*Article*

# Actual Conditions of Mixed Public–Private Planning for Housing Complexes in Beijing

**Chu Chu [1],\*, Rie Nomura [2] and Suguru Mori [2]**

[1]   Graduate School of Engineering, Hokkaido University, North 13, West 8, Kita-ku, Sapporo 060-8628, Japan
[2]   Faculty of Engineering, Hokkaido University, North 13, West 8, Kita-ku, Sapporo 060-8628, Japan;
     nomurarie@eng.hokudai.ac.jp (R.N.); suguru-m@eng.hokudai.ac.jp (S.M.)
\*   Correspondence: chuchu@eng.hokudai.ac.jp or chuchu_acad@hotmail.com

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**Abstract:** Mixed habitation environments have gradually proved to be an effective planning method to promote social integration in many countries. However, due to the differences in the social backgrounds of each country, it is essential to implement construction methods suitable for local conditions. On the other hand, the planning theories and construction methods discussed from multiple perspectives, including an architectural perspective of spatial forms, have been insufficient, which is not conducive to constructing a sustainable dwelling environment. This article aims to clarify the planning status of spatial forms and their issues by investigating existing projects with mixed habitation environments in China. Unlike other countries that have implemented relevant policies for many years, China has just begun to explore relevant schemes (i.e., public-rental housing in private-owned housing complexes) aiming to promote mixed habitation environments. The selected research objects included all projects already inhabited at the end of June 2017 in the city of Beijing. Through field survey, the research objects were divided into eight types via an analysis of building layouts and residents' traffic lines. The results show that out of the many research objects, two kinds of housing were clearly distinctive, and only a few research objects matched the basic conditions to be defined as a mixed habitation. The conditions are not conducive to the formation of mixed habitation; therefore, a more detailed discussion on how to design a mixed habitation environment is necessary to aid further research.

**Keywords:** public-rental housing; mixed housing complex; mixed habitation; pattern; China

## 1. Introduction

### 1.1. Mixed Housing Complexes

Recently, China has experienced rapid economic development, and the income gap is gradually widening compared with Europe and Japan [1]. Owing to the excessive gap between household incomes, the Chinese government has created different types of housing, including rentals and owned property rights, based on the demands of different income groups. For instance, low-income households were supplied rental-type housing, defined as low-rental housing by the government or the land agent. The housing was intended for medium-low income households having owned property rights, with criteria on the price limit (a price discount based on the anticipated selling price of neighboring housings) and housing area, called affordable housing [2,3]. Since 2003, housing prices have rapidly increased; the general urban residential income is disproportionate to a house purchase, reducing the ability of residents to purchase a house, especially among medium-low income households [4], and the proportion of people unable to obtain a house has rapidly increased. In addition, an unclear preapplication process and restrictive covenants has led to ambiguous tenancy standards, resulting in

a general phenomenon of medium-high or high-income households purchasing affordable housing [5]. Consequently, low-income households have been forced to live in the suburbs, where inconvenient transportation and access to facilities has caused social isolation and deteriorating living conditions [6]. To prevent the deteriorating situation, since 2010, for the majority of young people who have never owned a dwelling, as well as for medium-low income households not owning a dwelling, public-rental housing (PRH) has been available. After 2013, low-rental housings were replaced by PRH.

A survey in the study on housing provisions in some cities—especially in Beijing, Shanghai, Shenzhen, Chongqing, etc.—has found that each city has their own PRH provision with different purposes. Beijing has the maximum number of projects targeting low-income households who cannot purchase their own housing. Additionally, the construction model of PRH in the city of Beijing has three major approaches: C1 (affiliated construction)—the PRH is affiliated with and built on private property (private-owned housing: POH); C2 (intensive construction)—an unmixed PRH housing complex; C3 (acquire or rent)—a replacement building as compensation for urban development is rented or purchased by the government and then applied to PRH. According to the statistics on all PRH projects completed and occupied before July 2017 in the city of Beijing, most PRH buildings were built on private property (i.e., the C1 type). In principle, the C1 type can be described as a mixed housing complex, enabling the promotion of a residential environment to become "mixed habitation" with an intuitive and simple perspective under the required site plan dimension.

By the end of 2017, POH could be divided into four types based on the housing provision implemented in Beijing (Figure 1): R1 (directional-replacement housing)—the households own the property rights as compensation owed to their original one being demolished due to urban development. R2 (affordable housing)—housing with limited prices and dwelling areas for medium-low income households. R3 (price-controlled housing)—dwelling is set for medium-income households with limited dwelling areas and prices, which differs significantly from "affordable housing". R4 (commercial housing)—condominiums without any restrictions in the Chinese housing scheme. Among these, R1, R2, and R3 have been the most common. These types have been supplied as a general welfare safety net by the administration, described as low-income housing. Although housing types have been provided for different income groups, the problem of housing prices and supply mechanisms has remained unresolved. For these reasons, a new type of housing was created from the end of 2017, called "government-supported housing with common property", which means that the property is co-owned by individuals and the government.
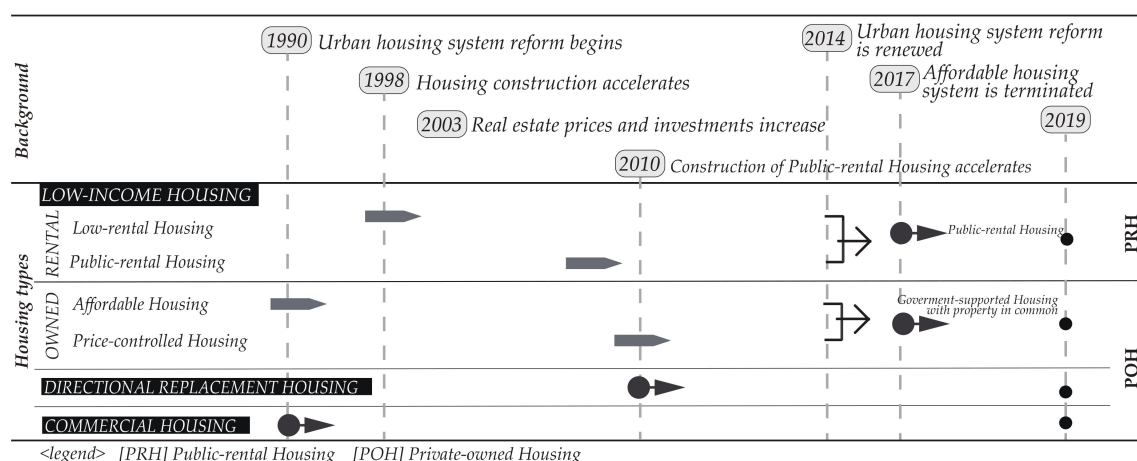


**Figure 1.** The formation process and content of mixed-housing complexes in Beijing.

The phrase "mixed habitation conditions" usually refer to a model in which people from different ethnic groups or income classes live together in a residential area. However, China still does not have a clear definition related to mixed habitation. The various dwelling provisions for different income

groups have been approved but are not yet fixed. The present situation for low-income households to own a PRH is relatively difficult due to criteria such as occupancy conditions and the scheme's target being more consistent with the actual situation. Regarding individually owned housing rights, the actual implementation effect is not obvious, although the government has proposed many different housing types, as described above. Many studies have also verified the differences between the living conditions of owning a house and renting a house from different perspectives [7–9]. Nonetheless, research focused on the mixed housing complex is absent. In addition, the present schemes do not clearly indicate the construction methods or complex design strategies, such as how to layout the residential buildings in the complex [10], nor does it clearly regulate the income limit of POH residents. Therefore, the definition of a mixed housing complex in this article is limited to the PRH supply for low-income households and POH with property rights planned together in a single housing complex (i.e., low-income residents with high-income residents living in one housing complex). The term "planning" will be used to indicate the method of planning the layout of various residential buildings within the housing complex.

