

Final Architecture Design Studio
Design of

PAX Tower Apartment

An Approach to Energy Efficient Through Facade

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Studio Akhir Desain Arsitektur
Desain dari

PAX Apartemen Tower

Dengan Pendekatan Efisiensi Energi Melalui Fasad

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PAGE OF APPROVAL

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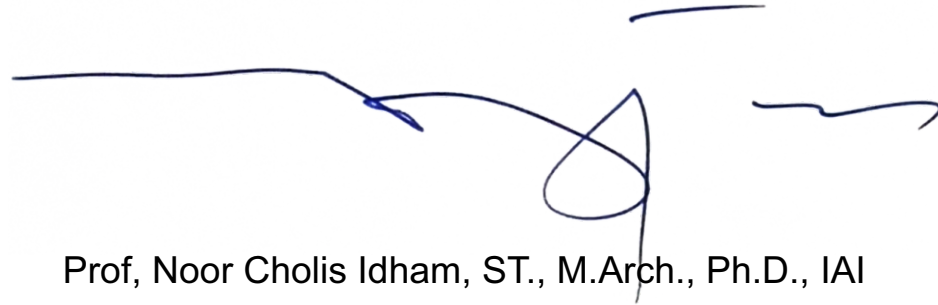
PAX Apartemen Tower Dengan Pendekatan Efisiensi Energi Melalui Fasad
PAX Tower Apartment An Approach To Energy Efficient Through Facade

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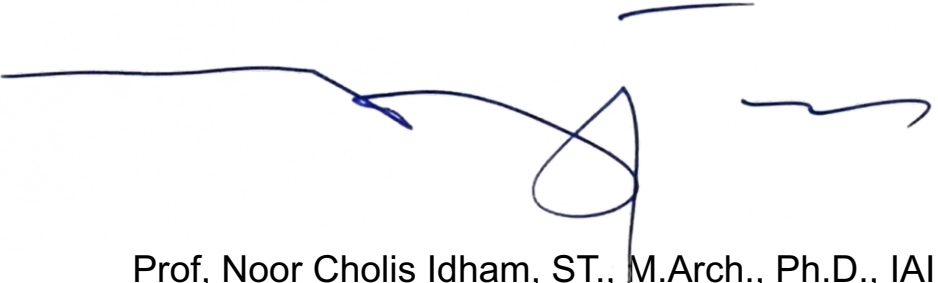
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I sincerely declare that this statement is true and submit it to the Department of Architecture at the Islamic University of Indonesia to be used for educational and publication purposes.

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FOREWORD.

Praise and thanks to Allah SWT for the mercy and blessings upon all His people, as well as our greetings and prayers to the Prophet Muhammad SAW who has given us a path for his followers. Gratitude to Allah SWT, Prophet Muhammad SAW, family, and close friends who have given the strength for the author to complete the Final Architecture Project with title **“Pax Tower Apartment An Approach To Energy Efficient Through Facade.”** Through this opportunity, I sincerely want to express my gratitude to those who generously offered help, support, guidance, and encouragement throughout the entire process for the author to achieve this degree.

1. Allah SWT, for all the grace and blessings that have been given to me in every process of the journey. The one who answers all my prayers to give me health and strength, who makes me able to finish this final project successfully.
2. My parents, Father and Mother, who always provide invaluable love, prayers, and support.
3. Prof. Noor Cholis Idham, S.T., M. Arch., Ph.D., IAI, as the supervisor of the Final Architecture Design Studio (FADS), who always shares his wide knowledge relentlessly and kindly guides the author, enabling the author to finish the project and learn a lot of precious knowledge.
4. Johanita Anggia Rini, S.T., M.T., Ph.D., as the examining lecturer. Who always provides the best constructive advice and criticism in a detailed manner to help the author complete the technical aspect of the final project and become better.
5. Ir. Hanif Budiman, M.T., Ph.D., as the examining lecturer and Chairperson of the Architecture Study Program at Islamic University of Indonesia. Who always provides the constructive feedback to enable the author to explore the conceptual aspect of the final project and become better.
6. Ar. Dr. Ir. Revianto Budi Santosa, M.Arch., IAI, as the lecturer and also as a father. Who always is patient and provides invaluable mental support throughout the process.
7. Fauzan Effendi, S.T., Who has given me the opportunity and space for discussion.
8. Adiba Ulwan Hibatulloh, S.T., Keisha Alma Primasha, S.Kg., Teuku Rifqi Fanshuri, S.Ars., Ahmad Nurfaizi, S.Ars., Chalid Muhammad Gilang Mahira, S.Ars., Ar. Abhista Abrar Irawan, S.Ars., Zaky, Subhan, Omar, Reza, Kirana, and entire UII Architecture 2018 for their invaluable encouragement, stories and camaraderie.

For all the assistance and dedication that has been provided, hope that these kindnesses will be rewarded many times over by Allah SWT. As the author, I am aware that this project is not perfect. The author hopes that the Final Architecture Project Studio (FADS) can serve as a reflection that we must all continue to learn and improve in future projects. Therefore, the author also hopes that this writing can be beneficial as a learning tool and useful for new innovations to be developed as a design approach in a similar context for the readers.

