Council on Tall Buildings and Urban Habitat Korea

International Journal of
High-Rise Buildings
www.ctbuh-korea.org/ijhrb/index.php

International Journal of High-Rise Buildings
December 2023, Vol 12, No 4, 351-362
https://doi.org/10.21022/IJHRB.2023.12.4.351

Reconfiguration of Korea Highrise Residential Spaces in Response to Pandemic

Myung Sik Lee† and Seung Jo Lee

Division of Architectural Engineering, Dongguk University, Seoul, South Korea

Abstract In modern society, rapid environmental changes are occurring due to the complex interaction of various factors. Starting in 2020, the social environment is changing rapidly due to the impact of the pandemic, and the social and economic living environment is changing significantly not only in Korea but also internationally. In this trend, behavioral and spatial changes are occurring in response to changes in the architectural living environment. To analyze changes in behavior and space from an architectural perspective in response to changes in the social environment, first organize the concept and aspects of the pandemic that caused the change, examine the theory of the pandemic, and examine architectural responses to changes in the social environment. There is a need to analyze. Therefore, in order to architecturally review changes in the social environment due to the pandemic, the purpose of this study is to analyze the living behavior and space of major highrise residential complexes in the living environment and present new spatial alternatives in response.

Keywords Reconfiguration, Social Environment, Pandemic, Highrise Residential Spaces, Social Change

†Corresponding author:
Myung Sik Lee
E-mail: mslee@dongguk.ed

1. Introduction

1.1. Research Purpose and Method

In contemporary society, rapid environmental changes are occurring due to the complex interaction of various factors. Since 2021, the societal and economic living environment, not only in South Korea but internationally, has undergone significant changes as a result of the impact of the COVID-19 pandemic. Within this context, architectural and behavioral adaptations have emerged in response to these environmental changes. To analyze architectural responses to societal environmental changes, it is essential to first comprehensively examine the concept and patterns of the pandemic (COVID-19) that triggered these changes. This entails a review of the theoretical aspects of pandemics and an analysis of architectural responses in accordance with societal environmental changes.

Therefore, this study aims to review the societal environmental changes brought about by the COVID-19 pandemic from an architectural perspective. It focuses on the analysis of communal housing, a vital aspect of the living environment, and aims to propose innovative spatial alternatives to adapt to these changes. To achieve this, the study will begin by analyzing the pandemic response actions within communal housing, examining the transformation of spaces resulting from these changes. Subsequently, it will explore the alterations in communal living environments and human behavior patterns in response to the changes. Additionally, by analyzing pre- and post-pandemic communal housing cases through previous research, the study will provide a basis for analytical criteria. Furthermore, specific recommendations for the reconfiguration of communal housing spaces in response to the COVID-19 pandemic will be proposed.

2. Theoretical Background

2.1. Theoretical Considerations Regarding Pandemics[1)]

The World Health Organization (WHO) initially classified diseases on a scale of 6 levels, with the highest level, Level 6, being designated as a pandemic during the influenza pandemic of 2009. However, since 2010, the WHO has ceased to use the 6-level classification system. Instead, a new approach was adopted, where when a disease spreads beyond national borders significantly, it

[1)]The World Health Organization (WHO) used to categorize disease levels into a total of 6 stages until the influenza pandemic in 2009, with the final stage, Stage 6, being designated as a pandemic. However, since 2010, the 6-stage classification is no longer in use. Instead, when a disease becomes widespread across borders, the WHO now first declares an International Public Health Emergency of International Concern (PHEIC), and if it is not brought under control, it is declared as a pandemic infectious disease.

first triggers a Public Health Emergency of International Concern (PHEIC) as a crisis alert. If this situation remains uncontrolled, it is declared as a pandemic infectious disease. The dictionary definition of “pandemic” refers to the widespread occurrence of a specific infectious disease across the entire world, unlike an endemic disease, which is limited to a specific geographic area. The word “pandemic” originates from Greek, combining "Pan," meaning “All”, and “Demos”, meaning “People”. This term has been used since the resurgence of the Black Death in 17th-century England when the Latin term “pandēmus” was adapted into “Pandemic” to signify a widespread outbreak of a disease. The World Health Organization (WHO) defines a disease as a pandemic or pandemic infectious disease when a specific infection is confirmed in various regions worldwide, transcending national boundaries and requiring urgent international cooperation.

3. Comparative Analysis of Co-habitation Cases Pre and Post the COVID-19 Pandemic

3.1 Selection of Case Study Subjects and Establishment of Analysis Criteria

The analysis in this study examines the changes in communal living spaces before and after the COVID-19 pandemic, which has brought significant societal changes and human responses. The selection criteria for the subjects of the analysis focused on housing projects in South Korea that can be considered as benchmarks for the country's housing policy. These projects were initiated by the Korea Land and Housing Corporation (LH) during the 2000s before the pandemic and from February 2020 to the present during the COVID-19 pandemic. The analysis aimed to investigate the spatial changes and characteristics of communal living spaces in LH's residential projects, differentiating between rental housing and publicly sold housing and further dividing them into the Seoul metropolitan area and non-metropolitan areas based on similar scales.

In this research, the analysis criteria were primarily centered around the planning and unit layouts, following the direction of reconfiguring communal living spaces due to the impact of the COVID-19 pandemic, as mentioned earlier. The analysis was conducted with a focus on site planning and unit design in response to the pandemic's influence on the redevelopment of communal living spaces.

