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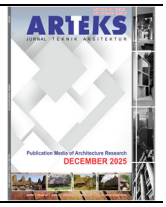

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Exploring hybrid architectural approaches in the Jatinegara Barat public housing complex as a model for urban residential development

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ABSTRACT

The development of urban areas presents a significant challenge in providing affordable and high-quality housing. One innovative approach to addressing this issue is the implementation of the hybrid architecture concept, which integrates multiple functions and design elements within a single framework to create more flexible, multifunctional, and sustainable spaces. This study investigates the application of hybrid architectural principles in Rusunawa Jatinegara Barat, a vertical housing project in Jakarta intended for low-income communities. Employing a qualitative methodology, the research analyzes how the integration of public and private spaces, alongside commercial and residential components, can enhance residents' quality of life while accommodating the increasing demands for urban space. Furthermore, this study utilizes Visual Graph Analysis (VGA) to examine the spatial and functional relationships within the Rusunawa design, thereby assessing the efficiency of circulation patterns and connectivity between spaces. The findings indicate that the application of hybrid architecture in Rusunawa Jatinegara Barat fosters the creation of inclusive, dynamic, and responsive environments that address both social and ecological needs, while also contributing positively to the sustainability of urban housing.

Introduction

The existence of slums and the limited accessibility of adequate housing represent major challenges in large cities worldwide, including Jakarta. The appeal of cities as centers for economic activity, trade, and services has driven increased migration from villages and smaller towns; however, this influx has not been matched by sufficient growth in decent housing (Tiara 2024). Consequently, low-income groups are disproportionately affected, as they gradually begin to occupy marginal urban areas. This often results in settlements with poor physical quality, commonly referred to as slums (Silalahi 2020).

The issue extends beyond physical or spatial concerns and encompasses significant social dimensions that require careful analysis and resolution. Efforts to revitalize or rehabilitate slum areas in urban settings frequently involve gentrification (Az-Zahra, Rahman, and Kautsary 2023). Gentrification typically occurs when middle- and upper-class populations move into an area, displacing lower-income residents from their original neighborhoods. Government-led revitalization of densely populated slum areas aims to improve physical quality and living conditions, thereby providing residents with more suitable housing. Nevertheless, despite these well-intentioned efforts, revitalization processes often produce unintended consequences or new challenges.

Gentrification refers to the process whereby residential areas initially designated for low-

income urban communities are gradually taken over by upper-middle-class populations. This transformation occurs due to pressures experienced by low-income residents and involves changes in land use and residential patterns, ultimately resulting in the replacement of the original community with higher-income occupants. Based on this definition, gentrification can be seen as a phenomenon arising from improvements in an area that attract wealthier residents, stimulate regional dynamism, and drive property prices upward. These rising property values frequently exceed the affordability of the original community, rendering them vulnerable to displacement from their residential areas. Clearly, gentrification poses a significant threat to community continuity, as residents are often unable to adapt to the rapid socio-economic and physical changes that accompany the elevation of an area's status to high-value real estate (Medha and Ariastita 2017; Aurunnisa and Rochani 2024).

The Jatinegara Barat Rental Flats (hereinafter referred to as Rusunawa) are housing units provided by the Jakarta Regional Government to accommodate residents relocated from the Kampung Pulo area, who were displaced by the Ciliwung River Normalization project. These flats serve as replacement housing for those affected by the project (Silalahi 2020). Covering an area of 7,460 m², the Rusunawa consists of two towers, A and B, each with 16 floors, providing a total of 518 residential units (Ainurrofiq 2018). Social and public facilities within the complex include healthcare, educational services, places of worship, and commercial amenities. Each residential unit spans 30 m² and comprises two bedrooms, one bathroom, a living room, a kitchen, a balcony, and an exhaust fan. Additional public facilities include a clinic, dental clinic, community health post (Posyandu), mosque, garden, preschool (PAUD), library, family welfare (PKK) room, hall, retail area, motorcycle parking, and an ATM (Ainurrofiq 2018).

