Formal-comparative Analysis of the Spatial Organization of Student Residence Halls Based on their Spatial Threshold Patterns (Case study: Girls Residence Hall Complex in Imam Khomeini International University of Qazvin)

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Abstract

Functional quality of the student residence halls has a great deal of importance due to their collective nature and the fact that they are considered as housing units, identifying and defining the role of intermediary spaces on the spatial organization and spatial consociation of student residence halls which is a compound system of masses and spatial borderlines can bring order to its system. This structure is defined through a hierarchy of transition spaces, between numerous external and internal factors and the interaction between the arenas and explains the thresholds in multiple orders, in the macro, meso, and micro scales. With an emphasis on the factors of spatial threshold in the student residence halls, the following study aims to refer to the impact of their presence on defining the subjective and physical borderlines in order to define local territories. In order to do so and in order to evaluate this concept with a qualitative method, after explaining the concepts of spatial threshold, at first it analyses the impactful physical factors on the spatial system of student residence halls and then there will be an analysis on two instances of residence halls in the residential complex of Imam Khomeini International University which includes linear arrangement and the other which possess courtyards using the opposition of space syntax and architectural concepts in some of the factors of spatial systems. Another tools of the research are field research and researching the environment, interviews and objective observations. Results of the study indicates an emphasis on the position of intermediary thresholds, especially the role of central courtyard on increasing the efficiency of student residence halls in respect to the prevalent linear instances because the existence of courtyard element in the spatial organization of the dwellings have caused an increase in the spatial threshold which itself have caused the rise in the spatial selection, permeability, increase in the intractability and according to the hierarchical characteristic of spaces in the structure of central courtyard, makes possible the development of borders within the arenas and separation of territories in different levels of the dwelling space for its inhabitants.

Keywords: Threshold, Spatial system, Student residence halls, International Imam Khomeini University, Qazvin

1. Introduction

We can consider the "collective residential environment" as a specific type of artificial environment, considering its central relationships with the elements of the space, place, and environment which acts as a context for the possibility of collective inhabitation by the human being in a certain section of time. Student residence halls are special types of "collective dwellings"; "Heterotopias" are among different methods of the dwelling. Using the name of the dwelling, the attention would be more directed to the "dwelling" place and can answer the needs of the residents more efficiently. In the compound structure of the residential environment, two objective-physical aspects (spatial organization) consist of its corporal structure and the subjective-semantic aspect, forms the resulting meaning between the central connection of the residents and the residential environment. Along with this study, the spatial structure of the dwellings which are surveyed with the categorization in the open, semi-open and closed spatial areas, there will be an effort to distinguish between the differences of behavioral patterns of individuals with different specifications in these spatial areas which lead to the definition of borders. Residents live in a complex collection of spatial pathways that gain spatial definition by visible borders and invisible territories. Spatial borders and territories are explanations of subjective and social barriers and the zones which construct the structure of the residential environment (Biarez, 1993).

Entrance "threshold" into these territories have specific spatial definitions, in a way that according to the urgency of blocking the unallowed entrance of others into the living spaces of people, control over the entrance of others in this area gains significance since the lack of attention to it would lead to the loss of personal identity of the residents. What is the role of spatial threshold in the student residence halls? How visible or invisible borders that separate between the people based on their spatial system (organization) have led to the development of different arenas in different levels and how it has established local territories following it? These are the main questions of his article which should be identified.

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This research aims to analyze the activities, behaviors and their reflection in the architecture of student residence halls from their dwellers in different local occasions with different spatial structures in the method of space syntax using the movement patterns of the residents, and along with this goal, the role of the space syntax, is the analysis of the behavior and individual and social activities of the users that are active in spaces. In this research, collection, decomposition, and analysis of data is evaluated in a descriptive method and analysis of the texts in the first step, and in the next step there is an analysis on the instances that are considered the research using the space syntax method, primary, secondary and public territories which itself have led to the appearance of physical or semantic borders. In the end, in order to reach for a conclusion, explaining the impact of the spatial system of student resident halls is done based on the component of spatial thresholds, using logical argumentation.

2. Analyzing Theoretical References on the

SubjectThis research is done in the field of recognizing the behavioral pattern of the inhabitants and typology of the collective architecture of residential buildings, therefore the background of this research fit in two parts, the first one is dedicated to the performed researches in the field of spatial threshold concepts and the second part is related to the syntax (analyzing the relationship between spaces) based on the different behavioral and social patterns of the inhabitants in these dwellings which lead to the formation of conceptual and subjective boundaries in this field.

2.1. Explaining the structure of the environment based on the spatial thresholds

We can argue that each residential space includes three aspects of the physical, functional and semantic forms, and each of the residential spaces falls into the intermediary physical inductors, series of residential spaces and the natural or artificial components within and it operates as a forming component for the structure of the residential environment. If the border is considered as an in-between entity in the structure of the residential environment in which each of the sectors is developed in the action between the interior, exterior spaces and the spaces in between of these two, then the border is interpreted as a fracture or non-articulatory elements which fit between two spaces. Which by adding opening and cavities as the inputs, with the possibility of developing a relationship between the two surrounding spaces around the border, best said the inside and outside space, physical space and its environmental inclusive context which leads to the discontinuity and fragmentations between two spaces, turns into a porous border which makes possible the possibility of communication and continuity of the spaces while fragmenting the spaces as a mediatory factor (Zimmerman, 2008: 65). This continuity and connection which is developed along with the physical and functional encounter of the two interior and exterior spaces is the fundamental factor in the formation of the physical structure of the residential environment. In this regard, spatial thresholds, as in-between borders, create spatial order and finally define the spatial quality which is developed by them. The most simple form of restriction of the space is the connectivity or separation of the interior space with the exterior. Separation or continuity in the interior and exterior space imply the separation or connection between two public and private spaces. The difference of between the behavioral and functional space becomes definite when human transfers his or her various activities from the exterior spaces to the interior by developing different behavioral patterns. Hillier and Hanson consider the relationships between the interior and the exterior based on the social functions: "The most important result of the primary cell lays in the difference between inside and outside; in the difference between the interior spaces of the building and exterior collective spaces. Difference between interior and exterior is the result of the difference of the exigency and control of the societies on the enjoyment of individual and social encounters" (Hillier, Hanson, 1984), therefore, division and continuity of two spaces would always demand a third space to appear. By analyzing the lexicology we will come along the conclusion that cognition of the spatial qualities and the in-between spaces need the employment of words that illustrate numerous formal, semantic and communicative aspects of this space. Therefore, using the word "threshold" is more proper for referring to the space between two identical and nonidentical architectural spaces, because "threshold" acts as a transitory zone and causes the synthesis or separation of at least two spaces by presenting different shapes (Balilianasl and Sattarzadeh: 2015: pp. 171-172). Physical intermediary spaces take fundamental roles in the formation of the physical structure of residential environments in addition to the fact that they come into existence by spatial thresholds and physical borders. In result, of the consisting categories of the structures of residential environment as a field of architecture, is divided into three sets of form, function and meaning, in-between spaces are organized by the possibility of developing interaction between these to arenas in the spatial thresholds, using the governing order on the residential complexes in addition to the characteristics of opposition and physical difference of the interior and exterior spaces, and they have an organizer role in the surrounding spaces in a way that eliminating or disregarding them will lead to severe spatial dissociations in the complex. On the other hand, in the structure of residential environments, physical structure that is formed by a system of interior, exterior and in-between spaces and in sequential scales contribute to the organization of spatial continuity which leads to the solid formation of physical environment in respect to the smaller scale and smaller scale of residential units in a way that balanced internal relationships, develop series of spatial relationships and influence macro, meso and micro scales based on this. This relationship is transactor, this means that in this system, smaller scales impact the macro scale with their own share. Indeed, this relationship is the same

communicative specification of in-between spaces which forms the restriction, spatial adjacency, spatial continuity and sequence, and spatial division and integration and the physical structure of the residential environments in the three patterns of continuity, connectivity and conduction (Moini, 2011: 70). The term "Threshold" was first used by scholars like Victor Turner (1967), Fred Kotter (1980), Jacques Derrida, etc. In the Table. 1, there is an emphasis on the concept of spatial threshold and similar theoretical approaches to it from the viewpoint of researchers.

Table. 1
Definition of the spatial threshold and similar theoretical approaches in the viewpoint of researchers.

Researcher	Theoretical approach
Victor Turner 1967	the threshold as the place of changes in the behavior.
Robert Venturi 1966	Conditions of the both (interior and exterior)
Jacques Derrida 1978	Relationship between outside and inside as a threshold
Fred Kotter 1980	Introduces the threshold as an in-between area or "territory" which is an essentially ambiguous space. In the threshold, three maxims of separation from outside, transfer from the outside to the inside and vice versa
Ashihara 1983	A borderline that separates the interior space from the exterior, it has a decisive role on the spatial structure.
Hillier and Hanson 1984	The most simple constructions include single borders, inter-and-outer border spaces that are defined with the entrance.
Biarez 1993	Residents live in a complex set of spatial routes which gain spatial explanation using visible borders and invisible territories.
Armand Burkman 1995	The border Adjusts between the residents and the environment on the outside.
Yan Gehl 1996	In-between space as a connecting element and connector of action and movement in the public and private spaces, facilitates this movement for the residents and activities.
Christopher Alexander 1997	in-between spaces as important physical and independent factors which makes possible the transfer from one arena to another in the role of articulation.
Norberg Schulz 2003	limits and threshold are the constructing elements of the place.
Bentley 2003	All of the hierarchies in the urban spaces and living arenas in whatever scales, have their own specific articulation and borders, these articulations develop continuity between spaces and make possible the
John Lang 2007	The territory of the behavioral setting is the area in which the behavior is deployed.
Naghizadeh 2008	Spatial categorization between inside and outside has an emphasis on the borders of spatial frontages. Physical categorization between the part and whole are used in order to display the movement from the part
Patrick Troy Zimmerman 2008	Threshold is defined as a transition space between two fixed positions. Threshold connects two disconnected spaces.
Altman 2011	Secondary territory or interactive territory includes all spatial areas in which a type of mutual relationship is established among the residents, in this territory, residents are translocated in an "invisible curtain" rather
Ardalan and Bakhtiar 2011	Spatial connectivity with a different space is forced to follow the fundamentals of communication (connectivity), transition (transfer) and destination (objective).
Rezakhani 2014	We can consider the threshold as a limit, as a substantialization of a difference. In a building, threshold separates and also connects at the same time and whatever from the interior from the exterior which is
BalilianAsl 2015	Separation and connectivity of two space always demands a third space to become manifested. Threshold acts as a transitory one and leads to the conflation or detachment of at least two spaces.

