International Journal Of Health, Engineering And Technology (IJHET) *E-ISSN 2829 - 8683*
Volume 4, Number 6, March 2026, *Page. 2077 - 2085*
Email : editorijhess@gmail.com

Identification Of Appropriate Architectural Elements For Design Application In Tropical Regions Of Southeast Asia

Hilda Kamila[1)], Erwin Djuni Winarto[2)]
[1,2)] Department of Architecture, Faculty of Architecture and Design, Universitas Pembangunan Nasional Jawa Timur, Surabaya, Indonesia

*Corresponding Author
Email : 22051010052@student.upnjatim.ac.id

Abstract

Southeast Asia with tropical regions has unique climate characteristics, such as high humidity, significant rainfall intensity throughout the year and high temperatures. These conditions require an architectural approach that is responsive to climate in order to create thermal comfort in buildings. The purpose of this study is to identify what architectural elements are considered appropriate to be applied in building design in tropical Southeast Asia. The methods used in this study include literature studies and case study analysis of several buildings designed with a tropical approach in the region. Through this approach, it is hoped that this study can provide an initial overview of architectural elements that have the potential to support adaptive designs to tropical climate conditions. The results of this study will be the basis for the development of contextual and sustainable tropical architectural designs.

Keywords: Architecture Elements, Contextual, Suistainable, Tropical Architecture.

INTRODUCTION

The tropical region, particularly in Southeast Asia, generally has climatic characteristics that pose unique challenges for building construction in the area. High temperatures, significant rainfall, and high humidity levels mean that designs must prioritize not only aesthetics but also practicality. Oliver (1997), in his research on vernacular architecture, showed that the forms and elements of traditional buildings in Southeast Asia have long evolved as responses to local climatic conditions. The use of steep roofs to quickly shed rainwater and the use of porous materials sourced from local natural resources exemplify how design adaptations in architecture function naturally and effectively.

Hyde (2000), in *Climate Responsive Design*, stated that achieving passive thermal comfort is a key principle in designing buildings in hot-humid climates. This principle involves the use of natural ventilation to protect against direct solar radiation and the incorporation of shading elements, such as overhangs or wide eaves. In the *Manual of Tropical Housing and Building*, Koenigsberger et al. (1974) emphasized that the regulation of ventilation, building form, and the control of heat and rainfall are crucial factors to consider when designing buildings in hot-humid tropical climates like those in Southeast Asia.

This study primarily focuses on identifying architectural elements suitable for use in building design in Southeast Asia's hot-humid climate. It is expected that this research will enhance understanding of how architectural design can systematically address climatic challenges in Southeast Asia, drawing from literature studies and analyses of contemporary and traditional tropical building characteristics. Additionally, this study is expected to contribute to the development of theory and practice in the design of contextually appropriate and sustainable buildings in Southeast Asia.

RESEARCH METHODS

This study employs a qualitative-descriptive approach, utilizing two main methods: literature review and case study analysis. The literature review examines theories proposed by experts and presented in various books. Some of the key references used as the theoretical foundation include *Climate Responsive Design* by Hyde (2000), *Manual of Tropical Housing and Building* by Koenigsberger et al. (1974), and Oliver (1997) in his research on vernacular architecture.

The case study analysis focuses on several buildings in Southeast Asia known for successfully implementing tropical architecture. The criteria for selecting these case studies include:

1. Using a design approach that considers local climatic factors.
2. Being located in the tropical region of Southeast Asia.
3. Having sufficient building documentation to support the theoretical framework.

The analysis was conducted by observing architectural elements in the selected buildings in relation to elements or principles proposed by experts, such as roof forms, building orientation and openings, ventilation systems, materials, and the use of vegetation. Documentation and observations were carried out through photo studies and technical data, including sections and details, to assess how these elements contribute to creating thermal comfort.

RESULTS AND DISCUSSION

Based on the theoretical framework, three main theories relevant to the tropical architectural approach have been identified: Paul Oliver (1997), Koenigsberger et al. (1974), and Richard Hyde (2000). These three theories provide a framework for understanding how architectural design responds to tropical climates adaptively, contextually, and sustainably.