Yogyakarta, 25 Agustus 2025
Yogyakarta, 25 August 2025



Farhad Hammam Mughni

ABSTRACT

This residential project, located in Central Jakarta, Indonesia, responds to the growing demand for comfortable and efficient housing for both local residents and newcomers, in line with the city's rapidly increasing population. The building design focuses on optimizing energy efficiency through a façade-based approach, adapted to user groups and building zones. The main challenge lies in designing a façade or building envelope that not only reduces energy consumption but also ensures comfort, functionality, and livability. To address this, the study integrates passive design principles, supported by Computational Fluid Dynamics (CFD) wind analysis to optimize natural ventilation, as well as Overall Thermal Transfer Value (OTTV) calculations to assess the thermal performance of the façade in reducing cooling loads. The results of simulations and calculations demonstrate that the application of façade design strategies significantly reduces energy consumption, enhances thermal comfort, and supports building sustainability. Therefore, this project highlights the importance of integrating façade approaches and passive design strategies as an urban housing solution with a strong emphasis on energy efficiency.

ABSTRAK

Proyek hunian ini, yang berlokasi di Jakarta Pusat, Indonesia, hadir sebagai jawaban atas kebutuhan akan hunian yang nyaman dan efisien bagi warga lokal maupun pendatang, seiring dengan pertumbuhan populasi yang terus meningkat. Desain bangunan difokuskan pada efisiensi penggunaan energi melalui pendekatan fasad, yang disesuaikan dengan kelompok pengguna dan zonasi bangunan. Tantangan utama yang dihadapi adalah merancang fasad atau selubung bangunan yang mampu mengurangi konsumsi energi sekaligus memberikan kenyamanan, fungsionalitas, serta kelayakan huni. Untuk mencapai hal tersebut, penelitian ini mengintegrasikan prinsip desain pasif, didukung dengan analisis Computational Fluid Dynamics (CFD) angin untuk mengoptimalkan ventilasi alami, serta perhitungan Overall Thermal Transfer Value (OTTV) guna menilai performa termal fasad dalam mengurangi beban pendinginan. Hasil perhitungan dan simulasi menunjukkan bahwa penerapan strategi desain fasad secara signifikan dapat menekan penggunaan energi, meningkatkan kenyamanan termal, serta mendukung keberlanjutan bangunan. Dengan demikian, proyek ini menegaskan pentingnya integrasi pendekatan fasad dan strategi desain pasif sebagai solusi hunian perkotaan yang berorientasi pada efisiensi energi.

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Introduction

1.0.1 Design Title

Design of PAX Tower Apartment An Approach To Energy Efficient Through Facade

Desain dari PAX Apartement Tower Dengan Pendekatan Energi Efisien Melalui Fasad

1.0.2 Title Description

- PAX derives from the Latin word meaning peace or tranquility. In Roman history, Pax was the goddess of peace and a symbol of stability and prosperity during the era known as Pax Romana. This philosophy reflects balance and serenity in daily life, which is translated into the architectural expression of two towers standing side by side, resembling two pillars of peace. PAX not only embodies harmonious architecture but also represents a modern lifestyle that prioritizes quality of life, privacy, and tranquility amidst the urban bustle. The relevance of the name becomes even more profound when associated with the two towers, which can be interpreted as guardians of peace, symbolizing balance and unity. As a brand name, PAX is short, distinctive, and memorable making it highly suitable for a premium or exclusive residential development. It appeals to the upper-middle-class market that seeks comfort and serenity within an urban living environment. As part of its branding potential, PAX can be further developed through visual identity elements such as logo design, visual style, and color tones, The PAX Towers. A simple yet powerful slogan reinforces this concept “Live in Peace, Live in PAX.”
- Tower is a vertical architectural structure that rises significantly above its surroundings, functioning as a landmark while accommodating diverse activities within a limited footprint. In urban planning, towers symbolize density management, land optimization, and the pursuit of vertical living solutions to address population growth and scarcity of land. Towers also reflect advancements in structural engineering and façade technologies, enabling not only height but also resilience, sustainability, and aesthetic expression.
- Apartment is a type of residential building that organizes multiple living units within a single vertical or horizontal structure, designed to accommodate modern urban lifestyles. Apartments address the challenges of high-density populations in metropolitan areas by optimizing space while ensuring privacy, comfort, and accessibility. As a residential typology, apartments emphasize community interaction, functional efficiency, and integration with supporting facilities, making them a key response to the demand for sustainable and affordable urban housing.
- Energy Efficiency is a concept in planning that involves implementing strategies to control, regulate, and reduce excessive energy consumption. The application of energy efficiency can be achieved through the use of more efficient technologies or production processes, as well as generally accepted methods aimed at minimizing energy expenditure. Reducing and limiting energy use in buildings can also be regarded as a solution to mitigate the problem of greenhouse gas emissions.
- Facade is the outer skin of a building that serves both aesthetic and functional purposes. As the first interface between the building and its environment, the façade contributes to architectural identity while regulating performance aspects such as thermal comfort, daylight penetration, and ventilation. In contemporary practice, façades are not merely decorative but operate as intelligent systems—integrating materials, technologies, and design strategies to achieve energy efficiency, environmental responsiveness, and visual harmony with the urban context.

