

## APPLICATION OF GREEN BUILDING DESIGN PRINCIPLES IN THE DESIGN OF SMALL HOUSES

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**Abstract:** *The increase in the population of Medan City has a direct impact on the increasing demand for housing and settlements, which is not always in line with environmental carrying capacity and the fulfillment of livable housing standards. Residential buildings contribute significantly to energy and water consumption, as well as environmental degradation, thus requiring a sustainable design approach. This study aims to formulate criteria and principles for the design of simple, livable houses by applying the concept of green buildings. The research method used is descriptive qualitative with a focus on the design of class 1a residential buildings. The study was conducted through a review of relevant regulations and standards, including the Ministry of Public Works and Public Housing's Green Building principles, the GREENSHIP Homes assessment system by the Green Building Council Indonesia, and livable housing indicators from the North Sumatra II Housing Provision Implementation Center. The results of the study show that the application of green building concepts in Small Houses can be realized through proper site management, optimization of natural lighting and ventilation, efficient use of energy and water, sustainable waste and wastewater management, and the selection of environmentally friendly building materials. The application of these principles can produce Small Houses that not only meet livable standards but also contribute to environmental sustainability.*

**Keywords:** *Small Houses, Green Buildings, Sustainable Design, Medan City*

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### INTRODUCTION

Based on Medan City in figures for 2024, the population of Medan City in 2024 will exceed 2.4 million, with a population growth rate of 1.45%. This increase in population is accompanied by an increase in the provision of facilities and infrastructure, one of which is housing and settlements. This is in contrast to the carrying capacity of nature, which is declining over time. One of the causes of the decline in carrying capacity is the increasing number of buildings being constructed. Buildings are the biggest contributors to global warming and environmental destruction. In addition, the rate of fulfillment of housing and settlement needs is not accompanied by the provision of livable housing facilities. Therefore, it is necessary to formulate criteria and principles for the design of simple, livable houses that apply the concept of green buildings.

The development of sustainable building design standards that are environmentally friendly, or more commonly known as green building standards, has been widely undertaken. In Indonesia itself, the assessment standards frequently used are Greenship, issued by the Green Building Council Indonesia, and government regulations related to green buildings.

In an effort to address these issues, the concept of Green Buildings (BGH) has become an important approach in residential building design. Green buildings are not only oriented towards energy and resource efficiency, but also emphasize health,

occupant comfort, and environmental sustainability. In Indonesia, the application of the green building concept has been regulated through various regulations, including Government Regulation No. 16 of 2021, Minister of Public Works and Public Housing Regulation No. 21 of 2021, and Circular Letter of the Directorate General of Human Settlements No. 3 of 2023, which specifically regulates Class 1a Green Buildings for Small Houses.

In addition to government regulations, the Green Building Council Indonesia (GBCI) has also developed the GREENSHIP Homes assessment system as a guide for applying green building principles to residential homes. On the other hand, the standards for livable homes developed by the North Sumatra II Housing Provision Implementation Agency through the Self-Help Housing Clinic program provide basic indicators for meeting housing quality standards in line with sustainable development goals (SDGs).

To address this growing issue, Panca Budi University (UNPAB) is offering students the opportunity to participate in an internship program as part of the Merdeka Belajar Kampus Merdeka (MBKM) program. In this MBKM internship program, students have the opportunity to gain insight and experience to enter the world of work. Some of UNPAB's partners related to housing, settlements, and Green Buildings are the Green Building Council Indonesia (GBCI), the North Sumatra II Housing Provision Implementation Agency (BPPPS), and Real Estate Indonesia (REI) North Sumatra. Through this internship program, standards and criteria for designing livable residential buildings with green building concepts were established, which were then applied in the design of simple residential buildings in the Green Building Design Principles course at the Architecture Study Program, Faculty of Science and Technology, Universitas Pembangunan Panca Budi.

## **LITERATURE REVIEW**

### **1. Principles of Green Buildings**

Green buildings are architectural and construction contexts that apply environmentally friendly principles.

By definition, green buildings refer to buildings that are well-designed in terms of planning, design, construction, and operation to reduce the negative impact of buildings, create a positive effect on the environment and climate, and improve the quality of life of their occupants.

According to PUPR Ministerial Regulation No. 2/PRT/M/2015, a building is a physical structure resulting from construction work that is integrated with its location, partially or entirely above and/or below ground and/or water, which functions as a place for humans to carry out their activities, whether for residential or dwelling purposes, religious activities, business activities, social and cultural activities, or special activities. A Green Building is a building that meets building requirements and has significantly measurable performance in energy, water, and other resource savings through the application of green building principles in accordance with its function and classification at every stage of its implementation.

