

Article

Characteristics of Changes in Residential Building Layouts in Public Rental Housing Complexes in New Towns of Korea

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Abstract: Public rental housing complexes in South Korea have played a critical role in addressing housing needs since their introduction in 1989, initially prioritizing rapid quantitative supply. However, challenges such as limited housing quality and evolving socio-economic demands have prompted a shift toward emphasizing qualitative improvements in residential environments. This study investigates changes in residential building layouts in public rental housing complexes constructed during the 1990s, 2000s, and 2010s to understand how planning practices have evolved over time. Using a structured analysis framework, this research examined layout types (orthogonal, parallel, staggered, and mixed) and key planning elements (density, building height, orientation, and building forms) across 24 complexes. The findings reveal a transition from orthogonal layouts with uniform linear flat-type buildings in the 1990s to mixed and parallel layouts incorporating tower-type buildings in the 2000s, reflecting an increased emphasis on density and aesthetics. By the 2010s, parallel layouts persisted but featured diverse building forms, such as modified flat-type buildings and L-shaped configurations, along with variations in floor heights, enhancing spatial efficiency and visual appeal. These changes in the layout forms of residential buildings are particularly driven by the combination of planning characteristics, such as building forms and orientation as well as socio-historical factors. Relevant legal frameworks and institutional systems, such as district unit plans, have played a significant role in shaping these transformations. This study provides insights into the evolution of public housing planning and offers guidance for sustainable and high-quality urban housing development.

Keywords: public rental housing complex; residential building layouts; apartment; district unit plan



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1. Introduction

The Republic of Korea began supplying permanent rental housing under government initiatives in 1989 and has been constructing various types of rental housing in the form of apartment complexes. Public rental housing has been divided into various types, such as permanent rental housing, national rental housing, happy housing, and long-term lease housing, in accordance with government policies [1,2]. These types have primarily been developed and supplied as apartment complexes in new towns through land development projects led by the Korea Land and Housing Corporation.

As of 2020, the stock of rental housing in South Korea was approximately 3.27 million units, of which approximately 1.74 million units, or about 53%, were provided by public

institutions [1]. Public rental housing has been positively evaluated for its affordability and rapid supply. However, issues such as increased fiscal burden on the government, limited housing options, administrative inefficiencies, and negative perceptions of residents have persisted. Furthermore, dissatisfaction with the qualitative aspects of the residential environment has also been consistently raised [2,3].

In response to these issues, the government has made continuous efforts to improve administrative procedures and the supply system. However, the focused attention on the qualitative aspects of the residential environment has only recently gained momentum [4]. Nevertheless, despite these changes, research on the physical planning characteristics, which serve as the most direct indicator of the quality of residential environments in public rental housing complexes, remains insufficient.

Against this backdrop, it is necessary to analyze and evaluate how public rental housing complexes, which have historically focused on quantitative supply, have evolved to incorporate qualitative aspects in their planning, particularly regarding apartment complex designs. While the qualitative aspects of public rental housing complexes can be discussed from various perspectives, this study focuses on examining the characteristics and changes from the perspective of planned residential environments. Specifically, the layout of residential buildings, floor plans, and outdoor spaces are critical planning elements that determine the quality of the physical residential environment. Among these, the layout of residential buildings is particularly significant as it affects factors such as sunlight, views, and noise, as well as the external space and landscape within the complex. Consequently, this planning element requires careful consideration from the initial stages of planning [5].

Therefore, this study aims to examine how the layout of residential buildings in public rental housing complexes in South Korea has changed over the past 30 years. To achieve this, it analyzes the characteristics of layout planning according to the period of development and the planning elements influencing these layouts. Additionally, by reviewing public rental housing policies and relevant legal frameworks, this study seeks to discuss the characteristics of layout planning in public rental housing complexes. Ultimately, this research aims to serve as a foundational study for establishing institutional frameworks and planning directions for the construction of public rental housing complexes in rapidly growing Asian countries and developing nations, similar to South Korea.

2. Literature Review

2.1. Public Rental Housing Policies and Legal Frameworks in South Korea

Public rental housing refers to housing supplied by public housing developers such as the national and local governments and the Korea Land and Housing Corporation, through construction, purchase, or lease with financial support from national or local government budgets or the Housing and Urban Fund.

The construction of public rental housing in South Korea is closely linked to the government's housing supply policies. According to Cho Deok-Hoon (2013), South Korea's public rental housing supply policies have undergone significant changes in response to international factors such as the oil crisis, the IMF financial crisis, and the global financial crisis, as well as domestic political, economic, and social conditions. Consequently, related legal frameworks have also evolved accordingly [6]. These policy changes have been institutionalized through laws such as the Building Act, which likely influenced the layout planning of public rental housing complexes. Before the inauguration of the Roh Tae-woo administration in 1988, South Korea was under a military regime. During this period, the primary national priorities were securing the legitimacy and stability of state power and achieving economic development to escape post-war poverty [6]. Although housing construction plans were included in the government's Five-Year Economic Development

Plans, they were mostly long-term construction plans with strong policy-oriented goals [7]. In 1979, the new military regime led by Chun Doo-hwan, which came to power through a coup, enacted the Housing Site Development Promotion Act in 1980 to address the political and economic challenges of the time. This law laid the foundation for the development of first-generation new towns in the Seoul metropolitan area. Additionally, in 1982, the government announced measures to promote rental housing, followed by the enactment of the Rental Housing Promotion Act in 1984. Based on these legal frameworks, the Roh Tae-woo administration in 1989 implemented the Two Million Housing Construction Plan, which led to the construction of the first permanent rental housing in first-generation new towns. During this period, major revisions were also made to the Building Act, particularly regarding building spacing regulations, which had a direct impact on site layout planning. The legal provisions related to the separation distances between residential buildings were significantly relaxed [4,8]. Following the 1998 IMF financial crisis, economic hardships among lower-income households led the Kim Dae-jung administration to introduce the National Rental Housing Program, announcing a plan to construct one million national rental housing units by 2002. Along with this policy shift, the Building Act was revised again, further easing distance separation and floor height regulations [8]. The subsequent Roh Moo-hyun administration continued this policy by constructing 470,000 national rental housing units. Previously, the primary beneficiaries of public rental housing were basic livelihood security recipients, socially disadvantaged groups, and the elderly. However, under the Roh administration, the scope of beneficiaries expanded to include the middle class and newlyweds, as various types of rental housing supply policies were actively promoted. During the Lee Myung-bak administration, the focus shifted toward integrating public sale and rental housing under the Bogeumjari Housing Program, which aimed to provide homes for low-income, non-homeowning citizens. Consequently, public rental housing has become more diverse in terms of supply type and scale. Additionally, the second-generation new towns developed during this period emphasized self-sufficiency functions, leading to distinct specialization plans for each new town. As a result, district unit plans, formulated based on the 1999 Building Act amendments, provided more detailed and diverse planning guidelines compared to first-generation new towns. Following this, the Park Geun-hye administration, which took office in 2013, pursued various rental housing supply policies under the framework of the “Creative Economy” initiative. In 2014, the Special Act on Public Housing Construction was enacted, further expanding the eligibility criteria for public rental housing. This new law introduced rental housing types that accommodated a broader range of beneficiaries, including university students and young professionals.

Thus, the supply of public rental housing in South Korea has continuously evolved over the past 30 years, influenced by changes in government policies and administrative directions. Consequently, the related legal frameworks have also been consistently developed and revised.

Table 1 presents the shifts in administrations, policy changes, and institutional reforms in South Korea.

Table 1. Social conditions, major policies, and legal frameworks by administration in South Korea (Source: [1,6,9]).

