Study of Interior Public Spaces for the Promotion of Social Interaction in High-rise Residential Buildings

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STUDY OF INTERIOR PUBLIC SPACES FOR THE PROMOTION OF SOCIAL INTERACTION IN HIGH-RISE RESIDENTIAL BUILDINGS

By Xinyi He

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Architecture

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Golisano Institute for Sustainability

ROCHESTER INSTITUTE OF TECHNOLOGY
ROCHESTER, NY
FALL 2018
COMMITTEE APPROVAL

“STUDY OF INTERIOR PUBLIC SPACES FOR THE PROMOTION OF SOCIAL INTERACTION IN HIGH-RISE RESIDENTIAL BUILDINGS”

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ABSTRACT

Urbanization is progressing rapidly in China. To accommodate the increasing population, high-rise residential buildings are becoming more prevalent in urban areas. But residents of high-rise buildings have little opportunity to socially interact with their neighbors, and this lack of social interaction may generate community-relevant negative outcomes, such as loneliness, reduced helpfulness, and insecurity, all of which have an adverse effect on the overall satisfaction level of the community. To address this issue, there is a need to develop strategies for community-oriented high-rise residential building designs that take into consideration China’s specific realities.

Due to the high-density living environment that is prevalent in China, it is difficult to create living environments that promote social interaction and the formation of good relationships between neighbors because the public space is typically limited to ground-floor areas. Although interior public spaces represent an important element of the space available in high-rise residential buildings and can provide useful areas in which residents can communicate with their neighbors, they are generally limited in function to traffic/circulation areas. Furthermore, in most cases, the design of these spaces is not conducive to social interaction. As such, the goal of this paper is to explore how the interior public spaces of high-rise residential buildings can be better used to promote social interaction between the occupants of the building.

Keywords: Social interaction, High-rise residential building, Community-oriented design, Neighborhood design
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INTRODUCTION

BACKGROUND INFORMATION

Urbanization in China

After reform and opening policies were launched in 1978, China experienced sustained, rapid economic growth for more than three decades (Yang 2015). This unprecedented economic development resulted in the largest urbanization in history in China (Seto 2013). Between the 1940s and 2007, the number of cities increased from 69 to 663 (Vassigh and Hove 2017). Rapid growth also increased the urban population. In 2017, there were 102 Chinese cities with a population of over one million. As seen in Figure 1, larger cities, such as Shanghai and Beijing, already have populations exceeding 10 million (Haas 2017).

![Figure 1. Megacities in China](image)

As can be seen in Table 1, in 1950, 13% of China’s population was city based. At present, urban residents account for roughly 45% of China's total population. By 2030, this figure is
expected to reach 60% (Vassigh & Hove 2017), which means that, for the foreseeable future, both
the size and density of Chinese cities will continue to increase. Increasing urbanization has created
a major demand for urban housing. High-rise buildings represent a realistic and desirable solution
for accommodating the growing population and have become a common feature of many urban
settings in China (Bemanian 2011).

Table 1. Urbanization of China versus the US

<table>
<thead>
<tr>
<th>Year</th>
<th>China</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>13</td>
<td>64.2</td>
</tr>
<tr>
<td>2010</td>
<td>44.9</td>
<td>82.3</td>
</tr>
<tr>
<td>2030</td>
<td>60.3</td>
<td>87</td>
</tr>
</tbody>
</table>

Changes of cityscape

Visually speaking, cityscapes have changed significantly within a short period in China. The construction of more high-rise buildings, in particular, has resulted in increased urban density. Figure 2 shows Nanjing’s skyline as an example; the city is unrecognizable in 2016 when compared to its 1983 appearance. The Jinlin Hotel, which was the tallest building in the city at that time (Chen and Jim 2003) and is highly visible in the 1983 photo, is now dwarfed by many others and is difficult to find unless specifically indicated.
Such transformations of Chinese cities beg the question of whether their original characteristics and identities can be retained at all. Historic streets, alleys, and plazas are now being replaced by central avenues, towering skyscrapers, and mega squares (Wang 2011). Consequently, the general atmosphere and the characteristics that defined these cities are being gradually eradicated. Over time, there is an inherent risk that many cities will lose their identities and share a similar skyline.

*Figure 2. Cityscape of Nanjing in 1983 and 2016*
For example, Nanjing (Figure 2), a city founded around 300 BC and Hangzhou (Figure 3), a city founded around AD 500 now share similar skylines. Largely because of the presence of skyscrapers, a city’s skyline is defined by its modernity, showing little evidence of pre-20th-century architecture, even when much of its heritage has been protected (Roan 2013). The reality is that most cities which experience significant redevelopment see a greatly reduced aesthetic impact from their traditional architecture, almost as if it has been erased completely as far as contributing to the unique urban context is concerned (Wang 2011).

**Changes of lifestyle**

Apart from the purely visual impacts, urbanization has completely changed the lifestyles of the inhabitants. Traditionally, streets provided a place for various events (Trancik 1987). As Figure 4 shows, there are spaces for walking, meeting, trading, and playing. As a result, the street can simultaneously function as a traffic space, commercial space, meeting space, communication space, etc. People used to live right beside the street and through it could be involved in different social activities. But today, streets have become less multifunctional. As Figure 5 shows, massive
infrastructure requirements and a condensed population require high-capacity traffic flow and an intense concentration on commerce, so streets no longer contribute as significantly to the social aspects of life in a city (Trancik 1987). They no longer serve as meeting or communication spaces, as they once did, or certainly not to the same extent. As a result, social interactions and activities have declined, and people have become more isolated from their fellow citizens, losing much of their sense of community and neighborhood culture (Yang 2015). This trend that is exacerbated by moving residential life to high above ground and away from any street life.

*Figure 4. Traditional street life*

*Figure 5. Modern street*
Furthermore, according to Kevin Lynch, every long-term citizen has personal associations with some parts of their city (Lynch 1960). A long-time residence in one place leads a sense of pride and belonging (Lynch 1960), eventually, an emotional connection with fellow residents and their surroundings is built. But, because many alleys, streets, and traditional yards where communal life once happened have been demolished in China, such connections—that many views with precious nostalgia—been eroded and become depersonalized (Yu 2012). As people see the streets, and the characteristics of those streets for which they have a deep affection, quickly becoming unrecognizable, their emotional connection with land is broken (Yu 2012).
High-rise residential building in China

Table 2. Total Population of China

![Total Population of China (Millions)]

High-rise residential buildings first appeared in China in the 1930s (Gaubatz, 1999). Large cities such as Shanghai were affected by the Western architectural movements of the time. In response to rising land prices, a few high-rise residential buildings were built in the city center (Gaubatz, 1999). After reform and opening policies, and especially since the 1990s (Ma 2015), due to the acceleration of urbanization and the commercialization of residential building development, high-rise residential buildings have sprung up in major cities, creating a new urban cityscape (Bracken 2012). It is undeniable that China's population is still growing (Table 2), and the urbanization process will continue.

Due to regional economic and cultural differences, population density distribution is uneven (Figure 6), and the population density of southeast coastal cities is relatively large, especially in developed cities such as Shanghai, Hongkong, Beijing, and Tianjin (Ma 2015). High-
rise residential buildings will inevitably represent the primary source of residential development in these cities and will continue to be developed in the future.

**Definition of high-rise residential buildings**

Different countries have different definitions of what constitutes a residential high rise; some are determined based on building height, while others are determined based on number of stories.

At present, China's "General Principles of Civil Architectural Design" (GB50096-2011) refers to buildings with 7-9 floors as middle high-rise buildings (also called small high-rise buildings in some places) and to those with 10 floors or more, which use an elevator as the main means of vertical transportation, as high-rise buildings. Also, as stipulated by fire safety requirements set out in the country’s National Building Code, residential buildings with a

![Figure 6. China population density map (By province)](image-url)
minimum of ten floors are categorized as high-rise in China, together with any public buildings more than twenty-four meters in height.

For the purposes of this paper, high-rise residential buildings are those with seven or more floors that are under 33 floors in height; this excluded the super-high-rise residential buildings with 33 or more floors that are required to provide refuge floors in case of earthquakes (Yang 2003).

**Characteristics of high-rise residential buildings**

![Figure 7. A high-rise residential building gated community in Pudong, Shanghai](image)

As Figure 7 shows, high-rise residential accommodations in China are typically gated communities that are grouped together. Developments tend to be fenced, and residents have access to one main entrance and several smaller entrances that each have security checks. Exterior areas located within the immediate site are inaccessible to the public and are reserved for residents’ use only. Once the building is inhabited, it is managed by a property management company that is responsible for controlling access to the complex. Consequently, the people who reside in the
building are genuinely isolated from the rest of city, as the controlled section does not fulfill any form of urban function or offer an opportunity for tenants to interact in street life.

![Diagram of a typical four-unit apartment building floor plan](image)

*Figure 8. Typical four-unit apartment building floor plan*

Common high-rise residential buildings in China contain 2-6 apartments per floor (Shan 2004). Figure 8 shows an example of a standard, rectilinear four-unit floor plan with two edges. Designed to invite as much sunlight in as possible, the long edges face north and south, with the shorter ends facing east and west. Additional measures to maximize natural light and reduce the need for artificial lighting include positioning living areas and bedrooms at the building edges, with as much southern exposure as possible, with other rooms like kitchens and bathrooms, being located in the central areas. To preserve privacy, there is no visibility between apartments, and the compact nature of developments of this nature reduces opportunities to incorporate interior public space. There is a clear boundary between public and private spaces. The areas marked in gray are interior public spaces that are used for circulation, not socializing. Therefore, residents have very few opportunities to interact with each other.
PROBLEM STATEMENT

A sense of community is hard to find in high-rise buildings in China, and most high-rise residents have little opportunity to socially interact with their neighbors (Yang 2015). They only meet in the elevators and have few chances to socialize. Without social interaction, people living in the same physical area represent a group of individuals living separately with little sense of community (Dempsey et al. 2011). Modern urban residents are exposed to various people on a daily basis; however, they still feel lonely because the psychological needs of community life are not satisfied in the same way they are in traditional living environments (Yang 2015).

**Definition of social interaction**

Social interaction is a social action between two or more individuals, which includes both verbal and nonverbal communication, such as body language (De Jaegher 2010). Social interaction is the foundation of community and society (Dempsey et al. 2011) and is a critical factor in achieving a higher level of social sustainability. According to the “Rio Declaration,” sustainability consists of three dimensions: economic, environmental, and social (Cassen 1987). Among these three dimensions, the social aspect of sustainability is the hardest to implement because it is the most challenging to define and measure (Cassen 1987). Although the implications of social sustainability vary, the goal is to create attractive and socially successful societies (Vallance et al. 2011). The This thesis aims to develop strategies to improve social interaction in high-rise residential building and thus create a more socially sustainable living model.

**The community-relevant problems of high-rise residential buildings**

The place of residence is the primary place in which human beings carry out daily interactions. But high-rise residential buildings do not encourage residents’ activities or facilitates the formation of friendly and pleasant neighborhood atmospheres (Yuen 2005). Studies of
community-life issues in high-rise developments, carried out by Yuen (2005) and Gifford (2007), list poor social relations, lack of security, reduced helpfulness, and hindered child development as the main problems caused by lacking social interaction

Poor social relations

Yuen (2005) discovered that most of the residents of high-rise buildings don’t know each other (Figure 10) and having many neighbors living in close proximity does not build a positive community mood. She mentioned that human interaction is difficult in high-rise buildings, so relationships do not thrive. So, there is a lack of trust, care, and mutual assistance among the residents. For example, research carried out on social interaction levels in Taipei, Taiwan, which has seen a significant increase in high-rise developments, found that only 15.63% of high-rise residents reported some form of social interaction occurring (Huang 2006). Such circumstances affect some people more than others and have been found to become more problematic on a personal level as individuals age (Conway 1977). Older people are typically retired and subsequently spend a great deal of time at home, without any form of engagement with others (Conway 1987). Residents can live in close proximity for many years while effectively remaining strangers, although the study does indicate a greater likelihood of interaction occurring between those who live on the same floor, with some signs of friendships being formed (Bochner et al. 1976). But the common high-rise residential buildings in China contain only 2-6 households per floor (Shan 2004) and the number of these households is too small to create a community feeling.

1 Two key domains are defined to understand social relations: Relationships within a dwelling and relationships among neighbors in the building. For context, it is important to note that this thesis is focused on relationships among neighbors.
Nevertheless, as shown in Figure 8, the lack of interior public space where social interaction and familiarity can thrive means that opportunities to socially interact are restricted.

$Lack of security$

Gifford (2007) pointed out less interaction leads to a lack of “natural surveillance” in a residential environment, which is prone to crimes such as theft, so residents rely on closed property management to strengthen security (Figure 9). Jacobs (1961) in her book “The Death and Life of Great American Cities” indicates that the safest place is the place have “natural surveillance” by the residents. For example, the ground space which residents can see is safe, and the ground space blocked by obstacles is not safe. She also discovered that if the residents have a sense of ownership of a space, they watch over it. As such, if they observe any criminal activity, they feel obliged to intervene.