Table 1. The list of analysis for cases

Division		Pre-pandemic (~2020year)	Post-pandemic (2021~Present)
Rental Housing	Capital area	A4-1BL, Hwasong Dongtan2 (1,640 houses, 2016/2021)	A-1BL, Goyang-si, (1,141 houses, 2022/-)
	Non area	Gyeongbuk Provincial Government New Town (869 houses, 2017/2019)	Gwangju, (460 houses, 2021/-)
Housing for sale	Capital area	A-21BL, Yangju-si, Heocheon (955 houses, 2019/ 2023)	A-1BL, Namyangju (800 houese, 2021/-)
	Non area	Complex 9, Blue City, Sejong-si (1,109 houses, 2012/ 2020)	A6BL, Busan (1,358 houses, 2021/-)

3.2. Case Studies of Rental Housing Pre and Post the COVID-19 Pandemic

To investigate the reconfiguration of communal living spaces based on behavioral responses before and after the COVID-19 pandemic, we selected the case analysis of rental housing as our target site. This choice was made in anticipation of its potential significance as a precedent in the post-COVID era.

Figure 1 shows that in the case of the existing Hwaseong Dongtan 2 A4-1BL, the design focal point was on creating a multifunctional living space with an emphasis on communication, serving as a local public asset where the city and its residents coexist and share diverse life stories joyfully. Additionally, it was planned to facilitate communication between the city and its people, with a

Table 2. Pre- and Post-COVID-19 cases of rental housing(1)

Division	Pre-pandemic (~2020year)	Post-pandemic (2020~present)
Case	A4-1BL, Hwasong Dongtan2	A-1BL, Goyang-si
Plan / Completion	2016/2021	2022/-
Site Area	45,196 m^2	41,744 m^2
Building Area	14,821 m^2	11,153 m^2
Building coverage ratio	32.79%	26.72%
Floor area ratio	180.5%	178.06%
Number of households	1,640 houses	1,141 houses

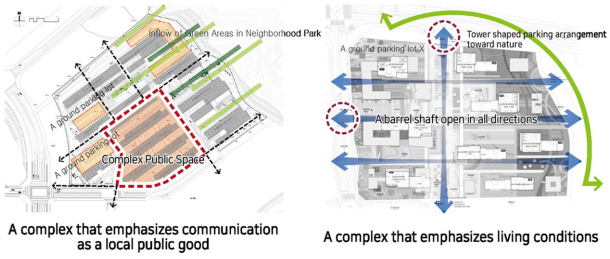


Figure 1. Complex Plan of Pre-pandemic(left), Post-pandemic (right).

focus on a circular public street opening towards the neighborhood park. However, a ground-level parking facility was situated to consider the economic viability of rental housing.

In contrast, Goyang Changneung A-1BL secures a broad longitudinal axis cutting through the center of the complex and a natural wind path following the east-west axis along the river. It is designed with a human-scale approach that harmonizes with the village by placing tower-type main buildings facing nature. Furthermore, it doesn't include a ground-level parking facility, underlining the importance of resident safety and the need for abundant outdoor spaces. These differences reflect the evolving workplace dynamics post the COVID-19 pandemic, leading to increased residential occupancy periods and the recognition of safer and environmentally friendly complex designs.

Significant differences in the main building plans are also evident in Figure 2. In the case of the existing Hwaseong Dongtan 2 A4-1BL, the design emphasizes creating a differentiated residential environment by combining architectural spaces such as a large open space on the ground floor, a low-width main building with a lifestyle-oriented horizontal (alleyway) character placed between the existing squares. The architectural spaces include features like direct ground-floor access, duplex units, specialized units with outdoor spaces, alleyways, ramps, bridges, rooftop gardens, and main building corridors. These elements, combined with a modular structural system, create pixel-level residential spaces, including duplex units, offering a diverse range of unit types.

In contrast, Goyang Changneung A-1BL places increased importance on external spaces that allow safe outdoor activities post the pandemic. This is reflected in various forms of balconies, private terrace houses that serve as buffer spaces both inside and outside the units, south-facing green areas, two-story open living rooms with a panoramic view, and front yards in penthouse units. These differences in main building plans are also manifested in the facade design, with the keyword “sharing” emerging as a key design principle in response to the social and environmental changes. This keyword extends to the reconfiguration of communal living spaces due to the pandemic's impact, involving the creation of low-rise residential SOC spaces and maximizing common areas

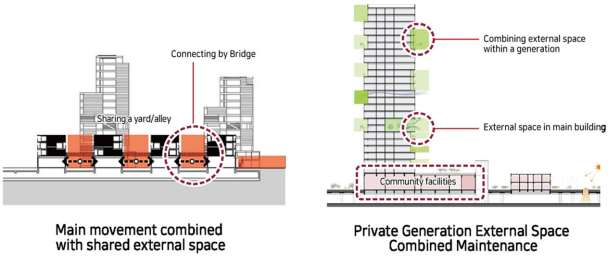


Figure 2. Master plan of Pre-pandemic(left), Post-pandemic (right).

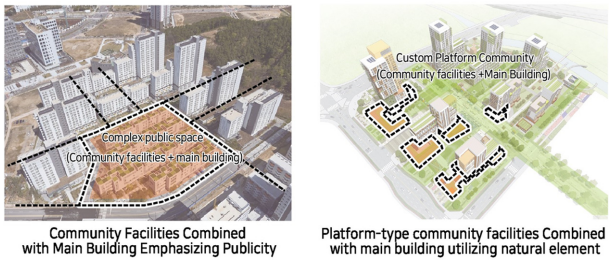


Figure 3. Community Plan of Pre-pandemic(left), Post-pandemic(right).

on the ground floor.

The community plans have evolved from the previous emphasis on public-oriented community facilities to incorporate natural elements. In Figure 3, Hwaseong Dongtan 2 A4-1BL actively promotes interaction between internal and external spaces, creating a new living culture space with urban and public qualities. Starting from the site, it extends from the residential buildings to the neighborhood park via a multi-level street with plans to utilize rooftop spaces for expanding living areas and provide community facilities for shared activities along the alleyways.