This Rusunawa is designed for low-income residents (MBR) originating from Kampung Pulo. Beyond its primary residential function, the Rusunawa incorporates additional facilities to support the sustainability of the Kampung Pulo community. Consequently, the Jatinegara Barat Rusunawa can be classified as a hybrid or mixed-use building. Fenton (1985) distinguishes between hybrid and mixed-use buildings, particularly in terms of the relationship between the intensity of one spatial program and another (Fenton 1985). Fernández elaborates that hybrid buildings are cosmopolitan structures embracing complexity, diversity, and multiple programs. Fernández further provides a detailed description of the various elements constituting a hybrid building (Per 2011). According to Mozas, an ideal hybrid thrives on the symbiosis of public and private spaces, with its permeability being its most significant strength. Hybrid architecture, therefore, represents a design strategy that integrates different elements, styles, and functions within a single building or environment. Within the residential context, hybridity may involve the combination of public and private spaces, residential and commercial functions, and the integration of technologies to enhance building sustainability.

Figure 1. Axial map of the integration value of the area surrounding the Jatinegara Barat flats

A macro-scale connectivity analysis of the DKI Jakarta region indicates that the Jatinegara Barat area exhibits a relatively high structural integration score within Jakarta, as shown by the red axial map. Occupying a highly integrated area presents both advantages and disadvantages (Leepel, Utomo, and Suganda 2017). On the positive side, such locations hold potential for vibrant economic development due to their strategic positioning. On the downside, elevated land values result in higher property prices, which limit the affordability of rent and taxes for low-income residents. Additionally, economically strategic areas often attract higher-income residents, increasing the risk of gentrification.

Based on the description of the existing conditions and challenges at the research site, the study raises the following question: How can the Jatinegara Barat Rusunawa be analyzed through the lens of hybrid architecture? This research examines the application of hybrid architectural principles to enhance the effectiveness of spatial relationships within the Jatinegara Barat Rusunawa. Furthermore, it seeks to identify and optimize solutions to the issues and potentials

revealed. The study aims to evaluate spatial integration and identify mobility-related problems within the building to propose design recommendations that mitigate these issues.

The spatial program categorizes spaces according to function and the intensity of interspatial relationships, facilitating an assessment of permeability, which is a primary concern when analyzing hybrid architectural functions.

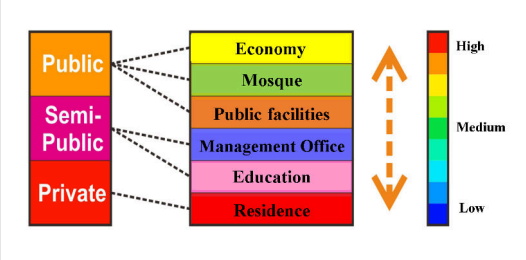


Figure 2. Relationship between zonification, spatial program, and visual graph analysis

Methods

This study employs a quantitative approach, using modeling and simulation strategies. Simulations are conducted through a spatial syntax approach with Depthmap software, the official platform developed by the Space Syntax Laboratory, which enables the analysis of human movement and circulation patterns within a space (Sa'diyah, Nugroho, and Purwani 2019). Space Syntax, assisted by Depthmap, operationally analyzes connectivity and integration across both simple and complex spatial structures (Jaya et al. 2025). The approach can generate graphical mappings using axial maps, convex maps, social space maps, and visibility maps (Gierlang Bhakti Putra 2022).

Space Syntax Theory offers diverse techniques to evaluate the built environment in terms of spatial use, configuration, visual perception, and programmatic function. Among the most intricate methods is Visual Graph Analysis (VGA) (Sunoto 2023), which examines the visibility between points within a spatial network (Yaseen and Mustafa 2023). For points not directly visible to each other, VGA calculates the number of intervening points required to establish sightlines (Desyllas 2003). This method evaluates visibility and permeability as dynamic components of spatial organization, revealing spatial hierarchies from public to private through color-coded diagrams. In these diagrams, orange to blue indicates low connectivity, while yellow to red indicates high connectivity (Hegazi et al. 2022).

