

Article

Diachronic Changes and Factors Influencing the Exterior Design of High-Rise Apartment Buildings

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Abstract: High-rise apartment buildings, the preferred type of housing in South Korea, have very similar exteriors. Thus, apartment complexes tend to look similar with no unique identity of complex or city. This study aimed to identify the factors influencing the exterior design of high-rise apartment buildings in their 40-year history. I surveyed 50 apartment complexes from the 1970s to 2010, categorized important periods in Korean history, and analyzed corresponding changes in the exterior design of high-rise apartment buildings. I visited apartments in Seoul to take photos and conduct field surveys, and statistically analyzed the results by classifying the buildings' external characteristics. I found correlations between the exterior design of the buildings and three major factors influencing their changes and development. The first is increasing institutional supply in the 1970s and developing landscapes in the 2000s. The second is an economic factor—economic growth. Third, as technology developed, apartment buildings transitioned from low-rise to high-rise, and their exterior design underwent many changes. This study reveals the relationship between changes in high-rise apartment buildings' exteriors as they developed alongside South Korea's growth and the influencing factors, and presents major factors that determine the direction of exterior design for high-rise apartment buildings in the future.



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Keywords: high-rise apartment buildings; residential buildings; exterior design; influencing factors

1. Introduction

Apartments comprise the majority of housing in South Korea and are the most common and preferred type of housing in the country. The period when apartments were introduced and developed, the 1970s, roughly coincides with the period of industrialization in South Korea. High-rise apartment buildings emerged in the form of large-scale complexes from the early 1970s and have greatly developed in their type and structure throughout their 40-year history.

Despite these changes and developments, however, apartment complexes look similar in appearance all over the country. The mainstream style is a design of matchboxes arranged side by side. Consequently, apartment complexes inevitably look similar nationwide, and it becomes difficult for a complex or city to capture its unique identity. In these circumstances, the only way to secure a complex's identity is to partially modify the exterior elements that can differentiate the complex without greatly changing the interior. Possible elements include the residential building type, roof, rooftop, and lower floors.

Many studies on the exterior design of apartment buildings have been conducted since 2000. In particular, studies have been conducted on the exterior, color, and material characteristics of residential buildings, roof and rooftop changes, and exterior design in low-rise areas. Regarding the type of apartment building, various planning methods for the type of building and the planned characteristics of the type of residential building have been conducted. These studies have mainly focused on the arrangement of residential buildings in terms of sunlight and direction. In addition, one study investigated the preference for

certain types of building in multi-family housing [1] (pp. 57–65). The characteristics of the changes in apartment building plans have also been investigated, but actual completed apartment buildings or architectural plans were not the focus [2]. Although the exterior design of the apartment building in the Seoul metropolitan area is being studied, there is a limitation that resulted in a failure to investigate due to the Seoul Metropolitan Government, which guides the exterior of the apartment [3]. However, no analysis has been undertaken on the changes in the type of buildings by era.

This study focuses on the changes in the exterior design of various apartments and the changing factors of elements that constitute their exterior from the past to the present. I investigate how the physical form of apartments has been influenced by institutional, economic, and technological factors according to the time period and how these factors are interrelated. Although numerous studies have examined the exterior of apartments, they do not clearly explain why the exterior designs have changed so much in terms of influencing factors. Apartments have become an important form of housing and the most important element of the urban landscape. To promote more desirable exterior designs in the future, it is necessary to answer this question at both the academic and policy levels.

2. Theoretical Review

2.1. Theories on Exterior

In the field of architecture, definitions of “exterior” originate from the various views of buildings. It is simply described as “the outside of something, especially a building,” and there are no specific theories regarding its concept and definition. However, explanations lean toward the concept of “identity” or emphasize the “external appearance of the aesthetic range” visually perceived by humans [4].

In architecture, the exterior is the most outwardly expressed part of a building. Just as the building itself is influenced by changes in the surrounding environment, so is its exterior. Functioning to distinguish between places and other buildings, the exterior reflects the surrounding environment and thus can become the building’s identity.

The building’s identity must be reflected in its external appearance to retain its essential character, which Roger Scruton described as its local attributes [5] (pp. 23–25). Thus, various works are restricted in buildings due to the sense of location, and the exterior of buildings is influenced by the area’s character.

As local characteristics are reflected in buildings, they are also reflected in the exterior of buildings. The building’s identity is ultimately transferred to its exterior and exerts influence. Although people may have different feelings or a different understanding about the exterior of a building, since a building cannot have multiple appearances at once, it formally possesses the commonality of one unified exterior [6] (pp. 173–178). Furthermore, if a building’s exterior expresses its identity, then differences in the exterior come from the building’s character. The character of a building is an expression of its intended purpose and originates from the implicit emotional relationship between the building and people [7].

