

Colonial Building Design Strategies for Tropical Climates - Case Study at SMPN 1 Lhokseumawe

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ABSTRACT

Colonial buildings are the historical heritage of the Dutch colonial period and become a special attraction for a region. Colonial buildings still survive today because they have an adaptation strategy to the local climate, especially the tropical climate. The secondary-level school building of SMPN 1 Lhokseumawe in the north Aceh region as the object of this research, shows that colonial buildings can survive and function as educational facilities. It is important to analyse the design strategies of colonial buildings in the face of tropical climate challenges. This research is expected to add insight and inspiration to today's architectural practices in designing buildings that are adaptive to tropical climates and preserving colonial architectural heritage as part of Indonesia's cultural heritage. Qualitative research methods were chosen to carry out the research process through observation, interviews, and documentation. As a result of this research, it was found that the building of SMPN 1 Lhokseumawe implemented several strategies in the form of symmetrical and elongated building layouts, maximizing the direction of openings and shade from the shield roof, additional clerestory on the roof, the use of materials to adapt to the tropical climate. Despite many adjustments to the climate, this colonial building still retains its design and characteristics of colonial buildings.

Keywords: Climate Adaptation, Colonial Buildings, Design Strategy, Historical Heritage, Tropical Climate



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1 INTRODUCTION

The existence of Dutch colonial architecture is a unique phenomenon and attraction in a region. Its ability to survive in Indonesia's tropical climate to this day is proof that architectural products of the past were of high quality. Colonial buildings are synonymous with their shape and architectural style. This colonial design arose from the desire of Europeans to create colonies like their home countries. Buildings with European architectural styles, especially the Netherlands, tend to retain heat inside the building considering the climate of the area is subtropical or temperate climate. The design in each country will be different due to climate differences, material differences, and others. Buildings in Indonesia will prioritize good airflow in buildings because the tropical climate tends to be hot and humid. Therefore, the design of colonial buildings in Indonesia must be designed with adjustments to the tropical climate (Dede et al., 2020; Purnomo et al., 2017).

Colonial buildings in Indonesia have undergone significant changes in terms of form and function to adapt to the tropical environment. Research states that Dutch buildings in Indonesia take local traditional elements in their architecture starting from the 18th century to the end of the 19th century. This is also in line with research that explains that colonial buildings undergo acculturation with local culture to adapt to the local climate. Acculturation is the incorporation of architectural styles or physical forms in buildings that are influenced by climate, environment, building materials and even surrounding culture. But this does not eliminate the characteristics of local culture and foreign culture (Handinoto, 1996; Roosandriantini et al., 2023; Nugraha & Bachtiar, 2018).

2 LITERATURE REVIEW

The character of Indonesia's tropical climate is synonymous with high heat intensity and humidity. The hot and humid weather is a challenge in designing comfortable buildings and local environmental conditions. So that the tropical climate can affect the physical shape of a building including colonial buildings. The tropical climate has certain characteristics caused by solar heat, humidity, rainfall, wind movement, and others. These adjustments are important so that the building can adapt and survive to this day considering the Dutch colonial buildings that come from different climates. Some adaptation strategies that are usually applied to colonial buildings include building layout, design of openings or extensive natural ventilation, the use of perforated roofs or overcutting for shading, the use of durable materials such as bricks and wood, thick walls, and the use of traditional architectural elements such as windows and crepe doors. This is important to note to respond optimally to the tropical climate. Although most of these buildings have undergone modifications over time, many of them retain recognizable colonial architectural features today (Ghassan et al. 2021).

Lhokseumawe City is one of the cities in Indonesia with humid tropical climate characteristics. High air temperature levels, solar radiation, and air humidity are also relatively high. The character of the tropical climate lasts almost all year round. With these climatic conditions, the need for good air circulation in buildings is very necessary to create a sense of comfort. The efforts of colonial buildings in adapting to the climate are also seen in the colonial buildings in Lhokseumawe City. SMPN 1 Lhokseumawe is one of the colonial buildings that still survives and functions today. This study aims to examine and analyse in depth the adaptation strategies of the colonial buildings of SMPN 1 Lhokseumawe to the tropical climate in Indonesia. By understanding the design principles applied to colonial buildings, this research is expected to provide insight and inspiration for today's architectural practices in designing buildings that are adaptive to tropical climates, as well as preserving colonial architectural heritage as part of Indonesia's cultural heritage (Lippsmeier, 1980).