Paul Oliver (1997)

In his findings in the Encyclopedia of Vernacular of the World, Oliver discusses:

Steep Roofs for High Rainfall

Steep roofs on buildings help accelerate rainwater runoff, preventing pooling and damage to the roof structure and the building itself, as in the case of the Gedung Sate building in Bandung, Indonesia.

Figure 1. Facade of Gedung Sate

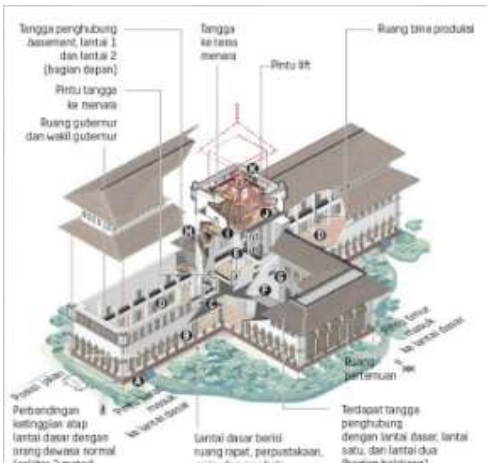

Figure 2. Axonometry of the Gedung Sate Building

Architect : Col. Geni V.L. Slors
Year Completed : 1924
Location : Bandung, West Java

The Gedung Sate building in Bandung is a government center whose design utilizes a steep roof to accelerate rainwater runoff and prevent damage from tropical weather. The building's wide roof overhangs also protect the walls and windows from sunlight and heat exposure, helping to maintain the building's comfort and durability. The steep roof helps accelerate rainwater runoff, preventing pooling and damage to the roof structure itself. The combination of the steep roof and wide overhangs also helps to passively lower indoor temperatures, creating thermal safety for the building. This harmonious blend of tropical and colonial architectural styles is a perfect blend.

Use of Local Porous Materials

The use of local porous materials such as brick, wood, and bamboo can reduce thermal temperatures in buildings due to their ability to absorb and store heat, particularly in Southeast Asia, and their ability to improve ventilation and evaporation. Buildings using porous materials, such as brick, produced locally from local natural resources, can be found in Thailand, such as the Kantana Film and Animation Institute.

Figure 3. Facade of the Kantana Film and Animation Institute Building

Figure 4. Canteen Interior

Figure 5. Vegetation inside the building

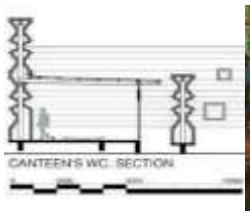

Figure 6. Section of th canteen building

Figure 7. Use of Natural Materials on Building Facades

Architect : Boonserm Premthada (Bangkok Project Studio)
Completion Year : 2011
Location : Nakhon Pathom

The Kantana Film and Animation Institute is a campus building located in Nakhon Pathom. Designed by Bangkok Project Studio, the facade utilizes local, porous clay bricks to create natural thermal comfort. This clay material allows the building to "breathe" and integrate sustainably with the tropical climate. The use of traditionally made local clay bricks with their porous texture absorbs heat and naturally retains humidity. The design demonstrates how simple local materials can be used to create a modern building that is both thermally comfortable and aesthetically pleasing. These materials are also produced from local natural resources, which is environmentally friendly and reflects local character.

Raised Floors to Address Ground Humidity

Buildings with raised floor structures, often elevated above ground level, improve air circulation and reduce humidity, creating thermal comfort without mechanical cooling, such as The Green Village, a hotel in Bali, Indonesia, that blends with nature.

Figure 8. The Green Village Building Form

Figure 9. Section of The Green Village Building

Architect : IBUKU
Year Completed : 2010
Location : Jimbaran, Bali.

The Green Village is a Balinese accommodation that adapts the principles of stilt houses into modern, eco-friendly architecture. The building is elevated above ground level to improve air circulation and reduce humidity, creating natural thermal comfort without mechanical cooling. The use of environmentally friendly materials in this building creates a blend of traditional stilt house philosophy with contemporary design that harmonizes with nature.