VGA provides a quantitative analysis of visual properties in the built environment, facilitating modeling and understanding of spatial perception and use by occupants (Barada and Mutiari 2013). Like other spatial syntax techniques, Visual Graph Analysis (VGA) relies on a graphical representation of the overall geometry of the built environment. To generate a representative graph, the space is divided into a fine grid, typically with units corresponding to the scale of a human footstep or stair. Once the graph is constructed, fundamental spatial syntax measures, such as connectivity and depth, can be calculated.

Among these measures, integration value is the most critical, as it determines the potential mobility within an area. Integration value is a mathematically derived measure that focuses exclusively on the physical configuration of space, without accounting for land use or density considerations (Askarizad, Lamíquiz Daudén, and Garau 2024). Although integration values are numerical, specialized software converts them into color-coded graphical representations known as spatial integration maps. The most integrated axes are depicted in red, followed by orange, yellow, and green, while the least integrated axes appear in blue and dark blue (Sunoto 2023). The primary advantage of this graphical presentation is that it immediately conveys potential mobility and spatial changes under existing conditions. In addition to classification by integration values, spaces are zoned based on their function as public, semi-public, or private.

The first stage of this research involved field observation to collect data on spatial functions, both in terms of zoning (private, semi-public, and public) and activity types, including residential, economic, educational, spiritual, public facilities, and management functions. The Space Syntax method was applied to determine the integration values between spaces (Indrawan and Yaniawati 2017; Sugiyono 2017). The first stage of this study involved field observation to collect data by classifying spatial functions, both in terms of spatial zoning private, semi-public, and public spaces and in terms of functional types, including residential, economic, educational, spiritual, public facilities, and management. In addition, the Space Syntax method was employed to evaluate

the integration value between spaces (Dursun 2007; Sailer and Koutsolampros 2021; Gierlang Bhakti Putra 2022). Technical analysis through Visual Graph Analysis (VGA) was also applied as a method to examine and visualize spatial and functional relationships among elements in architectural design (Muyasarah and Sarwadi 2023). Within the context of low-cost apartments (rusunawa), VGA enables an assessment of how spaces within a building are interconnected, both visually and functionally. This visual analysis employs diagrams or maps to depict circulation patterns, functional zones, and interactions between spaces within the building.

These two methods were discussed and applied to generate findings in the form of a list of problems and potentials at the Jatinegara Barat Rusunawa, addressing the first research question regarding the effectiveness of the spatial program. These findings were then used to develop arguments for potential solutions and the optimization of space usage, which are presented in this paper as design recommendations. The recommendations were subsequently retested using Space Syntax to observe changes in integration values before and after the implementation of proposed spatial modifications. The research flow is summarized in the following diagram:

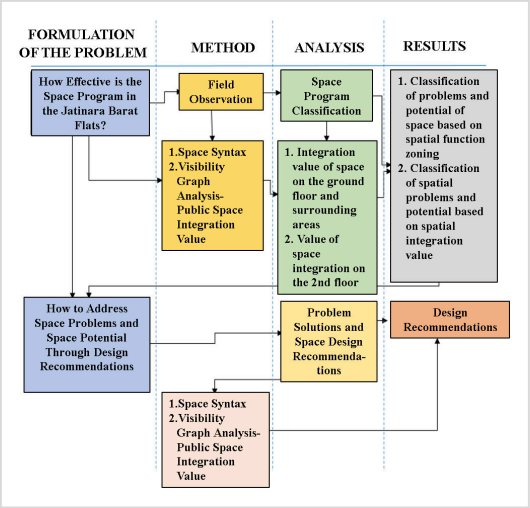


Figure 3. Research flowchart

Existing data

The Jatinegara Barat Rusunawa is situated in a highly integrated area in the center of Jakarta, surrounded by major roads. The presence of several nearby attractions significantly enhances the area's integration, including the Kampung Melayu Morning Market, Kampung Melayu Terminal, Premier Jatinegara Hospital, Jatinegara Mester Market, and Jatinegara Station. The surrounding roads contribute to a high level of accessibility and connectivity.