On the other hand, Goyang Changneung A-1BL's community plan aligns with the character of parts adjacent to the site, such as village communication routes, urban streets, green spaces, and rivers. It includes various sizes of courtyards and programs along the street, enabling continuous experiences and bringing natural elements into the interior. Eight nature-friendly architectural spaces have been designed, with four thematic spaces focused around village communication routes. These plans include customized platforms to facilitate a “home around” lifestyle, combining with the main buildings to create a living environment that fosters interaction.

As shown in Figure 4, the pre-pandemic individual units were originally designed with a plan layout that started from a 3.8 m × 3.8 m pixel basic module unit in a grid structure. The design focused on creating a strong relationship with various external communal spaces (shared courtyards, private yards, verandas) to expand the living areas of the residents. This plan underwent changes due to the impact of the COVID-19 pandemic, adopting

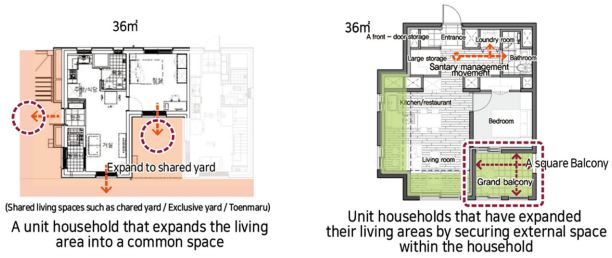


Figure 4. Unit household plan of pre-pandemic(left), Post-pandemic(right).

Table 3. Pre- and Post-COVID-19 cases of rental housing(2)

Division	Pre-pandemic (~2020year)	Post-pandemic (2020~present)
Case	Gyeongbuk Provincial Government New Town	Gwangju
Plan / Completion	2017/2019	2021/-
Site Area	44,405.4 m^2	15,495.6 m^2
Building Area	14,821 m^2	7,383.8 m^2
Building coverage ratio	32.79%	47.65%
Floor area ratio	180.5%	299.42%
Number of households	869 houses	460 houses

square-shaped balconies and terrace designs to allow for adaptable utilization of spaces according to the occupants' needs, such as hobby rooms, home offices, and small garden spaces. Additionally, a layered home pattern, tailored to various behavioral response patterns, was applied to bedroom 2-living room, and flexible wall structures were used in bedroom 1-bedroom 3, allowing versatile room arrangements based on the situation.

These cases are selected as examples in non-metropolitan areas with a scale of less than 1,000 units. In the comparison of rental housing case complexes in non-metropolitan regions, there may be differences in the analysis of the environmental aspects due to variations in floor area ratios. However, despite the limitations of the short time frame for the target cases to be compared before and after the pandemic, it is anticipated that there won't be significant challenges in analyzing building layout arrangements.

In the case of the existing K Company's development project in Gyeongbuk Provincial Government's New City, the design emphasizes communication as a regional public asset. The complex secures a prominent longitudinal axis for entry and, around this axis, plans a large central square. The square is surrounded by the placement of the main buildings. Furthermore, the design maximizes the view of

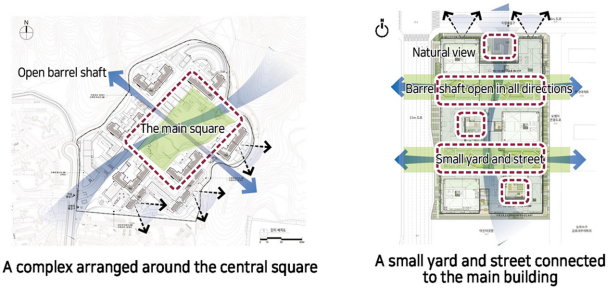


Figure 5. Complex Plan of pre-pandemic(left), Post-pandemic (right).

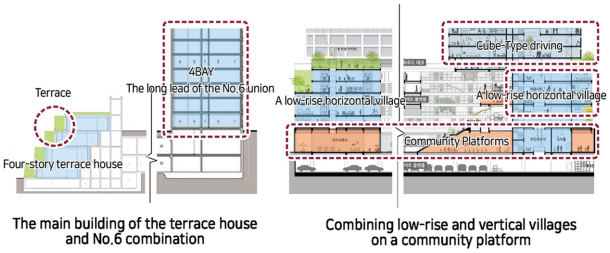


Figure 6. Master Plan of pre-pandemic(left), Post-pandemic (right).

the surrounding mountains and enhances natural ventilation and cross-ventilation for individual units through open wind paths. The layout of the main buildings maintains a considerable distance between them, prioritizing privacy between units.

On the other hand, in the case of Gwangju-type lifelong housing, the design focuses on creating an open community where residents interact with their neighbors. The layout connects the main buildings with small courtyards and streets, promoting an open environment rather than a closed-off complex. The design ensures a north-south orientation, with the main buildings facing south to align with the sun and bringing the northern natural views into the complex. This approach caters to the increasing demand for comfortable spaces in response to telecommuting and remote activities in a pleasant and compliant manner.

In the case of K Company's development project in Gyeongbuk Provincial Government's New City, a significant difference in main building plans can be observed, as depicted in Figure 6. The design makes effective use of the terrain, featuring a main building layout comprised of three-story terrace houses and units with projecting balconies. Similar to typical communal housing prior to the COVID-19 pandemic, the ground floor is elevated approximately 800mm above the ground, forming the first floor. In this design, part of it is planned as a piloti to create an outdoor community lounge. The main building design incorporates three-story terrace houses and units with projecting balconies, making use of the natural terrain.

