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Green Architecture of Nahdlatul Ulama Yogyakarta University Campus Building from Material and Energy Aspects

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ABSTRACT

The use of Green Architecture in designing a building is a necessity to create the principle of sustainability. The campus as a place where education is carried out is a benchmark in creating the principle of sustainability. The Yogyakarta Nahdlatul Ulama University Campus Building tries to implement green architecture in its construction. The research aims to investigate green architecture elements in the NU Yogyakarta Campus buildings. The method uses descriptive narrative by explaining in the description the application of green architecture in buildings. Applications are specialized in the application of materials and energy. The research results show that some materials use green architecture principles, such as the use of a hollow roaster so that it can incorporate elements of light and wind and the use of solar panels to save energy.

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1. INTRODUCTION

The campus is an important environment in the world of higher education, where students and academic staff gather to study, be creative, and develop knowledge, a place of good quality learning can produce good quality graduates and vice versa. However, with increasing awareness of the need for environmental preservation and sustainability, modern campuses are increasingly adopting environmentally friendly design approaches, such as the concept of green architecture. The green campus concept is based on the concept of green architecture which contains many criteria (Surjana, 2013).

One step toward a green campus is applying the Green Architecture concept. As time goes by, many universities in Indonesia and abroad are competing to introduce the campus concept (Karimah & Mokhtar, 2021). Campus Green Architecture refers to design and construction principles that aim to reduce negative impacts on the environment and create a more ecologically sustainable environment. In campuses that apply these principles, various aspects such as energy use, water management, environmentally friendly building materials, and integration with nature are the main considerations. Green architecture cannot be separated from the concept of thermal comfort which is based on occupant satisfaction with the thermal environment. The location of the building will influence environmental conditions, causing occupants' perceptions to vary in their thermal response (Hermawan & Arifin, 2021).

Thermal comfort is influenced by many factors. The building envelope is the most determining factor in providing passive thermal comfort in a building. Different wall materials will make people's perceptions of thermal environmental conditions different (Hermawan & Švajlenka, 2022). The cladding for high-rise buildings cannot be implemented by the cladding for low-rise buildings. There have been several studies that have tried to apply low-rise building envelope materials to tall buildings but not much has been successful. Wood material forms the cladding of low-rise buildings and there needs to be an increase in the use of wood material in the cladding of tall buildings to create material sustainability (Hermawan & Švajlenka, 2021). Sustainability is also one of the characteristics of green architecture.

Green campuses generally reduce energy use to a minimum and are efficient. Minimizing gas emissions and greenhouse effects, maximizing circulation with low carbon, recycling resources and so on. From the statement above, it can be confirmed that a high level of commitment is required from the campus academic community. Green architecture is a response from buildings that reduces the harmful impacts of project construction on human health and the health of the surrounding environment. Human health is important in life inside buildings. Sick Sydrome Building (SSB) is one of the factors that must be resolved with the green building concept (Felgueiras et al., 2023).

Development in this era has a huge impact on the environment, on the other hand, buildings that have been built certainly use up materials that produce environmental pollutants and damage the ozone. Interest and knowledge regarding the use of environmental materials is still quite minimal because they are still less familiar than old materials. Environmental damage and global warming in the world have put pressure on the majority of development lines and cultures of society to achieve a more environmentally friendly development paradigm and living behavior (green living and green development). In the world of architecture, the UIA (Union international des Architectest), a world architectural association institution, on September 28 2011 at the Tokyo declaration congress, has prepared the SbD-50 (sustainable by design 2050)

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program so that architectural designers throughout the world must apply environmentally friendly building principles (Surjana, 2013).

Green architecture is also expected to save energy. Energy use in buildings is known as one of the activities that contributes to energy waste. The use of energy to create thermal comfort for building occupants results in energy waste (Benito et al., 2021)(Permana, et. Al., 2021). Existing energy often uses fossil energy, so it is necessary to apply renewable energy to a building. The use of renewable energy will increase the green architecture criteria in a building design (Soroush & Hajimolana, 2023). The campus building, which is actually inhabited by educated people and is a landmark in the environment, can be an example and reference for surrounding buildings in demonstrating the use of environmentally friendly building materials. Research on materials and energy related to energy savings needs to be realized more massively so as to create energy efficient buildings. Emphasizing energy use through the selection of appropriate materials and energy is felt to be important. The aim of the research is to investigate the use of materials and energy in campus buildings as one part of realizing green architecture.

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2. METHOD

The research was conducted at the UNU Campus Building located in Student City, Yogyakarta. The UNU campus is a building that has not been used and is under construction (Figure 1).