### 1.2. The Necessity of Mixed Habitation towards a Sustainable Living Environment

In the last half-century, many countries have adopted policies on mixed habitation environments. Generally, it is used to solve the issue of social differentiation, decreasing concentrations of poverty in order to spur urban renewal [11,12]. One example of the method implemented to address these issues has been seen in France since the 1990s, with a view to create a social mix by establishing new residential areas for the low-income class and the middle class to reside in. Some research has shown that this method has great benefits for local social cohesion and social integration [13]. On the contrary, due to the lack of specific criteria, the low-income class in true need were not accommodated in the new residential area, resulting in poverty becoming concentrated [14]. Therefore, the policy should be formulated according to relevant criteria in order to support social equality. From the perspective of reducing social differentiation, it could be judged that the development of a mixed habitation environment is important. Alongside environmental improvement, urban renovation and community development have been heeded in the United States for a long time [15–17]. The living conditions of low-income groups became severe, along with public housing aging problems around the 1990s. Under these situations, Hope VI Program had been promulgated, aimed at physical space regeneration, resulting in achieving the goal of social enhancement. In particular, housing quality has been improved and the low-income class were able to live in better environments through renewal of old public housing. The residential planning of public housing was also successful in attracting the higher-income class, gradually decreasing the poverty concentration. The policy had also taken into account enhancing regional communication, such as creating opportunities for low-income residents to access education and employment [16,18]. However, the study showed that the level of physical integration of housing units in the mixed-income development have lacked the consideration to improve the familiarity among residents in creating the social interactions [19]. With respect to this problem, there has been much discussion in Japan regarding the physical planning model of housing units [20–22]. In Japan the recent mixed habitation issues have concerned the increasing number of permanent foreign residents. The suggested solutions included attaching importance to community management and cultivating the relationship between natives and foreigners, preventing spatial division and social separation in the future [23–25]. It can be indicated that the mixed habitation scheme has achieved mixed living of different classes, significantly reducing the homogenous living environment, as well as maintaining social stability to a certain degree. Nevertheless, present research does not address adequate strategies of housing planning of mixed habitation. The discussion on effective measures to directly enhance and promote social interaction [26] is still insufficient.

According to previous studies, we can point out some residential planning strategies regarding the planning of mixed habitation environments. Some studies have suggested that design, layout, and daily use of both public and private spaces in a housing complex are very important for understanding the

experience and standpoint of residential interactions, and these elements should be given attention in planning mixed habitation environments [27]. While different formation schemes may lead to different results, social ties must also be explored to increase opportunities and possibilities of social mix through spatial distance [28]. However, overly mixed attributes of residents will not promote social harmony as imagined; on the contrary, potential conflicts may increase [29]. Continuity of the scheme should be maintained throughout the entire area without discrimination [30].

Therefore, a comprehensive analysis is essentially required to exploring the connections between the hardware aspect (the spatial plan, without physical prejudice) and the software aspect (promoting opportunities in connecting residents of different classes). However, present research does not address spatiotemporal living style issues adequately, and the understanding of the different current planning methods for a mixed habitation environment must be improved greatly for future dwelling sustainability.

With the rapid economic growth in China, urban residential areas are constantly being developed in large numbers. Real estate developers generally choose an area based on economic priority and are more interested in housing development for groups with high purchasing ability. As a consequence, the purchasing power of the general public has gradually decreased, leading to distinct regional divergences in housing prices to expand [31]. Furthermore, an assessment of housing requirements and inadequate guidance regarding housing planning have caused higher land and real estate prices [32,33]. Due to the universality of this situation, low-income residents are incapable of owning a house, as well as struggling to adopt criteria that they consider sufficient for a good place to live, having to choose a remote living place far from the central cities and being forced into social isolation. Consequently, the problem of poor residential areas may arise.

Therefore, within the scope of the problem, which is still controllable, it is necessary to provide a living environment for low income citizens that is not isolated by urban housing conditions or determined by discrimination. Under the current situation, China has introduced relevant schemes similar to mixed habitation from the West [34], which have only recently been enacted. One of the main concepts in the enacted housing policy is to provide mixed housing complexes, seeking an income-based mixed habitation and introduce different income groups to share the housing complex with each other in further effort to prevent poverty from developing contiguously [35], in particular, providing a unique planning form so that low-income groups can have an opportunity to live in urban areas without discrimination. In addition, the mixed habitation scheme have been given careful attention by the government and sociologists for its aspects regarding financial sustainability, and its construction model, establishment, and improvement [36,37]. However, a large number of projects have already been constructed under the situation of the guidance of mixed housing complexes, which is still imperfect.

From the conditions stated above, the purpose of this article is to explore the issues regarding spatial form of mixed housing complexes, specifically, the possibilities of the current plans promoting interaction between different income residents. China was chosen as the research target, since China has constructed many mixed housing complexes in a short time compared with other countries. Almost all projects in China have a similar background, therefore are comparable to a certain extent.

While site plans influence residential interactions, a mixed habitation environment is a topic of crucial importance in creating a sustainable living environment, including housing complexes without physical prejudice. Although the issue of the residential scheme is being raised from multiple perspectives, prior in-depth analysis of physical planning is insufficient. The intention of this research is to comprehensively analyze the spatial form of mixed housing complexes and to discuss the feasibility of forming a mixed habitation environment.

## 2. Methods

### 2.1. Research Questions and Methodology

It is confirmed in research studies on the current social status and the changes and implementation of housing provisions in China that site plans for mixed housing complexes also consider interactions between residents in the housing complex, although these interactions have not been fully investigated. Therefore, the following questions are raised:

(1) Do the current mixed housing complexes with a plan for residents' interaction fulfill the planning of the residential environment to generate interactions between public-rental units and private-owned units without physical prejudice? As a response to this question, it is necessary to use the method of architectural typology to classify the existing housing complexes, determine the spatial relationship between PRH and POH, and identify the existence of an inside boundary.

(2) For the projects that satisfy the environment without inside boundaries in a block, do the design and layout characteristics adopt other outcomes to promote or obstruct the opportunity for PRH residents to mingle with POH residents? To answer this question, a field survey to analyze the planning strategy for residents' traffic lines is needed from the perspective of environmental behavior studies, along with discussion of the differences of the traffic lines between PRH and POH buildings in the studied block.

### 2.2. Study Area and Target

As noted earlier, the city of Beijing has the largest number of projects for mixed housing complexes, thus, it was determined as the research location. The research objects targeted for this research were PRH units selected by an open-recruit system, and all objects that qualified as housing provided for low income households that do not own a dwelling, occupied by the end of June 2017. Other types of PRH in the city of Beijing were excluded from this research, such as talent apartments built for enterprise talents without shelter, as well as projects that were unfinished and had not been occupied. In total, 149 research objects were selected from Beijing from the open information of government agencies, including the Beijing Municipal Housing and Rural Construction Bureau, the Beijing Municipal Commission of Urban Planning, the Beijing Public Housing Center, and each district's Housing and Construction Bureau. For several reasons, such as inconsistencies in names between planning and actual use, incomplete projects, or the PRH building construction method not being aligned with the planning of a mixed housing complex, some PRH projects were removed from the sample. Consequently, 85 PRH projects remained in the first stage of the research (i.e., PRH buildings planned in one housing complex together with POH buildings).