Hence, buildings are an important medium of commonality and emotional relationships and possess a unique identity signified by the exterior itself. It has its own significance independent of the process or content in which the exterior is formed, and this identity is also considered to provide distinctiveness to its external appearance. Kevin Lynch argued that identity is the characteristic that enhances the ability to recognize an environment, makes an object memorable and vivid, attracts attention and distinguishes it from other locations, and that identity is what gives buildings distinctiveness [8] (pp. 20–30).

The aesthetic meaning, sense of place, and uniqueness of the exterior are attributes of all buildings, and the exterior contains not only a simple visual meaning but various internal aspects as well. The exterior also carries important architectural significance as it creates an image necessary to distinguish the entity from other objects. When the exterior is being developed, it is influenced by the surrounding environment, which leads to changes in exterior planning elements. Therefore, for planners or policymakers to become involved

in the process of creating building exteriors, it is necessary to first investigate the changing process of exterior design.

2.2. Changes in the Form of Apartments and Influencing Factors

An apartment is defined as “a set of rooms for living in, usually on one floor of a large building” or “a self-contained housing unit that occupies only part of a building,” and refers to a building composed of multiple units [9]. Accordingly, an apartment house refers to a building comprising one or more dwelling units designed for one family, called a “flat” in the UK. An apartment house also refers to a group of houses built together, particularly a multi-family house built in large numbers [10] (pp. 20–21).

In South Korea, when there are multiple independent single-family dwelling units comprising one or more rooms and sharing an entry stairway or hallway in a building, each dwelling is called an apartment, and the building is called an apartment house. From a planning perspective, an apartment building refers to a middle-rise or taller multi-family housing; in terms of height, low-rise apartment buildings have four to five floors, while high-rise apartment buildings have at least six floors. The Enforcement Decree of the Building Act stipulates that multi-family housing with five or more stories is an apartment building, and it is differentiated from tenement houses that have four floors or fewer. The first apartment building in South Korea and the first multi-family housing was the Jongam Apartment built in 1958, which scholars regard as having served as a prototype for urban apartments that emerged later.

To understand the essential concept of the exterior design of apartment buildings, this study first reviews theories on the exterior design of buildings. In particular, this study examines the meaning contained in the exterior of a building and discusses how the exterior forms the building’s identity. This investigation finds that the identity of a building’s exterior has an important influence on the exterior. The uniqueness, distinctiveness, and identity of a building’s exterior are directly applied to the exterior of residential buildings. Therefore, we can understand the fundamental meanings of a residential complex’s identity, the urban landscape formed by the complex, and the exterior of apartment buildings.

The exterior of apartment buildings is an important factor that determines a city’s skyline. Apartment buildings’ exteriors form the city skyline according to changes in its shape, number of floors, and height, and also directly affects the urban landscape. As such, design plans for the exterior of apartment buildings must consider the urban landscape created by not only one building but also the entire complex. If that is the case, what factors influence an apartment building’s exterior design? Considering that the exterior of an apartment building is also a part of the housing style, the factors influencing the exterior design do not greatly vary from those influencing housing. Cultural, technological, and environmental factors are cited as those which influence housing, and they impact the exterior design as well [11]. The exterior designs of apartment buildings have morphed along with each time period, which is attributed to the diverse influences from cultural, social, and economic factors [12]. Historically significant background circumstances and events were the triggers inciting changes throughout the history of apartment buildings’ exterior designs. Regarding factors affecting the formation of the exterior of residential architecture, Korean scholars have cited environmental, traditional, functional, and formative factors, and some studies mainly address institutional aspects [13] (pp. 34–50). In summary, a commonality of previous studies is that they cite institutional, economic, and socio-cultural factors as influencing factors.

2.3. Components of the Exterior Design of Apartment Buildings

It is necessary to examine the components forming apartment buildings’ exterior design and its principles of composition. First, this can be analyzed through the lens of visual perception theory. Through a review of prior literature and related theories from this perspective, this study found that the exterior design of apartment buildings has been classified according to researchers’ varied perspectives, and that specific parts

of detailed items are also classified differently. Similar results were found in terms of other theories as well. For this reason, it seems impossible to address all the elements and influences of exterior design at once. Accordingly, this study first categorizes the exterior design of apartment buildings into complex layout, residential building, and unit dwelling according to scale, and then classifies all detailed elements from layout to exterior design [14]. According to an apartment building's slope topography, its elements are classified into complex shape elements, slope characteristic elements, and building shape elements [15]. Another study classified them into structural elements, exterior elements, and decorative and finishing elements [16]. An apartment building's exterior design has also been divided into primary, secondary, and tertiary perceptual elements and its components into detailed categories [17]. As such, researchers have different classifications for the detailed components of an apartment building's exterior according to their specific criteria and analyze specific aspects of the components differently according to varying standards.