Green Buildings in the Technical Planning, Construction Implementation, and Utilization stages have three objectives, namely:

- a. Reducing Natural Resource Use:
  - Energy
  - Water
  - Materials
- b. Minimizing Environmental Impact:
  - Trash

- Land
- c. Improving Spaces to be Healthy and Comfortable:
  - Indoor air quality
  - Thermal and visual comfort
  - Noise levels

According to PUPR Ministerial Regulation No. 2/PRT/M/2015, the principles of green building include:

- a. Formulation of common goals, understanding, and action plans;
- b. Reduction in the use of resources, including land, materials, water, natural resources, and human resources (reduce);
- c. Reducing waste generation, both physical and non-physical;
- d. Reusing previously used resources (reuse);
- e. Using recycled resources (recycle);
- f. Protecting and managing the environment through conservation efforts;
- g. Mitigating risks to safety, health, climate change, and disasters;
- h. Life cycle orientation;
- i. Orientation towards achieving desired quality;
- j. Technological innovation for continuous improvement; and
- k. Improved institutional support, leadership, and management in implementation.

## 2. GreenShip Home

The Green Building Council Indonesia is an independent non-profit organization established in 2009 by leading professionals and companies in the Indonesian building industry, with a mission to transform market players and the industry to be more responsible and sustainable.

GBCI operates two different certification systems, namely Greenship certification based on the Greenship rating tool developed by GBC Indonesia, which currently covers six types of certification, such as new buildings, existing buildings, interior spaces, houses, environments, and net zero. Greenship certification can also cover all types of buildings. One of them applies specifically to residential houses, namely GREENSHIP Homes.

The types of homes that can be assessed are single-landed residential homes, which are single-family dwellings built on land, whether they are newly designed homes or existing homes. GREENSHIP is designed to assess new homes, existing homes, and redeveloped homes.

GREENSHIP Single-Family Homes consist of 6 categories, namely:

- a. Appropriate Site Development: Focuses on site selection and initial planning of a building. The goal is to minimize negative impacts on the surrounding environment and maximize the positive potential of the site.
- b. Energy Efficiency and Conservation: Focuses on efforts to conserve energy in a building.
- c. Water Conservation: Focuses on efforts to conserve water usage and manage wastewater sustainably.
- d. Material Resource and Cycle: Focuses on the selection of environmentally friendly and sustainable building materials.
- e. Indoor Health and Comfort: Focuses on indoor air quality, lighting, and good acoustics to support the health and comfort of occupants.
- f. Building Environment Management: Focuses on sustainable building management after construction is complete.

### 3. Class I a Green Building

Buildings, especially residential buildings, contribute significantly to energy use and greenhouse gas emissions. Therefore, the Ministry of Public Works and Public Housing encourages the development of buildings that prioritize sustainability. This is in accordance with government regulations governing green buildings, namely Government Regulation No. 16 of 2021 and Minister of Public Works and Public Housing Regulation No. 21 of 2021. For the housing and residential areas sector, a special regulation has been issued governing Class 1a Green Buildings, namely in the Circular Letter of the Directorate General of Human Settlements No. 3 of 2023.

According to SE DJCK No. 3 of 2023, Class 1a Buildings are ordinary residential buildings in the form of a single house or one or more attached houses separated by fire-resistant walls. BGH provisions are applied to Building Class 1a, namely single residential buildings in the form of a single house or one or more attached houses separated by fire-resistant walls, with the following provisions:

- a. Building area up to 72 m<sup>2</sup> for single-story residential buildings; or
- b. Building area up to 90 m<sup>2</sup> for two-story residential buildings.

The assessment parameters for Class 1a green buildings according to SE DJCK Number 3 of 2023 consist of:

- a. Site management; Focuses on site selection and initial planning of a building within the design area.
- b. Energy efficiency; Focuses on efforts to conserve energy in a building.
- c. Water efficiency; Focusing on efforts to conserve water usage.
- d. Indoor air quality; Focusing on indoor air quality
- e. Use of environmentally friendly materials; Focusing on the selection of environmentally friendly and sustainable building materials
- f. Waste management; Focusing on efforts to manage waste sustainably
- g. Wastewater management; Focusing on efforts to manage wastewater sustainably

### 4. Standards for Livable Housing (North Sumatra II Housing Provision Implementation Agency)

According to Government Regulation No. 14 of 2016 concerning the Implementation of Housing and Settlement Areas, a house is a building that functions as a livable dwelling, a means of family development, a reflection of the dignity and character of its occupants, and an asset for its owners.

The North Sumatra II Housing Provision Implementation Agency was established to facilitate coordination and encourage the implementation of housing development in Indonesia's one million houses program. The agency's tasks include constructing apartment buildings, special houses, self-help houses, infrastructure, facilities, and public utilities, as well as coordinating land provision and residential development. Its functions include formulating programs and budgets for construction implementation and technical construction plans, as well as conducting construction supervision and technical control.

One of the programs of the North Sumatra II Housing Provision Implementation Agency is the Self-Help Housing Clinic, which provides information, consultation, and technical assistance to individuals or groups to enhance community self-reliance in meeting the need for decent housing.