Government Leadership	Political, Social, and Economic Context	Public Rental Housing Supply Policy	Related Legislation
Park, Chung-hee (1962–1979)	Oil shock, rapid population growth, urbanization, export-driven economic growth policy	Five-year economic development plan	Public Housing Act (1963)

Table 1. *Cont.*

Government Leadership	Political, Social, and Economic Context	Public Rental Housing Supply Policy	Related Legislation
Chun, Doo-hwan (1980–1987)	Military coup, economic and market stabilization	Announcement of rental housing development measures	Housing Construction Promotion Act (1972), Residential Land Development Promotion Act (1980)
Roh, Tae-woo (1988–1992)	Democratization, decentralization, welfare expansion, construction of the first new towns	Announcement of the 2 Million Housing Construction Plan, supply of permanent rental housing	Rental Housing Construction Promotion Act (1984)
Kim, Young-sam (1993–1997)	Liberalization, deregulation	Five-year new economy plan, supply of 50-year public rental housing	Amendment of the Rental Housing Act (1993), Amendment of the Housing Act
Kim, Dae-jung (1998–2002)	Overcoming the IMF financial crisis, housing stability for low-income and working class	Activation of the housing market, deregulation, announcement of national rental housing supply	
Roh, Moo-hyun (2003–2007)	Growth and welfare expansion, construction of the second new towns	Supply of various types of rental housing, expansion of rental housing construction scale	National Rental Housing Special Act (2003)
Lee, Myung-bak (2008–2012)	Global financial crisis, growth-oriented policy, deregulation, low-carbon green growth	Bogeumjari Housing Policy (Integration of Public Sale and Rental Housing)	Bogeumjari Housing Special Act (2008)
Park, Geun-hye (2013–2017)	Creative economy, welfare expansion	Introduction of happy housing (for young workers, social beginners, college students, newlyweds)	Public Housing Construction Special Act (2014)

2.2. The Importance of Residential Building Layout in Apartment Complex Planning

Housing is one of the fundamental necessities of life and serves as a critical space for social activities and personality development [2]. From the perspective of social space, individuals continuously interact with their residential environments, making housing a determinant of quality of life [10,11].

Over the past few decades, South Korea has prioritized the quantitative supply of housing to address rapid economic growth and population increases, leading to the construction of large-scale apartment complexes. Consequently, apartments have become a representative residential type in Korea, prompting ongoing research into various issues related to apartment complex planning.

As large-scale residential spaces within urban areas, apartment complexes encompass key planning elements, such as residential building layouts, floor plans, landscaping and green spaces, community facilities, and parking areas, all of which take into account socio-cultural, environmental, and aesthetic factors [5,12,13].

In Korea, a strong preference for south-facing orientation has been a dominant characteristic in residential choice due to sunlight and daylighting considerations. Accordingly, in Korea's early apartment complex plans, the strict south-facing arrangement of linear, flat-type buildings was predominant. However, to maximize housing supply today, layout plans primarily prioritize southeast or southwest orientations, favoring a southern direction as much as possible, even if not strictly south-facing.

Furthermore, apartment complexes play a significant role as large-scale landscape elements in urban environments. They contribute to the formation of openness, views, and skylines. In new towns, their potential to drastically alter the landscape makes them particularly important [5]. These characteristics are largely influenced by residential building

layout planning, as evidenced by variations in housing prices depending on proximity to parks, rivers, or other scenic features within or near the complex. Therefore, residential building layout is a critical planning element in ensuring high-quality residential and urban environments [5].

2.3. Review of Residential Building Layouts in Housing Complexes

A review of previous studies on housing types similar to public rental housing complexes in South Korea yielded the following findings. Recent studies have focused on the residential environment of public housing, housing welfare policies, socio-economic conditions, and legal frameworks, along with design analysis.

Belinda Yuen et al. analyzed the experiences of residents in high-rise public housing in Singapore to assess residential satisfaction and concerns. The study found that most residents were satisfied with high-rise living, citing advantages such as scenic views, better air quality, and privacy, but residents also expressed concerns about elevator malfunctions, safety issues, and a lack of neighborhood facilities. The research emphasized that ensuring quality views, privacy protection, enhanced safety measures, and sufficient neighborhood facilities is essential for the successful adaptation of high-rise housing [14].

Elvin Wyly and James DeFilippis examined the spatial distribution of public housing and housing vouchers (HCV) in New York City, challenging the stereotype that “public housing = concentrated poverty”. Their study found that, contrary to the policy argument that housing vouchers contribute to poverty deconcentration, many voucher recipients still reside in high-poverty areas, with some experiencing even higher poverty concentration than public housing residents. Additionally, they highlighted the disparity in housing subsidies, noting that high-income households benefit more from mortgage interest deductions than low-income households receive in public housing support, calling for a fairer housing policy [15].

Nami Hong and Saehoon Kim analyzed how Hanoi’s socialist housing complexes (KTTs) have changed physically, economically, and socially based on their location. The study found that KTTs remain crucial as affordable urban housing due to their accessibility and low housing costs. However, while residents support redevelopment, they also prioritize maintaining their communities and housing stability. The study highlighted that KTTs are not merely outdated housing but a symbol of urban history and community culture [16].

Hyungmo Yang et al. examined the impact of socio-economic changes, legal regulations, and architectural paradigms on apartment floor plan design. Over time, spatial layouts evolved from emphasizing hygiene and efficiency to promoting family interaction and, more recently, prioritizing individualization and flexibility. Legal regulations, such as Ordinances 70 and 71, the Strata Title Act, and SEPP 65, played a significant role in improving living environments and shaping apartment design standards [17].

Research on the layout of residential buildings in apartment complexes in Korea has been ongoing since the 1980s, primarily focusing on privately owned apartment complexes. Studies on the layout planning of these complexes have explored the relationship between residential building layouts and architectural elements, often analyzing layout characteristics during specific periods or in particular regions. Case study regions have included Seoul and other areas across the country, with findings indicating similarities in layout characteristics based on the period of construction, despite differences in the scale of housing complexes.

The previous studies on the layout of apartment complexes are as follows.

Jang [18] analyzed the characteristics of changes in nine apartment complexes in Seoul (1966–1980), while Choi [13] examined the classification of types and planning

characteristics according to layout forms and building types for 606 apartment complexes in Daegu (1970–1980). Son and Kang [19] analyzed 215 apartment complexes outside of Seoul (1970–1990), focusing on planning techniques for complex size, building types, and internal road layouts, and derived the characteristics of layout techniques. Similarly, Kim and Park [20] analyzed 66 apartment complexes outside of Seoul (1990–1998) to classify building types and layout techniques. Song [21] conducted a study on the preferences for the landscape according to the layout types of street-facing apartment complexes in six complexes in Changwon (1990s).

Regarding the relationship with rivers, Park et al. [22] analyzed the layout types based on the orientation and views of riverside apartment complexes in 24 complexes in Daegu (1966–2006). Lee et al. [23] examined 135 apartment complexes in Seoul (1990–2010) and identified the characteristics of layout types based on the physical spatial planning of the complex designs. Kim and Ahn [24] classified street-facing apartment layout types and identified the characteristics of changes over time by analyzing 64 apartment complexes in Seoul (1991–2010).

Meanwhile, Kim et al. [25] analyzed the building types and layout characteristics based on design proposals submitted for 40 apartment complexes in Sejong (2007). Seo et al. [26] studied 20 apartment complexes in Seoul (1970–2000) to examine changes in layout planning according to changes in accessibility within the complexes over time.

Lastly, Lee and Park [27] analyzed the characteristics and causes of changes in layout types over time for 260 apartment complexes in Busan (1980–2016).

Analysis of previous studies on privately owned apartment complexes reveals that prior to the establishment of Korea's first-generation new towns, most planned complexes featured parallel layouts with repetitive linear flat-type buildings. However, by the 1990s, residential building layouts shifted toward orthogonal arrangements, despite retaining similar flat-type forms. From the late 1990s onwards, notable changes emerged, with layouts transitioning away from traditional flat-type and orthogonal configurations to high-rise tower-type buildings arranged in parallel layouts. These shifts have been attributed to both supply-side considerations, such as increased floor area ratios, and demand-side factors, including a growing emphasis on views and other qualitative aspects of residential environments. In other words, the transition from a supply-driven to a demand-driven apartment market in Korea led to increased qualitative demands for housing, resulting in changes to residential building forms and layouts.

In contrast to privately owned apartment complexes, where market demands shape layout forms, public rental housing complexes prioritize policy-driven supply objectives. As a result, their layout characteristics differ significantly based on the period of construction. However, existing studies on the layout forms of public rental housing complexes are relatively limited. Most research on public rental housing focuses on residential satisfaction and environmental factors, primarily due to the nature of these complexes being targeted at specific socio-economic groups. Studies on residential satisfaction in public rental housing complexes have explored both physical planning factors and broader issues, such as housing supply methods, management and operation, facility programs, and inter-resident relationships. Among these factors, variables used to evaluate planning characteristics often include external spaces within the complex, such as rest areas, green spaces, community facilities, and parking lots, which are influenced by building layout forms. For instance, Byun and Roh [28] analyzed residential building layouts as one of the factors affecting satisfaction with the residential environment. Their findings indicated that layout orientation was rated above average among six external environmental factors contributing to residents' physical satisfaction. However, the study was limited to cases with orthogonal layouts, making it challenging to comprehensively assess planning characteristics, such

as inter-building spacing and view-related aspects. Other studies have examined specific themes within public rental housing, including energy consumption based on building layout and orientation [29], layout characteristics in mixed-tenure complexes [30], and planning characteristics tied to particular building forms in rental complexes [31,32]. However, these studies predominantly focus on secondary phenomena resulting from layout forms, such as external space usability or community-related aspects of public rental housing. Ultimately, no research has explicitly clarified the planning characteristics of layout forms and relational factors across different periods of development in public rental housing complexes in South Korea. This highlights a gap in understanding the evolution of layout forms and their planning elements over time.

