

Evaluation of Construction Quality Problems of Ujung Berung Transit Apartment Flat Building in Bandung City

Aprilia Dwi Rahmawati^{1*}, Sri Pare Eni², Posma SJK Hutasoit³
Universitas Kristen Indonesia

Corresponding Author: Aprilia Dwi Rahmawati apriadiwir@28gmail.com

ARTICLE INFO

Keywords: Apartemen
Buildings, Building
Reliability Quality,
Accessibility

Received : 02, October

Revised : 19, November

Accepted: 29, December

©2025 Rahmawati, Eni, Hutasoit :
This is an open-access article
distributed under the terms of the
[Creative Commons Atribusi 4.0
Internasional](https://creativecommons.org/licenses/by-sa/4.0/).



ABSTRACT

The rapid construction of apartment buildings in urban Indonesia addresses land limitations and growing housing demand. However, concerns persist regarding the reliability and quality of these structures, directly impacting resident safety and well-being. This study is grounded in Government Regulation (PP) No. 16 of 2021, which mandates four key technical standards for building reliability: safety, health, comfort, and accessibility. Focusing on a vital vertical housing solution for low-income communities, this research aims to evaluate the construction quality and compliance of the Ujung Berung Transit Apartment in Bandung against these national standards. The goal is to ensure that affordable housing provisions meet the required benchmarks for decent, safe, and comfortable living, ultimately supporting the residents' security and quality of life.

INTRODUCTION

Public housing is a multi-story building constructed by the government to provide housing for low-income families, equipped with various facilities 1.1 (Abdullah, Dunggio, & Ernawati, 2024). The construction of apartment buildings in urban areas is one effective solution to overcome land constraints and increasing demand for housing. However, various issues related to the quality and reliability of building construction are often a major concern, as they can affect the safety, durability, and comfort of residents.

Based on Government Regulation Number 16 of 2021 concerning the Implementation Regulations of Law – Law Number 28 of 2002 concerning Buildings, this Government Regulation aims to establish technical standards for buildings that must be met in accordance with those listed in Article 27 of Government Regulation Number 16 of 2021, which specifically regulates the reliability or construction of buildings, including aspects of safety, health, comfort, and accessibility to buildings.



Source: <https://earth.google.com>

Figure 1. Key Plan for the Transit Apartment Complex in Ujung Berung

The safety aspect is not only related to strong and sturdy building structures, but also how buildings can function as shelters from potential hazards such as natural disasters and accidents caused by human negligence. In addition, the health aspect is also important because buildings must meet standards related to good air ventilation, adequate natural lighting, supportive air circulation, and good water and waste management. Furthermore, the aspect of comfort, where comfort is not only related to aesthetics, but also conditions such as stable room or building temperature and good noise control. This supports the productivity and mental health of the building's occupants.

Finally, the aspect of convenience, where buildings must ensure good accessibility, especially for people with disabilities. This makes it easier for occupants to move around the building.

The Ujung Berung Transit Apartment in the city of Bandung is a form of vertical housing designed to provide temporary accommodation for low-income communities. This study aims to evaluate the reliability or construction quality of the Ujung Berung Transit Apartment building by referring to the standards set out in Government Regulation No. 16 of 2021. This ensures that low-income

communities can also enjoy decent housing in terms of safety, health, comfort, and accessibility to the building.

THEORETICAL REVIEW

Housing Typology: Low-Income Rental Apartments

Rumah susun in Indonesia represents a vertically planned multi-unit residential building designed to optimize limited urban land resources. Each unit is functionally structured both horizontally and vertically, equipped with shared facilities such as common areas, shared infrastructure, and communal land. Within this typology, the Rumah Susun Sederhana Sewa – commonly referred to as Apartemen Transit – serves as an affordable rental housing model funded through national and/or provincial government budgets. These units accommodate low-income households and temporary residents under regulated tenancy schemes.

A representative example is the Apartemen Transit Ujung Berung in Bandung, West Java, consisting of 196 units within three twin blocks, supported by basic public amenities including worship spaces, playgrounds, parks, and sports facilities.