This study aims to analyze the exterior design of high-rise apartment buildings with the scope limited to residential buildings, which have undergone the most changes in terms of the exterior design of apartment buildings. Even if the examination of exteriors is limited to residential buildings, it is necessary to first determine how to divide the exterior components of a residential building, and which elements play an important role in forming the exterior's identity and image. Regarding the exterior design of apartment buildings, this study determines the residential building type, roof, rooftop, side walls, and lower floors to be important factors constituting the exterior. Among these, this study analyzes the residential building type, which is an important element of the exterior type.

3. Analysis of the Changes in the Exterior Design of Apartment Buildings

3.1. Research Scope

The scope of the study is 40 years from the mid-1970s—when the supply of multi-family housing in South Korea began to greatly expand—to 2010. Although the exterior designs of apartment buildings have undergone various changes since the 2000s, a trend of gradual changes can be observed from the 1970s, when the full-fledged development of apartment buildings began. This study analyzed apartment complexes in Seoul, as shown in Table 1, which were selected by considering their year of establishment, number of households, and construction company—based on data on housing supply conditions and actual housing statistics.

Table 1. Scope of research.

Scope	Description	Notes
Time	40 years from 1970 to 2010	Analysis of changes in the exterior design of apartment buildings
Area	Apartment complexes in Seoul	Analysis of apartment complexes
Content	1. Factors influencing changes in the exterior design of residential buildings: institutional, economic, and technological review	Correlations between influencing factors and components of the exterior design of residential buildings
	2. Correlations between exterior design and influencing factors	

The process of changes is divided into five periods based on major historical events and era-specific circumstances, which form the background of changes in apartment buildings' exterior design over 40 years from the 1970s to 2010, as shown in Table 2.

Table 2. Designation of time periods.

Division	Criterion	Period	Notes
Period 1	Introduction of apartment buildings	1976–1985	Development of large-scale private apartment buildings
Period 2	Expansion of mass supply	1986–1989	New town development, design competitions
Period 3	Expansion of high-rises	1990–1997	Planned community development, supply of 2 million housing units
Period 4	Differentiation of exterior	1998–2002	IMF foreign exchange crisis, deregulation of new house sale prices
Period 5	Diversification of exteriors	2003–2010	Participatory government, unsold houses, global economic recession

3.2. Targets of Study

Judging 500 households to be the minimum size wherein new attempts to construct new building types are possible, this study analyzed apartment complexes with at least 500 households. In particular, 10 apartment complexes for 5 different areas located in Seoul were selected, giving a total of 50 complexes for the study. Apartment complexes located in Seoul might not best represent the nationwide trend, but this was not considered an issue since apartment complexes in Seoul tend to set trends across the country. In addition, large complexes built mainly by large construction companies were investigated because attempts to change and improve exterior design can be found mainly in complexes of large construction companies with financial power. It is desirable to use complexes of a medium or large size because new attempts for small complexes are almost impossible, which is owed to cost problems. This subsection analyzes apartment complexes with more than 500 households, as shown in Figure 1. I physically visited the apartments in Seoul to take photos and conduct field surveys for the study, as shown in Table 3, and statistically analyzed the results by classifying the external characteristics of the apartment buildings.

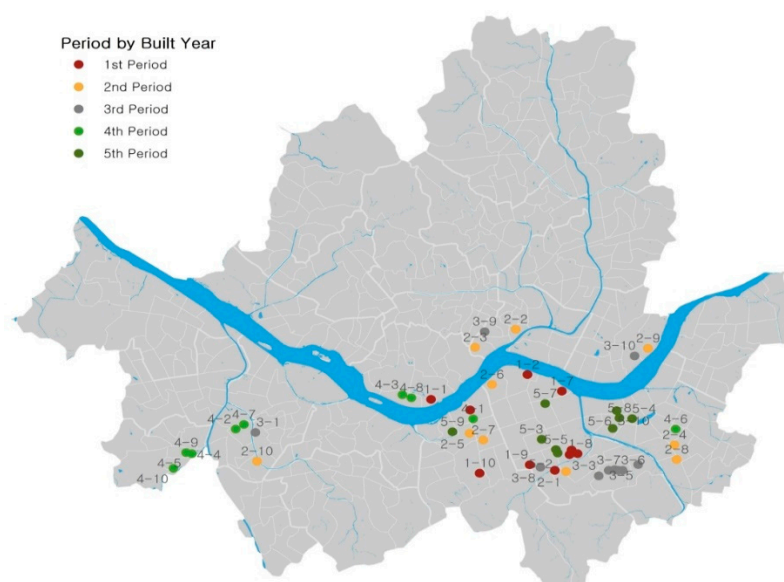
**Figure 1.** Location of apartment buildings used in this study in Seoul.