1.1 Design Premise

The energy mostly used by a building, and most of building with the high capacity energy is building in city. and building in city using energy is high-rise building. The population in Jakarta increase by 5% each year. PAX Tower Apartment is a high-rise commercial residential design concept that focuses on energy efficiency through facade design. This project aims to reduce energy consumption while improving the performance of high-rise buildings in dense urban environments. With two integrated functions, this tower functions as a residential apartment equipped with supporting facilities, including a shopping center in one building mass. This design prioritizes saving electrical energy such as air conditioning and lighting, as well as supporting aspects of circulation comfort, zoning efficiency, and spatial privacy for its residents.

Located in Central Jakarta, a very dense urban area with significant air pollution, the main challenge of this project is to create an environmentally friendly living space that minimizes energy consumption while maximizing occupant comfort. To achieve this, PAX Tower Apartment applies a triple glass facade, which is designed to increase energy efficiency, reduce the urban heat island effect, and create a healthier living environment. This material optimizes thermal insulation and natural lighting, thereby reducing the need for indoor cooling. Through this design approach, PAX Tower Apartment contributes to the Net Zero Emission concept, providing a comfortable, modern, and sustainable living space in the heart of Jakarta.

The facade designed with the principle of energy efficiency plays an important role in reducing the operational energy consumption of the building. One effective approach is the use of triple-glazed facades, which minimize heat transfer between the interior and exterior of a building, reducing the load on the heating, ventilation, and air conditioning (HVAC) system. By combining technologies such as Low-E coatings and filling argon or krypton gas between the glass layers, this type of facade can reduce solar heat gain by 30%-50%, maintaining stable indoor temperatures and reducing reliance on air conditioning. Furthermore, a facade design that takes into account building orientation and natural shading can further optimize natural lighting without increasing indoor heat. Through this strategy, the building improves energy efficiency while lowering the carbon footprint associated with electricity consumption.

1.2 Background

1.2.1 Energy Consumption In Indonesia

Indonesia has been the fourth-fastest growing large economy in the world over the course of the last five decades, behind Korea, Singapore and China. In 2021, Indonesia's poverty rate was less than 10% of the population, notable progress from the 60% level in 1970. Today, Indonesia's place in global rankings include fourth-most populous country seventh-largest economy, twelfth-largest energy consumer and ninth-largest emitter of CO₂ from fuel combustion. (An Energy Sector Roadmap to Net Zero Emissions in Indonesia, 2020)



Figure 1.1 Central Jakarta area with GBK and Thamrin Complex
Source: Author, 2025

Indonesia has experienced rapid economic growth over the past five decades, ranking among the top economies in Asia. This growth has led to increased energy consumption, particularly in the industry, transport, and building sectors, which has significantly contributed to CO₂ emissions. In fact, Indonesia is the ninth-largest emitter of CO₂ from fuel combustion globally. The energy demand in Indonesia is projected to change dramatically by 2060. Fossil fuel dependency, which accounted for around 70% of total energy demand in 2021, is expected to decline to about 50% by 2060 as the country transitions toward renewable energy. The use of natural gas, bioenergy, and electricity is predicted to rise substantially, particularly in the transport and buildings sectors, as energy efficiency measures and decarbonization policies take effect.

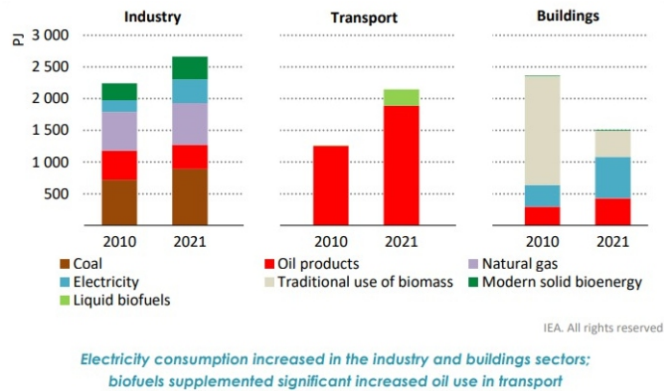


Figure 1.2.1 Final consumption by fuel and sector, 2010 and 2021.
Source : <https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia>