Building Construction: Technical Foundation and Performance Requirements

Construction is defined as an integrated process involving planning, execution, and supervision to ensure that a building performs safely, efficiently, and sustainably. Beyond the physical act of building, construction includes material selection, structural design, mechanical–electrical–plumbing (MEP) integration, and adherence to national standards. Indonesia's Government Regulation (PP) No. 16/2021 establishes four key performance criteria for building reliability:

1. Safety,
2. Health,
3. Comfort, and
4. Accessibility.

These criteria emphasize a holistic approach where structural stability must be complemented by indoor environmental quality, effective building services, and user-centered design.

Building Construction: Technical Foundation and Performance Requirements

Construction quality directly shapes the physical and psychological comfort of occupants in vertical housing.

1. Thermal Comfort

Structural components such as wall thickness, roofing insulation, and ventilation determine indoor temperature stability. Poor construction may cause overheating, trapped humidity, or insufficient air exchange.

2. Visual Comfort

The placement of windows, size of openings, and building orientation influence daylight access and visual clarity. Suboptimal construction results in dim spaces, glare, or inefficient lighting conditions.

3. Acoustic Comfort

Weak partition systems, improper sealing, and low-quality materials cause sound transmission between units, diminishing privacy and increasing disturbance.

4. Psychological Comfort

Visible structural defects—cracks, leaks, damp surfaces—create insecurity, stress, and reduced trust in the building's reliability. Collectively, these factors highlight that construction quality is not solely a technical issue but an essential determinant of residential well-being.

Regulatory Framework for Building Performance

The study is grounded in three major regulatory sources:

1. PP No. 16/2021 (Indonesia's Building Law Implementation) This regulation provides technical criteria for:
 - a) Structural load performance, including earthquake resistance, corrosion protection, and durability;
 - b) Fire protection systems, both passive (compartmentalization, fire-rated materials) and active (hydrants, alarms, sprinklers);
 - c) Lightning protection, through internal and external systems;
 - d) Electrical safety, including supply sources, panels, and grounding systems.
2. West Java Provincial Regulation No. 27/2019
Focuses on the management and maintenance of province-owned rental housing for low-income residents, emphasizing safety, sustainability, and administrative responsibility.
3. Ministry of Public Works Regulation No. 24/PRT/M/2008
Defines building maintenance standards—preventive, corrective, and predictive—ensuring continuous operational safety, functionality, and longevity. Maintenance must be documented, routinely inspected, and performed by certified personnel.

Health Standards for Habitable Buildings

PP No. 16/2021 also mandates healthy building criteria:

1. Ventilation systems (natural/mechanical) to ensure air exchange and maintain air quality.
2. Lighting systems (daylighting/artificial) designed for visual efficiency and energy optimization.
3. Water management systems, covering potable water supply, wastewater treatment, and stormwater handling aligned with natural hydrology.
4. Waste management systems, including collection, temporary storage, and disposal pathways to protect environmental and occupant health.
5. Use of non-toxic, environmentally safe building materials.

These standards ensure a healthy micro-environment supporting long-term residential well-being.

Building Accessibility and User Convenience

Accessibility regulations require buildings to provide:

1. Horizontal circulation: corridors, walkways, pedestrian paths, and connecting bridges sized according to building function and occupancy.
2. Vertical circulation: staircases, ramps, elevators, escalators, and related systems designed with considerations of load, user capacity, and safety.
3. Supporting facilities: toilets, prayer rooms, nursing rooms, child-care spaces, handwashing stations, waiting areas, signage, parking facilities, and CCTV systems.

These elements ensure inclusivity and ease of movement, especially in high-density vertical housing.

Comfort Standards in Building Performance

Comfort under PP 16/2021 is defined by:

1. Spatial comfort: adequate movement space and logical room relations.
2. Thermal comfort: temperature, humidity, air velocity, and fresh air exchange.
3. Visual comfort: privacy, daylight quality, and façade-bukaan relationships.
4. Acoustic comfort: control of noise and structural vibrations.

