ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

Green Building Performance Assessment on Building F Faculty of Engineering Widyatama University

Raden Herdian Bayu Ash Shiddiq[1]; Nia Nuraeni Suryaman[2]; Muhamad Nauval Rahman[3]; Desi Indriyanti[4]

[1,3,4]Department of Civil Engineering, Widyatama University, Bandung, Indonesia
[2]Department of Mechanical Engineering, Widyatama University, Bandung, Indonesia

Publication Date: 2025/02/22

Abstract: Climate change and environmental degradation have become pressing global issues, and building construction will inevitably affect the environment. Based on data from the World Building Council, buildings globally contribute to 40% of energy emissions and 50% of CO_2. The rapid growth of urbanization and increased demand for residential and commercial space demand more environmentally friendly solutions. Green building performance assessment has become an increasingly important topic in the construction industry. Green building is an innovative approach to designing and operating environmentally friendly buildings. Green building performance assessment in campus buildings is an important process in an effort to improve the sustainability of the campus environment. The results of the research analysis of green buildings in Building F Faculty of Engineering obtained cumulative results of light intensity 1080.8 lux for the minimum value, 1143.7 lux for the maximum value, and 1140.5 lux for the average value. Cumulative temperature obtained a minimum value of 28.6 ˚C, a maximum value of 28.7 ˚C, and an average value of 28.6 ˚C. Cumulative humidity obtained a minimum value of 60.2 RH, an average value of 60.4 RH, and a maximum value of 60.7 RH. The result of the WWR value on the envelope is 31.5% ≥ 30%. In the checklist of the 2021 PUPR Regulation No. 21, 31 out of 83 points were obtained for green building research. This assessment aims to evaluate the extent to which campus buildings meet sustainability criteria, which include energy efficiency, water management, use of materials and resources, and indoor environmental quality.

Keywords: *Assessment; Performance; Green Building; Campus.*

How to Cite: Raden Herdian Bayu Ash Shiddiq; Nia Nuraeni Suryaman; Muhamad Nauval Rahman; Desi Indriyanti. (2025). Green Building Performance Assessment on Building F Faculty of Engineering Widyatama University. *International Journal of Innovative Science and Research Technology*, 10(2), 313-326. https://doi.org/10.5281/zenodo.14908893.

I. INTRODUCTION

Environmental harm and climate change have emerged as major worldwide concerns. Satrio Dwi Prakoso, the head of the International Society of Sustainability Professionals Indonesia, claims that buildings are responsible for 50% of CO2 emissions and 40% of energy emissions worldwide, according to statistics from the World Building Council. Building development will undoubtedly have an impact on the environment. Buildings are the biggest source of CO2 emissions on Earth, accounting for between 30 and 40 percent of total emissions, according to [1]. As a result, the issue leads to pollution, biodiversity loss, and resource depletion.

The development of green buildings has emerged as a key strategy for establishing a more sustainable and healthful living environment in the current period, which calls for a greater awareness of the environment. Green buildings, also known as sustainable structures, are architectural and construction innovations that prioritize carbon footprint reduction, energy efficiency, and the use of eco-friendly materials. More ecologically friendly solutions are required in Indonesia due to the country's fast urbanization and rising demand for residential and commercial space. The evaluation of green building performance has grown in importance in the construction sector, notably on college campuses. On college campuses, green buildings or sustainable constructions offer a lot of potential to minimize adverse environmental effects, increase energy efficiency, maximize resource utilization, and provide a healthy learning environment for staff and students.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

One way to gauge and analyze how well a building satisfies certain sustainability standards is via the performance evaluation of green buildings. These standards encompass socioeconomic effect, indoor environmental quality, materials and resources, water management, and energy efficiency [2]. University campuses may track and evaluate how well their green buildings meet the set sustainability objectives by using performance evaluations.

Campus green building performance evaluation offers a number of important advantages. Initially, this evaluation may assist Widyatama University in pinpointing opportunities to enhance resource use and energy efficiency while mitigating adverse environmental effects. Second, this evaluation may provide quantifiable and pertinent information for tracking and reporting on the campus's sustainability accomplishments. Third, via better waste management, indoor air quality, and the use of eco-friendly materials, this evaluation may raise building occupants' understanding of environmental issues and increase their safety, including staff, instructors, and students.

II. LITERATURE REVIEW

A. Global Warming

Global warming is the term used to describe the steadily rising average Earth's surface temperature brought on by an increase in greenhouse gas concentrations in the atmosphere. Human activity is mostly to blame for the rise in greenhouse gasses, particularly the burning of fossil fuels like coal, oil, and gas for energy, which releases a lot of CO2 into the atmosphere [3]. Among these gases are nitrous oxide (N2O), carbon dioxide (CO2), and methane (CH4). Furthermore, the impacts of global warming are made worse by extensive deforestation, which lowers the amount of trees that can absorb CO2 [4].

The building sector, which uses the most natural resources worldwide, contributes significantly to mitigating the effects of global warming [5]. The effects of global warming are extensive and intricate. Changes in weather patterns, such as a rise in the frequency and severity of storms, heavy rainfall, and droughts globally, are among the most obvious. Furthermore, as a result of global warming, ice melts at the poles and mountain glaciers, increasing sea levels and posing a hazard to coastal regions, especially major cities worldwide, by increasing the likelihood of floods. Millions of people's lives are impacted by this phenomena, which results in large losses on both an economic and social level. The loss of habitat brought on by climate change also poses a threat to biodiversity; many plant and animal species are in danger of becoming extinct owing to their incapacity to adjust to the rapid changes in their surroundings. Furthermore, human health is at risk due to global warming [6].

This is a serious problem that requires immediate and coordinated response. Since fossil fuels are the primary source of greenhouse gas emissions, renewable energy sources like solar, wind, and water should be given priority. Reducing emissions and energy usage may also be achieved by increasing energy efficiency in areas like homes, businesses, and transportation. Because trees and plants naturally absorb CO2 from the atmosphere, reforestation and re-greening damaged regions are also crucial actions. However, there are further strategies to lower the quantity of trash produced, such as recycling, reducing, and reusing garbage. In the end, this will lead to a decrease in greenhouse gas emissions from landfill decomposition [7].

B. Green Building

Green buildings, also known as green construction or sustainable buildings, are structures designed in an environmentally friendly manner, energy-efficient, and using eco-friendly materials to address issues such as environmental degradation, global warming, and efforts to achieve efficient resource use throughout the building's life cycle, from planning and construction to operation, maintenance, renovation, and demolition [8]. Green buildings are structures that begin with design, construction, operation, and maintenance. It aims to protect, preserve, and reduce natural resources, maintain indoor air quality and sustainable profitability, and safeguard public health. All of this is done by adhering to the appropriate construction regulations [9]. In other words, a Green Building is a structure designed to reduce environmental impact with the aim of maintaining a healthy environment and human condition [10]. Green buildings are the result of planning, implementation, and the use of environmentally friendly construction, which uses energy and resources efficiently, at low cost, healthy, and comfortable for occupants, and based on sustainable principles [11]. Green buildings also have the characteristic that they are designed with consideration for the environment and natural conditions to maintain environmental sustainability and human health [12].