### 2.3. Data Collection Procedure

In this step, through a telephone interview of the managing operation department to confirm whether a project met the qualities of a mixed housing complex defined in this article, three projects were eliminated from the research objects as the PRHs were built using methods acquired or borrowed rather than via affiliated construction. The next step was the geographical location confirmation using a map of the city of Beijing. The locations of all research objects were confirmed via an on-foot observation field survey from January 13 to February 21, 2018. The main content of this field survey was the site plan of the housing complex, the constructed location, the relationship of location between the PRH and POH buildings, and the planning status of the residents' traffic lines. The field survey revealed four projects where the PRH was used as talent apartments and another three projects where the actual situation was unclear; therefore, these projects were removed from the analysis stage. Finally, 78 projects met the requirements of a mixed housing complex and were marked on the map using a mapping software to proceed with further analysis (Figure 2).
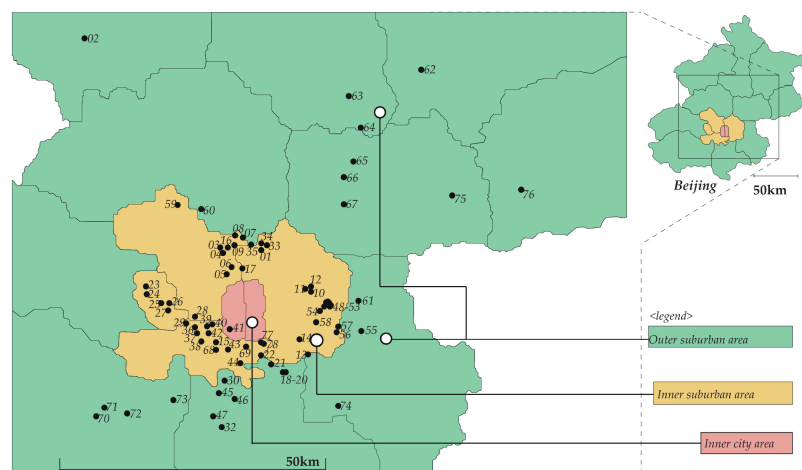
**Figure 2.** The location of the research objects for the field survey.

## 2.4. Analysis Methods

As indicated in previous study reviews, the layout of housing complexes has an effect on people's social interactions, family relationships, and even physical or mental health [38]. The structure of a housing unit has less effect than the structure of the public space [39], and building facades affect residents' psychological makeup, living satisfaction, and the relationship among residents, suggesting that negative factors affecting residents' relationships should be decreased by reducing differences in housing facades [40]. The current situation in China allows POH buildings to have different facade designs within the same project according to the developer's idea about building location, dwelling type, etc. In addition, the layout tends to have more impact on the assessment of residential experience compared with the exterior design. Therefore, this research started by focusing on the building layout and divided the content into two parts. First, the physical division is discussed from the perspective of whether some obstacles to human activities exist between the POH and PRH zones within the overall scope of each housing complex. Second, by summarizing the classification of the relationship regarding location of all residential buildings, differences in the locations of PRH and POH buildings are assessed.

Secondly, it is proven based on previous research that a lack of proximity reduces relations among public housing residents and others on site, implying that the level of physical integration among housing units for the various tenures and incomes in a mixed-income development has repercussions for social interactions [19]. For this part, the traffic line planning in blocks was used to determine the mingling of residents. The analysis of residents' traffic lines was performed using the samples without inside boundaries, where the residents are able to use the housing complexes together. The shortest course distance from the official gate to the entrance of the PRH building was taken as the analysis target and defined to be the distance from the gate nearest to the PRH. Measurement of the shortest path has also been used in the regional economic field to expose underlying urban structures [41]. In broad terms, strategies for the target direction of traffic lines can be divided into two types: from the gate to the building entrance, and leaving the building entrance (going outside the block to access the area between the public space and the building). The latter can be regarded as being more aligned with residents' senses and behaviors, while the former can be regarded as the line with a clear destination (returning home using the shortest distance of the traffic line in the block), considering the physical design. Therefore, the main content of analysis for this section is whether the plan strategy considers the possibilities of enhancing familiarity and interaction among the two types of residents. In addition, the variety of gate locations was confirmed through interviews conducted in the field survey, which is a direct factor influencing residents' traffic lines. The official gate is defined as the originally planned gate. The unofficial gate is defined as a gate which was not originally planned but was added by the

residents later (four samples were found through field survey). Using the official gate is an effective way of analyzing the strategy of traffic line design. Hence, the following analysis is only targeted at official gates.

## 3. Results

To answer the two questions to be mentioned in 3.1, the following analyses are provided in detail. Regarding the question "Do the mixed housing complexes with a plan for residents' interaction fulfill the environment of the interactions between the PRH and POH residents", the relationship of location between the PRH and the POH (Section 3.1.1) and the existence of an inside boundary was determined in all research objects (Section 3.1.2). Regarding the question "Are there other outcomes of promoting or obstructing the opportunity for PRH residents to mingle with POH residents", the analysis of the location of PRH buildings (Section 3.2.1) executed among research objects without inside boundaries was utilized, in addition to official and unofficial gates to housing complexes (Section 3.2.2) and the relationship between residents' traffic line and the PRH building locations.

### 3.1. Building Layouts of Public-Rental and Private-Owned Housing in Housing Complexes

#### 3.1.1. Building Layout Patterns

According to the results of the field observations (N = 78), four types of barriers were discovered as inside boundaries in blocks: public roads (n = 9), walls (n = 1), fences (n = 19), and hedges (n = 5). In this article, barriers such as walls, fences, and hedges were elements directly impeding free movement among residents in the residential complex. In addition, whether an entire building consists of PRH units or is shared with POH units must also be considered in the analysis. Consequently, the building layout can be divided into four patterns, as follows (Figure 3).

Pattern A: A public road is used to divide the project into two zones (n = 9; 12%)—the PRH and POH units were planned as one residential project, but a public road is located in the middle to strictly subdivide the entire housing complex into a PRH zone and a POH zone.

Pattern B: An inside boundary is used to divide the project within one residential block (n = 25; 32%)—the PRH and POH units were planned as one block but divided using walls, fences, or hedges. Although it is built within one block, residents are unable to freely move to the other zone if they do not use an official gate.

Pattern C: Different buildings constructed in one housing complex (n = 40; 51%)—the PRH and POH units are set in one block without an inside boundary, although the PRH units are divided into separate buildings from the POH units.