Indicators of livable housing based on the SDGs (Sustainable Development Goals) promoted by the Balai Pelaksanaan Penyediaan Perumahan Sumatera Utara II (North Sumatra II Housing Provision Agency) Self-Help Housing Clinic program consist of:

- a. Building Resilience

- b. Access to Sanitation
- c. Access to Clean Water
- d. Building Area (floor area per capita per person  $\geq 7.2 \text{ m}^2$ )
- e. Lighting and Ventilation (minimum lighting of 10% of floor area, minimum ventilation of 5% of floor area)

## **METHODS**

This research method uses qualitative descriptive, in which this study describes the criteria and principles of green building design. In this case, the research focuses on the design of Small Houses or class 1a buildings.

## **RESULTS AND DISCUSSION**

Green buildings are buildings that are designed, constructed, and operated with consideration for resource efficiency and reduction of negative impacts on the environment. In the context of Small Houses, the application of green building principles poses a unique challenge due to limited building space, construction costs, and site conditions. However, the results of the study show that green building principles can still be optimally applied to class 1a residential buildings if they are properly designed from the planning stage.

This study examines and synthesizes the Green Building principles from the Ministry of Public Works and Public Housing, the GREENSHIP Homes assessment criteria from the Green Building Council Indonesia, and the livable house indicators from the North Sumatra II Housing Provision Implementation Center. The results of the study show a strong correlation between the three standards, particularly in terms of site management, energy and water efficiency, indoor air quality, and the use of building materials.

### **1. Application of Land Use and Site Management Principles**

The results of the study show that site selection and management are initial aspects that greatly determine the success of applying the concept of green buildings to Small Houses. The principle of land use is applied through efficient building mass arrangement, maximizing open space, and maintaining a balance between built and unbuilt areas. Good site management also plays a role in reducing rainwater runoff, increasing soil permeability, and creating a more comfortable living environment.

In Small Houses, site management is carried out by considering the orientation of the building towards the sun and the prevailing wind direction. This arrangement aims to optimize natural lighting and ventilation, while minimizing the need for artificial energy.

### **2. Natural Lighting and Ventilation Quality**

Natural lighting and ventilation are important indicators in livable housing and green building standards. The study shows that the application of proportional building openings, with natural lighting of at least 10% of the floor area and natural ventilation of at least 5% of the floor area, can significantly improve indoor space quality. Good natural lighting can reduce dependence on electric lights during the day, while natural ventilation contributes to thermal comfort and indoor air quality.

In addition, the placement of cross ventilation openings is an effective strategy for improving air circulation, keeping indoor spaces healthy and comfortable for occupants.

### **3. Energy and Water Efficiency**

The results of the study show that energy efficiency in Small Houses can be achieved through passive design approaches, such as building orientation, use of natural lighting,



and selection of materials with good thermal performance. This approach is in line with the principles of Class 1a Green Buildings and the Energy Efficiency and Conservation category in GREENSHIP Homes.

In terms of water conservation, the implementation of water-saving sanitation devices and the management of rainwater and household wastewater are important steps. Water conservation not only reduces clean water consumption but also supports the sustainability of water resources in residential areas.

#### **4. Sustainable Waste and Wastewater Management**

Waste and wastewater management is an important aspect of green building implementation. Studies show that separating organic and inorganic waste at the household level and simple domestic wastewater management can reduce environmental pollution. This principle is in line with the waste and wastewater management parameters for Class 1a Green Buildings.

#### **5. Use of Environmentally Friendly Building Materials**

The selection of environmentally friendly building materials is an important aspect in supporting the sustainability of simple dwellings. Research results show that the use of local materials, materials with high durability, and recyclable materials can reduce the environmental impact throughout the building's life cycle. In addition, the use of appropriate materials also contributes to the thermal comfort and energy efficiency of buildings.

### **CONCLUSION AND RECOMMENDATIONS**

Based on the results of the study, it can be concluded that the application of green building design principles to Small Houses, particularly class 1a residential buildings, can be carried out effectively without compromising livable housing standards. The integration of the Green Building principles from the Ministry of Public Works and Public Housing, the GREENSHIP Homes assessment system by the Green Building Council Indonesia, and the livable housing indicators from the North Sumatra II Housing Provision Implementation Center has resulted in a comprehensive set of design criteria. The application of this concept is reflected in proper site management, optimization of natural lighting and ventilation, efficient use of energy and water, sustainable waste and wastewater management, and the selection of environmentally friendly building materials. Thus, Small Houses not only fulfill functional and technical aspects but also improve the quality of the environment and the comfort of residents in a sustainable manner.

As a recommendation, the application of green building principles in Small Houses needs to be encouraged from the initial planning stage so that the resulting designs are more efficient and sustainable. The government, academics, and housing developers are expected to use the results of this study as a reference in the design and construction of simple housing, especially in urban areas with high population growth pressure. In addition, further research is needed to examine the application of green building concepts in a more quantitative manner, especially in relation to energy and water efficiency and construction costs, so that the benefits of applying green buildings to Small Houses can be measured more objectively and practically.

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