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DESIGNING SUSTAINABLE AND COMFORTABLE HOMES: INTEGRATING SCANDINAVIAN CONTEMPORARY ARCHITECTURE FOR HOUSING DEVELOPMENT IN WONOSOBO

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Abstract: The growing demand for healthy, comfortable, and environmentally-friendly housing is increasingly urgent in Indonesia, particularly in areas experiencing high urbanization rates, such as Wonosobo. This study aims to design a housing plan using a Scandinavian contemporary architectural approach, emphasizing the creation of a clean, healthy, and cool living environment, equipped with supporting facilities such as sports areas, prayer rooms, and gardens. The design method involves data collection through site observations, literature studies, and analysis of factors such as site utilities, sun orientation, wind direction, noise, accessibility, and the social conditions of the local community. The study also includes comparative research on four different buildings to identify typical elements found in Scandinavian contemporary houses. The results of this planning process lead to the development of several room criteria used in the housing design in Wonosobo, which will consist of various-sized housing clusters. A primary focus of this design is maximizing natural lighting, reflecting Scandinavian contemporary values while ensuring comfort for the residents.

Keywords: Housing, Scandinavian, Residential, Contemporary, Planning

1. INTRODUCTION

Indonesia's rapid urbanization has led to numerous challenges, particularly in large cities and emerging urban areas. These challenges include housing shortages, traffic congestion, environmental degradation, and the inadequate provision of essential services, such as clean water, waste management, and healthcare. The growing population, coupled with urbanization, has increased the number of people residing in informal settlements, often on land they do not own, which exacerbates these issues (Sugiarto & Pramono, 2025). As urban problems become more complex, they demand immediate and comprehensive solutions from policymakers, especially in the realm of housing and urban development.

Despite the critical need for housing, Indonesia faces a significant housing deficit. The limited supply of urban land is unable to keep pace with the rapid population growth caused by continued migration and urbanization. This imbalance leads to increased population density, overcrowded settlements, and a worsening shortage of affordable housing (Ginting & Sutrisno, 2026). Housing, a fundamental human need alongside food and clothing, is essential

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for securing not only shelter but also a better quality of life. As urban populations increase, the demand for housing has reached a critical point where new, innovative housing models are required to meet the growing demand.

In the context of housing development, the design and construction of homes are influenced by a range of factors, including social, economic, and cultural considerations. The diversity of architectural styles and the complexity of housing needs reflect the different tastes, expectations, and resources of individuals and communities. However, urban housing must address more than just basic shelter—it must promote health, sustainability, and social well-being (Wang & Zhang, 2025). This is especially critical in Indonesia, where people are not only looking for a place to live but also for a home that offers comfort, safety, and environmental sustainability. The increasing pressures on land, coupled with limited access to necessary services and the threat of environmental degradation, make the integration of sustainability into housing planning imperative.

Advancements in contemporary architectural knowledge have shifted the focus towards integrating design elements that promote both environmental sustainability and the well-being of the inhabitants. Scandinavian architecture, known for its emphasis on simplicity, functionality, and sustainability, offers valuable insights into addressing these challenges. This approach prioritizes natural light, energy efficiency, and materials that support a healthy, clean environment, which is especially relevant in tropical and semi-tropical regions like Indonesia (Kristiansen & Johansen, 2025). Furthermore, the application of Scandinavian design principles, which prioritize user comfort, environmental harmony, and aesthetic simplicity, represents a novel and promising direction for housing development in Indonesia. By introducing Scandinavian contemporary design into Wonosobo's housing market, this research aims to explore the feasibility of incorporating these principles to create healthier, more comfortable, and environmentally conscious residential areas.