These elements reflect contextual design responsive to the tropical climate, and are rooted in local wisdom.

Koenigsberger et al. (1974)

In his book "Manual of Tropical Housing and Building," Koenigsberger emphasizes the importance of:

Building Designs that Allow Good Air Circulation

Building shapes and their orientation to the sun's rays can minimize excessive thermal temperatures, as in the Kampung Admiralty Building, a residential building, public space, commercial area, and healthcare facility located in Singapore.

Figure 10. Bird's eye view of Admiralty Village Building

Architect : WOHA
Completion Year : 2018
Location : Singapore

The building's vertical massing and east-west orientation maximize natural ventilation and minimize direct sunlight exposure. The building's orientation follows an east-west direction to reduce

direct solar heat gain and its elongated massing. The building's massing is also arranged in a stepped pattern to maximize natural ventilation/cross-ventilation and allow natural light to enter all areas. The building's green open spaces are designed vertically in the form of gardens on each floor to create a natural cooling effect. The building's spaces are arranged in a combination of efficient zoning, which includes commercial spaces, healthcare facilities, and residential complexes.

Figure 11. Section of the Admiralty Village Building

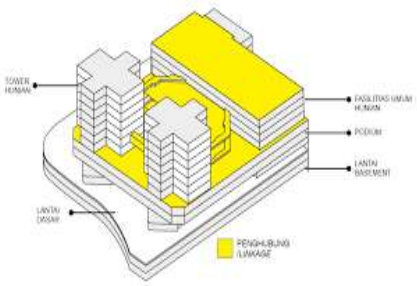

Figure 12. Illustration of Buildin Function Division

Figure 13. Vegetation on Buildings

Controlling heat and the surrounding climate through spatial planning

The spatial planning of a building can influence the thermal comfort experienced by both its occupants and its impact on the building itself. Arranging open spaces, using facades, and surrounding vegetation can help regulate the building's thermal temperature, both from the outside and inside. This is evident in the Chempenai House, a residential building located in Kuala Lumpur, Malaysia.

Figure 14. Shape of the Chempenai House Building Facade

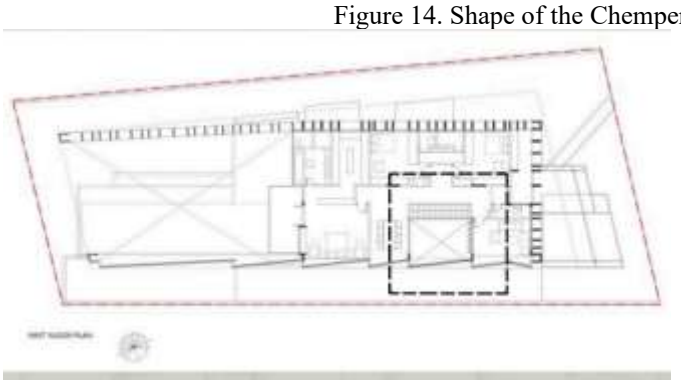

Figure 15. Building Plan with Open Spaces

Figure 16. Facade of the front building of Chempenai House

Figure 17. Window Openings in Buildings

Architect : WHBC Architects
Completion Year : 2015
Location : Kuala Lumpur

Chempenai House by WHBC Architects, located in Kuala Lumpur, Malaysia, is a modern tropical residential building that emphasizes permeability and openness in its design. The perforated concrete facade, with semi-open spaces within, allows for natural ventilation, a harmonious connection between the interior and exterior, and the flow of light into the building.

This design creates a comfortable microclimate within the building without relying on mechanical systems. The building utilizes numerous transitional spaces such as hallways, gardens, and verandas as elements that influence the micro-structure of the building. The open layout and high permeability between spaces ensure maximum air circulation and natural lighting. The perforated concrete structure appears to "breathe" with the surrounding vegetation, making it a strong representation of open and porous tropical architecture.

