# Secondary Spaces of Entrance, Corridor, and Balcony in Tehran Housing - A Comparative Analysis with Nagoya Residences (Case Studies: District 9 Residential Units of Tehran, Municipal Housing Units of Nagoya)

*Due to increasing costs and shrinkage of Tehran housing, interior layout plays a more critical role. In addition to the main spaces, such as the bathroom, kitchen, and bedroom, which are present and vital in each residential unit, we identified entrance, corridor, and balcony in our Tehran samples as secondary spaces. We aim to investigate these spaces' role in Tehran's current housing; we analyzed their existence, size, and relation with the unit's total area by considering the background and history of these spaces. Japan's experience in small housing convinced us to utilize under 100* $m^2$ *of Nagoya samples for comparison. Results revealed sufficient area for these three spaces in all Nagoya samples. In contrast, these spaces in a large percentage of Tehran samples did not exist or lacked efficiency contrary to related rules and regulations. There was a weak correlation between unit size and the lack of entrance and balcony, but corridor was usually removed in smaller units. We suggest separate entrance and corridor as essential spaces and not optional, regardless of unit size. Also, transparent, and visible balconies, especially in dense urban areas, are incompatible with the Iranian lifestyle and should be adjusted to cultural beliefs and norms.*

**Keywords:** *Tehran housing, Residential unit, interior layout, Secondary space functions, Entrance, Corridor, Balcony,*

## Research Background

### *Purpose of Research*

In Iran, traditional houses with a central courtyard which has been the most common form for centuries, were replaced by terraced houses. In the 1940s, the growing population and housing demand increased land values and density. Terraced houses, the most common type of modern housing, were built first in Tehran and then spread throughout the country[1]. In the 1970s, the government allowed multi-story buildings, and mid-rise apartments replaced low-rise houses. This shift towards apartment living was driven by a change in lifestyle and the size of households, resulting in smaller residential units in large cities[1]. In today's compact urban dwellings, the quality and layout of interior spaces are more important than in the past. While the main space functions of a residential unit, such as the toilet, bathroom, kitchen, living room, and bedroom, are vital, the secondary spaces of the entrance, corridor, and balcony also play a significant role in enhancing the performance of these main spaces.

We study the influence of cultural, social, and architectural factors on the design and layout of residential units in Iran and also conduct case study research.

We use Japan's experience as a country with expertise in building small apartments to benefit our research[2]. A key part of this study involves comparing both countries' importance of the entrance, corridor, and balcony. In Tehran, such space functions may not always be present in apartments with minimum basic size due to limited space. Still, they are supposed to be found in larger or more luxurious apartments where they can create a hierarchy between different space functions and improve the overall interior layout. In Japan, residential units' interior layouts are described by nLDK (n: number of bedrooms, L: living room, D: dining room, K: kitchen)[3], which typically include a small entrance space (*genkan*), and may also have a corridor leading to the main living room[4,5]. Some units may also have verandas or balconies[6].

We aim to understand the characteristics and role of secondary spaces within the interior layout of urban residential units in Tehran. We identify their presence and measure their size to examine their relationship with the overall area of the residential unit. The research also compares the characteristics and presence of entrance, corridor, and balcony in Tehran with those in Nagoya, Japan, to distinguish any differences or similarities and potentially benefit from Japan's experience through case studies and literature review. The findings of this study can be used to design residential units to improve the performance and livability of the interior spaces of dwelling units in urban areas. At the same time, some studies have compared architectural concepts in Iran and Japan[7,8]. However, there is no comparative research on a specific part of the house, such as the entrance, corridor, or balcony, in current residential units in Tehran and Nagoya.

*Research Limitation*

This study, conducted as part of a doctoral thesis, focuses on the delicate matter of interior parts of housing, which directly impacts individuals' privacy and is subject to specific limitations. Despite encountering various challenges and limited options, our objective was to carefully select case studies that were as homogeneous as possible and conduct precise measurements on them.

Nonetheless, future initiatives aim to minimize these obstacles by engaging in effective correspondence with relevant authorities to acquire accurate data and employ particular research methodologies. This approach will support the precision of results and analyses. Consequently, the research outcomes can contribute to developing recommendations, design guidelines and criteria, and revisions or establishing related rules and regulations. These measures will significantly impact the enhancement of efficiency and quality in interior spaces of residential units.

*History of Entrance, Corridor, and Balcony in Iran*

In Tehran, urbanization expansion and population growth intensify the housing shortage every year[9]. The current lifestyle has influenced the layout and interior spaces of apartment units. A variety of interior spaces that used to be critical in the past were gradually reduced in size or even eliminated[10]. For instance, traditional houses had a step-by-step approach to entering and accessing private room[11]. This hierarchy was a fundamental principle of Iranian architecture[12,13].

The *hashti*, *dalan*, and *eyvan* (*iwan*), known as archetypes of interior spaces of traditional Iranian houses[12,14] are the most similar equivalent for these three secondary spaces in current residential units. The entrance (hashti), corridor (dalan), and balcony (eyvan) had a key role in traditional Iranian houses[12,14]. Hashti, in most traditional houses and buildings in Iran, was the space behind the Sar-dar (doorway). The word hashti has been used in traditional Iranian architecture to describe a covered area at the entrance of a house. This term is derived from the Iranian word “Hasht,” which means eight and refers to its design as an octagonal space[15]. However, hashti are constructed in many different shapes, such as hexagonal, square, and rectangular designs. There were also some platforms (*saku*) in hashti for people to sit on. Hashti is also where guests can stay before being admitted into the main living area. Hashti has more ornamentation and a seating area in more luxurious homes[16].

The dalan refers to a corridor that usually leads to the courtyard that connects different parts of a traditional house. This space used to be a long corridor in large and luxurious houses. Dalan also contributed to a sense of privacy and security. The location and shape of dalan made it difficult for outsiders to see into the house's interior, and strangers could not easily access the house's private parts due to security concerns[11,17].

Eyvan is a covered semi-open space in traditional Iranian houses that is typically located at the center of the house and serves as a transitional area between the interior and exterior spaces. It is characterized by a large rectangular or square shape, with one or more sides open to a courtyard or garden. Eyvan usually has a raised platform covered by a flat or vaulted roof and is supported by a series of columns or pillars. It often features intricate tilework and other decorative elements, such as stucco or plaster carvings. In addition to providing a shaded and cool gathering space for residents and guests, eyvan also functions as a buffer zone between private and semi-private areas of the house, offering privacy for the family while still allowing for ventilation and natural light[16]. Overall, this is an important architectural element of traditional Iranian houses, and its design reflects its inhabitants' culture, climate, and lifestyle. It can be seen as an equivalent to today's balconies in apartments, providing a space for outdoor living while still being part of the house's interior.