Pattern D: Both the PRH and POH units are in one building (n = 4; 5%)—the PRH and POH units share one building with multiple entrances. In some cases, the entrance of the PRH units are different from those of the POH units.
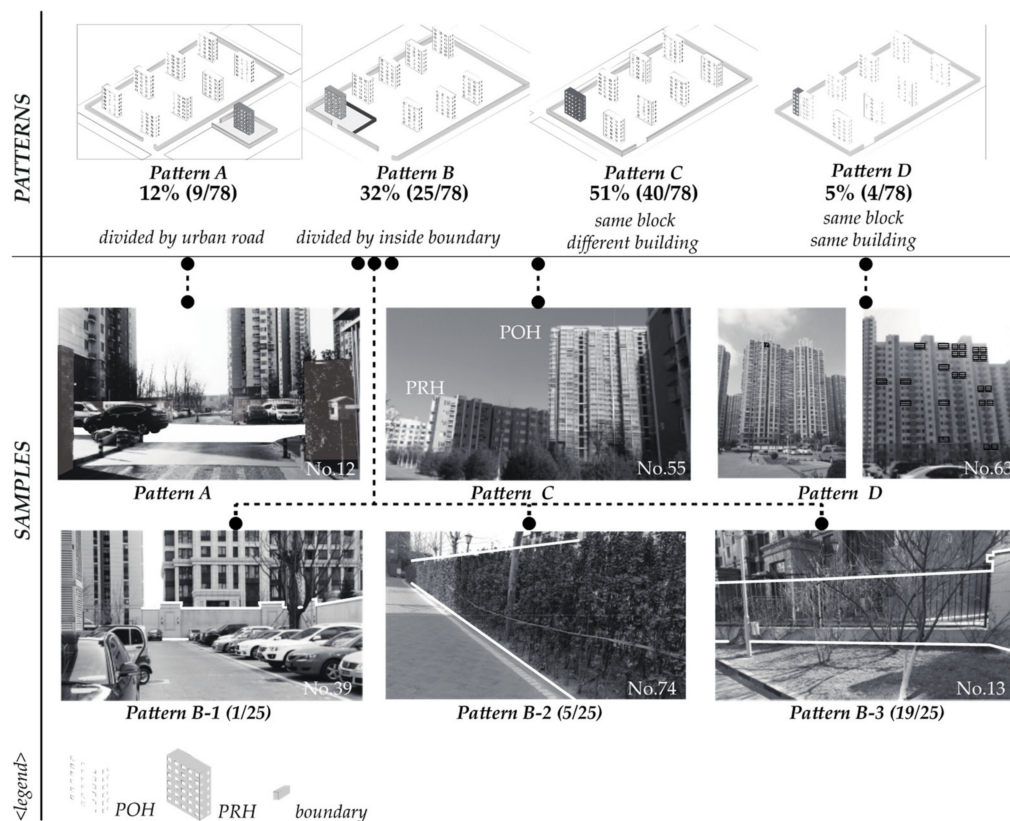
**Figure 3.** Housing complex patterns by building layout. PATTERN B-1—using a wall as an inside boundary. PATTERN B-2—using plants as an inside boundary. PATTERN B-3—using a fence as an inside boundary.

### 3.1.2. Housing Complex Patterns Focused on Building Shape and Direction

As seen in Section 3.1.1, in Pattern C, the PRH and POH units meet the basic definition of "mixed" in the same residential block. However, on-foot observations showed that both households differed regarding the shapes and facing directions of the buildings. Therefore, Pattern C was further classified into two patterns based on whether the PRH and POH buildings were mutually perpendicular (Figure 4).

Pattern C-1: The PRH building's shape differs from all POH buildings (n = 16; 40% of pattern C)—the PRH building has a unique building shape or direction. The following three types were confirmed: "vertical-shaped type" (n = 11; 28%), "L-shaped type" (n = 3; 7%), and "concave-shaped type" (n = 2; 5%).

Pattern C-2: The PRH and POH buildings have similar shapes and directions (n = 24; 60% of pattern C)—the PRH buildings cannot be clearly divided from the residential buildings by building shape. The following three types were confirmed: buildings are arranged in parallel (n = 9; 23%), buildings are arranged at angles in conformity with other residential buildings (n = 10; 25%), and all of the buildings surrounding the public space in the residential block have the same building shape (n = 5; 12%).
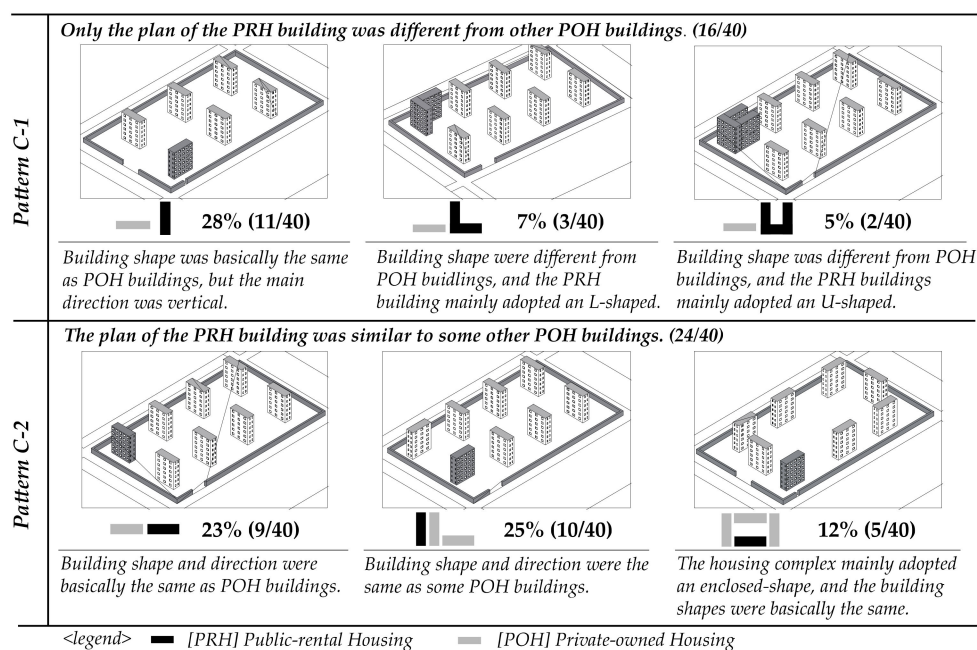
*Figure 4.* Building shape patterns based on the Public-rental housing in PATTERN C.

## 3.2. Residents' Traffic Line Patterns to Buildings in the Block

### 3.2.1. The Location of Public-rental Housing Buildings

The locations of the PRH buildings in a housing complex can be divided into two types: the building is located in the central area, or in the corner area (Figure 5). The building type defined as being located in the center area is as follows. One side of a PRH building is connected to the site boundary of the block due to the site plan of the housing complex in most cases. The type categorized as being located in the corner area is PRH buildings having at least two adjacent sides connected directly with the site boundary. According to this definition, among the 40 samples, only five samples (13%) were located in the center area, and 35 samples (87%) were located in the corner area. This result preliminarily indicates that the PRH buildings are mainly built in the corner of housing complexes.
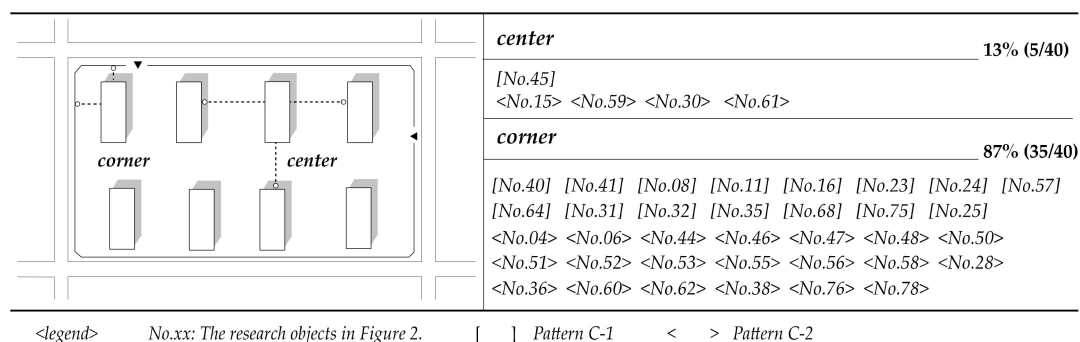


*Figure 5.* Location of public-rental housing buildings.

