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Effective Factors on Desirability of Private Open Spaces: A Case Study of Kuye Nasr Residential Buildings, Tehran

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Abstract

The gradual transformation of courtyard houses to apartments has contributed to the omission of certain spaces. The ill-matching of modern housing, with people's lifestyles, has caused undesirable changes to their quality of life, health and well-being. Providing houses that suit individuals' lifestyles plays an important role in the building social sustainability as well as economic and environmental aspects; this article will investigate, alongside, ways to improve private open areas in apartments. Two- to six-floor residential buildings in Kuye Nasr neighborhood were chosen to find factors that can improve the desirability of private open areas. First, a number of factors were collected by taking photos and conducting field studies. Next, several residents were randomly asked to share their opinions about such areas. Finally, a questionnaire examined the reliability of factors, which was then distributed to 100 residents. The final data was analyzed utilizing SPSS23. This study reveals that the functional aspect of a balcony is the most important item among semantic, perceptual, functional, physical, environmental, and beauty aspects. The following factors can contribute to residents' satisfaction with balconies: dimensions; use of plants; connection with sky; peace and comfort; safety; function; and beauty. Findings additionally suggests the connection of balcony with kitchen.

Keywords: desirability factors, private open area, balcony, residential building, Kuye Nasr neighborhood

1. Introduction

The insufficiency and high price of land have dramatically increased apartment living and as well as people's willingness [1, 2] to settle in residential units over recent decades [3]. The gradual conversion of courtyard houses to apartments and residential units has led to changes in the function or removal of spaces embedded in Iranian lives [3], illustrated in **Figure 1**. The vacuum created by the incompatibility of new housing—a significant part of which includes residential complexes and buildings—has caused unfavorable changes in human life [4, 5]. The land price is a major issue that limits individuals' choices, forcing them to buy units of a small size. Due to land prices, builders and designers prefer to eliminate open and semi-open spaces to increase and

replace indoor spaces [3, 6, 7]. Thus, spaces such as indoor and outdoor communication spaces (e.g., balconies) are rarely seen, and the removal of such important spaces from human life is more prevalent nowadays. This modern norm overlooks the necessity of developing housing that conforms to the lifestyle of its residents. What's more, the number of houses that can satisfy all the needs of Iranian families is too restricted. Thus, this research aims to investigate the removal or negligence of private open spaces that would ordinarily bring enjoyment to residents. Furthermore, this study seeks to share insights that will improve the quality of people's life environments and ultimately help them benefit more from their home spaces. The research background indicates a gap on how to design balconies that satisfy the residents of residential buildings. A scientific study into this area could be utilized in future projects to help enhance the quality of such home environments (Figures 1–5).

For example, Einifar and Ghazizadeh [10] showed that designing outdoor spaces is less dealt with by designers; rather, their main focus being the interior space of the building, without paying enough attention to the spaces between the outdoor and indoor space. The authors discuss the necessity and importance of designing the lost and forgotten space of buildings like open space, and recommend that designers of residential complexes pay more attention to such spaces.

Extant studies on private open spaces consider a range of views on residential building spaces including behavioral, environmental, physical, perceptual, semantic, and esthetics. What sets the current research apart from past studies into this subject is its seeking which one of these factors is more influential in this statistical population.

Designers are obliged to see all the approaches in designing open spaces while at the same time pay close attention to the aspects regarded as important by the residents. One article [11] examined the three categories of perceptual-semantic, functional-behavioral and physical-environmental factors in a social-cultural context, with the balcony selected as a private open space between the residential unit and the residential area. The main question of this research was what factors affect the quality of the balcony as an intermediate space and what do people expect from its function in different socio-cultural backgrounds? Based on interview, they examined three residential complexes and presented a model containing six factors. The authors concluded that attention to the secondary functions and the multi-purpose nature of intermediate spaces should be among the primary concerns of planning and designing to enhance the quality of life in apartment housing.

Badeie [12], on the other hand, expressed her research findings from a philosophical point of view: wall space-separators are not necessarily the only effective separation and limitation, but the space instruction of walls is characterized by

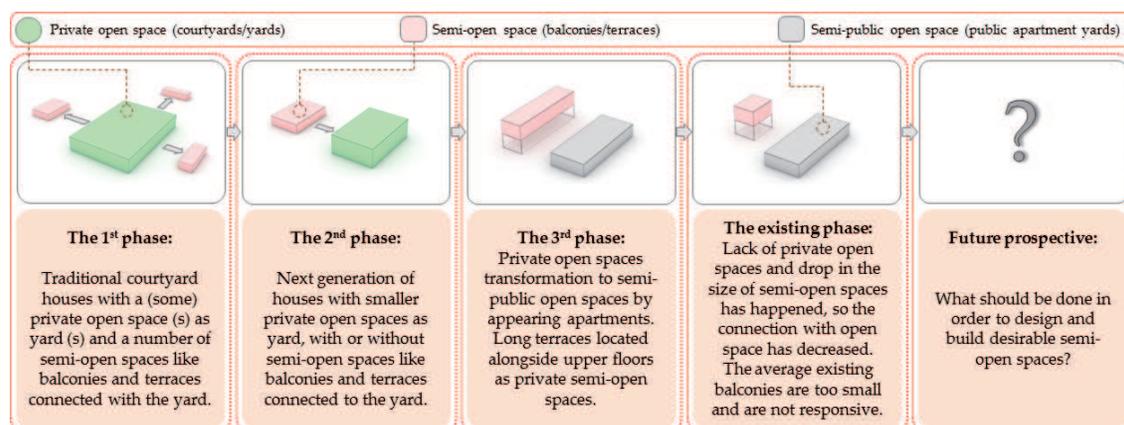


Figure 1. Gradual transformation of Iranian traditional courtyard houses to new apartments.