2.2. Qualitative analysis of the threshold concept

2.2.1. Structure of the dwelling environment based on the three levels of spatial threshold

If the inhabitants are considered as the main point in the definition of inhabitation environments, then we can imagine the inhabitants in a hierarchy of social-physical system in the center of a multi-layered structure of intermediary spaces. This structure forms in the innermost section of the private territories which gains meaning in respect to the fundamental factor of "privacy" in opposition to "social interaction" with the process of adjusting the boundary between the individuals and the quality of interactions of two individuals with other residents of the housing. According to this, privacy, in the field of interior with the nature of private and semi-private territory is known as a regulating factor between the actions of residents in the order of social systems of residential environments, demands inputs and outputs which is done between social units, including the individual, groups with same gender, etc., and are formed in relation with a set of social interactions between the individuals, individuals and groups and groups with each other (Altman, 2011: 14). We can observe in the definition that is specified in the form of a structured network between the residents, private and public spaces, in a way that they become dependent on the borders and areas that separate them from each other and separate identity of the public and private territories has a merit from each of the spatial threshold in each of their formation scales. According to the categorization of spaces into three sets of private, semi-private and semi-public in the structure of dwellings, also the spatial thresholds are analyzed in the three levels of micro, meso and macro in these types of dwelling. In Figure 1, threshold and its impacts on the three levels of micro, meso and macro on the spatial organization of student residence halls are described, which lead to the spatial stratification in numerous scales and development of objective and subjective borders which are influenced by the physical, behavioral and semantic specifications of these thresholds.

2.2.2. Spatial territories

Each of the residents in the dwelling, have occupied certain range around him or her which he or she considers as his or her living "territory", a boundary that may belong to someone else in the judiciary terms of it. Therefore, sense of territoriality gains meanings in respect with the two action systems including inhabitants- environment dwelling and inhabitant-inhabitants, this way it contribute to the formation of the dwelling environment structure. But according to the multi-layered and hierarchical nature of the dwelling environment structure become ordered in a system with a hierarchy of visible and invisible networks. The invisible network which includes the living arenas of the inhabitants can be explained based on the ideas of Altman (1975), according to three territories based on the hierarchical natures of them.

The primary territory is usually under the full control of the users for long periods of time, and it plays a vital role in their lives. The secondary territory is a long-term possession of the individual but also others have access to it, therefore such possessions of the individuals are not exclusive and since in this type of territory, each of the inhabitants or a group of them has the right to control and ownership, they will also achieve the right to enter the "spatial threshold" of these spaces and to take benefits from them, and the "in-between spaces" that will be explained through the use of the first definition, will have nature of semi-public arenas which is explained through the use of social activities as the activities which are impacted by the urgent and selective activities including gathering, discussion and controlling the activities of other residents in the form of semi-public in-between spaces. "Secondary territory is a bridge between the primary and the public territory that almost everyone can use" (Tabaian, 2014: 135). The public territory is relatively temporary and is accessible by the public until people obey social maxims and norms. Along with Altman, Newman has also proposed another categorization based on his defensible theory and proposes the concept of territory in three spatial domains of private, semi-public and public spaces (Newman, 1996: 58). In Figure 2, there is a comparison between the categorizations of these two theorists and the categorization of the authors of this article.

2.2.2.1.Role of the thresholds in the triple territory types of student residence halls

One of the most important tasks of the intermediary spaces is to control the territory and ownership (Balilian, 2011: 63). In the viewpoint of Chermayeff and Alexander, hierarchical notion in relation to the space and definition of private spaces, spaces that include threshold, semi-private and public spaces causes the sense of territory and to persuade the citizens to it (Alexander, 1965: 119) and in opposition, eliminating the intermediary spaces causes the interference of the arenas and mix of the spatial territories. While analyzing the relationship between the physical space and social environment, Newman points out that by defining the boundaries and borders using symbols and signs, we can provide security of the places and to make them active by developing social conciliations regarding the judiciary rights based on rituals and traditions, providing the hierarchy of access and privacy, elevating the visibility of the space and to pay attention to the shape of the spaces (Bahreini, 1998: 23). According to the different definitions and concepts of threshold in the studies, threshold usually possess the two physical and functional aspects with different input thresholds and spatial thresholds and in the role of the entrance, in order to enter a construction or a specific boundary of an exterior space, we should enter an upright plane, a plane which have cause differences between different spaces and have separated "here" from "there" The action of entering a building can be done through other methods than to create a cavity on a wall, as an instance we can refer to entering from a virtual level which is fixed using two columns and a shaft on the top. When we want a more spatial and visual continuity to be established between two

spaces, even a difference in the level can be considered as a threshold and to indicate the transition from a place to another (Ching, 2007: 250). Entrances and the gateway frames are the traditional tools that guide us to the pathway and welcome us into the building.

Other types of thresholds are the spatial thresholds that take a defined spatial explanation through the use of visible or invisible borders. Spatial thresholds are extracted from the heart of spatial inductors and are explained using stairs, borders, knots, and pathways. As an instance, walking up the stairs can be a sign of going into a more isolated and private space and the process of descending, in other words moving to a secure place or a stable piece of land or the corridors are considered as some types of movement routes, including the spatial threshold for reaching to the interior spaces from outside, and vise versa.

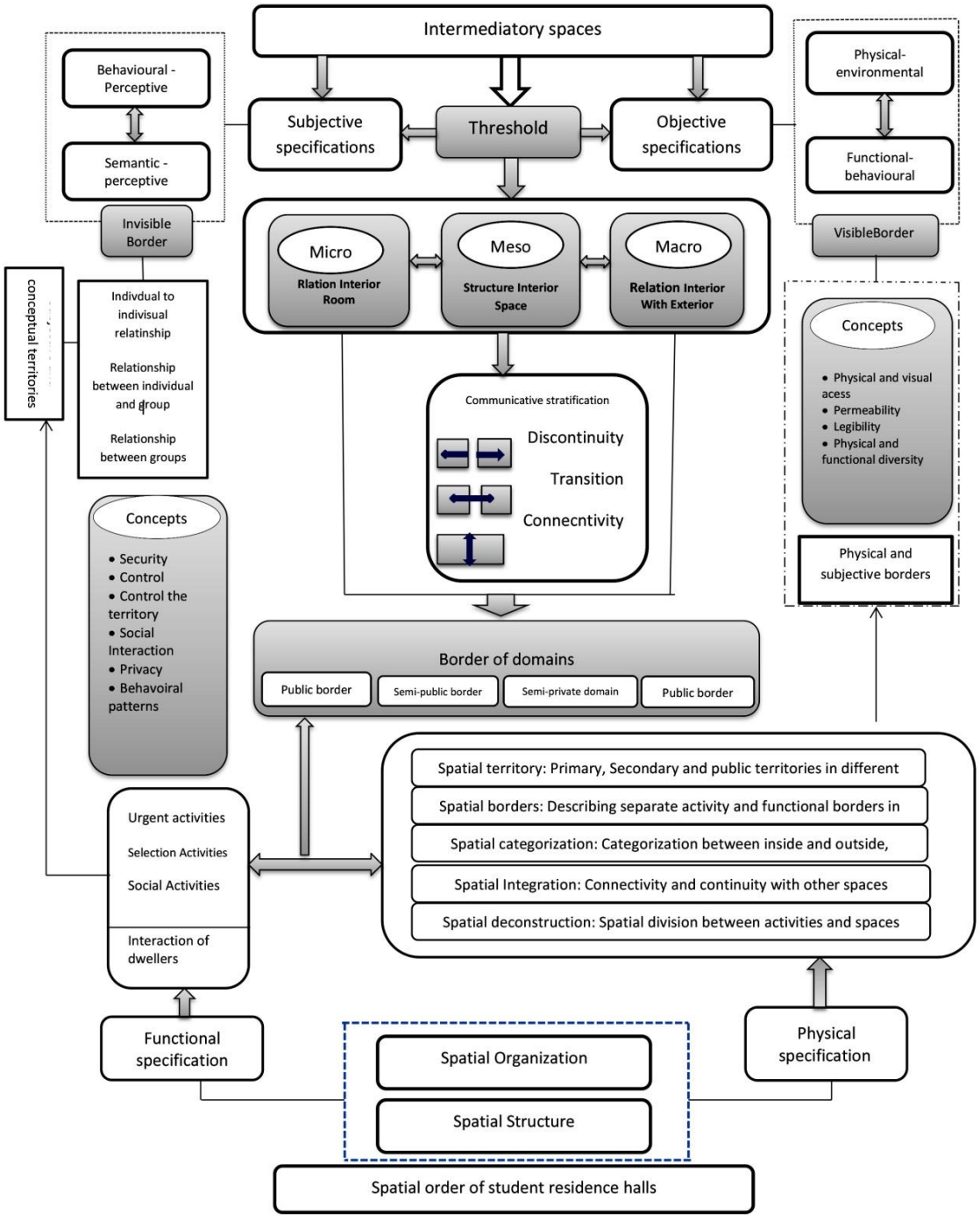


Fig. 1. Spatial threshold and its impact on the three levels of micro, meso and macro on the spatial organization of the student residence halls (Source: Authors, 2018).