Natural ventilation systems for indoor temperature control

Maximum ventilation systems can also be used in high-rise buildings to maximize air circulation and natural light from outside, which can emphasize the use of mechanical cooling. Located in the Jakarta area, this office building, Wisma Dharmala Sakti, is located.

Figure 18. Wisma Dharmala Sakti Building

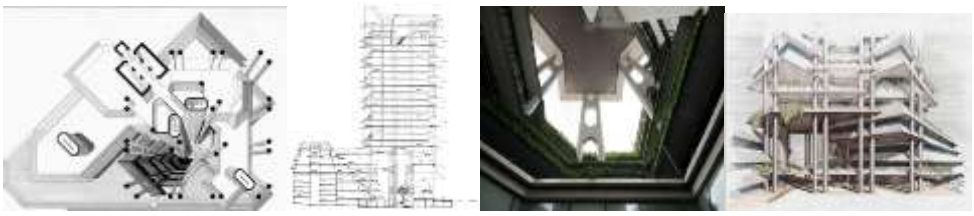

Figure 19. Top Section of the Building; Figure 20. Section of the Building; Figure 21. Ornamental Facade of the Building; Figure 22. Building Openings.

Architect : Paul Rudolph
Year of Completion : 1989
Location : Jakarta

Wisma Dharmala Sakti in Jakarta is a tropical-style office building designed by Paul Rudolph. The building has an east-west orientation with a climate-responsive massing to reduce excessive heat from sunlight and maximize natural ventilation. This theory is used to identify effective and contextual architectural elements for tropical climates.

Richard Hyde (2000)

Through his work on Climate Responsive Design, Hyde highlights:

The use of natural ventilation, the use of shading elements, and the use of vegetation.

This theory suggests that architecture should not only be an aesthetic form but also function as a natural thermal comfort control system in buildings. This is evident in the Parkroyal on Pickering hotel in Singapore.

Figure 21. Building Facade using Vegetation

Architect : WOHA
Completion Year : 2013
Location : Singapore

Parkroyal on Pickering, located in Singapore, is a hotel with a tropical architectural style that maximizes vegetation and a canopy system throughout the building. The building features sky gardens, ponds, and vertical gardens on various floors, which lower the ambient temperature and reduce heat from solar radiation, while creating a cool atmosphere. The building features sky gardens, vertical gardens, and green canopies on each floor, intensively. The building also utilizes an irrigation and recycling system to water the vegetation. This building is a concrete manifestation of Richard Hyde's adaptive and responsive architectural approach to the tropical climate.

Figure 22. Building interior with openings and vegetation

Figure 23. Vegetation on Buildings

Figure 24. Building form from the road

Based on the results and discussion above, regarding three tropical architectural theories: Paul Oliver (1997), Koenigsberger et al. (1974), and Richard Hyde (2000), a number of tropical architectural elements have been identified that have been applied to several case studies of buildings in Southeast Asia. These three theories serve as a framework for analyzing the relationship between design elements and their response to the region's tropical climate. The following table summarizes the main architectural elements associated with tropical design principles and the characteristics of relevant approaches, such as adaptive, contextual, and sustainable.

Table 1. Summary of Tropical Architectural Elements Based on Theory Review and Case Studies

No.	Architectural Theory	Main Principle	Tropical Architectural Elements	Case Study (Building)	Response to Tropical Climate	Approach Character
1	Paul Oliver (1997)	Steep Roof	Sloped roof & wide overhang	Gedung Sate	Direct rain runoff, protection from sun and rain	Contextual
2	Paul Oliver (1997)	Local Materials	Porous local clay bricks	Kantana Institute	Heat absorption, enhance natural ventilation	Sustainable & Contextual
3	Paul Oliver (1997)	Stilted Floor	Stilt house structure	The Green Village	Improve underfloor air circulation, reduce ground dampness	Adaptive
4	Koenigsberger	Building Form	Vertical mass & orientation	Kampung Admiralty	Maximize natural ventilation & daylight	Adaptive
5	Koenigsberger	Space Planning	Open spaces and vegetation	Chempenai House	Create natural microclimate, good circulation & lighting	Contextual
6	Koenigsberger	Natural Ventilation	Cross ventilation & openings	Wisma Dharmala Sakti	Reduce excessive heat, maximize passive ventilation	Adaptive
7	Richard Hyde	Vegetation & Shading	Sky garden, vertical greenery	Parkroyal on Pickering	Reduce surrounding air temperature, self-irrigation	Adaptive & Sustainable