### 3.2.2. The Residents' Traffic Lines

Among the 40 samples, seven samples (18%) have only one gate, and 33 samples (82%) have multiple gates. Through the relationship between the location of the PRH buildings and the gates in the housing complexes, the residents' traffic lines can be categorized into four groups (Figure 6). Three samples (7%) had a traffic line where residents must cross the POH to reach the PRH building located in the center of the block. Another fourteen samples (35%) had PRH buildings located in the corner

where residents must cross the POH. In two samples (5%), residents have no opportunity to pass by the POH area to reach the PRH building located in the center of the block. The PRH buildings in the rest of the samples (53%), located in the corner of the block closest to the gate, also leave residents with no opportunity to pass by the POH area. In summary, only seventeen samples (42%) in patterns C-1 and C-2 are likely to generate interaction among residents (i.e., PRH residents having the opportunity to mingle with POH residents). Twenty-three samples (58%) avoid PRH residents mingling with POH residents in the traffic line, partially due to a differentiation among PRH and POH residents.
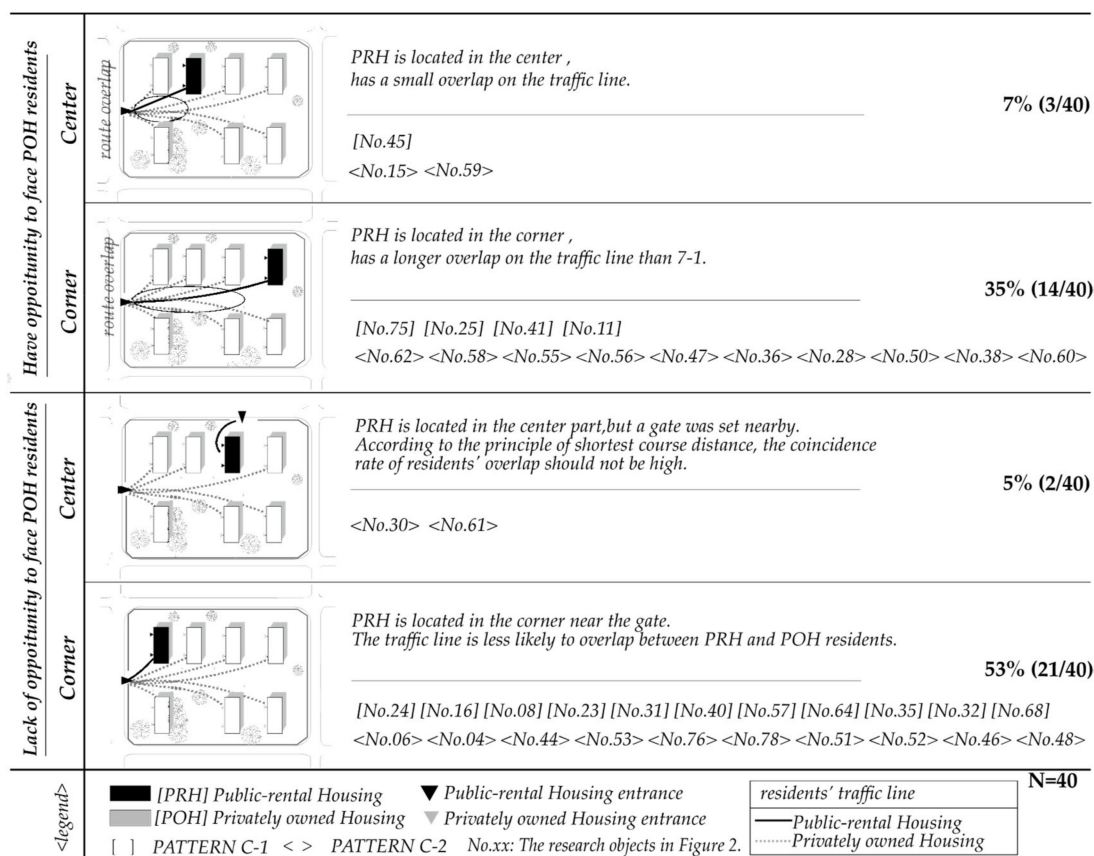


**Figure 6.** Location patterns of PRH buildings according to the traffic line from the nearest gate.

## 3.3. Classification of Building Layouts from the Perspective of Physical Division

The classification of physical division resulted in the following five patterns (Figure 7):

Pattern A: Divided by a public road—the PRH and POH units are subdivided by a public road, and both zones have their own gates; thus, the units cannot be recognized as one consolidated housing complex. Additionally, residents cannot freely access the other zone without crossing the public road. The plan in this layout pattern cannot be described as a mixed habitation environment.

Pattern B: A residence complex by an inside boundary—the PRH and POH units are constructed in one block but are divided by an inside boundary. The gates of both zones are also different. From the perspective of hindering the free movement of residents living in both the PRH and POH units across the entire housing complex by the plan layout, this pattern cannot be defined as a mixed habitation environment.

Pattern C-1: A separate PRH building that has a different building shape with no inside boundary—this pattern is constructed in one block without an inside boundary between the residential buildings. However, the building shape and direction of the PRH building is clearly different, creating a visible distinction between the PRH and POH buildings. Furthermore, inter-resident exchanges are presumably affected by the different building shapes.

Pattern C-2: A separate building in the same shape with no inside boundary—the PRH and POH buildings are constructed in one block with no inside boundary. The distinction between the PRH and POH buildings is ambiguous from the shape and direction of the buildings. Compared to pattern C-1, the influence of inter-resident exchanges is predicted to be less affected because of the same building shapes.

Pattern D: Coexisting in one building, possibly divided by separate entrances—the PRH and POH units are classified only by separating entrances. The physical division within the block is possibly the smallest of all patterns. Interaction among residents is likely to occur in a mixed habitation environment.

To summarize this section, 44% of all samples belong to patterns A and B, meaning PRH and POH buildings are completely divided, making it impossible for residents to share the public space. However, government regulations of the construction method for relevant constructions prohibit establishing an inside boundary between PRH and POH buildings. The research results show a great degree of inconsistency between the actual building layouts and the government-regulated provisions. Moreover, the basic consideration of interaction among residents is insufficient in the planning of mixed housing complex. In addition, as shown in the analysis of pattern C-1, even if a housing complex has no clear inside boundary, different building shapes and directions can have a negative impact on residential interactions [40].
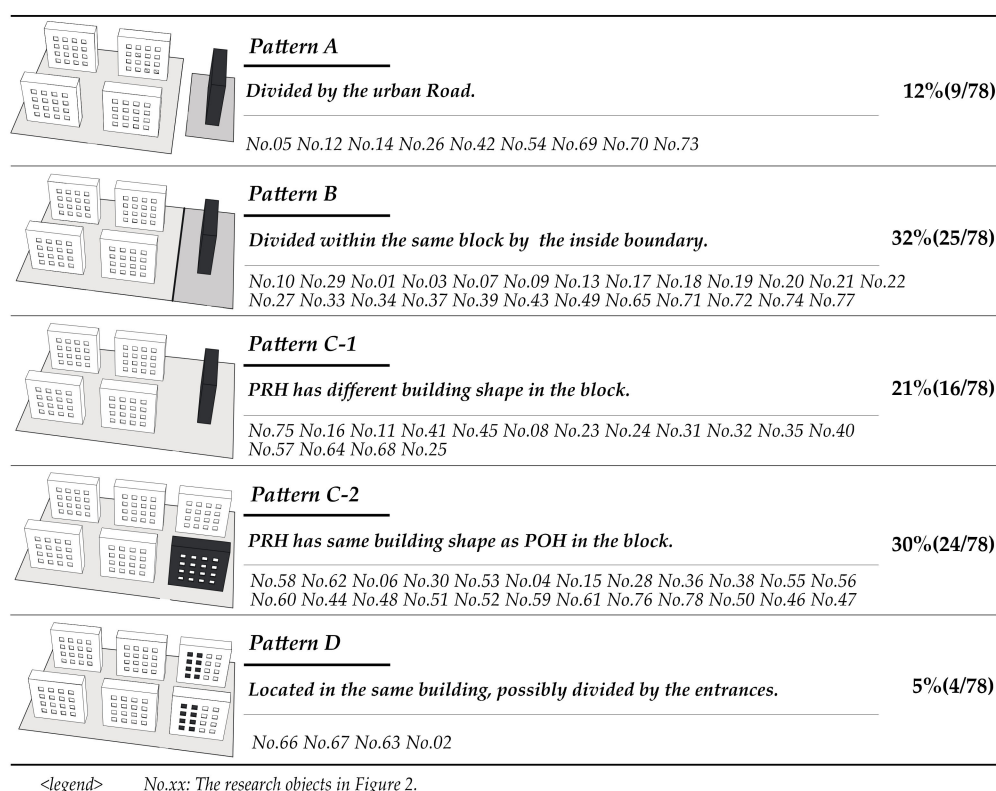