Table 3. Apartment building types by period.

















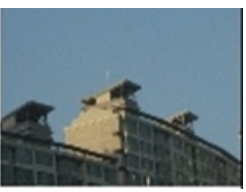
Division	Examples of Buildings and Years				
Period 1					
	1–1 Sindonga (1983)	1–2 Hanwang (1977)	1–3 Hansin (1978)	1–4 Eunma (1979)	1–5 Sunkyung (1983)
					
	1–6 Kyungnam (1984)	1–7 Samik (1984)	1–8 Mido (1985)	1–9 Hansin (1985)	1–10 Kyungnam (1978)
					
	2–1 Hyundai (1986)	2–2 Daerim (1986)	2–3 Kukdong (1986)	2–4 Woosung (1987)	2–5 Mido (1987)
					
	2–6 Misung in 1987	2–7 Sampyung (1988)	2–8 Olympic (1988)	2–9 Kukdong (1989)	2–10 Hyundai (1989)
					
	3–1 Hyundai in 1997	3–2 Moklyun (1993)	3–3 Hansol (1994)	3–4 Sansung (1997)	3–5 Sindonga (1992)
Period 3					
	3–6 Kachi (1992)	3–7 Samteo (1993)	3–8 Rukki (1993)	3–9 Doosan (1994)	3–10 Hyundai (1993)

Table 3. Cont.

Division	Examples of Buildings and Years				
Period 4					
	4-1 Donga in 1999	4-2 Lotte (1999)	4-3 Hankalam (1998)	4-4 Hometown (2001)	4-5 Hyundai (2001)
Period 4					
	4-6 Laemian in 2001	4-7 Taeyoung (2000)	4-8 Kangchon (1998)	4-9 Hyundai (2001)	4-10 Hanjin (2000)
Period 5					
	5-1 Arthill in 2004	5-2 Centrabill (2005)	5-3 Ipark (2006)	5-4 Lake (2006)	5-5 Ipark (2007)
Period 5					
	5-6 Risente (2008)	5-7 Hillstate (2008)	5-8 Tulajium (2007)	5-9 Laemian (2009)	5-10 Lets (2008)

3.3. Changes in Exterior Design by Period

3.3.1. Period 1: Introduction of Apartment Buildings (1976–1985)

According to the survey and analysis of the sample complexes, most apartment buildings during this period were plate-type. Additionally, the number of floors in the residential buildings' range from 12 to fewer than 15. Due to the large-scale development during this period, there were no changes in the number of floors or differentiation of residential buildings within the complexes. According to statistical analysis, plate-type residential buildings accounted for a high proportion at 95%. In particular, among the plate-type buildings, most were south-facing with a straight layout. Furthermore, mixed types of Y- and π -shaped layouts were rare.

In terms of the number of floors, 85% of the apartment buildings had fewer than 15 floors, while 15% had 15 or more. Regarding the height of residential buildings inside complexes, there were barely any changes in the number of floors, and they had the same floor height and a uniform layout. The residential buildings were mainly finished with brown colors, and there was no differentiation in finishing materials. Hence, the type, colors, materials, and the number of floors of the residential buildings were uniform, resulting in a uniform exterior of the apartment buildings.

3.3.2. Period 2: Expansion of Mass Supply (1986–1989)

According to the analysis of residential building types in the sample complexes during this period, plate-type apartment buildings accounted for 100% of them, most of which

were corridor-style. A high proportion of residential buildings, 60%, had fewer than 15 floors, while those with 15 to 19 floors comprised less than 40%. Although super high-rise apartment buildings with at least 20 floors emerged during this period, owing to the development of Sanggye New Town, they were not observed in the sample complexes discussed in this paper. However, the fact that 40% of apartment buildings had at least 15 floors shows that the number of floors was increasing compared to the previous period.

Moreover, complexes with changes in the number of floors accounted for 10%, indicating that the heights of apartment buildings inside complexes gradually changed from this period. Meanwhile, planners began to explore modifications to the monotonous exteriors of apartment buildings through color. In terms of color, 40% of the residential buildings were brown, 30% were white, 20% were apricot, and 10% were other. This indicates that planners began to use a wider variety of colors. These changes also affected the sidewalls and apartment elevation. The visual design of residential buildings began to change through the diversification of their monotonous colors.

3.3.3. Period 3: Expansion of Mass Supply (1990–1997)

According to the survey and analysis of apartment building types during this period, plate-type buildings accounted for 100% of apartment buildings. Thus, plate-type apartment buildings were still the prevailing trend. Meanwhile, residential buildings with 15 to 19 floors were the most common at 50%, while those with fewer than 15 floors comprised 33%, and super high-rise apartment buildings with 20 or more floors comprised 17%. Thus, the ratio of apartments with 15 to 19 floors exceeded the ratio of those with fewer than 15 floors, showing that the number of floors in apartment buildings continued to rise.