2.4. Research Differentiation

This study differs from previous research, which primarily analyzed public rental housing characteristics based on supply policies or residential satisfaction for specific socio-economic groups. Instead, it seeks to examine planning characteristics that can enhance the qualitative aspects of residential environments. By analyzing the layout forms of residential buildings in public rental housing complexes and the factors influencing layout planning from a diachronic perspective, this study aims to identify the drivers of changes in planning over time and provide empirical insights. This research is distinguished by its focus on planning characteristics and changes across different periods of construction. It will offer foundational data that can inform future urban design standards and planning for public rental housing complexes in new towns.

3. Materials and Methods

3.1. Research Process

This study was conducted in the following sequence to analyze the layout characteristics of public rental housing complexes (Figure 1).

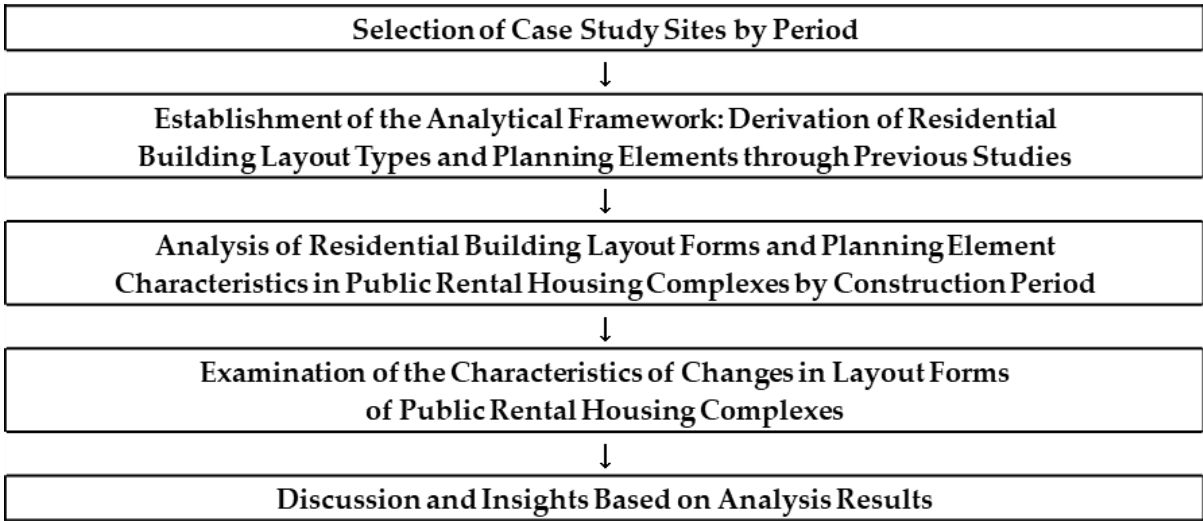


Figure 1. Flow of the study.

First, the construction periods of public rental housing complexes were categorized, and target sites for analysis were selected for case studies.

Second, to analyze the layout characteristics of public rental housing complexes, previous studies were reviewed to identify residential building layout types and the factors influencing layout planning. Based on these reviews, residential building layout types

and planning elements that influence layout planning were derived, and an analytical framework was established.

Third, using the established analytical framework, the characteristics of residential building layout planning and the influencing elements were analyzed across different construction periods of public rental housing complexes. Furthermore, the factors influencing layout forms, such as the district unit plans, were examined to explore the causes of changes in layout forms.

Finally, based on the results of the analysis, the study compared its findings with those of previous studies to discuss the characteristics of changes in layout forms. Through this comparison, the study provided critical insights into these changes.

This sequential approach allowed for a systematic exploration of the layout characteristics and changes in public rental housing complexes over time.

3.2. Selection and Overview of Case Study Sites

To analyze changes in the layout planning of residential buildings in public rental housing complexes, the construction periods were categorized, and apartment complexes were selected for each period.

First, the construction periods of public rental housing complexes were categorized based on the government's housing supply policies and the timing of public rental housing provision within land development districts. South Korea initiated large-scale public rental housing construction alongside the first-generation new town development in the 1990s, following the announcement of the "2 Million Housing Supply Plan" in 1988 [1]. Since then, the target demographics and policy directions for public rental housing in Korean new towns have gradually evolved over time.

In the 1990s, the primary focus was on housing supply for socially disadvantaged groups and those in need of basic living support. In the 2000s, policies shifted toward expanding welfare for low- to middle-income households, including newlywed couples, by providing housing aimed at improving the welfare of the middle class. By the 2010s, the emphasis was on enhancing welfare and promoting a creative economy, targeting households with multiple children, university students, and young adults entering the workforce [9]. Based on these changes, this study categorized the construction periods into the 1990s, 2000s, and 2010s to select case study sites. In addition, the timing of land development district projects and the periods of public rental housing construction were considered. For the 1990s, public rental housing complexes within the first-generation new towns of Bundang District and Ilsan District were selected. For the 2000s, early second-generation new towns such as Gimpo District, Pangyo District, Unjeong District, and Hyangnam District, were included. For the 2010s, public rental housing complexes in late second-generation new towns, such as Dongtan2 District, Byeollae District, and Okjeong District, were selected (Figure 2).

Second, the public rental housing complexes for each construction period were selected based on the size of their resident populations. Public rental housing complexes in Korean land development districts vary widely in scale, ranging from 300 to over 1000 households, making it impractical to analyze all complexes. According to Choi et al. [33], apartment complexes with a small number of residential buildings provide limited meaningful insights into layout planning trends. Therefore, this study followed the criteria of prior research [9,33] and selected public rental housing complexes with approximately 10 residential buildings or around 1000 households for analysis. Based on these criteria, a total of 24 public rental housing complexes were selected, encompassing eight complexes from each of the categorized construction periods. Table 2 summarizes the architectural overview of the study area for analysis [34–36].



Figure 2. Location of the case study.

Table 2. Overview of the case study.

Period	No.	Apartment Complex Name (District)	Site Area (m ²)	Building Coverage Ratio (%)	Floor Area Ratio (%)	Number of House- holds/Buildings	Completion Date
1990s	A1	Mokryeon Maeul Jugong 1st Complex (Seongnam Bundang)	44,139.8	16.11	136.24	1460/12	1993.5.
	A2	Hansol Village Jugong 4th Complex (Seongnam Bundang)	56,280.7	13.15	148.11	1651/17	1994.5.
	A3	Cheongsol Village Jugong 6th Complex (Seongnam Bundang)	46,318.8	11.09	121.96	1250/9	1994.8.
	A4	Moonchon Village Jugong 7th Complex (Goyang Ilsan)	43,351.5	12.95	132.45	1150/10	1994.9.
	A5	Hwindol Village Jugong 4th Complex (Goyang Ilsan)	37,729.0	13.69	124.68	1141/9	1995.4.
	A6	Moonchon Village Jugong 9th Complex (Goyang Ilsan)	35,811.3	12.52	132.23	912/8	1995.5.
	A3	Hansol Village Jugong 7th Complex (Seongnam Bundang)	51,272.9	13.8	128.31	1668/12	1995.7.
	A3	Cheongsol Jugong 9th Complex (Seongnam Bundang)	37,994.6	12.26	144.16	1020/6	1995.9.
2000s	B1	Chodang Village Humensia 1st Complex (Gimpo Hangang)	49,446.0	15.18	164.23	1114/15	2008.5.
	B2	Hyangnam Jugong 7th Complex (Hwaseong Hyangnam)	77,061.9	12.86	135.07	941/11	2008.11.
	B3	Botdeul Village 5th Complex (Seongnam, Pangyo)	45,818	16.4	166.11	870/12	2009.7.
	B4	Garam Village 2nd Complex Humensia (Paju Unjeong)	52,987.2	16.06	154.06	1231/13	2009.9.
	B5	Hanumul Village 6th Complex (Hwaseong Hyangnam)	67,645.9	14.33	120.38	1330/18	2009.11.