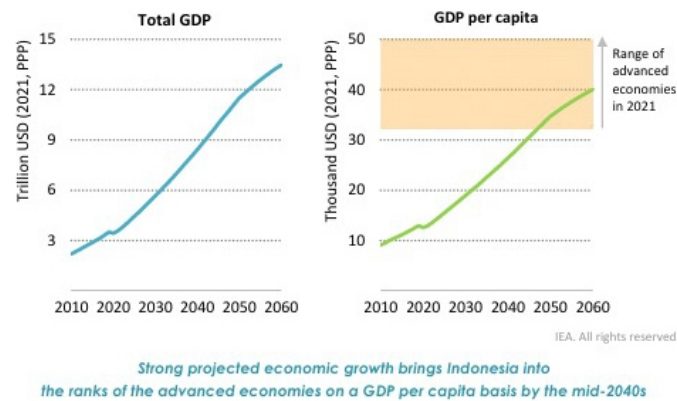


Figure 1.2.2 Total GDP and GDP per capita in Indonesia, 2010-2060, and relative to advanced economies in IEA scenarios.
Source : <https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia>

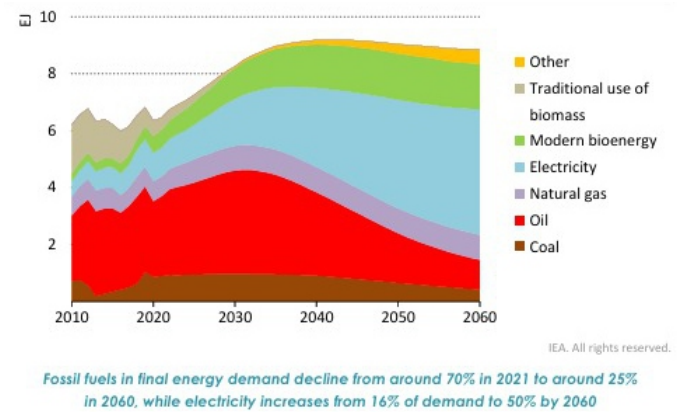


Figure 1.2.3 Final energy demand in the Announced Pledges Scenario.
Source : <https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia>

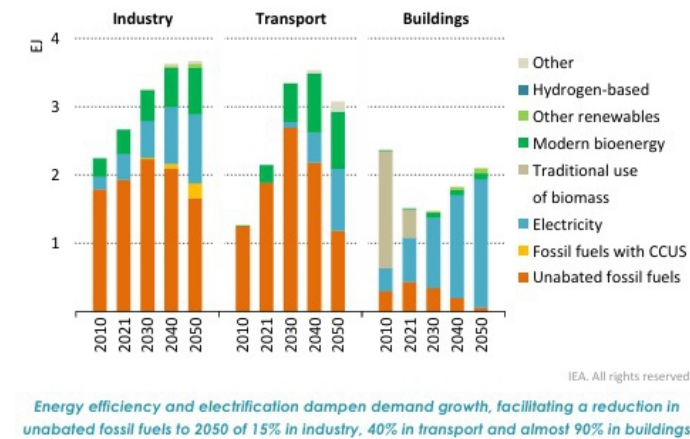


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Source : <https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia>

Economic growth in Indonesia is expected to remain strong, with total GDP projected to rise significantly by 2060, reaching levels comparable to advanced economies by mid-century. This growth, however, will require substantial efforts to balance energy demand and sustainability. To meet climate targets, energy efficiency measures and the adoption of low-carbon energy sources, such as renewables and hydrogen-based fuels, are essential. Eventually, Indonesia's future energy landscape will be shaped by its ability to implement sustainable policies, improve efficiency, and reduce dependence on fossil fuels while maintaining economic growth and urban development. With the facts and background above, the author chose the topic of designing the facade of a high-rise building in order to make the building more energy efficient.

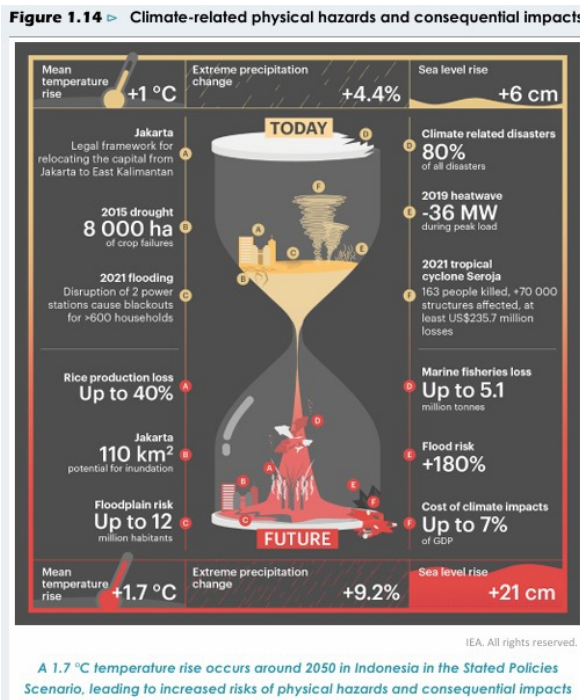


Figure 1.2.5 Climate-related physical hazards and consequential impact
Source : <https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia>

Climate change has already demonstrated significant impacts in Indonesia, with current warming of approximately +1 °C accompanied by a 4.4% increase in extreme precipitation and a sea level rise of around 6 cm. These conditions have contributed to recurrent flooding in Jakarta, with an inundation risk of up to 110 km² and potential exposure for 12 million residents, prompting the government to establish a legal framework for relocating the capital to East Kalimantan.

