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Redevelopment of Female Student Dormitories of Universitas Sumatera Utara with Tropical Architecture Approach

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Abstract (English)

The University of North Sumatera (USU) experiences an increase in the number of students each year, increasing the need for adequate female dormitories. Currently, USU's female dormitories are not enough to accommodate all students, forcing many of them to live off-campus, which is less conducive. This research aims to design the development of a girls' dormitory with a tropical architecture approach. This was chosen to create an environmentally friendly, energy-efficient, and comfortable building for residents. The development will be done with a focus on increasing the number of rooms. The design will consider the climate, local culture, and the needs of female students. This development is expected to provide adequate accommodation solutions and a sustainable environment.

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female student dormitories, tropical architecture

1. Introduction

The education sector in Indonesia is developing rapidly, with both public and private institutions contributing to its growth. The city of Medan itself has a leading public university, Universitas Sumatera Utara (USU), located at Dr. T. Mansyur Street No. 9, in the Padang Bulan area. USU is the largest university in North Sumatera, with approximately 33,000 registered students, most of whom come from outside Medan city [1]. USU has provided dormitories for USU students to live in [2]. The female dormitory building for female students is divided into the old female dormitory building and the new female dormitory (Figure 1).

Figure 1 (a) old dormitory building; (b) new dormitory building.

The residence provided by the university needs to be expanded and more sufficient to meet the residential needs of students, most of whom come from outside Medan city [1]. The negative impact of high growth in the number of incoming students occurs when the increase is not matched by adequate facilities and infrastructure, such as special housing. For migrant students from outside Medan City, various residential alternatives must address the issue of how to create a comfortable residential concept, both as a place to live and support their activities [3]. To address this urgent need, this research proposes the redevelopment of the USU women's dormitory by using a tropical architecture approach. Visual and thermal

comfort is a challenge that tropical architecture must achieve without relying on designs that use active technologies [4]. Tropical architecture emphasizes the design of buildings that seamlessly adapt to the hot and humid climate of the tropics. This ensures occupant comfort and allows the buildings to function well to support the daily lives of those who use them [5].

Tropical architecture is a philosophy that emphasizes passive design strategies to minimize energy consumption and maximize natural ventilation and cooling [6] [7]. This approach is particularly suitable for the hot and humid climate in Medan, Indonesia, where the USU campus is located [8]. It is concluded that the design concept of this dormitory building is to apply the concept of modern tropical architecture. In addition to supporting the thermal comfort of its occupants, this concept can also make the building more energy efficient without reducing the aesthetics of a modern building facade [9].

2. Method

The method of solving this design problem uses a descriptive method with a descriptive approach to describe the conditions and needs of the USU women's dormitory and the potential for development with a tropical architecture approach. Primary data was obtained through direct observation and interviews with relevant parties such as students and dormitory managers. Secondary data was obtained from literature on tropical architecture, local climate, and building design standards. Data analysis was conducted to identify challenges and opportunities for dormitory development, focusing on increasing the number of rooms and environmental quality. This method is expected to guide the designing of appropriate and sustainable solutions for USU's student accommodation needs [10].

3. Result and Discussion

3.1 Student Dormitories

A student dormitory is a building for residence for students from outside the region for a certain period to carry out learning activities in an institution [11]. The function of student dormitories is to serve as a means of residence, a means of personal formation, and a means of supporting student learning activities. Student dormitories also have objectives such as creating a learning environment, a place to socialize students, a place to increase student creativity, and other positive contributions [12].

The space configuration of student dormitories has several types, such as single rooms, double rooms, triple rooms, four student rooms, suites, and apartments. The USU women's dormitory was chosen with a single room type, intended for one student in one bedroom, and a double room type inhabited by two students in one room [13].

3.2 Tropical Architecture

Tropical architecture is an architectural design that aims to address tropical climate issues. Tropical climates are characterized by high air humidity (up to 90%), high temperatures (15-35°C), strong solar radiation, and high rainfall (more than 3000 mm/year). These factors significantly affect physical comfort, especially thermal comfort [14]. Tropical architecture is very concerned about local climatic conditions for what needs to be considered, namely factors that affect the comfort, ability, and physical occupants of buildings, such as too much and intense solar radiation, temperature changes, rainfall, air movement and pollution, glare due to incoming sunlight [15].

Tropical architecture is characterized by: a) buildings that are not too thick to allow for optimal cross-ventilation; b) roof designs that are designed to minimize heat in the building; c) openings and vents that allow for internal cross-ventilation; d) the use of light and thin materials with light wall colours; e) building orientation and arrangement of spaces that affect the temperature in the room; f) the use of glass walls or blocks that must provide a barrier to prevent sunlight from directly entering the room [16].

Tropical architecture adapts building design for hot and humid climates by utilizing natural ventilation, wide-sloping roofs, and heat-resistant local materials. Natural lighting is maximized through large windows and transparent roofs, reducing the need for artificial lighting. The design also integrates green open spaces and water elements to create a cool and comfortable environment that functions aesthetically and sustainably according to tropical conditions [17].

3.3 Project Description

This project reimagines the female student dormitories of USU, located at Universitas Road, Padang Bulan, Medan Baru, Medan City, North Sumatera, using a tropical architectural approach. This area consists of the existing built-up land of the USU women's dormitory and vacant land next to it as a design location owned by the USU campus, with a total area of ± 1.2 Ha (Figure 2).