Conversely, in the case of Gwangju-type lifelong housing, there is a spatial response in line with the increased importance of outdoor spaces for safe activities

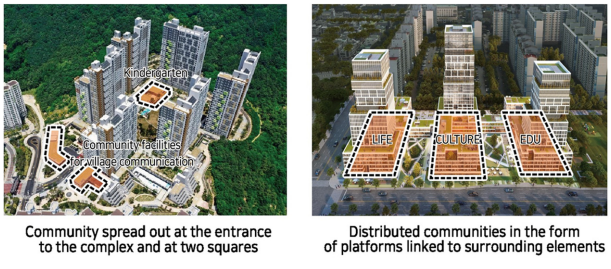


Figure 7. Community Plan of Pre-pandemic(left),Post-pandemic (right).

post the COVID-19 pandemic. A barrier-free main building entry lobby with no level changes is planned, establishing a clean zone (sanitization area) to ensure safe entry and exit protection from fine dust and viruses. The design includes a dedicated resident lounge to provide a spacious lobby experience, unlike cramped ones. Furthermore, the project forms a horizontal village through a low-rise residential platform consisting of five stories atop a community platform open to the local community, integrating the cubical shape of the vertical main building structure.

K Company's community plan in Gyeongbuk Provincial Government's New City initiates at the entrance with pedestrian paths leading to the placement of community facilities, fostering diverse community activities throughout the village. This design aims to create a communicative village with an open and communal character, prominently featuring an open square.

In contrast, the community plan for Gwangju-type lifelong housing focuses on the intersection of three axes connecting urban elements. It incorporates outdoor spaces, lifestyle SOC programs, and community facilities, fostering communication with the local community. The plan also forms a private community space through low-rise residential horizontal village development, creating a safe and everyday communication-oriented village. The community plan for Gwangju-type lifelong housing is designed with a pattern of response related to community linkage with distributed platform communities connected to surrounding urban elements.

As depicted in Figure 8, prior to the COVID-19 pandemic, the individual units featured a universal 84? layout characterized by a common 4-bay structure. The layout included a large dressing room connected to the master bedroom and an alpha room[2)] located between the dining area and pantry. The emergence of the alpha room began before the pandemic, but the pandemic's influence led to changes in the configuration. In response, the existing 4-bay structure has been modified by connecting a laundry room and bathroom to optimize hygiene management flow. The use of adaptable wall structures between bedroom 1-bedroom 2 and living room-bedroom 3 allows for flexible space configuration that aligns with various lifestyles.

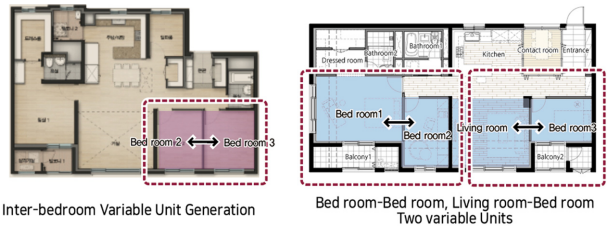


Figure 8. Unit household plan of pre-pandemic(left), Post-pandemic(right).

[2)]It refers to a kind of service area as an interior space that remains in the design of the apartment floor plan. It is usually placed between rooms and rooms, its use has recently been expanded to study rooms, dressing rooms, and bedrooms.

3.3. Case Studies of Publicly Sold Housing Before and After the COVID-19 Pandemic

To understand the reconfiguration of communal living spaces based on behavioral responses before and after the COVID-19 pandemic, case analysis of publicly sold housing is an essential element. Just like rental housing, the analysis of publicly sold housing's patterns can serve as a crucial precedent for the post-COVID era. This is why it has been selected as a case study subject

The following cases are selected as examples due to their similar scale and the number of units, divided into pre and post-COVID-19 pandemic periods. By conducting a case analysis of publicly sold housing, we can compare and understand how publicly sold housing has adapted in response to the pandemic and how it reconfigures communal living spaces based on behavioral responses before and after the pandemic.

In the case of Yangju Hwacheon A-21BL, the design features a harmonious complex with gable and top-shaped main buildings, prioritizing south-facing layouts with numerous gable-shaped main buildings to secure visual transparency from the west residential street. However, it doesn't provide panoramic views for all units.

Table 4. Pre- and Post-COVID-19 cases of housing for sale(1)

Division	Pre-pandemic (~2020year)	Post-pandemic (2020~present)
Case	A-21BL, Yangju-si, Heocheon	A-1BL, Namyangju
Plan / Completion	2019/2023	2021/-
Site Area	60,272 m^2	38,282 m^2
Building Area	10.176 m^2	5,842 m^2
Building coverage ratio	16.88%	15.26%
Floor area ratio	178.91%	192.93%
Number of households	955 houses	800 houses

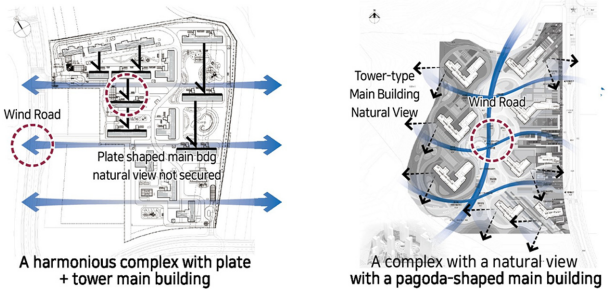


Figure 9. Complex Plan of Pre-pandemic(left), Post-pandemic (right).

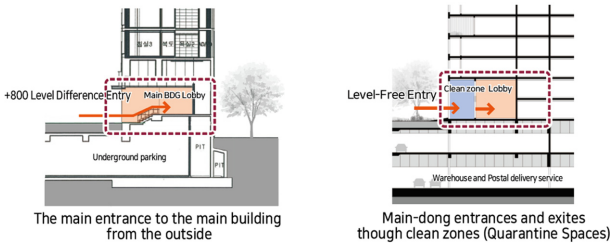


Figure 10. Master plan of Pre-pandemic(left), Post-pandemic (right).