These criteria reinforce the multi-dimensional nature of comfort, integrating physical, functional, and perceptual dimensions.

Final summary – for journal introduction or review section

Rumah susun in Indonesia serves as an essential housing solution for low-income urban populations. The performance of these buildings is significantly influenced by construction quality, which directly affects thermal, visual, acoustic, and psychological comfort. Indonesia's PP No. 16/2021 provides a comprehensive legal framework that integrates structural safety, health standards, comfort parameters, and accessibility requirements to ensure building reliability. Supporting regional and ministerial regulations emphasize continuous maintenance and systematic management of vertical housing. Collectively, these theoretical foundations highlight that evaluating construction quality is vital not only for technical compliance but also for safeguarding occupant well-being in dense urban residential environments.

Conceptual Framework

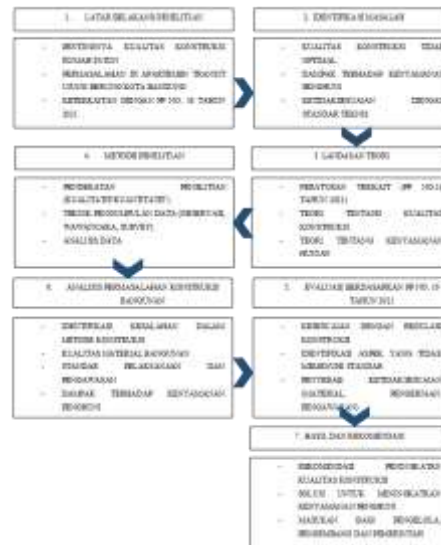


Figure 2. Conceptual Framework of Research

METHODOLOGY

This type of research uses qualitative and quantitative research methods. The qualitative method uses observation techniques. The research method with observation is a method of data collection through direct observation of phenomena or behavior in the field. This technique allows researchers to observe and record what they see in real situations without interference or changes from the researchers (Romodana, Junista, & Gunawan, 2025).

The quantitative method in this study is used to measure the level of comfort of residents regarding the quality of apartment building construction objectively and systematically. The main focus of this quantitative approach is to describe the relationship between technical aspects of construction (such as lighting, ventilation, noise, material quality, and accessibility) and residents' perceptions of comfort, based on indicators.

In this study, observations will be conducted at the research location, namely the Ujung Berung Transit Apartment in Bandung City, to collect technical specification data from existing buildings for comparison with the building specification standards from Government Regulation Number 16 of 2021.

Research Approach

The analysis of construction quality issues at the Ujung Berung Transit Apartment was conducted using a multidimensional approach that involved visual observation of the building, technical evaluation, analysis of national and international standards, and identification of residents' perceptions through questionnaires. This approach is in line with the Building Performance Evaluation (BPE) and Post-Occupancy Evaluation (POE) frameworks, which emphasize the importance of understanding the relationship between the physical condition of a building and the comfort level of its occupants after it has been occupied for a certain period of time.

The Ujung Berung Transit Apartment is more than a decade old, so it is natural for the building to experience a decline in performance. However, the

extent of the decline shows that the initial construction quality, maintenance system, and suitability of the design to the needs of the residents still have a number of shortcomings. This condition not only affects physical comfort but also influences the psychological condition of the residents in the long term.

Population and Sample

The population of this study comprises all residents of the Ujung Berung Transit Apartment in Bandung, which consists of three residential blocks with a total of 196 units predominantly occupied by low-income households. From this population, the sample was selected using a purposive sampling technique to ensure that respondents were active occupants with direct experience of the building's construction quality and its impact on daily comfort. Residents from different floors and blocks were included to capture variations in unit conditions, such as differences in ventilation, noise levels, structural integrity, and spatial configuration. The sample also involved key informants, including long-term residents, individuals who had previously reported building issues, and occupants of units in different structural positions, as they were considered to have more comprehensive insights. This sampling approach supports the study's mixed-methods design, combining quantitative data from questionnaires with qualitative data obtained through in-depth interviews to provide a holistic understanding of occupant comfort and building performance.