Furthermore, complexes with changes in the number of floors accounted for 33%, signaling attempts to diversify the number of floors. This suggests the intention of introducing changes to apartment complexes, which were densely populated due to the construction of super high-rise apartment buildings. In terms of color, 42% of the residential buildings were brown, 25% were white, 17% were apricot, and 17% were other, indicating the universal diversification of colors. This is the result of efforts to break away from the uniform and monotonous building colors with finishes of various colors and to diversify the elevations of residential buildings by varying the number of floors.

3.3.4. Period 4: Differentiation of Exteriors (1998–2002)

According to the survey and analysis of residential building types during this period, plate-type buildings still accounted for 100% of apartment buildings. However, what is noteworthy is the number of floors in the residential buildings. In all sample complexes, 100% of the residential buildings had at least 20 floors. This demonstrates that in Period 3, when super high-rise apartment buildings began to emerge, all of the apartment buildings were constructed as super high-rises within just a few years. As the number of floors in apartment buildings rose to super high-rise levels, residential buildings became diversified in several ways.

First, apartment complexes with changes in the number of floors in residential buildings increased to an overwhelming 83%. In most apartment complexes, the number of floors of the residential buildings was changed. Moreover, 50% of apartment complexes showed differentiation in the upper, middle, and lower floors in residential buildings, showing the full implementation of strategies to differentiate the exterior design of apartment buildings. These diverse changes manifested especially in the colors of residential buildings, which changed, for example, to brown, apricot, and white.

3.3.5. Period 5: Diversification of Exteriors (2003–2010)

According to the analysis of residential building types in this period, 44% were mixed-type, 31% were plate-type, and 25% were tower-type, demonstrating that various changes occurred in the types of residential buildings. This is the largest change compared to the previous period.

Consequently, substantial changes have occurred in the length and number of households that make up apartment buildings. Meanwhile, 87% of residential buildings had at least 20 floors and 13% had 15 to 19 floors, indicating the continuing trend of high density due to super high-rise apartment buildings from the previous period. Apartment complexes with changes in the number of floors in residential buildings accounted for 81%, showing that planners considered the skyline by modifying the number of floors in residential buildings. During this period, 69% of apartment complexes showed differentiation in the upper, middle, and lower floors in residential buildings, and it is also worth noting the beginning of diverse attempts to change materials and exterior finishes.

Nevertheless, the colors of residential buildings were mostly unchanged compared to the previous period, with 50% brown and 19% apricot, but gray emerged as a new color with 25%.

3.3.6. Discussion

The previous subsection analyzed the changes in the exterior design of apartment buildings according to the time period. This subsection presents a comprehensive system summarizing the trends in the changes of each component based on the above analysis.

When analyzing the results of the survey by period, less than 20% of apartments have less than 12 floors in Period 1 and are not found after Period 2. Apartments with 12 or more floors and 15 or fewer floors account for a high proportion, 60%, in Period 2 but less than 40% in Period 3 and are not found in Periods 4 and 5. Apartments with 15 to 19 floors continued to increase to about 50% until Period 3, and then decreased from Period 4. There were no apartments with at least 20 floors in Periods 1 and 2, but they grew to 20% in Period 3 and increased rapidly to 100% in Period 4, continuing to increase to 80% in Period 5.

Based on the results of the analysis as shown in Figure 2, plate-type buildings were the most prominent type of residential building in all the periods, and, from Period 5, they diversified into tower-type and mixed-type buildings. Moreover, from Periods 1 to 5, the number of floors of residential buildings rose to 15 or more floors, demonstrating the phenomenon of super high-rise apartment buildings. By contrast, apartment buildings with fewer than 12 floors were no longer observed. Regarding the color of residential buildings, brown accounted for the highest proportion, and there were no substantial changes between periods.

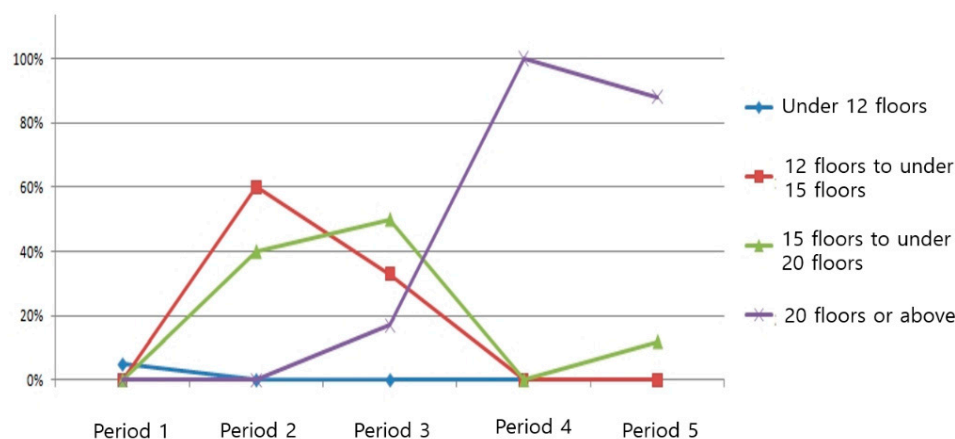


Figure 2. Changes in the number of floors in residential buildings by period.