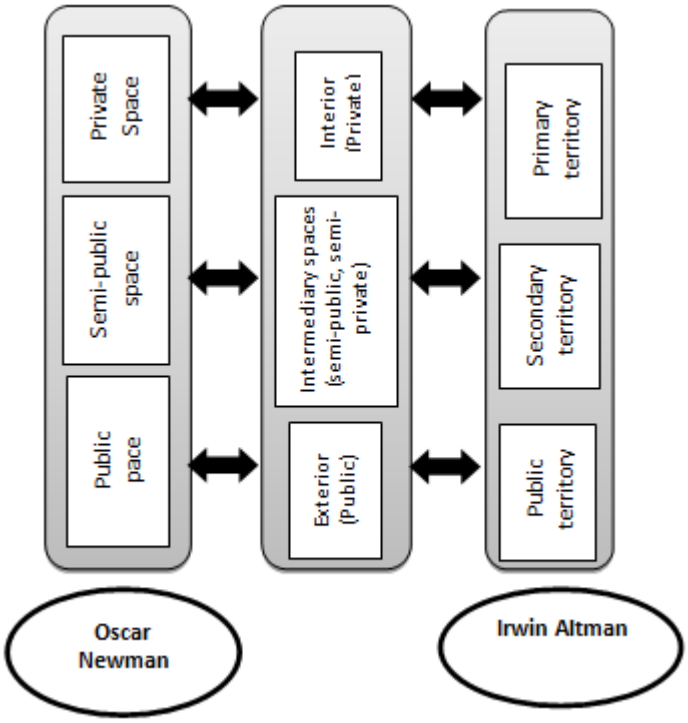


Fig. 2. Comparison of the classification of Altman, Newman and the authors (Source: According to Pakzad and Bozorg, 2014).

2.2.3 Spatial categorization

Spatial categorization or the hierarchy in architecture is an appearance of the effort for explaining the concept of transition and the gradual aspect of the perception process. In his book with the title of "Entrance areas in the traditional architecture of Iran", Hossein Soltanzadeh considers the hierarchy as the organization and consolidation of the spaces and elements based on some of the physical and functional specifications which have led to the appearance of hierarchy in the type of the organization quality or the use or observation of the elements (Soltanzadeh, 1993: 106). This way, an appearance of the hierarchy maxim in architecture can be observed in two aspects, formal, which are related to elements of the architectural and spatial, which are related to architectural spaces (Bemanian. Et al, 2016: 145).
According to Ardalan and Bakhtiar, spatial connectivity with another space is a type of hierarchy that is forced to follow the fundamental pattern Connectivity, transition, and destination (Ardalan and Bakhtiar, 2011: 47). Borders are agents of this communicative pattern which make possible the transfer from the interior space to the exterior and vice versa.

2.3.Quantitative evaluation of the threshold concept based on the space syntax theory

Space syntax method is a developed method on the decomposition and analysis of the spatial structure of the artificial environments (Manum, 2009: 3) which aims to do a formal analysis of the construction and to identify the relationships between the existing spaces in all of the spatial configurations (Memarian, 2000). The importance of this method has roots in its aid in recognizing the social logic and culture behind the formation of different spaces in each configuration of architecture (Hillier, 1996: 77). One of the tools for analyzing the structure of space in the space syntax method is the briefing schemas which is the basis for its formation based on the graph theory. According to this theory, the structure of each environment is illustrated in the form of a graph. The most important aspect of using these schemas is to check the internal or general circulation route of each space. Some of the other employed tools for analyzing the structure of spatial configuration is the DepthMap software, this software let the researchers analyze the space in all of the macro, meso and micro scales with a higher accuracy in respect to the briefing schemas, with more indices in respect to the previous method (Heidary, et al., 2017: 24).

2.3.1.Indices for analyzing the spatial structure based on the space syntax

2.3.1.1.Depth

This is referred to have an ordered change in the space. By moving from each space to another which is at a higher level than to the root space (the space that is considered as the source space, e.g., entrance), the overall depth of the collection will increase. In other words, increasing the depth would lead to a reduction in the integration of this space (Beck, 2012; Hillier, 2007: 266; Hillier and Hanson, 1984: 108). In the space syntax technique, depth is analyzed with two meaning and approaches, it is known as the metric depth in the first definition, which is referred to the distance between two points and in the second definition which is known as the step depth is the number of spaces which the individual should move in order to reach for another point (Memarian, 2002). Metric depth is extractable using the Depth map and the step depth can also be extracted using the analysis on the briefing schemas. Increasing the spatial depth, contributes to the increase in the spatial privacy in addition to the separation and detachment, it means that it leads to a higher depth of the space collection, spatial hierarchy, and reduction in the level of access and permeability for some of the spaces which lead to better control of the space. Therefore, by increasing depth, the amount of controllability of the space will be increased and in return, it leads to the factor of privacy in the environment (Heidary, et al., 2017: 24). In the studies related to the depth, the red color code indicates the highest depth and the blue indicates the lowest depth.

2.3.1.2.Connectivity

The concept of connectivity or in other words communication is referred to the number of links which is developed between space and other spaces (Klarqvist, 1993: 11). The more space is connected to the adjacent space, that space is more public, and the less this amount is, it reflects the privacy of that space (Heidary. Et al., 2017: 24). The higher this index is, it will signify the applicability of the concerning space, desirable spatial circulation, proper permeability rate and in result increase in the function of that space and vice versa, in a spatial configuration, the less the number of spatial connectivity, there will be more spatial solitude (Hillier, 2007: 202; Penn. et al., 1999: pp. 193- 2018).

2.3.1.3.Integration

In the spatial configurations, it is equal to the extent of continuity or solitude of that space with respect to other spaces in that configuration. In a way, the concept of integration has a direct relationship with the concept of depth, this means that we refer a space as integrated when other spaces in the environment are n a relatively lower depth. This way, fewer changes are made in the orientation of the individual for moving from each space with the high level of integration to other spaces in the systems (Peponis, et al., 1990: 765; Penn, 2003: 45). This concept also has a direct and linear relationship with the index of connectivity, it means that the more the number of connections with space raises, that space has more integration (Heidary, et al., 2017: 24), integration is equal to the more connected to the adjacent spaces.

2.3.1.4.Spatial Solitude

The meaning of spatial solitude is the separation and spatial divergence between the activities and spaces (Hillier, et al., 1986: 365). Spatial solitude has a negative relationship with integration, it means that the when a space has a low amount of integration, it will possess less connection and solitude, indeed in the definition, spaces with high level of solitude are in a higher depth and has limited relationship with other spaces, in other words, the more a space is located in a higher depth and possessing solitude, it is more private and vice versa, spaces in lower depths and solitude, has a more public nature.

2.3.1.5.choice

It is a general scale of "circulation in a space". Indeed, space has a more level of selection that various numbers of small connecting routes pass through them (Jiang, et al: 2000). When there is a right to choose in relation to a phenomenon for an individual, it means that there is more than one way for reaching the mentioned goal (Jun and John, 1998: 153).

3. Research Method

In order to reach for the goal of the research, which was the evaluation of the threshold concepts from the objective and subjective point of view in a student residence hall (Case study of the student residence hall complex in Imam Khomeini International University of Qazvin), two methods have been employed. In the first method, by analyzing the spatial configuration and zonification of residential spaces using qualitative indices have analyzed impactful physical components in the spatial system of dwellings and then evaluates the two case studies using the opposition of the space syntax factors and architectural concepts in some of the components of a spatial system. In order to do so, Graph and DepthMap software were employed to analyze the data in this part and in the second part, in order to evaluate the mentality of the individuals regarding the concept of threshold which leads to defining conceptual and subjective territories, field observations, and cognitive maps are used. According to this, the research guideline is a combination of quantitative (Computer factors of space syntax) and qualitative (method for analyzing the contents of observations) and logical argumentation of the results, below you can find the presentation of the components of these two methods.

4. The theoretical Framework of the Research

In order to evaluate and analyze the spatial system in the dwellings based on the spatial threshold pattern, we will analyse and decompose the spatial configuration in the dwellings in a comparative viewpoint and analyse the physical specifications in the terms of structure, spatial

barriers, spatial classification, territories, connectivity, integration, solitude and finally the spatial choice. While analyzing these specifications, in some of through using the physical qualitative method and in some others it is done by opposing the space syntax components and architectural concepts(Figure 4).

Since the objective specifications of the threshold which is itself divided into physical-environmental specifications and functional-behavioural specifications, and according to the proposed material in the research background for the objective concepts of threshold, makes possible the physical and functional diversity which we can assume that with the oppositions between architectural concepts and syntactic factors of the space that we can analyze the influence of thresholds in a quantitative method using the syntactic indices of depth and integration based on the number of links of the space with other spaces in the graph of the space. It is evident that the more these links are, that space is an in-between space and plays a threshold role, and by opposing the concepts of graph of the space syntax and impact of integrated points on each other, we can conclude that thresholds cause a development of local territories and they separate the primary, secondary and public territories from each other. Also, according to the results from the theoretical framework of the study, the opposition of architectural components of the permeability extent in the space syntax theory is evaluated using the syntactic index of mean relative depth. The more space is located in the depth, the extent of privacy for space is higher.