When it comes to developing bonds between individuals and building long-term relationships, Dempsey (2011) singles out trust as a fundamental factor that needs to be present. Trust is directly related to a sense of safety and, the less social interaction that takes place, the less
trust that develops (Chan and Lee 2008). Feeling safe and secure can be seen as one of the most essential features in social sustainability as it encourages social interaction (Chan and Lee, 2008, Dempsey et al., 2011). The irony here is that high-rise residential buildings are designed to promote safety and security, and while effective at keeping crime out, these design elements also encourage suspicion and paranoia among residents (Dempsey 2011). Neighbors who remain strangers to one another cannot build the necessary trust, and the presence of numerous safety features like door security systems, guardrails to keep out thieves, and burglaryproof doors only serve as constant reminders of danger, potentially from within. For example, Chan and Lee (2008) note that people tend to lock their doors even when only heading to the first floor to check their mail, precisely because of these concerns. Neman (1996) considered such security concerns to be a major factor in the undermining of the social environment.

Also, as can be seen in Figure 8, each apartment is enclosed and isolated; therefore, people have no knowledge of what happens in the surrounding area. As discussed by Jacob (1961), when people know what is happening around them, their perception of safety is increased. So, the price of the kind of privacy shown in Figure 8 is a lack of understanding of what is going on nearby, resulting in paranoia about safety.

*Reduced helpfulness*

Where positive social qualities exist, people are more likely to help each other where there is a need (Gifford 2007). Being acquainted with someone leads to a concern for their well-being, but people are far less likely to act on behalf of a stranger, especially as they probably have no understanding of the challenges that person faces (Gifford 2007). In high-rise building, because most residents’ neighbors are just anonymous others to them, the tendency to help is reduced. A
survey of students living in high- and low-rise buildings clearly indicates that an individual living in a low-rise building is far more likely to offer assistance to others (Nadler et al. 1982).

**Hindered child development**

Living several stories off the ground makes people less inclined to seek the outdoors, reducing access to natural environments (Yuen 2005). This can be particularly detrimental to child development, as children interact with the world less, have reduced interaction with their own generation, and have less access to fresh air (Ekblad and Werne 1990). Because there is no space inside high-rise buildings for children to play, if they want to play, they must go to ground-level play areas. But, these areas are inconvenient and can be unsafe for children without parental supervision because they are separate from the home, with no clear connection between playground and home (Ekblad and Werne 1990).

**Limitation of exterior public space for social interaction**

There are open spaces between high-rise buildings and some of these outdoor public spaces are designed as gardens or plazas with seating areas, and children’s playgrounds and exercise facilities are sometimes also incorporated (Figure 11). These areas are accessible to all residents, nevertheless, their relationship with such areas has been noted sometimes to be less than comfortable. As Newman (1976) argues, the communities require multiple families and individuals to share areas without the notion of territorial advantage associated with the front lawn of a house.

*Figure 11. Outdoor public spaces (left: plazas, right: sitting area) at the Zhongshan Community in Shanghai*
or the patch of green at a house’s entrance. The more people that dwell in a condensed space, the less likely it becomes that they will develop a personal relationship with their surroundings (Newman 1976). As a result, though these shared areas are designed for versatility and to accommodate personal freedoms, they become little more than walk-through areas. A study based on the observation and the results of the questionnaire shown there is a low rate of use of the outdoor public space in a community in Algeria, which demonstrate that outdoor public space is not the reason for the high degree of acquaintance of this community (Farida 2013).

**Lack of interior public space for social interaction**

Because of the technological limitation and the economic status of intended residents, the design of early residential high-rises focused on construction of private living spaces, while public space was seldom valued (Li and Liu 2006). Today, economic development and advances in technology have led to improvements in living standards and living requirements, and residential high-rises with both public and private spaces have been rapidly developed. Potential residents no longer focus on only private living spaces but consider public spaces an important factor for judging the overall living environment.

Public spaces inside residential high-rises experience the highest occupancy rate and are where most social contact within the neighborhood takes place (Chen 2007). But, compared to exterior spaces, little attention has been paid to interior social spaces. The design of most interior public space in high-rise buildings completely ignores the need for social engagement, as illustrated in Figure 8. As these spaces are designed for circulation, not for socializing, residents have very little opportunity for interaction with each other.

It is believed that the key issue in promoting neighborhood communication in modern high-rise housing is to provide corresponding space for communication (Wang 2004). So, it is important
to create public space inside high-rise buildings as such areas could help promote a feeling of community and bring residents together, potentially addressing several community-relevant problems. First, these spaces could provide areas people to sit, study, have a conversation, hold events, and for many other social uses, facilitating social interaction among residents to increase the opportunity to meet one another (Chen 2007). Second, once residents begin to meet one another, the sense of insecurity will start to be reduced, especially as they begin recognizing fellow residents and neighbors rather than viewing them as strangers (Dempsey et al. 2011). It is therefore important to design meeting places imbued with the feeling of being safe and secure, to facilitate for social interaction to occur. Chan and Lee (2008) mentioned that people want to know what is happening, and can happen, in their surrounded area. Meeting in the interior public space would help the residents build a cognizance of the surroundings, thus, feeling of being safe will increase. Third, once residents have familiar with the neighbors, the resulting community feeling would encourage prosocial behaviors. Also, Dempsey (2011) argues that feeling trust in people in our surroundings creates a the sense of well-being and strengthens the feeling of being secure. Fourth, interior public spaces can also provide possibilities for activities that appeal to various groups of people (Li and Liu 2006), including children and the elderly. Children could have a much closer connection to their home, and older people could have more social lives. Interior public spaces provide an opportunity for redefining the relationship between public and private space (Wang 2004).
Despite evidence from research indicating the importance of positive living experiences, China’s real estate market is market-driven, and decisions are made to maximize profit rather than positive living conditions (Dong 2016). Still, housing prices in China are always rising. For example, the average transaction price for residential buildings in Shanghai increased steadily over a period of ten years according to the Shanghai Housing Market Report, 2017. As Table 3 shows, in 2008, the unit price per square meter was less than 15,000 yuan, while in 2017, the unit price per square meter was close to 50,000 yuan. Over the past ten years, the price per square meter has increased by almost 35,000, to three times the price of the past. Also, as shown in Figure 12, in the
past six years, the most common sizes for apartments in Shanghai were 90-120 square meters and 70-90 square meters.

According to data from the Shanghai Municipal Bureau of Human Resources and Social Security, however, the average salary of Shanghai residents in 2017 was 85,582 yuan, and the average monthly salary was 7,132 yuan. In other words, the cost of one square meter of room space is equivalent to the seven months of an average salary. Such high housing prices place an enormous burden on buyers.

The price of the apartment is determined by multiplying the unit price per square meter by the area of the apartment, but the area of the apartment for sale is not the actual area that is purchased. Because of the existing estate policy, shared interior public spaces, such as corridors, elevators, staircases, and entrance halls, are recorded in the sales area (Dong 2016). If additional interior public spaces are designed on this basis, the price of per square meter will increase.

Figure 12. Housing size in Shanghai (source: Shanghai Centaline Property)
Using Figure 13 as an example, imagine a standard floor plan with six apartments in total. The space in each apartment is 100 square meters (including the shared circulation space marked in gray), and the unit price per square meter is 50,000 yuan, giving a total price of 5,000,000 yuan. To add extra public space on this standard floor while keeping the gross floor area the same, we have two options. Option 1: Remove one apartment and use this space as interior public space, keeping the space of the other five apartments the same, and share the cost of the removed apartment among the other five apartments. So, each apartment remains 100 square meters, but the total cost of each apartment increases to 6,000,000 yuan, 20% more than the original price, and

Option 2:  
83 square meter, 5,000,000 yuan per apartment  
60,000 per square meter  
6 apartments in total

Figure 13. Responses to standard floor, option 1 and option 2
the unit price increases to 60,000 yuan per square meter. Option 2: Decrease the size of each apartment by 17% and use the recaptured space for interior public space. Now each apartment is 83 square meters but still costs 5,000,000 yuan, for a cost per square meter of yuan, representing an increase of 20% over the original cost.

The cost of each apartment will increase to 6,000,000 yuan, and the unit price is 60,000 per square meter, the cost of both options is 20% higher than the original price. Comparing the two options to the standard floor, the choice is to pay a higher price for the same amount of space or pay the same price for less space. In both options, the unit price per square meter increases 20%, representing the cost to residents for the addition of interior public space.

In reality, as we do not need to take the space of an entire apartment for added interior public space, the unit price and the total price would not increase by 20% with the addition of interior public space. But the price factor remains the biggest concern in this study because we do not know if the added value for residents would outweigh the added cost. This paper aims to propose strategies to enhance neighborhood interaction through the design of interior public space. However, if the residents are not willing to pay for additional interior public space, there is no point continuing the discussion. Thus, it is important to perform a survey to investigate whether or not people would be willing to pay for the extra interior public space if doing so yields a better community feeling.
LITERATURE REVIEW

Types of Interior Public Space in High-Rise Buildings

The interior public space in a high-rise residential building serves both as a circulation space and a connection between each apartment. It offers great potential for the improvement of social interaction through enhanced interior public space (Wang 2004). For the purposes of this paper, the interior public space in high-rise residential buildings is understood to include public circulation space and transition spaces inside the building; however, it does not include outdoor exterior public spaces or the private living areas inside each apartment.

In this thesis, the interior public spaces that are commonly found in high-rise residential buildings are categorized into five types: ground-level open public spaces, entrance halls, stairs, corridors, and elevators.

Ground-level public space: This type of space is open public space on the ground floor that is not enclosed and is usually designed to create an area in which people can engage in activities. These spaces are often equipped with different facilities, such as tables and chairs, fitness equipment, children's play facilities, etc. (Figure 14). They usually represent a pleasant space in

Figure 14. Ground floor open space of Lanshan community in Wuhan

Figure 15. Entrance hall of Zhongshan community in Shanghai
which people can gather and interact socially. They are shared by all the households of the building and are open to the residents of the whole gated community.

Entrance hall: This space serves as a transition space, connecting the outside of the building to the interior spaces. The entrance hall is usually very open. It has a larger floor area compared to the corridors, and the lighting and landscape views are better (Figure 15). Entrance halls are usually equipped with mailboxes, and sometimes tables and chairs are also provided. This is the highest traffic area in the building because people pass through it to go in and out (Chen, 2007). It is a space in which people often meet each other.

Corridor space: Corridors connect each apartment to the common spaces like stairs and elevators. They are often very narrow and are designed for circulation, not social interaction.

Staircases: Stairs serve as functional spaces that connect the upper and lower floors; however, the use rate of staircases in high-rise buildings is very low as people prefer to use elevators, especially those living on the higher floors.

Elevators: Elevators lift and transport people to their desired floor. This is the area in which neighbors most frequently encounter one another; however, it is very confined.

**Range of social interactions**

Social interaction is defined as social relationships between individuals (Shor & Roelfs, 2015). Many different forms of social interaction have been identified, but in this thesis, the forms of social contact considered are related to those within the neighborhood, casual social encounters in particular, which include greeting, talking, and so on. According to Kim and Kaplan (2004), social interaction within communities is defined as a formal (e.g., active, planned) or informal (e.g., casual, unplanned) social opportunities in which two or more residents build relationships with one another. Similarly, much of the literature, such as that presented by Glynn (1986) and Burke
(2005), further define social interaction as neighboring and casual social encounters, as formal and informal social opportunities.

Gehl (1996) identified a range of interactions, which were subsequently ranked from low-intensity interactions to high-intensity interactions (see Figure 16). Low-intensity contacts were defined as forms of simple interaction involving seeing and hearing people and are considered prerequisites for high-intensity contacts. High-intensity contacts are explained as complex and emotionally involved connections between people. According to Gehl (1996), by increasing opportunities for low-intensity interactions (seeing and hearing), relationships between neighbors may be established and strengthened.

**Distances for social interaction**

Everyone is surrounded by an invisible bubble of space that controls their perception of the appropriate distance between themselves and others (Hall 1966). Maintaining an appropriate distance between persons is very important for social interactions; otherwise, people may experience uncomfortableness, a sense of a lack of protection, anxiety, and other negative effects. Based on his study of spatial behavior and psychology, Hall divided interpersonal distances into four types. These are presented in Table 4.
Table 4. Interpersonal distances defined by Edward T. Hall. Source: Edward T. Hall. “The Hidden Dimension”

<table>
<thead>
<tr>
<th>Distance</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intimate distance</td>
<td>0-45 cm</td>
<td>It is a distance to express strong feelings such as tenderness, comfort, caress, and anger.</td>
</tr>
<tr>
<td>Personal distance</td>
<td>0.45-1.3 m</td>
<td>It is the distance between close relatives, friends or family members; distance between people at the family table is a prime example.</td>
</tr>
<tr>
<td>Social distance</td>
<td>1.2-3.6 m</td>
<td>It is the distance between friends, acquaintances, colleagues, and neighbors in daily conversation. The remaining space that is formed between the coffee table and armchair shows this kind of social distance.</td>
</tr>
<tr>
<td>Public distance</td>
<td>3.6-7.6 m</td>
<td>It is a distance for one-way communication, like public speaking or when people just want to watch and don't want to participate in more formal occasions like this.</td>
</tr>
</tbody>
</table>

Neighborhood social interaction and communication falls under social distance (Hipp 2006). Therefore, it is only easy for neighbors to communicate when they meet at this distance (1.2-3.6 meter). Interior public spaces in high-rise buildings, however, do not usually accommodate maintaining a social distance, and it is difficult to make unfamiliar people want to communicate when they feel they are too close; for example, in confined elevator spaces.