Strategically located, Jatinegara has undergone considerable development due to its proximity to Jakarta's core urban structure. The area maintains direct connections with surrounding urban zones and is linked to the nearby Ciliwung River. Multiple local attractions within this area further support the city's urban presence. The fundamental characteristics of the Jatinegara Barat Rusunawa area are summarized as follows:

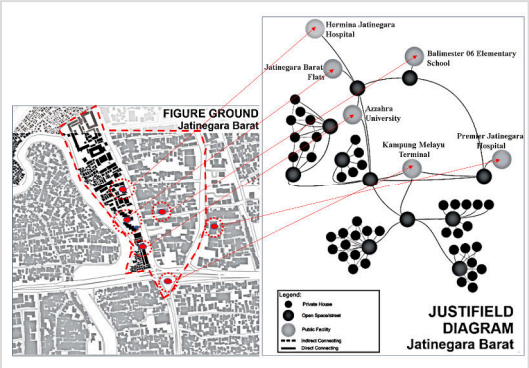


Figure 4. Justifield diagram of the Jatinegara Barat flats area, radius 500 m

Analysis of the network diagram (justifield diagram) reveals the relationship between residential units and their surrounding environment, emphasizing direct connections to outdoor spaces and road access. The area exhibits a lack of transitional spaces; such spaces are only present in non-private units, typically serving as yards or parking areas.

Connectivity between private and non-private residential units is neither direct nor separated, despite being within the same complex. Private units demonstrate both direct and indirect connectivity; spatial limitations necessitate indirect connections, resulting in private spaces transforming into public spaces and fostering a cohesive social community system.

Field observations indicate that the Jatinegara Barat Rusunawa functions as a high-rise residential building accommodating low-income families. The multi-storey structure integrates six primary functions: commercial, spiritual, community/open space, office, educational, and

residential. The building consists of 16 floors, of which the first two above the ground floor serve as public spaces, while the remaining 14 floors function as private residential areas. According to the master plan, the commercial area (food court) and spiritual area (mosque) are located in the north, parking areas are situated to the north and south, and the main entrance and open green spaces are in the east. On the ground floor, the Jatinegara Barat Rusunawa incorporates mixed-use functions. The administration area is located at the front, immediately following the main entrance, while the central portion of the building accommodates a community area or indoor open space combined with a small commercial area. At the rear of the building, a kindergarten is situated. The existing minimarket, designated as a commercial area, is placed adjacent to the community hall and mosque; however, field observations indicated that it is largely non-functional. The nearby community area serves multiple purposes, including an indoor play area for children, a gathering space for residents, venues for cultural events, and a reserved area for Friday prayers. The placement of the kindergarten in a publicly accessible rear section near the parking area raises safety concerns for children due to unrestricted access.

Figure 5. Children's playground and parking facilities

The second floor provides a mixed-use environment encompassing commercial, community, and spiritual functions. Several food stalls are positioned near elevators and staircases; nevertheless, most of these commercial establishments are non-operational, with only a limited number currently in use.

Figure 6. Commercial facilities (food court)

Floors three through sixteen are exclusively dedicated to residential functions. Each floor contains a consistent number of units, with Tower 1 comprising 20 units and Tower 2 comprising 19 units. The two towers are interconnected by a shared lobby on the ground and second floors, as well as a roof terrace on the third floor. From a design perspective, the roof terrace on the third floor currently functions as underutilized space and presents an opportunity for repurposing to enhance building functionality.

