

Investigating the Variation and Versatility of an Effective Environment in Resident's Satisfaction of Residential Complexes (Case study: Isfahan Zeytun Residential Complex)

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Abstract

The development of modern housing has been accompanied by less attention paid to the versatility and the variation of the living spaces. The quality of residential spaces has declined to a degree that the home has merely become a place to meet physical needs and many psychological problems have been neglected. Recognizing the factors affecting the environmental capabilities of today's housing and design for improving the quality of life can create a desirable effect on the residents' satisfaction. The present study was conducted to achieve the satisfaction of residents with creating a diversified and versatile (adaptable) space and investigate the effect of flexibility components on their satisfaction level. For this purpose, a residential complex in Isfahan (an Iranian city) was selected as the case study. This qualitative research was performed using library studies, field surveys, and questionnaires. By examining the concepts of flexibility, the theoretical framework of the research was extracted. Then, according to the research's background, the valuation of the housing units was done in 7 plan types and three plan types with the highest average score were sampled. Finally, 38 residents of these units were questioned. The results showed that among 9 components effective on the concept flexibility, three factors of visual diversity, air moderation, and spatial hierarchy in all studied units are most important in terms of listener's questions and play a significant role in the satisfaction of the residents of the flexible atmosphere.

Keywords: Flexibility; Internal space; Residential Complex; Variation; Versatility.

1. Introduction

Improving the quality of housing with the concept of flexibility is not a new topic and has been widely used in the traditional urban and rural Iranian architecture. In traditional Iranian families, various generations (grandparents and grandchildren) used to live together in a house. In such a house, all the needs of three consecutive generations could be made using spatial diversity in different parts of the house (Einifar, 2003). Today, cultural and family diversity makes it difficult to understand social relationships in the spaces. Therefore, the lack of attention to space and family status reduces flexibility (De Paris & Lopes, 2018). Moreover, the combination of private and professional life requires a variable space that shows no deficiencies resulting from the lack of versatility and flexible space. In this regard, rapid economic and social growth along with technological development has led to some changes in the concept and form of housing system to meet the needs of users. Ignoring these changes increases the dissatisfaction of users and the instability of homes (Abbaszadeh et al., 2013). Flexibility was widely discussed in the 1950s. Since then, its concepts and plans have been continually renewed. Therefore, the re-definition of its basic concepts is necessary (Groak, 1992). Given the concept of flexibility and the creation of spatial compatibility, the spatial and structural reformation of buildings is created and the needs of users are met with technological, cultural, and economic changes that have been created

over time. A flexible design brings economic and social sustainability (stability) and increases the building's useful life using versatility (De Paris & Lopes, 2018). Moreover, before and after seizure, flexible space with the possibility of compatibility or change for diverse use will lead to improved quality of housing space (Ghafourian & Aghaei, 2017). Such a design has also been used as an appropriate solution to the lack of space in social housing, evolved by changing the need of residents and compatibility with living conditions, replaced the space hierarchy, and enhanced the quality of life (Hosseini Raviz et al., 2015). Considering the flexibility of the housing sector based on the diversity potential of spaces and their adaptation to the needs and expectations of residents and their personal taste, it transforms the home into an ideal place (Abbaszadeh et al., 2013). In the present study, based on the definitions of flexibility, it is analyzed the designed flexible species in Isfahan Zeytun residential Complex and identified the factors affecting the flexibility of apartment housing with the aim of achieving the satisfaction of residents. Hence, the main question in this research is: How and to what extent do flexibility components affect the satisfaction of residents?

2. Methodology

This qualitative research was conducted using a field survey tool and questionnaire. The statistical population consisted of residents of Zeytun complex in Isfahan City, Iran. To determine the sample size according to the