As shown in Figure 1, hashti and dalan created intermediary areas between the inside and outside, protecting the interior private spaces from direct view and strangers' access, providing security and privacy[11,12]. In addition, intermediary spaces allowed the guest to enter gradually and adjust to the new environment

while the host had time to be prepared for the guest's reception[11]. Eyvan also here is a semi-open space facing the central courtyard. This space was one of the most notable and appealing parts because of the pleasant scenery overlooking the central yard and exposure to the fresh air. Residents could use it for various activities such as resting, having a meal together, entertaining guests, and sleeping, especially in summer[14].

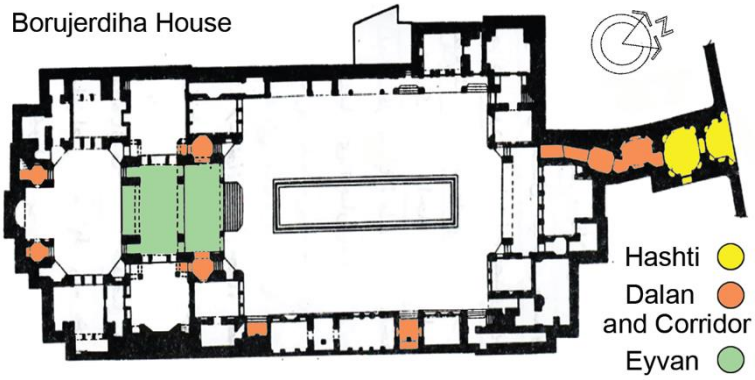


**Figure 1.** *Boroujerdiha house, Traditional Courtyard House in Iran, Kashan, 1857. All the secondary spaces are included. Hashti (entrance part) is connected to dalan (long corridor) to protect the private part of the house, eyvan is located around the center and axis of the site plan with sufficient size, and the best part of the house is dedicated to it.*
Source: Ganjnameh, cyclopaedia of Iranian Islamic Architecture, Kambiz Hajighassemi, volume I: Mansions of Kashan, published by Rowzaneh, Shahid Beheshti University, 1996[18].

Starting from the 1940s, the design of buildings and houses gradually transformed due to increased exposure to Western culture and the rapid growth of urbanization. Traditional houses used to have no windows or openings to the passage, and plain high walls separated the passage from the houses[19]. One of the changes in the housing layout was attaching a balcony to the building facade as an extroverted and Western element. This architectural element gained popularity during the late Qajar and early Pahlavi eras as the cultural and economic connections with the Western world increased. These balconies became widespread in Tehran and then throughout the country[19]. These housing changes gradually formed today's apartments and affected the units' interior layout[10].

*Previous Research*

Researchers have studied the important role of various interior spaces by scrutinizing historical and traditional Iranian houses[20–24]. Dehbandi and Einifar (2017) conducted a study on 40 traditional and 40 contemporary houses in Isfahan and Kashan, suggesting including a public meeting space in the yard and an entrance space for apartment units[12]. Safarkhani (2016) highlighted the loss of vitality in balcony and its transformation into a faded space in the urban landscape in Tehran[19]. Payami Azad (2018) found that as buildings became denser and windows less common in Tehran, the urban design and policy of spatial openness increased[25]. There is no research on the interior corridor's role inside contemporary

housing. In this study, we have focused on the details and size of current Tehran residential units' interior floor plans and various secondary space functions to emphasize the remaining gap in previous studies to understand the situation and value of Tehran's entrance, corridor, and balcony.

*History of Entrance, Corridor, and Balcony in Japan*

The typical interior space in a traditional Japanese house is shown in Figure 2. The *genkan*, a Japanese entrance space, is an integral part of a traditional Japanese house. It is a small area where people remove their shoes while entering the house. It helps residents leave the outside world and gradually adapt to the private area. Common rituals, like bowing and changing footwear, highlight this separation[4]. The use of genkan dates back to ancient Japan when people would enter their homes by stepping on Tatami mats made of woven rice straw[26]. It was a small platform slightly lower than the main living area[27]. People would remove their shoes before entering the interior parts to protect the Tatami mats from dirt and rub. Genkan was an important element of Japanese dwelling and culture; it continues to be a common feature of interior layout throughout Japan. In current residential units also, a small entrance hall (genkan) often appears just beyond the entrance door. The floor level of the genkan is situated a few centimeters below the rest of the interior spaces, creating a distinct and tangible boundary between the exterior, where shoes are worn, and the interior, where they are taken off[4]. In Japanese culture, the entrance space functions as a brief waiting area for temporary visitors or individuals seeking interaction with the residents. It's a place designated for short stays, and its clearly defined and constrained boundaries serve as a subtle signal that individuals should not cross beyond this part. This space is typically segregated from the home's main interior and private rooms. It does not provide a direct view into those areas while also preserving cultural norms and the household's privacy[27].

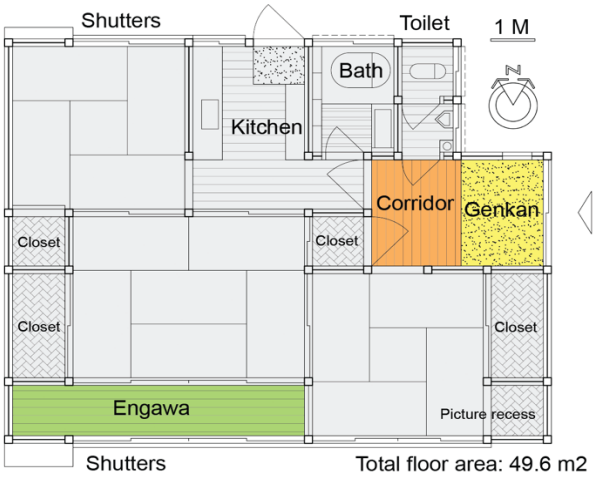


**Figure 2.** *An Example of Typical Residence in Japan, for a Family of 4-5 Persons, 17th and 18th Centuries*

Source: Measure and Construction of the Japanese House, Heino Engel, Published by Tuttle Publishing, 2020, P 58 [28]

The corridor is used for space circulation and is usually connected to the genkan. It also serves as a central point of access to the various rooms and helps to create a sense of flow and continuity within the residential unit. The corridor in traditional Japanese houses had no walls facing the outside and received only diffused light from the entrance hall. Light sliding walls provide access from the corridor to any of the interior rooms. A door often connected the corridor to the family's main living space. In traditional houses, different spaces and rooms were separated by sliding panels. From the nineteenth century, space hierarchy was more utilized by crossing the corridor and entrance. This central corridor played a significant role in modern Japanese housing. In addition to their various practical functions, these secondary spaces also maintained the family's privacy[29,30].