Agricultural productivity has also been severely affected, as evidenced by the 2015 drought that damaged 8,000 hectares of crops and ongoing reductions in rice yields, which are projected to decline by as much as 40%. Climate-related disasters already account for nearly 80% of all natural disasters in the country, with events such as the 2021 tropical cyclone Seroja causing 163 fatalities, damage to more than 70,000 structures, and economic losses exceeding USD 235.7 million. Looking toward 2050, projections indicate further warming of +1.7 °C, intensified precipitation of +9.2%, and sea level rise reaching 21 cm. These changes are expected to result in a 180% increase in flood risk, a loss of up to 5.1 million tonnes in marine fisheries, and an overall economic impact equivalent to 7% of Indonesia's GDP. Such data underline the urgent necessity for adaptive measures in urban planning, infrastructure, and energy systems to mitigate future vulnerabilities and support long-term resilience.

1.2.2 Growing Demand of Energy Efficient Apartments in Jakarta

Urbanization is rapidly increasing, especially in major cities like Jakarta. According to Indonesia's Central Bureau of Statistics (BPS), Jakarta's population reached 11.25 million in 2023, with an estimated growth rate of 1.2% per year. This rise in population has led to a higher demand for high-rise residential buildings, particularly apartments. However, this growth also results in a significant increase in energy consumption. Residential buildings in Indonesia account for about 38% of total electricity consumption, with air conditioning (40%) and lighting (20%) being the main contributors (Ministry of Energy and Mineral Resources, 2022). Given Jakarta's tropical climate, where temperatures range from 27°C to 34°C year-round, the demand for cooling systems remains high, leading to increased electricity consumption and carbon emissions.

1.2.3 Towards a Sustainable Apartment Design in Jakarta

With Jakarta's rapid urban expansion and increasing energy demands, adopting energy-efficient facade designs is crucial. This research aims to explore facade strategies that align with Jakarta's tropical climate, focusing on reducing energy consumption, improving indoor comfort. By integrating passive design strategies, smart materials, and green technologies, apartment towers in Jakarta can become more energy-efficient, and environmentally responsible.

1.2.4 Application and Integration of Energy Efficiency through Facade Design

The application and integration of energy efficiency through facade design refers to the strategic use of building envelope elements especially the exterior facade to reduce energy consumption while enhancing thermal comfort and environmental performance. The facade is not merely an aesthetic layer but a functional system that directly influences the building's energy behavior.

Application refers to how specific technologies, materials, and architectural strategies are implemented to improve energy efficiency. This may include:

- High-performance glazing (e.g., double or triple-pane windows with low-E coatings).
- Shading devices (e.g., louvers, brise-soleil, vertical fins).
- Insulated wall systems.
- Reflective or green facade surfaces.
- Ventilated or double-skin facades.

Integration emphasizes how these energy-efficient strategies are not added as afterthoughts, but are embedded holistically into the design process considering orientation, climate, building use, and occupant needs. For example, integrating passive design principles such as daylight optimization, natural ventilation, and solar heat control into the facade can significantly reduce reliance on mechanical heating,

cooling, and lighting systems. lighting systems. a well-designed facade contributes to:

- Lower energy consumption.
- Enhanced indoor environmental quality.
- Reduced operational costs.
- A smaller carbon footprint.
- Compliance with green building standards (such as LEED, EDGE, or Green Mark).

By addressing energy efficiency from the early design stage through the building's skin, architects and engineers can create sustainable solutions that perform effectively in both tropical and temperate climates.

1.2.5 Conclusion Problem and Issue

The rapid urbanization and population growth in cities like Jakarta have led to a significant increase in the construction of high-rise apartment buildings. However, these developments come with major challenges, particularly in terms of energy consumption.

The challenges of high energy consumption, inefficient facade design concerns highlight the urgent need for energy-efficient facade solutions in apartment towers. This research aims to explore innovative facade strategies that enhance energy efficiency, and lighting, and contribute to a more sustainable urban environment in Jakarta.

Main Issues to Address :

- How can facade design strategies reduce energy consumption in apartment towers?
- Which facade technologies are most effective for Jakarta's tropical climate?

High Energy Consumption in Apartment Towers :

- Residential buildings account for 38% of Indonesia's total electricity consumption, with 40% used for cooling systems (Ministry of Energy and Mineral Resources, 2022).
- Jakarta's tropical climate, with temperatures ranging from 27°C to 34°C, results in excessive use of air conditioning.