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availability of the total number of a statistical population, the Cochran formula was used. The confidence level was 95%, suggesting that 5% of the error was accepted. The data collection tool was using published relevant studies, desktop studies, and field data, which were collected by arranging and distributing the questionnaires within the scope of the research. In this research, a preliminary study was conducted to evaluate the reliability of each questionnaire. Through this process, the questionnaires were distributed randomly among 12 units and then Cronbach's alpha test was used to test the validity and reliability of the tool. The reliability of the questionnaire using Cronbach's alpha coefficient for the whole questionnaire was 0.762. So, the final questionnaires were designed to measure the variables. Finally, in the internal consistency analysis, the Cronbach's alpha of the entire questionnaire was 0.769. A total of 38 sample groups were selected randomly in the morning from 10:00 a.m. to 13:00 p.m. and in the afternoon from 18.30 p.m. to 21.30 p.m. on normal and off days. About 10 of the units refused to answer the questionnaire due to lack of knowledge and about 10% of them did not write their age and education information. The measurement of the satisfaction level of the units in the questionnaire was divided into two parts. The first part refers to independent variables such as age, sex, education, marital status, residence length in the complex, house area, and the number of bedrooms. This part evaluated the effect of these variables on the satisfaction level of residential units. The second part of the dependent variable is the satisfaction of variation and versatility, which were validated using the Likert spectrum (1= Very low, 2 =Low, 3 = High, and 4 =Very high) (Figs. 1 and 2). In order to improve the satisfaction of residents, descriptive-field research was carried out. The satisfaction of the residents was measured by the level of flexibility of the units. The data were analyzed using SPSS software.

The case study of this research is the project of Isfahan Zeytun Residential Complex, which is adjacent from the north to Razmandegan Street and from east and south to two 10-m by streets. This collection is made up of a courtyard. The buildings of the complex consist of 42 volumes with 10 different designs (Fig. 3). The complex has 18 blocks of 4 stories and 16 blocks of 3 stories and 8

towers of 9 stories (Fig. 4). The parking lot is located in the basement. The entrance mansion on the ground floor has a number of stores that provide the needs of the residents. At the bottom of the mansion, a movie, a conference hall, and an indoor gym were considered, which are located on the upper floors of the ground floor of the residential apartments. Approximately, 25% of the apartments are one-bedroom, 25% are three-bedroom, and 50% are two-bedroom apartments. Moreover, 30% of the apartments have been designed for people with physical disabilities.

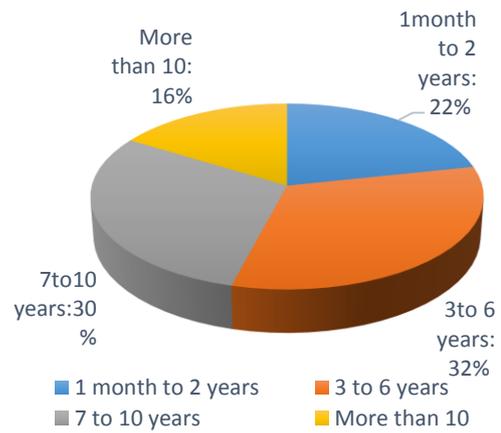


Fig. 1. Residence time (period)

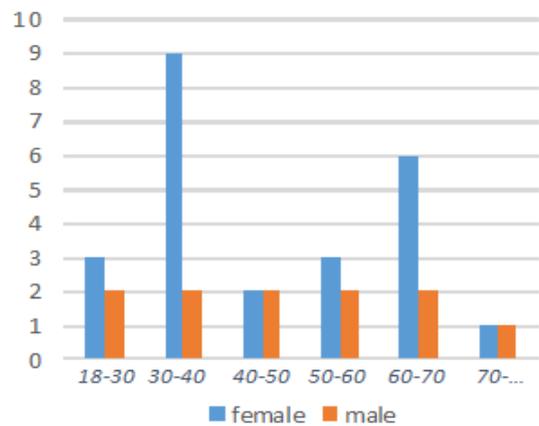


Fig. 2. Age and sex of residents



Fig. 3. Zeytun residential complex (source: www.zeytun.co)