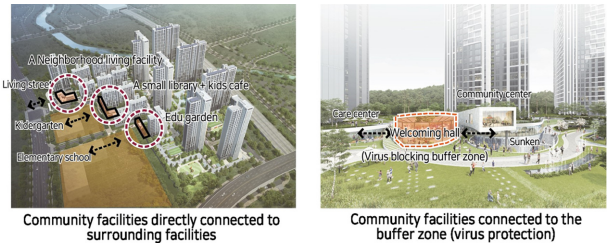


Figure 11. Community Plan of Pre-pandemic(left), Post-pandemic(right).

The design emphasizes a human-scale complex, forming a gradual skyline based on the school's skyline as a reference, resembling the apartment layout that was prevalent before the pandemic (COVID-19).

Conversely, in the case of Namyangju Wangsuk 2 A-1BL, the complex focuses on securing natural views. The site is surrounded by a 7 m sloped area to the west, mountains to the west, and an Edu-Park to the east. Inside the complex, a park is created, and the surrounding natural environment provides open visual transparency. Utilizing the sloped terrain, various scales of parks are planned, showcasing an eco-friendly complex design in close proximity to nature. The complex gradually connects to the natural environment, adapting to the surroundings, from the low city scale of Edu-Town to the high natural scale of the western mountains. These changes are attributed to the increased duration of residential stays and heightened interest in health post the COVID-19 pandemic.

The pre-pendemic building layout for the Namyangju WANGSUK 2 A-1BL complex features the ground floor set 800 mm higher than the foundation, creating an outdoor community space at the entrance portion with some piloti planning. The primary design principle is to form a clean zone (sanitary area) in the lobby, eliminating level differences and providing barrier-free access to protect against fine dust and viruses. This design reflects a significant influence from the COVID-19 pandemic.

Furthermore, by utilizing level differences, the community facilities are combined with residential units, and the outdoor living area extending to the rooftop garden forms a private external living space, transforming the community residential building. This reshaping was significantly influenced by the pandemic (COVID-19), expanding external spaces within the building's wings, community facilities, and unit external space integration.

The community planning aspect also demonstrates notable differences. In Figure 11, the Yangju Hoecheon A-21BL complex utilizes level differences to introduce symbolic community facilities at the primary entrance on the west side, including neighborhood amenities and a welcome plaza. It incorporates kindergarten and elementary school facilities like a kids' café and a small library, catering to the educational town's environment, reflecting a proactive approach to community facility planning. This approach differs significantly from the pre-pandemic era, which mainly focused on standardized and symbolic community facility planning.

On the other hand, the Namyangju Wangsuk 2 A-1BL complex makes use of architectural design techniques like step, folly, ramp, direct, cascade to plan nature-friendly community facilities, capitalizing on the sloped terrain. The design includes a reception hall to manage hygiene and disinfection before entering community facilities, forming buffer zones. Additionally, the primary entrance of the complex is designed to have pickup zones linked to neighborhood amenities, minimizing face-to-face contact through a drive-through system. These changes reflect a post-pandemic response pattern, enhancing adaptability and reducing direct contact.

Moreover, new facilities like a shared caregiving center, a rolling café, a family center, are planned to offer flexible spatial configurations with no clear boundaries between indoor and outdoor areas, allowing for adaptable use based on different situations.

Even before the COVID-19 pandemic, social and environmental changes had started to introduce the concept of an "alpha room" within unit plans. In the 74 m² and 84 m² unit designs, an alpha room connected to the master bedroom is incorporated, allowing versatile use according to different lifestyles. This design includes large north-facing windows that facilitate cross-ventilation between the master bedroom and the alpha room. These changes in unit planning evolved significantly during the pandemic, where the alpha room is now connected to the master bedroom through a dressing room, enabling direct access to the alpha room. This structural adaptation maximizes the utility of the alpha room, and the proximity of the

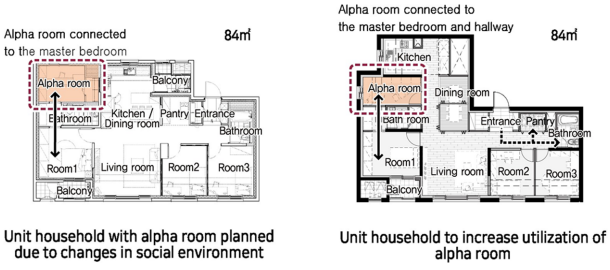


Figure 12. Unit household plan of pre-pandemic(left), Post-pandemic(right).

Table 5. Pre- and Post-COVID-19 cases of housing for sale(2)

Division	Pre-pandemic (~2020)	Post-pandemic (2020~present)
Case	Complex 9, Blue City, Sejong-si	A6BL, Busan
Plan / Completion	2012/2020	2021/-
Site Area	63,674 m^2	57,027 m^2
Building Area	8,001.50 m^2	8,101.80 m^2
Building coverage ratio	12.57%	14.21%
Floor area ratio	159.89%	189.56%
Number of households	1,109 houses	1,358 houses

laundry room to the bathroom optimizes the hygiene management flow within the unit.

The following is the second case in the analysis of public pre-sale housing before and after the COVID-19 pandemic, selected for its large scale, with over 1,000 units.

In Figure 13, Sejong Blue City Gaon Village 9th Complex features a site plan divided into rectangular-shaped[3] (flat) and tower-shaped[4] residential buildings. The tower-shaped buildings face the eastern park and river views, while the rectangular-shaped buildings on the southern side are oriented toward the urban street. This layout considers both scenic views and residential privacy. However, the multiple rectangular-shaped buildings result in a configuration that does not provide unobstructed panoramic views. This plan prioritizes optimal spacing between units and the overall environment, offering an excellent daytime lighting environment. Yet, it may not be considered a city-nature-friendly design.