The current advancement in housing science emphasizes sustainable and climate-responsive designs that reduce energy consumption while maintaining high levels of comfort. Several studies have highlighted the importance of passive design strategies, such as the use of natural ventilation, solar orientation, and green building materials, which are all core components of Scandinavian design (Kristiansen & Johansen, 2025). However, the application of these principles in Indonesian housing, particularly in rural and semi-urban contexts like Wonosobo, remains underexplored. This research, therefore, contributes to the development of a Scandinavian-inspired housing model that not only integrates contemporary design but also addresses the critical issues of environmental sustainability, energy efficiency, and the growing housing demand in rapidly urbanizing areas.

In Wonosobo, with a population growth of 886,522 in 2021 (BPS Wonosobo, 2021), there is an urgent need for housing solutions that balance urbanization with the need for environmental and social sustainability. This study proposes a contemporary Scandinavian housing approach, focusing on maximizing natural light, promoting energy efficiency, and creating a healthy living environment through thoughtful architectural design. By exploring this novel housing model, this research aims to address the dual challenge of meeting housing demand while ensuring that the built environment remains environmentally sustainable and socially inclusive.

2. METHOD

The design methodology is a structured system or approach employed to collect data and generate insights that support the design process. The methods to be utilized in this approach are as follows:

1. Data Collection
   Data collection begins with observations conducted at the design site to gather essential information regarding the site's existing conditions. This includes assessing site utilities, sun orientation, wind direction, noise levels, accessibility, and the local community's socio-economic context. The methods for data collection include:
   - Survey Method: Direct observations of the site to gather data on current site conditions, including physical characteristics, environmental factors, and infrastructural elements.
   - Literature Review: An analysis of existing literature, including books, academic journals, and previous studies, to support the design process by providing foundational knowledge and theoretical insights.
2. Data Analysis
   Following data collection, an in-depth analysis is performed to interpret the gathered information. This analysis aims to identify both the potential and the challenges of the site. The focus is on evaluating the site's utilities, sun orientation, wind direction, noise levels, access/ accessibility, and the social dynamics of the local community. This stage forms the critical basis for making informed design decisions.
3. Conceptualization
   The analysis results are translated into conceptual outputs that guide the design. This includes the formulation of spatial layouts, utility plans, and building massing strategies, integrating contemporary design concepts and

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modern architectural principles. The concepts developed at this stage aim to create a balanced relationship between functional requirements, aesthetic values, and environmental sustainability.

4. Design Development
   The final design process involves translating the conceptual ideas into detailed plans and working drawings (Detailed Engineering Design, or DED). These plans are developed using various software tools such as AutoCAD, SketchUp, CorelDRAW, Photoshop, and Lumion. This phase involves not only technical drawing but also visualization, ensuring that the proposed design is both feasible and aligned with the project's goals.

Fig. 1. Research Flow Chart

3. RESULT AND DISCUSSION

The selection of a location for the Scandinavian Contemporary Housing Project in Wonosobo must consider multiple factors, including the building's function. The proposed building must be a suitable residential space, meeting the requirements of structural integrity, functionality, and aesthetics. The design should prioritize user comfort, incorporate supporting social and public facilities, ensure clean and sanitary water installations, and have a positive impact on the surrounding environment. In this context, the land should be strategically located near the city center and well-connected to main transportation routes. Additionally, the community should have easy access to the location. The planning of Scandinavian contemporary housing in Wonosobo addresses both primary and secondary housing functions. The primary function focuses on providing housing that meets the needs of current or future residents, taking into account functional, structural, and aesthetic requirements. Comfort for the residents is prioritized in the design to ensure a high-quality living experience. The secondary function emphasizes the strategic location of the housing development, ensuring its proximity to key urban facilities such as business centers, educational institutions, terminals, and other public services. This integration with the broader urban context enhances the functionality of the housing and supports the surrounding infrastructure.