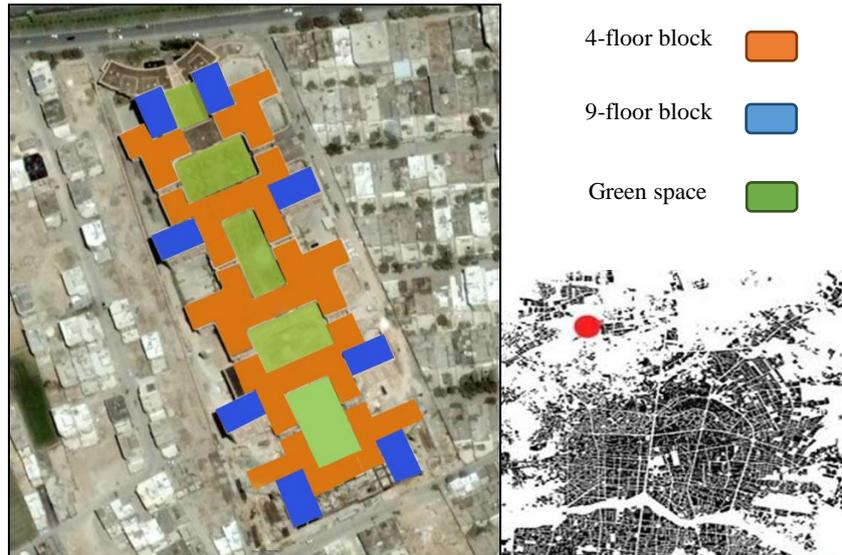


Fig. 4. Location of blocks

The Zeytun residential complex, due to its spatial complexity and plan diversity, has the responsiveness of the specimens of species responsiveness and flexible scales. In this project, 10 different designs were used, which included 7 categories. Then, from each category, one plan in 4-story blocks and without elevator and one plan in 9-story blocks with the elevator was selected as the representative. Finally, seven selected projects were evaluated as one, two, three-bedroom and family units. To

evaluate the selected samples, the first step was to examine the variation and versatility components using some developed indexes for measuring them. These indexes were made for various sections of the housing including living room, kitchen, bedroom, entrance and service spaces, and the overall housing unit and were rated by the researcher. Based on the same indicators among the selected units, a questionnaire was distributed to measure the views of space users.

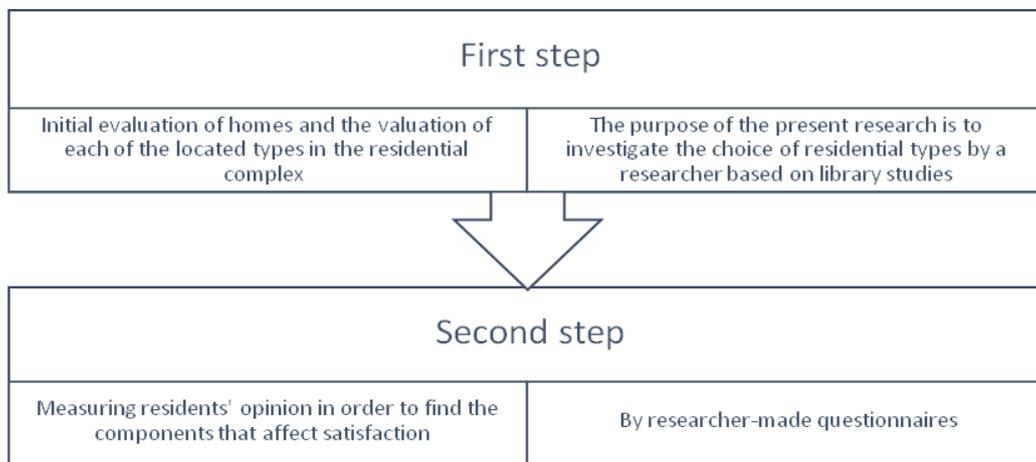


Fig. 5. Steps to conduct research

3. Subject Literature

3.1. Definition and the nature of the flexibility

Flexibility generally is defined as a bending ability, variability, being non-sensitive to amend or change, preparation and capacity for compatibility for different purposes or conditions, and freedom from drought, or stiffness. One of the basic principles of flexible design is to prevent non-flexibility (Schneider & Till, 2005). Commonly, the flexibility is referred to “the ability to change in objects and things” in the architecture and design of the environment and the housing, which is the subject of this research. The term “flexibility” refers to

the spatial flexibility and organizing the human-made space and making changes in it to achieve new conditions, needs, and applications (Einifar, 2003).