Table 2. *Cont.*

Period	No.	Apartment Complex Name (District)	Site Area (m ²)	Building Coverage Ratio (%)	Floor Area Ratio (%)	Number of House-holds/Buildings	Completion Date
2000s	B6	Paju Unjeong Humensia 11th Complex (Paju Unjeong)	50,136.6	16.43	154.04	1165/12	2009.12.
	B7	Hanumul Village 5th Complex (Hwaseong Hyangnam)	58,482.6	13.44	119.39	1150/16	2009.12.
	B8	Baekhyeon Village 2nd Complex (Seongnam, Pangyo)	53,512.0	18.26	183.61	772/13	2009.12.
2010s	C1	Mirinae Village 4-4 Complex (Namyangju Byeollae)	45,694.1	19.11	189.16	1331/10	2014.1.
	C2	Byeolsarang Village 2-10 Complex (Namyangju Byeollae)	35,543.1	14.31	164.73	886/7	2014.10.
	C3	Yuljeong Village 7th Complex (Yangju Okjeong)	66,170.0	13.86	121.86	1256/14	2014.11.
	C4	Mirinae Village 4-2 Complex (Namyangju Byeollae)	39,149.0	13.29	144.19	1058/7	2016.11.
	C5	Okjeong Village LH 8th Complex (Yangju Okjeing)	61,244.0	11.56	135.46	1550/10	2017.5.
	C6	Okjeong Village LH 16th Complex (Yangju Okjeing)	60,571.4	10.61	136.61	1618/8	2017.5.
	C8	Dongtan 2 LH 35th Complex (Hwaseong Dongtan 2)	66,720.0	11.00	140.28	1768/7	2020.10.
	C9	Dongtan 2 LH 2nd Complex (Hwaseong Dongtan 2)	46,079.4	37.03	173.15	1390/13	2021.11.

3.3. Site Status and Legal Conditions

The case study site is a public rental housing complex developed within a new town. At the time of its development, the land was fully owned by the public institution, the Korea Land and Housing Corporation (LH). However, the building laws and related regulations for the site plan were largely the same as those applied to sale apartments, and the development was planned according to the district unit planning guidelines of the new town.

The case study site falls under the district unit plan as an apartment land use and is categorized as a residential area under related laws. The land use of adjacent sites is also mostly residential, and some cases in the target site are adjacent to single-family residential land or neighborhood commercial facility land. Sites from the 1990s, due to the characteristics of the new town, generally have a square or rectangular land shape, with several examples where educational facilities, such as elementary schools, were developed within rectangular-shaped plots. Additionally, some complexes are adjacent to small parks and pedestrian-only roads. There are no building setbacks prescribed in the district unit plan, but mid-rise and high-rise zones are typically designated. In the 2000s, the case study sites also generally have square or rectangular land shapes, with examples of educational facilities located at the corners of these plots. Most of the sites are adjacent to parks, and some sites are confirmed to be near subway stations. The district unit plan specifies the maximum building heights for some complexes and provides guidance on the floor height zoning. In the 2010s, the case study sites showed a variety of shapes, including square, rectangular, and irregular forms, depending on the topographical conditions. The

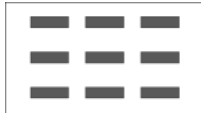
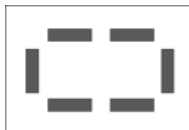
conditions such as adjacency to educational facilities and parks are similar to those of previous periods. In the district unit plan, most sites have designated building setbacks, and zoning for floor height regulations is often applied.

3.4. Analytical Framework

To analyze the characteristics of layout forms in public rental housing complexes by construction period, planning types and elements were derived from previous studies to establish the analytical framework.

First, the layout planning types of residential buildings, as reviewed in prior research, were found to vary depending on factors such as building forms, orientation, and their relationship with adjacent streets. Son and Kang [19] categorized layout types into parallel, cluster, and orthogonal forms based on building forms. Song [21] classified six types, including straight perpendicular, straight parallel, and staggered layouts, based on the orientation of residential buildings and their alignment with adjacent streets. Choi and Choi [29] categorized layouts into perpendicular and cluster forms based on building forms and orientation. Lee and Park [27] divided layouts into parallel, grid, and staggered forms, focusing on the relationship between buildings. Additionally, other studies categorized layout types based on the relationship between residential buildings and streets or internal spaces. This study aims to analyze the layout forms of residential buildings based on their relationships within the entire complex, rather than focusing on individual buildings situated at specific locations, such as along streets or riverfronts. Therefore, the study adopted the parallel and orthogonal forms, which are commonly presented in prior studies, as the basic layout types. Additionally, staggered forms, as suggested in recent studies by Lee and Park [27], were included. Considering that post-2000 apartment complexes often feature hybrid applications of layout types, a mixed type was also added to account for these combinations (Table 3).

Table 3. Analytical framework for residential building layout types.

Layout Type	Definition	Image		
Parallel	A layout where all main buildings are arranged parallel in the same direction			
Orthogonal	A layout where the main buildings are arranged at right angles to each other, forming a grid pattern			
Staggered	A layout where the main buildings are staggered and arranged parallel to each other			
Mixed	A layout where two or more types, such as parallel, orthogonal, and staggered arrangements, are combined			

To establish the planning elements related to residential building layouts, factors influencing layout planning were first derived from previous studies [5,27]. These elements were then refined to focus on legal and institutional planning elements, such as building codes and district unit plans, which directly impact complex layout planning. Accordingly, this study identified density, height, orientation, and building form as the key planning elements related to residential building layouts. Furthermore, the study defined specific

residential building forms for analysis (Table 4). The linear flat-type buildings, commonly found in Korean apartment complexes, were referred to as “linear flat types”. Tower types were defined based on the criteria provided in the district unit plans for new towns. Specifically, tower types are defined as buildings where the ratio of the shortest length to the longest length when horizontally projected is 1:2 or less, or where the ratio of the longest length on the floor plan to the building height is 1:2 or greater.

Table 4. Analytical framework for layout planning elements of residential buildings.

Layout Elements	Detailed Elements	Content
Density	Floor area ratio (FAR)	The ratio of the total floor area of buildings to the site area
Building Height	Average number of floors	The value obtained by averaging the number of floors of all main buildings within the complex
	Maximum number of floors	The highest number of floors among all main buildings within the complex
Orientation	The orientation of the residential building	The proportion of south-facing layouts, including southeast and southwest orientations
Building Forms	Types of residential building forms	The number of main building types within the complex and the proportion of each type
	Modified residential building forms	The proportion of modified linear flat-type residential buildings
	The number of floors within the residential building	Variations in the number of floors within the same residential building

4. Results

4.1. Characteristics of Residential Building Layout Forms by Construction Period

The analysis revealed that the layout forms of residential buildings in public rental housing complexes varied and evolved according to their construction periods, each reflecting distinct planning characteristics (Table 5).

Table 5. Layout types of public rental housing complexes by period. (Source: drawn by the author and based on the numerical topographic map provided by the Ministry of Land, Infrastructure, and Transport).

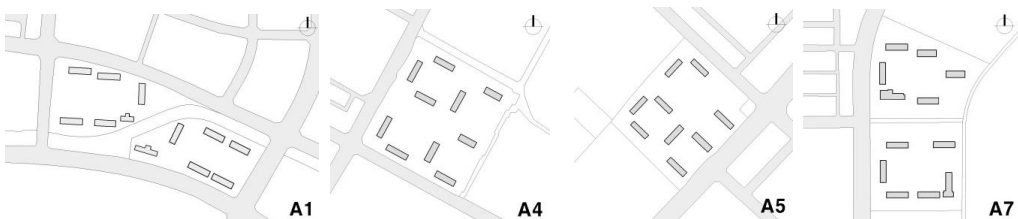
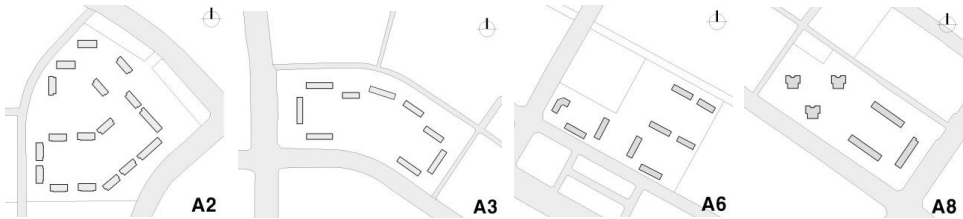
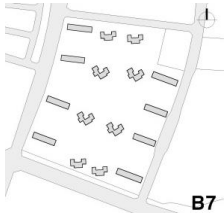
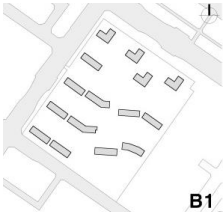
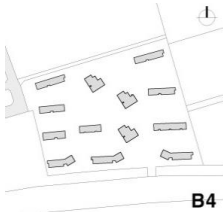
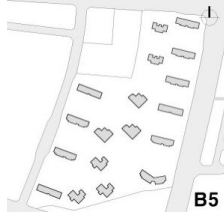
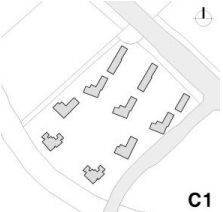
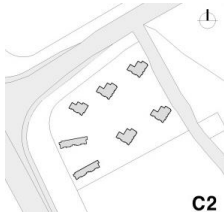
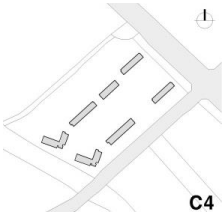
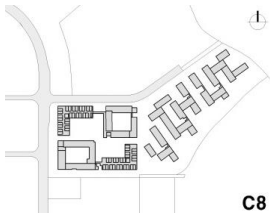
Period	Type	Layout and Characteristics
1990s	Orthogonal	 Orthogonal layout by three or more main residential buildings
	Mixed	 The primary layout is composed in an orthogonal arrangement, with some residential buildings designed in parallel or staggered hybrid forms

Table 5. Cont.

