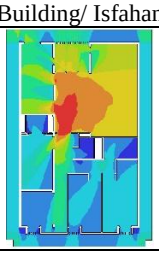
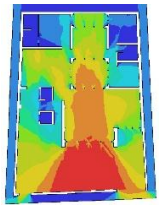
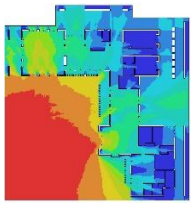
Residential complex	Apartment house	Multi-unit attached house	Single-unit attached house	Garden Villa
				
Khab-e-Aram Residential Complex	Malek Residential Building/ Isfahan	Nazar Mansion / Isfahan	Yast Khaneh / Yazd	Pomegranate garden house of grandfather
				
Earrings Residential Building/ Tehran	144 House Apartment/ Shiraz	Two Generations / Tehran	The House of Numerous Yards	Yazd Home

Table 5
Comparison of average values and normal values of two indicators of order and coherence of space and enclosure (visual and physical)

Housing type	Building's name	Visual confinement		Physical confinement		space order and coherence		
		visibility		gate count		global integration	local integration	
Garden Villa	Pomegranate garden house of grandfather	12091/1	0/58	12/725	0/22	0/719946	0/852129	17%
	Yazd Home	17103/4	1	12/0668	0/16	0/975872	1/10193	1
Single-unit attached house	Yast Khaneh	7023/35	0/16	12/8191	0/23	0/836765	0/933811	0/44
	The House of Numerous Yards	11289/2	0/51	14/1747	0/34	0/958829	0/978069	0/59
Multi-unit attached house	Nazar Mansion	6483/06	0/11	21/7625	1	0/733985	0/837744	0/12
	Two Generations	7020/34	0/16	10/1346	0	0/805702	0/907033	0/35
Apartment house	Malek Residential Building	11704/7	0/55	17/8717	0/00067	0/784764	0/911902	0/37
	144 House Apartment	7838/4	0/23	10/1425	6/79	0/774183	0/799128	0
Residential complex	Khab-e-Aram Residential Complex	5042/6	0	12/7452	0/22	0/641206	0/923081	0/4
	Earrings Residential Building	8648/17	0/29	16/6258	0/55	0/788817	0/888661	0/29

The integration values of courtyard houses show more amounts in the software output. The maximum amount of integration in Yazd Home is (1/10193) due to the way the yard is connected with the house's inner spaces. But the location and geometry of the Pomegranate Garden house grandfather and its four-sided neighbors are the main factors in reducing the order and coherence of the space (0/852129) compared to Yazd Home. Therefore, despite the central location of the yard, its distributor role has decreased as a result of few spatial connections from four sides. Also, the courtyard isolation in Yast Khaneh and its separation from other internal areas has reduced the role of this spatial element in improving the spatiality indicators. In other words, although the yard is effective in increasing the integration and spatial order, and coherence of the housing, the incorrect location and geometry will reduce its effective role. Examining the gate count indicator and people following in the space shows that the type of organization in multi-unit houses and apartments determines the maximum and minimum of this indicator. Multi-unit houses of Nazar Mansion and Malek Residential Building have high traffic compression and Two Generations house and 144 House Apartments have traffic scattering. Examining the plans shows that the

small number of spaces, the removal of obstacles, expansion, and the existence of long axial views have led to traffic compression in Nazar Mansion (21/7625) and Malek Residential Building (17/8717). And on the other hand, the existence of a dividing space as a stayer between the private and public areas in 144 House Apartment and the phasing of access to the areas in the Two Generations house has been effective in scattering traffic. In this way, the installation of stayers and spatial multiplicity reduces gate counts and increases physical enclosure. The visibility indicator value in Yazd Home, Pomegranate garden house, and Numerous Yards cases is high due to the wide area of the yard. So that this space has the highest visibility (red color) and on the other hand, and the inner private areas have the lowest visibility (dark blue color). The alternation of yards and the organization of porous space in The House of Numerous Yards causes patulousness and increased visibility. The viewing angles at the Isovist output of The House of Numerous Yards show the maximum nature perspective in this house, at the same time as the low level of open areas. However, this organizing way and increasing two indicators of visibility and visual field has led to the reduction of privacy and interference of realms that have reduced visual enclosure. Also, the examination of residential complexes' outputs shows the factors' roles such as “plan geometry” “meddle space” and “smallness of spaces” in the visual enclosure degree. So that the stepped geometry and the multitude of private areas with a small area have reduced the inner space visibility and at the same time increased the nature perspective. Locating the kitchen between the private and public areas (private living room/public living room) has reduced visibility (5042/6) and at the same time increased the functional efficiency of the house. Table 6 shows the amount of vision and visual angles from two spatial stages including the kitchen (K) and the main living room (L). Table 7 contains the Justified Plan Graph of analytical cases in Agraph software and Table 8 contains the numerical values of the output graphs as well as the Isovist value of the two spatial phases under investigation.