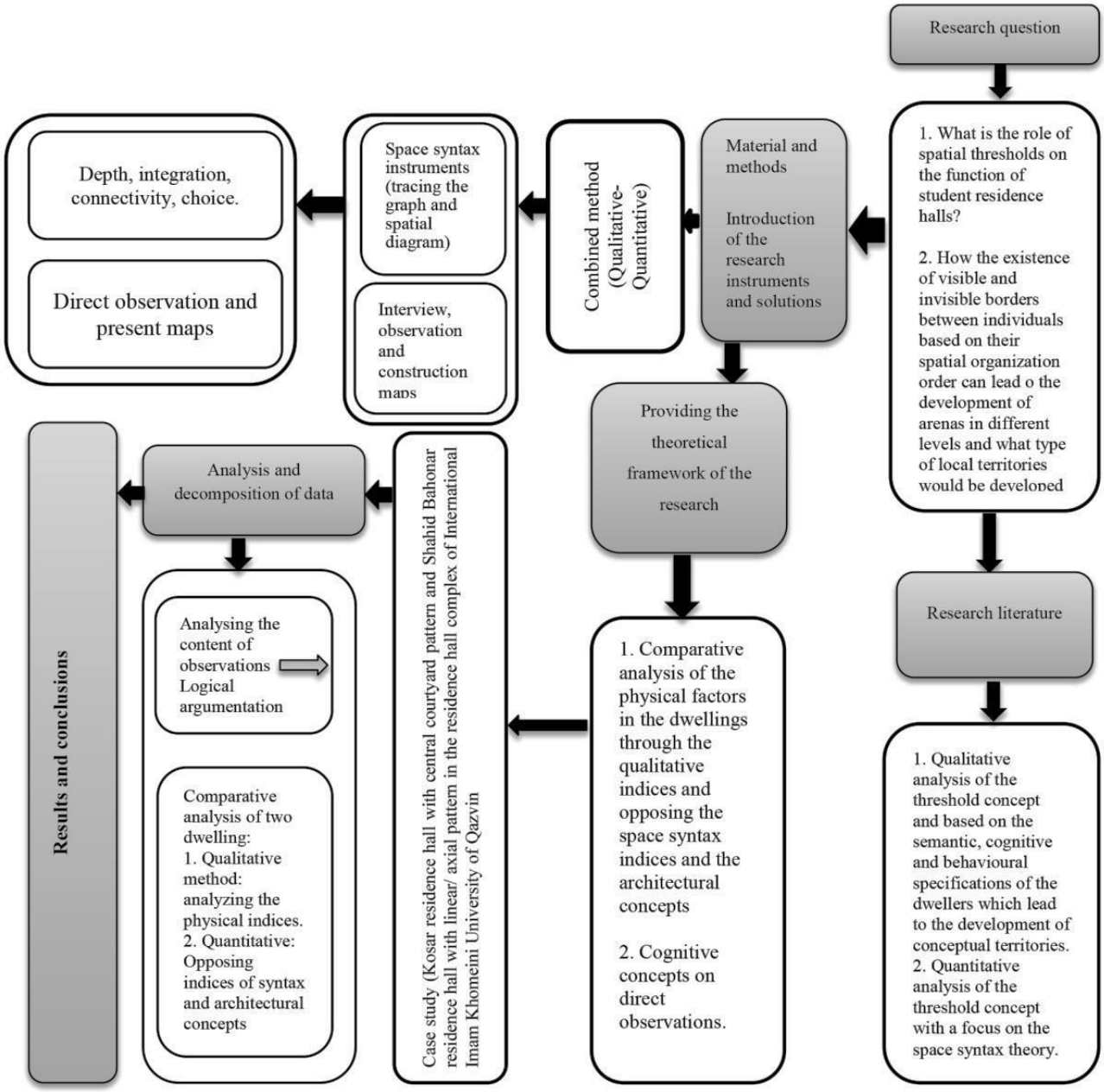


Fig. 3. Theoretical model of the research process

5. Introduction of the Case Study

Kosar and ShahidBahonar residence halls in the Imam Khomeini International University of Qazvin are the case-studies of the research, which are located in the residential complex of the Imam Khomeini International University of Qazvin, located in the 3rd municipality region of Qazvin, with a 1.5 km distance from the university. According to the last statistics from the student fellowship of the university, more than 2750 individuals are residing in the residence halls of this center, in which a number of 707 of them are girls who are residents of the Kosar and ShahidBahonar residence halls. Two residence halls of ShahidBahonar and Kosar are selected among the buildings in this residential complex, the Kosar hall is designed with the form of central courtyard which includes two central courtyards and two garden trenches with the traditional structure, using the patterns from the houses with central courtyard in the hot and dry areas in which a number of 303 female students reside in 94 rooms of it, a number of 135 students are from foreign countries and 150 of them are from Iran. But the next case-study is related to the ShahidBahonar hall with an axial-linear form that has hosted a number of 470 students in its 64 rooms and 3 stories.

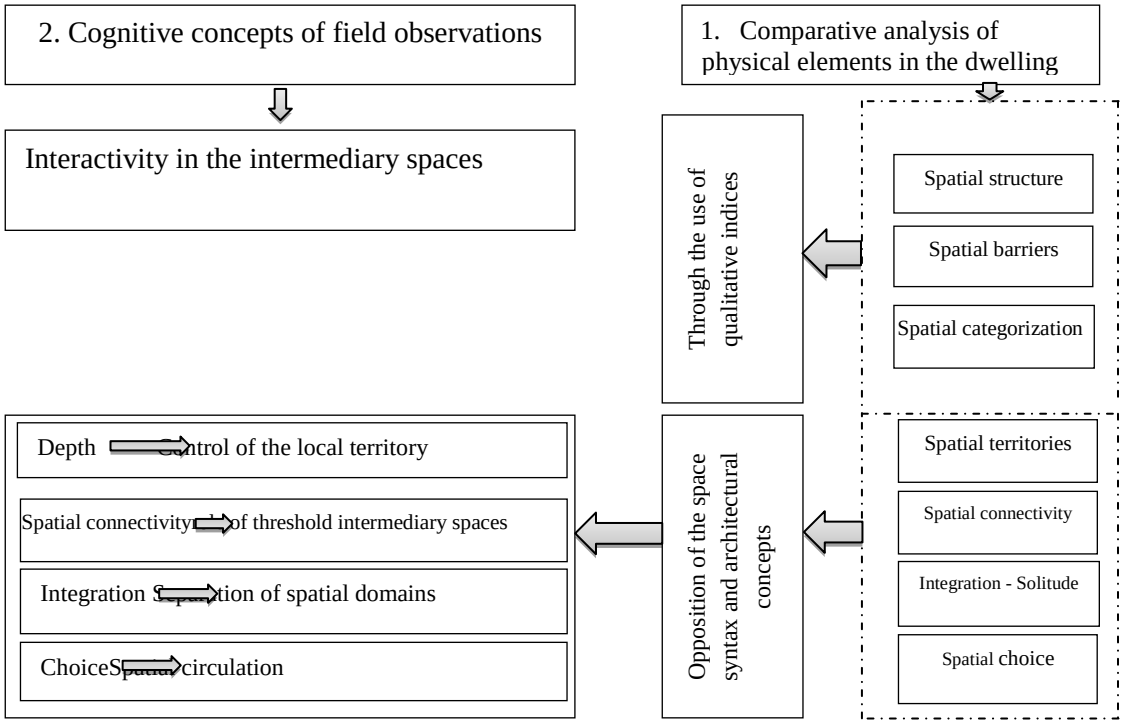


Fig. 4. Schema for the theoretical framework of the study (Source: Authors, 2018).

6. Analysis and Evaluation of the Physical-Environmental Specifications of two Dwellings from the Comparative Point of View.

6.1. Spatial structure of two dwellings

Spatial structure in ShahidBahonar residence hall is linear-axial and takes advantage of corridor systems in order to access the bedrooms. A corridor is a place for quick access to the rooms without an interrupt. In order to avoid the continual, rather boring form, threshold of the room entrances in the corridor develops a type of collectivism with a small amount of withdrawing.

Structure of Kosar residence hall is a structure with a central courtyard and according to the form of the plan, an apartment system is employed to access the rooms, with this difference that the living room space is not considered separately for each section. The spatial focus in this state is higher with respect to the previous state and the control of territory is more to the linear instance based on the existence of spatial hierarchy. In Table. 2, the structural connection is reflected for each of the two residence halls.

6.2. Spatial barriers

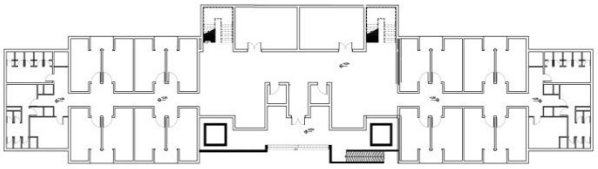
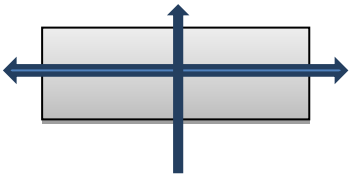
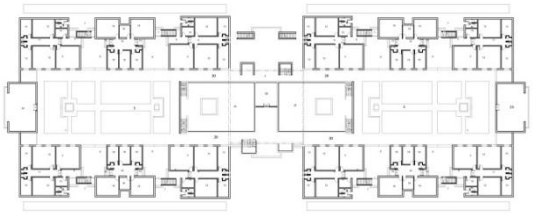
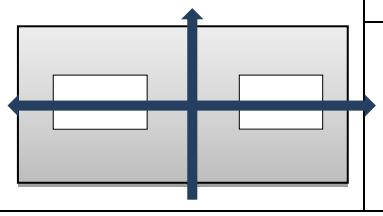
This term refers to the definability of separate physical and functional spaces in each level of the dwelling, this word is the equivalent of the spatial diagram which is considered with this title in this study. By analyzing the constructing components of the two following residence halls, we can figure out that spatial variation in Kosar residence hall is higher due to a specific design structure, and this has led to the development of physical and functional diversity in the totality of the plan. This physical diversity, which is itself playing a role on the categorization and translocation of the apartment plan of the dwelling, include the gateway, portal, courtyard, forecourt and verandah, defines the access to each of the sets of rooms, back corridors or backyards, while in the linear sample, courtyard takes spatial meaning in the front space of the plan of dwelling and the relationship of the

physical space of the dwelling is not established because of the gap between these two functions and a constant rhythm of the identical form of the rooms in the internal structure have led to the formation without functional and physical diversity. In Table. 3., spatial barriers are detached by colors.