Period	Type	Layout and Characteristics
2000s	Parallel	    
		Parallel layout with flat-type and tower-type residential buildings
	Mixed	  
		The primary layout is parallel, with a hybrid arrangement where some sections are staggered
2010s	Parallel	     
		Flat-type, modified flat-type, and tower-type buildings are arranged in a parallel layout
	Mixed	 
		The primary layout is parallel, with a mixed arrangement incorporating staggered sections in some areas

In the 1990s, the layout forms of residential buildings in public rental housing complexes predominantly exhibited orthogonal or mixed planning characteristics with linear flat-type buildings. Orthogonal layouts formed large-scale open spaces in the center of the complex through the arrangement of three or more residential buildings (A1, A7) or medium- to small-scale open spaces through the arrangement of three to four residential buildings (A4, A5). These open spaces were typically enclosed on three or four sides, creating courtyard-like external spaces that were mostly used for parking lots or equipped with children's playgrounds. In mixed layouts, the primary layout within the complex comprised linear flat-type buildings arranged orthogonally to form open spaces, while some buildings were arranged in parallel (A2, A3, A6) or staggered layouts (A8). Buildings forming the orthogonal layouts accounted for more than 50% of the total number of residential buildings in these complexes, and most open spaces were developed as parking lots.

In the 2000s, the layout forms shifted from those of the previous period, exhibiting planning characteristics based on parallel or mixed layouts formed by flat-type and tower-type buildings. Parallel layouts combined slab-type and tower-type buildings. The slab-type buildings were arranged in parallel, while tower-type buildings, which were the tallest structures within the complex, were placed in the center of the complex (B2, B3, B7, B8) or adjacent to parks or south of schools near the complex (B5). Mixed layouts featured primary arrangements of flat-type and tower-type buildings in parallel, with some tower-type buildings arranged in staggered layouts with flat-type buildings (B4, B6) or multiple tower-type buildings and some flat-type buildings arranged in staggered layouts (B1). Despite the changes in layout forms during this period, the external spaces formed between residential buildings remained similar to those of the previous period, with most of these spaces being developed as parking lots.

In the 2010s, the residential building layouts continued to be predominantly based on parallel layouts, as in the 2000s. However, there were notable variations in building forms, with modified flat-type and tower-type buildings contributing to diverse layout characteristics.

Parallel layouts were categorized into those where flat-type and tower-type buildings or flat-type and modified flat-type buildings were mixed and arranged in parallel (C1, C3, C4, C5) and those where identical building forms were arranged in parallel (C2). Mixed layouts primarily consisted of L-shaped buildings arranged in parallel with some buildings arranged in staggered layouts (C7) or complexes with diverse building forms resulting in mixed layouts (C8). In the case of C8, new building forms, unlike traditional apartment complexes, were introduced, such as modified T-shaped, large L-shaped, and courtyard-shaped buildings arranged in parallel. These forms created structures distinct from traditional parallel layouts. In these complexes, external spaces were mostly developed as ground-level parking lots. However, some areas within the complexes were developed into plazas, courtyards, playgrounds, and green spaces, indicating changes in external space planning as well.

4.2. Characteristics of Planning Elements for Residential Building Layouts

4.2.1. Density

The floor area ratio (FAR) related to the density of public rental housing complexes by construction period showed little difference between the 1990s and the 2000s but exhibited a slight increase after 2010 (Figure 3). In the 1990s, the FAR ranged from a minimum of 124.68% to a maximum of 148.11%, with an average of 133.5%. In the 2000s, the FAR ranged from a minimum of 113.87% to a maximum of 164.23%, with an average of 138.41%. These figures indicate that there was no significant change in density between the two periods.

However, after 2010, the FAR ranged from a minimum of 121.86% to a maximum of 189.16%, with an average of 150.68%. This shows a noticeable difference from the earlier periods. Notably, in public rental housing complexes after 2010, although there were significant variations between the minimum and maximum FARs, complexes with FARs exceeding 170% emerged for the first time, representing a distinct shift compared to earlier periods.

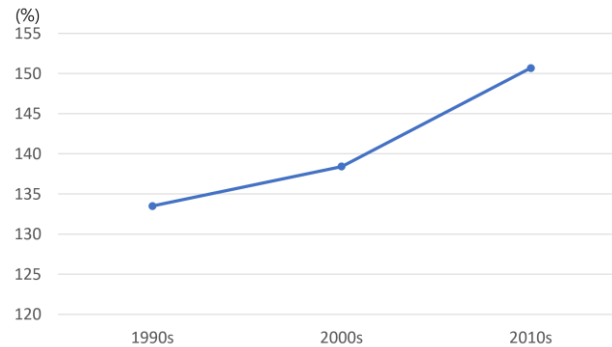


Figure 3. Average floor area ratio (FAR) by development period.

4.2.2. Building Height

The average number of floors and the average maximum height of residential buildings in public rental housing complexes showed no significant differences across construction periods. However, changes were observed in the maximum heights and the floor configurations of the buildings.

In the 1990s, the heights of residential buildings ranged from a minimum of 10 floors to a maximum of 25 floors, with the average maximum height being 20 floors. Considering that the average number of floors across the eight complexes was approximately 15, there was a difference of about five floors between the average and maximum heights within a complex.

In the 2000s, the floor configurations of residential buildings began to change. The number of floors ranged from a minimum of nine to a maximum of 23, with the average being about 15 floors. The maximum height within a complex ranged from 15 to 23 floors, with an average of 19.8 floors, similar to the 1990s. However, the minimum number of floors within a complex increased to 15 floors, indicating an overall increase in building heights. Additionally, in five of the analyzed complexes (B1, B3, B5, B7, B8), some flat-type buildings along the streets showed floor variations ranging from one to 14 floors, highlighting differences from the 1990s.

After 2010, residential buildings in public rental housing complexes ranged from a minimum of five floors to a maximum of 25 floors. The average number of floors within a complex was approximately 17, while the maximum height ranged from 18 to 25 floors, with an average of 21.5 floors across eight complexes. Among the 76 analyzed buildings, more than half (38 buildings) exhibited floor variations. These buildings showed floor variations ranging from one to 13 floors, with an average difference of 4.4 floors. This indicates that floor variations within buildings, which began to appear in the 2000s, became more diverse in the 2010s.

4.2.3. Orientation

Given South Korea's preference for south-facing orientation, the direction of residential buildings plays a critical role in apartment layouts. Accordingly, most public rental housing complexes across construction periods were planned with south-facing orientations. To this end, the unit composition within the residential buildings was planned with a south-facing orientation, as shown in Figures 4 and 5. While there are variations depending on unit size,

buildings with an exclusive area of approximately 59 square meters typically have a flat-type layout, where two units are arranged around a central stairwell, forming clusters of two to three buildings. For smaller unit sizes, the layout consists of a flat-type configuration with a single-loaded corridor, where seven or more units are combined. However, some differences were observed between the 1990s and the post-2000 periods.



Figure 4. Residential building layout and unit plan of Hwindol Village Jugong 4th complex (Source: drawn by the author and based on <https://www.myhome.go.kr/>, accessed on 1 December 2024).