**Impact of elevator-based transportation**

The use of elevators as the main transportation method is one important feature that distinguished high-rise building from low- and middle-rise building, which typically do not have elevators (Shan 2004). The rapid operation speed of elevators allows residents to spend less time moving from the ground level to their living floor compared to residents in low- and middle-rise building, reducing the time and opportunities for neighbors to meet (Lee 1987). In the low-rise and middle-rise buildings without elevator, residents use staircases to travel between the ground level to the floor on which they live, moving floor by floor.
As shown in Figure 22, when residents use staircase, their movements create routes linking each floor. The staircase connects the upper and lower floors, giving residents a sense of familiarity with each floor they pass. Residents may linger a moment in the process of going home, take a break, and engage in casual interactions with any neighbors they meet (Chen 2007). But, when they use an elevator, residents’ movements are isolated from the building and cannot create such routes. Elevators serve to separate each floor, leaving residents only familiar with the floor on which they live.

Although residents have the most opportunities to meet their neighbors in the elevator, elevators are small in scale and crowded. The high-speed operation gives people a feeling of instability and urgency (Lee 1987). In such an environment, people do not like to have close contact with others, and there is usually only a silent, awkward atmosphere in the elevator (Lee 1987). The priority of elevators makes the stairs into negative spaces that no one to uses, but the staircase still occupies a certain amount of space within the layout, and the price of this space is equally divided to every household. Since, it is also an indispensable space, it is necessary to increase the use of stairs (Chen 2007).
Height for social interaction

Living high above the ground is the biggest feature of high-rise residential buildings (Shan 2004). The height of high-rise residential buildings is defined as being more than 24 meters the country’s National Building Code or even more than 100 meters. The higher the residents live above the ground, the weaker their perception of the ground environment tends to be (Gehl 1996). Under normal circumstances, based on the scope of a person's field of vision, anyone living above the fifth floor cannot be associated with ground activities (Gehl 1996) (Fig. 15). Therefore, it is difficult for ground activities to attract residents living on upper floors. In low- and mid-rise...
buildings, neighborhoods can easily get together and interact through activities in ground spaces, and people on the ground can even talk directly to people who live below the fifth floor.

According to Lee (1987), an increase in the vertical height of high-rise residential buildings leads to a reduction in the use of ground spaces by residents. Although elevators are very convenient for moving up and down the building, residents develop a psychological separation from the ground, and this makes high-rise occupants sometimes reluctant to go downstairs. The reduction of outdoor activities inevitably reduces the number of contacts and the amount of social interaction between neighbors (Lee 1987).

*Figure 18. The relationship between building height and ground activity*
Living above the ground has a particularly strong impact on children's outdoor activities. In low-rise building, parents can observe the children's activities on the ground through the window, but this is almost impossible for parents living in high-rise building, so children are generally not allowed to go downstairs without their parents, greatly hindering interactions and activities between children (Ekblad and Werne 1990). Thus, ground-level public spaces should not be the only activity spaces that are available for the residents of high-rise residential buildings; it is necessary to develop other interior public spaces that facilitate social interaction.

**Neighborhood levels**

The architectural concept of “neighborhood” first appeared in the “neighborhood unit” theory proposed by Perry (1933) and refers to a relatively small, identifiable, low-level unit in the city, with service facilities that meet daily needs and which are situated between the residents' houses and the city area.

Some scholars have divided neighborhood into three or four levels according to factors such as size, level of cohesion, and services shared.

Based on physical conditions, Marans and Rodgers (1975) argued that the neighborhood can be divided into three levels:

1. Micro-neighborhoods are a very small neighborhoods consisting of an immediate group of six or so adjacent houses that share an intimate relationship.
2. Macro neighborhood are often characterized by elementary school districts. They are larger than a micro-neighborhood and are likely to consist of planned communities.
3. Communities, which are bigger than intermediate neighborhoods, are frequently defined by political jurisdictions.
Other scholars, Birch et al. (1979), also divided neighborhood into three levels:

1. Micro neighborhood refers to the one-block radius around the home, where children can play. It consists of a group of 12 or so dwellings.

2. Intermediate neighborhoods are areas in which residents share a relatively homogeneous socioeconomic status and feel “socioeconomic brotherhood.” This level of neighborhood comprises a continuous area of more than several blocks.

3. Macro neighborhoods share the same identity and facilities. They are often bonded by shared names, school district service boundaries, or major trans-potation arterials. Macro neighborhoods comprise a group of “the secondary neighborhood” but can be seen as different types of secondary neighborhoods.

Both studies indicate that the residents of a micro neighborhood will more easily develop intimate relationships, and residents of an intermediate or macro neighborhood will mostly just develop simple recognition relationships.

Lee (1987) also divided neighborhoods into three levels. He noted that a residential group consists of 15 or so households, which is level 1 and is of a scale that allows neighbors to have strong interpersonal relationships. At level 2, which includes 50-150 households, people may still...
know each other's names. At level 3, which includes anywhere between 500 households and thousands of households, people may find it harder to know each other, but they may still share same facilities, such as convenience stores or gyms.

Table 5. Comparison of neighborhood levels presented by different scholars

<table>
<thead>
<tr>
<th></th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marans</td>
<td>Micro neighborhood</td>
<td>Macro neighborhood</td>
<td>Community</td>
</tr>
<tr>
<td></td>
<td>(cluster of 6+ houses)</td>
<td>(elementary school)</td>
<td>(political jurisdiction)</td>
</tr>
<tr>
<td>Birch</td>
<td>Micro-neighborhood</td>
<td>Intermediate neighborhood</td>
<td>Macro neighborhood</td>
</tr>
<tr>
<td></td>
<td>(one block or cluster of 12+ houses)</td>
<td>(several blocks)</td>
<td>(official boundary, several facilities)</td>
</tr>
<tr>
<td>Lee</td>
<td>Around 15 households</td>
<td>50-150 households</td>
<td>500–thousands of households</td>
</tr>
</tbody>
</table>

A high-density living environment is another primary feature of high-rise residential buildings (Shan 2004). Compared to low- and mid-rise buildings, residential high rises have very high floor area ratios. A mid-rise building usually contains about 12 households, while the number of residents living in one high-rise building is usually between 40 and 180 households (Bai 2003). According to Lee and Birch’s research, a residential high rise could be considered as an intermediate neighborhood (level 2). At this level, residents may form simple recognition relationships but will find it challenging to develop more intimate relationships. Thousands of households may live in the same gated community, which can be categorized as the macro neighborhood (level 3). At this level, residents are unlikely to know each other.
As shown in figure 17, there are often two levels of neighborhoods in a standard gated high-rise community; however, there is not typically a defined micro-neighborhood (level 1). In order to develop a more intimate relationship between the neighbors and improve social interaction, level 1 (micro-neighborhood) could be added into the neighborhood design.

Figure 20. Two levels of neighborhood of gated high-rise residential community
STRATEGIES

As discussed in the previous section, there are limitations on the ability of exterior public spaces to promote social interaction between neighbors. Exterior public spaces, like community centers and plazas, are shared by too many households without the notion of territorial advantage (Newman 1976). Residents typically engage in only low-intensity interaction, such as seeing, hearing, and greeting one another, and it is difficult to develop more intimate neighborhood communications (Newman 1976).

First-floor public spaces experience similar problems. They are shared by all the households in each high-rise building, which generally includes around 40-180 households. According to the research on neighborhood levels, this is equivalent to Level 2, making it hard to develop more intimate relationships.

The existing research findings indicate that there are limitations in terms of the extent to which the interior public spaces can promote social interaction:

1. The spaces, such as the entrance hall and elevator lobby, are shared by all the households in the high-rise building, making it difficult to promote high-intensity interaction.

2. Most of the spaces, including the entrance hall and primary public spaces, are on the ground floor, making them inaccessible as social environments for residents who reside on higher floors.

3. Some spaces, such as the elevator and corridors, are too narrow, so residents cannot maintain a comfortable distance between one another (For cost-efficiency reasons, the corridor space is as compact as possible).

4. Spaces such as corridors and stairs are designed to function as circulation spaces, not social spaces.
5. Spaces like stairways do not provide opportunities for people to meet.

Thus, the existing interior public spaces are not appropriate for promoting social interaction, and it is necessary to add an additional interior public space to increase the opportunity for residents to meet and to evaluate low-intensity interaction (hearing, seeing) to high-intensity interaction (chatting, playing together).

*Strategy 1: Based on height for social interaction*

*Figure 21. Diagram of strategy based on height*
In the previous discussion about height and social interaction, we established that the residents who live above the 5th floor lose connection with the ground floor and that higher-floor residents tend to use ground spaces less than their counterparts who live on the lower floors (Gehl 1996). Based on this finding, we propose the addition of a “platform” on every fifth floor to create a “ground space” feeling (Figure 18). The people who live on higher floors can interact with these “platforms” and will be more willing to use this space for social interaction.

**Strategy 2: Based on neighborhood level**

In the previous discussion on neighborhood levels, we established that there are generally two levels of neighborhood in gated, high-rise building communities (Lee, 1987). To promote a more intimate relationship between the neighbors, we propose the addition of micro-neighborhoods within high-rise buildings. Based on the research findings, about 12 households could be grouped together to produce a micro-neighborhood that enhances social interaction.

*Figure 22. Diagram of strategy based on neighborhood level*
Public spaces should be provided for each neighborhood level. Exterior public space is provided for Level 3 and first-floor public space is provided for Level 2. We also need to provide a corresponding public space for the micro-neighborhood (Figure 19).

SUMMARY

High-rise residential buildings are currently the most common way of living in large- and medium-sized cities in China, and their development will continue in the future. Research on the interior public space of high-rise residential buildings can promote neighborhood communication and social interaction, help develop harmonious neighborhoods and enhance interpersonal relations between residents, improve the sense of security and belonging for residents, and create a better living environment. In addition, a harmonious neighborhood atmosphere could alleviate the mental illnesses associated with urban living, such as loneliness and depression, thus promoting the development of a more harmonious society.
METHODOLOGY

A survey was conducted to investigate the neighborhood social interactions in high-rise buildings. In order to get a more comprehensive understanding of the influences and preferences referred to as social interactions among high-rise residents, a questionnaire based on the problem statement and literature review was designed. The questionnaire was distributed to residents living in Shanghai, China. After the data was collected, statistical analysis was used to analyze the data and present design suggestions based on the findings.

This chapter is organized into four sections that define the process of this research. The first section discusses the survey location. The second section explains the design of the questionnaire. The third section introduces the proposed cross tabulation. The final section discusses the questionnaire distribution data analysis techniques.

SURVEY LOCATION

Survey data was collected from residents living in Shanghai, China. Shanghai, one of China’s largest cities, has experienced a housing development transformation from low to medium or high density since the 1980s (Gaubatz 1999). According to the Statistical Bureau of Shanghai (1993), there has been a marked increase in the construction of high-rise housing in order to ease the high-density pressure in both commercial and residential construction fields (Blackman and Picken 2010). In 1980, only 1.4 percent of residential housing was located in buildings taller than ten stories. However, by 1992, 7 percent of the residential housing in Shanghai was located in structures taller than ten stories and this boom continues to exist today (Blackman and Picken 2010). Because Shanghai is a high-density city, residential housing in communities of high-rise
buildings is common. As such, this city represents the ideal location in which to draw data relevant to the study.

**QUESTIONNAIRE DESIGN**

The first part of the questionnaire investigates the demographic information of the participants according to the following variables: gender, age, educational level, and income. These individual demographic attributes were examined to understand the personal and social backgrounds of the participants and to explore the relationships between the demographic information and the other survey questions.

**Q1: Your gender:**

*Choices: a) Male, b) Female*

The answers were divided according to the two choices of gender, which helped to analyze the differences in the answers provided by females and males.

**Q2: Your age:**

*Choices: a) 18-25, b) 26-40, c) 41-55, d) 55+*

The answers were divided into four groups according to the ages of the people and those aged 18 to 25 were mostly students, including college students and graduate students. Those aged 26 to 40 tended to be people who were in the beginning of their careers, putting their ambitions into practice. The 41 to 55 group were mostly middle-aged people with relatively mature careers. At 55+ years, most people had started to retire or think about retirement. The mentality and income of the four age groups were very different and the classification helped in analyzing the needs of different groups later.

**Q3: What is your educational background?**
Choices: a) Middle school and below, b) High school, c) Undergraduate, d) Master and above

The answers were divided into four choices according to education level, which helped to analyze the preference of participants according to their educational backgrounds.