6.3. Spatial Categorization

On designing Kosar residence hall, entrance follows the triple hierarchical system of connectivity, transition, and destination. Following the spatial and movement hierarchy maxims in this dwelling, is a focus on the spatial borders between public, semi-public and private spaces which is established using in-between spaces including forecourt, portal, verandah, corridors and the courtyard in the Kosar residence hall, while in the Bahonarhall this hierarchy for access, minimizes the possibility of developing such spatial borders with smallest access distance. In Figure 5, the semantic conceptual hierarchy of the space in the Kosar residence hall is shown.

Table 2
Structural relationship in two residence halls of Kosar and ShahidBahonar.

Plan image	Schematif form	Type/ Structure	Dwelling
		Corridor/ linear	Shahid Bahonar
			
		Apartment/ central courtyard	Kosar
			

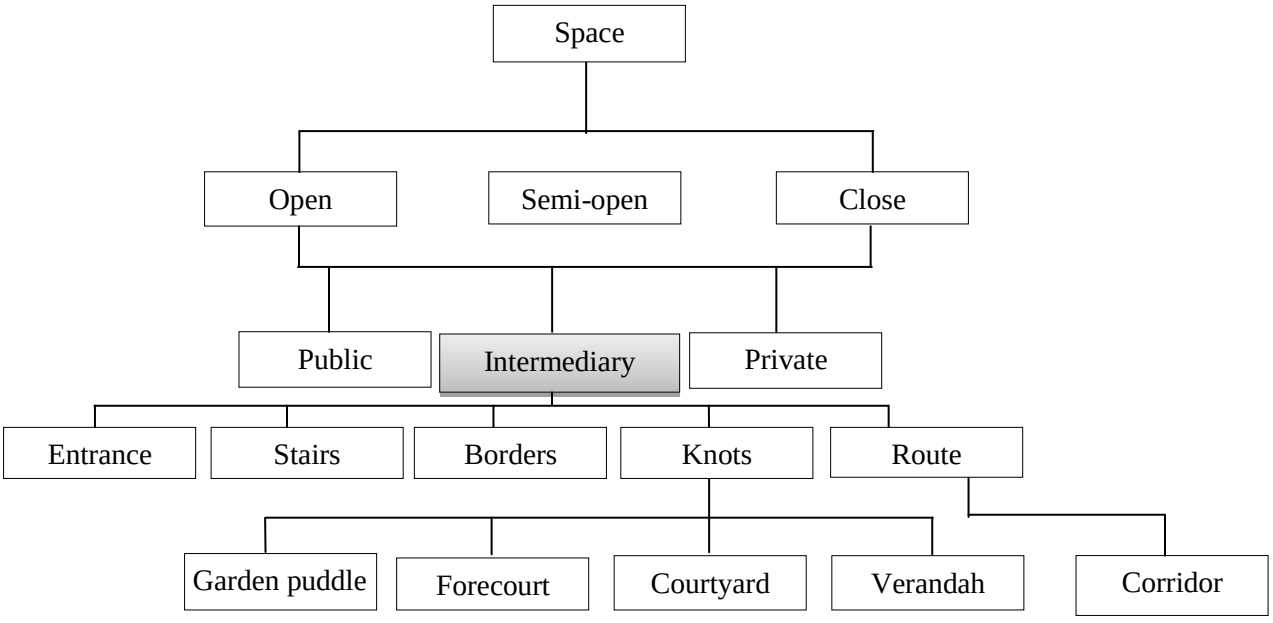
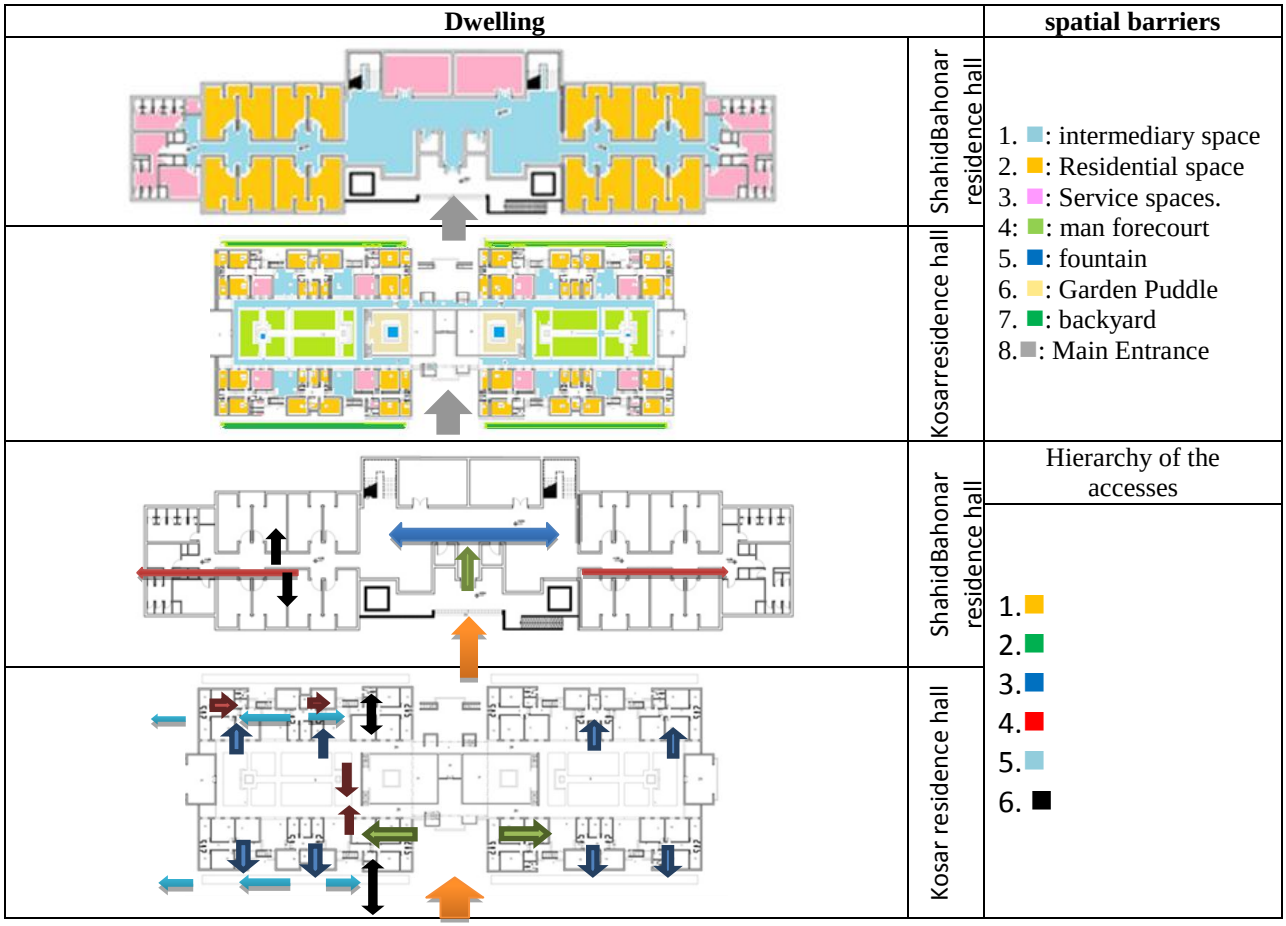


Fig. 5. Conceptual hierarchy of the space in the traditional structure of Kosar residence hall (Source: Authors, 2018).

Table. 3
Hierarchy of the accesses and spatial barriers in the two dwelling



As it is visible in Figure 6, the transition stage is located between the connectivity stage and destination stage and in order to reach for the destination, relocation between these in-between spaces will be guided to the destination. Passing from each stage to the next is done using these" intermediary spaces".

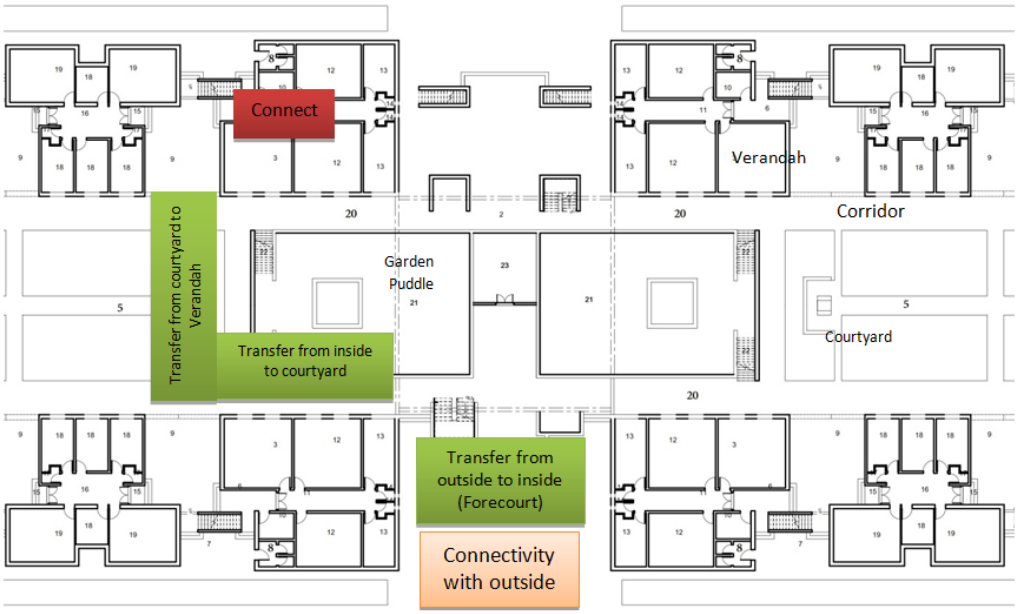


Fig. 6. A type of spatial organization based on the three axioms of connectivity, transition, and destination in Kosar residence hall (Source: authors, 2018).