Table 6
Comparison of visual angles in nature perspective based on Isovist amount in the main areas of the house

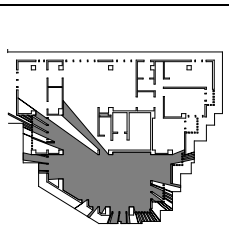
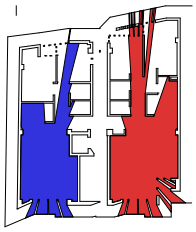
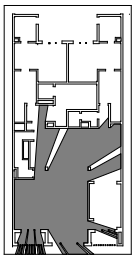
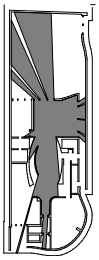
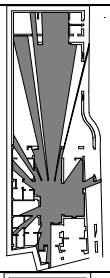
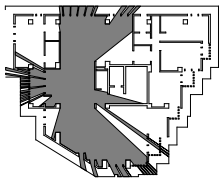
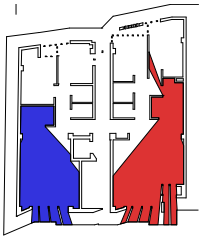
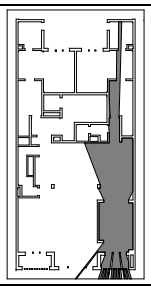
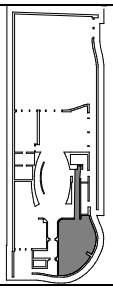
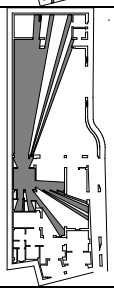
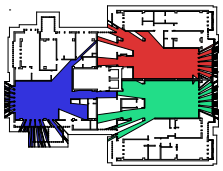
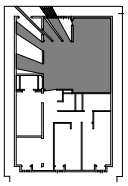
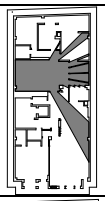
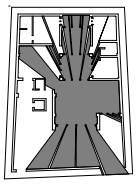
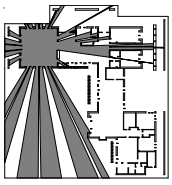
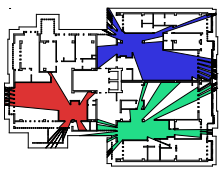
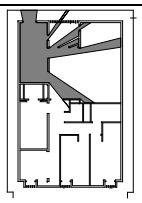
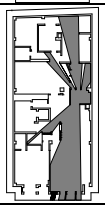
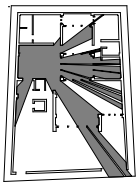
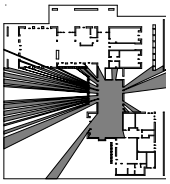
Space	Residential complex	Apartment house	Multi-unit attached house	Single-unit attached house	Garden Villa
Main living room (L)					
Kitchen (K)					
	Khab-e-Aram Residential Complex	Malek Residential Building/ Isfahan	Nazar Mansion/ Isfahan	Yast Khaneh / Yazd	Pomegranate garden house
Main living room (L)					
Kitchen (K)					
	Earrings Residential Building/ Tehran	144 House Apartment/ Shiraz	Two Generations/ Tehran	The House of Numerous Yards	Yazd Home