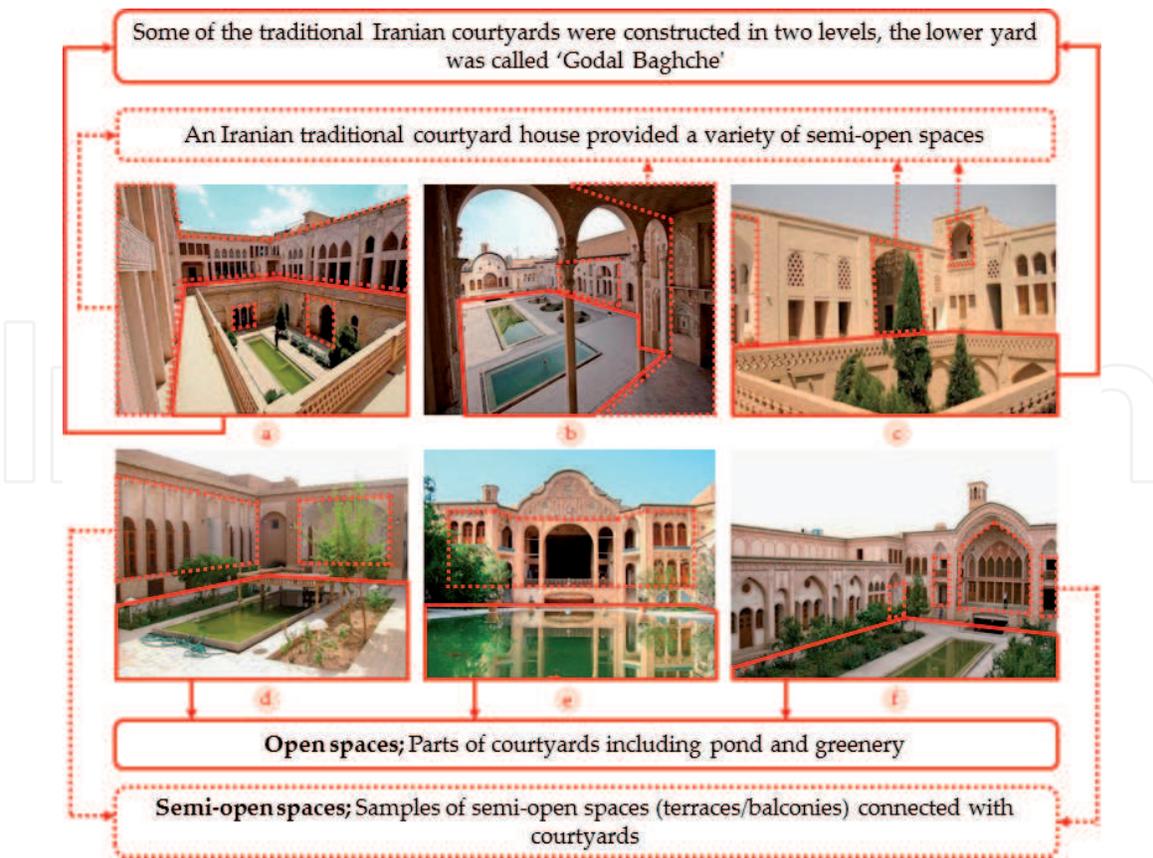


Figure 2. Samples of Iranian traditional courtyard houses: (a) Abbasi House, Kashan, (b) Tabatabaei House, Kashan, (c) Pirnia House, Yazd, (d) Navab Vakil House, Yazd, (e) Borujerdis House, Kashan, and (f) Ameri House, Kashan; adopted from [8], analyzed by authors.

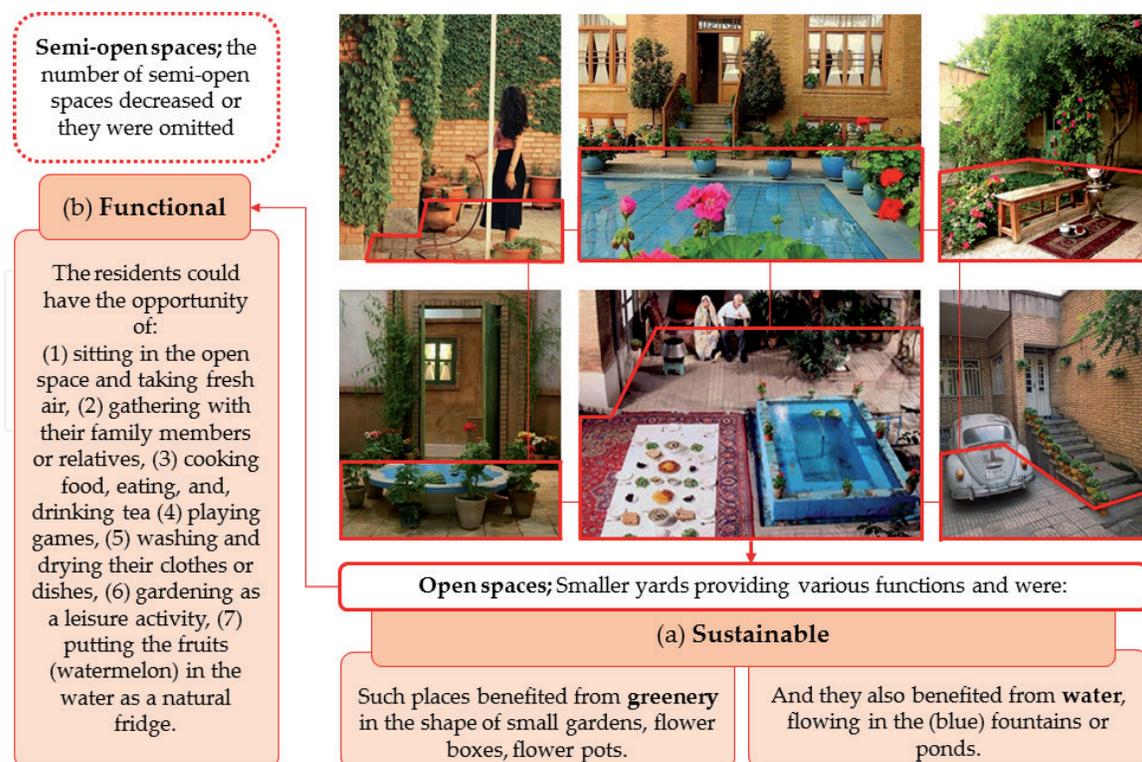


Figure 3. The second generation of Iranian houses with yard, adopted from [9], analyzed by authors.

inferential definition of connectivity. Privacy creates protection, security, and confidentiality in the design of appropriate space frame of artifact environment on one hand and fortifies the dynamic and diverse capabilities of space components

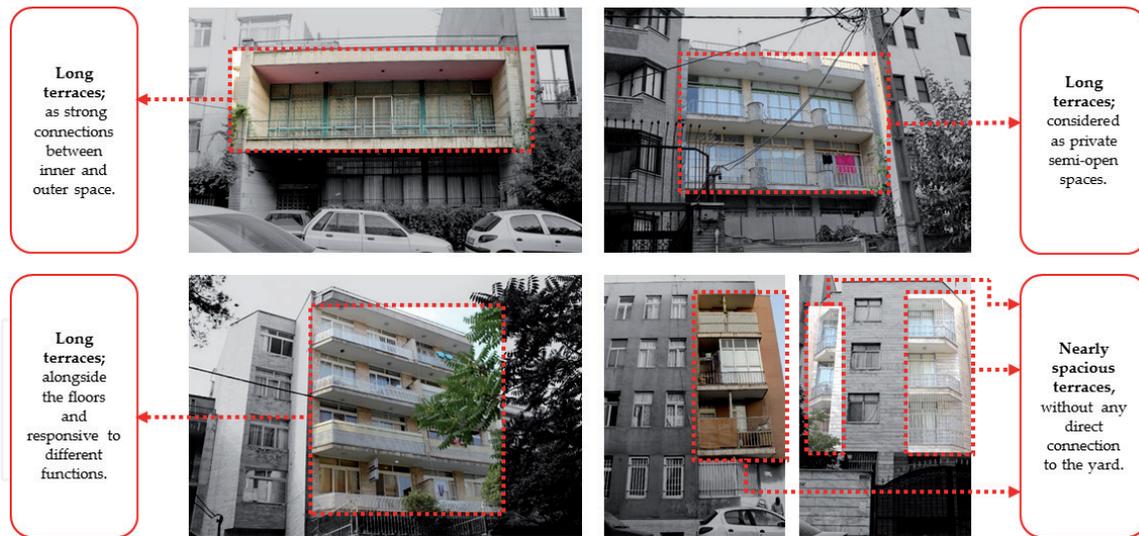


Figure 4. Old apartments designed with terraces or balconies as private open spaces [ref: photos are taken and analyzed by researchers, 2019].