Figure 2 Project Location

3.4 Mass Concept

The dormitory has the same repetitive form on all four floors. Each floor has a uniform mass form of substracted beams, creating a back-and-forth form on the front facade and a void in the centre of the building. This form strategically places the main facade facing west, directly facing Universitas Road, the main street of the USU campus. This deliberate alignment ensures the design of the dormitory facade harmonizes with the surrounding buildings along this main road (Figure 3).

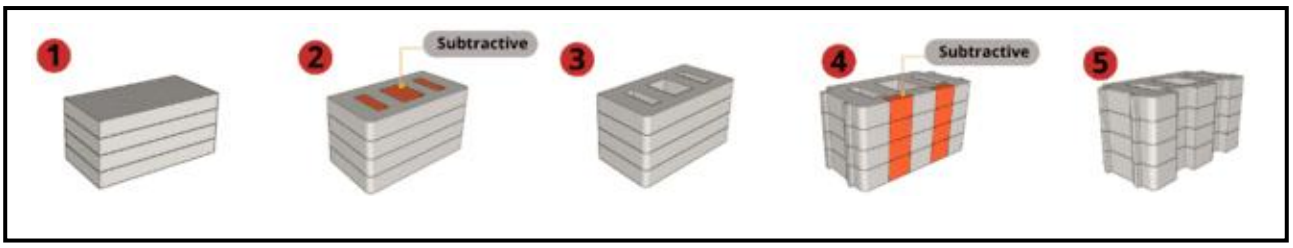

Figure 3 Massing

3.5 Basic Concept

The dormitories are designed to blend in with the character of the surrounding environment, including existing buildings, vegetation, and natural topography. Dormitories are designed with easy access for residents in mind and connectivity with public facilities such as roads, public transportation, and other campus facilities.

Figure 4 Site Plan

3.6 Theme Implementation

The principles of dormitory buildings that apply the concept of tropical architecture include response to the direction of sunlight with rooms facing north/south, reducing the intensity of solar radiation by using the double facade, sun shading (canopy), and placement of vegetation, response to high rainfall by using sloping roofs, and expansive terraces, response to the wind by using openings (airing) that cross, and response to changes in air temperature day and night using building materials that are resistant to extreme weather such as concrete, ceramics, clay tiles etc. [6].

Figure 5 Theme Implementation

3.7 Privat Area

Private areas are based on activities specific to dormitory residents, such as the dormitory master's room and bedrooms. Dorm rooms are divided into two main types: single rooms for one person and double rooms for two. Single rooms offer a higher level of privacy, allowing residents to enjoy private facilities and organize the room to their liking. It is suitable for those who need quiet to study or rest. In contrast, double rooms offer the opportunity to share space and facilities with roommates, enhancing social interaction and encouraging cooperation and cost-sharing, making them an ideal choice for those who prefer a more social environment (Figure 6).

Figure 6 (a) Single room; (b) Double room.

3.8 Supporting Area

The dormitory's support areas include a shared kitchen and dining area, a shared study room, a canteen, photocopying, a minimarket, public bathrooms, a sports area, and laundry. These facilities are designed to support residents' daily needs, such as cooking, studying, obtaining food and supplies, printing documents, bathing, and washing clothes, thus creating a comfortable and efficient dormitory environment. Support facilities are located on the 1st floor and on the left side of the 2nd floor, which are communal spaces accessible to the public from the source road (Figure 7).

Figure 7 Sumber road

At the centre of the building is a garden that functions as a sitting area or communal space. The garden is designed to be a gathering and relaxing place for the residents, creating a comfortable and refreshing environment in the middle of the dormitory (Figure 8).

Figure 8 Communal area

Residents can use the cafeteria and study rooms together to study. These spaces are accessible to the public, but the access is not directly connected to the residential area to maintain the privacy and security of the dormitory residents (Figure 9).

Figure 9 (a) Cafetaria; (b) Shared study room.

The outdoor sports facility is located on the old dormitory site, providing residents with an area for physical activity and fitness. This facility allows residents to exercise without leaving the dormitory environment (Figure 10).

Figure 10 Sports area

3.9 Concept of Façade

The concept of the dormitory's face is formed through the dynamic back-and-forth play of the building, combined with the selection of local materials such as exposed brick and clay roster. In addition, the shape of the roof is also an essential part of the face concept, creating an attractive visual impression and harmonizing with the surrounding environment (Figure 11).

Figure 11 Facade

4. Conclusion

The development of dormitories with tropical architecture aims to create a comfortable and efficient residential environment in tropical climates. Applying tropical architecture principles, such as using natural ventilation, environmentally friendly local materials, and high roofs to improve air circulation, is essential to reduce energy demand and increase occupant comfort. Dormitories with tropical design also pay attention to sustainability aspects, including rainwater management and green gardens, to reduce the effects of heat and improve air quality. Overall, this approach not only creates a functional and aesthetically pleasing living space but also contributes to environmental conservation and the well-being of residents.

5. Acknowledgements

This project is a development of female student dormitories of USU with a tropical architecture approach, which aims to create a comfortable and efficient residential space for students of the University of North Sumatra. The application of tropical architecture principles such as natural ventilation, the use of local materials and sustainable design is expected to improve residents' quality of life and reduce environmental impacts. Thank you to the Department of Architecture, Faculty of Engineering, University of North Sumatera and all those who have contributed to this research and design.

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