In Japan, veranda (called *engawa* in Japanese)[6] has a long history as a traditional feature in residential buildings instead of today's balconies. It was typically found in traditional Japanese houses and apartments and used as a transition space between the indoors and outdoors[6,26]. Due to its proximity to the outdoor environment, this space functions as a buffer zone, reducing the amount of energy required to cool and heat the temperature in indoor spaces. The engawa was often located along the perimeter of the building and was generally covered by a roof, which protected it from the sun and rain. Its visual effect made the indoor space look wide and had several functions. It was often used as a space for relaxation, where people could sit and enjoy the outdoors without being exposed to the outside. It was also used to store shoes, as it was common practice in Japan to remove shoes before entering a house. The engawa was also used to hang laundry, as this covered area was protected from the rainy weather. That was often made of wood and was connected to the main living area by sliding doors. In modern Japanese houses and apartments, engawa may be made of various materials, including wood, concrete, and glass, and may be enclosed with walls or screens to create a more private space. The engawa has been an important part of Japanese residential architecture for centuries and continues to be a popular feature in modern housing in Japan. However, engawa has been replaced with Western-style balconies in many residential apartment units today[6].

The prevalence of balconies in Japan's pre-war housing complexes was limited, but their popularity grew significantly following the war[31]. While evacuation regulations were not a direct catalyst for the spread of balconies, their availability increased due to related rules and regulations being implemented. Today, balcony is commonly included in Japanese multi-unit housing and serves various purposes, including providing service functions such as drying clothes, allowing for leisure activities such as sunbathing, and serving as evacuation routes. However, some research suggests that the primary use of balcony is for service functions, with minimal leisure[31].

## Methods

We divided this research into two parts. In case study I, we studied the residential unit floor plans of District 9 of Tehran, Iran. In case study II, we

collected our samples from municipal housing units in Nagoya, Japan. District 9 of Tehran is not among the prosperous Tehran districts and is primarily populated by middle or low-income residents. It is located in Tehran's central region, with dense urban texture and narrow passages[32]. Due to the high cost of housing in Tehran, residential units are frequently smaller than 100 $m^2$, and the area of more than half of our samples is less than 75 $m^2$, which is less than the minimum desirable area of housing for Tehran[33].

On the other hand, Nagoya is the third largest city in terms of city area and the fourth most populous city in Japan[34]. In the Nagoya municipal housing program, a prioritization system exists for low-income applicants over wealthy families or individuals. Therefore, high-income residents are not the target population for our case study. These units are home to a variety of residents, including seniors, singles, families with disabled members, single-child families, and large families[35]. Our Nagoya samples are below 100 $m^2$ in size. We attempted to select two case studies as homogenous as possible by considering the obstacles and limitations of reaching accessible data about the interior of existing residential units due to their confidential and private nature. We analyzed the architectural floor plans and identified secondary spaces within each unit. We measured the secondary spaces' area and the total unit's area to comprehend their function and importance and the relationship between their existence and the total unit's size.

The rules and regulations related to entrance, corridor, and balcony are mentioned in booklet 4 of Iran National Building Regulations (B4 INBR). The need for entrance is emphasized and described in detail in 5 clauses, demonstrating the significance of this space function. It needs sufficient space for installing entrance-related equipment, such as shoe racks and clothes hangers. After installing the equipment, at least a remaining 2 $m^2$ area with a depth of 1.4 $m^2$ is mandatory. It also emphasizes that the entrance space should restrict strangers' depth of view into the unit's interior[36], p83. Proceeding to the corridor, A separate corridor is not required for residential units with less than 75 $m^2$ of area limited to a single bedroom. However, for units with multiple bedrooms or an area exceeding 75 $m^2$, a separate corridor with a minimum width of 0.9 m is mandatory[36], p84. Regarding balconies, they are not obligatory in residential units according to B4 INBR regulations. However, if present, they must meet specific criteria. Balconies should be obstacle-free and have a minimum size of 1.40 x 1.40 meters. Additionally, the main door leading to the balcony must not reduce its width and depth below 0.9 m[36], p47.

In this study, we define the entrance space as a dedicated area after the entry door of the dwelling unit, used for storing shoes and shoe racks, and as a buffer zone separating the unit's interior from the exterior. The corridor is a separate transition area connecting various space functions within the unit, and a balcony is an exterior open space associated with a specific apartment unit.

*Data Collection from Tehran (Case Study I)*

We studied 469 residential units from 65 buildings (3-7 story) constructed in 2018 and 2019 in District 9 of Tehran (Figure 3).

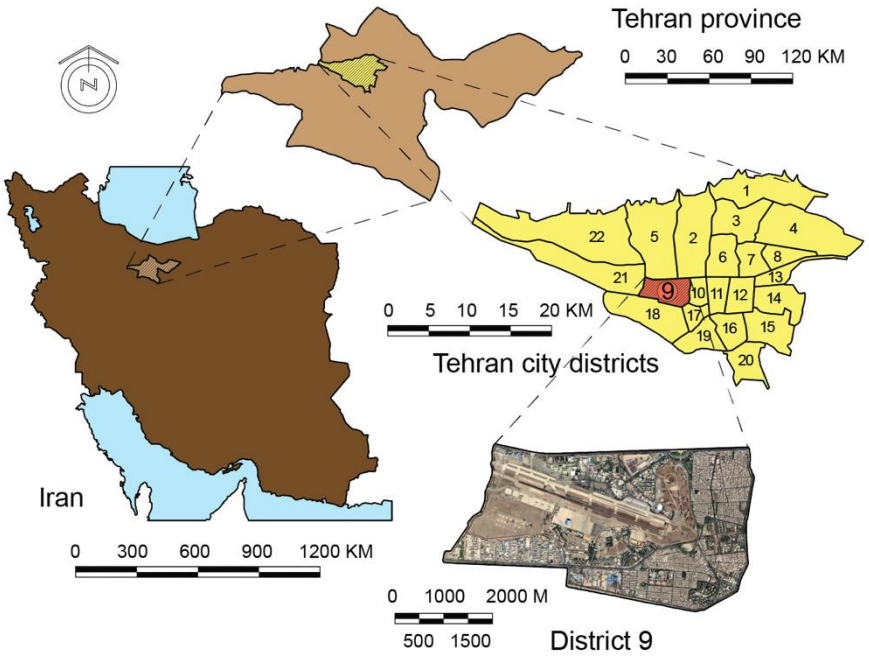


**Figure 3.** *Location of District 9 in City, Province, and Country*

The Interior layouts of units were analyzed, and two groups of space functions were classified, including main and secondary spaces. The main spaces (living room, kitchen, services, and bedrooms) were observed in all the units. However, the entrance, corridor, and balcony were not found in all the samples that in this study referred to them as secondary spaces. They varied, with entrances at 49%, corridors at 69%, and balconies at 86.