According to the Regulation of the Minister of PUPR of the Republic of Indonesia Number 21 of 2021, a Green Building is a building that meets the technical standards of building construction and has significantly measurable performance in energy, water, and other resource savings through the application of Green Building principles according to its function and classification at each stage of its implementation [2]. The parameters in the assessment of green building performance according to the Regulation of the Minister of PUPR of the Republic of Indonesia Number 21 of 2021, among others:

- *Environmental Conservation Policy and Development of BGH Utilization SOP*

Building management policies are the first step towards environmental preservation. The policies created are expected to help reduce energy and water consumption, as well as efforts to repair the environment if the building pollutes it. The efforts to implement field socialization ensure that the policy is reviewed.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

➢ *Legislative Requirements*

The regulations applicable to green building ensure that construction meets sustainability and environmentally friendly standards by reducing negative environmental impacts, improving energy efficiency and water resource usage, and enhancing the health and comfort of occupants. In addition, these regulations ensure that buildings comply with environmentally friendly standards and use durable materials and the latest technology.

➢ *Methods and Performance of Operation and Maintenance*

The operation and maintenance methods of green buildings focus on effective resource management, scheduled preventive maintenance, and long-term sustainability and efficiency. This includes regular monitoring and performance evaluation to ensure the system operates according to regulations and remains safe for the environment and the comfort of the occupants.

➢ *State of Emergency*

Emergency response situations include procedures and systems used to protect residents and the environment in case of crises such as fires, natural disasters, or system failures. This includes implementing integrated alarm and detection systems, creating clear evacuation plans, and providing regular training to residents and employees on emergency procedures.

➢ *Development of Building Manager Capacity*

The Development of Building Manager Capacity is ongoing training and education to ensure managers can manage and maintain complex systems such as environmentally friendly technologies, energy efficiency, and water management.

➢ *Modification Planning for Performance Adjustment*

Renovation Planning for Performance Adjustment involves building design and system evaluation to enhance sustainability and efficiency based on the latest performance data. A thorough analysis of energy use, air quality, and resource management is conducted in this process to determine which areas need improvement. Technology upgrades, the use of environmentally friendly materials, or operational adjustments to maximize building performance in accordance with green building standards.

C. Assessment of Green Building Performance

According to the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 21 of 2021, the performance assessment of green buildings is conducted by evaluating the compliance with the technical standards of green buildings according to the established parameters and criteria, among others:

- A new building with mandatory category.
- New building with recommended category.
- Buildings that already exist are categorized as mandatory.
- Existing buildings are categorized as recommended.
- H2M with the recommended category.
- New Green Area with recommended category.
- Existing Green Areas with the recommended category.

Particularly in the Green Building's use phase for existing structures, the Green Building's performance was evaluated in Building F, Faculty of Engineering, Widyatama University.

In the performance assessment of the Green Building at Building F, Faculty of Engineering, Widyatama University, specifically in the utilization phase of the Green Building for existing buildings.

The performance assessment of the Green Building at Building F, Faculty of Engineering, Widyatama University, is conducted with reference to the Regulation of the Minister of Public Works and Public Housing (PUPR) Number 21 of 2021. This regulation provides a basic framework for assessing how green and sustainable a building is, particularly in terms of energy efficiency, water usage, waste management, and other aspects that support environmental sustainability. In addition, this assessment also follows the point criteria outlined in the Minister of PUPR Circular Letter Number 01/SE/M/2022 [13].

Table 1: Points Parameter for Building Performance Assessment

No	**Building Performance Assessment Parameters**	**Point**
	Organization and Governance of Green Building	
1	Environmental Conservation Policy and the Development of BGH Utilization SOP	18
2	Legislative Requirements	2
3	Methods and Performance of Operation and Maintenance	5
4	State of Emergency	1
5	Development of Building Manager Capacity	4

D. Determination of Temperature and Humidity Measurement Points

Air temperature is a quantity that describes the degree of heat or cold of an object, and the instrument used to measure temperature is a thermometer [14]. Meanwhile, humidity is the concentration of water vapor in the air. First, prepare all the necessary tools for measurement [15]. After that, perform a functional test and calibration of the equipment to ensure that it is in good condition and ready for use. Standard Operating Procedures for measuring temperature and humidity are as follows:

➢ *Tools and Materials:*

- Thermohygrometer
- Stationery

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

- Measurement observation sheet

➢ *How it Works:*

- Prepare the tools that will be used.
- Conduct a functional test of the equipment and calibrate the equipment.
- Read the equipment usage instructions before operating the equipment.
- Operate the tool.
- Hold the tool 1-1,5 meters from the floor, 1 meter from the wall, and 1 meter from the ceiling.
- Slide the on/off button to the on position
- Pay attention to the number displayed on the screen.
- Wait until the number displayed is constant.
- Take the measurement 3 times.
- Record the measurement results on the measurement sheet.
- Keep the device away from direct sunlight.

E. Determination of Light Intensity Points

Measurement of indoor lighting is conducted by considering the area of the room and the necessary measurement points. For rooms with an area of less than 50 m², the number of measurement points is calculated based on the rule that one measurement point represents a maximum of 3 m³. These measurement points are determined at the intersection of two diagonal lines connecting the length and width of the room. In rooms with an area between 50 m² and 100 m², the minimum number of measurement points is 25 points, with the placement of these points also being at the intersection of the two diagonal lines of the room's length and width. Meanwhile, for rooms larger than 100 m², a minimum of 36 measurement points is required, with their placement also following the same principle. In addition, for local lighting measurements, measurement points are specifically determined on objects, work items, equipment or machines, as well as certain work areas that require more detailed lighting evaluation [16].