On the other hand, Busan Myeongji 2 A6BL combines rectangular and tower-shaped structures, featuring an axial layout that considers the visibility of adjacent

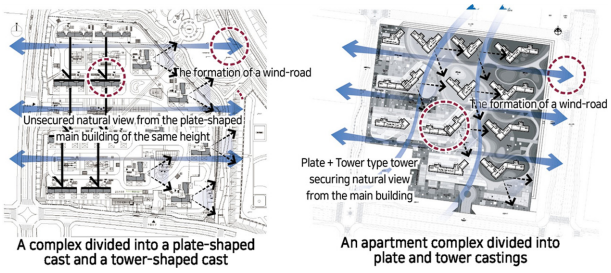


Figure 13. Complex Plan of Pre-pandemic(left), Post-pandemic(right).

[3]Among the structures of houses, it refers to the structure of apartments, in which rooms and living rooms are arranged sideways. It is called a plate-shaped apartment because it is the same thickness and has a longer width on its side

[4]It refers to a structure in which the shape of an apartment building is arranged in a Y-shape or T-shape, not a -shape

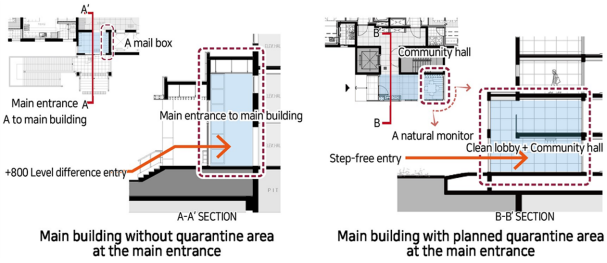


Figure 14. Master plan of Pre-pandemic(left), Post-pandemic (right).

residential areas and pedestrians. The buildings have a south-southeast orientation at a 45-degree angle to maximize residential quality. The plan also includes level planning with open areas, such as courtyards and community spaces, taking local residents into account. This design can be viewed as one of the responses to the COVID-19 pandemic, focusing on community engagement with the local area.

This analysis highlights the differences between the two complex layouts regarding the building structures and orientations, as well as their implications in response to the pandemic.

In the case of Sejong Blue City Gaon Village 9th Complex, the main building plan does not significantly deviate from the pre-pandemic (COVID-19) era's communal housing patterns. On the other hand, for Busan Myeongji 2 A6BL, it shows an evolving response to changes in medical and healthcare environments by incorporating elements of prevention spaces. Notably, the barrier-free main entrance lobby eliminates level differences and includes a clean zone (sanitary area) with features like air showers and washbasins to ensure safe entry, minimizing exposure to fine dust and viruses. Moreover, the buildings feature balconies on two sides, extending the interior unit's viewing areas and an overall design that includes rooftop gardens to provide private and nature-friendly outdoor spaces within the complex, catering to the well-being of the residents. These features are distinctive characteristics of the design, reflecting a response to the changing medical and health environment brought about by the pandemic.

In summary, while the Sejong Blue City Gaon Village 9th Complex maintains a more conventional communal housing layout, Busan Myeongji 2 A6BL incorporates innovative elements to address healthcare and prevention in its design, demonstrating an adaptation to the evolving circumstances shaped by the pandemic.

The community plan for Busan Myeongji 2 A6BL, as depicted in Figure 15, reflects a response to the changing cultural activities and workplace transformations in the aftermath of the COVID-19 pandemic. By utilizing level changes in the vast border area between residential and commercial zones, the plan aims to create both public and private spaces. Community facilities are strategically



Figure 15. Community Plan of Pre-pandemic(left), Post-pandemic(right).

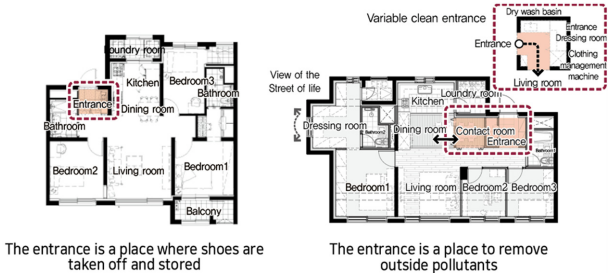


Figure 16. Unit household plan of pre-pandemic(left), Post-pandemic(right).

distributed throughout different areas, with an emphasis on outdoor spaces, allowing for a flexible spatial configuration without clear boundaries between interior and exterior. This flexible spatial arrangement is designed to accommodate various uses, allowing for the subdivision or utilization of the space as needed, depending on the circumstances.

Prior to the pandemic (COVID-19), the unit floor plan primarily focused on storage with an emphasis on the entrance area, which was subdivided for large storage and shoe storage. However, in the post-pandemic (COVID-19) era, there has been a shift in perception regarding the entry points, including the entrance to the unit's interior space. It is no longer seen as merely a space for removing shoes and entering indoors but is now considered a hygiene space for ultimately eliminating contaminants. The design places an emphasis on creating a versatile space that can adapt to various needs.

This space planning approach can be viewed as having elements of both a pleasant space and a prevention space, with a focus on hygienic and pleasant environments. The floor plan incorporates elements of both “care-type” and “alpha-type” designs to achieve this goal.

3.4. Comparative Analysis of Collective Housing Cases Before and After the Pandemic (COVID-19)

In the site planning, before the pandemic, rental housing primarily emphasized layouts that encouraged communication with the city and its inhabitants. However, post-pandemic planning exhibits a shift towards passive planning for eco-friendly housing, securing panoramic views, emphasizing livability, and recognizing the importance of safety and outdoor spaces. This change in layout planning can be attributed to an increase in the duration of residential stays and heightened interest in health.