The users of the housing are categorized into two groups: residents and managers. Residents are individuals or families who will reside in the housing units, while managers are the developers responsible for maintaining the housing infrastructure, conducting inspections, cleaning, and making repairs as necessary. In terms of spatial planning and area requirements, the housing units are designed to reflect the characteristics of the residents. The

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development includes four unit types: one single-story unit, one two-story unit, and two three-story units. The spatial relationships between the various spaces are carefully planned to ensure that they function harmoniously, supporting the activities that take place within them. Micro spatial relationships involve site analysis, function analysis, user behavior analysis, and spatial configuration analysis. Macro spatial relationships, on the other hand, look at the site within its regional context, considering its location in the broader urban landscape. The site covers an area of 45,000 m² (4.5 hectares), characterized by relatively flat terrain and open land, which contributes to the overall planning strategy.

The primary entrance is located to the south, facing the Ajibarang-Secang road, which provides convenient access to public transportation. A service entrance is also positioned southward, adjacent to the main entrance, serving as the pedestrian access and exit point for the housing area. Performance and technical aspects are integral to the design process, especially when selecting structural materials and construction techniques. The design incorporates various material alternatives, with wood being a prominent choice for the housing structure. The roofing materials considered include wood, reinforced concrete, lightweight steel, and bamboo, each offering unique advantages in terms of durability and structural integrity. For instance, wooden roof frames are a critical component, providing both strength and stability to support the weight of the covering. Lightweight steel roof structures, made from materials like aluminum, zinc, and silicon, offer improved resistance to rust compared to conventional steel. The design will also feature solid and partition walls, where solid walls function as both load-bearing structures and privacy partitions, while partition walls are used to divide spaces. Reinforced concrete columns will support vertical loads, transferring them to beams and ultimately to the foundation. Regarding the foundation design, both river stone and footing foundations will be employed. River stone foundations offer flexibility and efficiency in load-bearing, making them suitable for soft soils and minimizing the risk of structural instability. Footing foundations will support the building on soft soil, ensuring stability and preventing settlement.

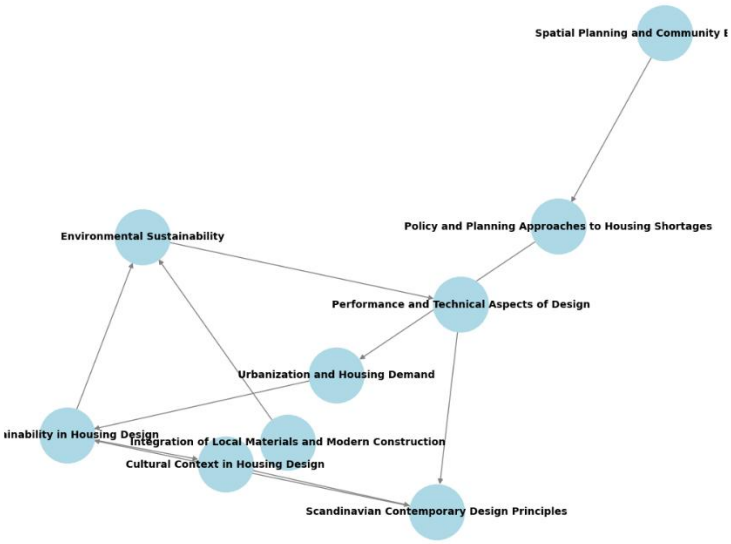

Fig. 2. Key Themes in The Scandinavian Housing Design

The building utility systems are designed to provide essential services. Lighting systems will include both natural and artificial lighting, with natural lighting being utilized during the day and artificial lighting powered by electricity at night. The water supply system will be connected to both arterial wells and the PDAM (Regional Water Company), while wastewater will be managed through septic tanks and seepage pits to ensure proper sanitation. A waste management system will separate wet and dry waste, with designated bins used for collection and transport to municipal waste disposal sites. Stormwater will be managed through a drainage system to prevent flooding and ensure efficient removal of excess water from the site. Architecturally, the design of the housing aims to be simple and functional. The use of clean shapes such as squares and triangles provides a minimalist aesthetic while maintaining practicality. The design maximizes natural light and ventilation through strategically placed openings, enhancing environmental comfort for residents. The materials chosen are of high quality yet

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unpretentious, focusing on durability and functionality rather than decorative ornamentation. The design reflects modern architectural trends while integrating sustainable practices, contributing positively to the urban landscape and the surrounding community.