Q4: What is your monthly salary?

Choices: a) Below 10000 yuan, b) 10000-30000 yuan, c) Above 30000 yuan

The answers were divided into three choices according to monthly salary, which helped to analyze the preferences of participants according to their incomes. To find the right group of participants who had the ability to pay for extra interior public space, the number of options for monthly salary was set much higher than the average monthly salary in Shanghai.

The second part of the questionnaire investigated the community-relevant problems and phenomena mentioned in the problem statement and literature review. Participants were divided into two groups. One group comprised of low- and mid-rise building residents and the other group was made up of high-rise building residents. These two groups were then compared in terms of the answers they provided to the questions about social relations, security, helpfulness, and children development to examine whether community-relevant problems really existed in high-rise buildings.

Q5: How many floors does the building you live in have?

Choices: a) 1-6 floors, b) 7-12 floors, c) 13-20 floors, d) 21-33, e) above 33 floors

According to the definition of a high-rise residential building presented in China's "General Principles of Civil Architectural Design," participants living in a building less than seven floors would be considered as low- and mid-rise building residents, and participants living in buildings
with seven floors or more would be grouped as high-rise residents. As super high-rise buildings were excluded from this study, participants living in buildings of more than 33 floors were excluded from the analysis.

**Q6: How many neighbors do you know in the same building?**

**Choices:** a) 0 people  b) 1-5 people  c) 6-10 people  d) 11-15 people  e) More than 15 people

This question was designed to ascertain how many neighbors a participant knew and examined if the problem of poor social relations among neighbors in high-rise residential buildings was widespread.

**Q7: Does the interior environment of the building you live in make you feel insecure?**

**Choices:** a) most of the time  b) some of the time  c) a little of the time  d) not really at all

This question was designed to ascertain if high-rise building residents felt secure in their living environment. As mentioned in the problem statement, people living in high-rise buildings should experience feelings of insecurity because they lack the natural surveillance of the interior environment and the trust between neighbors (Gifford 2007).

**Q8: How many times have you ever helped your neighbor or had your neighbor help you?**

**Choices:** a) 0  b) 1-5  c) 6-10  d) 11-15  e) more than 15 times

As mentioned in the problem statement, high-rise residents will be less likely to help their neighbors (Gifford 2007). This question examines if the helpfulness between neighbors is reduced in a high-rise building.
Q9: How much time do you spend on your daily activities and social interaction near your home within your community every day (including walking, using outdoor amenities, interacting with other residents, accompanying your children playing, etc.)?

Choices: a) Basically did not spend time b) Less than half an hour c) Between half an hour and an hour d) More than an hour

This question was designed to examine if high-rise residents spend less time on daily activities and social interaction in comparison to low- and mid-rise residents. The participants were all adults as no children participated in this survey. To ascertain if living in high-rise buildings influenced children’s development, it was necessary to apply some assumptions. If high-rise residents of different ages all spend less time on daily activities and social interaction than low- and mid-rise residents, it is reasonable to conclude that children would also be affected and spend less time outside. Also, the children mentioned in the problem statement are little children who need adult supervision when they play. Therefore, it can be stated that the children were influenced by the adults if the adults were less likely to go out.

The third part of the questionnaire investigated preferences regarding social interaction, interior public space, and the high-rise building of high-rise residents.

Q10: Are you willing to interact with your neighbors?

Choices: a) Most of time b) Some of the time c) Not really at all

This question investigated if high-rise residents were willing to interact with their neighbors.

Q11: How close do you want to be with your neighbors?

Choices: a) Close friends b) Friends c) Acquaintance d) Strangers
As mentioned in the problem statement, it is well known that most people living in high-rise buildings are just strangers to each other (Dempsey et al. 2011); however, do they want to become friends? This question investigated the extent to which they wanted to forge a close relationship with their neighbors.

Q12: Does the outdoor public space meet your needs for daily activity and social interaction?

Choices: a) Yes, b) Basically meet the need, c) No

As mentioned in the literature review, ground-level space is not very accessible for high-rise residents (Lee 1987); as such, the available outdoor public space may not fully meet a resident’s need for daily activity and social interaction. This question was designed to ascertain whether the public space available to residents met their needs.

Q13 Do you want to add extra interior public spaces to improve social interaction between neighbors?

Choices: a) Yes b) Maybe c) No

As mentioned in the literature review, adding extra interior public space is a strategy by which it is possible to improve social interaction between neighbors (Wang 2004). This question was designed to ascertain how many residents really wanted more interior public space.

Q14 Do you want to add extra interior public spaces to have more living space?

Choices: a) Yes b) Maybe c) No

The interior public space is shared space. However, as Figure 23 shows, each household only has to pay for a small part of the public space while gaining access to a much larger space together. If this larger space could be designed reasonably, it could help residents expand their
living space. This question investigated how many residents wanted to have more public space to enlarge their own private living space.

\[ \text{Total extra public space} \]

\[ \text{the space each household need to pay} \]

**Figure 23. Diagram of shared extra interior public space**

**Q15:** Are you willing to pay for the extra interior public space?

**Choices:** a) Yes, b) Not sure, will consider for it, c) No

As Table 3 shows, housing prices in Shanghai are extremely high (Dong 2016) and obviously, not everyone would be willing to pay for extra interior space. So, it is important to investigate how many residents would be willing to pay for it. Also, when comparing this question to the answers from Q4, it can be determined what kind of people are more willing to pay this extra cost.

**Q16:** Which floor do you live on?

**Choices:** a) 1-6th floor, b) 7-12th floor, c) 13-20th floor, d) 21-33rd floor

This question investigated which floor participants lived on.

**Q17:** Which height of floors do you prefer?

**Choices:** a) 1-6th floor, b) 7-12th floor, c) 13-20th floor, d) 21-33rd floor

According to the description of general characteristics of high-rise residential buildings presented in the background introduction, the most obvious feature of these buildings is their
Most of the residents of high-rise buildings live far away from the ground. Furthermore, the higher they live, the further away they are from the ground, weakening their connection with activities that take place on the ground level. This question was designed to ascertain which floor high-rise residents preferred to live on.

Q18: How many square meters is your apartment?

Choices: a) Less than 90 square meters b) 90 to 120 square meters c) 120 to 150 square meters d) more than 150 square meters

According to Figure 12, the most popular housing size in Shanghai is 90 to 120 square meters, followed by 120 to 150 square meters. This question verified whether this is true.

Q19: How many square meters of an apartment is your ideal size?

Choices: a) Less than 90 square meters b) 90 to 120 square meters c) 120 to 150 square meters d) More than 150 square meters

Corresponding to Q18, it is important to understand the desired apartment size of the participants. If most of the participants wanted to live in bigger spaces, as was discussed in Q14, the extra interior space could be used as one method of enlarging living space.

Q20: How many floors are you willing to climb using a staircase?

Choices: a) Don’t want to use stairs b) 1-2 floors c) 3-4 floors d) More than 4 floors

As mentioned in the literature review, it is necessary to increase the use of stairs (Chen, 2007). As such, this question investigated the residents’ willingness to use stairs. Also, it was important to ascertain how many floors participants would be willing to climb to use suggested platforms for high-rise buildings and to group five floors as a unit.
SCHMATIC ILLUSTRATION OF QUESTIONNAIRE DESIGN

Demographic information
- Q1: Gender
- Q2: Age
- Q3: Educational background
- Q4: Monthly salary

Two groups
- Q5: How many floors does the building you live in have?

Problem statement
- Poor social relation
  - Q6: How many neighbors do you know in the same building?

- Lack of security
  - Q7: Does the interior environment of the building you live in make you feel insecure?

- Reduced helpfulness
  - Q8: How many times have you ever helped your neighbor or had your neighbor help you?

- Hindered child development
  - Q9: How much time do you spend on your daily activities and social interaction near your home within your community every day?

- Preference for social interaction
  - Q10: Are you willing to interact with your neighbors?

- Limitation of exterior public space
  - Q11: How close do you want to be with your neighbors?

- Lack of interior public space
  - Q12: Does the outdoor public space meet your needs for daily activity and social interaction?

- Preference for social interaction
  - Q13: Do you want to add extra interior public spaces to improve social interaction between neighbors?

- Preference for social interaction
  - Q14: Do you want to add extra interior public spaces to have more living space?

Literature review
- Neighborhood levels
- Height for social interaction
- Distance for social interaction
- Range of social interaction
The conflict between housing price and additional interior public space

Q15: Are you willing to pay for the extra interior public space?

Q16: Which floor do you live on?

Q17: Which height of floors do you prefer?

Q18: How many square meters is your apartment?

Q19: How many square meters of an apartment is your ideal size?

Q20: How many floors are you willing to climb using a staircase?

Preference for interior public space and high-rise building

Impact of elevator-based transportation
CROSS TABULATION

This survey will use cross tabulation to compare two selected variables (questions in this case) in order to find the relationship between those variables.

Q1: Gender & (Q6, Q9, Q10, Q13, Q15)

Q2: Age & (Q6, Q9, Q10, Q13, Q15)

Q3: Educational level & (Q6, Q9, Q10, Q13, Q15)

Q6: How many neighbors do you know in the same building?

Q9: How much time do you spend on your daily activities and social interaction near your home within your community every day (including walking, using outdoor amenities, interacting with other residents, accompanying your children playing, etc.)?

Q10: Are you willing to interact with your neighbors?

Q13: Do you want to add extra interior public spaces to improve social interaction between neighbors?

Q15: Are you willing to pay for the extra interior public space?

What are the relationships between the demographics, such as gender, age, and education level, and the other survey questions related to social interaction and interior public space? These cross tabulations studied individual characteristics and whether these characteristics influenced an individual’s preferences for social interaction and interior public space.

Q4: What is your monthly salary? & Q15 Are you willing to pay for the extra interior public space?
What is the relationship between the participants’ income and the willingness to pay for extra interior public space?

**Q16: Which floor do you live on?** & **Q9: How much time do you spend on your daily activities and social interaction near your home within your community every day (including walking, using outdoor amenities, interacting with other residents, accompanying your children playing, etc.)?**

What is the relationship between the height of the floor on which the participant lives and the time that the participant spends outside? This cross tabulation examined if people living higher up were less likely to go outside.

**Q16: Which floor do you live on?** & **Q17: Which height of floors do you prefer?**

What is the relationship between the floor the participants lived on and the floor they would prefer to live on?

**Q18: How many square meters is your apartment?** & **Q19: How many square meters of an apartment is your ideal size?**

What is the relationship between the size of the apartment the participants had and the ideal size of the apartment the participants wanted to have?

**QUESTIONNAIRE DISTRIBUTION AND DATA COLLECTION**

The participants were residents of Shanghai and needed to choose their most preferred answer from several answers. The questionnaire was conducted by the author through social media for distribution among eligible people whom the author knew and was continuously spread through them for a period of four days. All information collected from the questionnaire was used as data for this study.
The online survey software “WJX.CN” was used to design and distribute the questionnaire. It was also used for the data collection and analysis as it is a tool capable of presenting descriptive and inferential statistical analysis.

The inferential analysis used Fisher’s Exact Test, a statistical significance test used in the analysis of contingency tables, to examine the available data. In inferential statistical analysis, if the p-value is less than 0.05, it can be concluded that the difference was significant. In this study, inferential analysis was used to analyze the relationships of two selected variables or questions and “WJX.CN” has built-in SPSS software to automatically calculate the “P” value.

The survey included a mix of questions examining the opinions and theories discussed in the problem statement and literature review for the purpose of investigating the relationship between the demographics and the other survey questions relating to social interaction and interior public space. Also, the findings and results were used as references to formulate design strategies and design recommendations.
RESULTS AND FINDINGS

This chapter presents the research and results from the statistical analysis of the data collected by the survey. The results will be presented in four sections: the demographic statistics; the results regarding community-related problems; the results regarding the high-rise residences’ preferences related to social interaction, interior public space, and high-rise residential buildings; and the analysis of cross tabulation.

DEMOGRAPHIC STATISTICS OF ALL PARTICIPANTS

There were 289 questionnaires collected in total. As Table 6 shows, 5 samples need to be excluded because those participants lived above the 33rd floor (at heights of more than 100 meters). Thus, there are 284 final samples and the demographic information of these participants is listed in Table 7.

Table 6. Results of Q5: How many floors does the building you live in have?

<table>
<thead>
<tr>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>289</td>
</tr>
<tr>
<td>1-6 floors</td>
<td>141</td>
</tr>
<tr>
<td>7-14 floors</td>
<td>49</td>
</tr>
<tr>
<td>15-20 floors</td>
<td>40</td>
</tr>
<tr>
<td>21-33 floors</td>
<td>54</td>
</tr>
<tr>
<td>above 33 floors</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 7 shows 42% (n=120) of the participants were male, and 58% (n=164) of the participants were female. For the age ranges, 25% (n=72) of the participants were 18 to 25 years old, 28% (n=79) of the participants were 26 to 40 years old, 37% (n=104) of the participants were 41 to 55 years old, and 10% (n=29) of the participants were above 55 years old. For educational levels, only 7% (n=20) of the participants had a middle school degree or below, while 14% (n=40) of the participants had obtained a high school degree, 54% (n=154) of the participants had obtained
undergraduate degree, and 25% (n=70) of the participants possessed a master’s degree or above. For income, 56% (n=158) of the participants’ monthly salaries were below 10,000 yuan, 29% (n=83) of the participants’ monthly salaries were between 10,000 to 30,000 yuan, and 15% (n=43) of the participants’ monthly salaries were above 30,000 yuan.