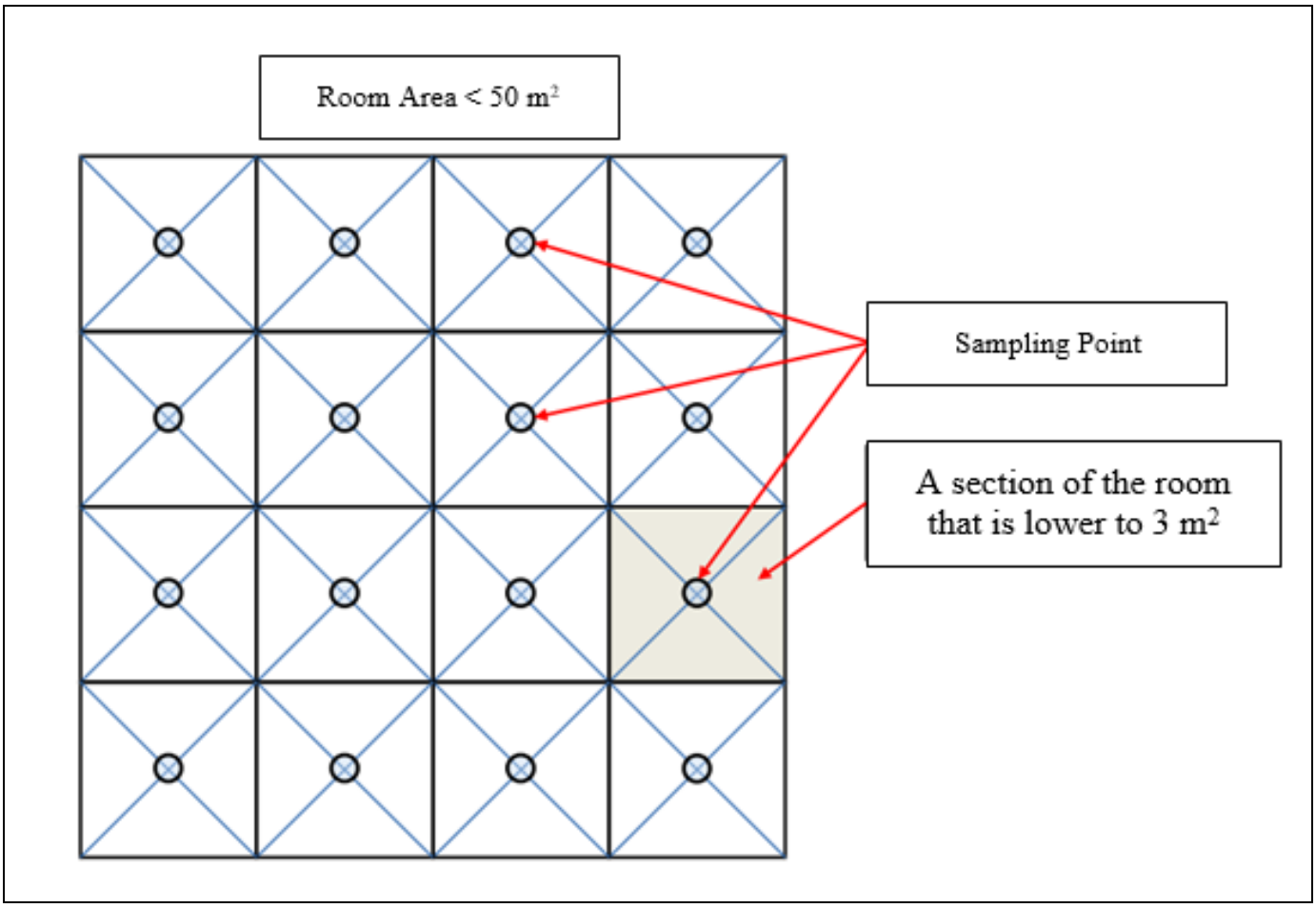

Fig 1: Determination of Light Intensity Measurement Points

F. Determination of the Cloak Measurement Point

According to the Jakarta Green Building User Guide Vol.1, the building envelope is a component that forms the building, consisting of opaque components (such as walls) and fenestration systems or transparent components (such as windows) that separate the interior of the building from its external environment [15]. This measurement has a systematic approach by calculating the width and length of walls throughout the building, and also measuring the length and width of openings such as doors, windows, and glass. Once the areas are obtained, the WWR value can be calculated, with the calculation referring to the Minister of PUPR Regulation 2021 no. 21:

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

$$WWR = (\text{Building area}/\text{Envelope Area}) < 30\% \quad (1)$$

G. Use of Tools

The Environment Meter is a measuring device that can be used to measure the surrounding environmental conditions. This device combines several measurement parameter functions, namely temperature, humidity, light intensity, air circulation, and noise level [17]. For measuring room temperature, room humidity, and light intensity, the Krisbow KW06-291 Environment Meter is used. Environment Meter KW06-291 is a meter designed to combine several functions as follows:

- The function of the light meter is used to measure lighting in the field. The light-sensitive component used in this meter is very stable, a long-life silicon diode.
- Humidity / temperature using humidity / semiconductor sensors and type K thermocouples.
- The function of a temperature meter is to measure the temperature of a specific area, region, or place.

➢ *The Way the Environment Meter Works is as Follows:*

- Insert the 12-volt battery.
- Press the on/off button to turn it on.
- Insert temperature, humidity, and light intensity tools.
- Set or change the 4 in 1 Environment Meter function.
- Then the screen will display the temperature, humidity, and ambient light.
- Press the avg/min/max button.
- Press hold and read the value displayed on the Environment Meter.

H. Previous Research

The research uses information from previous studies as a comparison to identify the strengths and weaknesses of those studies. In addition, the researcher seeks information from other articles and journals about theories relevant to the title used as the basis for the scientific theory.

Table 2: Previous Research Studies

Sr. No.	Title, Author, Year of Publication	Analysis Method	Research Variables
1	Implementation of the Green Building Concept (GBC) in the Educators' Apartment Complex at UGM, Nugroho Eko Praptomo, Year 2024. [6]	The analysis method used is the qualitative descriptive method.	Performance assessment of green buildings based on PUPR Regulation No. 21 of 2021. Conducted by evaluating 7 parameter aspects.
2	Assessment of Green Building Performance at the Faculty of Education Building, Samudra University, Alnanda Hafiez Lagalgarin, Meilandy Purwandito, Nova Purnama Lisa, Year 2023. [18]	The analysis method used in this research is the qualitative descriptive method.	The research variables include: Site management, Energy use efficiency, Water use efficiency, Waste management, and Wastewater management.
3	Assessment of Green Building Performance During the Construction Phase According to PERMEN PUPR NO. 21/2021, Aziz Ilmiansyah Sudaryanto, Galih Adya Taurano, and Julmadian Abda, Year 2024. [19]	The research method used in this study is descriptive analytical. by collecting data through observation methods, document studies, and literature reviews.	This research uses the Method descriptive and assisted data presentation using AHP. The variables being tested are variables X, Y, and Z. The validity and reliability tests were conducted on the variables.
4	Application of the Green Building Concept Case Study: The Building of Istiqlal Mosque Jakarta, Aristia Kusuma, Year 2022. [20]	The analysis method used is a qualitative descriptive method with a case study approach.	The variable of this research lies in its focus on the application of green building principles and highlights how the renovation of this mosque not only meets functional but also aesthetic needs.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