Fig. 3. Housing Perspective

The Scandinavian contemporary housing project in Wonosobo exemplifies a comprehensive and innovative approach to addressing housing needs in a rapidly urbanizing region. As highlighted by Liu et al. (2026), urbanization poses significant challenges, particularly in Southeast Asia, where rapid population growth exacerbates housing shortages. The Wonosobo project responds to these challenges by addressing both the functional and aesthetic needs of future and current residents. By prioritizing comfort, accessibility, and integration with the surrounding urban fabric, the design ensures that the housing units not only serve as homes but also as part of a broader urban strategy that enhances community well-being.

One of the most critical elements of the Wonosobo project is its focus on the cultural context and the importance of integrating local values into housing design. This principle aligns with the work of Ismail and Zainal (2026), who argue that understanding local traditions, lifestyles, and environmental conditions is crucial for creating spaces that are not only functional but also meaningful to residents. In the case of Wonosobo, the incorporation of Scandinavian contemporary design with local materials such as wood and bamboo reflects a fusion of modernity with traditional practices. This approach ensures that the housing is relevant to the local context, fostering a sense of belonging and community. The use of materials suited to the tropical climate, such as lightweight steel and bamboo, not only supports the aesthetic appeal of the project but also contributes to its sustainability by reducing the carbon footprint associated with the construction process.

Moreover, the project's attention to spatial planning is reflective of broader trends in contemporary urban housing development, as emphasized by Wang and Zhang (2025). Their research on the impact of urbanization on housing development in China underscores the importance of thoughtful spatial organization in meeting the growing demand for housing. In Wonosobo, the project features four types of housing units—ranging from single-story to three-story units—designed to accommodate a diverse range of family sizes and lifestyles. The careful planning of micro and macro spatial relationships ensures that the housing units support the specific needs and behaviors of the residents while fostering community interaction. This spatial planning approach ensures that the housing is not only functional but also contributes to a sense of community, where residents can interact and engage with one another.

Furthermore, the strategic location of the Wonosobo housing development reflects the growing recognition that housing projects must be well-integrated into the surrounding urban infrastructure. Li and Liu (2025) emphasize that addressing housing shortages requires more than just the construction of new units; it involves creating housing that is accessible and connected to essential services and public facilities. The Wonosobo project's location, with its proximity to business centers, educational institutions, and public transportation hubs, ensures that residents have easy access to these essential services. This integration not only makes the housing more functional but also contributes to the broader urban planning goals of reducing congestion and promoting sustainable urban growth. The emphasis on location within the urban fabric is a key factor in enhancing the quality of life for residents and ensuring that the housing development contributes to the long-term sustainability of the city.

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The integration of sustainability principles into the Wonosobo housing project also aligns with recent trends in urban housing design. As Kristiansen and Johansen (2025) discuss, the growing focus on sustainable building practices has led to the adoption of energy-efficient designs, renewable materials, and environmentally responsible construction techniques. The Wonosobo housing development's use of natural materials like wood and bamboo, as well as its emphasis on energy efficiency, highlights the importance of sustainable practices in addressing the housing challenges of urbanizing regions. By maximizing the use of natural light and ventilation, the design reduces the need for artificial lighting and cooling, lowering energy consumption and contributing to a more sustainable living environment. The adoption of sustainable construction techniques also aligns with the findings of Li and Liu (2025), who argue that sustainable planning and policy approaches are essential to addressing the housing shortages in Southeast Asia.