Table 7. Demographic information of participants

<table>
<thead>
<tr>
<th></th>
<th>Numbers (N)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>284</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>120</td>
<td>42%</td>
</tr>
<tr>
<td>Female</td>
<td>164</td>
<td>58%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-25 years old</td>
<td>72</td>
<td>25%</td>
</tr>
<tr>
<td>26-40 years old</td>
<td>79</td>
<td>28%</td>
</tr>
<tr>
<td>41-55 years old</td>
<td>104</td>
<td>37%</td>
</tr>
<tr>
<td>&gt; 55 years old</td>
<td>29</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Educational level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school and below</td>
<td>20</td>
<td>7%</td>
</tr>
<tr>
<td>High school</td>
<td>40</td>
<td>14%</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>154</td>
<td>54%</td>
</tr>
<tr>
<td>Master and above</td>
<td>70</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Monthly salary (RMB)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10,000 yuan</td>
<td>158</td>
<td>56%</td>
</tr>
<tr>
<td>10,000-30,000 yuan</td>
<td>83</td>
<td>29%</td>
</tr>
<tr>
<td>&gt; 30,000 yuan</td>
<td>43</td>
<td>15%</td>
</tr>
</tbody>
</table>

In summary, there were 16% more female participants than male participants. Most participants were between 41 and 55 years of age, largely because the author asked family members to distribute the questionnaire to their colleagues (and through them, to more people), causing most of the people surveyed to be in the same age range as the author’s family members.
(41 to 55 years of age). Most participants had an undergraduate level education and a monthly salary below 10,000 yuan.

RESULTS ON COMMUNITY-RELATED PROBLEMS

The participants were separated into two groups with one group of low and mid-rise residents (marked in red) who lived in buildings under seven floors high and the other group of high-rise residents (marked in blue) who lived above seven floors high. As shown in Table 6, there were 141 participants living in buildings under seven floors high and 143 (49+40+54=143) participants lived in buildings with seven or more floors. Therefore, as shown in Table 8, there were 49% (n=141) low- and mid-rise residents and 51% (n=143) high-rise residents in total.

Table 8. Results of the number of low-, mid-, and high-rise residents

<table>
<thead>
<tr>
<th></th>
<th>Numbers (N)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>284</td>
<td>100%</td>
</tr>
<tr>
<td>low- and mid-rise residents</td>
<td>141</td>
<td>49%</td>
</tr>
<tr>
<td>High-rise residents</td>
<td>143</td>
<td>51%</td>
</tr>
</tbody>
</table>

Figure 24. Distribution of low-, mid-, and high-rise residents
As shown in Figure 24, participants were split almost evenly between the low- and mid-rise buildings and the high-rise buildings of Shanghai, proving that there are many people living in high-rise building nowadays in big cities in China.

Table 9. Demographic information of two groups

<table>
<thead>
<tr>
<th></th>
<th>Low and mid-rise residents</th>
<th>High-rise residents</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>65 (23%)</td>
<td>55 (19%)</td>
<td>120 (42%)</td>
</tr>
<tr>
<td>Female</td>
<td>76 (27%)</td>
<td>88 (31%)</td>
<td>164 (58%)</td>
</tr>
<tr>
<td>Total</td>
<td>141 (50%)</td>
<td>143 (50%)</td>
<td>284 (100%)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-25 years old</td>
<td>41 (14%)</td>
<td>31 (11%)</td>
<td>72 (25%)</td>
</tr>
<tr>
<td>26-40 years old</td>
<td>30 (11%)</td>
<td>49 (17%)</td>
<td>79 (28%)</td>
</tr>
<tr>
<td>41-55 years old</td>
<td>52 (18%)</td>
<td>52 (18%)</td>
<td>104 (37%)</td>
</tr>
<tr>
<td>&gt; 55 years old</td>
<td>18 (6%)</td>
<td>11 (4%)</td>
<td>29 (10%)</td>
</tr>
<tr>
<td>Total</td>
<td>141 (50%)</td>
<td>143 (50%)</td>
<td>284 (100%)</td>
</tr>
<tr>
<td><strong>Educational level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school and below</td>
<td>15 (5%)</td>
<td>5 (2%)</td>
<td>20 (7%)</td>
</tr>
<tr>
<td>High school</td>
<td>24 (8%)</td>
<td>16 (6%)</td>
<td>40 (14%)</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>75 (26%)</td>
<td>79 (28%)</td>
<td>154 (54%)</td>
</tr>
<tr>
<td>Master and above</td>
<td>27 (10%)</td>
<td>43 (15%)</td>
<td>70 (25%)</td>
</tr>
<tr>
<td>Total</td>
<td>141 (49%)</td>
<td>143 (51%)</td>
<td>284 (100%)</td>
</tr>
<tr>
<td><strong>Monthly salary (RMB)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10,000 yuan</td>
<td>89 (31%)</td>
<td>69 (24%)</td>
<td>158 (56%)</td>
</tr>
<tr>
<td>10,000-30,000 yuan</td>
<td>35 (12%)</td>
<td>48 (17%)</td>
<td>83 (29%)</td>
</tr>
<tr>
<td>&gt; 30,000 yuan</td>
<td>17 (6%)</td>
<td>26 (9%)</td>
<td>43 (15%)</td>
</tr>
<tr>
<td>Total</td>
<td>141 (50%)</td>
<td>143 (50%)</td>
<td>284 (100%)</td>
</tr>
</tbody>
</table>

Table 9 and Figure 25 show the demographic data of the two groups. Overall, there were more female samples than male samples, especially in the high-rise residents group with 12% more females than males. For participants’ age, there were more people in the 26 to 40 year range living
in high-rise buildings than those aged 18 to 25 years and those above 55 years old. For participants’ educational levels, there were more undergraduate and graduate degree holders living in high-rise buildings than those who had less education. For participants’ monthly salary, there were only a few people more in the higher income groups than those people earning less than 10,000 yuan salary per month living in high-rise buildings.

Figure 25. Distribution of gender, age, educational level, and monthly salary of the two groups

After exploring the demographic attributes of the two participant groups, the results of four questions on community-related problems were presented. Table 10 and Figure 26 show that roughly half (51%) of the participants knew only one to five people within the building they live in and 7% of them knew none of their neighbors. Taken together, there are 58% of the participants that basically don’t know their neighbors.
In the high-rise residences, 55% knew one to five neighbors and 9% didn’t know any, making 64% of high-rise residents having poor social relations with the neighbors, 11% more than the low- and mid-rise residents. There were 19% of low- and mid-rise residents who knew more than 15 of theirs neighbors, relatively good social relations and 10% higher than the high-rise residents.

Table 10. Results of Q6: How many neighbors do you know in the same building?

<table>
<thead>
<tr>
<th>Count</th>
<th>Low and mid-rise residents</th>
<th>High-rise residents</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 people</td>
<td>8</td>
<td>13</td>
<td>21</td>
</tr>
<tr>
<td>1-5 people</td>
<td>66</td>
<td>79</td>
<td>145</td>
</tr>
<tr>
<td>6-10 people</td>
<td>28</td>
<td>26</td>
<td>54</td>
</tr>
<tr>
<td>11-15 people</td>
<td>12</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>More than 15</td>
<td>27</td>
<td>13</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>141</td>
<td>143</td>
<td>284</td>
</tr>
</tbody>
</table>

Figure 26. Diagram of Q6
Also, the numbers of households in high-rise buildings were much higher than low- and mid-rise buildings. Take a hypothetical six-floor building with two households per floor and each household being a three-person family, making 36 (6*2*3) residents total in the building. According to Figure 26, most residents knew one to five people, which would mean they knew 3% (1/36) to 14% (5/36) of their neighbors. Extending that hypothesis to a high-rise building with 20 floors [(7+33)/2 +7], as well as the same two households per floor and three people per household, gives 120 (20*2*3) residents in total. So most high-rise residents knew between 0.8% (1/120) and 4% (5/120) of their neighbors. In reality, there are often four to six households per floor in high-rise buildings (Shan 2004), which would make the resulting percentages much smaller. Therefore, social relationships were poor for high-rise residents when compared to low- and mid-rise residents.

Table 11 Results of Q7: Does the interior environment of the building you live in make you feel insecure?

<table>
<thead>
<tr>
<th></th>
<th>Low and mid-rise residents</th>
<th>High-rise residents</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>most of the time</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>some of the time</td>
<td>12</td>
<td>35</td>
<td>47</td>
</tr>
<tr>
<td>a little of the time</td>
<td>76</td>
<td>68</td>
<td>144</td>
</tr>
<tr>
<td>not really at all</td>
<td>49</td>
<td>32</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>141</td>
<td>143</td>
<td>284</td>
</tr>
</tbody>
</table>
Table 11 and Figure 27 show that half (51%) of the overall participants only felt insecure a little of time about the interior environment of the building they lived in while 29% of the participants thought they were completely safe. Taken together, 80% of the people surveyed basically felt safe in the interior environment of their buildings.

Then again, there were 70% (48%+22%) of high-rise residents who felt basically safe, which is 19% less than those in other residences (89%=35%+54%). As well, there were 24% of high-rise residents who felt insecure some of the time and 6% who felt insecure most of time about the interior environment of their building, which means 30% of the high-rise residents felt relatively insecure, an increase of 19% compared to those in low- and mid-rise residences (11%=9%+2%).

![Diagram of Q7](image-url)
Table 12. Results of Q8: How many times have you ever helped your neighbor or had your neighbor help you?

<table>
<thead>
<tr>
<th></th>
<th>Low and mid-rise residents</th>
<th>High-rise residents</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 time</td>
<td>17</td>
<td>36</td>
<td>53</td>
</tr>
<tr>
<td>1-5 times</td>
<td>42</td>
<td>77</td>
<td>119</td>
</tr>
<tr>
<td>6-10 times</td>
<td>63</td>
<td>16</td>
<td>79</td>
</tr>
<tr>
<td>11-15 times</td>
<td>11</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>more than 15 times</td>
<td>8</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>141</td>
<td>143</td>
<td>284</td>
</tr>
</tbody>
</table>

Figure 28. Diagram of Q8

Table 12 and Figure 28 show that 42% of the overall participants only helped their neighbors or received help from their neighbors one to five times and 19% of the participants never helped or received help from their neighbors. Taken together, 61% of the people surveyed lived in an environment lacking neighborhood helpfulness.
There were 79% (54%+25%) of high-rise residents helping or being helped by their neighbors zero to five times, which is 37% less than the low- and mid-rise residents (42%=30%+12%). There were 45% of the low and mid-rise residents helping or being helped by their neighbor six to ten times, which was 34% higher than the high-rise residents. Therefore, the helpfulness in high-rise residents was less than that in low- and mid-rise residents.

*Table 13. Results of Q9: How much time do you spend on your daily activities and social interaction near your home within your community every day?*

<table>
<thead>
<tr>
<th></th>
<th>Low and mid-rise residents</th>
<th>High-rise residents</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basically did not spend time</td>
<td>33</td>
<td>32</td>
<td>65</td>
</tr>
<tr>
<td>Less than half an hour</td>
<td>49</td>
<td>50</td>
<td>99</td>
</tr>
<tr>
<td>Between half an hour and an hour</td>
<td>34</td>
<td>44</td>
<td>78</td>
</tr>
<tr>
<td>More than an hour</td>
<td>25</td>
<td>17</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>141</td>
<td>143</td>
<td>284</td>
</tr>
</tbody>
</table>

*Figure 29. Diagram of Q9*
Table 13 and Figure 29 show that, overall, 23% of the participants did not spend time on daily activity and social interaction, 35% spent less than half an hour every day, 27% spent between half an hour and an hour, and 15% spent more than an hour.

The distribution over the high-rise residents and low- and mid-rise residents are basically consistent with the overall results. Only a few more low- and mid-rise residents spend more than an hour on daily activity and social interaction when compared to the high-rise residents. Therefore, the time spent on daily activity and social interaction within the community was not influenced by whether a resident lived in high-rise or not. Based on these results, for children needing their parents to accompany them (assuming they spend the same amount of time as the adults), their outside playtime was not influenced by the type of buildings they lived in.

However, there are also a certain number of high-rise residents actually living in lower floors, so this question cannot accurately examine the opinion of whether people living on higher floors feel less likely to go out. So, the relationship between the height a resident lives on and amount of time spent outside needs further research.