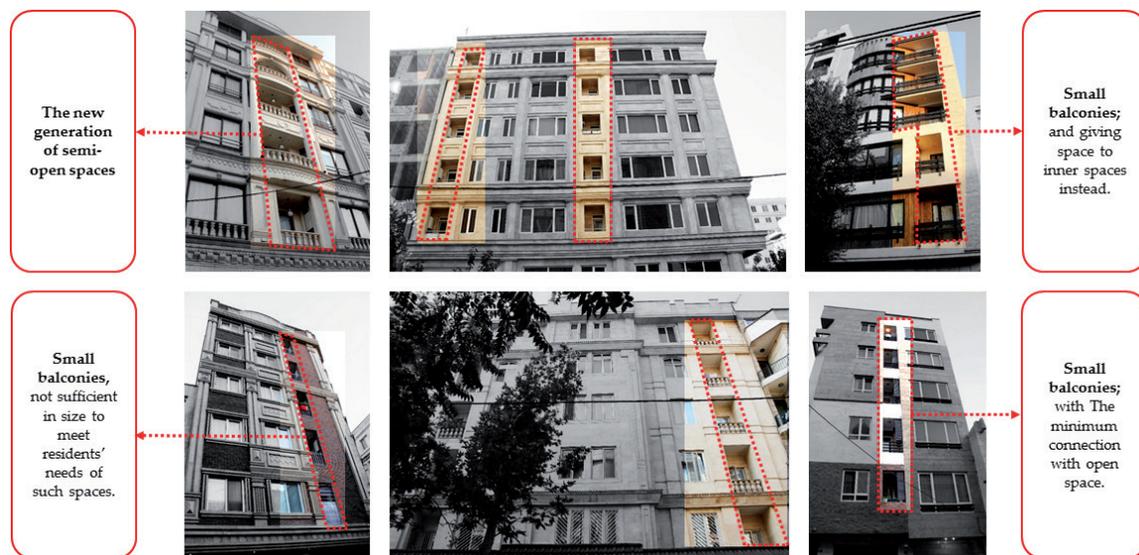


Figure 5. Younger than 5-year-old apartments designed with balconies as private open spaces [ref: photos are taken and analyzed by researchers, 2019].

for coherence on the other hand. The research focused on enhancing the capabilities of walls in creating links and distance; the capabilities resulting from the concepts of privacy and connection enriched the walls' functionality area in the construction of space (**Figure 6**).

Another research [13] emphasizes the need for intermediate spaces, asserting that joint spaces like balconies play the roles of both interior and exterior spaces and are regarded as the distance between outside and inside space. Also, Mir Shahzadeh [14] examined the role of the linking boundary space, such as balcony and porch, etc., in producing meaning.

Christopher Alexander reported a British study in the Architects Magazine (1957) concerning the balconies of apartments and small houses. He stated that two-thirds of people, for their own reasons, have never used balconies that lack privacy. And in "a pattern language" [15], a model is presented for balconies according to physical characteristics; yet only the quantitative aspect is considered in the book—for example, a minimum depth of 180 cm is considered for such spaces.

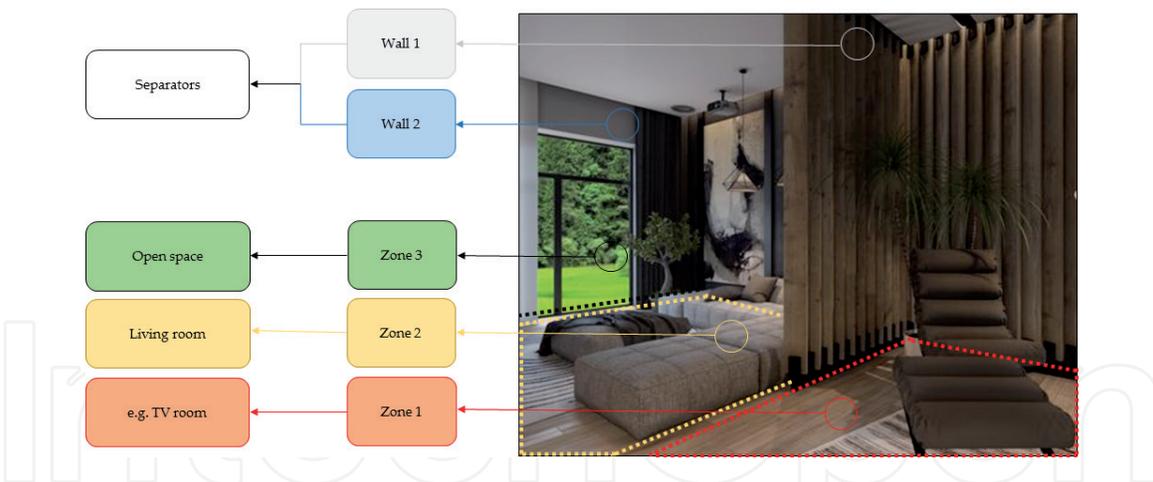


Figure 6.
Use of walls as space separators, by which links and distances can be made, adopted from [9] and analyzed by authors.

Pierre Bourdieu, a well-known French sociologist and anthropologist, also acknowledges that different lifestyles will create a distinction in the living space; the higher the social hierarchy, the higher the esthetic properties of space than its functional responses will be. Therefore, we will have distinct spaces based on necessity-favored need or luxury-favored need, an issue that can be reviewed in the balconies, but not in the present article [16].

Research by Mazandarani [17] investigating housing developments from past to present represents the foundations and status of the intermediate space. The importance of the spaces discussed in the article is underlined by the authors, and general rulings on the points that should be considered by the designers are presented. Unfortunately, there is no comprehensive discussion on balconies as discussed in article [17].

Among other international books in this field is the *Book of Life between Buildings*, which deals with the concepts of public open spaces, and the initial principles that can be used for intermediate spaces [18]. In the book *Esthetics in Architecture* [19], regarding the interactive spaces of interior and exterior, the author divides such spaces into three categories: (1) architecture without interaction with outside; (2) architecture with interaction with outside; and (3) modern architecture and border distortions.

In another study, in the chapter on zones and thresholds, the importance of focusing on the scopes that provide a correct definition of outside and inside space for the user of environment is presented. It is argued that humans create limits to understand that we belong within this environment and that we are safe. Furthermore, thresholds and passage spaces are places where the environment manifests itself. Stairs, the edges of roofs, gates, doors, balconies, windows, etc. are all regulators of this manifestation and control the penetrability of these borders. These design factors approve the space separation while at the same time create the possibility of physical and visual passages for people. Hence, the author expresses the necessity and importance of addressing such spaces, and expresses the role of such spaces in three parts: (1) use-oriented role (functional); (2) protective role, or a controlled space, through which the perspective can be seen. This role can be divided into two parts, social and physical; (3) the semantic role, being that the signs of each place, according to the common conventions and social traditions, have a special behavior in each corner and within the desired range. About the balconies, the author says: “Balconies are not practically considered as privacy zone and play the role of seeing and being seen more than the terrace and porches” [20].