Figure 1: Front view of the UNU Yogyakarta Campus Building
Source: author, 2023

The method used in this research uses a qualitative method, namely a descriptive approach as an answer to the problem formulation as the aim of this research. The data that is used as a reference for this paper is primary data and secondary data. Primary data

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was collected by direct observation of the UNU campus building construction project, and secondary data as literature data obtained from journals and the internet.

Table 1. Project Data

Identity	Information
Project Name	Construction of the UNU Yogyakarta Campus
Project Location	Padukuan, Dowangan, Baturaden Village, Gamping Subdistrict
Building Function	educational facilities
Effective Land Area	7.478 m^2
Gross Floor Area	Main building 15,212.64 m^2 UKM Building 837.04 m^2
Number of air conditioners	9
AC system	Variable Refrigerant Value
clean water source	PDAM and Deep Well
Assignor	Ministry of Public Works and Public Housing
User	Universitas Nahdlatul Ulama
start the work process	Agustus 2020

This research focuses more on analyzing the application of environmentally friendly modern materials which were applied to the Nahdathul Ulama Yogyakarta limestone campus buildings. The location of the object is at 686J+R52, Sawah Area, Banyuraden, Kec. Gamping, Sleman Regency, Special Region of Yogyakarta, where at the time this research was built the building was still in the final stages of construction.

3. RESULTS AND DISCUSSION

Steps to keep the environment clean and beautiful certainly have a positive impact on all elements in the environment, but this is not easy to do. It requires a lot of innovation and high consistency and it takes time to be able to implement it. As time goes by technological advances are based on developing thinking so that they are able to create a concept that is mutually beneficial for humans and the environment, one of which is in the form of building materials.

One thing that influences the concept of Green Architecture is the aspects of material selection and use. Environmentally friendly materials are materials that are minimally dangerous for the environment and the users of the building. The application of this material can also have a positive impact on the level of efficient use of natural resources (Ramadhan et al., 2021). The materials used in the UNU campus building construction project include the following:

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Porous paving blocks

Figure 2: Porous Paving Blocks for the UNU Yogyakarta Campus Building
Source: author, 2023

To cover the ground so that it does not come into direct contact with pedestrians in the campus yard area, it is necessary to apply pavement on the ground surface area. There are many types of surface layer pavement materials. To align with the Green Campus concept, the choice of materials to be used is not arbitrary, a material specification that is capable of being used is required. This porous paving block material is included in the development of new materials and the work of the nation's children, this material is able to absorb rainwater through its grout and the pores on the paving surface function to reduce pooling of rainwater on the surface area and also function as a water absorber but with a fairly low intensity. This is quite ideal in supporting and strengthening the Green Campus concept.

Grass Blocks

Figure 3: Porous Paving Blocks for the UNU Yogyakarta Campus Building
Source: author, 2023

To maintain green elements on the surface of the yard's pavement, it is necessary to apply materials that suit the needs of the building concept. Grass block is a soil pavement material that can be combined with vegetation in the gaps. The application of this material, apart from reducing puddles of rainwater and absorbing rainwater, also gives a cool impression that can reduce the glare of sunlight reflected by the material itself.

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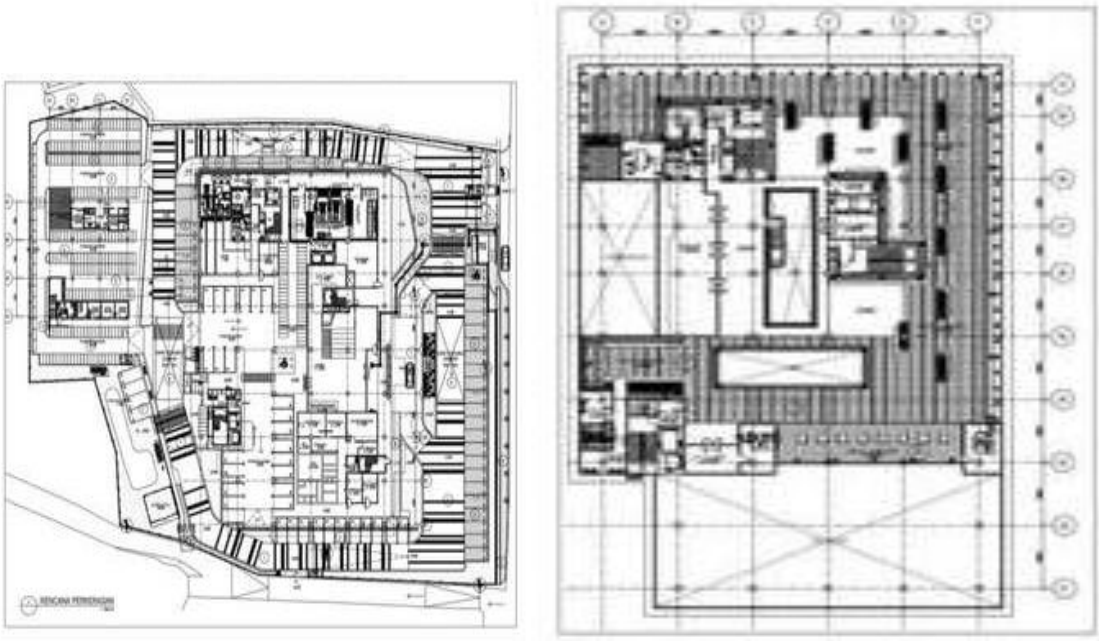