In summary, we can see that: 1. The social relationships of high-rise residents are poor compared to those of low- and mid-rise residents; 2. Most residents feel relatively safe about the interior environment of the buildings they live in, but high-rise residents feel less secure when compared to low- and mid-rise residences; 3. Reduced helpfulness is a common problem in all buildings, but high-rise residents receive much less helpfulness from their neighbors when compared to low- and mid-rise residences and; 4. The time people, including small children, spent on daily activity and social interaction within the community is basically not affected by whether they live in high-rise building or not.
RESULTS OF PARTICIPANTS’ PREFERENCE FOR SOCIAL INTERACTIONS, INTERIOR PUBLIC SPACE, AND HIGH-RISE RESIDENTIAL BUILDINGS

This section presents the results of the high-rise residents’ preferences related to social interaction, interior public space, and high-rise residential buildings. The results shall be used as reference to form design recommendations.

The first part showing results of surveying participants on their preferences regarding to social interaction, through Q10 and Q11, is indicated in Table 14 and Figure 30. There are 72% of high-rise residents who were willing to interact with their neighbors some of the time, 18% who were willing to interact with the neighbors most of the time, and only 10% who did not want to interact at all. This means most people wanted to have social interactions with their neighbors.

There were half (51%) of high-rise residents who wanted to become acquaintances with their neighbors while 38% wanted to become friends. Only 5% of the participants wanted to become close friends with their neighbors and 6% did not want to know them. Therefore, it can be concluded that most people want to be familiar with their neighbors in a range between friendship and acquaintance, but that they do not prefer to become close friends or strangers with their neighbors.

In summary, most of the high-rise residents wanted to know who their neighbors were, wanted to have some kind of familiarity with them, and wanted to have social interaction with them. But they also wanted to keep some distance from their neighbors.
Table 14. Results of Q10 & Q11

<table>
<thead>
<tr>
<th>Q10: Are you willing to interact with your neighbors?</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>most of the time</td>
<td>26</td>
<td>18%</td>
</tr>
<tr>
<td>some of the time</td>
<td>103</td>
<td>72%</td>
</tr>
<tr>
<td>not really at all</td>
<td>14</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
</tbody>
</table>

Q11: How close you want to be with your neighbors?

<table>
<thead>
<tr>
<th>How close you want to be with your neighbors?</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close friends</td>
<td>7</td>
<td>5%</td>
</tr>
<tr>
<td>Friends</td>
<td>54</td>
<td>38%</td>
</tr>
<tr>
<td>Acquaintance</td>
<td>73</td>
<td>51%</td>
</tr>
<tr>
<td>Strangers</td>
<td>9</td>
<td>6%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 30. Diagrams of Q10 & Q11
The second part shows the participants’ preferences regarding to interior public space, which was surveyed using Q12, Q13, Q14, and Q15. As Table 15 and Figure 31 indicate, there were 54% of the high-rise residents who felt their outdoor public space basically met their needs for daily activity and social interaction, but there were still 36% of residents who felt their outdoor public space did not meet their needs and 10% who felt their needs were completely met.

For Q13, there were 41% of the high-rise participants wanting to add extra interior public space to improve social interaction between neighbors, while 43% of them were uncertain, and 17% of them did not want to add space. For Q14, there were 52% of the high-rise participants wanting to add extra interior public space to have more living space, while 34% of them were uncertain about such change, and 13% of them did not want it. So, it can be concluded that most people want to have, or will consider having, extra interior space. For Q15, 46% of the high-rise residents were willing to pay for the extra interior public space, while 46% of them were willing to consider paying, and only 8% of them were not willing to pay.

In summary, most of the participants felt their outdoor public space basically meet their needs for daily activity and social interaction, but still wanted and were willing consider for paying for more interior public space to improve social interaction with their neighbors and expand their living space.
Table 15. Results of Q12, Q13, Q14, and Q15

<table>
<thead>
<tr>
<th>Question</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q12: Does the outdoor public space meet your needs for daily activity and social interaction?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15</td>
<td>10%</td>
</tr>
<tr>
<td>Basically meet the need</td>
<td>78</td>
<td>54%</td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>36%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
<tr>
<td>Q13: Do you want to add extra interior public spaces to improve social interaction between neighbors?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>58</td>
<td>41%</td>
</tr>
<tr>
<td>Maybe</td>
<td>61</td>
<td>43%</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>17%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
<tr>
<td>Q14: Do you want to add extra interior public spaces to have more living space?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>75</td>
<td>52%</td>
</tr>
<tr>
<td>Maybe</td>
<td>49</td>
<td>34%</td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>13%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
<tr>
<td>Q15: Are you willing to pay for the extra interior public space?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>66</td>
<td>46%</td>
</tr>
<tr>
<td>Not sure, will consider for it</td>
<td>66</td>
<td>46%</td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>8%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
</tbody>
</table>
Q12: Does the outdoor public space meet your needs for daily activity and social interaction?
- Yes: 10%
- Basically meet the need: 42%
- Not enough: 48%

Q13: Do you want to add extra interior public spaces to improve social interaction between neighbors?
- Yes: 41%
- Maybe: 43%
- No: 17%

Q14: Do you want to add extra interior public spaces to have more living space?
- Yes: 52%
- Maybe: 34%
- No: 13%

Q15: Are you willing to pay for the extra interior public space?
- No: 46%
- Not sure, will consider for it: 46%
- Yes: 10%

Figure 31. Diagrams of Q12, Q13, Q14, and Q15
The third part shows the participants’ preferences regarding high-rise buildings and other basic information as surveyed by Q16, Q17, Q18, Q19 and Q20. As Table 16 and Figure 32 indicate, there were 29% of high-rise residents living on the first to 6th floors, 35% of them living on the 7th to 12th floors, 24% of them living on the 13th to 20th floors, and 13% of them living on the 21st to 33rd floors. For Q16, there were 20% of high-rise residents who would prefer to live on the first to 6th floor, 34% of them preferring the 7th to 12th floors, 27% of them preferring the 13th to 20th floors, and 19% of them preferring the 21st to 33rd floors.

For Q18, there were 14% of the high-rise participants living in apartments of less than 90 square meters in size, 37% of them living in 90 to 120 square meter apartments, 32% of them living in 120 to 150 square meter apartments, and 17% of them living in apartments larger than 150 square meters. That proved the fact that the most popular size of apartment in Shanghai is 90 to 120 square meters. For Q19, only 2% of high-rise participants surveyed wanted to live in an apartment less than 90 square meters, while 18% of them wanted to live in 90 to 120 square meter apartments, 34% of them wanted to live in 120 to 150 square meter apartments, and the remaining 45% wanted to live in apartments larger than 150 square meters. So, it can be concluded that most people in high-rise buildings want to live in a larger apartment.

For Q20, 41% of the high-rise residents did not want to use the staircase, 27% of them were willing to climb one or two floors, 24% of them were willing to climb three or four floors, and just 8% of them were willing to climb more than four floors. Taken together, more than half of the high-rise participants were willing to climb a few steps.
Table 16. Results of Q16, Q17, Q18, Q19, and Q20

<table>
<thead>
<tr>
<th>Question</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q16: Which floor do you live on?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-6th floor</td>
<td>41</td>
<td>29%</td>
</tr>
<tr>
<td>7-12th floor</td>
<td>50</td>
<td>35%</td>
</tr>
<tr>
<td>13-20th floor</td>
<td>34</td>
<td>24%</td>
</tr>
<tr>
<td>21-33rd floor</td>
<td>18</td>
<td>13%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Q17: Which height of floors do you prefer?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-6th floor</td>
<td>28</td>
<td>20%</td>
</tr>
<tr>
<td>7-12th floor</td>
<td>49</td>
<td>34%</td>
</tr>
<tr>
<td>13-20th floor</td>
<td>39</td>
<td>27%</td>
</tr>
<tr>
<td>21-33rd floor</td>
<td>27</td>
<td>19%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Q18: How many square meters is your apartment?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 90 square meters</td>
<td>20</td>
<td>14%</td>
</tr>
<tr>
<td>90 to 120 square meters</td>
<td>53</td>
<td>37%</td>
</tr>
<tr>
<td>120 to 150 square meters</td>
<td>46</td>
<td>32%</td>
</tr>
<tr>
<td>more than 150 square meters</td>
<td>24</td>
<td>17%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Q19: How many square meters of an apartment is your ideal size?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 90 square meters</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>90 to 120 square meters</td>
<td>26</td>
<td>18%</td>
</tr>
<tr>
<td>120 to 150 square meters</td>
<td>49</td>
<td>34%</td>
</tr>
<tr>
<td>more than 150 square meters</td>
<td>65</td>
<td>45%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Q20: How many floors are you willing to climb using a staircase?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t want to use stairs</td>
<td>59</td>
<td>41%</td>
</tr>
<tr>
<td>1-2 floors</td>
<td>38</td>
<td>27%</td>
</tr>
<tr>
<td>3-4 floors</td>
<td>34</td>
<td>24%</td>
</tr>
<tr>
<td>More 4 floors</td>
<td>12</td>
<td>8%</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>100%</td>
</tr>
</tbody>
</table>
Figure 32. Diagrams of Q16, Q17, Q18, Q19, and Q20
ANALYSIS OF CROSS TABULATION

This part presents the results on the relationships between selected variables or questions.

In Fisher’s Exact Test, the smaller the P-value is, the greater the difference between the choices of different genders, ages, and educational levels. For inferential statistical analysis, if the p-value is less than 0.1, it can be concluded that the difference was relatively significant; if the p-value is less than 0.05, it can be concluded that the difference was significant.

Table 17 shows the P-value when comparing Q1, Q2, and Q3 with Q6, Q9, Q10, Q13, and Q15. There is a relatively significant difference between Q1 and Q6, and there are significant differences between Q2 and Q13, and Q3 and Q6.

Table 17. P-values of comparing Q1, Q2, and Q3 with Q6, Q9, Q10, Q13, and Q15

<table>
<thead>
<tr>
<th>Question</th>
<th>Q1: Gender</th>
<th>Q2: Age</th>
<th>Q3: Educational Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q6: How many neighbors do you know in the same building?</td>
<td>0.060*</td>
<td>0.105</td>
<td>0.048**</td>
</tr>
<tr>
<td>Q9: How much time do you spend on your daily activities and social interaction near your home within your community every day?</td>
<td>0.664</td>
<td>0.110</td>
<td>0.346</td>
</tr>
<tr>
<td>Q10: Are you willing to interact with your neighbors?</td>
<td>0.310</td>
<td>0.491</td>
<td>0.173</td>
</tr>
<tr>
<td>Q13: Do you want to add extra interior public spaces to improve social interaction between neighbors?</td>
<td>0.293</td>
<td>0.004**</td>
<td>0.792</td>
</tr>
<tr>
<td>Q15: Are you willing to pay for the extra interior public space?</td>
<td>0.513</td>
<td>0.886</td>
<td>0.632</td>
</tr>
</tbody>
</table>

* p<0.10 ** p<0.05
**Difference in Q1: Gender & Q6: How many neighbors do you know in the same building?**

*Table 18. Q1 & Q6 cross tabulation*

<table>
<thead>
<tr>
<th>Choice</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>X²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 people</td>
<td>9(16.36%)</td>
<td>4(4.55%)</td>
<td>13(9.09%)</td>
<td>9.048</td>
<td>0.06</td>
</tr>
<tr>
<td>1-5 people</td>
<td>32(58.18%)</td>
<td>47(53.41%)</td>
<td>79(55.24%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-10 people</td>
<td>8(14.55%)</td>
<td>18(20.45%)</td>
<td>26(18.18%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-15 people</td>
<td>2(3.64%)</td>
<td>11(12.50%)</td>
<td>13(9.09%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>more than 15</td>
<td>4(7.27%)</td>
<td>8(9.09%)</td>
<td>12(8.39%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>88</td>
<td>143</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 33. Diagram of Q1 & Q6 cross tabulation*

The results shown in Table 18 indicate a relative significant difference between different genders and the numbers of neighbors known by a high-rise participant (p = 0.06, Fisher’s Exact Test). Figure 33 indicates that males knew fewer neighbors than females. There were 42% of females who knew more than five neighbors and only 25% of males knew more than five neighbors.
**Difference in Q2: Age & Q13: Do you want to add extra interior public spaces to improve social interaction between neighbors?**

Table 19. Q2 & Q13 cross tabulation

<table>
<thead>
<tr>
<th>Choice</th>
<th>Q2: Age</th>
<th>Total</th>
<th>X²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18-25</td>
<td>26-40</td>
<td>41-55</td>
<td>&gt; 55</td>
</tr>
<tr>
<td>Yes</td>
<td>10(32.26%)</td>
<td>13(26.53%)</td>
<td>25(48.08%)</td>
<td>10(90.91%)</td>
</tr>
<tr>
<td>Maybe</td>
<td>14(45.16%)</td>
<td>28(57.14%)</td>
<td>18(34.62%)</td>
<td>1(9.09%)</td>
</tr>
<tr>
<td>No</td>
<td>7(22.58%)</td>
<td>8(16.33%)</td>
<td>9(17.31%)</td>
<td>0(0.00%)</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>49</td>
<td>52</td>
<td>11</td>
</tr>
</tbody>
</table>

Figure 34. Diagram of Q2 & Q13 cross tabulation

The results shown in Table 19 indicate a significant difference between different ages and the preference towards adding extra interior public space (p = 0.004, Fisher’s Exact Test). Figure 34 indicates that high-rise participants over 40 years old were more willing to have extra interior public space for social interaction than participants under 40 years old. As well, over 90% of
participants over 55 years old wanted to have extra interior public space for social interaction and none of participants in that age range did not want it.