III. METHODOLOGY

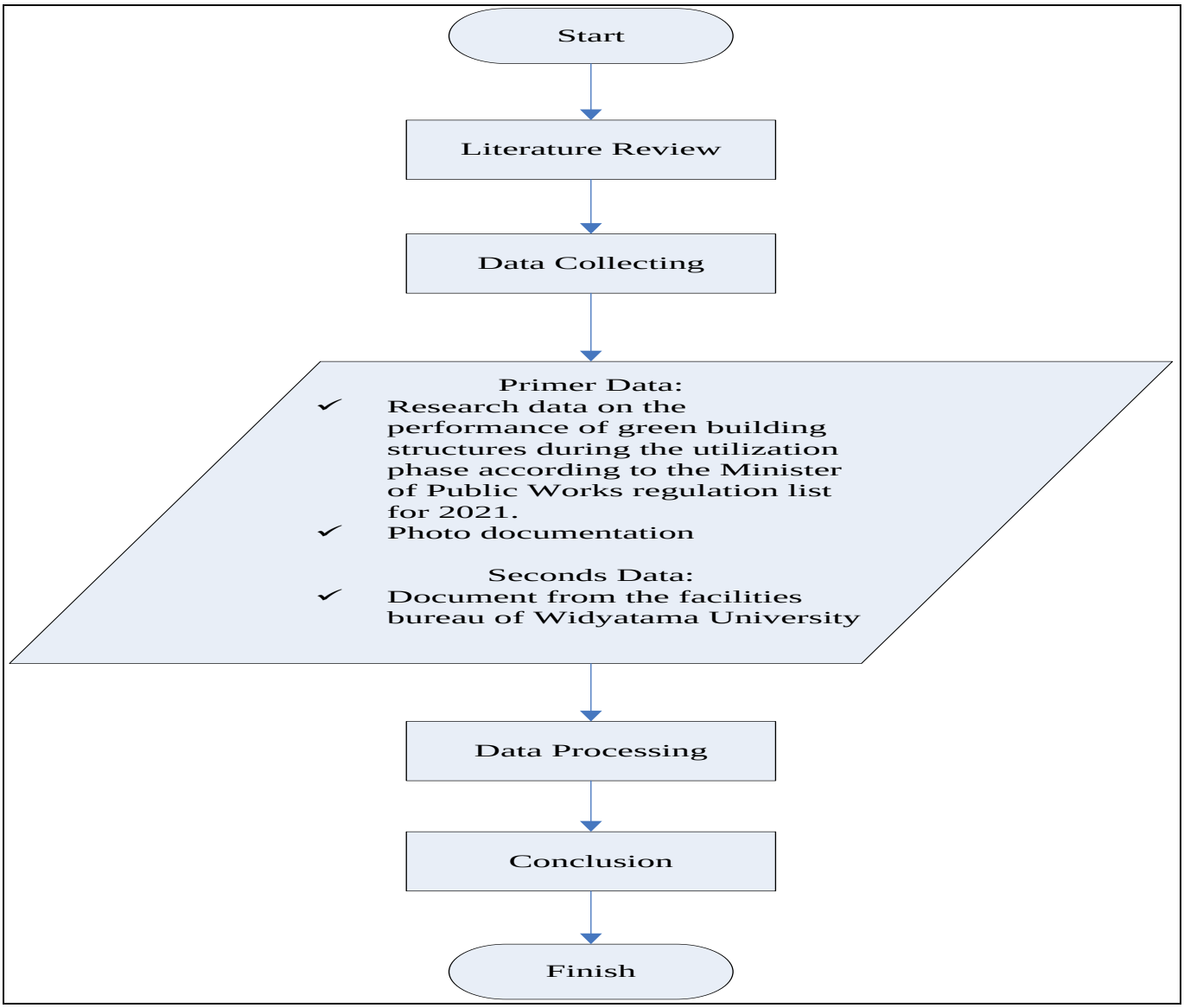

Fig 2: Flowchart

➢ *To Achieve the Aims and Objectives of the Research, the Methods Used in this Research Writing are as Follows:*

- *Literature Study.* At this stage, reference literacy related to the assessment of green building performance is conducted from various sources such as scientific journals, books, and other articles.
- *Data Collection.* At this stage, two types of data will be collected, namely secondary data in the form of design images of Building F and its specifications (if available). Also, primary data will be collected through measurements referring to the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 21 of 2021.
- *Data Processing.* At this stage, data processing is carried out according to the needs of evaluating the performance of green building structures for existing buildings in the utilization phase, in accordance with the technical guidelines in the Minister's Circular No. 01 of 2022.
- *Conclusion.* At this stage, the author will present the core summary or outline of this research.

The location of this research is in Building F, Faculty of Engineering, Widyatama University, located at Jl. Cikutra No. 204A, Sukapada, Cibeunying Kidul District, Bandung City, West Java 40125.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

Fig 3: Building F, Faculty of Engineering, Widyatama University

IV. RESULTS AND DISCUSSION

A. Data Collection Methods

The data requirements in this research include primary and secondary data. Primary data in the form of building performance assessment data during the utilization phase in Building F, Faculty of Engineering, Widyatama University, in accordance with the list of the Minister of Public Works and Public Housing of the Republic of Indonesia Regulation Number 21 of 2021 and activity documentation in the research. For secondary data, it consists of the physical condition of the research area obtained from the Facilities Bureau of Widyatama University and literature and journal data.

This research begins with the collection of data from interviews with the Facilities Bureau of Widyatama University and the observation of the floor plan of Building F, both visually and directly regarding the physical condition of the research area.

Fig 4: Interview Documentation

The performance assessment of Green Buildings is determined based on a checklist of performance assessment for the utilization phase of Green Buildings for existing buildings. The stage of collecting the necessary document evidence on the checklist is carried out before the calculation analysis stage.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

➢ *Environmental Conservation Policy and the Development of BGH Utilization SOP*

- *Having a Document in the Form of an SOP on Energy Conservation Efforts in the Energy Management System*

The SOP document for energy conservation within the energy management system includes structured guidelines and steps to ensure efficient and sustainable energy use by all employees and relevant departments. The energy management system is regulated by standards and regulations, including energy management in building structures to support energy savings.

- *Having a Document in the Form of an SOP on Water Conservation Efforts*

The SOP document for water conservation will contain guidelines and procedures that must be followed by all employees and work units to ensure efficient and sustainable water use. Water savings are planned based on the water balance calculations that have been prepared during the planning stage.

- *There is a Commitment from the Building Management to Make the Building Smoke-Free*

The prohibition of smoking in green buildings is implemented through a commitment statement from the Building Manager regarding the ban on smoking in all green buildings.

The commitment of Building Managers to make the building smoke-free is an important step in creating a healthy and friendly environment for all residents. By prohibiting smoking in all areas, especially in green buildings, the management supports better environmental and health standards. This commitment not only enhances the well-being of residents but also supports environmental preservation through the implementation of a smoke-free green building concept.

Fig 5: No Smoking Warning

- *Waste Management Policy in Building Structures*

The waste management policy for buildings aims to ensure that the waste generated is managed efficiently, environmentally friendly, and in accordance with regulations. This policy includes waste production reduction, as well as safe waste processing and disposal. The waste management policy document for buildings will regulate every step in waste management to support sustainability and compliance with applicable regulations.


Fig 6: Waste Management in Building Structures

➢ *Legislative Requirements*

- *Having Expert Personnel with Work Competence in Accordance with Legal Regulations (SKK in the Field of Building Maintenance)*

Work Competence according to Legal Regulations (SKK in the Field of Building Maintenance) refers to the standards that must be met by experts in building maintenance. The Work Competency Certificate (SKK) serves as proof that an individual possesses the skills, knowledge, and attitudes in accordance with the standards set forth in the legislation.

- *Expert Staff for Modifications Must Have SKK Relevant to Their Field*

Policy on Expert Workforce with Work Competence In accordance with the provisions of the legislation, it emphasizes the importance of using qualified and certified experts to ensure that the maintenance, management, and modification of buildings are carried out professionally and safely. With this policy, building managers ensure that all work is carried out by competent and licensed experts, which ultimately maintains the safety, quality, and sustainability of the building.