Another book on this subject is the work of Rudolf Arnheim, which states: no spatial issue is as much an inherent characteristic of an architect's work given that they should consider the inside and outside spaces as related concepts. That is, indoor and outdoor areas should be considered as components of one concept [21].

To summarize, **Table 1** includes all the related literature.

Researchers looked at these spaces from different perspectives. But, as it is clear to every researcher, architecture is not meaningful outside of its context and should be designed and developed on the basis of its main context and social, cultural, and physical conditions.

Therefore, this study tries to help architects to define and explore a specific context in order to have optimal design of open spaces in residential buildings of a neighborhood. By using factors that have been previously investigated and extracted by previous studies, this research uses the case study the Kuye Nasr neighborhood to examine the lifestyle of the residents of the residential buildings. It considers the physical conditions of the buildings, the instructions and rules for improving their design quality, and the desirability of open spaces within residential buildings (balconies). The abovementioned factors will be then evaluated and the results will be available to designers as executable and functional factors.

It should be noted that during the research process, it was found out that the residents of residential buildings in Kuye Nasr were more concerned about the

Author or researcher	Year	Subject or title	Theoretical perspective	Approach
Swapan, et al. [22]	2019	Understanding the importance of front yard accessibility for community building: a case study of Subiaco, Western Australia	Front yards as semi-public-private areas can play an important role in the residents' sense of community	Behavioral
Reuben, et al. [23]	2019	Residential neighborhood greenery and children's cognitive development	The whole study puts an emphasis on the contribution of surrounding open space greenery of residential buildings on the cognitive development on the children, who were raised in such places.	behavioral, environmental, esthetic
Azad, et al. [24]	2018	Effect of housing layout and open space morphology on residential environments—applying new density indices for evaluation of residential areas case study: Tehran, Iran	Putting an emphasis on the vitality of presence of private or public open spaces and the importance of considering them in the construction laws.	Physical-environmental
Milanović and Vasilevska [2]	2018	Influence of private open spaces on the quality of living in low-rise high density housing	The research focuses on the advantages of private open areas	Behavioral physical
Einifar and Ghazizadeh [10]	2010	Typology of residential complexes of Tehran with open space measure	Importance of paying attention to lost spaces such as open spaces in residential buildings	Physical, behavioral

Author or researcher	Year	Subject or title	Theoretical perspective	Approach
Einifar and Ali Niaye Motlagh [11]	2014	Explaining the concept of outside-inside in in-between spaces of apartment housing “the case study of balcony in three types of Tehran residential complexes	Considering the secondary functions and multi-purpose nature, the intermediate spaces are among the planning, and design needs to improve the quality of life in apartment housing	Physical-environmental
Badeie [12]	2002	Walls-privacy connection	Philosophical review of connection space	Meaning, behavioral
Rezakhani [13]	2013	An introduction to the concept of joint in architecture based on Heidegger methodology of word etymology	Joint etymology	Meaning
Mirshahzadeh, et al. [14]	2013	The role of boundary space in the creation of meaning	Semiotics approach in boundary-connection space	Esthetic, meaning
Alexander [15]	1977	A pattern language: towns, buildings, construction	Physical examination	Physical
Bourdieu [16]	2013	Distinction: A social critique of the judgment of taste.	Effect of lifestyle on spaces	Behavioral
Haeri Mazandarani [17]	2009	Home, culture and nature	Past developments have changed for the present day and represent the foundations of the space between them	Physical
Gehl [18]	2011	Life between buildings: using public space	Expression of the rules of public open space	Behavioral, physical
Grütter [19]	2014	Grundlagen der Architektur-Wahrnehmung	The division of architectural time periods regarding the relationship between inside and outside space	Physical, perceptual
Von Mayes [20]	2013	Elements of architecture: from form to place	The importance of focusing on the scopes as the elements separating inside and outside	Behavioral, physical
Rudolf Arnheim [21]	1977	The dynamics of architectural form	Relation between inside and outside and attention to this in architecture	Meaning, behavioral
Bentley [25]	1985	Responsive environments: a manual for designers	The strong role of designers in designing flexible ways to keep track of the budget	Behavioral, meaning
Lawson [26]	2007	Language of space	It addresses the issue of realm and perceptual mechanisms in space	Behavioral, meaning

Table 1.
Selected papers referring to open spaces and relevant measures.

functional aspect of balconies. Hence, this component has been emphasized more than several other factors influencing the usefulness of balconies. The main questions that this research tackles are what factors can satisfy the residents of the Kuye Nasr residential buildings regarding their balconies, and what is the association between the influential factors in the desirability of private open spaces?

To achieve this, the concerns, needs, and opinions of the residents of Kuye Nasr were determined through a field study and interviews, based on which a number of factors were extracted. The validity of such factors was then examined by means of a questionnaire; those factors with a higher statistical weight were presented as features that should be applied by designers of balconies.

2. Theoretical framework

2.1 The connection between interior and exterior space

The interior of each place is distinguished from the exterior and the surrounding environment by various spatial elements. People have always lived in both outside and inside environments and must be active between these two poles. Consequently, both of these currents cannot be separated, but it is possible that the impact of one of them outweighs the impact of the other. In fact, the kind of governing relationship between the external and internal environment is determined by the spatial relationships between these elements. The structuring and arrangement of these relationships (relations between inside and outside) result from the contradiction between them; that is to say, the separation of a protective shelter from the surrounding area on one hand, and the establishment of the relationship between the two locations on the other hand, are essential for human life. This contradiction is revealed only when the characteristics of the inside and outside location are compared. In spite of these contradictions, there are relations between the inside and outside. According to Christian Norberg Schulz, the relations and conditions governing these two create the art of architecture [19].

Many activities take place around low-rise residential buildings with direct access to the outside. What's more, there is a flow between the inside and the outside; for instance, in order to know what is going on outside, residents can quickly step out or drink a cup of coffee on the stairs. While multi-story buildings, have less inhibiting them from stepping outside and being among their residential community [18].

Therefore, the role and influence of the intermediaries of the outer and inner space (such as the balcony) are not only undeniable, but also quite significant. Hence, by eliminating or ignoring each of them, the interfacing of the inner and outer spaces is disturbed and the quality of spatial sequencing is declined. Therefore, maintaining the identity of such spaces and optimizing their architectural design is of great importance today.

2.2 Private open spaces

The border between the closed space and the surrounding open space can be understood as the interface of two worlds. The set of elements—the main function of which is to keep the open space from being enclosed—is called a building and plays a significant mobilizing role in the integration of the interior and exterior space. The best example of such spaces is in traditional Iranian architecture. Semi-open spaces have played an important role in traditional architectural spacing in

the past and in the Iranian traditional architecture. The appearance and geometry of these spaces get their models from the features of their own surroundings, and these areas have hosted a range of individual and social activities. This character has been constructed simultaneously in the building in past architecture; modern semi-open spaces do not invite such human interactions and past times as they did in the past and generally lack architectural value. Today, semi-open spaces can be a good way to link human life with nature [1].