6.4. Spatial territories

According to the studies of Dolapo Amole (2008) on the context of satisfaction and territorial behavior of the

students in their dormitories in Nigeria, the analyzed territorial monitoring scales are classified in three sets of micro, meso and macro. The microscale is indeed the structure within a room, mesoscale includes collection of private spaces (rooms) and also semi-private spaces (spaces related to services, living rooms, dividing spaces of the rooms , corridors and stairs) while semi-public spaces (courtyard and the surrounding space of a residential block) and the macro scale is indeed the relationship of the exterior space with the interior of the dwelling which is categorized into two levels of interior area of the dwelling space with the public area of the complex and on the next level is the public space of the complex and its exterior view of the public (the street). According to the studies, the existence of decisive thresholds for these borders and frontages is proposed in different scales, as an instance, we can refer to the macro scale of this border between inside and outside which is defined by the entrance gate of the dwelling. In the mesoscale, these thresholds are the communicative in-between spaces and in the micro-scale, these thresholds in the two categories of visible and invisible causes the development of personal space for each of the individuals. In Figure 7 the role of thresholds is explained in the functional scales of student residence halls.

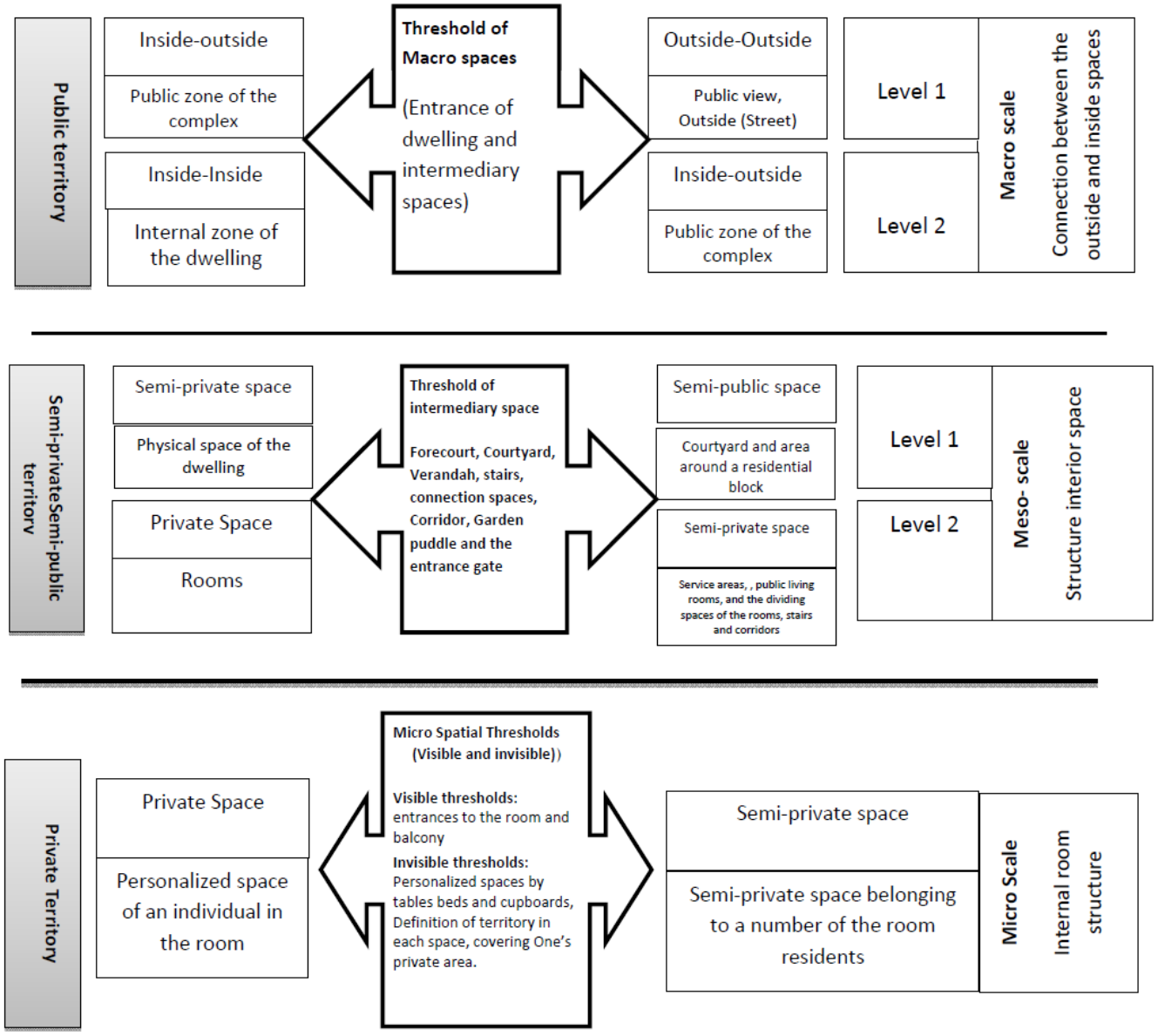


Fig. 7. Role of Thresholds in the functional scale of student residence halls (Source: Authors, 2018).

6.5. Analyzing the spatial structure using briefing diagrams

According to the proposed material, we can correspond the syntax indices of depth with physical factors of architecture, and to employ the syntactic index of depth in order to evaluate the control of territories and the extent of permeability in the environment of student residence. Also, we can analyze the spatial organization of the selected case and the indices for the space depth and the number of thresholds and their situation conditions on the graph and the percentage of their occupancy with respect to the whole building is used in the analyses. The more in-between thresholds we have, permeability becomes higher which would cause an increase in the integration of the building.

Table 4
Analysing the depth and number of thresholds in two instances of dwellings.

Number of the Micro threshold	Depth of the Micro threshold	Number of Meso thresholds	Depth of the(meso) intermediary threshold	Number of Macro thresholds	Depth of macro thresholds	Intermediary threshold		Number of total spaces	More depth in the dwelling	Type of the courtyard		Structural typology	dwelling
						Percent	Number			Percent	Number		
24	5	4	2, 3, 4	1	1	11/5%	4	35	5	External Including public yard	1	Linear / With corridors	Shahid Bahonar
80	7	40	2, 3, 4, 5, 6	1	1	25%	40 (2)×20	154 (2)×77	7	Internal 33%	2	Central courtyard	Kosar

In Figure 8, the relationship between the mediatory spatial depth to the number of thresholds in the two resident halls of Kosar and ShahidBahonar are compared with each other. As it is observable in the following diagram, the number of intermediary thresholds are higher in Kosar hall due to the existence of central courtyard, and garden puddles and have caused a higher permeability and access rates. In the mediatory threshold points, the possibility of the connection between the people is established and the level of interactivity in the in-between spaces is reinforced. In addition to this, higher step depths in Kosar hall indicate the hierarchy of spatial orders and the development of secondary or interactive territories in this instance with respect to the other one.

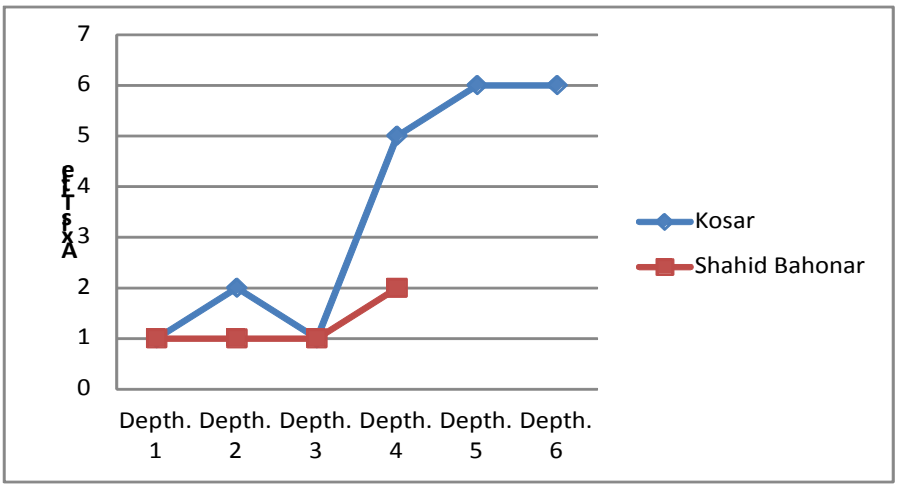


Fig. 8. A Comparison chart of the intermediary threshold(meso) depth with respect to its number in the two resident halls of Kosar and ShahidBahonar (Source: authors, 2018).

6.6. Spatial connectivity

In the resulting images from the Table. 6., the spatial connectivity in two analyzed dwellings are indicated. The red color code shows the highest connectivity and the dark blue color code indicates the lowest connectivity. Spatial connectivity in the syntactic analysis shows the in-between spaces which are indicated in the graph of two residence halls which have caused the connectivity of the spaces with each other in different functional scales. After

analyzing the extent of spatial connectivity using the space syntax software and observing the spatial connectivity chart in the two residence halls of Kosar and ShahidBahonar, it is observed that the mean connectivity rate in the ShahidBahonar residence 43.16 while this value is equal to 30.33 for the Kosar residence hall. It seems that the existence of in-between spaces (courtyards) in Kosarresidence hall, the spatial connectivity in the open spaces and semi-open spaces are divided into the courtyards and verandas, and as a result, the average spatial connectivity possesses a lower value in respect to ShahidBahonar residence space which has a spinal structure. Analysing the values in the table related to the integration of the two residence halls indicates that existence of courtyards in Kosar hall has caused the division of integrated points, in which the average integration value for this dwelling space is 1.27 which has a lower value in respect to the spinal structure of ShahidBahonar residence hall with the value of 2.16. By analyzing the values in the table for the integration-spatial connectivity, the research pays to the evaluation of the legibility index using syntax diagrams, as in the Table. 6, the legibility is indicated for the two spaces. The more the value of R2 is closer to 1, the spatial integration is higher. As result, users are confronted with a more simple space and the more this value gets closer to 0, the spatial detachment will increase and the plan becomes more complex (Hillier, 2007: 127). As is evident in the images, the value for R2 in ShahidBahonar residence hall is 0.776 which reflects the spatial simplicity and its high level of legibility with respect to Kosar residence hall (R2= 0.360) which indicates it's spatial complexity and it's a lower amount of legibility. The result of these values shows that a higher number of thresholds in the Kosar hall brings more permeability, complexity, and less legibility.