3.2. Flexible species

3.2.1. Variation (multi-functional space)

Variation is the ability to provide various uses of space. This kind of flexibility is associated with two variables of space and time. Residential space can be used for several functions simultaneously and for different functions at different times. Variation can be achieved by designing a map with a regular geometric structure, legible and easy access to housing equipment or adjusting the size of the

rooms. The most important properties of spatial diversity are as follows:

- Facile and easy access to rooms
- Combining the functions in space and reducing wastes in communication spaces
- Useful utilization of access space, so that to make it possible to convert the functions
- Following building facades from the general pattern of house formation

variation is the most basic and effective way to find the flexibility in the traditional Iranian housing design because of its ability to change the function of space over time. Moreover, since this approach did not require extensive open space or new structural methods, and traditional building systems were well suited, it could easily be adapted to the everyday lives of people (Einifar, 2003). Many components play an important role in the variation of spaces. Optical expansion, outlook and space, optimal interference, and functional diversity all play important roles in shaping the diversity (variation) of space. Therefore, according to studies performed at Isfahan Zeytun Complex, this research examines residential spaces based on the items listed in Table 1.

3.2.2. Versatility (adaption) of the seasonal and daily displacement

Versatility is the ability to coordinate space with new required conditions. In the new housing, versatility is a feature that does not change the new needs by changing

the interior walls and installing parts in residential units. In practice, the versatility of all internal changes (e.g., changing personality and structure, microelements, and composition of spaces) is taken into account. In the planning of new residential complexes, the most effective method is to achieve versatility, non-constant internal components, and the possibility of their diverse combination. For example, when the kitchen, the bathroom, and the entrance are considered constant, the rest of the spaces can be allocated to other functions.

In traditional Iranian housing, according to the mapping, facade and house spaces could be built by a general pattern of formation and the construction system of the stabilization spaces, the daily and seasonal adjustment with the horizontal and vertical adjustment of the house, and the use of different spaces at different times of the day and in different seasons. Spaces such as summer stay, winter stay, basements, houses, and roofs make it possible to adapt a home to different living conditions. The organizer of flexibility on this scale is the central element of the house; i.e., the courtyard (Einifar, 2003). As mentioned earlier, in today's housing, as in the past, the general pattern of the formation based on the construction system of the stabilization spaces is constant. Other functions are adapted around it. However, the central element of the house is not the courtyard and it is examined on a larger scale. Therefore, in this research, spaces and their compatibility with daily and seasonal life and analysis of the mentioned cases in Table 1 are discussed.

Table 1
Factors effective in variation and versatility

Factor	Component
Variation	1- Separation of the public and private space
	2- Space hierarchy
	3- Visual diversity
	4- Furniture changeability
	5- Optical expansion and outlook
	6- Desirable spatial interference
	7- Functional diversity
	8- Spatial expansion
	9- Confidentiality
Versatility	1- Draft
	2- Seasonal compatibility
	3- Air adjustment
	4- Relationship with nature
	5- Furniture compatibility
	6- Spatial compatibility

3.2.3. Variability (separation and aggregation)

In the design of flexible housing, the variability is referred to as a small increase or decrease, or the separation and aggregation of spaces, and the possibility of returning to the original design of a residential unit after its expansion or reduction. In this case, flexibility means the ability to respond to the growth of the household at different stages of life. In other words, this feature makes it possible to resize the residential unit either in the direction of the smaller or larger. The concept of variability is related to the study of substructure changes, spatial needs, and the shape of a residential unit. The need for such flexibility

may be due to long-term or short-term needs. The long-term type of flexibility is because of changing the size of the household and the need for more space for life while the type of short-term flexibility is due to other reasons. Variability can be achieved in two ways; i.e. 1) by adding to the existing infrastructure of the house and 2) by separating its spaces without changing the area. This has been applied to the horizontal or vertical expansion of traditional Iranian homes and the separation of multi-courtyard houses and their use for the extended family life in different stages of life (Einifar, 2003). Based on the mentioned explanations, variability occurs through the

horizontal and vertical expansion of the house. Since these arrangements are not considered in this project

before the design, we examine the role of flexibility based on two factors: variation and versatility.