In Iranian homes, there is always a space between open and closed spaces. Indoor spaces between closed and open spaces are spaces that provide a variety of facilities for activities of the home and the community; such a presence offers a new connection with nature, light, and climate. Indoor spaces in Iranian homes have varied sizes and functions and are as important as open and closed spaces [27, 28]. Having said that, the presence of indoor spaces in the space organization of contemporary houses has dropped significantly. In some cases, the presence of a porch toward the yard creates a usable connector space between the open and closed space. In the upper floors, the covered terraces and balconies are the covered spaces. These spaces usually are not used completely, and in many cases they are presented as an abandoned floor. Although the balconies and terraces today are located along closed spaces, people prefer not to occupy them due to an undesirable view. Rather, residents typically use balconies as a storage. Nevertheless, these balconies can provide both the perspective and light from the northern and southern fronts for closed areas of contemporary houses [17] (**Figure 7**).

2.3 Designing private open space (balcony)

Many resources that provide designers with information on how to design spaces also include a series of criteria and components about the design of balconies; for example, Neufert et al. stated that balconies are effective factors in increasing the attractiveness of residential units. Balconies also create a space for some activities, such as outdoor play area for kids that can be easily monitored [29]. Furthermore,

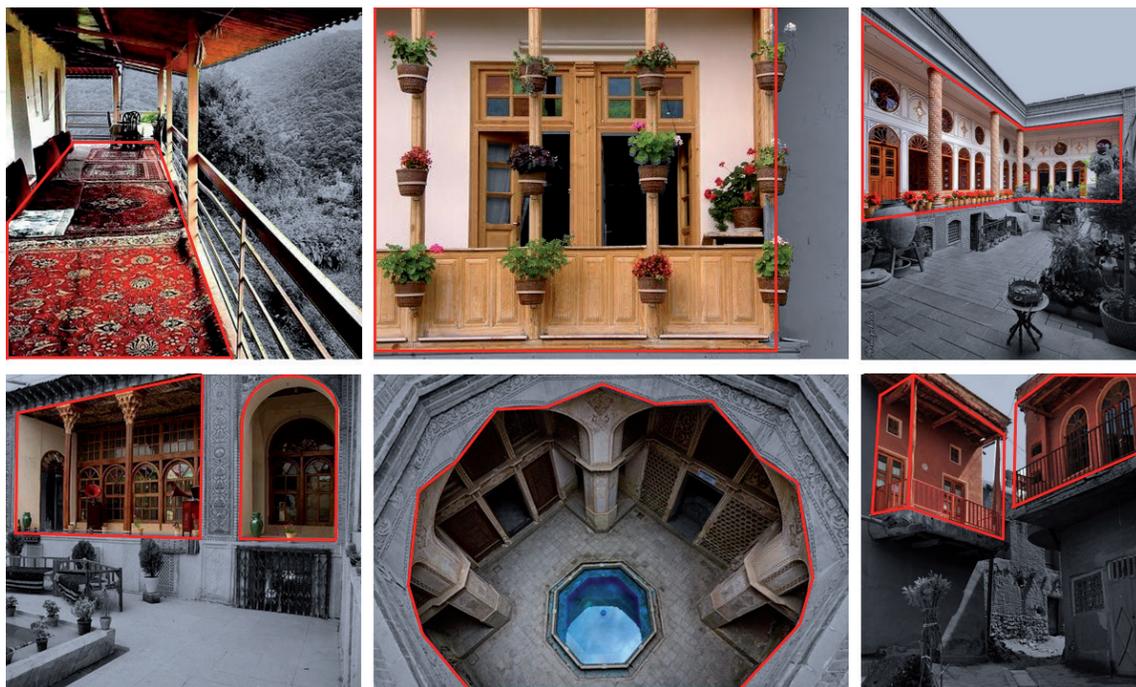


Figure 7. Areas that are located between the inner and the outer spaces of Iranian houses are highlighted in the images, adopted from [9], analyzed by authors.

balconies can be used to rest, sunbathe, study, eat, etc. In addition to the bio-functional aspects required, a space for the flower box in each part of the balcony is needed [30].

According to the Housing Design Handbook on Balconies Under Regulation and Principles, balconies should cater to the following uses: children's play space, a space for drying clothes, a space for sitting, gardening and planting, keeping pets, etc. [31].

Time Savers Standards for Building Types presents residents' opinions on what a balcony is ideally used for: people who have discussed much about the balconies and their positive role have emphasized the pleasure of using and sitting outside. In addition, they emphasize the visual expansion of life space and the opportunity to grow plants and use the balconies to store equipment [32]."

Therefore, the following uses are extracted from the studies on the design of balconies: "children playing, relaxing, sunbathing, studying, eating, keeping flowers and plants, drying clothes, sitting, keeping animals, and warehousing equipment." However, the factors mentioned are very general and it cannot be said that it is definitely welcomed by the residents in the specified neighborhood in which the research is carried out. Therefore, it is necessary to obtain an estimation of these factors and the factors extracted from the interview section, evaluate them quantitatively in the statistical population, and assess their external validity.

2.4 Description of theoretical model

2.4.1 Influential components in designing private open areas in residential buildings

The collection method of influential factors in the design of private open areas was discussed in the previous section (interviewing the residents of Kuye Nasr residential buildings and surveying balcony design studies). All collected factors are categorized into six groups as dependent variables, which can affect the quality of a space like a balcony. The components are classified based on a theoretical framework shown in **Figure 8**.

2.4.1.1 Esthetic aspects

This is a system based on balance and harmony. Regularity, balance, and fit are perceived and viewed automatically by the viewer and recognized for its beauty [19]. The beauty factors of balcony and the presence of greenery on the balcony belong to this category.

2.4.1.2 Behavioral aspects

These aspects include the hierarchical ordering and functional domains, access hierarchy, spatial hierarchy, and the hierarchy of various functions forming the communication between inside and outside spaces [33]. The functional structure of space affects the occurrence of behaviors in the environment and is simultaneously affected by the behaviors and anticipation of their occurrence [11]. Hanging clothes, sitting in the open air, cooking or barbecuing, smoking, using tools, entertaining children, enjoying a safe space, and escaping people are in this category.