Table. 5
Numerical analysis of the syntactic indices in the two residence halls of Kosar and ShahidBahonar.

ShahidBahonar Hall	Kosar Hall	
43.16	30.3	Connectivity
24.12	28.7	Macro Threshold
65.34	46.5	Meso Threshold
38.36	15.7	Micro Threshold
2.16	1.27	Integration
1.74	1.32	Macro Threshold
3.51	1.64	Meso Threshold
1.23	0.85	Micro Threshold
3.90	6.09	Step Depth
2.1	3	Macro Threshold
3.4	5.6	Meso Threshold
6.4	9.7	Micro Threshold
23.2	47.71	Metric Depth
7.2	15.6	Macro Threshold
24.5	53.43	Meso Threshold
37.9	74.1	Micro Threshold
0.77	0.36	Legebility

6.7. Spatial Integration - Spatial Solitude

In order to analyze the better function, using the integration index, mathematical instruments of space syntax are employed, which is referred to as the spatial structure index (relation space - connection). In this index the relation (space – connection) (R) which is resulted from the division of all of the existing connections between the spaces (L) in addition 1 to the whole number of existing spaces in the building (K) (Equation 1) (R=L+1/k) (Bellal, 2007: 7). In the following equation, the values of R revolve around a number1 with different significances. Amounts more than 1 indicates the distribution of a spatial structure which itself indicates the extent of flexibility in the use of spaces and better function and interactivity of the space and the extent of public usage by the students, while the lower than 1 amount, indicates the more segregation of the space, which is according to the use of the residence house as the student dormitory, existence of such spaces in the configuration causes a more extent of peace and privacy for the students. On analyzing the (space-connection) index, Kosar hall gains a value of 0.25 and ShahidBahonar hall gains a value of 0.0850, and as long as both of them resulted values for the two dwelling spaces is lower than 1, it shows that the considered space has spatial solitude considering the housing type of the building but the extent of spatial solitude in ShahidBahonar residence hall is higher in respect to Kosar, this indicates that the existence of integrated spaces which are the in-between spaces and their mediatory thresholds causes the lower solitude and development of interactive spaces for the students.

6.8. Spatial choice

In the architecture and in relation to the collective uses, the more the amount of pathfinding is higher for reaching space, accumulation, and evacuation of the space will happen easier and as a result, the users can easily use the

mentioned space. When there are numerous choices in a space, that space turns into a distributing space, the role which central courtyard play in traditional architecture is an instance of this subject, in other words by arranging the spaces around the central courtyard, the spatial circulation will increase and in return the link between spaces increases accordingly (Heidary. Et al., 2017: 101). Analyzing the spatial choice is possible by using the spatial diagram and the extracted data from the briefing schemas. According to the analysis of the spatial diagrams of the analysis instances, in the spaces that possess the highest amount of choice, the function of the yard is a type of distribution space which will cause the enhancement in the function of a dwelling according to the interactive role of its inhabitants with each other. Both of the dwellings possessed a courtyard, but due to the introvert nature of Kosar residence hall and extrovert nature of ShahidBahonar spatial structure, the role of the courtyard had difference significances in the two buildings. In the Kosar resident hall, in which the space of courtyard is located in the functional center, the highest amount of choice is formed for entering all of the spaces, which have caused the usability of all of its spaces and to enhance the interaction of the residents in the interior spaces without leaving the building, while in ShahidBahonar resident hall, the distributive function of the courtyard is lost with the establishment of the courtyard as the front area of the dwelling and the role of distributive space is assigned to the main hall of the building. This point has caused the smaller role of the courtyard in the functional structure of the dwelling and according to the ideas of the resident students, the usage rate of the dwellers from the space of courtyard has a considerable drop in rates in respect to a similar instance to Kosar residence hall, and this fact has reduced the functional efficiency of the dwelling in respect to a similar instance.

7. Discussion

According to the proposed subjects in the research literature and analyzing the case studies and using the qualitative indices in order to analyze the syntactic cases in this regard, the summation of the findings in order to answer the research questions are as follow:

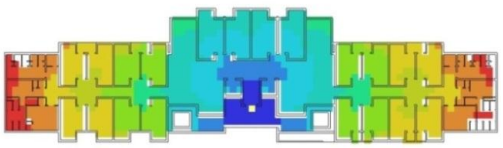
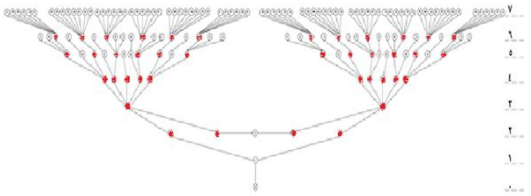
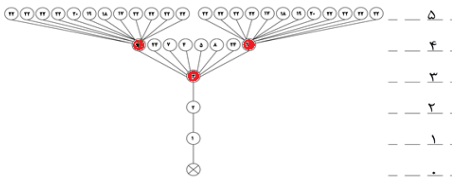
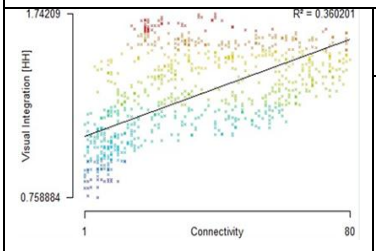
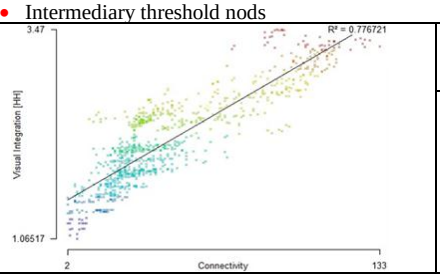
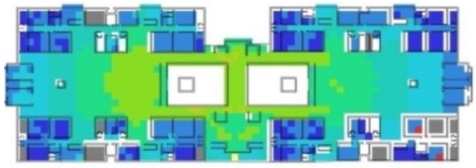
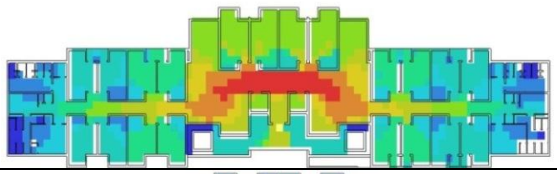
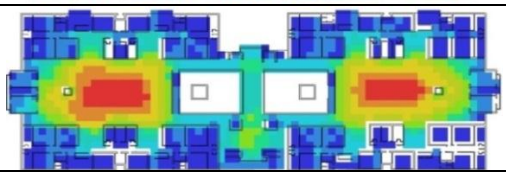
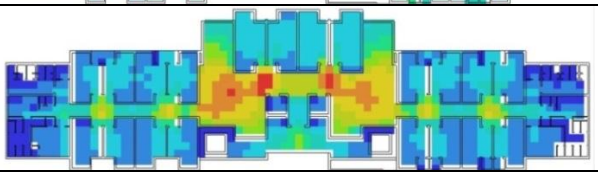
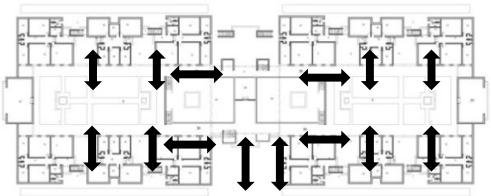
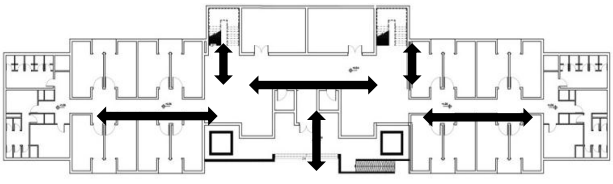
The first question is regarding the role of the spatial threshold in the function of student residence halls. Considering the findings of the research toward the mentioned subject it seems that a number of analyses were done in the qualitative method for the first and second methods. According to the proposed definitions by the experts in the context of the role of spatial thresholds, we can refer to the impact of thresholds in three stages of micro, meso and macro according to the classification of the space into private, semi-private and semi-public and public arenas in the structure of dwellings which cause the spatial stratification in multiple scales and development and objective and subjective borders which is the physical, behavioural and semantic specification of these thresholds.