Differentiation was based on changes in the shape of residential buildings and changes in the color of the exterior. Section 3.3 investigated the shape and color of buildings for each period, while a statistical analysis was conducted to reflect the results of the changes observed.

The change in floor numbers gradually increased to less than 30% from Periods 1 to 3, and rapidly increased to more than 80% in Period 4, staying at 80% until Period 5. The differentiation of apartment buildings also rose to 20% up to Period 3 but increased to 50% in Period 4 and 70% in Period 5. Based on the analysis results, it can be seen that high-rise apartments have been built since Period 4 with an increase in the differentiation of residential buildings as shown in Figure 3.

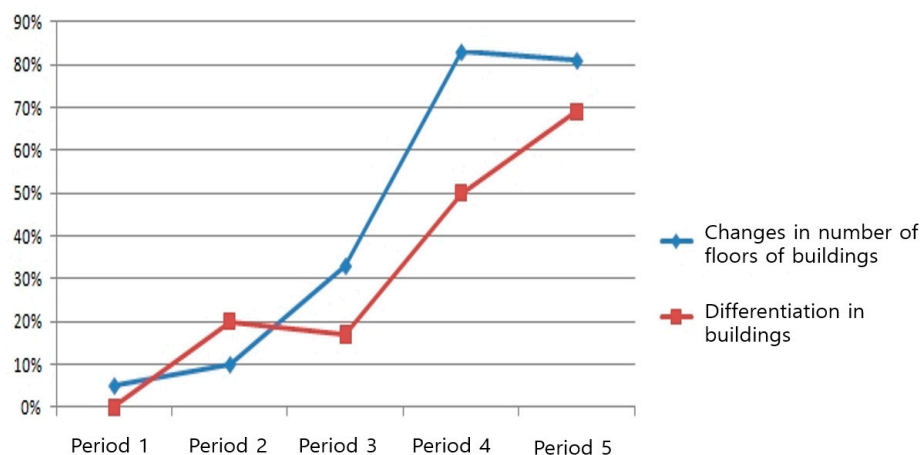


Figure 3. Differentiation of residential buildings by period.

4. Influencing Factors of Changes in the Exterior Design of Apartment Buildings

In terms of factors inducing changes in the exterior design of apartment buildings, the first are institutional factors related to the type of multi-family housing, which has a decisive influence on the changes in type. The second are economic factors; in this regard, apartments function as simple living spaces and are also highly important investments in the form of assets. The third is changes in type due to the development of construction technology, where both the exterior and type change according to the changes in construction methods or mechanical facilities.

4.1. Institutional Factors

Apartment buildings previously had the same number of floors, although in Seoul this began to change as high-rise apartment buildings developed. First, behind the development of these high-rise apartment buildings is the easing of regulations on the number of floors. In May 1975, building review guidelines that limited the number of floors in apartment buildings to 12 were enacted, and in April 1977, the 12-floor limit was lifted [18] (pp. 21–50). At the same time, installation standards for basement floors in the Building Act were relaxed, making it advantageous to construct apartments with 15 or more floors [19].

According to the survey and analysis results of this study, residential buildings with between 12 and 15 floors rapidly increased in floors during Period 2 (1986–1989), while super high-rise apartment buildings with at least 20 floors started to develop in Period 3 (1990–1997) and rapidly increased in Period 4 (1998–2002). This is a result of the relaxation in the number of floors in residential buildings and the government's institutional change to supply high-density housing for planned community development.




Regarding changes in residential building type, plate-type residential buildings have been the most common residential building type, which created the south-facing housing layout, the traditionally preferred layout since the 1970s when apartments began to be supplied [20] (pp. 30–50). At that time, legal regulations for securing separation distance, e.g., regulations on the distance between buildings, could be easily met with a plate-type residential building layout. However, scholars have noted that plate-type residential buildings are a major factor in creating uniform and monotonous apartment complexes. Moreover, consumers' obsession with south-facing apartments has resulted in excessively long straight buildings and created a stifling urban landscape. Moreover, the trend of

super high-rises and the elevation of excessively large buildings not only overwhelms the surrounding landscape but also occludes beautiful natural scenery. As problems of urban aesthetics due to these uniform apartment buildings were raised in the mid-1980s, changes were introduced to diversify residential building types [21] (pp. 20–30).