3 METHODOLOGY

The object of this study is the building of SMPN 1 Lhokseumawe located on Jalan Sultanah Nahrasiyah Kampung Jawa Lama, Banda Sakti District, Lhokseumawe City (Figure 1). The research focused on the observation of the main school building that represented buildings with colonial characteristics. The building has seven classrooms with the same conditions and physical form. The method used in this study is a qualitative descriptive method by making observations on the object of research and recording data obtained in the field. The type of data to be taken from the object of research related to the characteristics of colonial building design with a tropical approach in the form of building layout, opening design, roof design, and building materials. Data was collected through observation, interviews, and documentation thoroughly through detailed photographs of the exterior and interior of buildings. Then the data will be analysed with appropriate literature and theory to perfect the results of further studies and understanding to formulate the expected research results.



Figure 1 The Location of SMPN 1 Lhokseumawe

4 RESULT AND DISCUSSION

Lhokseumawe City is one of the cities that has historical relics in the form of colonial buildings. One of these buildings is SMPN 1 Lhokseumawe which functions as an active school from morning to evening. The physical condition of the SMPN 1 Lhokseumawe building is still maintained and there has not been much change, so it is still possible to identify the characteristics of the building. The school design of SMPN 1 Lhokseumawe combines colonial and local architectural styles. The design concept is very visible from the shape, scale, and proportions of the symmetrical building (Figure 2). This illustrates colonial buildings as having a sturdy and strong structure. In general, colonial buildings have symmetrical shapes and floor plans. The symmetrical shape of Dutch colonial buildings also creates an impression of harmony and balance (Handinoto, 2012).



Figure 2 Top view and building perspective of SMPN 1 Lhokseumawe

4.1 Building Layout

According to Tyas et al. (2015) the position of the building in tropical climates, the ideal is to extend from east to west. This consideration is because the east and west directions are sources of direct sunlight and heat, so the direction is avoided to place openings and the largest side of a building.



Figure 3 Building layout of SMPN 1 Lhokseumawe

At SMPN 1 Lhokseumawe the orientation of the building extends from north to south in a slightly tilted position, so that the side of the wall will be exposed to direct sun exposure which affects comfort in the room. However, this colonial building has a very good strategy for dealing with these problems by placing shade in the form of a wide roof and protruding to the side. This shade serves to reduce heat and dispel direct sunlight. With the right mass arrangement and layout, colonial buildings can optimally utilize the potential of the tropical climate, create strategies to maintain thermal comfort in space, as well as integrate natural elements such as sunlight, wind, and vegetation into the design of the building.

4.2 Aperture Design

Large doors and windows with a relatively large number are another characteristic of a tropical house (Hardiman & Sukawi, 2013). The design of doors and windows in colonial buildings allows doors to open fully, thus maximizing airflow and aiding natural airing. Doors and windows in buildings using models crepe namely a combination of wood panel shapes and additional holes or small cavities that can reduce wind speed from outside the building so that the wind entering the building remains comfortable and not too disturbing (Figure 4). Doors and windows crepe It is also able to maintain user privacy while still allowing air circulation into the room. This is one of the smart solutions for responding to the tropical climate.



Figure 4 Doors and windows in SMPN 1 Lhokseumawe

In addition to windows, there is a large additional ventilation at the top as a source of lighting and air for the building. This is important to maintain indoor air quality to stay healthy and comfortable. Ventilation on windows and crepe doors is also a characteristic and beauty of colonial buildings. The decorative ventilation design adds character and uniqueness to the building.

4.3 Roof

The roof becomes an important element in design in tropical climate regions. The school building uses a shield roof that can protect the entire wall of the building, the slope of the roof also serves to provide shade from direct sunlight on the building and rain that often occurs in the tropics. The shape of the roof with a shield model is a roof model of an ancient Dutch colonial house so it becomes the model of most colonial buildings (Figure 5).



Figure 5 Roof Shape of SMPN 1 Lhokseumawe

The roof of an identical colonial building has a sharp slope and consists of two layers with gaps to circulate hot air (Ardiyanto et al., 2015). A room with a high ceiling is also one strategy to prevent heat in the room (Noer et al., 2024). The condition of the roof and high ceiling causes the room to feel cooler because the flow of hot air will go directly to the roof without disturbing the user's activity area (Fuady et al., 2024). On the roof, there is also additional ventilation /clerestory (Figure 6) commonly referred to as clerestory. Ventilation on this roof allows the flow of heat entering the building to be directly flowed out.