➢ *Methods and Performance of Operation and Maintenance*

- *There are As-Built Drawings and Other Documents such as Catalogs, Equipment Manuals/Guides, Testcom Data, and Others*

As-Built Drawing is a technical document that depicts the actual condition of a building after the construction process is completed and all changes that occurred during

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

the construction have been implemented. This document is very important for building management and long-term maintenance.

- *Performance of Building Management (Has Conducted Building Maintenance/Repair According to SOP)*

The performance of Building Managers in carrying out maintenance and care according to SOP (Standard Operating Procedure) is an important indicator to ensure that the building functions well, is safe, and meets quality standards.

➢ *State of Emergency*

- *Having an Emergency Response SOP Containing the Emergency Response Organization, Scope of Responsibilities and Authorities of Each Person in the Organization, and Others*

The condition of disaster emergency response is an event that threatens and disrupts, whether caused by natural factors and/or non-natural factors or human factors. Examples include earthquakes, fires, floods, demonstrations, and so on. Emergency response activities can include rescue and evaluation of victims, property, fulfillment of basic needs, and/or recovery of infrastructure and facilities.

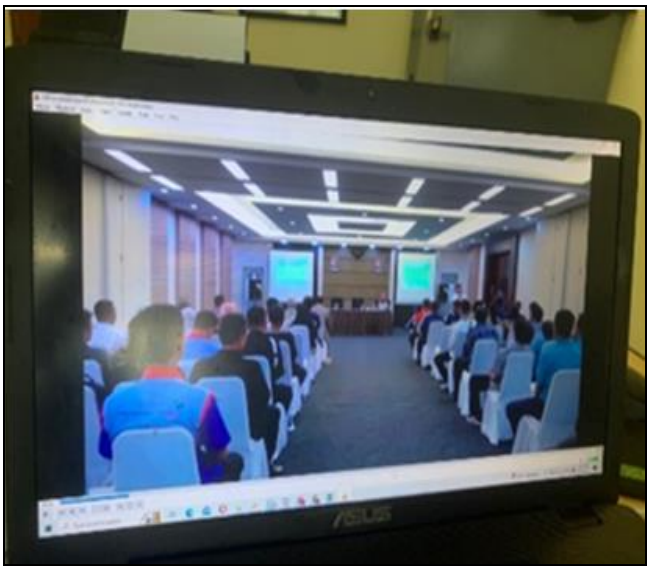

Fig 7: Emergency Response SOP Training

➢ *Development of Building Manager Capacity*

- *Maintenance Manager Training*

Maintenance Manager Training is an important step in ensuring that the building management team has the necessary knowledge, skills, and competencies to perform maintenance tasks effectively and efficiently.

- *Training to Improve Soft Skills (Excellent Service Standards)*

Training to Improve Soft Skills and Prima Service Standards is very important to ensure that the building management team is not only technically proficient but also capable of providing high-quality service to residents and visitors.

- *Modification Planning for Performance Adjustment*

The Room Is Designed Not to Use Air Conditioning Machines That Use Refrigerants

Refrigerant is a substance used in cooling systems and air conditioners to absorb and release heat during the cooling cycle. This substance functions as a heat transfer medium, allowing cooling systems such as air conditioners or refrigerators to lower and maintain the desired temperature.

✓ If the room must use an air conditioning unit, choose a unit that uses a refrigerant with an Ozone Depletion Potential (ODP) value of zero.
Ozone Depletion Potential (ODP) is a measure that indicates the potential of a substance to damage the ozone layer in the atmosphere, compared to CFC-11 which has an ODP of 1. ODP is used to assess the environmental impact of refrigerants and other chemicals on the ozone layer, which protects the Earth from harmful ultraviolet radiation. Choosing refrigerants with low or zero ODP is very important to protect the ozone layer, while also considering Global Warming Potential (GWP) to minimize the impact on climate change. The use of environmentally friendly refrigerants has become a priority for sustainability and environmental protection.

✓ Air conditioning units use refrigerants with a Global Warning Potential (GWP) value of no more than 700.
Global Warming Potential (GWP) is a measure used to compare the global warming impact of various greenhouse gases over a specific period, usually 100 years. GWP indicates how much heat the gas can trap in the atmosphere compared to carbon dioxide (CO_2), which has a GWP of 1. Choosing refrigerants with low GWP is an important step in reducing the impact on global warming. The use of alternative refrigerants that are more environmentally friendly supports climate change mitigation efforts, in line with global policies to reduce greenhouse gas emissions.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

Fig 8: Air Conditioner Specifications

- *Plan to Build a Temporary Waste Collection Point (TPS) With Sufficient Capacity Within the Building Complex, And to Collect and Transfer Waste from The Source to The TPS On a Scheduled or Daily Basis Using Segregated/Segregated Waste Collection Tools*

This plan aims to improve the efficiency of waste management in the building environment and ensure that waste collection and disposal are carried out regularly, hygienically, and in accordance with environmental standards. By implementing this plan, buildings can manage waste more effectively, support cleanliness, and minimize negative impacts on the health of residents and the surrounding environment.

Indoor lighting measurements are conducted by considering the room area and the necessary measurement points. Considering the building area that has been calculated to be more than 100 m², the number of measurement points used in this study is at least 36 points. The measurement points are determined at the intersection of two diagonal lines connecting the length and width of the room. The determination of these points is intended to ensure that the data obtained is representative of the entire measured area. Thus, this methodology is expected to produce valid and reliable data for further analysis.