Data Analysis Techniques

Technical data analysis is the process of systematically searching for and compiling data obtained from field observations, interviews, and literature studies, which is then organized into information so that the characteristics of the data obtained become easy to find solutions to a problem. According to Miles and Huberman, data analysis has several components, namely (Zulfirman, 2022):

1. Data Reduction, reduction is the process of selecting, focusing, and simplifying all types of information that supports the research data obtained and recorded during the research observation process.
2. Data presentation is the process of compiling information that allows conclusions to be drawn in the research. Data presentation can be in the form of brief descriptions, charts, and the like. This data presentation will make it easier for researchers to understand the problems that occur and plan further actions in accordance with what has been understood.
3. Drawing conclusions is the final process of data analysis techniques. Conclusions are drawn from the analyzed data and data that has been checked based on evidence obtained from observations, interviews, and literature studies related to the research topic.

Research Location and Time

This study was conducted at the Ujung Berung Transit Apartment, located at Jalan A.H. Nasution No. 117, Sukamiskin, Pasir Endah, Ujung Berung District, Bandung City, West Java Province . The apartment complex consists of three five-

story twin-block buildings with a total of 196 residential units designated for low-income households. The site was chosen due to its function as temporary housing for low-income communities and its relevance to evaluating building performance against the technical standards mandated by Government Regulation No. 16 of 2021. Data collection activities—including field observations, surveys, and interviews—were carried out directly at the site to assess construction quality, environmental conditions, and occupant comfort. The research period encompassed the full cycle of on-site observation, documentation review, and resident interaction, allowing for a comprehensive evaluation of the building's safety, health, comfort, and accessibility aspects.

Research Originality

The originality of this study lies in its focused evaluation of the Ujung Berung Transit Apartment using the four reliability criteria—safety, health, comfort, and accessibility—outlined in Government Regulation No. 16 of 2021. Unlike previous research that examined public housing only partially or from a single-aspect perspective, this study provides an integrated assessment combining field observations, regulatory analysis, and resident perceptions. No prior research has specifically analyzed this apartment complex or systematically measured how construction quality affects occupant comfort. Therefore, the study offers new empirical insights into the performance of government-provided rental housing and its compliance with national building standards.

RESULTS

Overview of Research Locations

This study was conducted at the Ujung Berung Transit Apartment, located at Jalan A.H. Nasution No. 117, Sukamiskin Village, Ujung Berung District, Bandung City, West Java Province 40293.

This location is situated in the eastern part of Bandung City, which is characterized by dense urban settlements with main transportation access via Jalan A.H. Nasution as a connecting route between the Cicaheum–Cileunyi areas.

Administratively, the Ujung Berung Transit Apartment is under the management of the West Java Province Housing and Settlement Agency ..

(Disperkim). The function of this building is as temporary (transit) housing for low-income communities (MBR), especially for residents who do not yet have permanent housing.



Source: UPTD – P3JB Prov Jabar

Figure 3. Flat House Building

The location of the apartment is quite strategic because it is close to public facilities such as schools, hospitals, and shopping centers, thus supporting the daily activities of the residents.

The building consists of three main blocks (twin blocks) with five floors and a total of 196 residential units measuring 21 and 24 m². Each unit is designed for the basic needs of small families, with rooms divided into bedrooms, living rooms, kitchens, Transit Ujung Berung Apartments consist of three main blocks (twin blocks) with a height of five floors. Each block has a varying number of residential units, with a total of 196 units. The available unit types range from 21–24 m², which are intended for small families (2–4 family members).

In general, the building uses a reinforced concrete structure, plastered brick walls, and a concrete roof. Vertical circulation in each block uses a main staircase, while horizontal circulation takes the form of straight corridors on each floor without a central void system. This layout is effective in terms of construction, but it results in a lack of natural air circulation and natural lighting in some of the middle units. Each unit has a main room, bedroom, small kitchen, and bathroom.