Figure 6 Roof ventilation and clerestory at SMPN 1 Lhokseumawe

Clerestory serves as a natural source of lighting and ventilation in buildings, which is very important in responding to tropical climates. Design clerestory Allows sunlight to enter the building optimally, especially in the central area of the building which is difficult to reach by lighting from ordinary windows. Clerestory It also serves as a means of cross-ventilation and creates good airflow inside the building.

4.4 Shade

Shading is one of the important strategies in colonial building design in the tropics, given the year-round high-intensity sun exposure conditions in the region. The main purpose of shading is to protect the building from excessive exposure to direct sunlight, as well as extreme weather such as rain and strong winds. Wide porches are one of the most distinctive forms of shading in colonial buildings. It serves as a transitional area between the outer space and the inner space while providing shade for the area below from direct sunlight (Figure 7).

According to Fuady et al. (2023) buildings that have hallways as building protection, tend to be cooler than buildings that directly receive solar heat on the façade walls. Then there are also cuttings or cuttings in the form of parts of the roof that protrude out, shading walls and openings such as doors or windows from direct sun exposure. Overcutting also helps drain rainwater so that it does not directly hit the walls of the building. In addition to its function in climate adaptation, the form of shade also

gives an aesthetic impression and visual character that is typical of colonial architecture in the tropics (Kurumur, 2018; Purwanto, 2004).

4.5 Building Materials

These materials were selected considering tropical climate factors, the availability of materials in the local area, as well as aspects of building strength and durability. The use of appropriate materials is one of the characteristics of colonial architecture that prioritizes the quality and sturdiness of buildings. The choice of building materials also affects the distribution of heat in the room. Wall material in the form of concrete and bricks with a thickness of more than 15 cm serves to withstand extreme weather such as heavy rain, direct sunlight, and high humidity, so it is more durable.



Figure 7 Material used in the building of SMPN 1 Lhokseumawe

Doors and windows in buildings use wood material with additional grilles so that airflow and sunlight can enter through the window grilles. The roof material is in the form of clay tiles supported by a high ceiling distance so that it can reduce heat entering the room (Figure 7). Clay roof tiles work well in lowering the average radiation temperature because the surface temperature of clay is lower compared to metal roofing. Clay tile roofing material is also a good building material such as safe against strong winds, has good sound damping, is durable, environmentally friendly, and safe from fire.

Another uniqueness can be seen in the material of building floor tiles that display distinctive motifs or carvings commonly called tile tiles (Figure 7). The tile measures 20 x 20 and the characteristics of this tile do not absorb heat, so it still maintains the indoor temperature. The choice of the type of floor tiles in colonial buildings not only considers aesthetic aspects, but also factors of comfort, durability, and ease of maintenance. Cold and non-slippery tiles are perfect for hot and humid tropical climates (Anumah & Anumah, 2018; Romanova & Skanavi, 2017).

The choice of materials in colonial buildings not only considers aspects of strength and durability but also pays attention to the ability of materials to adapt to hot and humid tropical climates. Natural materials such as wood, brick, and clay are perfect for helping to create thermal comfort in colonial buildings.

Overall, the colonial building design strategy towards the tropical climate in Indonesia aims to maximize the potential of the local climate and minimize its negative impacts, so that optimal comfort will be achieved for building occupants. In tropical regions with high air temperatures throughout the year, strategies such as natural ventilation, thick walls, the use of overcutting, and building layouts that optimize shade aim to control overheating indoors. The clerestory design, large windows, and building layout also allow optimal sunlight to enter.

5 RESULT AND DISCUSSION

The design strategy applied to SMPN 1 Lhokseumawe as a colonial building succeeded in solving problems related to tropical climate. The strategy helps improve comfort in buildings and protect buildings from negative climate impacts on buildings. The main design strategies applied to colonial buildings include building layouts assisted by additional shading from the roof to avoid direct solar heat. Natural ventilation became the main key in colonial building design, with wide door and window openings, crepe windows, and clerestory in buildings allowing cross-ventilation. This helps create good air circulation and reduces humidity in the room. The selection of building materials such as bricks, wood, and natural stone that have heat-retaining properties and the resistance of these materials to tropical climates is an important consideration. Thick walls and the use of overcutting also help keep the room temperature cool.

By implementing design strategies that are adaptive to tropical climates, colonial buildings can provide thermal comfort for their occupants and create a healthy and sustainable building environment. This research provides insights and findings into developing tropical architectural principles that are environmentally friendly and answer climate challenges, especially in tropical regions.

6 CONCLUSION

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CONFLICT OF INTEREST

No conflict of interest declared for this paper.

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