Figure 4: UNU Yogyakarta Campus Building Site
Source: author, 2023

Roster Dinding

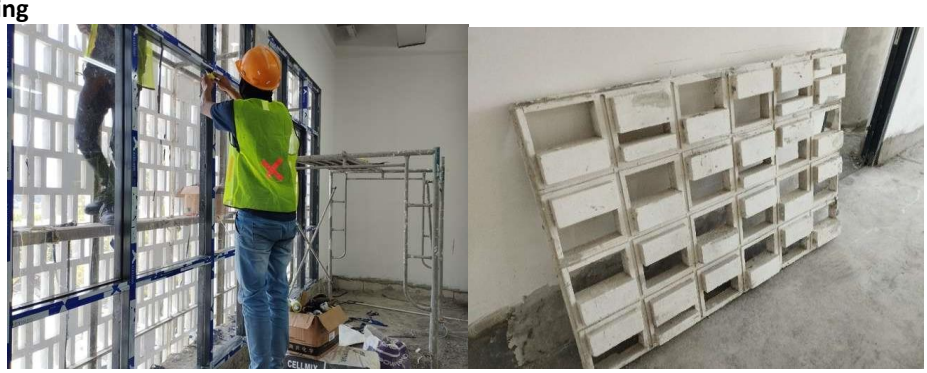

Figure 5: Roaster has a hole in the UNU Yogyakarta Campus Building
Source: author, 2023

Roster is a layering or wall sheathing material which is usually applied to the facade to add to the aesthetic value of the building. On the other hand, the roster also functions as a porous material which is able to channel natural light during the day which has an impact on saving electrical energy. This material also functions as a layer to reduce the intensity of light entering the room in excess and becomes a gap for air to circulate.

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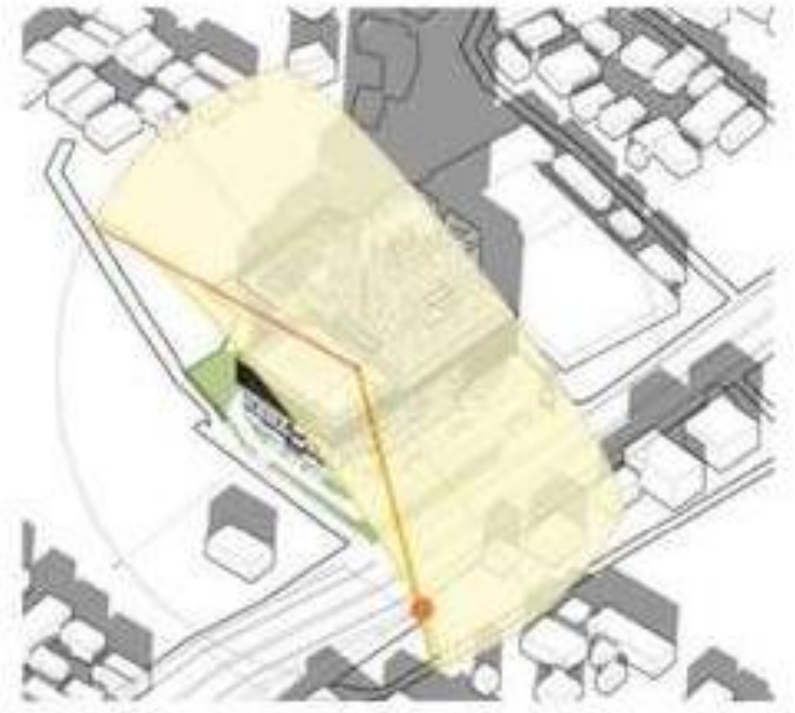

Figure 6: Orientation of the UNU Yogyakarta Campus Building
Source: author, 2023

The facade of this campus building is dominated by the use of a roster facade, the orientation of this building is towards the east which will definitely get excessive light and heat. With the double layer concept, the heat from sunlight will be reduced and will not increase the temperature behind the main wall to become hot. In this context, the use of AC can be minimized.