In the core planning, there is a noticeable change in the planning approach to the main entry points of commonly used, reflective areas after the pandemic. Pre-pandemic, these entry points combined shared spaces with a communicative role. In contrast, post-pandemic planning prioritizes their role in disease prevention as a shared space, combining community spaces for units that cannot be handled within individual units. This configuration aims to create living areas that reduce external contact.

In community planning, there is a notable shift in the planning approach for community facilities used by local residents. These facilities, which are shared with the community, are now prioritized as spaces with a higher risk of virus transmission. The planning direction has shifted towards spaces that are not only conducive to communication but also facilitate easy disinfection. Before the pandemic, the focus was primarily on communication when designing these spaces. However, in the post-pandemic era, the planning emphasizes flexible spatial configurations without clear boundaries between interior and exterior, allowing for adaptability and the imposition of restrictions as needed. Entry points have transformed into buffer zones, serving as areas where viruses can be blocked and managed.

In unit floor planning, there were already unit layouts with “alpha rooms” demanded by residents' lifestyles before the pandemic, driven by social changes. However, these layouts have become even more essential after experiencing the pandemic. Furthermore, there has been a change in perception regarding the entry points, including the entrance to the unit's interior space. This area is no longer viewed simply as a space for removing shoes and entering indoors but is now considered a hygiene space for ultimately eliminating contaminants. The planning focuses on creating a versatile space that can adapt to various needs.

4. Reconfiguration of Collective Housing Spaces in the Pandemic (COVID-19) Era

4.1 Reconfiguration of Site Planning

Summarizing the previous case analysis, the reconfiguration of collective housing space for pandemic response results in Table 6 below. To adapt to the pandemic, the collective housing plans reviewed so far are categorized into three types: Flexibility, Care, and Alpha, and presented in Table 6.

4.2 Reconfiguration of Core Planning Spaces

To reconfigure pandemic-responsive spaces in the core planning, the collective housing plans reviewed thus far can be categorized into three types: Flexibility, Care, and Alpha, as presented in Table 7.

Table 6. Complex planning: space reorganization according to architectural solution

Complex plan: spatial reconstruction contents	Architectural solution	Space reconstruction
· Considering comfort as important, arrnaging buildings with a view of outside(nature), creating various parks, and securing an open view. · Integrated space plan connected with a green network and a pedestrian network, and a pleasant trail plan by actively connecting with surrounding green spaces.	· Pleasant space	· Care type - Structure with ventilation and view
· Plan to connect the natural environment and the urban area by utilizing the adjacent park with a yard for communication with local residents.	· Flexibility space	· Flexibility type - Shared community space
	· Pleasant space	· Care type - natural environ-ment connecting urban areas
	· Additional space	· Alpha type - life stay community space - additional living SOC space

Table 7. Complex planning: space reorganization according to architectural solution

Complex planning: space reconstruction details	Architectural solution	Space reconstruction
· Balconies and private terraces of various shapes with the main building with buffer space secured	· Pleasant space	· Care type - Structure with ventilation and view
· The entrance lobby is designed as a clean zone (prevention area) to increase safety from fine dust and viruses	· Prevention space	· Care type - Quarantine function of the lobby (protected)
· Planning a community residential building connected to the outside community	· Variety space	· Flexibility type - Shared community space
	· Additional space	· Alpha type - life stay community space -additional living SOC space

Table 8. Community planning: spatial reconstruction according to architectural solution

Community planning : spatial reconstruction details	Architectural solution	Space reconstruction
· Nature-friendly community planning that brings natural elements into the interior	· Pleasant space)	· Care type - Structure with ventilation and view
· Buffer zone, clean zone space formation and pick-up zone planning by reception hall (prevention area)	· Prevention space	· Care type - Quarantine function of the lobby (protected)
· Community facilities are planned so that people can used with restrictions depending on the situation with a flexible spatial composition without internal and external boundaries	· Variety space	· Flexibility type - Expanding the function of the room - Variable space
· Platform community planning in connection with surrounding urban area	· Additional space	· Alpha type - Life stay community space - Additional living SOC space

4.3. Reconfiguration of Community Planning Spaces

To reconfigure community spaces in response to the pandemic, the collective housing plans propose three types based on the elements of Flexibility, Care, and Alpha, as presented in Table 8.

4.4. Reconfiguration of Unit Space

To incorporate pandemic-responsive spaces into unit planning, the collective housing plans reviewed thus far propose three space types based on the elements of Flexibility, Care, and Alpha, as presented in Tables 9, 10, and 11.

Table 9. Unit household planning : space reconstruction according to architectural solution(1) (Flexibility type)

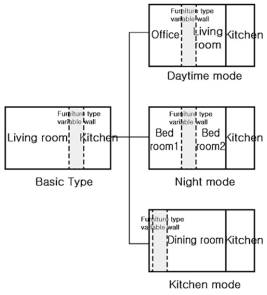
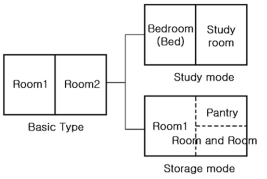
Unit household planning : space reconstruction details	Architectural solution	Space reconstruction
· Basic Type - Basic type of daily life by utilizing a furniture-type variable wall between the living room and the kitchen · Day mode - When working from home, the furniture-type variable wall can be moved and used as an office space · Night mode - Use of 2 bedrooms · Kitchen mode - When welcoming guests, use the living room and kitchen as one large space 	· Variety space · Flexibility space · Additional space	· Flexibility type - Expanding the function of the room - Variable space · Alpha type - Expanding of living area - Additional space
· For the bedrooms, existing rooms can be used in various ways, such as room-in-room + pantry or study room, depending on the number of children or user characteristics 	· Variety space · Flexibility space · Additional space	· Flexibility type - Expanding the function of the room - Variable space · Alpha type - Expanding of living area - Additional space
· Attempt to revitalize the the monotonous and stuffy life at home through a spacious kitchen like a high-end restaurant · Apply home layer by allowing it to be expanded into a wide dining space (use it as a cultural leisure space such as dining, cafe etc.)	· Variety space · Flexibility space · Pleasant space	· Flexibility type - Expanding the function of the room - Variable space - Shared community space · Care type - Structure with ventilation and view