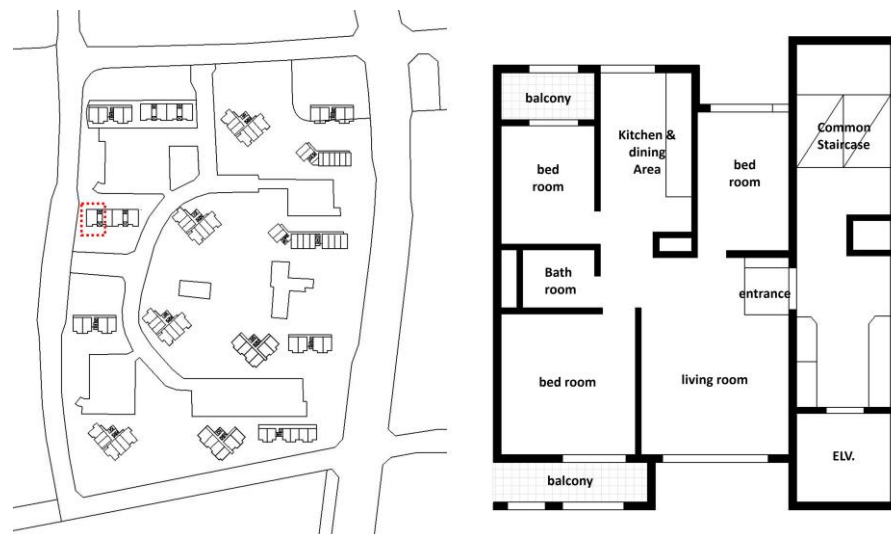


Figure 5. Residential building layout and unit plan of Yuljeong Village 7th complex (Source: drawn by the author and based on <https://www.myhome.go.kr/>, accessed on 1 December 2024).

In the 1990s, 92.6% of the 83 buildings across eight complexes were oriented south, including southeast and southwest directions, while the remaining buildings were oriented east or west. This reflects the orthogonal layout characteristics of the period, with south-facing buildings combined with east- or west-facing buildings to form orthogonal layouts. In contrast, after 2000 and 2010, most buildings were oriented south, but with a notable difference: instead of true south, buildings were primarily oriented southeast or southwest.

4.2.4. Building Forms

In the 1990s, 94% of the 83 residential buildings across eight complexes were linear flat-type buildings, with 78 buildings adopting this form. Notably, six of the eight complexes exclusively used linear flat-type buildings without variations. In complexes where T-shaped or tower-type buildings were introduced, these accounted for less than 50% of the total buildings. For example, in complex A7, two of the 12 buildings were modified to T-shaped forms after 2000, while in complex A8, three of the six buildings were tower-type. However, the number of units in the linear flat-type buildings was approximately 1.4 times higher than in the tower-type buildings, indicating that the linear flat-type dominated this period, with variations primarily in height.

In the 2000s, the building forms in public rental housing complexes began to diversify. Unlike the previous period, when only linear flat-types were used, at least three different building types were introduced within each complex. Linear flat-type buildings accounted for 36.4%, while modified slab-type buildings made up 32.7%. Additionally, all eight complexes included at least three tower-type buildings, typically in V-shaped or modified V-shaped forms, comprising between 23% and 42% of the buildings within a complex. These tower-type buildings were often located along central axes or served as landmarks, forming the tallest structures in the complexes, marking a shift from the dominance of linear flat-type buildings in the previous period.

In the 2010s, building forms became even more diverse. Linear flat-type buildings accounted for 32.9%, while modified flat-type buildings increased to 44.7%, reflecting a rise in the use of modified forms compared to the 2000s. These modified flat-types included L- and $\perp$ -shaped buildings, which were either partially (C1, C4, C5) or entirely (C2, C6, C7) planned across complexes. In contrast, the proportion of tower-type buildings decreased to 17.1%, and some complexes (C4, C5, C6, C7, C8) did not include any tower-type buildings. Additionally, entirely new building forms emerged, such as large $\perp$ - and $\square$ -shaped buildings and single-family housing units integrated atop residential buildings (C8). The images illustrating the representative building types by construction period are shown in Figure 6, while the analysis results for layout planning elements are summarized in Table 6.



Figure 6. Representative residential building types by period. Source: Naver map (<https://map.naver.com/>, accessed on 30 July 2024).

Table 6. Analysis of layout planning elements by complex.

Classification		Density	Building Height		Orientation		Building Forms		
		V1 ¹	V2 ²	V3 ³	V4 ⁴	V5 ⁵	V6 ⁶	V7 ⁷	V8 ⁸
1990s	A1	136.24	12.9	15	91.7	1	100.0	0.0	0.0
	A2	148.11	15.6	25	82.4	1	100.0	0.0	0.0
	A3	121.96	16.3	20	88.9	1	100.0	0.0	0.0
	A4	132.45	15.0	20	100.0	1	100.0	0.0	0.0

Table 6. *Cont.*

Classification		Density	Building Height		Orientation		Building Forms		
		V1 ¹	V2 ²	V3 ³	V4 ⁴	V5 ⁵	V6 ⁶	V7 ⁷	V8 ⁸
1990s	A5	124.68	15.0	20	100.0	1	100.0	0.0	0.0
	A6	132.23	15.0	20	100.0	1	100.0	0.0	0.0
	A7	128.31	14.5	20	100.0	3	100.0	0.0	0.0
	A8	144.16	17.5	20	77.9	2	50.0	50.0	0.0
	Average	133.50	15.2	20	92.6	1.4	93.8	6.25	0.0
2000s	B1	113.87	14.3	15	100.0	4	53.3	26.7	46.7
	B2	164.23	14.7	20	100.0	3	63.6	27.3	36.4
	B3	146.27	15.6	18	100.0	4	0.0	41.7	100.0
	B4	135.07	14.4	23	100.0	3	53.8	23.1	46.2
	B5	154.06	15.1	23	100.0	3	41.7	25.0	58.3
	B6	154.04	12.8	15	100.0	6	16.7	33.0	77.8
	B7	120.38	13.3	15	100.0	4	50.0	25.0	50.0
	B8	119.39	17.3	25	100.0	5	15.4	38.5	84.6
	Average	138.41	14.7	19.8	100.0	4	36.8	30.04	62.5
2010s	C1	189.16	17.2	25	100.0	4	28.6	20.0	50.0
	C2	164.73	19.3	25	100.0	2	30.0	71.4	71.4
	C3	121.86	14.8	30	100.0	3	42.9	42.9	57.1
	C4	144.19	16.6	19	100.0	2	71.4	0.0	28.6
	C5	135.46	18.7	21	100.0	2	70.0	0.0	30.0
	C6	136.61	19.7	21	100.0	1	0.0	0.0	100.0
	C7	140.28	21.9	23	100.0	1	0.0	0.0	100.0
	C8	173.15	7.0	18	100.0	7	15.4	0.0	84.6
	Average	150.68	16.9	21.5	99.5	2.75	26.9	16.8	65.2

¹ FAR (%), ² Number of floors (floor), ³ Maximum number of floors (floor); ⁴ The proportion of south-facing orientation (%), ⁵ Types of residential building forms (number); ⁶ The proportion of linear flat-type buildings (%), ⁷ The proportion of tower-type buildings (%); ⁸ The proportion of modified residential buildings (%).

4.3. Examination of Changes in Layout Forms of Public Rental Housing Complexes

The official beginning of Korea's public rental housing supply policy can be traced back to 1989, when permanent rental housing started being supplied. Examining the corresponding legal and institutional changes, until the late 1970s, laws related to rental housing supply were fragmented and symbolic, resulting in a lack of effectiveness in planning [6]. However, with the government's announcement of the construction of 2 million housing units in 1980, the Residential Land Development Promotion Act was enacted, leading to the development of new towns in the Seoul metropolitan area. This also triggered revisions to the Building Act, particularly concerning the arrangement of apartment complexes.

With the land development of the first new towns and the initiation of permanent rental housing supply, various amendments were made to the Building Act in 1990. Notably, the classification criteria for apartment buildings were changed to buildings of five stories or more. Additionally, the setback distance between residential buildings and the site boundary was adjusted from a minimum of 3 m to either 6 m or half the building height, whichever was smaller. However, in 1992, this was relaxed back to a minimum of 3 m. Furthermore, in 1992, the setback distance from residential openings to the site boundary was modified. For buildings 15 stories or lower, the requirement remained at half the building height, while for buildings 16 stories or higher, it was relaxed to 4/10 of the building height. Later in 1992, the requirement was further eased to a minimum of one-fourth of the building height, regardless of the number of floors [8]. These changes indicate that the Building Act was progressively relaxed to facilitate smooth housing construction. On the other hand, due to the characteristics of new towns, district unit plans were strengthened

to address urban landscape differences from conventional developments and to resolve issues related to the aesthetic quality of traditional apartment complexes.