As approved by the Ministry of Roads, Housing, and Urban Development, the optimum and standard area for a residential unit in Tehran is, and 42% of our samples are over 75 $m^2$ (Figure 4)[33]. We expected a relationship between secondary space elimination and unit area. Therefore, in units larger than 75 $m^2$, we normally expected to have secondary spaces, but this initial hypothesis did not match our observations.

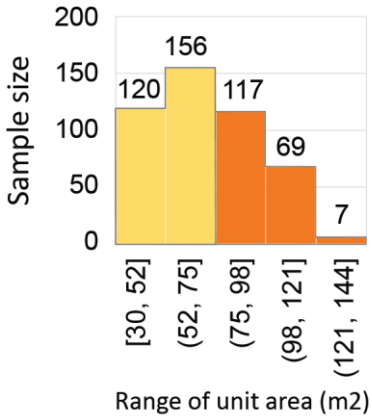


**Figure 4.** *Unit Area Distribution of Tehran Samples based on 75* $m^2$ *mentioned in Rules and Regulations as an Optimum Area of a Residential Unit in Tehran. Data Collection from Nagoya (case study II)*

We studied 1,154 apartments in 19 renovated multi-story buildings from 2015 to 2019 (Figure 5). All unit samples have a floor area of less than 100 $m^2$ (Figure 6) and each unit includes all secondary space functions.

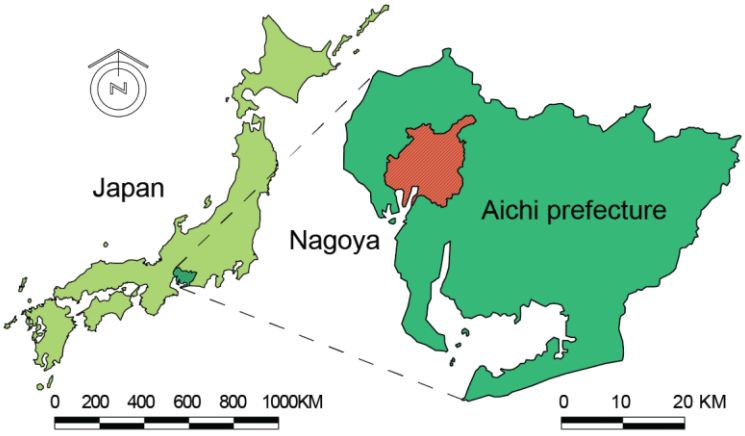


**Figure 5.** *Location of Nagoya in Aichi Prefecture, and Japan*

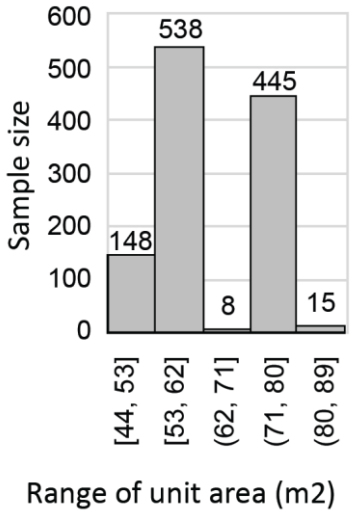


**Figure 6.** *Unit Area Distribution of Nagoya Samples, more than 90% of our Samples in Nagoya are less than 80* $m^2$

## Result and Discussion

*Case Study I (Tehran, Iran)*

The Entrance Space in Tehran Units

In a dataset of 469 Tehran samples, 51% (237 samples) lacked an entrance. Meanwhile, 17% (80 samples) had an entrance area of less than 2 $m^2$. Conversely, 32% (152 samples) exhibited an entrance area greater than 2 $m^2$. Therefore, 68% of the samples did not satisfy the minimum size requirements as specified by the building rules and regulations p83[36]. Furthermore, there was no strong correlation between the unit's size and the entrance's elimination (Figure 7,8). About 40% of units larger than 75 $m^2$ did not have an entrance; also, 53% of units smaller than 75 $m^2$ lacked an entrance.

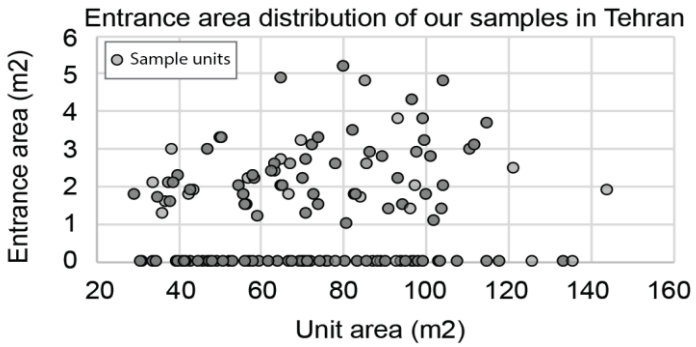


**Figure7.** *The Correlation between the Total Area of Units and their Corridor Areas in Tehran. Each Circle Denotes a Unique Sample (unit). It is Evident that the Size of an Entrance Space doesn't Significantly Correlate with the Overall Unit Area*

In the unit without entrance space, shoes, and shoe racks are often moved to the building's common area as a predictable and expected approach. When the number of units on the same floor increases, the potential tension among residents rises, and they will face unorganized common space (Figure 9). Permanent storage and placement of personal items such as shoes and shoe racks in the common spaces of the building are incompatible with the spirit of the common space and also make it hard for residents to safely evacuate in case of emergency, particularly in the staircase that often lacks natural light. In Tehran, due to the narrow width of the residential units and land plots and the small size of housing units, natural light is not a priority for staircases. In addition, Tehran is prone to earthquakes, and it is recommended to keep a disaster prevention bag in the entrance space. Storing disaster equipment close to the unit's door is difficult without this definite space. The entrance is one of the primary spaces mandated by rules and regulations, regardless of the unit size. However, as mentioned, this space function is frequently omitted and not given the attention it deserves. This negligence concerning the entrance's role can negatively impact the unit's overall functionality and safety (Figure 10).