Additionally, the Wonosobo project places a significant emphasis on environmental sustainability by incorporating advanced stormwater management and waste management systems. As discussed by Wang et al. (2025), effective waste management and stormwater systems are critical for ensuring the long-term sustainability of housing projects. In Wonosobo, the incorporation of a drainage system to manage rainwater runoff and prevent flooding is an essential component of the project's sustainability strategy. Similarly, the housing development's waste management system, which separates wet and dry waste, ensures that waste is properly handled and disposed of in an environmentally responsible manner. This approach reflects the increasing importance of environmental sustainability in urban housing development and contributes to the broader goals of reducing the environmental impact of construction projects.

In terms of building utilities, the Wonosobo housing development adopts a comprehensive approach to ensuring that residents have access to reliable services. The integration of both natural and artificial lighting systems, as well as the use of sustainable water supply and wastewater management systems, reflects the project's commitment to providing a high quality of life for its residents. As noted by Liu et al. (2026), housing developments in rapidly urbanizing areas must prioritize the provision of essential services to ensure that residents can live comfortably and sustainably. The Wonosobo project's focus on lighting, water supply, and waste management is a key component of this approach, ensuring that the development meets the basic needs of residents while minimizing its environmental footprint. Moreover, the emphasis on building structure and material selection in the Wonosobo project reflects the growing recognition of the importance of durable and resilient construction. As Kristiansen and Johansen (2025) highlight, sustainable construction practices must focus on selecting materials that can withstand the challenges posed by the local climate and environmental conditions. In Wonosobo, the use of reinforced concrete columns, river stone foundations, and lightweight steel structures ensures that the housing is both structurally sound and capable of withstanding the pressures of urbanization and environmental changes. This focus on durable construction materials contributes to the long-term resilience of the housing development and ensures that it can continue to serve the needs of residents for years to come.

The Wonosobo housing project's innovative approach to urban housing, which integrates modern architectural trends with sustainable practices and cultural context, offers valuable insights for addressing the housing challenges in Southeast Asia. By prioritizing functionality, comfort, and sustainability, the project contributes to the broader goals of creating livable, resilient, and sustainable communities in rapidly urbanizing regions.

To further enrich the discussion by comparing the findings with recent research, one important reference is a study on biophilic design in sustainable housing. Sholanke, Babalola, and Oni (2026) emphasize that biophilic design – an approach that connects residential spaces with nature – can create living environments that are not only environmentally friendly but also enhance the comfort and well-being of residents through rich visual and sensory experiences. This approach incorporates elements such as green spaces, integration of plants within the building, natural ventilation, and the use of materials that promote a connection with the natural environment. Such integration allows housing projects to contribute to sustainable development goals, such as promoting the health and well-being of communities, fostering sustainable cities, mitigating climate change, and conserving biodiversity in urban ecosystems. The biophilic design approach aligns with global trends in sustainable housing and offers an additional framework that could complement Scandinavian contemporary design principles in the Wonosobo project. This would strengthen the connection between residents and the natural environment while also enhancing the overall quality of life for long-term inhabitants.

Thus, the introduction of biophilic design research demonstrates that contemporary housing architecture is increasingly focusing not only on spatial efficiency, building structure, and social connectivity but also on the relationship between the quality of spaces and natural elements. This approach becomes highly relevant when considering the residents' need for a higher quality of living environments in the face of urbanization, climate

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change, and the well-being demands of people living in urban or semi-urban areas like Wonosobo. By incorporating these principles, housing projects could provide additional value not just in terms of technical aspects and spatial functionality but also in terms of the psychological well-being of the inhabitants, such as comfort, tranquility, and a stronger connection to their living environment. This perspective would further enrich the discourse on housing design in Indonesia with a more holistic approach that emphasizes long-term sustainability.