Construction Conditions and Building Damage Findings

Field observations revealed various construction problems at the Ujung Berung Transit Apartment. Cracks were visible on interior walls and corridors, indicating possible material aging, structural fatigue, or insufficient reinforcement during initial construction. In addition, signs of moisture and local leaks were found on the ceiling and wall corners, indicating an inadequate waterproofing system and suboptimal roof drainage. This physical damage reduces the durability of the building and directly affects the comfort level of the residents.

Several units also showed damage to the finish, such as peeling paint, damp wall surfaces, and corrosion on metal components. This pattern of damage indicates that maintenance has been limited or irregular, in line with the building's operational age of nearly a decade. These findings reflect the general condition of low-cost public housing, where construction quality and long-term management are often limited by budget availability.



Source: UPTD – P3JB Prov Jabar

Figure. 4 Cracks in the Bathroom Area

Safety Performance Based on Government Regulation No. 16/2021

The evaluation of safety performance indicates partial compliance with national regulatory standards. Although the main structural frame remains functional, the presence of cracks may pose structural risks during extreme conditions such as earthquakes or additional structural loads.

Fire protection facilities were found to be inconsistent across the building. Several areas lacked functioning fire extinguishers, and alarm or hydrant systems were not available on every floor. This condition may reduce the effectiveness of emergency response and evacuation. Evacuation routes were present, but some signage had faded or was poorly maintained.

Electrical installations were generally operational, but exposed wiring and outdated fixtures were identified in several units, increasing the risk of short circuits and fire. The building is equipped with a lightning protection system; however, documentation confirming its functionality was limited. Overall, the safety assessment highlights the need for significant improvements to fully meet the standards outlined in Government Regulation No. 16/2021.

Health-Related Building Performance

Health-related aspects—including ventilation, lighting, sanitation, and water management—showed varying levels of performance.

Several units had minimal openings, resulting in inadequate natural ventilation, poor air circulation, and elevated indoor humidity. Mechanical ventilation was rarely used, leaving residents fully dependent on natural airflow.



Source: UPTD – P3JB Prov Jabar

Figure 5. Humidity of the Bathroom Area

Natural lighting varied depending on unit orientation. Units facing outward received sufficient daylight, while centrally positioned units tended to be dim even during daytime.

The wastewater disposal system generally functioned, although some residents reported slow drainage and occasional odors. Centralized solid waste management was available, but container capacity was insufficient, leading to waste accumulation during peak periods. Overall, the building meets some health-related requirements but requires improvements in ventilation, waste management capacity, and wastewater flow.

Accessibility and User Convenience

Horizontal circulation—corridors and staircases—was functional but experienced congestion during peak hours. Vertical circulation relied entirely on staircases due to the absence of elevators, posing challenges for elderly residents, people with disabilities, and those carrying heavy loads.



Source: UPTD – P3JB Prov Jabar

Figure 6. Building Access

Public facilities such as prayer rooms, play areas, and open spaces were available but showed signs of wear.



Source: UPTD – P3JB Prov Jabar

Figure 7. Play Areas and Learning Areas

Some wayfinding signs were faded or damaged, reducing navigational clarity, particularly during emergencies.

In general, accessibility remains functional but does not meet universal design standards that ensure inclusiveness for all user groups.

Integration of Resident Perceptions with Field Findings

Resident survey results aligned with the field observations. Many residents reported concerns about structural cracks, moisture issues, and potential leaks. Complaints regarding insufficient fire protection equipment and electrical risks were also common.

These perceptions confirm that the observed deficiencies are not isolated cases but are experienced consistently by residents across multiple units. Integrating resident feedback with field data strengthens the conclusion that the

building does not fully meet the safety, health, and accessibility requirements mandated by Government Regulation No. 16/2021.