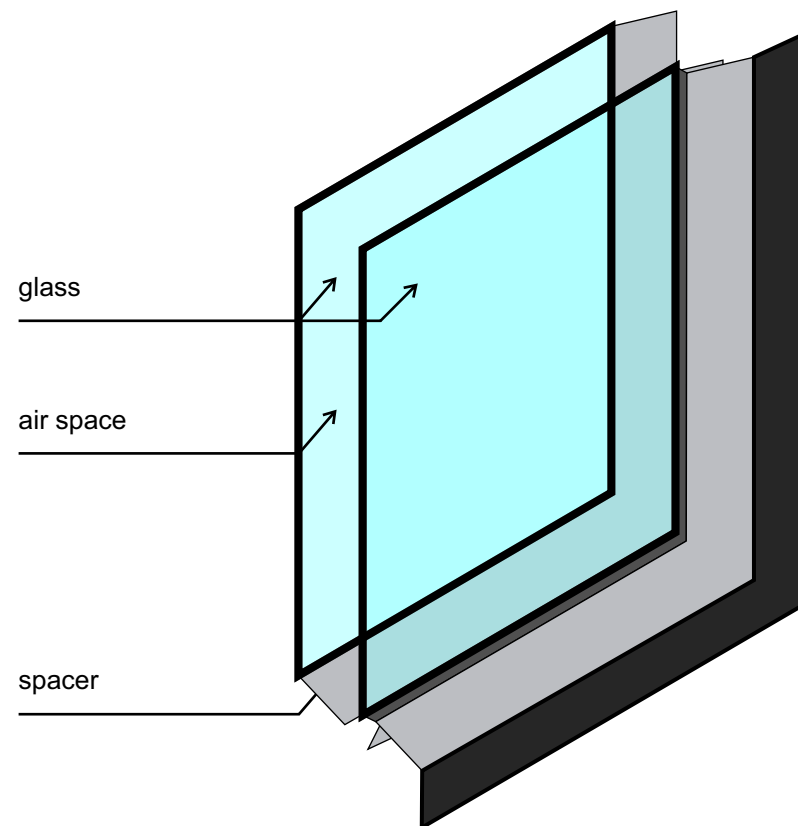


Figure 1.2.5.1 Double glass facade
Source : Author, 2025

1.3 Goals & Objectives

Problem Statement

Based on the background of the problems described above, the following problem formulations are obtained

General Problem

How to design a PAX Apartment Tower an approach to energy efficiency through facade design and materials to save energy

Specific Problem

1. How to design an effective, inovative and sustainable tower apartment building to address high population growth and land constraints in urban areas
2. How to design an PAX Apartment an approach to energy efficiency through facade skin.