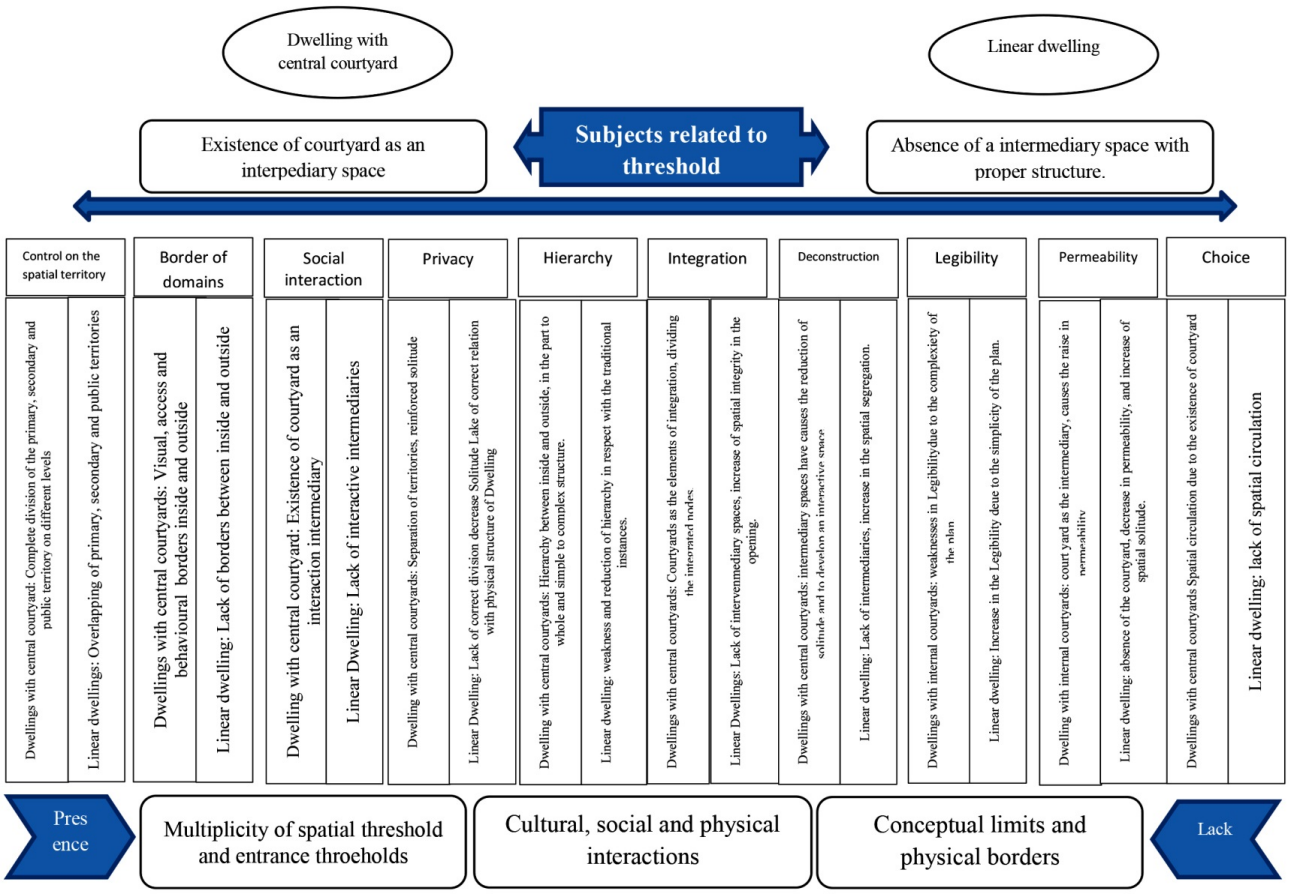
In the second question, according to its subjectivity of the separated visible and invisible borders between the people, how these developed borders can contribute to the creations of arenas that develop local territorials in different levels based on the spatial organization system? According to the categorization of thresholds in two physical and functional aspects, we will be working with the input and output thresholds. In the role of input, thresholds are formed for entering a building or a specific area of exterior space. But another type of thresholds is defined by visible or invisible borders. According to the research, spatial thresholds are extracted from the core of spatial intermediary spaces and take their definition using stairs, borders, nodes, and routes. According to the categorization of thresholds in three scales of macro, meso and micro, it leads to the development of visible and invisible border in the three arena types of public, semi-public, semi-private and private, which is considerable that according to the diminution of spatial arena of the input thresholds to these spaces, are not only done using visible borders, but it can also be possible through the personalized space, including bed, dresser and writing table, carpeting the personalized spaces have also lead to the development of spatial territories through the invisible division of threshold. According to the analysis of the two mentioned questions in a qualitative method, proposed criteria in form of two instances of residence hall(one designed with the form of central courtyard and the next case study designed with an axial –liner form), reach to this hypothesis: Existence of central courtyard in the structure of spatial configuration of student residence halls have led to the multiplicity of thresholds and to elevate the factors including the spatial choice, permeability, spatial stratification and spatial territories in respect to the linear-axial instances. As it is evident, in this hypothesis, the subject of locating the courtyard is considered. Findings of the research shows that the best way of locating the maximum interaction role in the student residence halls, is to use the central courtyard pattern because, in this condition, the highest extent of spatial connectivity and the access between closed and open spaces are available, and in result, the maximum spatial circulation will result in the complex, while the amount of permeability will be increased for the interior spaces and the spatial categorization are maximized and the raise in the hierarchies of access have also increased the spatial territories. In the analyzed case studies of this research, in spite of possessing a courtyard with lower spatial choice, permeability and lower spatial categorization, Bahonar hall also have less spatial territories in respect to the instance with the central courtyard. In this instance, courtyard is positioned in a way that it is only in connection with the front side and this matter have caused the decrease of permeability of the building in respect to the case with central courtyard based on the four-way connection with the building. This matter have caused the decrease in the distributivity and accessibility, together with the drop in the rates of social interactions of its residents. By analyzing the cases, we can argue that existence of the courtyard have not led to the rise in the function of the space but locating it have increased the functional role of the space and this matter increases the

interactivity role of the residents in the space. The resulting evaluations of the software from the syntax of the two resident halls indicated that the multiplicity of thresholds, through the use of more intermediary spaces, have ed to the lower legibility of the dwelling and in result in includes a more spatial complexity. In the case studies of in Kosar residence hall, according to the definition of central courtyards as a in-between space, we observe the definition of thresholds with different functional forms, including entrance, stairs, borders, nodes and routes. Spatial nodes are shaped into the form of verandah, courtyard, forecourt and garden puddles and its denomination aspect is referred to as intermediary interventors which should be passed through the intermediary thresholds in order to enter them, the same matter than have made the possibility of perceiving the totality of the spaces a complex matter for the users and increased the usability of the space for the collective activities.

Table. 6

Formal analysis in the theory of space syntax (Hierarchy of the territories of briefing diagrams, legibility, integration, connectivity, spatial choice)

Kosar residence hall			ShahidBahonar residence hall			
						Hierarchy of the territories base on the metric depth
			 • Intermediary threshold nods			Briefing diagram of space syntax
	Legibility	Type		Legibility	Type	Legibility graph
	R2=0/360	Central Courtyard		R2=0/776	Linear	
						Spatial Integration
						Spatial Connectivity
						Spatial Choice



8. Conclusion

According to the mentioned explanations, we can argue in the overall conclusion that looking to the student resident halls as a collective dwelling environment which is considered as the social life of human groups, has a compound structure of the two objective-physical aspects (spatial organization) that makes its material structure, and in the subjective-semantic aspect, it is the resulted meaning from the central relationship of the residence with the residential environment, which has together formed this residential environment. In the general view of existence of intermediary space in the traditional form with the structure of central courtyard and prevalent linear forms of this dwellings, there are significant differences, in the traditional structure, defining the intermediary space have happened in the best and most functional forms of it in the dwelling and this matter is highly visible in the hierarchical design of these dwellings and the definitions of their spatial organization. In dwellings with traditional structure (central courtyard) connection from outside to the inside and vice versa, is shaped with hierarchy that is formed by the intermediary spaces have gradually happened, while in most of the dwellings with linear structure, by eliminating these types of intermediary spaces, confrontation of the exterior and interior space happens without an inductor and with the least hierarchy. Due to the lack of hierarchy between public and private space with respect to the instances with the traditional structure, social communications have become lighter and a single-functional space is provided for temporary habitation and sleeping and referring the term dormitory [bedchamber] to them is a manifest instance of these structures. Also, the spatial thresholds are related to the concepts and human factors of the environment like territory making, interaction, isolation and the type of the presence of thresholds in the structure of dwellings have impacts on the quality of fulfilling the following concepts. Spatial thresholds lead to the definition of local territories for the residents and they are able to prepare the context for defining social interactions between individuals in addition to develop privacy for the residents. On defining and designing student resident halls in Iran, with explaining intermediary spaces in the form of central courtyard, a number of spaces are established for the interaction of different groups of students to produce spatial connectivity between the spaces in order to avoid the interference of territories in addition to the development of spatial hierarchy and the cultural, physical and social continuity will be resulted between inside and outside. This cultural, physical and social continuity leads to the relationship between people and provides the substrates of dwellings. Result of the study show that in the analyzed instances, due to the fact that in the residence hall of the students which include different cultures of foreign geographies, existence of the courtyard as an in-between space will have a more efficient help for a better connection between these cultures, also in these dwellings, we witness the territorial behaviors of the residents with

different nationalities, using the flags, use of the signs with their own national writing symbols and such cases in the in-between spaces. In Figure 9, we will compare the role of spatial thresholds in the two studied cases as the result of the proposed subjects. Finally, what is most important to propose as the result of this study, is an emphasis on the position of intermediary(meso)thresholds, especially the role of central courtyard for increasing the efficiency of student dwellings in respect to the prevalent linear instances in which the courtyards are located as a separate item in the front of the building. According to the fact that the element of the courtyard will cause the increase in the spatial thresholds in the spatial organization of traditional houses have led to the increase in the spatial thresholds, this matter has caused a rise in the spatial choice, and permeability in the spatial structure of the house. The existence of the courtyard in the structure of students' residence halls has also caused the reinforcement of the mentioned functions, that can be employed according to their positive role in the future design of dwellings spaces in order to increase their function.

Existence of the intermediary threshold points, makes possible the interaction of people with each other and the context for social interactions in the courtyard, also according to the hierarchical characteristic of the spaces in this spatial system, it leads to the development of privacy for the arenas and division of the territories in different levels of dwellings which itself develops a secure space that influences privity for its residents.

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