Sanggye New Town, built by Korea National Housing Corporation in 1985 to 1988, introduced Y-shaped residential buildings that opened the landscape to Jungnangcheon Stream. This is a case demonstrating that the residential building type should be decided by considering not only the buildings' direction but also their view.



In the late 1990s, spurred by the deregulation of new house sale prices, the government of Seoul set relevant standards and decided to actively intervene from the establishment stage of apartment district master plans. The government announced a policy forbidding construction unless in the case of a high-quality apartment building with unique characteristics [22]. Thus, the high-quality apartment complexes that Seoul sought to promote were based on the idea of appropriately mixing and harmonizing tower-type and Y-shaped layouts, as shown in Table 4.

Table 4. Changes in the exterior types of residential buildings.

1980s: Plate-Type	1990s: Y-Shaped	2000s: Tower-Type
		

Various types of building exterior designs have emerged since the 2000s, as shown in Table 5. In August 2007, the Seoul government conducted a pilot implementation of building review and improvement measures to eliminate matchbox-like apartments, based on which the “Seoul Apartment Housing Design Review Guideline” was established [23]. The guideline comprises five main items: diversification of residential building type, elevation and landscape plan, eco-friendly and energy-saving plan, layout and external space plan, and auxiliary facilities plan (e.g., parking lots). The items were set in with consideration for the environment and the space used, rather than simply aesthetic appearance. Particularly, there are many mandatory items regarding the exterior, such as the increase in wall ratio (40%), restrictions on the apartment logo and balcony length (70%), and a review of landscape lighting. These changes in the exterior are not limited to Seoul but also impact other local governments. According to the “Building Plan Guideline for Buildings in District Unit Planning Zones” announced in Suwon City on 19 August, the external appearance of buildings is determined differently in each district unit zone, and regulations and mandates to improve the exterior are being strengthened [24].

Table 5. Diversification of the exterior of apartment buildings since 2000.

CW Apartment Exterior Plan	KM Apartment Exterior Plan
	
<ul style="list-style-type: none"> - Landmark tower-type roof - Composition of various elevations through solids and voids - Point elements to address the staleness of buildings - Stable clay brick finish suited for lower floors 	<ul style="list-style-type: none"> - Diversification of elevations through overlapping masses and varying balconies - Formation of visual points by differentiating the materials of each element

4.2. Economic Factors

Apartment development has rapidly spread through super high-rise apartments, and the first super high-rise apartments of 24 to 30 floors were sold in Seoul. This rapid spread of super high-rise apartment buildings has also further exacerbated densification. The system for apartment sale prices was revised so that it would be advantageous for housing suppliers, from a business perspective, to construct super high-rise apartment buildings. In November 1989, after the government implemented an apartment construction cost linkage system, approximately 12% of excess construction costs for super high-rise apartment buildings were recognized compared to 15-floor apartment buildings; given the upper limit on new housing sale prices, the raised construction cost standard for super high-rise apartments was advantageous for housing builders [25]. This later enticed housing builders to construct super high-rise apartments.

Hence, this institutional support, coupled with housing providers' pursuit of profit, led to the rapid development of super high-rise apartment buildings. Since the average development density for apartment sites was often set to at most 200% of the floor area ratio according to housing site development plans, it was possible to prevent the over-densification of residential complexes. Nevertheless, in major redeveloped and re-constructed apartment complexes in Seoul, super high-rise apartment buildings were constructed in large numbers at high densities of over 300% [26]. The construction of high-rise apartment buildings is more often carried out by private rather than public development. For the Korea National Housing Corporation, it was not until the late 1980s that high-rise apartment construction surpassed low-rise apartment construction, whereas private corporations had already been constructing high-rise apartment buildings much earlier. This is evidenced by the fact that in Gangnam-gu, more super high-rise apartment complexes were already being built in 1978. This situation arose because profit-pursuing private companies faced poor conditions for purchasing affordable housing sites; therefore, they participated early in the construction of high-rise apartment buildings. In addition, the exterior design was differentiated by the branding of apartments after 2000, while the exterior finishing material was decorated with marble, as shown in Figure 4 on the low floor, and various designs were introduced at the entrances to make the apartments more luxurious [27]. In fact, rooftop design and main building design also affected apartment prices [28]. However, even with an additional cost for exterior design, additional profits

are generated, which is economically advantageous [29]. In other words, factors related to apartment building planning affect economic value [30].



Figure 4. Diversification of lower floors and entrances of apartments after 2000.