Around 1990, the most common layout for apartment complexes in South Korea was the parallel arrangement using a linear flat-type configuration, which was the most typical planning model [27]. However, parallel layouts were criticized for their monotonous landscapes and lack of community spaces, prompting discussions on alternative layout types around the time the first-generation new towns were planned in the 1990s [37].

The district unit plan for first-generation new towns reflect this shift. In the case of Bundang District, the guidelines stipulated that 20% of the total building frontage in the main orientation should be arranged perpendicularly to the primary direction within the complex [38]. Similarly, in Ilsan District, the guidelines discouraged uniform parallel arrangements of flat-type buildings and required at least 10% of the total building frontage to be arranged perpendicularly to the main direction [39]. These measures aimed to avoid uniform and monotonous parallel layouts by encouraging orthogonal arrangements. Although the relaxation of setback distance regulations under the Building Act made the arrangement of residential buildings more flexible, district unit plans were implemented to guide building layouts and discourage the traditional parallel arrangement.

With the beginning of Kim Dae-jung's administration in 1997, the People's Government initiated a more systematic expansion and refinement of rental housing-related laws [6]. Laws related to apartment complex planning, such as the Housing Act and the Rental Housing Act, were either revised or newly enacted. Notably, the 1999 amendment to the Building Act significantly expanded the authority of local government ordinances. For the setback distance between residential buildings, it was set at 0.8 times the building height or a range ensuring two consecutive hours of sunlight, while also allowing local ordinances to determine the specific regulations. Additionally, the setback distance between side walls of residential buildings was reduced from 6 m to 4 m. The distance from residential openings to the site boundary was adjusted to at least one-fourth of the building height, but this too was left to local government ordinances for final determination. One of the most significant amendments was related to height restrictions based on road width. Previously, residential buildings along roads were required to have a height limit of no more than 1.5 times the distance across the road. However, the revision introduced maximum height designations for each street section, allowing more flexible regulations in residential land development districts. Furthermore, in balcony area calculations, if a simple flower bed was installed, the deduction was calculated using 2 m instead of 1.5 m along the exterior wall, allowing a greater portion of the area to be included in the floor area calculation. These relaxed standards became a crucial guideline for apartment complex layouts in the 2000s [8]. In 1998, along with the existing permanent rental housing and 50-year public rental housing, national rental housing was newly introduced, further diversifying the floor plan sizes of rental housing. Meanwhile, in the district unit plans of the second new towns, the orthogonal layout emphasized in the first new towns was no longer a requirement. Instead, setback distance and height regulations were further relaxed, with a greater focus on variations in building heights within residential complexes.

As a result, the parallel arrangement, which was primarily planned before 1990, re-emerged, driven by the traditional linear flat-type, modified flat-type, and tower-type residential buildings. In the 2000s, parallel layouts reemerged, comprising linear flat-type, modified flat-type, and tower-type buildings, echoing similar trends in the privately owned apartment market of the time. Until the late 1990s, Korea's apartment market was supply-driven. However, following the IMF financial crisis in the late 1990s, it transitioned to a demand-driven market. In this new paradigm, factors such as orientation, views, and openness influenced the design of complexes [27]. Therefore, while the previous parallel

arrangement was based on a linear slab-type layout, the parallel arrangement that emerged in the 2000s was planned not only with the traditional linear slab-type buildings but also with modified slab-type buildings featuring more diverse facades due to balconies and high-rise tower-type residential buildings. Unlike the parallel layouts of the pre-1990s, which were predominantly composed of linear flat-type buildings, those in the 2000s included modified flat-type and tower-type buildings. While some tower-type buildings appeared in the 1990s, they were not common in either public or privately owned apartment complexes. According to Lee and Park [27], over 80% of general sale apartments in the 1990s were linear flat-type buildings, and only 0.3% were tower-type buildings. In contrast, in public rental housing complexes of the 2000s, tower-type buildings were commonly V-shaped or modified V-shaped, with a minimum height of 15 floors, making them the tallest structures in the complexes. These V-shaped tower buildings were primarily oriented south or southeast due to their structural design. Consequently, to adhere to the building code, which mandates distances between buildings based on height (0.5 to 1.0 times the residential building height in the direction of the living room windows to ensure sunlight), these tower buildings were arranged in parallel layouts alongside flat-type buildings. Additionally, some complexes featured staggered layouts for certain buildings based on site conditions. In staggered layouts, not only tower-type buildings but also modified flat-type buildings were included, indicating a consistent preference for south-facing orientations (B1, B6). These layout forms align with district unit plan. For example, in Dongtan1 District, sections adjacent to parks and pedestrian paths were designated for tower-type buildings to provide scenic views, while other sections designated perpendicular placements of buildings along roads to mitigate noise and improve aesthetics [40]. Similarly, in Unjeong District, tower-type buildings were planned along central parks and view corridors to enhance visibility and ensure scenic continuity, while perpendicular placements were required along major arterial roads [41]. These conditions made parallel layouts the most suitable for maintaining building distances while accommodating tower-type and high-rise flat-type buildings.

Finally, in the 2010s, public rental housing complexes were primarily developed in second new towns, similar to those of the 2000s. However, in 2008, the Lee Myung-bak administration introduced the Bogeumjari Housing Policy, which integrated public sales and rental housing, leading to notable changes in public rental housing planning. As public housing supply continued under the same legal framework, efforts were made to ensure that public rental housing complexes reflected the planning standards of publicly sold apartment complexes. To enhance design quality, international design competitions were held. In Seoul, experimental public rental housing complexes were developed through design competitions, such as in the Naegok and Gangdong residential development districts. Furthermore, in 2013, the Park Geun-hye administration introduced happy housing, a new type of public rental housing targeting university students, newlyweds, and one- to two-person households. This led to further diversification of public rental housing types, bringing changes in scale and planning strategies.

Accordingly, public rental housing complexes in the 2010s were also based on a parallel arrangement, similar to those in the 2000s, but there were changes in the building types that shaped the layout structure. Linear flat-types became more elongated, and L-, U-, and T-shaped modified flat-types and variations of tower-types emerged. Additionally, building heights within complexes also changed. While the 1990s featured skyline variations based on differences in building heights, after 2000, rhythmic skylines emerged due to variations within individual buildings. Although the range of building types within complexes decreased compared to earlier periods, the introduction of height differences within individual buildings provided a three-dimensional aesthetic. The ratio of buildings with floor

variations within a complex also increased, from about 21% in the 2000s to approximately 50% in the 2010s. Furthermore, district unit plan became more specific during this period. For example, in Byeollae, Namyangju, the guidelines encouraged placing low-rise flat-type buildings along roadways [42]. Similarly, in Dongtan-2 District, high-rise tower building zones and landmark residential zones were designated to preserve and enhance the new town's skyline [43]. Unlike earlier periods, which focused solely on layout types or building forms, post-2010 guidelines incorporated comprehensive planning standards addressing both forms and heights to consider overall urban aesthetics. Consequently, the increase in FAR, introduction of new building forms, and stricter adherence to legal requirements such as inter-building distances made parallel layouts the most suitable option. Therefore, although the building regulations in the 2010s remained similar to those of previous periods, the increased floor area ratio (FAR) and maximum building height, along with the emergence of new residential building types, suggest that the parallel arrangement was likely the most suitable layout to comply with legal requirements, such as building spacing regulations. Additionally, public rental housing complexes began incorporating designs influenced by domestic and international architectural competitions, contributing to greater diversity in layout forms. This explains unique layouts, such as those in C8, which feature innovative arrangements and building types.

5. Discussion

The residential building layout forms in public rental housing complexes in Korea have undergone changes in planning characteristics and associated planning elements over time. Additionally, as public rental housing policies and legal frameworks that directly influenced planning elements were revised over time (Figure 7), these changes also impacted the layout planning of public rental housing complexes. In particular, setback distance regulations, which have the most significant influence on the arrangement of residential buildings within complexes, were relaxed around the periods when the first and second new towns began construction.

In the 1990s, orthogonal layouts dominated, primarily composed of linear flat-type buildings. By the 2000s, there was an increase in tower-type buildings exceeding 20 floors, leading to the emergence of complexes with parallel layouts or mixed layouts combining parallel and staggered arrangements. In the 2010s, modified flat-type buildings and buildings with floor variations became more common, though the layout form continued to be predominantly parallel.