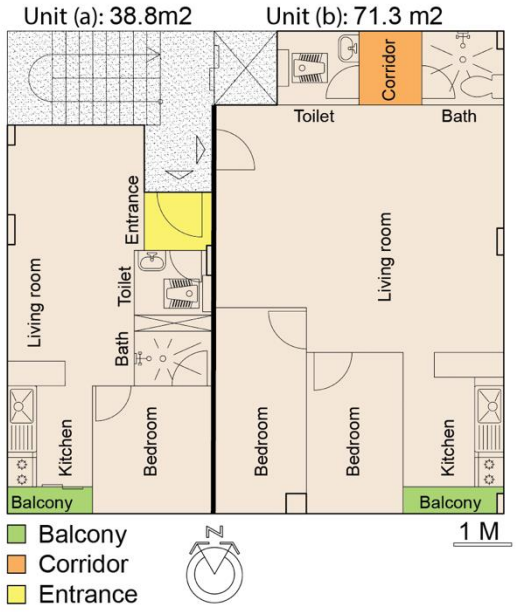


**Figure 8.** *A Representative Sample of Entrance Spaces in Tehran Residential Units. Unit (a) shows the Presence of an entrance Space in a Smaller Unit, while unit (b) Demonstrates its Absence in a Larger Unit*
Source: Authors

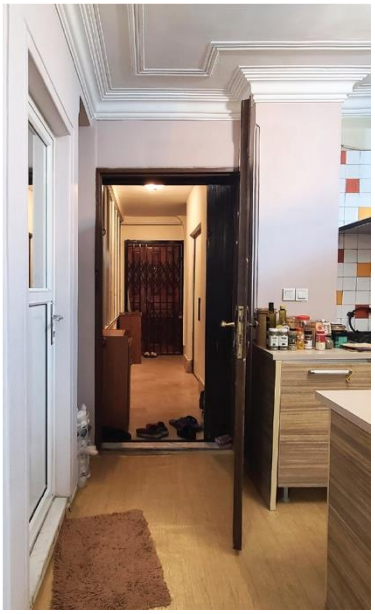

**Figure 9.** *An Example of Two Units on the same Floor in Tehran with no separate entrance, the interior exposed to a direct view of the neighbor, and the building's common space used for shoes and shoe racks*
Source: authors

**Figure 10.** *The Interior of a Sample Unit in Tehran without any Separate Entrance Space*
Source: authors

The Corridor in Tehran Units

There is a correlation between the size of a residential unit and the presence and size of a corridor. In smaller units, the need to allocate sufficient space for other main spaces, sometimes eliminates corridors, as shown in (Figure 11). This

lack of corridor was observed in 31% of the analyzed samples, and it was particularly prevalent in units with a floor area of less than 75 $m^2$ (Figure 12).

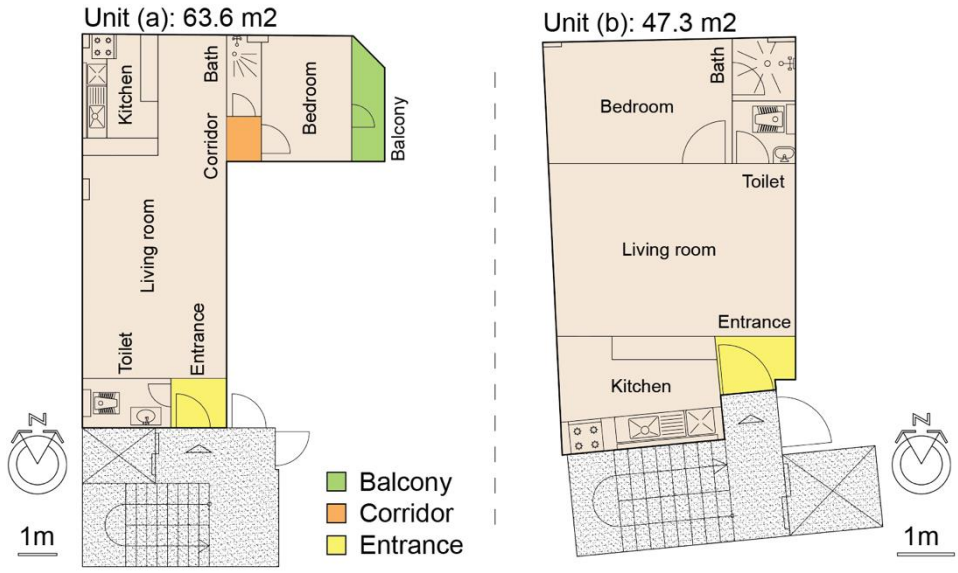


**Figure 11.** *The Probability of the Corridor Removal (Unit b) occurs more with decreasing the Total Unit Area in our Tehran Samples*
Source: authors

Numerous units with an area of around 75 $m^2$ contain two bedrooms, which absence of a distinct corridor within these units violates the rules and regulations. A separate corridor in a residential unit facilitates the space arrangement and placement of semi-fixed objects in the living room. Typically, in our samples, the interior corridor is located between the living room and the bedrooms, despite what used to be in traditional houses adjacent to the entrance door (Figure 13). without a corridor, the spaces of the bathroom, toilet, and bedrooms open directly into the living room, reducing privacy and space hierarchy.

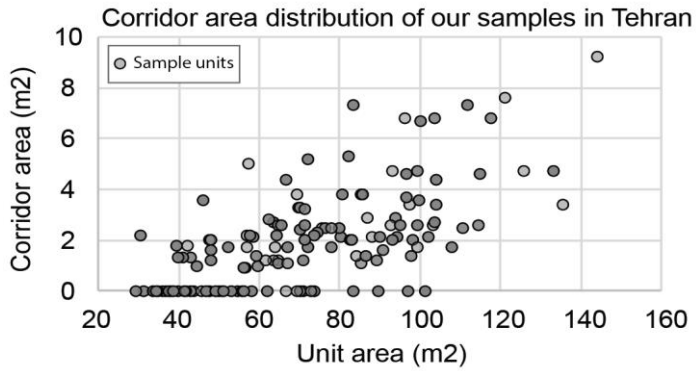


**Figure 12.** *Corridor area distribution in our Tehran samples also shows the relationship of the corridor's presence with the unit's total area. Each circle represents a unique sample (unit). We can observe that a corridor is more common in larger units.*

**Figure 13.** *An example of a corridor space in a Tehran apartment unit*
*Source: authors*

The Balcony in Tehran Units

Balconies in Tehran's central districts, such as District 9, lack adequate privacy because of the dense urban residential texture and narrow passages (Figure 14). privacy has been a significant consideration in the design of Iranian houses throughout history. This privacy concern is evident in the case of the balcony (Figure 16, 17, 18, 19). There is not a strong correlation between the overall size of a unit and the size of the corresponding balcony (Figure 20). In our sample, 38% of the balconies occupied an area smaller than 2 $m^2$, which is less than the minimum size requirement stated in the B4 INBR. furthermore, it was found that 14% of the units lacked a balcony altogether.