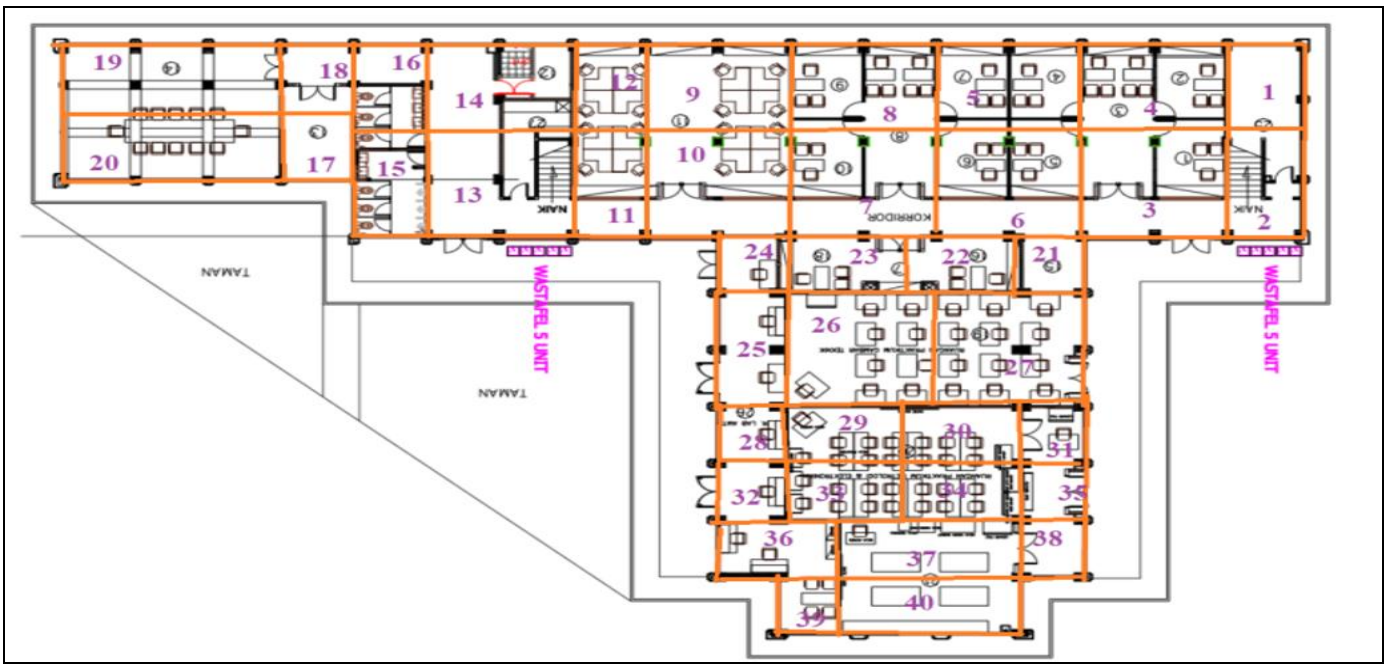

Fig 9: Light Intensity Survey Layout

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

Table 3: Research Data Light Intensity

	Light Intensity (Lux)		
	Maximum	**Average**	**Minimum**
Result	1143,7	1140,5	1080,8

In the results of the light intensity calculations on the 1st and 2nd floors, the total average value of the light intensity calculations was a maximum of 1143.7 Lux, a minimum of 1080.8 Lux, and an average of 1140.5 Lux. These figures indicate that in the sixth assessment of the Planning for Adjustment for Performance Adjustment, point six of the Energy Efficiency Calculation, the Lighting System Energy Conservation section, which refers to the Minister of PUPR Regulation No. 21 of 2021, does not meet the standard criteria in the energy consumption savings plan with reference to the light intensity energy efficiency criteria calculated based on the points in the Minister of PUPR Circular No. 01/SE/M/2022.

Air temperature is a measure that indicates the degree of heat or cold of an object, and the instrument used to measure temperature is a thermometer. Meanwhile, humidity is the concentration of water vapor in the air.

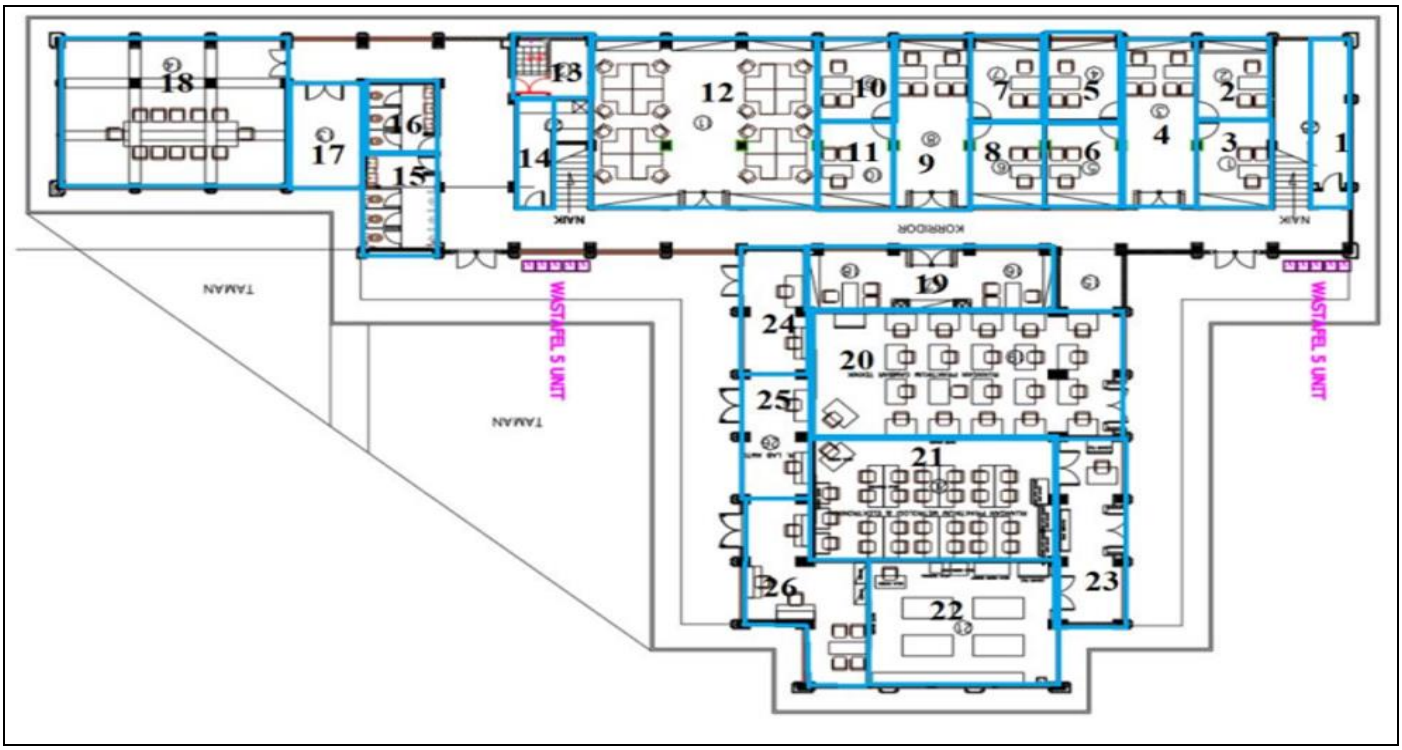

Fig 10: Temperature and Humidity Survey Layout

Table 4: Temperature research data

	Temperature (°C)		
	Maximum	**Average**	**Minimum**
Result	28,7	28,6	28,6

Table 5: Humidity Research Data

	Humidity (RH)		
	Maximum	**Average**	**Minimum**
Result	60,7	60,4	60,2

In the results of the temperature and humidity calculations on the 1st and 2nd floors, the overall average temperature calculation yielded a maximum value of 28.7°C, a minimum of 28.6°C, and an average of 28.6°C. In the humidity calculations, the maximum value was 60.7RH, the minimum was 60.2RH, and the average was 60.4RH. The figures indicate that in the sixth assessment of the Performance Adjustment Modification Planning, point six of the Energy Efficiency Calculation, the energy conservation section of the air conditioning system in the building is stated to not meet the standard criteria in the energy consumption savings plan, with reference values for temperature and humidity energy efficiency calculated based on the Minister of PUPR Regulation No. 21 of 2021 and the reference criteria points in the Minister of PUPR Circular No. 01/SE/M/2022.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

The part of the building known as the room enclosure includes all construction elements such as exterior walls, roofs, windows, doors, and floors that face outside, and serves as a barrier between the indoor and outdoor environments. The building envelope functions to protect the interior space from external weather, control temperature, humidity, and lighting, and maintain privacy and security. With good insulation and proper design, the envelope can reduce the need for heating and cooling, which is an important factor in energy efficiency.