To further strengthen the comparison with recent research and expand the discussion, additional literature on sustainable and eco-friendly housing design provides valuable insights that complement the Scandinavian contemporary housing concept proposed for Wonosobo. One such perspective is offered by Castillo (2026), who underscores the importance of integrating life-cycle and multi-criteria evaluation approaches in social and affordable housing design. This research explains that beyond meeting immediate residential needs, housing must be evaluated across its entire lifespan, considering affordability, long-term performance, environmental impacts, and construction efficiency. Such an approach resonates with the Wonosobo project's emphasis on both functional and technical performance, especially in terms of selecting durable materials and appropriate foundation systems that ensure stability while minimizing maintenance challenges over time. Integrating life-cycle considerations helps planners balance cost-effectiveness with sustainability goals, ensuring that housing developments remain viable and environmentally responsible in the long term.

Another strand of research relevant to contemporary housing design is the integration of sustainable architectural design with digital technologies. Studies like the one by Abbas, Adeel, Akbar, Hayyat, Bibi, and Din (2025) highlight how Building Information Modeling (BIM), modular construction, and smart energy systems can be combined with green building principles to enhance both the efficiency and environmental performance of affordable housing solutions. Their framework shows that digital design tools can optimize energy modeling, material use, and construction sequencing, which are crucial for reducing waste and enhancing the resilience of housing units. This notion aligns with the Wonosobo project's focus on performance and technical aspects, where advanced planning and material optimization can improve structural performance and sustainability, potentially reducing construction time and costs while boosting overall quality.

Research on sustainable design in vertical housing emphasizes similar principles of maximizing natural ventilation, energy efficiency, and eco-friendly materials to reduce carbon footprints and improve livability in dense urban contexts. Although vertical housing differs from the Scandinavian housing typologies proposed in Wonosobo, the underlying sustainable strategies—such as harnessing natural ventilation and lighting while incorporating eco-friendly design elements—reinforce comparable design imperatives. This adds empirical support for the Scandinavian housing design's emphasis on environmental comfort and passive design strategies that promote energy efficiency and resident well-being.

In addition, research on green open spaces highlights that integrating landscape elements and ecological infrastructure into housing developments can significantly contribute to urban resilience and livability. Kurniawan's (2025) review shows that green open spaces are more than aesthetic amenities: they promote ecological balance, support climate adaptation, and enhance community well-being. This complements the Scandinavian contemporary housing vision for Wonosobo, which strives for environmental comfort and sustainability. Incorporating landscaped areas, communal green spaces, and ecological corridors within the housing development would improve residents' physical and psychological well-being while reinforcing the project's sustainability goals.

By integrating these additional research findings, the Wonosobo Scandinavian housing project can be situated within a broader body of cutting-edge scholarship that advocates for holistic, performance-oriented, and sustainable housing strategies. Whether through life-cycle assessments, digital design integrations, passive and active sustainable design elements, or ecological infrastructure, these diverse literatures collectively signal a shift in housing design thinking—from merely delivering shelter to creating resilient, efficient, and life-enhancing living environments. This expanded research base strengthens the theoretical and practical foundation of the Scandinavian housing concept in Wonosobo, demonstrating its relevance not only to local needs but also to global discourses on sustainable urban housing.

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4. CONCLUSION

The contemporary Scandinavian housing development in Wonosobo Regency represents a residential area with a modern style blended with natural style. This housing is intended as a problem solver for people who desire to own their own home. Housing plays a crucial role in the continuity of life, which is subject to various conditions, making it crucial because housing itself is not only a place for shelter but also a place to protect oneself from

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various natural conditions that are not always favorable. Different social, cultural, economic, and physical environments give rise to varied responses, attitudes, and architectural ideas from the community. Facilities available in the contemporary Scandinavian housing complex vary, including: a sports hall, a children's playground, a waste disposal area, and others. In addition, other facilities around the housing complex include the Ngasinan gas station, the Wonosobo Prosecutor's Office, the Wonosobo City Square, and others. The contemporary Scandinavian housing development is expected to create a decent residential area and provide a positive impact on the surrounding community. The greater the population, the greater the economic opportunities that will be generated. The housing design is also expected to meet government regulations, so that legal requirements such as building permits (IMB) can be obtained.

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