Figure 7: Sunlight of the UNU Yogyakarta Campus Building
Source: author, 2023

Solar Panels

A solar panel is a device that is capable of converting the heat from sunlight into electrical energy which is processed through the photovoltaic effect (photovoltaic cell - PV for short) (Purwoto et al., 2018). The use of this material is a step in implementing the Green Campus concept, where the campus is able to produce electrical energy independently. Based on references from research literature sources from 'Efficiency Of

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Using Solar Panels As An Alternative Energy Source' the use of solar panels for alternative electrical energy is superior to the use of generators both in terms of investment costs and operational costs, so solar panels are superior and efficient (Purwoto et al., 2018).

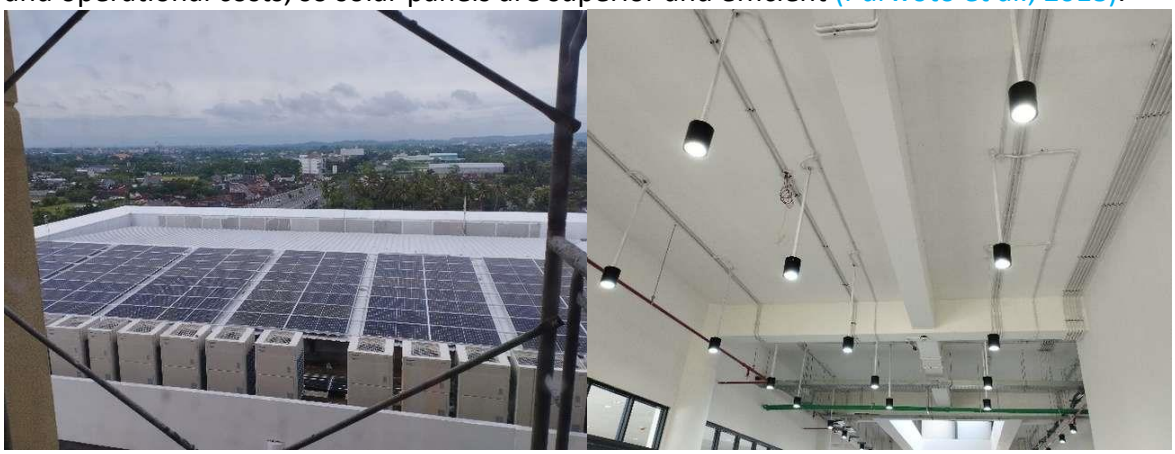

Figure 8: a)Photovoltaic in UNU Yogyakarta Campus Building, b)Lighting
Source: author, 2023

Disscussion

The use of materials as a form of energy savings has been widely used. Other research reveals that good selection in an area will reduce indoor air temperature (Hermawan et al., 2020). Materials that cannot be separated from one of the factors determining the building envelope can affect many elements of the envelope, both walls and roof of the building. The choice of building roof material will also create comfort for the occupants, although not too significantly. Comparison of the use of roofs will produce different indoor air temperatures (Hermawan & Fikri, 2020). Material is one of the factors that is modified in order to find materials that meet the green architecture criteria. One material is Phase Change Material (PCM) which is believed to be able to change according to environmental conditions so that it can create comfort for building occupants (Sun et al., 2016).

Energy use has been widely researched by experts in order to find energy savings, especially in buildings. Research on energy can be seen from the direct use of electrical energy or by calculating the heat transfer value of buildings (Lu et al., 2020). Research on energy can be carried out by different scientific disciplines so that there are many variations found in energy research. Cross-disciplinary research will produce comprehensive knowledge and findings (Du et al., 2023). In architecture, energy is associated with the use of the building envelope, especially building materials. The use of good materials that are appropriate to environmental conditions will create energy savings (Hoseini et al., 2016).

4. CONCLUSIONS

Based on research regarding the Green Architecture of Nahdatululama University Yogyakarta Campus Buildings from Material and Energy Aspects, the use of the materials mentioned above is included in the use of materials in the principles of green architecture. Which of the material specifications above is able to reduce negative impacts on the environment around campus buildings. The concept of green architecture is highly prioritized nowadays, where environmental damage is increasingly caused by the large number of buildings and infrastructure that increasingly help people but do not pay attention to the impact on the environment. There is a need for innovation in the

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development of materials that are more modern but friendly to nature. Not only in terms of materials, but high commitment from users is also needed to realize this green architecture concept. Selection of the right materials and careful planning are the keys to the success of this context.

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