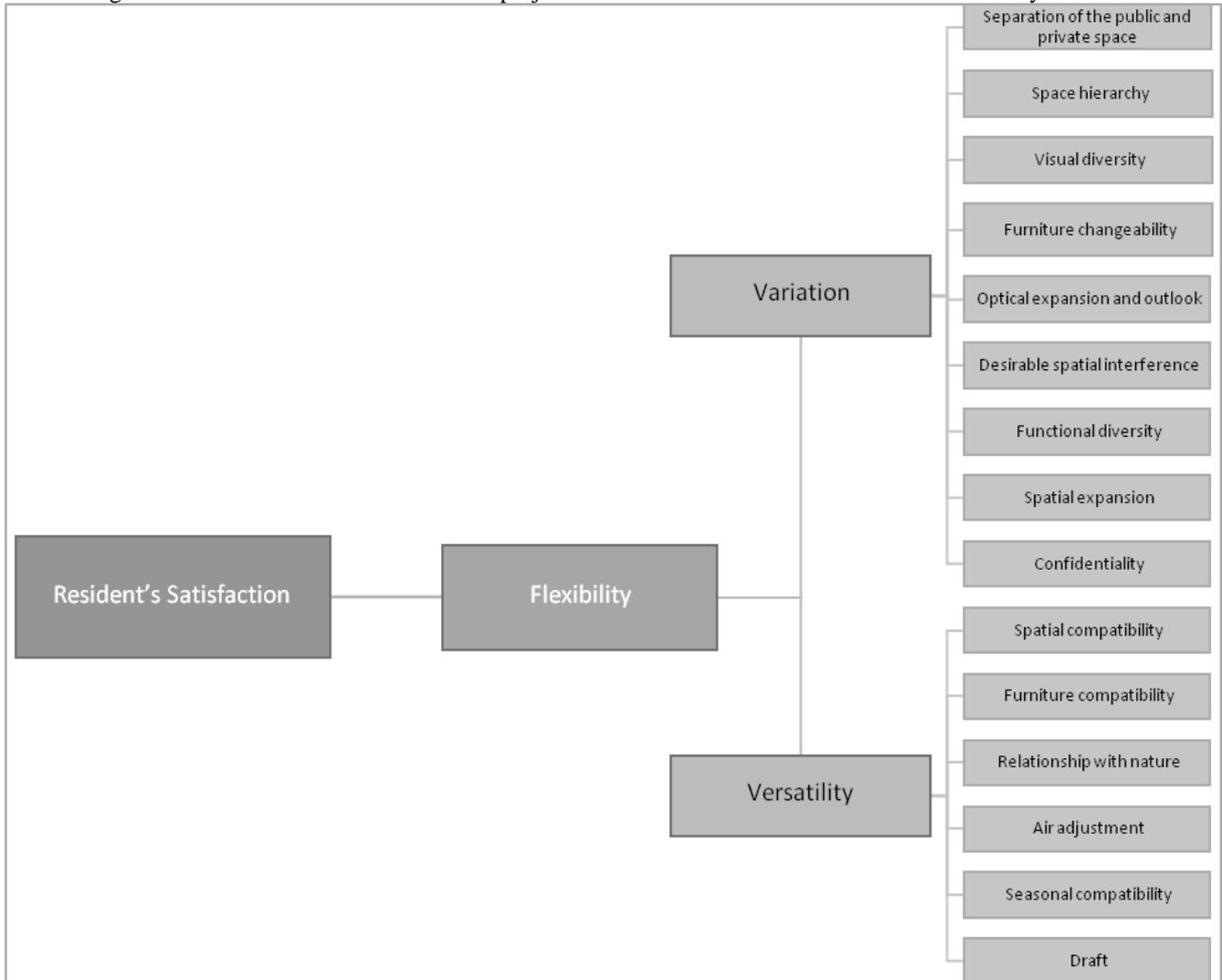


Fig. 6. A theoretical model of research

3.3. Flexibility Scales

The importance of flexibility in the exterior and interior spaces is the same, but its design requirements for buildings are different from what is involved with outer space (Bentley et al., 2012). All spaces are measured at micro, medium, and macro scales. Because of selecting the starting point of the interior spaces of the residential complexes in this study, the analyses Residential on a small (micro) scale.

3.3.1. Small Scale

This scale of flexibility is defined in terms of the dimensions, spatial, and functional components of the home of the service provider and the service recipient spaces and communication spaces. Flexibility includes rooms, courtyards, and other communication and home services.