*Pattern A*

*Divided by the urban Road.*                                                              **12%(9/78)**

*No.05 No.12 No.14 No.26 No.42 No.54 No.69 No.70 No.73*

*Pattern B*

*Divided within the same block by the inside boundary.*                            **32%(25/78)**

*No.10 No.29 No.01 No.03 No.07 No.09 No.13 No.17 No.18 No.19 No.20 No.21 No.22 No.27 No.33 No.34 No.37 No.39 No.43 No.49 No.65 No.71 No.72 No.74 No.77*

*Pattern C-1*

*PRH has different building shape in the block.*                                       **21%(16/78)**

*No.75 No.16 No.11 No.41 No.45 No.08 No.23 No.24 No.31 No.32 No.35 No.40 No.57 No.64 No.68 No.25*

*Pattern C-2*

*PRH has same building shape as POH in the block.*                                **30%(24/78)**

*No.58 No.62 No.06 No.30 No.53 No.04 No.15 No.28 No.36 No.38 No.55 No.56 No.60 No.44 No.48 No.51 No.52 No.59 No.61 No.76 No.78 No.50 No.46 No.47*

*Pattern D*

*Located in the same building, possibly divided by the entrances.*               **5%(4/78)**

*No.66 No.67 No.63 No.02*

*<legend>*     *No.xx: The research objects in Figure 2.*

**Figure 7.** Patterns based on Public-rental housing and Private-owned housings' building shapes.

*3.4. Classification of the Residents' Traffic Lines in Regard to the Gate of the Housing Complexes*

This section explores the residents' traffic lines, focusing on the relationship between the number of official gates and the traffic lines from the gates to the PRH building entrances of all samples. Seven patterns were determined (Figure 8). First, the samples of housing complexes with only one gate were divided into two categories by the location of the PRH building and the traffic line from the gate: those having the opportunity to interact with POH residents, and those lacking the opportunity. The samples of housing complexes with multiple gates were categorized utilizing the groups introduced in Figure 7: patterns A and B are physically divided, and patterns C-1, C-2, and D are one housing complex without

an inside boundary. Out of the samples without an inside boundary, nineteen samples (24%) have the opportunity for PRH residents to interact with POH residents, whereas fifty two samples (67%) lack the opportunity for resident interaction. Therefore, the samples with an inside boundary fall into the group lacking the opportunity for interaction with POH residents. However, three samples (4%) have an inside boundary between the PRH and POH units, although a gate is also placed on the inside boundary enabling residents to interact with each other. In addition, four samples (5%) can be considered to have an unofficial gate built by the residents. From the location of the official gate in these four samples, all samples have the opportunity for interaction among residents, though unfortunately, the presence of the unofficial gate near the PRH building is likely to change the PRH residents' traffic line, thus obstructing the opportunity to interact with POH residents.
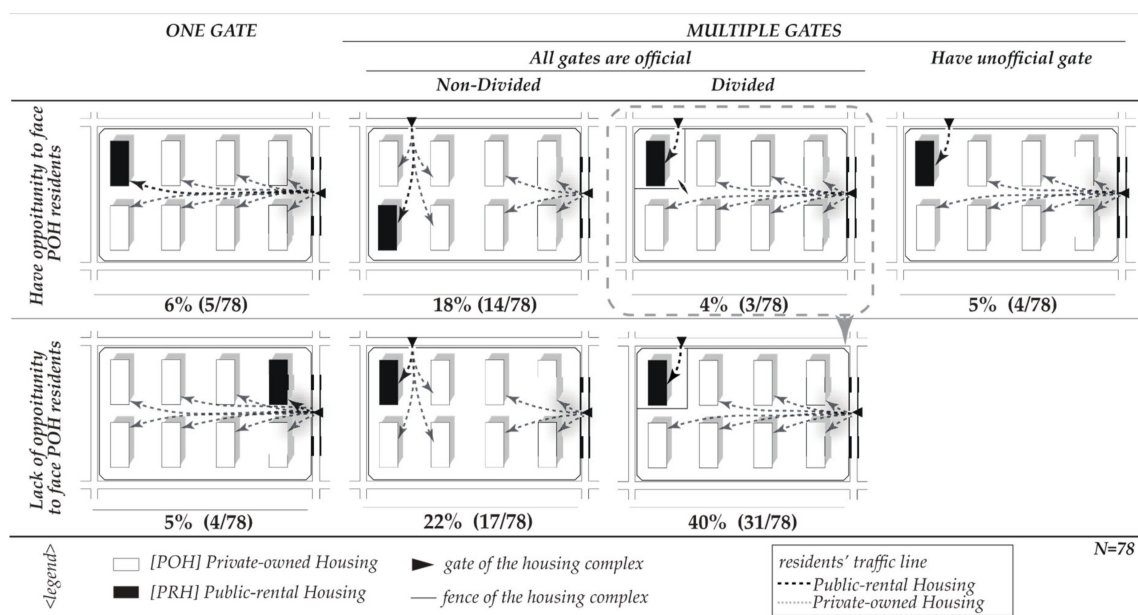


**Figure 8.** The location of the PRH building from the perspective of the residents' traffic line.

### 3.5. Summary of the Classification based on Building Layout and Traffic Line Analysis

Based on the analysis above, the housing complexes are categorized into eight types (Figures 9–11).

Type 1: The inside boundary is located between the PRH and POH zones with gates and site boundaries present in both zones. Thus, mixed habitation cannot occur in the housing complexes of this type. Thirty-one samples fall into this type, accounting for 40% of the samples. Specifically, in sample No. 12, an public road in the middle divides the two zones; the PRH zone on the east, and the POH zone on the west limiting the free passage of residents.

Type 2: The PRH and POH zones are set in one block with an inside boundary. Unlike type 1, an official gate is located on the boundary between the PRH and POH zones, and the residents can pass freely. No. 10 is one sample of this type, in which the residents in both zones cross freely as the gate opens daily.

Type 3: PRH and POH exist in one block, but pattern C-1 has a visible distinction in building shape and direction. Additionally, the traffic line from the official gate to the PRH building is designed to avoid encounters with POH residents. This fact sufficiently demonstrates the practical difficulties of creating a mixed habitation environment, although the housing complex has no obvious barrier. Regarding sample No. 23, PRH residents have direct access to the building without walking past the POH area through the nearest south gate (shortest distance of the traffic line). Residents have few opportunities for face-to-face interaction, although the south gate is available to POH residents.

Type 4: There are no visible differences in the building shape and direction. In Pattern C-2, PRH residents also lack the opportunity to face POH residents in the traffic line. The strategy of a

consistent design throughout the residential buildings develops a familiarity of layout. However, this is also a typical type causing division between the residents' traffic lines. In sample No. 52, a gate is located on both sides of the PRH building, creating separate residents' traffic lines without an overlap.

Type 5: The traffic line from all gates to the PRH building was originally designed to cross the POH area, but an unofficial gate was established to separate the traffic line. In sample No. 46, the unofficial gate is located in the northwest corner, a position that can directly access the PRH buildings. The overlapping traffic lines of POH residents and PRH residents to interact are obstructed when using the unofficial gate.