2.4.1.3 Environmental aspects

The environment and behavior are so intertwined that it is difficult to separate them. Therefore, human behavior should be defined in an environmental context. In the past, the environment was considered as an independent variable that

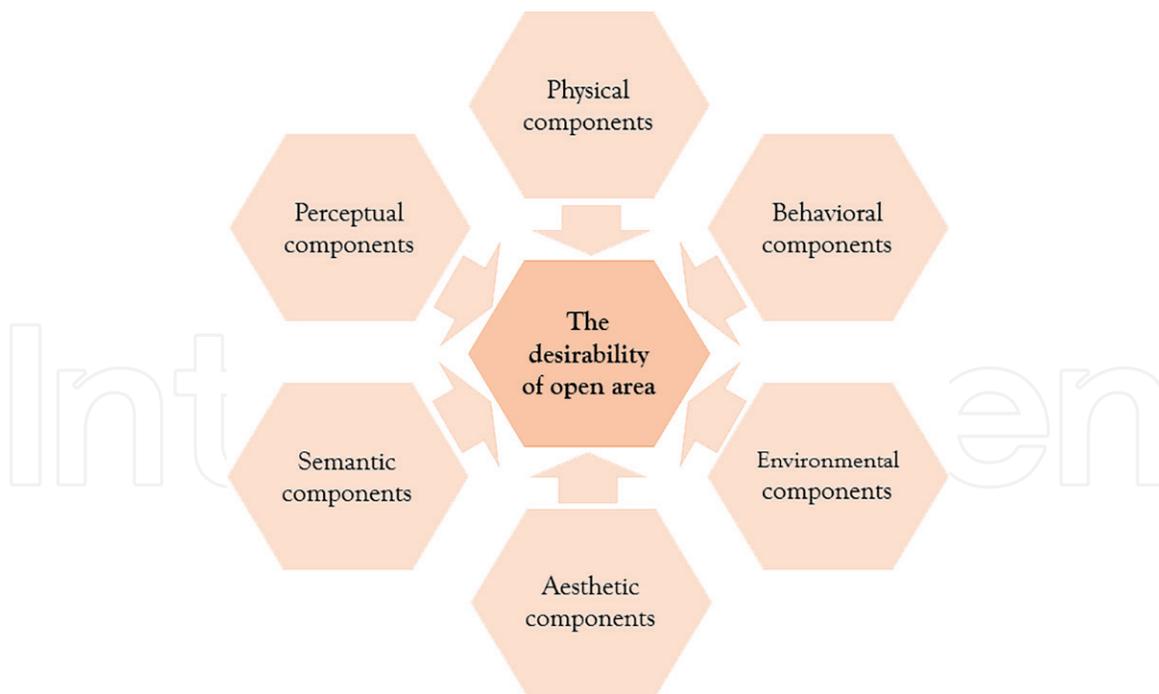


Figure 8.
Influential components in increasing the desirability of private open spaces.

affected behavior, shaped it, and created it. Consequently, one of the implications of this traditional approach is that human authority over the environment must be limited and the environment must be coordinated with people in a constant and unchanging form. Recently, however, research has been emphasized to have flexible and variable designs for the environments. In fact, people are now the cause of environmental change and are not limited to environmental influences [34]. Climate factors, tranquility and comfort of the balcony, and balcony orientation fall into this category.

2.4.1.4 Physical aspects

Physical factors include physical and visual order, balance in open and closed environments, walls, and physical bordering structure [35]. Proportional factors and the area of the balcony are included in this category.

2.4.2 Perceptual-semantic aspects

The most common approach to human psychology is one that considers several inner processes: perceptual reactions to the environment (how people understand and organize environmental stimuli and react to them), emotional and motivational states associated with environmental stimuli (psychological pressure and negative or positive emotions), and cognitive reactions to the environment (estimates of affluence, complexity, and meanings of the environment). This component considers humans as beings that have internal processors and deals more with mental and psychological processes than with obvious behavioral responses [34]. This factor is related to the human mental perception of the living environment. Visual communication, scale, and proportions, creating the sense place attachment and the sense of separation from space, visibility, and perspective from outside to inside and from inside to outside belong to this category of communication. The perception of sky, earth, buildings, surrounding spaces and, in general, the surroundings and relationship with them actually develop through giving meaning

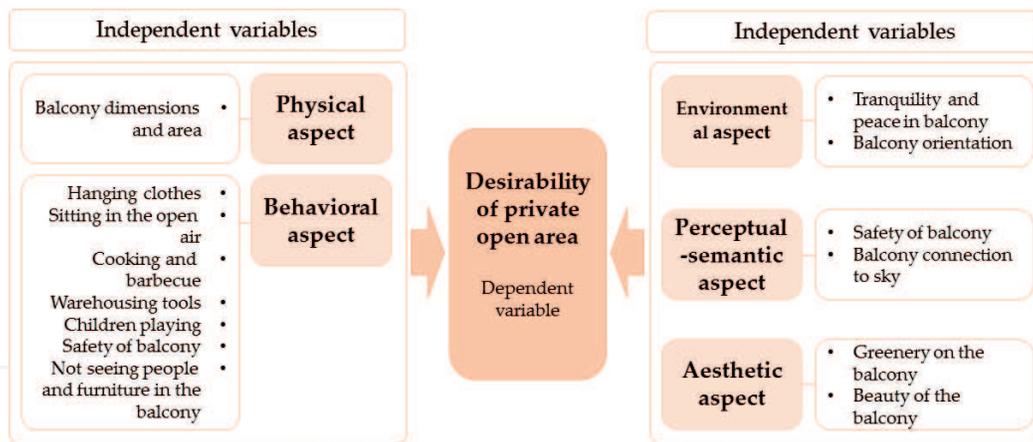


Figure 9. Theoretical model of desirability of private open areas including five main aspects including physical, behavioral, environmental, perceptual semantic, and esthetic aspects.

Statistical methods and tests	Application	Type of statistical method
Frequency and rate of frequency	Describing demographic variables, describing main questions and variables	Descriptive statistics
Spearman correlation, chi-square test, one sample chi-square, Friedman rankings	Testing hypotheses	Inferential statistics

Table 2. Statistical methods.

to the environment. This component is completely subjective before becoming an objective one [11]. Factors such as the security of the balcony space and the connection of the balcony to the sky fall into this category.

Therefore, based on the title of this article, “Effective factors on desirability of private open spaces in residential buildings”—independent components in a six-class categorization, in line with the following model in **Figure 9**— have a linear effect on the desirability of private open spaces as a dependent variable.

The next section investigates the role of the abovementioned components as influential independent factors in the design of a desirable balcony and introduces the methods and statistical patterns used to explore it, a summary of which is shown in **Table 2**.

2.5 Case study details

Kuye Nasr is the name of one of the northwestern neighborhoods of Tehran located in district 2. The main street of Kuye Nasr (Gisha), stretching approximately 1.5 km, directly connects two main highways to each other. Kuye Nasr has well-organized even and odd streets with English architecture and a complete grid-system urban structure with a total of 41 streets.

The reason for choosing this neighborhood as the case study of the research is the systematic grid texture of the district, which caused the lands in this area to be segmented north-south (regular northern and southern streets). Hence, the research and presentation of this proposal is more targeted and systematic compared to situations where buildings are studied in organic texture or other urban structures. Therefore, by distributing the questionnaire in a homogeneous statistical society, the final result will be generalizable and will have a greater external validity in the statistical population (**Figure 10**).