On this scale, unlike new housing, in which home spaces are named by the use of the specific function of the space, spaces get their name from the pattern of space formation. Each of the house elements, such as the Five Doors, the Three Doors, the sashes, and so on, have their own spatial definitions, which are responsible for different functions and their space. On these scales, the smaller elements of space, such as niches and racks are also used to form semi-stabilized space and flexible impressive rooms (Einifar, 2003).

4. Evaluate and Collect Data

After the initial evaluations and in order to evaluate the units, 7 types of plans were selected as samples. To accelerate the study process, these 7 types with the highest impact among the evaluated units were investigated (fig7).

4.1. Type 7: family unit (2 bedrooms + suites)



Fig. 7. Type 7 plan of (right) and block of type 7 plan (left) (Zayandeh Rood Housing Investment Company, 2018)

4.1 Variation

The unit is located on the eighth floor of high-rise blocks and it is designed as a two-bedroom suite. The main reason for placing the dining room in the main unit is that all events and private spaces are merged into one another and space acts as a single function. In other words, it does not have spatial expansion but provides the ability to create visual expansion through the window. Like other units, the shape of the kitchen table has increased the amount of visual and functional diversity and, in connection with the dining room, provides different functions at different levels, and creates an optimal space interference. This interference is also seen in the suite and the main communication space such that the suite does not require a variety of space and creating privacy or separate collective space and the terraces provide visual

diversity in connection with the reception room. Pre-input space regarding the privacy issues are considered as the space between the inside and the outside. This space, which is used as a space for communication with neighbors, has more functionality than communication space. Also, access space to the suite and unit is separated by this pre-space and can also be operated in the form of two independent units. Therefore, in addition to communicating between neighborhoods and creating a hierarchy, it is also a space for the division of the public and private space of the unit. The rooms are single-functional and only one of them can be connected to the terrace with a wider outlook. However, because of the small dimensions of the terrace, it does not merge or create a new function and only creates visual diversity through the window of the room (Table2).

Table 2
Strengths and weaknesses of the variation of the 7 types of the component in family units of tall blocks

Factor	Component	Pre-entrance space	Communication space	Bedroom	Terrace	Service space (kitchen, bathroom and WC, cooler room)	Living room and reception room	Valuating
Variation	Separation of public and private space							1
	Space hierarchy							1
	Visual diversity							3
	Furniture changeability							1
	Optical expansion and outlook							2
	Desirable spatial interference							3
	Functional diversity							1
	Spatial expansion							0
	Confidentiality							1
Total								13

4.2 Versatility

The dining room space does not have the compatibility of private or public space. As a result, it minimizes spatial compatibility. In conjunction with the window, in addition to the outlook expansion, it provides the ability of air adjustment. However, it does not have the ability to make the draft. On the other hand, the versatility is created only by changing the layout of the furniture in the reception room and the ability of spatial and functional compatibility is not provided more than that. As a result, only the interference between the living room and the kitchen in the suite can reveal the compatibility of the furniture. In the case of two open entrances doors at the

same time, only the draft can be created. The suites can only be accessed through the terrace and windows in connection with nature, which provide seasonal and daily versatility. The overall family unit displays the versatility component completely and when the family grows bigger or the need to separate their living and even create different working conditions or various activities, the unit creates the ability to be compatible with new conditions without changing the structure. This reflects the original designer's perception of compatibility with the new conditions. The results of the other samples are summarized in Table 3.

Table 3
Strengths and weaknesses of the versatility of 7 types of the component in family units of tall blocks

Factor	Component	Pre-entrance space	Communication space	Bedroom	Terrace	Service space (kitchen, bathroom and WC, cooler room)	Living room and reception room	Valuating
versatility	Draft							2
	Spatial hierarchy							2
	Air adjustment							5
	Relationship with nature							3
	Furniture compatibility							1
	Spatial compatibility							0
Total								13

Table 4
Comparison of the flexibility components on a small scale

Block	Sample	Points of variation	Points of versatility	Points of flexibility	Average
4 floor blocks	Type1: singlebedroom	11	9	20	10
	Type2: two bedrooms	11	11	22	11
	Type3: three bedrooms	11	14	25	12.5
9 floor blocks	Type4: single bedroom	12	10	22	11
	Type5: two bedrooms	11	11	22	11
	Type6: three bedrooms	13	12	25	12.5
Total	Type7: family unit	13	13	26	13

Table 4 summarizes the results of the performed analyses and results of other cases.