**Figure 14.** *In condensed area in district 9 the balconies suffering lack of privacy*
Source: IRNA English, Colorful Alley in Tehran District 9 [37]

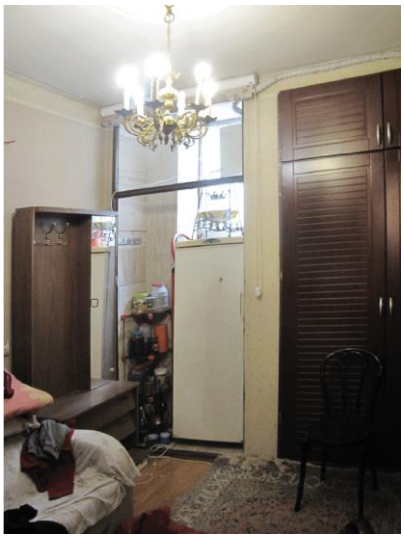

**Figure 15.** *An example of balcony in district 9, inside view*
Source: authors

**Figure 16.** *Examples of balconies in the 70s in the center of Tehran show the lack of privacy; residents have resorted to various techniques to solve this problem 19. Here, we can see the incompatibility of the design of the balcony space with the resident lifestyle*
Source: authors

**Figure 17.** *An example of how residents use the balcony*
Source: authors

**Figure 18.** *Example of a small balcony in Tehran that respects privacy*
Source: authors

The analysis of interior layouts reveals that many samples show inefficiencies in terms of the shape and aspect ratio of the balconies. Moreover, elements like columns, drainage pipes, and air conditioning ducts within the balcony space further reduce its overall efficiency. In most samples, this space has no priority, and the primary focus is given to the design of other interior spaces. A balcony in a residential unit is not mandatory, but related rules mentioned in B4 INBR must be followed if it exists[36] p47. Our samples often do not observe the minimum rules and regulations regarding the current balconies.

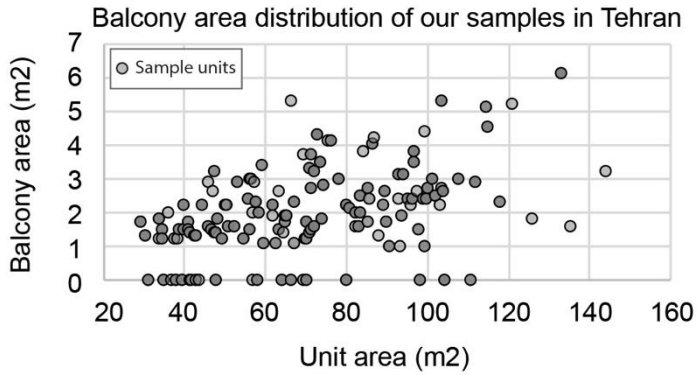


**Figure 19.** *Balcony area distribution in our Tehran samples also shows the relationship between the Balcony's presence or size and the unit's total area. Each circle represents a unique sample (unit). The size of the Balcony does not correlate strongly with the unit area.*

The balcony is supposed to be a place of rest, connecting with the outside environment, and increasing air circulation. However, our samples' balconies are unsuitable for relaxing and do not prepare their residents with a comfortable semi-open space; they have lost their original functions and are now used for storage or putting clothes drying racks, installing ventilation, heating, and cooling facilities (Figure 16). In this region of the city, due to the density of the urban residential texture and the high level of air pollution, balconies are expected to play a service role than a leisure role.

*Case Study II (Nagoya, Japan)*

The Entrance Space in Nagoya Units

The entrance space in Nagoya units is designed to prevent contamination from outdoor shoes (Figure 20). This approach is accomplished by creating a distinct area with a lower floor level than the adjacent interior corridor and utilizing different floor materials. This entrance configuration resembles the traditional design of various Japanese houses. (Figure 21). This design is consistent across all of our samples in Nagoya and is also present even in the smallest units with a 40 $m^2$ area. In order to make the interior more efficient, the entrance door in all units opens outwards or has sliding doors. The size of the entrance space varies, ranging from 1.2 to 5.7 $m^2$ in size. More detailed observations show that, 85% (981/1154) of the sample units' entrance space ranges from 3.5 to 4.6 $m^2$ (Figure 22).

In addition to providing a transition space for removing shoes, the entrance also serves as storage for entry-related equipment such as shoe racks, mirrors, clothes hangers, and disaster prevention bags and equipment. This definite space helps to ensure that these items do not obstruct the route during an emergency evacuation. By separating the entrance space and designing it to be functional and efficient, the Nagoya units' interior spaces are able to effectively prevent

contamination and facilitate safe and smooth movement in and out of the units (Figure 23).