Table 7
Justified Plan Graph based on the plan of analytical cases

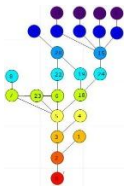
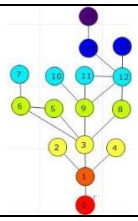
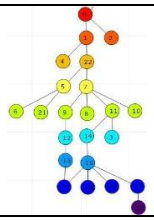
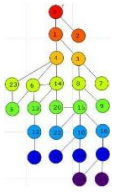
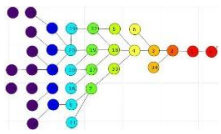
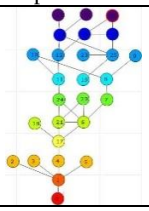
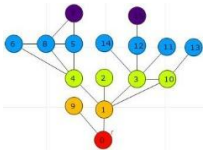
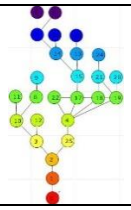
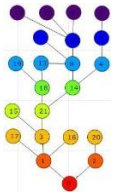
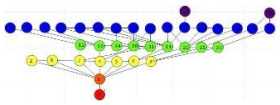
Residential complex	Apartment house	Multi-unit attached house	Single-unit attached house	Garden Villa
				
Khab-e-Aram Residential Complex/ Isfahan	Malek Residential Building/ Isfahan	Nazar Mansion/ Isfahan	Yast Khaneh / Yazd	Pomegranate garden house of grandfather / Yazd
				
Earrings Residential Building/ Tehran	144 House Apartment/ Shiraz	Two Generations/ Tehran	The House of Numerous Yards/ Isfahan	Yazd Home

Table 8
Comparison of the privacy amount based on the average and normal value of the mean depth and the number and connection of the space and the comparison of the perspective (main living room and kitchen)

Housing type		Residential complex		Apartment house		Multi-unit attached house		Single-unit attached house		Garden Villa	
Building name		Earrings	Khab-e-Aram	144	Malek	Two Generations	Nazar	Numerous Yards	Yast Khaneh	Yazd Home	Pomegranate
Mean depth		3/846	4/125	2/8	2/866	4/4	3/954	4/046	3/791	3/529	5
		0/47	0/6	0	0/03	0/72	0/52	0/56	0/45	0/33	1
connections		2/518	2/16	2/375	2/25	2/23	2	2	2/4	2/944	2/114
Number of spaces		27	25	16	16	26	23	22	25	36	35
Connection max		5	5	5	5	5	5	4	5	8	5
depth max		9	8	4	6	9	8	7	7	5	10
Isovist (Mean)	L	32/2%	27/8%	26%	37/4%	28/8%	19/8%	39/4%	31/5%	32%	39/7%
	K	30/9%	35%	13/6%	27/9%	14/5%	14%	27/6%	7/8%	20/8%	22/3%

The direction, angles, and the visual field area from certain spatial stages are effective on the number of spatiality indicators. The expansion of the visual field towards the inner and outer open green areas increases the nature perspective indicator and increases attachment, and on the other hand, the expansion of this view from the public and guest realms to the private space reduces the enclosure and spatiality of the housing. This indicator is the second lowest value (26 and 13.6) in the two spatial stages under investigation (main/common living room and kitchen) in 144 House Apartment. On the other hand, the small number of spaces has reduced the mean depth and the small number of spatial connections has reduced the integration, and as a result, it has reduced the privacy and the order and coherence of the space. Also, despite taking advantage of the introversion of the traditional house and reducing the visual field to the outside in Yast Khaneh, the sequence of open and closed spaces has not been paid attention to, which has led to a reduction of "nature perspective" indicator in both spatial stages. Regarding the role of the number of spaces and the number of connections in the spatiality of housing, the Pomegranate garden house's analysis shows that a large number of spaces has a direct relationship with the increase in mean depth and the maximum depth, while a low number of connections has reduced integration and spatial coherence. For the comparative evaluation of housing attachment indicators in the analytical samples, the normalized output values are presented in Figure 3.