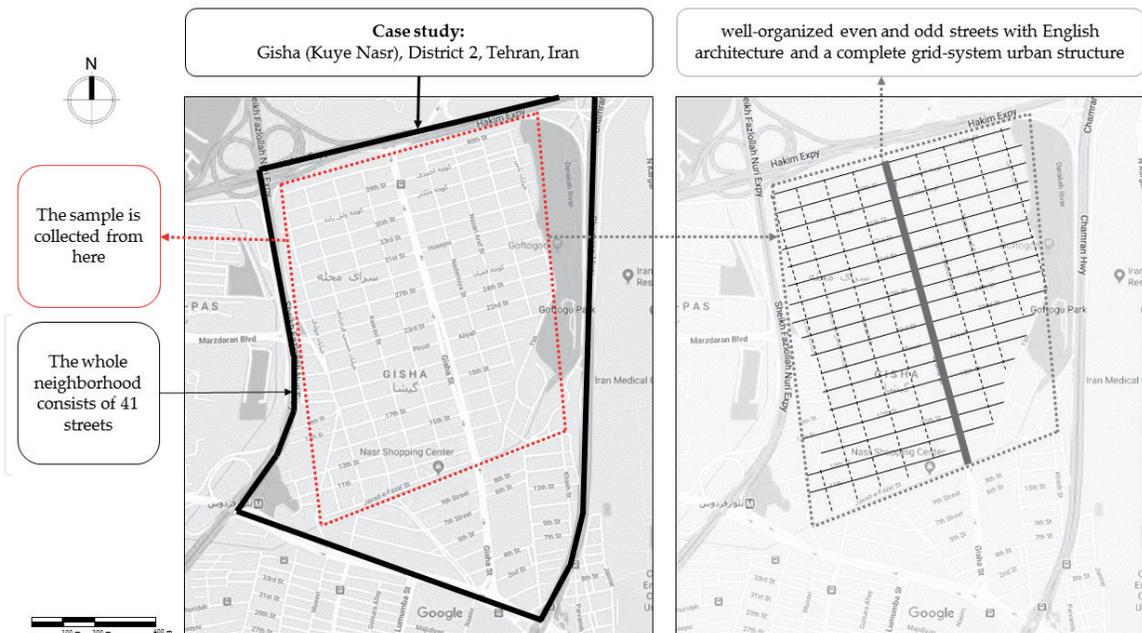


Figure 10.
Aerial map of the neighborhood, adopted from [9], detailed by authors.

3. Methodology

3.1 Type of research

The present research is categorized as applied research using quantitative method [36] and, using the results of the study, seeks to help improve and optimize the behaviors, products, structures, and patterns used by human societies.

3.2 Research method

The researcher photographed residential buildings in the intended texture to primarily extract the design factors of buildings. Next, using the interview method, the researcher collected the views and opinions of the residents of the residential buildings (the statistical population) regarding balconies; the optimal design factors for such spaces were collected by default. In order to ensure and assess the validity of the default factors, statistical studies (quantitative research method through the questionnaire tool and analysis of these data through SPSS 23) were implemented.

3.3 Research tools

This quantitative research method was adopted, in the form of a questionnaire distributed among people over the age of 20 who were living in the area. After the required data was collected, the principles, methods, and results of statistical analysis were used to study the validity and generalizability of hypotheses in the neighborhood.

3.4 Statistical population

The statistical population of the study includes the building residents in the Kuye Nasr neighborhood. The reason for choosing Kuye Nasr as the statistical population is the systematic grid texture of the neighborhood, which has

led the lands to be segregated as northern and southern (regular northern and southern streets); therefore, the research and presentation of this proposal are more targeted and systematic compared to situations where buildings are studied in organic textures or other urban structures. Therefore, by distributing the questionnaire in a more homogeneous statistical society, the final result will be more generalizable and will have a greater external validity in the statistical population.

3.5 Statistical sample and sampling method

The research sampling method was a simple random sampling method. That is, from 20 alleys with even numbers and 20 alleys with odd numbers, two or three residents were selected randomly. After introducing the researcher and purpose of the study, the questionnaires were distributed. In total, 100 questionnaires were completed and analyzed.

3.6 Validity and reliability of the questionnaire

3.6.1 Validity

The validity of the questionnaire was tested by a non-statistical method; specifically, through confirmation by a number of experts. Experienced professors and PhD students in the field of architecture reviewed and approved each item on the questionnaire.

3.6.2 Reliability

Cronbach's alpha was used for the three-item questions. Cronbach's alpha coefficient was used to assess the reliability of the questionnaire. The most commonly used method for calculating reliability is the Cronbach alpha, which is called the alpha coefficient. The general rule is that the Cronbach alpha value of a scale should be at least 0.7 [37]. The Cronbach's alpha coefficient of the questionnaire is indicated in **Table 3**.

As can be seen, Cronbach's alpha value of the questionnaire is higher than the criterion 0.7, which confirms the reliability of the questionnaire.

Variables	Cronbach's alpha
Reliability	0.78

Table 3.
Reliability through internal consistency method (Cronbach's alpha).

4. Analysis and results

4.1 Analysis of the results obtained from field observations

A field study of the current balconies in the apartments or houses available in the site (**Figures 11, 12**) indicates that a large percentage of balconies on the first floors, which have easier access to the street or alley, are changed due to security concerns. That is, the balconies have lost their original form, creating a special



Figure 11.
(a) Northern apartment. (b) Southern apartment.



Figure 12.
(a) Southern apartment. (b) Northern apartment.

irregularity in the facade (as indicated in the figures below). The residents, for example, have fenced the balconies or have covered the open sides, so that they are safer and cannot be seen when they are on the balcony. Therefore, it can be concluded that it is best to design the balconies of the first floors in such a way that security is considered as a significant point in the design. It should be designed such that it does not require future changes by residents.

4.2 Analyzing the results of interviews

During their interviews, building residents were asked to identify their primary concerns regarding the balconies so that the researcher can start designing the questionnaire with an appropriate initial perception.

4.2.1 A list of primary requirements of residents regarding balconies is given below

The following requirements of residents in terms of using balconies are as follow: hanging clothes, planting flowers, cooking, having a spare section for putting kitchen appliances that are better kept in the open air, children's playing, having a view to beautiful landscapes, ventilation, and connecting balconies with kitchen (**Figure 13**).