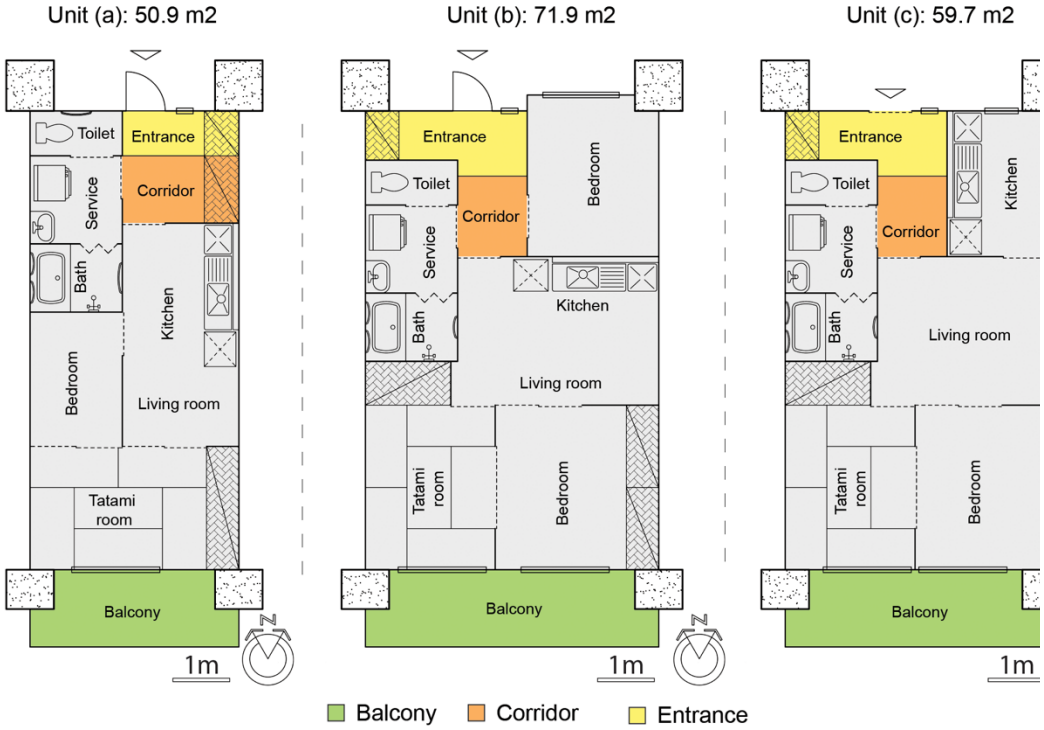


Figure 20. *Examples of the interior floor plan of residential units in Nagoya samples. The tatami room in a Japanese house is a versatile space, serving as a living area during the day and a bedroom at night*
Source: Nagoya Municipal Housing Division

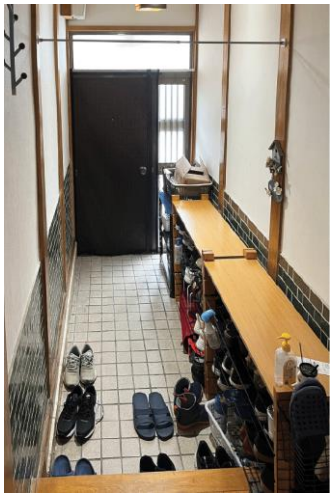

**Figure 21.** *An example of the entrance space in a Nagoya detached house*
Source: authors

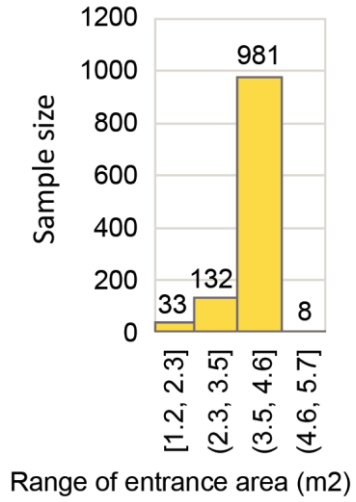


**Figure 22.** *Entrance area distribution of our samples in Nagoya*

**Figure 23.** *Examples of the entrance space in Nagoya Municipal Housing*
Source: authors

The Corridors in Nagoya Units

The corridor area in our samples' floor plans ranges from 2.4 to 4.8 $m^2$. In 87% (1004/1154) of the samples, the corridor measures between 2.4 and 3 $m^2$ (Figure 24). The corridor is positioned next to the entrance to establish a gradual hierarchy of spaces; interestingly, this pattern is similar to traditional Iranian houses, where the hashti and dalan were adjacent to one another to prepare for a smooth, safe, and step-by-step entry. The corridor is a transition space in our Nagoya samples, connecting different interior areas. In conjunction with the entrance, it gradually separates the interior from the exterior to maintain privacy within the residential unit (Figure 25). Additionally, due to the prevalence of natural disasters in Japan, the entrance and corridor are designed to facilitate an

easy emergency evacuation. This form highlights the significance of these two spaces in the overall layout.

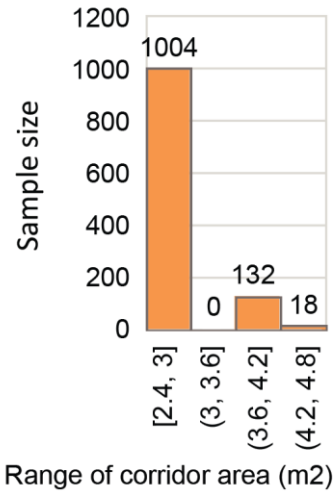


**Figure 24.** *Corridor area distribution of our samples in Nagoya*

**Figure 25.** *An example of a corridor space in a Nagoya Municipal Housing unit*
Source: authors

Balcony in Nagoya Units

The area of the balconies ranges from 5.6 to 14 $m^2$, and in 85% of the units (981 out of 1154), the balcony size is between 7.7 and 9.8 $m^2$, as shown in (Figure 26). The broad size of these balconies, even in smaller units, highlights their critical function. This semi-open space, exposed to fresh air, offers residents, especially those with limited mobility, an opportunity to engage with the outdoor environment and nature. The expansive dimensions of these balconies can also be

attributed to their additional function as emergency evacuation routes. To serve this purpose effectively, balconies must adhere to strict safety standards and building codes, as the following figures (Figures 27, 28) indicate.

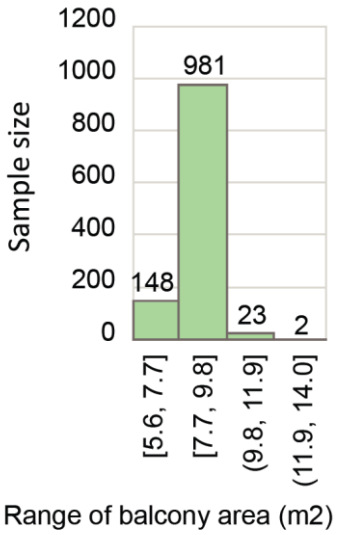


**Figure 26.** *Balcony area distribution of our samples in Nagoya*

**Figure 27.** *Example of a balconies in Nagoya Municipal Housing units which also plays the role of evacuation route in case of disaster*
Source: authors

**Figure 28.** *Example of a balconies in Nagoya Municipal Housing units which also plays the role of evacuation route in case of disaster*
Source: authors

## Comparison of Secondary Spaces in Nagoya and Tehran

This study conducted in Tehran and Nagoya showed that secondary spaces were removed or inefficient in many cases in Tehran samples, while samples from Nagoya demonstrated that even the smallest units included an entrance, corridor, and balcony.