Type 6: The residential buildings are visibly distinct, but the traffic line allows interaction opportunities; therefore, it is less likely for the residents' traffic lines to be divided in pattern C-1. As seen in sample No. 45, the traffic lines to the PRH building from all gates cross the POH area, and the residents have the opportunity to interact.

Type 7: The residential buildings show no visible distinction, and the possibility of a traffic line division is assumed to be low in pattern C-2. In sample No. 36, the traffic line crosses the POH area from all gates to the PRH building, though it is located in the corner of the block; therefore, PRH residents have the opportunity to encounter POH residents.

Type 8: PRH and POH units are not distinguished by the residential building. There is the greatest possibility of social interaction between residents to occur from the perspective of site plan. In the case of sample No. 63, the PRH and POH units are mixed within the building; therefore, the residents are not differentiated and share both the traffic line from the gate and the open space in the block.
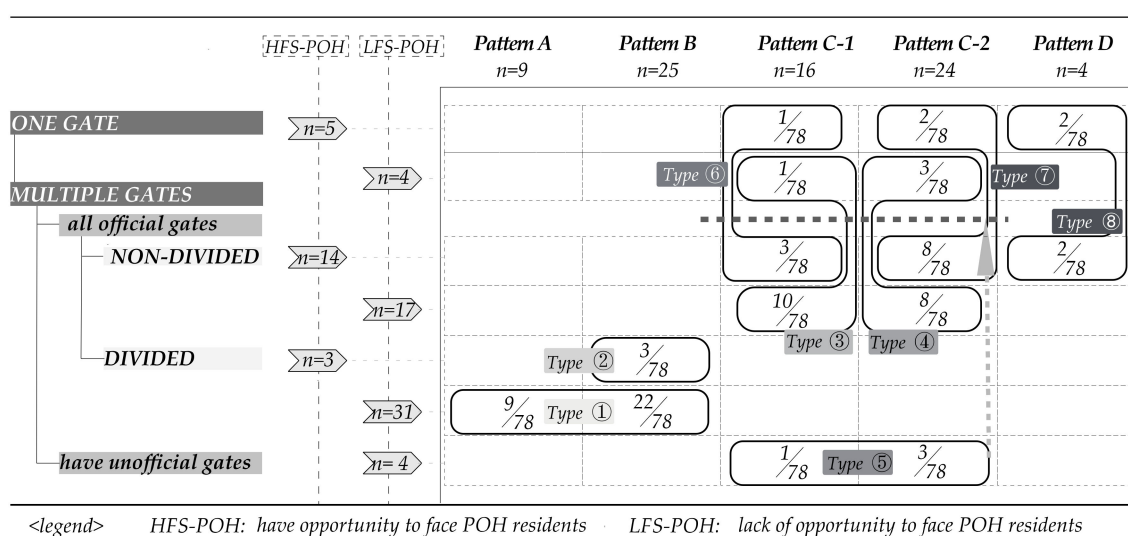


<legend> HFS-POH: *have opportunity to face POH residents* · LFS-POH: *lack of opportunity to face POH residents*

**Figure 9.** Summary of the spatial forms of mixed housing complexes in relation to the layouts and traffic lines.

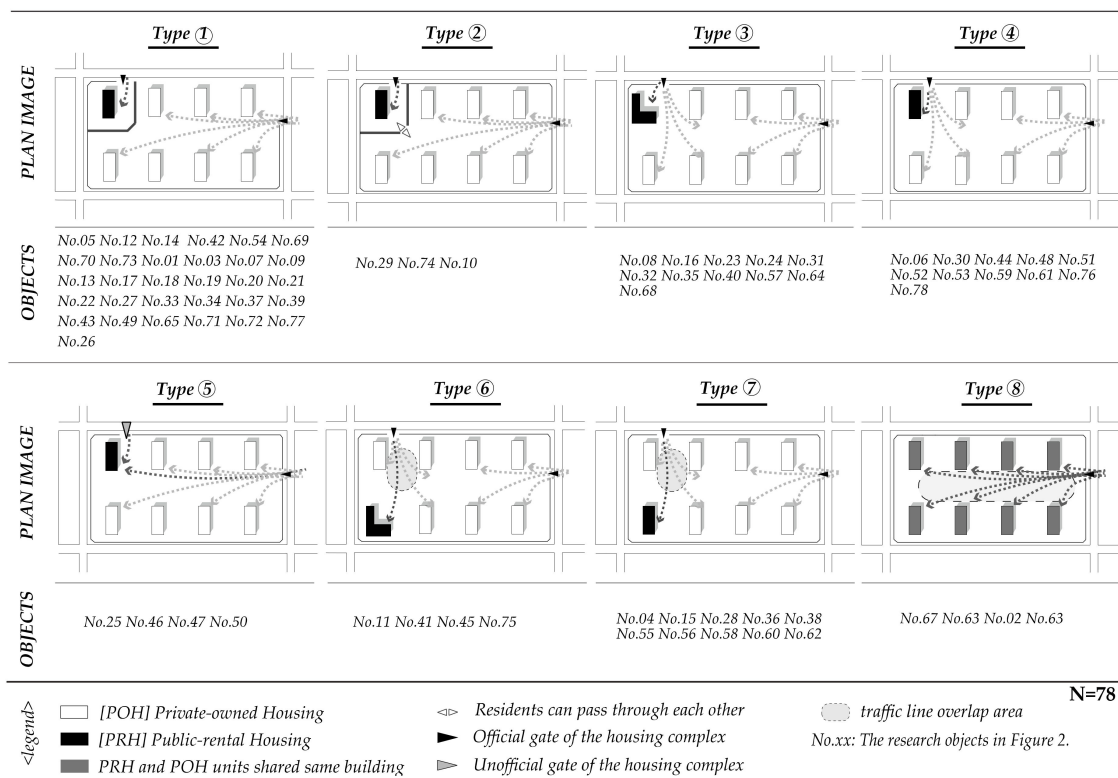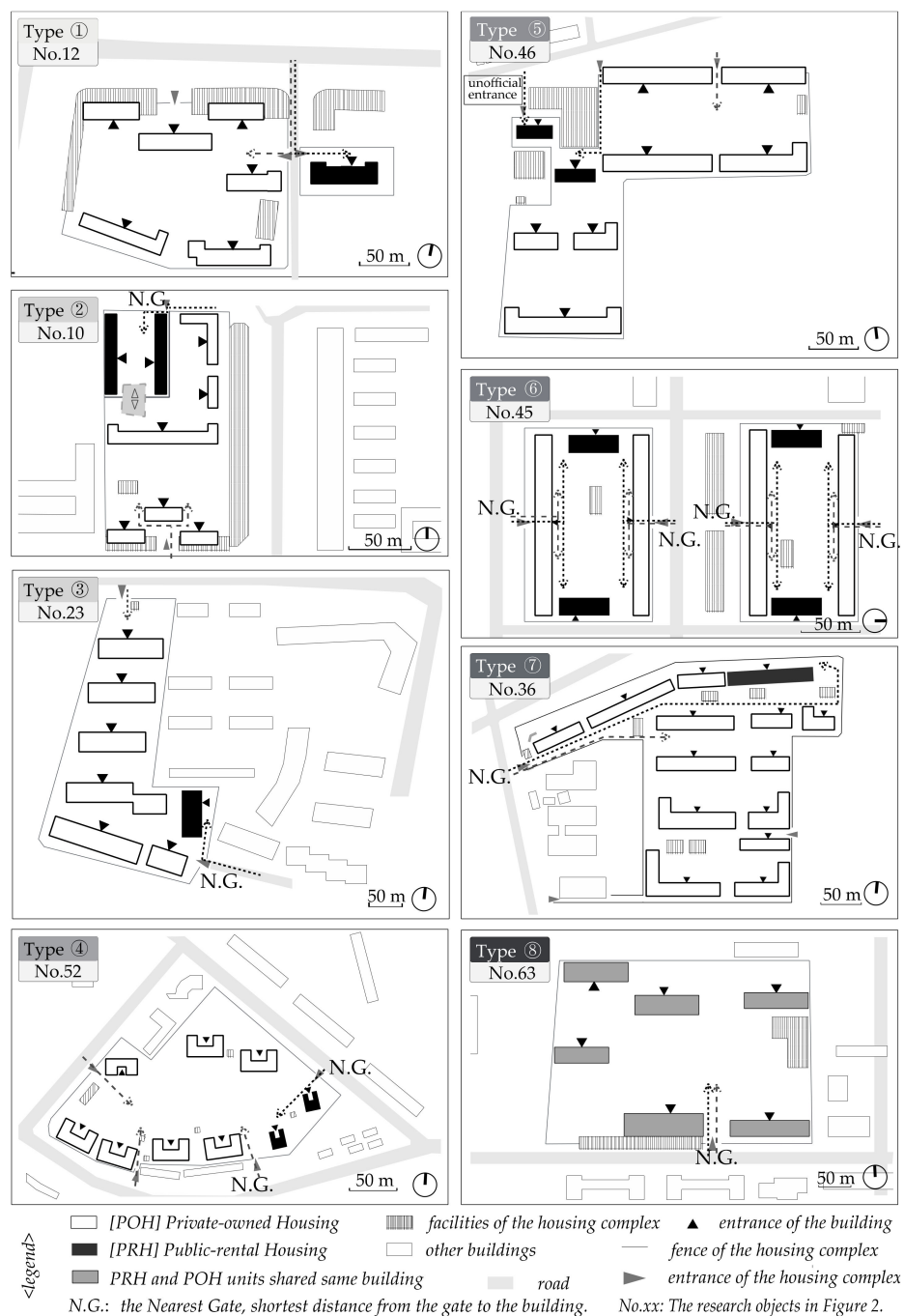**Figure 10.** The plan image for each type of mixed housing complex.