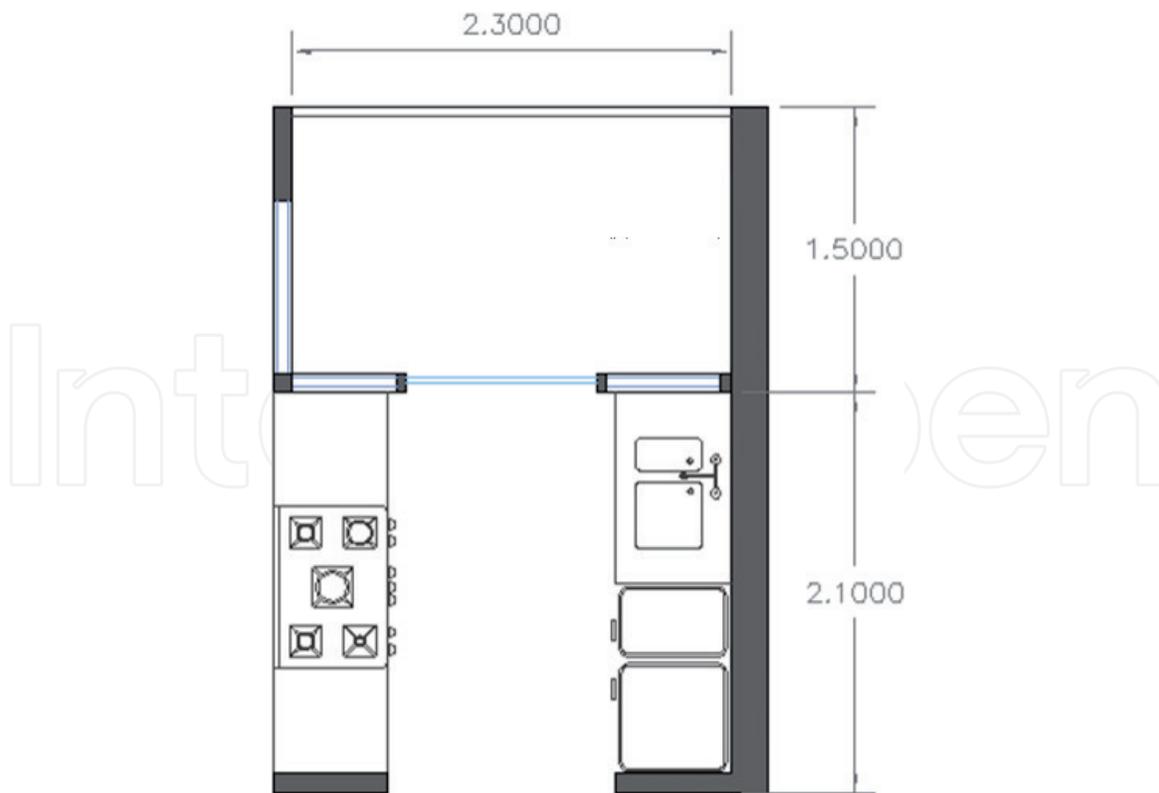


Figure 13.
Sample plan of a balcony connected to the kitchen, drawn by authors.

4.2.2 Connection between balcony and kitchen

The connection between kitchen and balcony is one of the main suggestions and requests made by Nuye Kasr building residents. During the interview process, the following reasons were extracted:

- The connection of the open space (balconies are almost the only open space available to the units) and cooking allows easier access to foodstuff and dining when barbecuing, as well as better ventilation of the kitchen while cooking.
- A space for sitting and drinking tea, having food, etc.; such a place is better to be connected to the kitchen.
- Access to kitchen appliances that are best protected in the open air.
- Proximity and easy access of the kitchen to the balcony to irrigate the plants on the balcony.
- A place for hanging clothes in the open air and easy access to the kitchen; nowadays, washing machines are embedded in this space.

All of the abovementioned arguments indicate that balconies are better placed and more efficient when connected to the kitchen. Thus, it can be concluded that in the intended neighborhood, the functional dimension of the balcony is highly regarded.

4.3 Analysis of the results

- Analysis of questions related to the main research hypothesis indicates that the presence of spaces, such as balconies, is essential in modern residential

housing. A total of 99 out of 100 people who answered to the questionnaire agreed with the necessity of a balcony presence in their residential units. The results in **Table 4** also illustrate that the significance level of chi-square is less than the assumed value of 0.1, thereby confirming the hypothesis.

- Analysis of the demographic part of the questionnaire shows that tenants and homeowners do not differ in their need for a balcony, indicating the importance of designing balcony for residential houses of both types of economic situations. As shown in **Table 5**, the significance level of the chi-square independent test is 0.507 and is more than the assumed value of 0.10. This means that there is no significant relationship between the status of the residents of being tenant or owner and the need for a balcony.
- The activities performed on balconies nowadays are ranked in **Table 6**.

The comparison of the average ratings (**Table 6**) shows that the highest average rating for flowering and planting activity is at 5.55, which means that this is the most common activity on balconies. The activity of hanging clothes with an average of 5.43 and sitting in the open air with an average rating of 5.27 are the next highest ranking activities. The lowest average rating (3.09) is for children's activity, which indicates that children playing on the balcony have the lowest activity.

Type of relationship	Chi-square value	Degree of freedom	Significance level
Necessity of balcony	87.36	1	<0.001

Table 4.
Chi-square test: investigating the necessity of balcony presence.

Type of relationship	Chi-square value	Degree of freedom	Significance level
Between owner or tenant and necessity of balcony	1.356	2	0.507

Table 5.
Chi-square test: investigating the necessity of balcony from owner or tenant point of view.

Rank	Dimensions	Average score
1	Plants	5.5
2	Hanging clothes	5.43
3	Sitting in the open air	5.27
4	Enjoying view	5.12
5	Cooking and barbecue	4.80
6	Smoking	3.49
7	Storage	3.25
8	Children's activities	3.09

Table 6.
Friedman test: ranking of activities carried out on the balcony.

5. Satisfaction measures for designing private open spaces and future studies

It should be noted that considerations such as balcony dimension and area, the presence of greenery on the balcony, the connection of the balcony with the sky, comfort and tranquility of the balcony area, balcony space security, not being observable on the balcony, functionality of the balcony, and the beauty of balcony are the influential factors in the satisfaction of residents of buildings of their desirable private open area.

This topic of desirability and sustainability of private open areas can be extended further based on the following directions:

- Implementing new digital technologies including the Internet of things (IoT) [38] and geographic information system (GIS) [39–41] for monitoring and evaluating the space quality;
- Adoption of open space desirability measures in different types of buildings in dense urban areas [42];
- Challenges and opportunities for sustainable development of private open spaces to sustainable development of societies [43, 44];
- Investigating the process, factors, barriers, drivers, and decision makers using NVivo for analyzing the desirability of open spaces [45, 46];
- Analyzing the trend of private open spaces toward sustainable smart cities [46];
- Promoting more integrative strategies between stakeholders to improve the quality of private open spaces [47, 48].

6. Conclusion

This study tries to find ways to optimize the private open spaces of residential buildings; to this end, the required results were obtained through the analysis of the data and with the help of quantitative methods. The results are presented in the form of logical propositions. Firstly, this study recommends that the designers of the Kuye Nasr residential buildings consider security issues so that first-floor residents can use such spaces without the need for changes or extensions to the building's facade. Secondly, the functional features of balconies are of great importance to residents, and thus, its desirability factors should be paid close attention. Thirdly, the kitchen is the best and most welcoming space to be connected to the balcony. The kitchen offers the most suitable space connection in the buildings, in line with the functional aspect of the balcony. Fourthly, neighborhood building residents advocate for desirable factors including the presence of greenery on the balcony, the connection of the balcony with the sky, the tranquility and comfort of the balcony space, the security of the balcony, not being observable on the balcony, the functionality of the balcony, and beauty of the balcony. Finally, the present study ends with this question for future researchers: to what extent will the desirability of different parts of Iranian homes, which have been forgotten today or lack suitable quality, help improve the quality of their living spaces.

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