Results and discussion

Effectiveness of the space program

The Jatinegara Barat Rusunawa was developed as part of a relocation initiative for riverbank communities, aiming to organize slum areas and mitigate flood risks in DKI Jakarta. The design employs a vertical housing model incorporating shared spaces to improve residents' quality of life socially, economically, and ecologically. The spatial effectiveness analysis evaluates the extent to which the spatial program including residential and shared spaces supports residents' functional needs, promotes social interaction, encourages economic empowerment, facilitates public services, and provides an adaptive and sustainable living environment.

a. Changes in the Function of Residential Space
Most residential units experienced functional alterations, particularly in the living room and kitchen, which were converted into commercial spaces such as shops, salons, and laundries. These modifications reflect a mismatch between the original design and residents' needs, particularly for supplemental income. Factors influencing these changes include economic conditions, household size, and the absence of formal commercial areas. While these modifications reduce the spatial effectiveness in maintaining residential functions, they demonstrate residents' adaptive flexibility in utilizing available space.

b. Utilization of Shared Spaces
Shared spaces, including hallways, plazas, playgrounds, and lobbies, are intensively used for social interaction, children's play, and leisure activities. Usage intensity increases during evenings and holidays. Although some areas were not designed optimally for interaction, residents adapt available spaces to facilitate community engagement. This effective use of shared spaces highlights their role in fostering social cohesion and empowering the community.

c. Social Activities, Empowerment, and Services
Shared spaces accommodate various social and economic empowerment activities, such as skills training, health services, and community events. They are also used for collective activities, including exercise, tutoring, workshops, socialization, and community service. These functions enhance participation and strengthen social bonds among residents.

d. Service Quality & Resident Satisfaction
Service quality assessments indicate that most residents consider the services provided by the Rusunawa including cleanliness, management, and security to be adequate. Shared facilities, such as elevators, open spaces, and places of worship, support comfortable vertical living. Nonetheless, improvements in the maintenance and management of shared spaces are required. Overall, residents perceive the effectiveness of the Rusunawa's services in supporting sustainable use of shared spaces as satisfactory.

The overall effectiveness of the spatial program and shared space utilization at Jatinegara Barat Rusunawa is summarized in table 1.

Table 1. Assessment of the effectiveness of the spatial planning program and the use of shared spaces in the Jatinegara Barat Rusunawa

Analysis aspects	Effectiveness assessment	Information
Function of living space	Low - Moderate	There are many functional modifications due to non-adaptive design.
Utilization of shared spaces	High	Actively used as a social and family interaction space
Social/econo-mic activities	High	Space supports community empowerment and participation
Quality of service and facilities	Good Enough	Providing a basis for comfort for the use of shared spaces

Visual Graph Analysis of existing conditions

A Visual Graph Analysis (VGA) was conducted to assess the spatial integration of the ground floor of the Jatinegara Barat Flats.

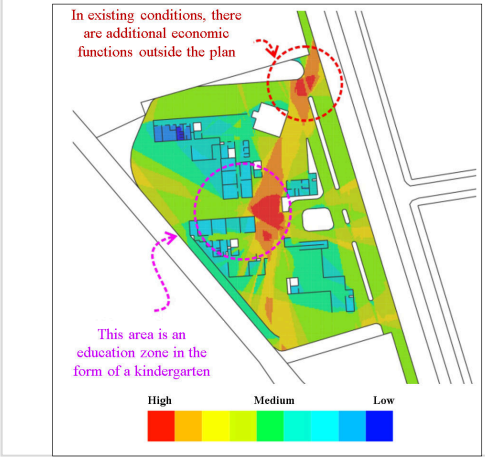


Figure 7. Integrated value of the first floor

The analysis indicates that the highest integration values are concentrated in the northern and central areas of the floor (red and pink circles, respectively). The red zone, representing the area of maximum integration, is divided into two sections, with the central zone exhibiting a higher value and broader spatial extent, even though it functions as an educational space in the form of a kindergarten. Ideally, educational zones should be located in semi-public areas with moderate integration values, allowing children to interact with peers while remaining within a secure environment monitored by residents and Rusunawa management.