**Difference in Q3: Educational Level & Q6: How many neighbors do you know in the same building?**

*Table 20. Q3 & Q16 cross tabulation*

<table>
<thead>
<tr>
<th>Choice</th>
<th>Q3: Educational Level</th>
<th>Total</th>
<th>X²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Middle school and below</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 people</td>
<td>0(0.00%)</td>
<td>16</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1-5 people</td>
<td>79</td>
<td>57</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>6-10 people</td>
<td>43</td>
<td>27</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>11-15 people</td>
<td>43</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>more than 15</td>
<td>143</td>
<td>43</td>
<td>26</td>
</tr>
</tbody>
</table>

| Q6                     |                      |       |     |     |
| 0 people                | 0(0.00%)              |       |     |     |
| 1-5 people              | 40.00%                |       |     |     |
| 6-10 people             | 20.00%                |       |     |     |
| 11-15 people            | 40.00%                |       |     |     |
| more than 15            | 0(0.00%)              |       |     |     |

**Figure 35. Diagram of Q3 & Q6 cross tabulation**
The results shown in Table 20 indicate a significant difference between different educational levels and the numbers of neighbors known by high-rise participants (p = 0.048, Fisher’s Exact Test). Figure 35 indicates that participants with high school education or less knew more neighbors than participants with undergraduate or higher degrees.

**Difference in Q4: What is your monthly salary? & Q15 Are you willing to pay for the extra interior public space?**

**Table 21. Q4 & Q15 cross tabulation**

<table>
<thead>
<tr>
<th>Choice</th>
<th>Q4: Monthly Salary (yuan)</th>
<th>Total</th>
<th>X²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 10,000</td>
<td>10,000-30,000</td>
<td>&gt; 30,000</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>29(42.03%)</td>
<td>24(50.00%)</td>
<td>13(50.00%)</td>
<td>66(46.15%)</td>
</tr>
<tr>
<td>Not sure, will consider for it</td>
<td>33(47.83%)</td>
<td>22(45.83%)</td>
<td>11(42.31%)</td>
<td>66(46.15%)</td>
</tr>
<tr>
<td>No</td>
<td>7(10.14%)</td>
<td>2(4.17%)</td>
<td>2(7.69%)</td>
<td>11(7.69%)</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>48</td>
<td>26</td>
<td>143</td>
</tr>
</tbody>
</table>

The results shown in Table 21 indicate that there is not a significant difference between different incomes and a willingness to pay for extra interior public space (p = 0.748, Fisher’s Exact Test), which means a participant’s monthly salary does not influence that participant’s willingness to pay for extra interior space.
**Difference in Q16: Which floor do you live on? & Q9: How much time do you spend on your daily activities and social interaction near your home within your community every day?**

Table 22. Q16 & Q9 cross tabulation

<table>
<thead>
<tr>
<th>Choice</th>
<th>Q16</th>
<th>Total</th>
<th>X²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6th floor</td>
<td>7-12th floor</td>
<td>13-20th floor</td>
<td>21-33rd floor</td>
<td></td>
</tr>
<tr>
<td>Basically did not spend time</td>
<td>12(29.27%)</td>
<td>8(16.00%)</td>
<td>9(26.47%)</td>
<td>3(16.67%)</td>
</tr>
<tr>
<td>Less than half an hour</td>
<td>11(26.83%)</td>
<td>20(40.00%)</td>
<td>12(35.29)</td>
<td>7(38.89%)</td>
</tr>
<tr>
<td>Between half an hour and an hour</td>
<td>13(31.71%)</td>
<td>17(34.00%)</td>
<td>8(23.53%)</td>
<td>6(33.33%)</td>
</tr>
<tr>
<td>More than an hour</td>
<td>5(12.20%)</td>
<td>5(10.00%)</td>
<td>5(14.71%)</td>
<td>2(11.11%)</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>50</td>
<td>34</td>
<td>18</td>
</tr>
</tbody>
</table>

The results shown in Table 22 indicate that there is not a significant difference between the height participants live at and the time they spend on daily activity and social interaction within the community (p = 0.859, Fisher’s Exact Test). This means the height of the floor does not influence the participants’ use of ground space. Therefore, despite what is mentioned in the literature review, this survey has found that people who live higher from the ground will not be less likely to use ground public space.
Difference in Q16: Which floor do you live on? & Q17: Which height of floors do you prefer?

Table 23. Q16 & Q17 cross tabulation

<table>
<thead>
<tr>
<th>Choice</th>
<th>1-6th floor</th>
<th>7-12th floor</th>
<th>13-20th floor</th>
<th>21-33rd floor</th>
<th>Total</th>
<th>X²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6th floor</td>
<td>18(43.90%)</td>
<td>7(14.00%)</td>
<td>3(8.82%)</td>
<td>0(0.00%)</td>
<td>28(19.58%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-12th floor</td>
<td>15(36.59%)</td>
<td>30(60.00%)</td>
<td>4(11.76%)</td>
<td>0(0.00%)</td>
<td>49(34.27%)</td>
<td>115.362</td>
<td>0.000</td>
</tr>
<tr>
<td>13-20th floor</td>
<td>4(9.76%)</td>
<td>9(18.00%)</td>
<td>22(64.71%)</td>
<td>4(22.22%)</td>
<td>39(27.27%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-33rd floor</td>
<td>4(9.76%)</td>
<td>4(8.00%)</td>
<td>5(14.70%)</td>
<td>14(77.78%)</td>
<td>27(18.89%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>50</td>
<td>34</td>
<td>18</td>
<td>143</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 36. Diagram of Q16 & Q17 cross tabulation

The results shown in Table 23 indicate a significant difference between the floor height high-rise participants lived in and the floor height they preferred to live in (p = 0.000, Fisher’s
Exact Test). Figure 36 indicates that most residents preferred to live on the same floor as they were living on, which means most participants were satisfied with the height of the floor they lived on, whether they were living on lower floors or higher floors.

**Q18: How many square meters is your apartment? & Q19: How many square meters of an apartment is your ideal size?**

*Table 24. Q18 & Q19 cross tabulation*

<table>
<thead>
<tr>
<th>Choice</th>
<th>Q18 Less than 90 square meters</th>
<th>Q18 90 to 120 square meters</th>
<th>Q18 120 to 150 square meters</th>
<th>Q18 more than 150 square meters</th>
<th>Total</th>
<th>X²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 90 square meters</td>
<td>0 (0.00%)</td>
<td>3 (5.66%)</td>
<td>0 (0.00%)</td>
<td>0 (0.00%)</td>
<td>3 (2.10%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 to 120 square meters</td>
<td>8 (40.00%)</td>
<td>14 (26.42%)</td>
<td>4 (8.70%)</td>
<td>0 (0.00%)</td>
<td>26 (18.18%)</td>
<td>37.533</td>
<td>0.000</td>
</tr>
<tr>
<td>120 to 150 square meters</td>
<td>8 (40.00%)</td>
<td>17 (32.08%)</td>
<td>21 (45.65%)</td>
<td>3 (12.50%)</td>
<td>49 (34.27%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>more than 150 square meters</td>
<td>4 (20.00%)</td>
<td>19 (35.85%)</td>
<td>21 (45.65%)</td>
<td>21 (87.50%)</td>
<td>65 (45.45%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>53</td>
<td>46</td>
<td>24</td>
<td>143</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results shown in Table 24 indicate a significant difference between the size of the apartment participants lived in and the size of the apartment they preferred to live in ($p = 0.000$, Fisher’s Exact Test). Figure 36 indicates that most residents preferred an apartment 30 to 60 square meters bigger than their current apartment.

In summary of the cross tabulation analysis, females were found to know more neighbors when compared to males; residents with undergraduate degrees and above were found to know fewer neighbors when compared to residents with lower education levels; people over 40 years old were found to be more willing to have extra interior public space, especially when over age 55; monthly salary was found not to influence participants’ willingness to pay for extra interior space; the height of a participant’s floor was found not to influence the time participants spent in ground public space; most people were found to enjoy the height of floor they were living on; and most people were found to want to live in spaces that were 30 to 60 square meters bigger.

*Figure 37. Diagram of Q18 & Q19 cross tabulation*
CONCLUSION

The survey results indicate that high-rise residents have poor social relationships with their neighbors, especially if they are male and highly educated. Although most high-rise residents spend a certain amount of time outside within the community every day, they still want to interact with, and become familiar with, their neighbors. Most high-rise residents think their outdoor public space basically meets their needs, but they still want to have extra interior public space for social interaction and extended living space. For retired people or people close to retiring, the desire for extra interior public space for the purposes of facilitating social interactions is especially high. Regardless of income, most high-rise residents want to improve their quality of life and are willing to paying extra to do so. As such, incorporating additional interior public space into a high-rise building to enhance social interactions is feasible. This solution has the potential to reduce the feelings of insecurity associated with living in a high-rise building and increase the helpfulness neighbors provide to one another.

The results indicate that social relationships in low- and mid-rise buildings are better than those in high-rise buildings. There are often ten to twelve households in one low- or mid-rise building that is the size of a micro-neighborhood. As mentioned in the literature review, micro-neighborhoods help promote more intimate relationships between neighbors (Marans, 1975; Birch et al., 1979). The survey results verify the findings of the literature review. So, as assumed in strategy 2, it could be useful to add another neighborhood level, a micro-neighborhood, into the high-rise building. The size of a micro-neighborhood is around 12 to 15 units (Birch et al., 1979; Lee, 1987), so 12 to 15 apartments can be grouped into a micro-neighborhood unit with each unit having an extra interior public space that is shared between the units. Furthermore, based on the
results of Q20, most residents are willing to climb one or two floors, so a unit could be as small as two or three floors.

The findings of the literature review indicated that people who live above the 5th floor have no perception of the activities that are taking place at ground level and, as such, are less likely to participate in such activities. However, the survey results revealed that the level the residents live on doesn’t influence their use of the ground public space; as such, the height of the building doesn’t impact the amount of time residents spend outside engaged in daily activities and social interactions. The survey results overthrow the theories presented in the literature review. As such, we don’t need to add platforms into high-rise building to create a feeling of living close to the ground as we assumed in strategy 1.

Most residents want to be familiar with their neighbors, and while they want more intimate relationships, they also do not want to be too close to their neighbors. Therefore, the size of an extra interior public space should allow residents to keep their distance if they choose, which means the size of the space should allow for the social distance according to Edward T. Hall’s study (1.2m-3.6m). Also, according to the survey results, most residents want their living space to be 30 to 60 square meters larger.

In summary, Strategy 1 is not necessary; however, Strategy 2 could improve quality of life. So, our strategy is to group 12 to 15 apartments together as a unit and add extra interior public space into the “unit.” Each would be two to three floors high and incorporate at least 30 to 60 square meters of functional space that residents share. And the interior public space should be big enough for residents to maintain an adequate social distance.
This chapter focuses on methods of designing interior public spaces of high-rise buildings, examines design principles that can improve social interaction, and explores how to integrate “extra interior public space” into building design. Because designing space for social interaction challenging, I have started by exploring a housing model which explicitly promotes social interaction and from there will extract inspiration that can be applied to other housing models. The example selected for this thesis is a traditional Chinese courtyard house, which is a housing model that encourages individuals within the homes to integrate with their fellow residents (Yang 2015). The design of traditional courtyard houses creates a feeling of community, satisfying community needs and promoting social interaction between its residents (Yang 2015). This chapter will discuss the design concepts of the traditional residential courtyard space and try to adapt the courtyard form to contemporary lifestyles. This chapter will also integrate theoretical analysis and case studies that enable interior public spaces within high-rise buildings; such a design would fully consider the psychological and physiological needs of residents as inhabitants of public space and seek to ensure that people are satisfied with the resultant space.

Traditional courtyard houses are rich in humanistic connotation arising from Chinese culture and using such a house as the object of this case study demonstrates cultural continuity. Although lifestyles are changing, courtyard houses remain a common cultural reference point. These houses are not only architectural spaces, they are also an expression of traditional culture, and provide a sense of a harmonious living style. There is an old saying, “close neighbors are better than distant relatives,” which shows that people pay attention to relationships between neighbors. Traditional courtyard housing reflects this harmonious social relationship and creates abundant space for neighborhood communication. In a high-density, high-volume urban living environment,
however, people have very little opportunity to experience this model or the culture and customs it facilitates. Thus, it is necessary for us to integrate traditional courtyard house design concepts into modern neighborhoods.