In the results of the envelope calculation for the 1st and 2nd floors, with a total wall area of 2374.6 m² and a total door and window area of 752.53 m², the WWR values for the 1st and 2nd floors are as follows. The Discussion Results contain the following explanation:

$$WWR = \frac{2374,6}{752,53} \leq 30\% \quad (2)$$

$$WWR = 31,5\% \leq 30\% \quad (3)$$

Based on the Minister of PUPR Regulation No. 21 of 2021 and the reference criteria points in the Minister of PUPR Circular No. 01/SE/M/2022, the aforementioned points indicate that in the sixth assessment of Performance Adjustment Planning, point 6 on Energy Efficiency Calculation, the building envelope energy conservation section in the building is stated to not meet the standard criteria in the energy consumption savings plan with the reference amount for building envelope energy efficiency that has been calculated.

B. An Analysis of the Performance of Green Building Stage Utilization

➢ *Environmental Conservation Policy and the Preparation of SOP for BGH Utilization*

Environmental preservation starts with policies made by building management leaders. The policies made are expected to provide direction for savings in energy and water usage, as well as efforts to improve the environment in case of pollution caused by the building. The verification of the implementation of these policies is reviewed through efforts to conduct field socialization.

Table 6: Assessment parameters for the Conservation Policy and the formulation of SOP for BGH utilization

No	Performance Assessment Parameters	Points to be Claimed	
		Point SNi	Survey Point
1	Environmental conservation policy and the preparation of SOP for BGH utilization		
a	Having documents in the form of SOP for environmentally friendly building policies.	14	4
b	Having a document in the form of an SOP regarding environmental improvement efforts, at least containing plans to engage the surrounding community in communal waste management, greening, and other activities.	4	3
Total		**18**	**7**

In the Environmental Preservation Policy and the Preparation of BGH Utilization SOP, the analysis results of the Environmental Preservation Policy and the Preparation of BGH Utilization SOP yielded 7 points, while the SNI Standard points are 18 points.

➢ *Per Legislative Requirements*

Legislative requirements related to green buildings in Indonesia encompass various aspects regulated by laws, government regulations, and regional regulations aimed at ensuring the construction and management of buildings adhere to sustainability and environmental preservation principles. Legal entities are third parties that perform the maintenance and care tasks for buildings.

Table 7: Assessment Parameters for Legal Requirements

No	Performance Assessment Parameters	Points to be Claimed	
		Point SNi	Point Survey
2	Legislative Requirements		
a	The legal entity manager possesses a Business Entity Certificate (SBU) in accordance with the provisions of the legislation (SBU in the field of building maintenance/care).	1	1
b	Expert personnel for modifications must have SKK in their respective fields.	1	1
Total		**2**	**2**

In the Legislative Requirements, the analysis results of the Legislative Requirements yield 2 points, meeting the SNI Standard points also yield 2 points.

➢ *Methods and Performance of Operation and Maintenance*

Methods and Performance The operation and maintenance of green buildings are steps and standards used to ensure that the building functions optimally and sustainably. This approach involves various methods designed to maintain energy efficiency, minimize environmental impact, and ensure user comfort and safety.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

Table 8: Assessment Parameters for Operation and Maintenance Methods and Performance

No	Performance Assessment Parameters	Points to be Claimed	
		Point SNi	Point Survey
3	Methods and Performance of Operation and Maintenance		
a	Having a document in the form of an SOP regarding the organizational structure of Operations and Maintenance (O&P) with a scope of work in accordance with the laws and regulations.	1	0
b	There are as-built drawings and other documents such as catalogs, equipment manuals, testcom data, and others.	1	0
c	The performance of the building manager (has carried out building maintenance/repairs according to SOP).	1	1
d	Documents of results and operational parameter data of equipment in the form of logbooks (AC, elevators, generators, etc.) must be stored for at least the last 12 months (for periodic reports).	1	0
e	Conduct periodic inspections of buildings in accordance with legal regulations, covering architecture, structure, mechanical-electrical, exterior layout, and housekeeping (cleanliness).	1	
Total		**5**	**1**

In the Method and Performance of Operation and Maintenance, the analysis results in a score of 1 point for the Method and Performance of Operation and Maintenance, while the SNI standard score is 5 points.

➢ *State of Emergency*

The condition of disaster emergency response is an event that threatens and disrupts, whether caused by natural factors and/or non-natural factors or human factors. Emergency response activities can include rescue and evacuation of victims, property, fulfillment of basic needs, protection, management of refugees, rescue, and/or recovery of infrastructure and facilities.

Table 9: Emergency Response Assessment Parameters

No	Performance Assessment Parameters	Points to be Claimed	
		Point SNi	Point Survey
4	State of Emergency		
a	Having an emergency response SOP that includes the emergency response organization, the scope of responsibilities and authorities of each person in the organization, and so on.	1	1
Total		**1**	**1**

In an Emergency Response Situation, the analysis results in an Emergency Response Situation score of 1 point, meeting the SNI Standard score of 1 point.

➢ *Development of Building Manager Capacity*

The Development of Building Manager Capacity is an effort to enhance the skills, knowledge, and competencies of building managers so that they can perform their duties more effectively and efficiently. Building managers with good capacity can ensure that the operation and maintenance of the building are carried out according to standards, including in terms of environmental preservation, energy efficiency, and excellent service.

Table 10: Parameters for Assessing the Capacity Development of Building Managers

No	Performance Assessment Parameters	Points to be Claimed	
		Point SNi	Point Survey
5	Development of Building Manager Capacity		
a	Maintenance manager training.	2	2
b	Training to improve soft skills (excellent service standards).	2	2
Total		**4**	**4**

On 5. Development of Building Manager Capacity, the analysis results of Building Manager Capacity Development obtained 4 points, meeting the SNI standard points of 4 points.

➢ *Modification Planning for Performance Adjustment*

Retrofitting Planning for Performance Adjustment of Existing Buildings that are not yet planned as BGH or do not meet BGH performance criteria is recommended to undergo retrofitting to obtain BGH certification. The assessment of BGH performance can begin as soon as the retrofit planning is conducted.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

Table 11: Assessment Parameters for Adaptation Planning for Performance Adjustment

No	Performance Assessment Parameters	Points to be Claimed	
		Point SNi	Point Survey
6	Modification Planning for Performance Adjustment		
a	Energy Efficiency Modification Planning	34	7
b	Planning for Water Use Efficiency Modifications	6	0
c	Planning for Indoor Air Quality Modification	7	7
d	Waste Management Modification Planning	6	2
Total		**53**	**16**

Adjustment Planning for Performance Adjustment, obtained an analysis result of Adjustment Planning for Performance Adjustment of 16 points, while the SNI standard points are 53 points.