DISCUSSION

Field observations at the Ujung Berung Transit Apartment revealed several construction-related deficiencies that affect the overall performance of the building. Structural cracks were identified on interior walls, corridors, and joint areas, indicating material deterioration and insufficient long-term maintenance for a building of this age. Signs of water infiltration, such as damp stains and localized leaks on ceilings and wall corners, suggest that waterproofing systems and roof drainage are not functioning optimally. These findings are consistent with typical degradation patterns in low-cost public housing. In terms of safety, the building demonstrates only partial compliance with Government Regulation No. 16 of 2021: the primary structural frame remains functional, but the presence of cracks raises questions regarding structural reliability under extreme conditions such as earthquakes. Fire protection facilities are unevenly distributed, with some floors lacking adequate extinguishers, alarms, or clearly marked evacuation routes, while electrical inspections revealed exposed wiring and outdated components that could increase the risk of short circuits.

Health-related performance also shows mixed results: limited natural ventilation in several units leads to poor air circulation and higher indoor humidity, and natural lighting is inadequate in centrally located units that do not face the exterior. Wastewater disposal generally functions, but slow drainage and occasional odors were reported, and centralized solid waste facilities appear undersized, causing periodic accumulation of waste. Accessibility is operational yet not fully inclusive, as vertical circulation relies solely on staircases in the absence of elevators, which burdens elderly residents and people with disabilities. Resident perceptions collected through surveys and interviews corroborate these observations, confirming that the identified deficiencies are experienced consistently across different units. Taken together, these results indicate that the apartment does not fully meet the safety, health, and accessibility requirements stipulated by Government Regulation No. 16 of 2021, and they underline the need for a more systematic maintenance and rehabilitation strategy in publicly provided rental housing.

CONCLUSIONS AND RECOMMENDATIONS

The findings of this study indicate that the Ujung Berung Transit Apartment experiences multiple issues related to construction quality, safety, health, and accessibility, demonstrating that the building does not fully comply with the technical requirements mandated by Government Regulation No. 16 of 2021. Physical deterioration—such as structural cracks, surface damage, water infiltration, and corrosion on metal components—reflects aging construction and inadequate long-term maintenance. Safety systems, particularly fire protection and electrical installations, remain inconsistent across the building and pose potential hazards. Health-related aspects, including natural ventilation and lighting, are insufficient in several units, while waste management and drainage systems require improved capacity. Building accessibility is also limited due to the

absence of vertical mobility facilities such as elevators, causing significant constraints for elderly residents and individuals with mobility challenges. Based on these conditions, this study recommends a comprehensive structural audit and targeted repairs, enhancement of fire protection facilities, upgrading of electrical systems, improvement of ventilation and lighting performance, expansion of wastewater and solid-waste handling capacity, strengthened building accessibility, and the implementation of a scheduled preventive maintenance program. These interventions are essential to ensure regulatory compliance, extend building lifespan, and improve overall housing quality in government-provided rental facilities.

Key Points (Conclusion & Recommendations):

- a) Construction quality has deteriorated (cracks, leaks, corrosion).
- b) Safety systems are uneven and do not fully meet standards.
- c) Ventilation and natural lighting are inadequate in several units.
- d) Wastewater and solid-waste systems require increased capacity.
- e) Accessibility is limited due to the absence of elevators.
- f) A full structural audit and comprehensive repairs are required.
- g) Fire protection and electrical systems must be upgraded.
- h) Ventilation and daylighting should be optimized.
- i) Accessibility improvements are needed for vulnerable groups.
- j) Preventive and scheduled maintenance must be implemented consistently.

FURTHER STUDY

Future research should expand the scope of analysis by incorporating a more detailed assessment of structural performance using quantitative engineering measurements such as load-bearing analysis, material testing, and non-destructive evaluation techniques. Studies may also include long-term monitoring of building degradation to better understand the rate and pattern of physical deterioration. Additionally, future work should examine the effectiveness of maintenance management systems in public housing and how governance, budgeting, and policy frameworks influence building performance over time. Comparative studies with similar low-cost housing projects in other regions or countries would also provide valuable insights into best practices and benchmarking standards. Finally, integrating socio-economic factors of residents could offer a more holistic understanding of how physical building conditions interact with user needs, public housing policies, and long-term sustainability.