The entrance space in units in Nagoya was found to serve a number of functions, including helping to prevent contamination via shoes, providing storage for entry-related and disaster prevention equipment, and facilitating safe and smooth movement in and out of the units. These functions were achieved through the use of a separate space with a lower floor level and different floor materials, as well as a sliding or outward-opening entrance door. In Nagoya, the majority of the units have an entrance space of 3.5-4.6 $m^2$ (Figure 22). Considering the Nagoya sample's total unit area, which is around 90% less than 80 $m^2$, it is an acceptable size. In Tehran units, the entrance space was often removed, in units of various sizes, leading to several negative impacts. The removal of the entrance area was not correlated to the unit size or shortage of space. However, the absence of an entrance has resulted in residents placing their shoes and shoe racks in common areas such as exterior corridors or staircases, hindering quick and safe evacuation in case of emergency. Additionally, the apartment entrance door in Tehran units typically opens inward, which prevents the use of the space behind the door for storing items or as an entrance area and decreases the efficiency of this space.

Predicting a separate corridor can enhance functionality and livability even in small units. It was observed as a common practice in our Japanese samples. The corridor in units of Nagoya had an average size of 2-3 $m^2$ and was next to the

entrance space. In contrast, small units in Tehran often did not include a corridor. While removing this space may seem appealing to increase the size of main space functions, it is important to consider the potential negative impacts on the arrangement and efficiency of the living room. The lack of a corridor decreases the independency of the living room.

Furthermore, removing this intermediary area disrupts the space hierarchy, compromising the clear and defined pathway for moving between different interior areas. As a result, residents may have difficulties organizing the living room, arrange furniture and other interior elements. In our samples of Iran, the internal corridor is frequently positioned between the living room and bedrooms. In traditional Iranian houses, there used to be a corridor adjacent to the entrance before other interior spaces, which supported residents' privacy. In contrast, most Tehran apartments had no such space, while all Nagoya samples had this distinct interior corridor following the entrance area.

When Western-style and exposed balcony was introduced to Iranian houses, this kind of balcony in residential apartments faced resistance from the majority of Iranian society as an extroverted living space did not align with traditional Iranian cultural norms and values. As a result, many residents covered their balconies and turned them into closed spaces. A desire for privacy partly drove this approach, as Iranians tend to keep their living areas out of public sight. Enclosed balconies often featured thick curtains covering the windows and were frequently used as storage spaces. Even in many apartment units, they combined balconies with adjacent interior rooms. However, new-style balconies gradually over the years became popular in urban apartments.

We found that the minimum size of balconies in our samples in Nagoya was larger than the maximum size in our Tehran samples (Figure 19, 26). In most of the samples in Tehran, balconies exist. However, upon observing location, shape, aspect ratio, and size factors, it becomes obvious that its utilization is inadequate, neglected, and violated the relevant rules and regulations. In Japanese apartment units, balconies function not only as outdoor living spaces but also as emergency exit corridors for disaster evacuation. Additionally, they often serve as typical Safety of Fire Brigades bases, allowing them to combat fires from the smoke-free outdoors[31]. Considering the emphasis on safety in Japanese buildings, balcony space is typically provided in residential apartments.

Based on the findings, we recommend the implementation of balconies with sliding doors and a minimum size of 2 $m^2$ in urban neighborhoods. These balconies should also have a visual barrier to provide privacy and control the view of outsiders while still allowing for air circulation and natural light access to interior spaces. Balconies in these residential units can serve both functional and socio-cultural purposes. Balconies provide extra space for drying laundry and fresh air. They can also facilitate a sense of community and improve quality of life by connecting people to their surroundings on a social and cultural level. If the balcony's design aligns with the concept of traditional houses, reflecting the current lifestyles and cultural backgrounds, the tendency to use this space among the residents will increase. Consequently, this alignment will ensure that the norms and compulsory regulations will not be neglected.

In practice, we see a considerable gap in secondary spaces with the principles and concepts of traditional houses that used to continue for years. This historical continuity seems lost in many of today's residential units. However, in Nagoya, contemporary units still maintain a strong link to their historical principles and traditions.

## Conclusion

Our study revealed significant differences in the units' interior spaces in Tehran and Nagoya. In Tehran, we observed that the overall quality of the interior space was compromised in favor of maximizing the quantity of some main space functions. As a result, secondary functions that significantly impact the quality of the space were removed or neglected. The entrance space is a mandatory space function according to B4 INBR; however, it is often removed in practice regardless of the unit size. The corridor space, which plays a crucial role in improving efficiency, space hierarchy, interior layout arrangement, and organizing furniture and household items, is frequently removed in small units because of a lack of space.

On the other hand, in our Nagoya samples, these spaces are not removed, even in units with minimum size. Since the house in Japan is a totally private space, the entrance, and corridor are located along each other to separate and preserve this private space. They act as a hierarchy for transitioning from public area to private area; each of these two space functions has specific and defined functions that cannot be ignored; those are also considered necessary for the overall efficiency of the interior space. In Tehran, while balconies are common in most units, they tend to be small, lack convenient access, and have improper form and aspect ratio, leading them not to be optimally utilized. They are typically used primarily for storage rather than other potential purposes, detracting from the interior space's quality and negatively impacting the neighborhood's image. In contrast, balcony in our Nagoya samples is considered essential and wide. It is included even in the smallest units, where it serves as valuable outdoor space that contributes to the overall livability of the unit.

We conclude that omitting secondary spaces, particularly entrance, and corridor, can negatively impact the interior's functionality and quality. In order to create a well-balanced and efficient layout, these two spaces must be considered essential and not optional. As evidenced by our Nagoya samples, the lack of space does not excuse the neglect of these important space functions. The overall residence atmosphere and its usability can be improved by including secondary spaces, even in small units. Regarding the design and location of the balcony inside the interior layout, designers should consider the historical background of this space and the residents' current lifestyle in Tehran. By accomplishing so, the balcony can become a functional and efficient space that enhances the city's visual image and the interior efficiency of residential units.

## Future Plan

The housing problem in Tehran and other major cities of Iran is progressively intensifying, clearly distinguishable by diminishing housing sizes and escalating housing costs over recent years. This issue has led to a significant challenge in providing affordable housing for families and citizens. In addition to the main space functions, the secondary spaces and their arrangement have assumed a more prominent role in housing interior layout.

We intend to carefully select other districts or neighborhoods with diverse approaches as part of our future plan. Specifically, examining the wealthy northern districts of Tehran, such as Districts 1 and 3, will enable us to compare the residents' perspectives and designers' approaches with those of other districts. Furthermore, we will learn from the experiences of housing strategies in other societies and countries, gaining valuable knowledge to improve the housing situation in Iran. The outcomes of this research endeavor will enhance the quality of housing. By amending current rules and regulations and formulating design guidelines tailored to the unique conditions of each district or neighborhood, we can optimize interior design solutions that better align with the cultural and lifestyle preferences of the residents.

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