On the other hand, according to the study by Lee and Park (2019) [25], privately owned apartment complexes in the 1990s primarily featured orthogonal layouts composed of linear flat-type buildings [27]. In the 2000s, both orthogonal layouts with linear flat-types and parallel layouts with tower-types were common. By the 2010s, parallel layouts dominated, primarily formed by tower-type buildings. While the 2000s and 2010s shared a tendency toward parallel layouts, the composition of residential building types differed, with privately owned complexes relying more on tower-type buildings. Existing research attributes the shift toward parallel layouts to planning factors such as increased building heights, orientation, and the introduction of modified building types like tower-type buildings. However, the analysis in this study found that while tower-type buildings were introduced in public rental housing complexes in the 2000s, flat-type buildings remained dominant. By the 2010s, parallel layouts characterized by modified flat-type buildings rather than tower-type buildings became a notable feature. This trend can be attributed to the smaller household sizes in public rental housing compared to privately owned housing, making elongated flat-type buildings with corridor-based units more efficient. Additionally, variations in floor heights mandated by district unit plan further

influenced this outcome. Unlike privately owned housing, where demand for south-facing orientations and views led to the adoption of high-rise tower-types, public rental housing in this study rarely exceeded 25 floors, highlighting another difference. In addition, the tower-type configuration with a terraced design, accommodating only 2–3 units per floor, appears to have been advantageous in terms of unit size. Therefore, when compared to conventional studies on private sale apartment complexes, the layout pattern is similar in its parallel arrangement, but the form of the residential buildings reflects differing levels of consumer demand.

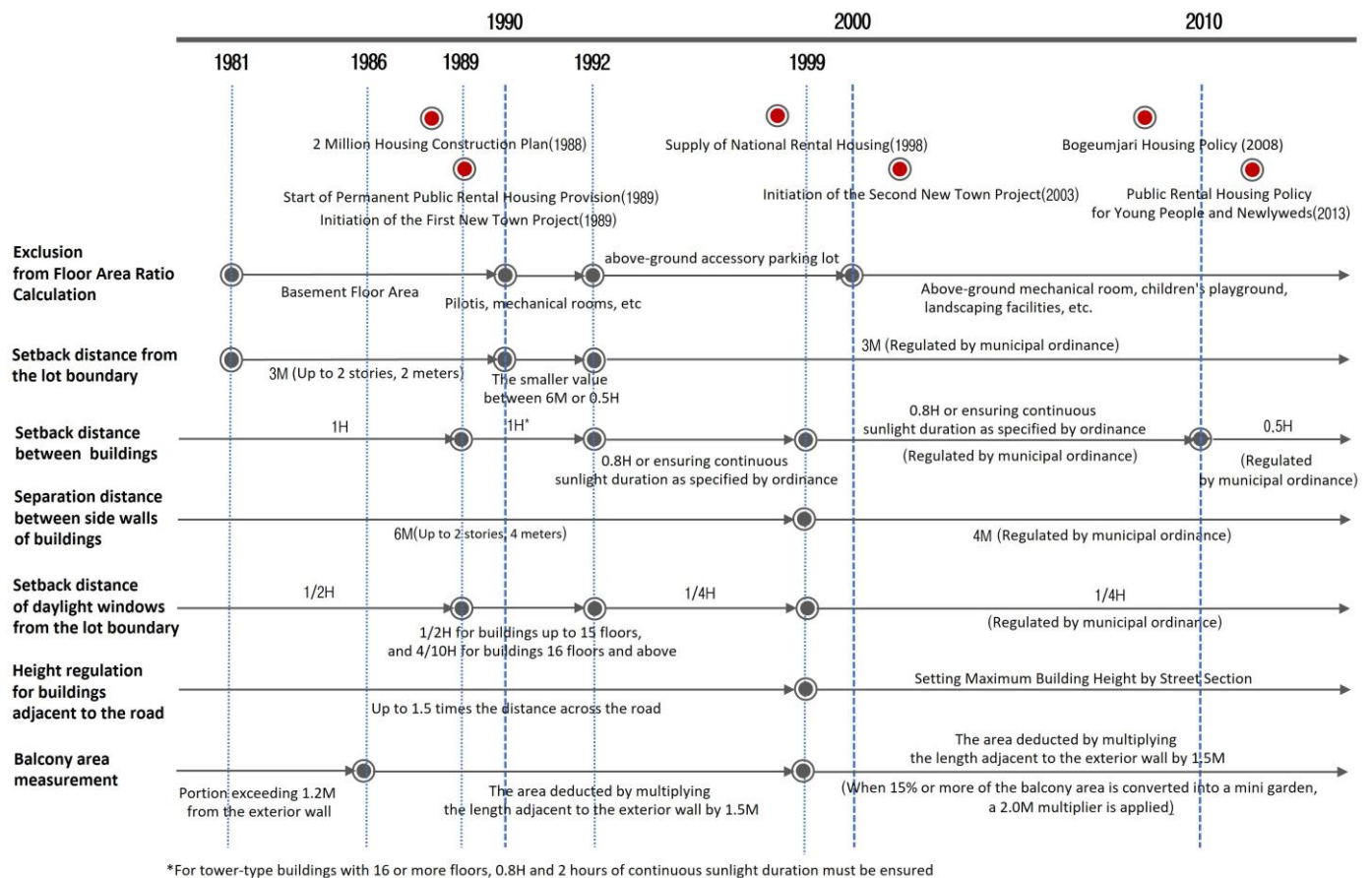


Figure 7. Public rental housing policies and building act by period.

This study is limited by its focus on 24 public rental housing complexes in new towns and its emphasis on the physical planning characteristics of layout forms. Future research should explore the relationship among building forms, floor plans, and external spaces influenced by layout forms. Nevertheless, as an early study on the planning and changes in public rental housing complexes, this study provides foundational insights for advancing subsequent research and contributes to enhancing the quality of residential environments in public rental housing complexes.

6. Conclusions

This study analyzed the characteristics of changes in residential building layout forms in public rental housing complexes within Korean new towns by examining the planning elements and layout characteristics across construction periods.

In the 1990s, orthogonal layouts composed of linear flat-type buildings were predominant. In the 2000s, parallel layouts emerged, featuring flat-type and tower-type buildings

designed to consider views and landscapes. By the 2010s, while parallel layouts remained common, more diverse building forms and variations in floor heights began to appear.

Several factors influenced these changes in layout forms. In the 1990s, the district unit plan aimed to move away from the uniform landscapes criticized in previous parallel layouts by requiring buildings exceeding a certain size to be arranged perpendicularly to the main orientation of the complex. These guidelines encouraged orthogonal layouts composed of flat-type buildings. In the 2000s, high-rise construction of buildings over 15 floors became more prevalent, and district unit plans introduced specific requirements, such as designated zones for tower-type buildings. Considering inter-building distances, parallel layouts were more efficient for arranging flat-type and tower-type buildings. By the 2010s, while parallel layouts continued to dominate, new building forms and variations in floor heights emerged, reflecting advancements in density, construction technology, and planning standards.

These changes in residential building layout forms reflect not only the changing socio-economic conditions and demands of each period but also advancements in building technology and urban planning. The role of district unit plans, which regulate planning elements such as building heights and inter-building distances, was found to be crucial in shaping layout forms.

This holds significant theoretical value as an early analysis of changes in residential building layout forms in public rental housing, moving beyond policy analysis or resident preference studies. By providing a new perspective on the physical planning elements of public rental housing, this study serves as a foundation for future research and enhances understanding of layout planning in public housing within new towns. Furthermore, the findings can inform efficient layout strategies for public rental housing, offering practical value to urban planners, architects, and policymakers.

Over the past 30 years, the development of public rental housing in Korea has followed two primary approaches, similar to those observed in Western and other Asian countries: large-scale supply through new town developments and small-scale, customized rental housing provision through urban regeneration projects in aging urban areas. This supply strategy has provided an opportunity to reduce the housing cost burden for low-income households, young adults, and newlyweds seeking well-located housing complexes. However, concerns about the insufficient quality of public rental housing have been continuously raised. In response, during the 2000s, efforts were made to diversify building types and layout patterns. Since the 2010s, design guidelines have been reinforced, and architectural design competitions have been introduced to establish diverse and high-quality public rental housing complexes. As a result, vacancy rates have decreased, and residential satisfaction has improved.

These public rental housing policies align with the global trend toward protecting vulnerable populations and promoting social integration. Further research could be expected to present planning strategies that address issues such as social integration, climate and environmental changes, and demographic shifts. These efforts would contribute to the development of more sustainable and qualitatively advanced public rental housing models.

However, this study is limited to public rental apartment complexes within the metropolitan area, rather than conducting a comprehensive survey analysis, focusing only on complexes of a certain scale. Additionally, the research methodology is confined to qualitative research, such as literature review and drawing analysis. Therefore, future studies should include not only quantitative research that can provide more specific numerical insights into changes in layout planning but also an analysis of the characteristics of changes related to floor plans and external spaces.

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