ACKNOWLEDGMENT

The author would like to express sincere gratitude to the Department of Housing and Settlement of West Java Province for providing access to data and permission to conduct field observations at the Ujung Berung Transit Apartment. Appreciation is also extended to the residents who generously participated in surveys and interviews, contributing valuable insights to this research. Special thanks are conveyed to the academic supervisors and lecturers at Universitas Kristen Indonesia for their continuous guidance, critical feedback, and support throughout the research process. The author also acknowledges all individuals

and institutions who, directly or indirectly, contributed to the successful completion of this study.

REFERENCES

- Abdullah, F. L., Dunggio, M. F., & Ernawati. (2024). Rumah Susun Sewa di Kelurahan Biawu Dengan Pendekatan Arsitektur Energi. *JAMBURA Journal of Architecture*.
- Bandung News Photo Portal Berita Bandung dan Jawa Barat. (2015, Desember 29). Retrieved from Bandung News Photo Portal Berita Bandung dan Jawa Barat: <https://www.bandungnewsphoto.com/>
- Barat, U. P. (2021). UPTD Pengelolaan Dan Pelayanan Perumahan Jawa Barat. Retrieved from UPTD Pengelolaan Dan Pelayanan Perumahan Jawa Barat: <https://p3jb.jabarprov.go.id/>
- Hidayat, T., & Yuliani, D. (2020). Analisis Pengaruh Kualitas Konstruksi Terhadap Kenyamanan Hunian di Rumah Susun Sederhana. *Jurnal Teknik Sipil dan Lingkungan*, Vol. 12, No. 2, Hal. 100-109,.
- Jabar, P. (2019). Peraturan Gubernur (Pergub) Provinsi Jawa Barat Nomor 27 Tahun 2019 tentang Pengelolaan Rumah Susun Sederhana Sewa Di Daerah Provinsi Jawa Barat. Bandung: Pemerintah Provinsi Jawa Barat.
- Natsir, M. (2020). *Kenyamanan Hunian dalam Arsitektur Tropis*. Yogyakarta: Graha Ilmu.
- PUPR, K. (2008). Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 24/PRT/M/2008 Tahun 2008 tentang Pedoman Pemeliharaan dan Perawatan Bangunan Gedung. Jakarta: Kementerian Pekerjaan Umum dan Perumahan Rakyat.
- PUPR, K. (2021, Desember 30). Peraturan Pemerintah (PP) Nomor 16 Tahun 2021 tentang Peraturan Pelaksanaan Undang-Undang Nomor 28 Tahun 2002 tentang Bangunan Gedung. Jakarta: Kementerian Pekerjaan Umum dan Perumahan Rakyat. Retrieved from Database Peraturan JDIH BPK: <https://peraturan.bpk.go.id/Details/104476/permen-pupr-no-24prtm2008-tahun-2008>
- Romodana, S., Junista, S. S., & Gunawan, A. (2025). Teknik Pengumpulan Data Observasi, Wawancara dan Kuesioner. *JISOSEPOL : Jurnal Ilmu Sosial Ekonomi dan Politik*.
- Santosa, W. (2018). *Arsitektur dan Kenyamanan Ruang: Pendekatan Humanistik dalam Desain Bangunan*. Yogyakarta: Pustaka Pelajar.
- Suhartini, T., & Rizal, M. (2019). Evaluasi Kualitas Lingkungan Fisik Rumah Susun Terhadap Kenyamanan Penghuni di Jakarta. *Jurnal Arsitektur Nusantara*, Vol. 2, No. 2, Hal. 75-87, 2019.
- Zulfirman, R. (2022). Implementasi Metode Outdoor Learning Dalam Peningkatan Hasil Belajar Siswa Pada Mata Pelajaran Pendidikan Agama Islam Di MAN 1 Medan. *JPPP Jurnal Penelitian, Pendidikan dan Pengajaran*.