4.3. Technological Factors



The development of construction technology also plays a key role in the changes in the height of apartment buildings. Even in the 1970s when apartments were first supplied in South Korea, the buildings used a Rahman structure with columns and beams [31] (pp. 21–30). The Rahman structure is the most common method for high-rise buildings with 10 or more floors. However, in apartment buildings where even the smallest space is valuable, the columns that occupy space in the lower floors make the unit plans highly unfavorable, and the additional floor height caused by the beams has raised construction costs all over the country. Moreover, limited natural water pressure to supply water restricted the height of buildings. The increase in high-rise apartment buildings from the initial 12 floors to 13 and 14 floors is the result of strenuous efforts to increase the number of floors as much as possible under these structural conditions. However, the detailed drawings and construction of rebars on the walls of apartments built in the 1970s also reveal problems [32].

The advent of wall-type structures in the late 1980s brought about the development of technology, freeing builders from these structural limitations. The wall-type structure replaced columns and beams with load-bearing walls and flat slabs and was a revolutionary technological advancement at the time. Consequently, 14-floor column-beam apartment buildings began to transition to 15-floor wall-type apartment buildings while maintaining the same height [33] (pp. 15–20). However, the wall-type structure also has limitations. As these buildings evolved into super high-rises with 16 or more floors, the limit that the load-bearing walls could withstand became an issue. The solution to this was the production of high-strength rebar and high-strength cement. Current technology has made it possible to reach 30 floors with a load-bearing wall structure.

High-rise apartment buildings were made possible with the introduction of a steel frame, whose performance was insufficient with the existing reinforced concrete [34]. From a structural point of view, the steel-framed apartment had excellent stability [35]. With the

development of such a steel frame, the number of floors of the apartment was developed into a super high-rise. When such a high-rise apartment became possible, a splendid decorative element was introduced into the monotonous exterior of the apartment building since the 2000s. In particular, various elements are being used in design that owe themselves to the symbolic meaning and technological development of high-rise apartments on roofs and rooftops, as shown in Table 6.

Table 6. Diversification of roofs and rooftops since 2000.

D-Apartment	L-Apartment
	

5. Conclusions

The exterior designs of apartment buildings have varied widely across different time periods and were greatly impacted by changes in laws and systems, as well as economic and technological changes. The influence of these change factors varies in degree according to the time period.

Firstly, apartments were mostly located around the Hangang River with a good landscape from period 1 and 2. The 3rd period started the introduction of high-rise apartments, which eventually became a new trend in the early period of technology. It is a widely distributed inland area of Gangnam, where the floor area can be optimized. Since then, the Gangseo area became a popular place for building apartments during the new experimental period that occurred in the 4th period. The area had shown a new trend, including the emergence of tower-type high-rise apartments, which are mainly large-scale apartments with a modern city concept. In addition, during the 5th period, the apartments had a tendency to become luxurious again and are distributed in the Gangnam area where there are many high-end offices in Seoul—in terms of skyscrapers and design differentiation in exterior.

As a result of analyzing the apartments that are the subject of this study, in Period 1(1976–1985), 85% of the apartments had fewer than 15 stories and most of them were low-rise apartments. In Period 2 (1986–1989), 100% of flat-type apartments were the same as apartment buildings, and 60% of apartments had fewer than 15 floors. In Period 3 (1990–1997), 33% of apartments with fewer than 15 floors and 17% of apartments with at least 20 floors started to be built. In Periods 4 and 5 (1998–2010), the number of apartment floors increased sharply to 80% or more for buildings with at least 20 floors, and the differentiation of residential buildings due to high rise appeared. In Period 5 (2003–2010), the differentiation of apartment buildings reached its peak at more than 70%.

In Period 1 (1976–1985), when the mass supply of apartments first began, mass production's economic feasibility was the main determinant of building type, whereas in Period 2 (1986–1989), welfare facilities for the disabled and the development of construction technology and methods exerted a greater influence, while that of economic factors declined. In Periods 4 and 5 (1998–2010), economic factors exerted a substantial influence, after which differentiation in building type due to the emergence of brands began to have an influence. Most importantly, in Period 5 (2003–2010), decorative changes transformed the exterior designs of buildings; particularly, affordable building materials made it possible to diversify exterior wall materials and even influenced changes in building type. Of

course, each factor's level of influence somewhat varies depending on the exterior design component. Nevertheless, they can confidently be cited as major factors inciting changes in each component.

This study is significant in that it attempted to understand and analyze the exterior designs of apartment buildings under increasingly complex social and economic conditions using an approach from various factors. The findings of this study can present directions for designers and policymakers for more desirable exterior designs of apartment buildings, as well as substantially contribute to establishing future policies.

A limitation of this study is that because the number of complexes selected for the case study was limited, their locations were limited to Seoul, and they mainly consisted of large apartment complexes. However, the cause analysis extended somewhat beyond the data analysis results. Future research should expand the scope of investigation to the national level and perform a more in-depth and objective analysis based on case studies and surveys.

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