| | | |
|---|---|---|
| □ [POH] Private-owned Housing | ▥ facilities of the housing complex | ▲ entrance of the building |
| ■ [PRH] Public-rental Housing | ▢ other buildings | — fence of the housing complex |
| ▨ PRH and POH units shared same building | ▨ road | ▶ entrance of the housing complex |

*<legend>*

N.G.: the Nearest Gate, shortest distance from the gate to the building.    No.xx: The research objects in Figure 2.

**Figure 11.** Samples of mixed housing complexes.

## 4. Discussion

Residents respond to the physical and spatial features of a property [38]. This article focuses on the actual planning method of mixed housing complexes from the perspective of residents' interactions, utilizing the analysis of site plans and traffic lines. The results showed that the present state of the design method is not conducive to forming a mixed habitation environment, it only houses residents with different income levels in one residential complex. Accordingly, whether a mixed habitation environment can be fulfilled remains questionable.

Generally, real estate developers build high-end housing complexes to increase income. Thus, it is unlikely for developers to be enthusiastic about low-income housing construction. In other words,

housing development for low-income groups is not their target in terms of corporate growth. Therefore, to develop a healthy real estate market, public housing policy should adopt a system for a certain proportion of housings to be mixed housing complexes and promote comprehensive construction to develop housing for different income groups.

Regarding the complex design and its strategy, a well-designed layout enhances resident interaction and decreases negative prejudice. Recent articles have not explained this planning issue, and this article seeks to better understand the current situation to take advantage of the site plan. Compared with previous studies that concentrated on policy analysis and utilization for current residents [42,43], this article focuses more directly and accurately on the impact of physical planning to express the current status. However, as opposed to introducing the status quo using residential zones as a case study, the investigation for this article included all samples around Beijing. Thus, the analysis results are more comprehensive.

From the analysis of the results, we found few samples that have the potential to create or promote interaction among residents in the same block that were the result of planning the housing complexes for mixed habitation. More samples have inside boundaries or traffic lines intended to separate residents. The current mixed housing complexes can be divided into eight types based on different building layouts or traffic lines according to the research results. In Figure 9, only types 6, 7, and 8 are considered as mixed habitations that promote interaction opportunities among residents, accounting for only 23%. Conversely, type 1 uses an urban street, a fence, or some other object as a barrier, and types 3, 4, and 5 establish visible inside boundaries, adding up to a proportion of 73%. This result illustrates that PRH residents are separated from POH residents and have less opportunity to form ties in a housing complex.

This research also has its limitations. Although many sociological and construction model studies seek to take advantage of mixed housing complexes to prevent social isolation and to create a sustainable living environment, this research studied spatial information. The study was limited to significant impacts associated with mixed habitation characteristics in different spatial types of mixed housing complexes. To improve this limitation, other research scopes could be used to analyze the living environment, such as facilities planning, utilization, and so forth, as in previous studies which concentrated on residents' satisfaction [43]. Residents' use of facilities and interactions between residents could be studied objectively, and such information could be assessed directly by conducting interviews.

Therefore, the next phase of the research topic should be conducted to propose the elements related to the relationship between the site plan and individual behavior to further explore the characteristics of mixed housing complex plans. Following topics are also necessary for completing the planning method of mixed housing complexes: (1) comparing residents' behavioral awareness and the status quo of physical environment planning to take advantage of environmental behavior; (2) comparing the behavior under different physical environments; and (3) in addition to the relationship of location of residential buildings discussed in this article, studying the impact of public or commercial facilities in housing complexes. Under these topics, we could plan design strategies to form a sustainable habitation environment for different social classes living in one housing complex.

## 5. Conclusions

While the government was inclined to create physical space for mixed habitation, consideration of communication among residents belonging to different social classes is still lacking. It can be assumed that if the planning had pursued an integrated design, the opportunity for sharing residential areas would have increased. The planning method in mixed housing complexes can be clarified accordingly in regard to the analysis on building layouts and traffic lines.

Herein, three key issues could be raised as follows:

(1) PRH and POH buildings were planned in one mixed housing complex, but as the research results show, PRH and POH buildings are distinctly classified. As a method of classification, some elements

visibly divide the residential zone; other factors include the building shape or direction, indicating that the PRH building is different from the POH buildings. Inconsistency of policy requirements and the actual conditions were found, and the consideration of the concept of residents' interaction in the mixed housing complexes is insufficient.

(2) Among the samples, there were cases where PRH and POH buildings are not clearly divided. However, the location of PRH buildings is often at the corner, near the entrance of the housing complex. Considering residential mingling and traffic line planning, results showed that PRH buildings located at the shortest distance from the entrance do not give PRH residents sufficient opportunities to encounter with POH residents, since PRH and POH residents use different pathways from the gate to the buildings. These types of physical environments make public spaces difficult to share and cause difficulties for residents to interact.

(3) All samples of mixed housing complexes in Beijing where the PRH and POH buildings are combined were classified into eight types. However, as mentioned in (1) and (2), the majority of the samples do not actively promote residents creating social connections. Additionally, clear intentions could not be identified from assessing each sample on the complex design strategies of creating a mixed habitation environment.

These findings pointed out that the actual conditions in the planning of a mixed housing complex is formalized based on little consideration of residents' interaction, which can be attributed to the imperfect guidance and criteria. Therefore, more attention should be paid to related items of the policy, such as devising particular items aimed at increasing the interaction between residents with different income levels.

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