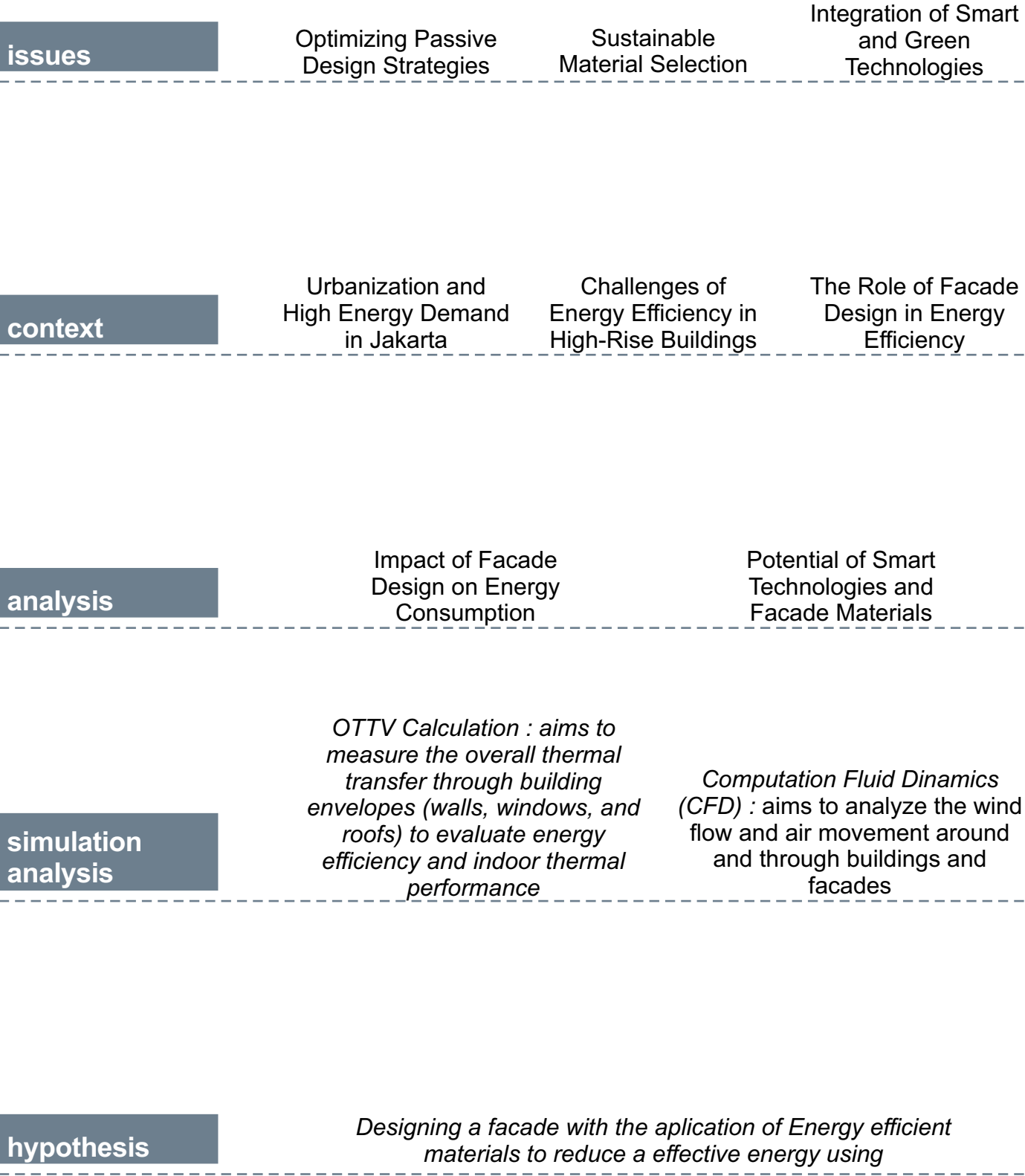
Goals

1. Creating a green economy, energy-efficient commercial high-rise building so that it can save energy usage in buildings.
2. Creating a comfortable spatial layout and circulation that fulfills the privacy of building users in accordance with the principle of spatial comfort.

Objectives

1. Designing high-rise commercial buildings (apartment towers) with energy-efficient building achievements,
2. Designing tower buildings to become new icons in the Jakarta sky and also growth symbols of infrastructure,
3. Developing innovative technology-based facade designs to improve operational efficiency and competitiveness of apartment towers.