Similarly, the VGA conducted on the second floor reveals the following:

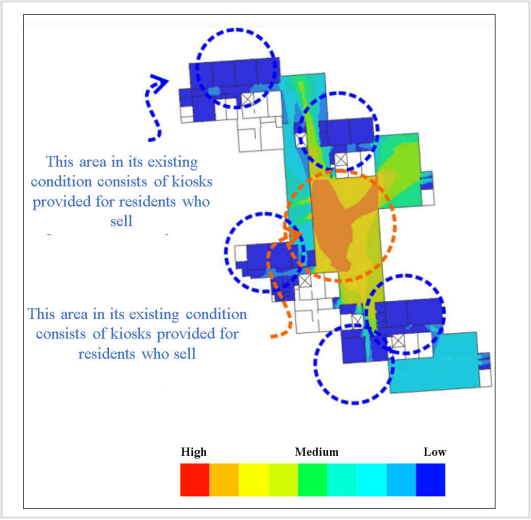


Figure 8. Integrated value on the second floor

The analysis shows that economic spaces specifically kiosks (marked in blue) are located in zones with low integration values, which corresponds with field observations of limited commercial activity on the second floor. Although the central area (marked in orange) exhibits moderately high integration, it lacks sufficient kiosk infrastructure, and underutilized spaces are rented at prices disproportionate to their conditions. As a result, the economic potential of the second floor is not fully realized.

Design engineering based on Visual Graph Analysis results on the first and second floors

Based on the VGA results, spatial engineering strategies were developed to optimize the integrated value of existing conditions. The central educational zone (pink circle), which exhibited excessively high integration, was relocated to the northern zone (red circle) to enhance its function as an economic area requiring high integration. This redesign involved moving the mosque from the ground floor to the second floor and constructing a pedestrian bridge to connect the Rusunawa with the street-level pedestrian network, thereby increasing accessibility and integrated value.

The results aligned with expectations, reducing the integration value in the educational zone while increasing it in the northern economic zone. This adjustment is anticipated to optimize economic functions that benefit from high integration, while maintaining educational zones within semi-public areas suited for moderate integration values.

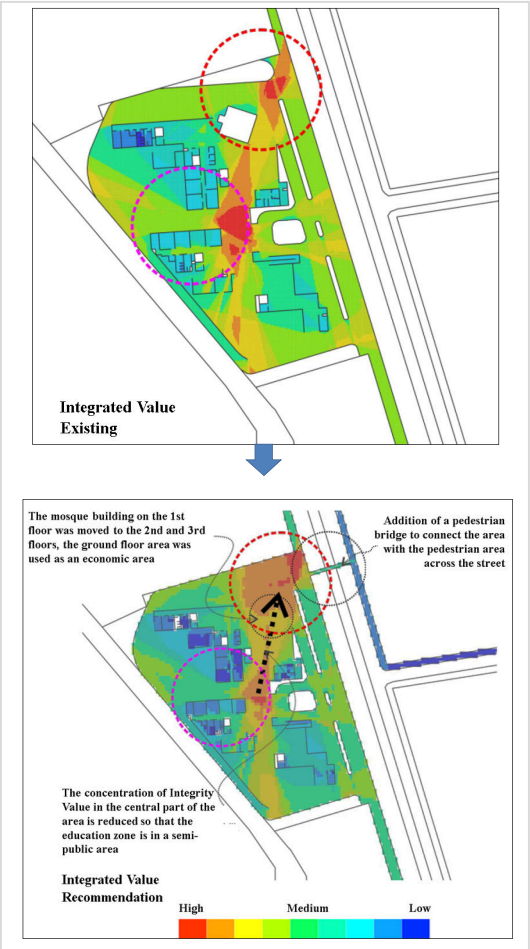


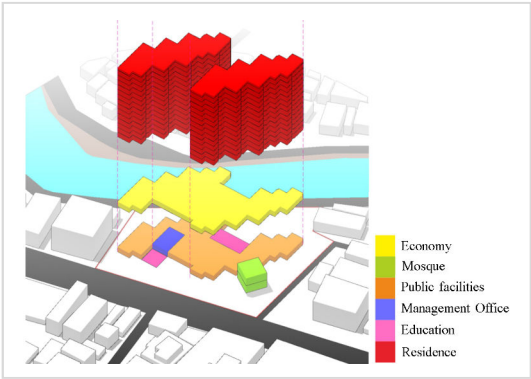
Figure 9. Integrated value engineering design