Table 10. Unit household planning: space reconstruction according to architectural solution(2) (Care type)

Unit household planning : space reconstruction details	Architectural solution	Space reconstruction
· By separating the space of a medium-large apartment and installing a separate entrance, kitchen and bathroom, two households can live in one house - Independent living space where the privacy of the children or elders is protected - Separated space creates rental income through partial rental · In the case of an infectious disease patient or suspected symptoms in the household, it is possible to self-isolation space	· Prevention space	· Care type - Separation into self-isolation space - Lobby entrance blocking function (protected)
· Plan a clean care room at the entrance to reduce external pollutants, and install a separate washbasin or bathroom to block viruses or fine dust	· Prevention space	· Care type - Lobby entrance blocking function (protected)

Table 11. Unit household planning space reconstruction according to architectural solution(3) (Alpha type)

Unit household planning: space reconstruction details	Architectural solution	Space reconstruction
- Planning of various types of balconies and private terraces as a buffer space inside and outside the household due to the increasing importance of outside	- Additional space	- Alpha type - Expansion of living area
	- Pleasant space	- Care type - Structure with ventilation and view
- The first floor from the lower floor is a ground terrace through expansion, and the upper floor is a space plan to secure your own space by expanding to a terrace house	- Additional space	- Alpha type - addition living SOC space
	- Variety space - Flexibility space)	- Flexibility type - Expanding the function of the room
· Plan an open balcony to create a private open space inside the house so that you can enjoy the natural environment privately	· Additional space	· Alpha type - life stay community space
· Plan a pleasant community space with a structure that allows air to flow through the public space	· Pleasant space	· Care type - Structure with ventilation and view

5. Conclusion

The study explores the architectural changes in response to the COVID-19 pandemic, which has brought about significant societal and urban transformations. The research categorizes and analyzes the different types and characteristics of pandemics and examines how they have influenced architectural and urban developments over different eras. This analysis leads to the identification of various architectural elements and spatial changes in response to the societal changes induced by the pandemic.

The study also conducts a comparative analysis of communal housing spaces before and after the COVID-19 pandemic, focusing on the impact of societal changes on architectural adaptations. The importance of ecological planning and securing panoramic views for future ecological living is emphasized in the post-pandemic era.

Additionally, communal housing spaces are reconfigured in response to the increased emphasis on hygiene, resulting in the development of external spaces, prevention spaces, and pleasant environments. The access points and community spaces have evolved to reduce external contact and create safe living areas. The community planning involves setting priorities on disease prevention while maintaining a flexible layout that can adapt to various situations.

In conclusion, the research has explored the architectural responses to the societal changes brought about by the COVID-19 pandemic. It has provided valuable insights into how communal housing spaces can adapt to the post-pandemic era, taking into account the likelihood of living alongside COVID-19. However, it is essential to acknowledge that communal housing is influenced not only by infectious pandemics like COVID-19 but also by various societal and economic factors. Therefore, more in-depth research is required, based on a broader range of post-COVID-19 data and expert opinions, to provide a comprehensive understanding of the future of communal housing spaces. The limitations of this study include the differences in plot ratios in the compared cases and the short duration of post-pandemic data, which may restrict the generalizability of the research findings. Nonetheless, this study serves as a foundation for further developments in the architectural adaptation of communal housing spaces in response to the COVID-19 pandemic and future societal changes.

Acknowledgement

This work is supported in 2023 by the Korea Agency for Infrastructure Technology Advancement(KAIA) grant funded by the Ministry of Land, Infrastructure and Transport (Grant RS-2021-KA163269). This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government(MSIT) (No. 2021R1A2C2013499).

References

Kang, M. H. (2020) The history of pandemic, BRIC View 2020-TX5. Available from https://www.ibric.org/myboard/read.php?Board=report&id=3493.

Yoo, S, J. (2021), COVID-19 and other ultra-fine hazards environment and construction, urban response, construction technology Ssangyong.

Seo, Y. N. (2022), A Study on the Development Direction of Apartment Residential Flats in the Post-Corona Era, Master's Thesis, Dongguk University Graduate School.

Yang H, J. (2020), Analysis and Consideration of Shared Housing for Post-Corona Response. Focusing on newspaper data after COVID-19-, Proceedings of the Korean Housing Association.

Lim, S, K. (2021), A Study on the Change in Space Use of the Untact Era of the Housing Unit Household Floor Plan - Focusing on the Case of the 84? Unit Household Floor

Plan of the Korea Land and Housing Corporation since 2015-, Proceedings of the Korean Society of Spatial Design.

Ha, H, Y. (2020) The Outbreak of COVID-19, The Story of Vacuum, Korea Institute of Biotechnology.

Bae, M, K. (2020), Infectious disease outbreak status and prevention and management measures in North Chungcheong through the COVID-19 crisis, CRI Chungbuk Research Institute.

Lee, E, Y. (2022), A Study on Landscape Planning Measures in Consideration of the Changed Residential Environment in the Post-Corona Era, Korea Land and Housing Corporation Land and Housing Research Institute (Research Support 2022-27).