5. Analysis

Table 4 compares the flexibility components among different types. As mentioned, 7 types of plans were considered as examples and among them, three units with the highest average were selected.

Due to the high averages of types 3, 6, and 7 plans, researcher-made questionnaires were distributed randomly among 38 questioners. In these three types, which include three-bedroom and family units, the

average of the flexible components is the highest, indicating the greater importance of these units than the other units. According to Table 5, components with a mean of 2.5 or greater are meaningful while the significance of those with a mean score of less than 2.5 is not proved. As a result, the separate components of public and private space, the spatial hierarchy, visual diversity, light expansion and outlook, confidentiality(privacy), draft, seasonal compatibility, air adjustment, and relation with nature have an average above 2.5 and show the impact on flexibility.

Table 5
Frequency of data in relation to the defined indexes

Component	The first option		The second option		The third option		The third option		Average
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	
Separation of the public and private space	9	9.3	12	12.4	54	55.7	22	22.7	2.91
Separation of the public and private space	26	26.8	21	21.6	41	42.3	7	7.2	2.25
Spatial hierarchy	9	9.3	23	23.7	41	42.3	24	24.7	2.82
Spatial hierarchy	5	5.2	20	20.6	46	47.4	26	26.8	2.95
Visual diversity	5	5.2	16	16.5	50	51.5	26	26.8	3
Visual diversity	8	8.2	25	25.8	29	29.9	35	36.1	2.93
Furniture changeability	28	28.9	41	42.3	19	19.6	9	9.3	2.09
Optical expansion and outlook	3	3.1	18	18.6	37	38.1	39	40.2	3.15
Desirable spatial interference	8	8.2	41	42.3	41	42.3	6	6.2	2.44
Functional diversity	14	14.4	48	49.5	26	26.8	9	9.3	2.30
Spatial expansion	19	19.6	44	45.6	26	26.8	7	7.2	2.19
Confidentiality	6	6.2	23	23.7	43	44.3	25	25.8	2.89
Draft	2	2.1	12	12.4	53	54.6	30	30.9	3.14
Seasonal compatibility	6	6.2	19	19.6	58	59.8	14	14.4	2.82
Air adjustment	2	2.1	10	10.3	56	57.7	29	29.9	3.15
Relationship with nature	12	12.4	28	28.9	30	30.9	27	27.8	2.74
Furniture compatibility	13	13.4	45	46.4	28	28.9	10	10.3	2.36
Spatial compatibility	7	7.2	64	66	24	24.7	2	2.1	2.21

By examining the effective factors in Table 5, we can put items such as air adjustment, draft, and seasonal compatibility in one category. So, it can be stated that the connection with the outside environment in the presence of good weather conditions plays a significant role in the strengthening of the three factors. Also, green space with adjustment and air purification has helped the performance of the three mentioned factors. Green spaces play a fundamental role in increasing human health and the quality of urban life (Kabisch & Haase, 2014). Among the role of these spaces, one can name the sensory role of these spaces in creating tranquility, encouraging people to get out of the house, walking, physical activity and satisfaction, and visual diversity, and most importantly,

encouragement for social interactions (Charkhchian & Daneshpour, 2010). In such spaces, it is possible to communicate with friends more than other spaces. Not only these spaces are the ideal places for users in which they can have free time, communication, and social interaction (Heyuan, 2016), but also they can provide physical health and be safe from weather conditions, pollution, and noise (Givoni, 1991). The effects of green space on human life include psychological, sociological, and cultural effects. The psychological effects of green space are divided into several sub-categories: mental and psychological, physical, aesthetic, cultural, sociological impacts, and social interactions (Yaran&Bahroo, 2017).