Design recommendations

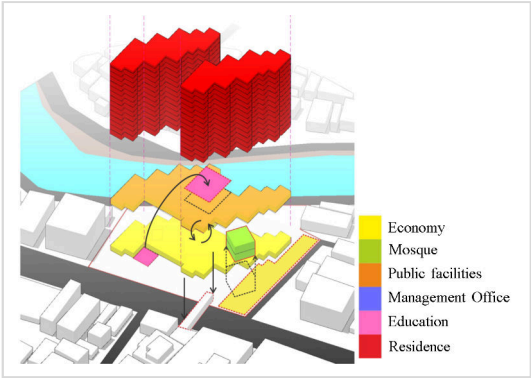
To address functional inefficiencies, the Jatinegara Barat Rusunawa should transition from a conventional multi-story residential building to a hybrid architectural model. Architectural and fabrication strategies are central to this transformation, aiming to optimize the building's multifunctionality.

The proposed design recommendations involve significant modifications to the Jatinegara Barat Rusunawa. The Economic Zone, originally situated on the second floor, is relocated to the ground floor to maximize the potential of this public space. Concurrently, the mosque, previously located on the ground floor, is moved to the second and third floors. Elevating the mosque allows the ground floor to function as a hub for community economic activities. The northern section of the site is developed into a dedicated economic zone, where kiosks can be constructed and rented affordably to Rusunawa residents. This transformation ensures that the Jatinegara Barat Rusunawa serves not only as low-income housing but also as a generator of local economic activity, increasing residents' income and providing resilience against potential increases in property prices. Moreover, this strategy helps protect residents from gentrification by preventing the displacement of low-income communities by higher-income groups.

The second floor is repurposed as an integrated educational and spiritual zone. Relocating educational activities to this semi-public zone allows supervision by parents and the local community, as it remains proximate to the residential areas, while still permitting children to interact and play safely with their peers. By applying hybrid architectural principles, these design recommendations aim to enhance the effectiveness of spatial relationships and optimize the functionality of both economic and educational spaces.



First Alternative Design Recommendation



Second Alternative Design Recommendation

Figure 10. Design recommendation

Conclusions

The spatial planning program at Jatinegara Barat Rusunawa has experienced notable functional changes since occupancy, particularly with the conversion of residential units into commercial spaces. These transformations have been influenced by residents' needs, activity patterns, environmental context, family size, and economic conditions. Despite frequent modifications to private spaces, the program has proven effective in promoting social interaction and fostering a sense of community. Shared spaces have been successfully utilized for social engagement and productive activities, highlighting their importance in enhancing communal life.

Nevertheless, there remains a discrepancy between the original design and residents' evolving needs within private units, which has led to functional adaptations of domestic spaces. While the spatial program effectively supports social interaction and communal activities, it is less successful in addressing private residential needs. This emphasizes the necessity of adopting an adaptive design approach and responsive space management that aligns with the social and economic dynamics of residents. Enhancing structured shared spaces to support social and economic activities, alongside improved management services, is essential to ensure sustainable and comfortable use. As a model of urban housing employing hybrid architectural principles, Jatinegara Barat Rusunawa demonstrates significant potential for creating multifunctional, inclusive, and adaptive living environments.

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Author(s) contribution

Tri Endangsih contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

Hakim contribute to methodology, supervision, and validation.

Sri Kurniasih contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.