TRADITIONAL COURTYARD HOUSE – SIHEYUAN, BEIJING

The courtyard house is a traditional dwelling typology that was common in China for more than 1,000 years (Yang 2015). It has a heritage deeply rooted in specific Chinese traditions and culture (Yang 2015). The name of the courtyard house indicates its basic layout: a residential compound with a courtyard enclosed by surrounding buildings and walls on four sides, as Figure 38 shows. Siheyuan is an example of one kind of courtyard house that exists in Beijing. It used to be occupied by a single, large family. After a new government was established in 1949, the rules of property ownership were changed to accommodate a rapidly growing urban population (Yang 2015) and what were originally single-family homes began to accommodate many families, forming a neighborhood unit linked by geographical proximity. Figure 39 shows neighbors, living together in one big courtyard house, having a community meeting in the courtyard. Although the
living environment of Siheyuan is crowded and residents have very limited privacy, its harmonious and lively neighborhood atmosphere is beyond the reach of modern high-rise buildings.

Figure 39. Neighbors, living together in one big courtyard house, having a community meeting in the Siheyuan

The courtyard is the center of both social life and of the geometric form of the house (Yang 2015). It is the center of the house, so it is an accessible, open space that everyone can see and use. It serves as a living room, with people spending a lot of time there. Children can play in the courtyard and adults can socialize together; they can garden, do laundry, and even cook (Figure 40). Also, courtyard houses are adjacent to small streets or alleys, enabling people to easily become involved in different activities on the streets (Figure 40). Sellers can sell their products on the streets. Children can play on the streets with their friends and parents can call them or easily find them and are therefore more willing to let their children play outside without supervision. Neighbors also help watch over children playing on the streets. Elderly people can interact with
more people more freely, fulfilling their needs for human communication. Some elderly people even put their chair in front of the door in order to sit and see people passing by. They are able to easily participate in social activities, like playing cards with neighbors. So, it is clear that people living in courtyard houses have strong, social relationships with their neighbors. Familiarity between neighbors increases neighborly helpfulness and allows residents to know what is happening nearby, which makes them feel safe. Residents are connected, they know each other, and they are comfortable with their neighbors, thus building a strong community feeling.

In Figure 40, the upper-left image shows three residents sitting in a courtyard enjoying the sunshine, and one resident watering the plants; the upper-right image shows caged birds, a fish tank, and plants in a courtyard house; the middle-left image shows neighbors playing chess in an alley; the middle-right image shows one old man reading the newspaper in an alley and a child playing in front of him; the lower-left image shows some women together in front of the gate of a courtyard house; and the lower-right image shows a seller with their products on a small street.
Figure 40. Scenes of residents socializing in courtyard houses
FOUR LEVELS OF SPACE

American scholar Oscar Newman divided the living space into four spatial zones: private space, semi-private space, semi-public space, and public space (Newman 1973).

As Figure 41 shows, it is a gradual process for people enter from a public space to a private space. During this process, the sense of belonging within each space gradually increases, and the sense of security of the residence gradually strengthens. Going from public space to private space, residents are likely to feel more casual and relaxed.

In traditional courtyard housing, courtyard space is semi-private space, and adjacent, small alleys are semi-public spaces. The outside street is public space. Streets, alleys, and courtyards constitute different levels, or zones, of space (Figure 42). Each zone has enough space for people to engage in social interaction.
Figure 42. Diagram of four levels of space within courtyard-style housing
In this street-alley-courtyard living mode, the spatial zones from outside to inside go from public to private, with a sense of home continuously enhanced. When people’s sense of field or realm is increased, they feel that they are “home.” Residents that live together in the same courtyard house have the most intimate neighborhood relationship—they constitute a big “family.” Residents that live together in the same alley have a relatively close neighborhood relationship—they constitute a close community. Together, residents build a sense of responsibility for the shared space and are mutually vigilant about outsiders, effectively preventing crime and creating a strong sense of security. Thus, people feel both physically and psychologically safe and comfortable and are more likely to form relationships with their neighbors and to help each other.

Figure 43. Diagram of four levels of space in a high-rise residential building
In high-rise buildings, because of the large number of people sharing them, the ground outside can only be designated as public space, and even interior circulation spaces like elevators and stairs are shared by many people and are therefore very public, such that they could be designated as semi-public space. Corridors on each floor could be designated as semi-private space because these spaces are shared by the apartments of people living on the same floor. Private space exists only within the apartment units. The corridors, elevators, stairs, and the outside ground space constitute the different levels or zones of space (Figure 43), but we can see that there is no interaction space—only circulation space in semi-private and semi-public zones. The semi-private and semi-public spaces are too small to make people to develop the sense of community.

Compared to traditional courtyard housing, modern high-rise buildings don’t have a semi-private space (like a courtyard) for social interaction and don’t have a semi-public space (like an alley) to connect the residents of each floor. Due to this lack of social interaction space, it is hard to build a sense of belonging and a feeling of being “home” in the semi-private and semi-public spaces of such buildings. High-rise residents do not generally visit each other or go into their neighbors’ apartments because the apartment space is private space and people feel uncomfortable letting others in. In courtyard housing, however, residents visit each other frequently because they have the courtyard to function as a buffer area. It is not a private space but still has a sense of home and provides a great space for people to hang out.

**VISIBILITY OF INTERIOR PUBLIC SPACE**

Everyone has a dual psychological need for social interaction and for privacy. This need is reflected in the spaces in which we live. When people want to socialize with others, they seek a
more open space, and when people want to be alone, they want a space that cannot be seen by others.

The public space of a traditional courtyard house has high visibility. As seen in Figure 44, residents in the room and residents in the courtyard can see each other through the window; people in the courtyard house and people in the alley can also see each other through the window or door. Although in reality sometimes sightlines may be blocked, we can still feel the visual connection of the spaces. Because of this high visibility, the courtyard space is very open and attracts residents to participate in activities and interact with others. On the other hand, the space does not have very much privacy and is very crowded.

The interior public space of high-rise buildings has low visibility. As seen in Figure 44, residents in the apartment and residents in the corridor cannot see each other because there is no window installed in the walls facing the corridor and doors are always closed. Residents on the stairs and in the elevators have no visibility because they are moving vertically. The interior public space of high-rise buildings is isolated and has no connection with other spaces. It provides enough privacy for the residents living in the apartments but, on the other hand, it does not prompt residents to interact with each other.
Lack of visibility between spaces can lead to isolation and loneliness and undermines people's normal mode of communication. Too much visibility can create a sense of crowding and disturbance, which limits individuals’ concentration and freedom. People need different levels of privacy at different times, in different locations, and for different activities. The spatial environment design of a residential area should provide different levels of visibility to create different levels of privacy, and transitions between these different levels should be smooth.

There is enough privacy for residents’ individual homes within high-rise buildings, so we need to focus on making the interior public spaces more open in order to attract more residents to participate in neighborhood activities. Also, high visibility of interior public spaces makes it easy for residents to observe the surrounding environment and, to some extent, improves the security of the space (Jacobs 1961), so that residents feel safer and parents will be more confident in letting their children play in the public spaces without supervision.
DESIGN STRATEGY

Based on what we have researched in previous sections, the design strategy to promote social interaction in high-rise building public spaces is as follows:

A. The “Unit”

Separate high-rise buildings into smaller communities. Group 12-15 apartments as one “Unit.” Each unit would encompass two floors of apartments. The unit should provide enough interior public space for different ranges of social interaction. The unit should provide enough functional space for residents to extend their living space into the interior public spaces.

B. Courtyard

The courtyard should be big enough for different kinds of activities, like greeting, hanging out, walking, and playing. The courtyard should provide a buffer space between private space (home) and semi-public space, and should be attractive and welcoming, encouraging resident use. The courtyard space should have enough natural light to make residents feel comfortable.

C. Corridor

Integrate corridor or circulation space with courtyard space to increase opportunities for socializing. Corridor or circulation space should direct residents to courtyard space.

D. Staircase

Increase use rate of the staircase and integrate it with courtyard space.

E. Indoor Functional Space

Indoor functional space should provide different uses for residents, making neighborhood activities more frequent, diverse and longer-lasting.
F. Different Levels of Spaces (Privacy):

Divide space into different levels and provide enough corresponding interior public space for each level of space for social interaction.

G. Visibility

Provide different levels of private spaces for different activities. Private space should have the highest privacy level, semi-private should be more open, and semi-public space should be the most open space within the high-rise building.

H. Diversity and Flexibility

The interior public space should have different uses and be flexible enough to change its function. The space should fully consider the needs of all the residents and promote social interaction. The residents should have some kind of control over this space.
DESIGN

DESIGN CONCEPT

In this paper, high-rise residential buildings are defined as buildings from seven to thirty-two floors in height (Yang 2003). The prototype model is flexible enough to apply to buildings from eight to thirty-two floors. Because a unit is two floors high, an eight story building would need four units and a thirty-two story building would need sixteen units. In order to better describe the prototype model, in this section we focus on a theoretical building of sixteen stories encompassing eight units.

![Diagram of prototype model](image)

*Figure 45. Diagram of prototype model*

We first need to establish a courtyard in the design of a standard unit. As shown below, if we put the courtyard in the center there will be no sunlight. If we move the courtyard to one side,
just one side of the courtyard will be open to sunlight, which is not enough. If we move the
courtyard to one corner, two sides of the courtyard would be open to sunlight, which is optimal.

Figure 46. Diagram of courtyard selection

We then stack the units together to create the overall building.

Figure 47. Diagram of model with courtyard
Then we rotate the units ninety-degrees clockwise from bottom to top to get the overall design of the building.

Now we have courtyards facing each side with views. The courtyard spaces rise spirally, creating upward movement, and feel like someone on the ground could walk through each courtyard to get to the roof.

The next step is adding space to connect each unit to its courtyard. As shown below (Figure 49), the space marked in light gray is designed as connection space, linking each unit and creating an alley space like what we have seen in traditional courtyard housing. Like actual alleys, these connection spaces would also be designed to attract resident participation in different activities. Meanwhile, a beautiful rooftop garden would be the destination of these “alleys” so that when people walk along an “alley” there are different activities happening on both sides and the rooftop garden is waiting at the end.

Figure 48. Diagram of unit rotation
Figure 49. Diagram of model with connection space
CONCEPTUAL FLOOR PLANS

First floor

Second floor

Figure 50. Conceptual floor plans
Figure 51. Diagram of how the “Unit” rotates

Figure 50 shows the conceptual floor plan of the model, where each unit has twelve apartments. The orange space shows the indoor space for different functions, the white space shows the circulation space, and the green space shows the courtyard space. There are two elevators and one set of stairs within the center core, as well as one outside stairwell connecting each courtyard and indoor functional spaces. Figure 51 shows how each unit rotates without disturbing the center core.
Figure 52. Diagram of different levels of space
Figure 53. Diagrams of how to integrate courtyard and alley space in a high-rise building

Figure 52 shows different levels of space: red is semi-public space, yellow is semi-private space, and blue is private space. Figure 53 shows how to integrate courtyard and alley space into a high-rise building. Figure 54 shows different uses and different activities within the indoor functional and courtyard spaces. Figures 55-58 show renderings from different perspectives.
Figure 54. Different uses and activities of indoor functional space and courtyard space
Figure 55. Rendering 1

Figure 56. Rendering 2
Figure 57. Rendering 3

Figure 58. Rendering 4
In a previous section, we imagined removing one apartment space from a six-unit apartment floor plan in order to use that space as interior public space, and we calculated a resultant cost increase of 20% to make this change. In the prototype model, as we can see in Figure 59, the red area shows this additional interior public space. If we remove the additional interior public space, each unit could have sixteen apartments, but as currently shown each unit has twelve
apartments. The prototype model would therefore cost 33.3% more than the same building without additional interior public space.

This indicates that residents need to pay 33.3% more to live in a building with the prototype’s design compared to standard high-rise apartments—a huge burden for people living in Shanghai. Although most survey participants said they would either consider paying or be willing to pay the extra cost to improve their standard of living, in reality it may be difficult to implement.

Although it is hard to design a high-rise building that promotes social interaction while still being affordable, I hope with the aid of advanced technology that we can create such a building in the future.

I also want to talk about my motivation for choosing this topic. Before the age of six, I lived with my grandparents in a courtyard house within a broader community of courtyard houses. At that time, I could always find someone to play with and often went into others’ courtyards to see what they were doing. When I stood in my courtyard, I could hear the sound of a television from my neighbors’ home, I could smell what they were cooking for dinner, and I could see people passing by our big, wood gate into the courtyard. After I turned six, I lived with my parents in a seven-floor building: the stairwell and hallway were dark, isolated, and dirty, and everyone kept their reinforced-steel doors closed. I always felt scared when I climbed the stairs because I thought no one would help me if I was followed by strangers. Also, I often came home much earlier than my parents and felt bored and lonely when I was at home by myself.

Now our family lives in a very nice high-rise building community with good landscaping, but my grandmother still doesn’t want to live with us. She feels bored when living in high-rise buildings because she has no friends nearby and she cannot find people to socialize with. She likes her courtyard housing lifestyle. I am therefore motivated to replicate the feeling of living in a
courtyard house in a high-rise building. The goal of this design is to improve social interactions between residents, especially keeping in mind the elderly and children.
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