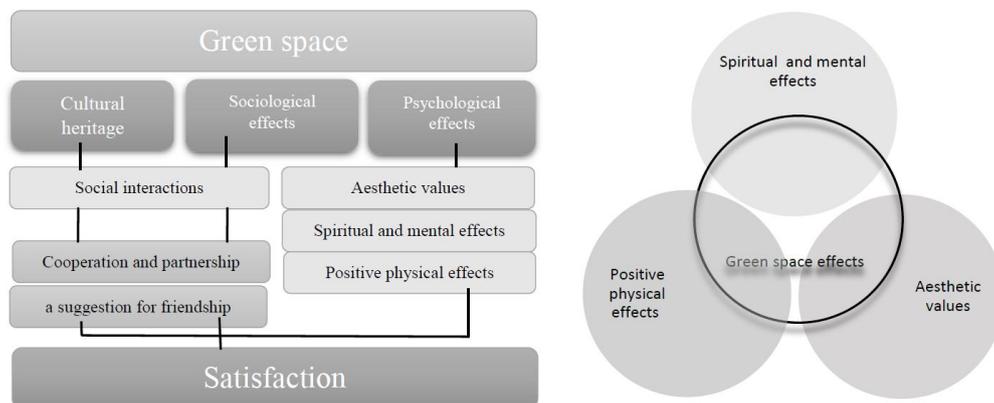


Fig. 8. The impact of green space on the satisfaction of individuals(Yaran&Bahroo, 2017).

Moreover, the connection with the green space creates a comfortable and compatible atmosphere and provides an appropriate perspective and vision that can greatly increase light expansion and outlook. In addition, it allows air adjustment and purification, improve the comfort and health condition of the indoor environment, and minimizes air and noise pollution. Viewing nature and reduced visibility to neighbor's homes have diminished the possibility of privacy shortage and reduced the dissatisfaction level. The variable of the space hierarchy increases the satisfaction of residents in residential complexes through creating the discipline between the environment's components, overlapping with other factors such as privacy and confidentiality, the separation of the private and public spaces, and increasing the level of security, comfort, tranquility of the residents (Naghibi & Hosseini, 2015). Also, one of the features considered in achieving unity is the principle of hierarchy (Tabibian et al., 2012). Preservation and applying values such as confidentiality, tranquility, security, privacy, modesty, simplicity, adjustment of environmental conditions in a variety of climates, and more attention to the inside more than indoor have led to a strong, clear, and unique hierarchy in Islamic cities (Nasr, 2018).

The existence of visual diversity in space is an important factor in attracting and inclining people into it (Karami & Mohamadhosseini, 2018). Designing multiple plans with different inside perspectives (view or outlook) and diversity in texture and facade, non-residential user, water fluid element by fountain, texture and different colors of the body, and variety of the amount of light and shadow, green space and different altitudes in the outer space play a significant role in enhancing the satisfaction of the residents and their desire attendance in such spaces.

6. Conclusion

Identifying and studying the factors that influence the satisfaction level of residents with the flexibility of their housing environment can help design new residential complexes with high levels of satisfaction. By studying the factors that influence variation and versatility, the components of light expansion and landscape, air adjustment and draft, visual diversity, spatial (space) hierarchy, area separation, confidentiality, seasonal compatibility and relationship with nature showed a strong role in increasing the satisfaction level of residents. In this regard, light expansion and perspective are the most effects. Each of these components has some common elements with other components. For example, as the light expansion and the outlook increases, communication with nature also increases, leading to more desirable visual diversity and vision. This interaction with nature showed an effect on the mental and physical relaxation of the residents and created the field of further social interaction. It also has an effect on the air moderation and ventilation, provides comfort conditions by affecting ambient temperature and inside moisture, and saves energy. It can be stated that the higher the ability to change to meet the needs, the more

interaction with the environment. This higher involvement creates a sense of attachment, ownership, and more satisfaction and has a significant contribution to achieving social stability. Based on the results of the present research, the following solutions are proposed to provide residents' satisfaction of flexible spaces:

- Per capita increase of green space to enhance the interactions and visual diversity in the residential complex
- More utilization of the landscape and natural light
- To design hierarchy for separating the spaces and create the required privacy and confidentiality
- To create an open social environment with the ability to change for different people

Considering the role of flexible spaces and relying on the importance of having green space and visual diversity, future studies can take an effective step in evaluating the integration of housing and green space and provide a basis for editing a design guide to improve the quality of residential spaces.

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