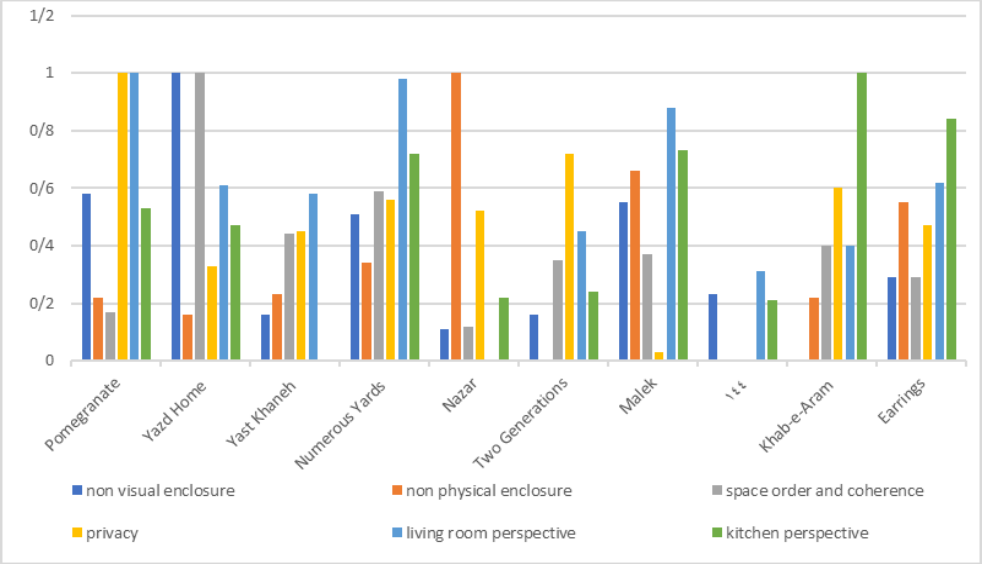


Fig. 3. Comparison of average values of spatiality indices according to normal data values

6. Conclusion

In response to the first research question, effective physical approaches in creating the spatiality of the contemporary house according to the literature review include four main factors of order and coherence of the space, enclosure (visual/physical), privacy, and nature perspective. According to the shape and software analyses of the study cases, they can be evaluated through multiple physical/spatial factors including spatial arrangement, multiplicity and sequence of space, border and obstacle, geometry and configuration, spatiality and contiguity, number of spaces, spatial communications. So that the creation of spatial arrangement and the multiplicity and sequence of space and considering the border and obstacle in the design of spaces will increase privacy as well as the spatial enclosure and as a result will be effective in improving place attachment and spatiality indicators. On the other hand, the direct adjacency of open and closed areas, according to the location of the spaces, in some examples has led to the reduction of enclosure (decrease of spatiality) and in others to the improvement of the natural perspective indicator (an increase of place attachment). The role of the number of spaces is closely related to the number of connections between them. So that increasing the number of spaces and decreasing the number of connections due to the opposite effect on each other, does not have a favorable effect on the overall improvement of spatiality indicators.

In response to the second question, the components that shape spatiality in five types of contemporary housing were investigated. In houses of types 1 and 2, the role of the yard's geometry and location in the connection and integration of the house spaces and consequently the spatial structure coherence was recognized as very important. In this way, the central position of the yard has played an important role in increasing place attachment due to the positive effect on the integration indicator and distribution. However, the analysis showed that the two factors of adjacency and function together can affect the role of geometry and location of the yard. This result is revealed in the courtyard of the Pomegranate Garden house despite the central location of it. Sequence and multiplicity of space in multi-unit houses have played a more important role in creating privacy. Also, soft structures, obstacles, and interface physical elements play a major role in determining the visibility level and the circulation possibility in the space (people following) and, accordingly, visual and physical enclosure. In other words, the existence of such structures and elements will have a positive effect on home attachment due to the increase in the enclosure, privacy, and independence of the spaces. The comparison of housing types shows that courtyard houses have a better situation in terms of benefiting from spatiality indicators which are mainly related to the distribution areas role such as yard and porch. In this way, removing the distributor role of the yard (Yast Khaneh) leads to a decrease in spatial coherence.

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