V. CONCLUSION

Building F at Widyatama University continues to fail to meet Green Building (GB) standards established by the Minister of Public Works and Public Housing Regulation No. 21 of 2021 and the Minister of Public Works and Public Housing Circular Letter No. 01/SE/M/2022, according to the research done on the building. According to the building performance evaluation, Building F's Window-to-Wall Ratio (WWR) is 31.5%, which is higher than the 30% maximum limit, even if the temperature, light intensity, and room humidity are all within intolerable bounds. Building F received just 31 points out of a possible 83 points on the evaluation questionnaire, meaning that it has not yet satisfied the requirements for "Organization and Governance of Green Building."

Standard Operating Procedures (SOP) for waste management, smoke-free area regulations, and energy and water conservation have been created, but their execution still has to be improved to satisfy BGH requirements. Building F still needs to improve its energy efficiency and environmental maintenance, even though it is trying to use more eco-friendly technologies, like air conditioners with low Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP), and handle its waste better.

This study underscores the critical importance of implementing the Green Building concept in the development of Indonesian infrastructure. To guarantee sustainability and efficiency in building structures in the future, considerable advancements in energy management, environmental management, and adherence to current norms are required. Based on the results of the current assessment, Widyatama University's Building F is a good example of why the BGH concept needs to be reviewed and improved all the time in learning settings and other areas.

We can implement several recommendations to improve the functionality of the green buildings at Widyatama University's Building F. Firstly, we recommend upgrading the transportation infrastructure by incorporating amenities for walkers and bicycles to reduce automobile emissions. Second, selecting paints with low or no volatile organic compounds (VOC) and using materials with a high recycled content and eco-friendly certifications may maximize the usage of ecologically friendly products. Third, placing lux sensors on each bulb to regulate energy use and classifying lights according to places that get natural light and those that do not are two ways to increase energy efficiency. Fourth, we need to improve waste management by separating hazardous, inorganic, and organic (B3) trash and using fewer single-use goods. Finally, as this study was carried out by people without any particular accreditation in the area of green building, the analysis and computations made make reference to the relevant green building standards.

ACKNOWLEDGMENT

This paper is part of / derived from a research report funded by LP2M Universitas Widyatama for the 2023/2024 fiscal year. I would like to express my gratitude to the LPPM of Universitas Widyatama for their support in the success of this research. To the Lecturers and Students who have worked hand in hand in completing everything from the beginning to the end of the research.

REFERENCES

[1]. O. L. Sari, A. A. I. Saputra, and N. A. Aprilla, "Assessment of Green Building Concept in the Integrated Laboratory Building of Kalimantan Institute of Technology According to Standards," Journal of RAB Construction Research, vol. 8, no. 2, pp. 253-259, 2023.

[2]. Ministry of PUPR Regulation, "Minister of PUPR Regulation No. 21 of 2021 Concerning Green Building Performance Assessment," 2021.

[3]. F. Febrina and B. Febriyanti, "Assessment of Green Building Criteria in the Faculty of Economics and Business Building, Ar-Raniry State Islamic University Banda Aceh Using Greenship Rating Tools for New Building Version 1.2," The Civil Engineering Student, vol. 2, no. 1, pp. 78-84, 2020.

[4]. Ratnaningsih, A. Hasanuddin, and R. Hermansa, "Assessment of Green Building Criteria in IsDB Project Building Construction Based on Index Scale Using Greenship Version 1.2 (Case Study: Engineering Biotechnology Building, University of Jember)," Berkala Saintek, vol. 7, no. 2, pp. 59-66, 2019.

[5]. R. Syahriyah, "Application of Green Material Aspects to Environmental House Building Criteria in Indonesia," Indonesian Built Environment Journal, vol. 6, no. 2, pp. 100-105, 2017.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14908893

[6]. N. E. Praptomo, "Implementation of Green Building Concept in UGM Educational Staff Apartment," Siar-V, pp. 551-558, 2024.
[7]. Adeswastoto, Hanantatur et al., "Analysis of Green Building Implementation in the University Pahlawan Clinic Building," JES-TM, vol. 3, no. 1, pp. 37-43, 2023.
[8]. T. Suharyadi, A. Abdurrahman, and M. I. E. Nur, "Implementation of Green Building Concept Based on Minister of Public Works and Public Housing Regulation of the Republic of Indonesia Number 21 of 2021 Concerning Green Building Performance Assessment in Cianjur Asri Residence Housing," Journal of Civil Engineering Moment Suryakacana, vol. 6, no. 1, pp. 59-73, 2023.
[9]. M. Haikal, Firdasari, and E. Mutia, "Assessment of Green Building Criteria in the Integrated Hajj and Umrah Service Center Building (PLHUT) Langsa City Based on Greenship Assessment," Journal of Civil Engineering & Environment, vol. 7, no. 1, pp. 57-65, 2022.
[10]. Roshaunda et al., "Assessment of Green Building Criteria in Pembangunan Jaya University Building Based on Green Building Council Indonesia Indicators," Widyakala Journal, vol. 6, pp. 28-46, 2019.
[11]. D. Prasustiawan and S. Winarni, "Comparison of Green Building Assessment Criteria Between Greenship GBCI and Minister of PUPR Regulation No. 21 of 2021 and Its Correlation with Green Architecture," Proceedings of Semsina, vol. 4, no. 1, pp. 75-83, 2023.
[12]. Zulistian, M. Purwandito, and E. Mutia, "Review of Green Building Performance Assessment (BGH) in the PGSD Laboratory Building, Samudra University," Journal of Civil Engineering Syiah Kuala University, vol. 12, no. 1, 2023.
[13]. SE Minister of PUPR, "Technical Guidelines for Green Building Performance Assessment - No.01/SE/M/2022," 2022.
[14]. Tiaraningrum, S. D. Zulfani, A. Jabbar, and T. R. Fariz, "Comparison of indoor air quality in d1 fmipa building based on sunlight direction," in Proceedings of National Science Seminar, 2022, pp. 134-141.
[15]. M. S. Bahri, "Thermal Performance of Building Envelope in Multimedia Nusantara University Serpong Lecture Building," Semantic Scholar, 2018.
[16]. SNI 7062:2019, "Measurement of lighting intensity in the workplace," 2019.
[17]. M. V. Fauzan, "Analysis of Energy Consumption Saving Opportunities in Electrical Equipment at PT PLN (Persero) UPT Bogor Office Building," Journal of Electrical Technology Mercu Buana University, vol. 11, no. 1, pp. 16-23, 2020.
[18]. H. Lagalgarin, M. Purwandito, and N. P. Lisa, "Green Building Performance Assessment in the Faculty of Education Building, Samudra University," Journal of Architecture Arcade, pp. 207-212, 2023.
[19]. M. R. Priyanto, A. I. Sudaryanto, G. Adya, and J. Abda, "Green Building Performance Assessment in Construction Phase According to PUPR MINISTER REGULATION NO. 21/2021," Journal of Konstruksia, vol. 15, no. 2, pp. 120-129, 2024.
[20]. Kusuma, "Implementation of Green Building Concept Case Study: Istiqlal Mosque Building, Jakarta," Journal of Ismetek, vol. 13, no. 2, pp. 24-30, 2022.