CONCLUSION

This research identifies that the use of design elements that passively respond to hot and humid climates significantly influences the effective and contextual design of tropical architectural buildings in Southeast Asia. Based on the literature review and case studies used, it was found that the following architectural elements are crucial for creating thermal comfort in buildings:

1. Adjusted massing and orientation to minimize direct sunlight exposure and maximize natural ventilation.
2. Permeability and openness of spaces, such as hallways, voids, and wide openings, help control the building's temperature and humidity naturally.
3. The use of porous materials derived from local natural resources, such as clay and bamboo, can help control the building's temperature and humidity naturally.
4. Steep roofs and wide overhangs protect the building from rain and excessive heat.
5. Maximum natural ventilation (cross ventilation) allows for comprehensive air flow without the aid of mechanical systems.
6. The use of vegetation and canopies can create a cooling effect and improve air quality, as in vertical gardens and sky gardens.
7. Building elevation (stilt houses) to improve air circulation and reduce soil moisture within the building.

By implementing these elements, building designs in tropical Southeast Asia can develop contextually, sustainably, and adapt to the surrounding climate while providing optimal thermal comfort without heavy reliance on artificial cooling systems.

REFERENCES

Art4D. (2016). Chempenai House. Diakses dari https://art4d.com/2016/10/chempenai-house

Bangkok Project Company. (2012). Kantana Institute. Diakses dari https://www.archdaily.com/230041/kantana-institute-bangkok-project-company.

Hyde, R. (2000). *Climate Responsive Design: A Study of Buildings in Moderate and Hot Humid Climates*. London: E & FN Spon.

Koenigsberger, O. H., Ingersoll, T. G., Mayhew, A., & Szokolay, S. V. (1974). *Manual of Tropical Housing and Building: Part 1 – Climatic Design*. London: Longman Group Limited.

Leksono, S. (n.d.). Pendekatan kualitatif deskriptif. *Penelitian Kualitatif Ilmu Ekonomi BAB 7*. Diakses Dari https://www.wisnuwardhana.ac.id/wp-content/uploads/2015/07/Penelitian-Kualitatif-ilmu-Ekonomi-BAB-7-oleh-Prof-Dr.-Ir.-Sonny-Leksono-S.E.-M.S.1.pdf

Nauli, F. (2008). *Pendekatan Desain Bangunan Kantor Ramah Lingkungan*. Skripsi. Universitas Kristen Maranatha. Diakses dari http://repository.maranatha.edu/887/2/0763098_Chapter1.pdf

Oliver, P.(1997). Vernacular Architecture: A Reader. Thesis. Oxford Brooker University.

Paul Rudolph Institute. (n.d.). Wisma Dharmala Sakti. Diakses dari https://www.paulrudolph.institute/198201-wisma-dharmala-sakti

PT Bambu. (2013). The Green School. Diakses dari https://www.archdaily.com/81585/the-green-school-pt-bambu

PT Bambu. (2013). The Green Village. Diakses dari https://www.archdaily.com/296667/the-green-village-pt-bambu

WOHA. (2013). Parkroyal on Pickering. Diakses dari https://www.archdaily.com/363164/parkroyal-on-pickering-woha-2

WOHA. (2018). Kampung Admiralty. Diakses dari https://www.archdaily.com/904646/kampung admiralty-woha

Yuliana, I. (2019). Arsitektur Tropis pada Bangunan Komersial (Studi Kasus: Parkroyal on Pickering). *Rekakarsa: Jurnal Arsitektur*, 17(1), 45–56. Diakses dari https://ejurnal.itenas.ac.id/index.php/rekakarsa/article/download/694/1072