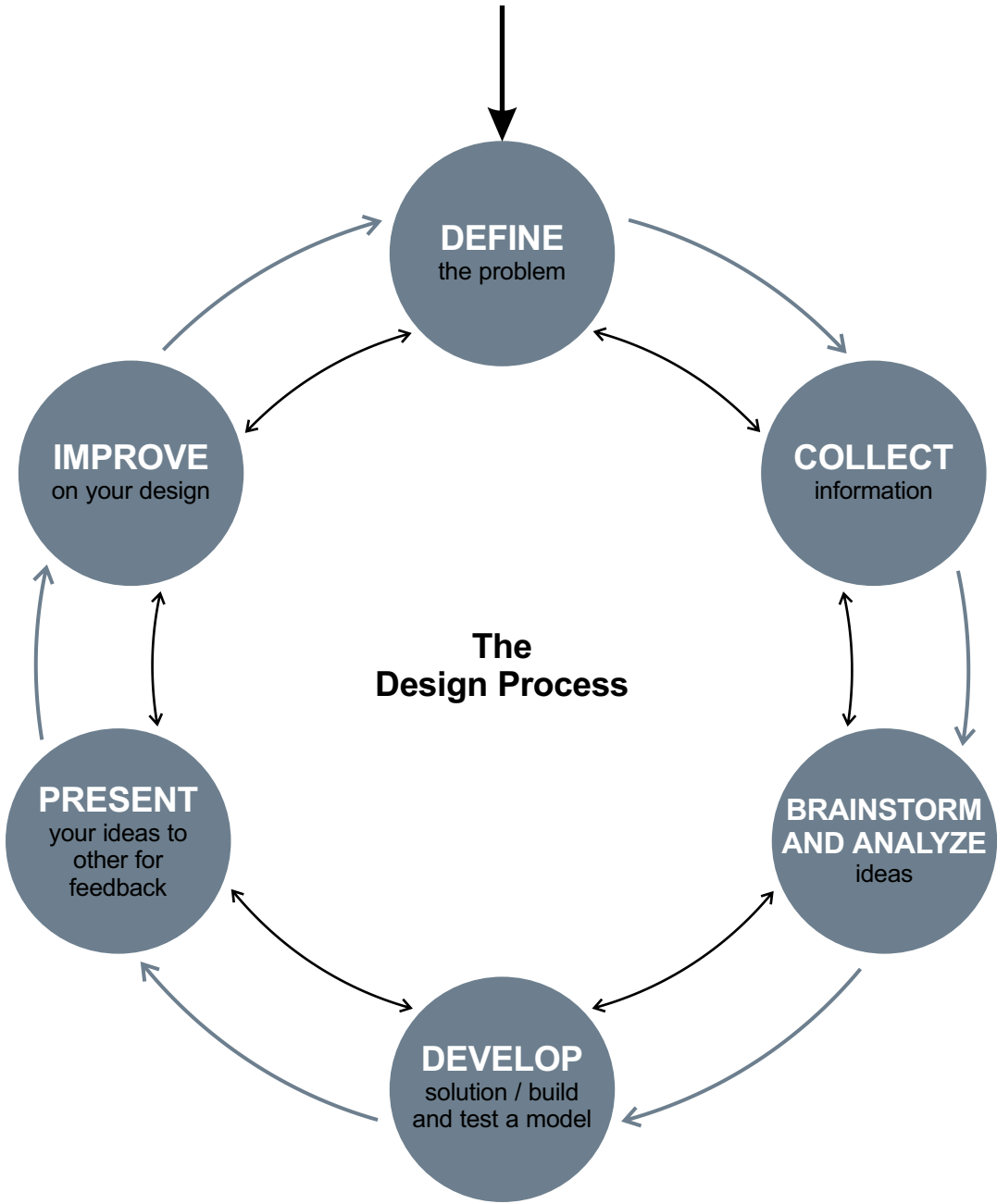
1.4 Design Method



Design method scheme
Source : Author, 2025

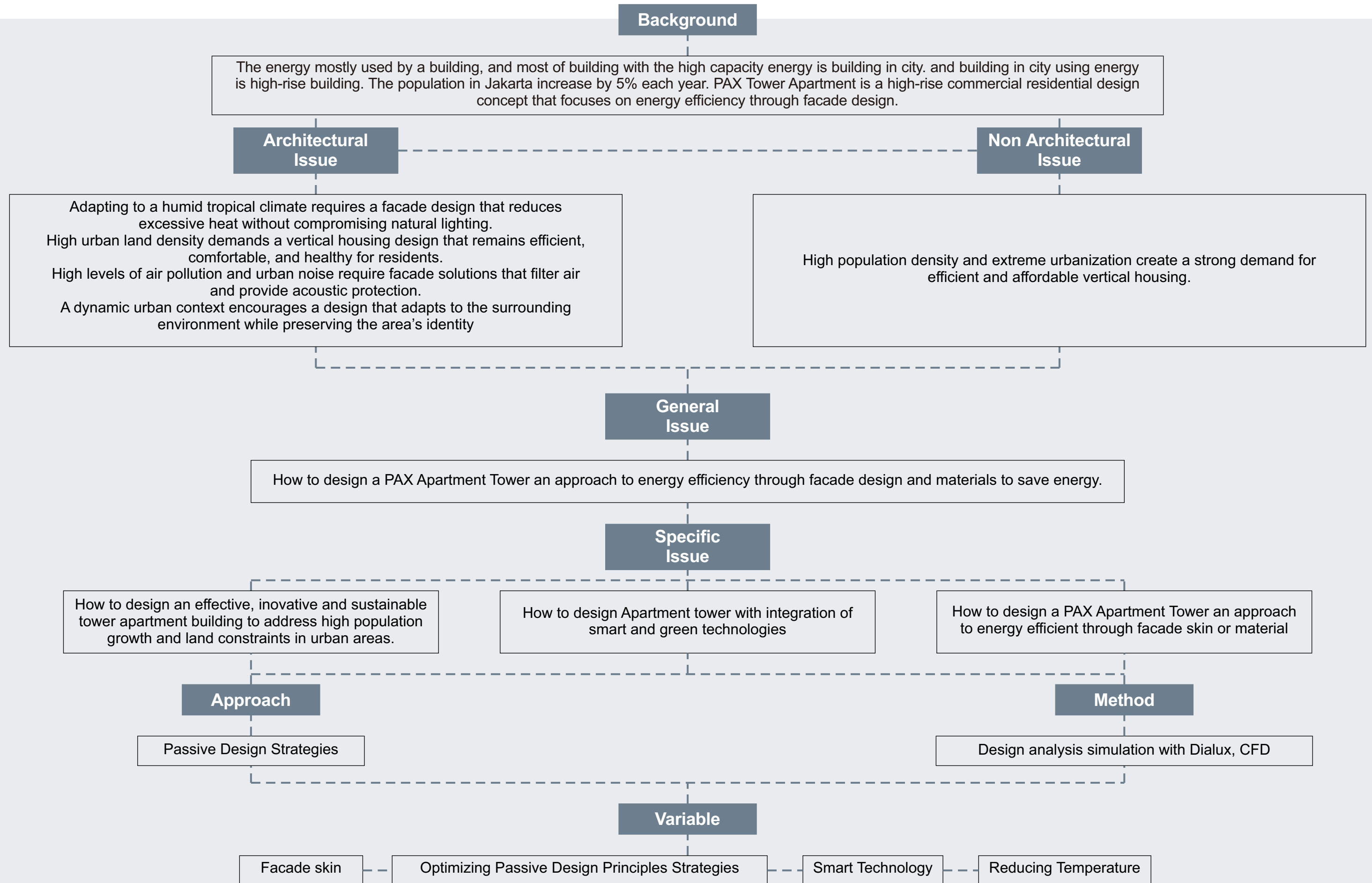
1.4.1 Preliminary Design Methods

According to Andrew Pressman (2012), the Process is about thought and feelings that are interrelated and assume a certain magnitude and direction. This process must of course be clear, individual, and constantly evolving. Forced to find a goal in the process, I would characterize it as repetitive, requiring sequential loops, each of which yield more information and the resolution of the previous one. A resolution may get results or a suggestion to reformulate the problem and a question to answer. The design process map shows the negotiation between a problem and a solution with each seen as a refelction of a scheme.

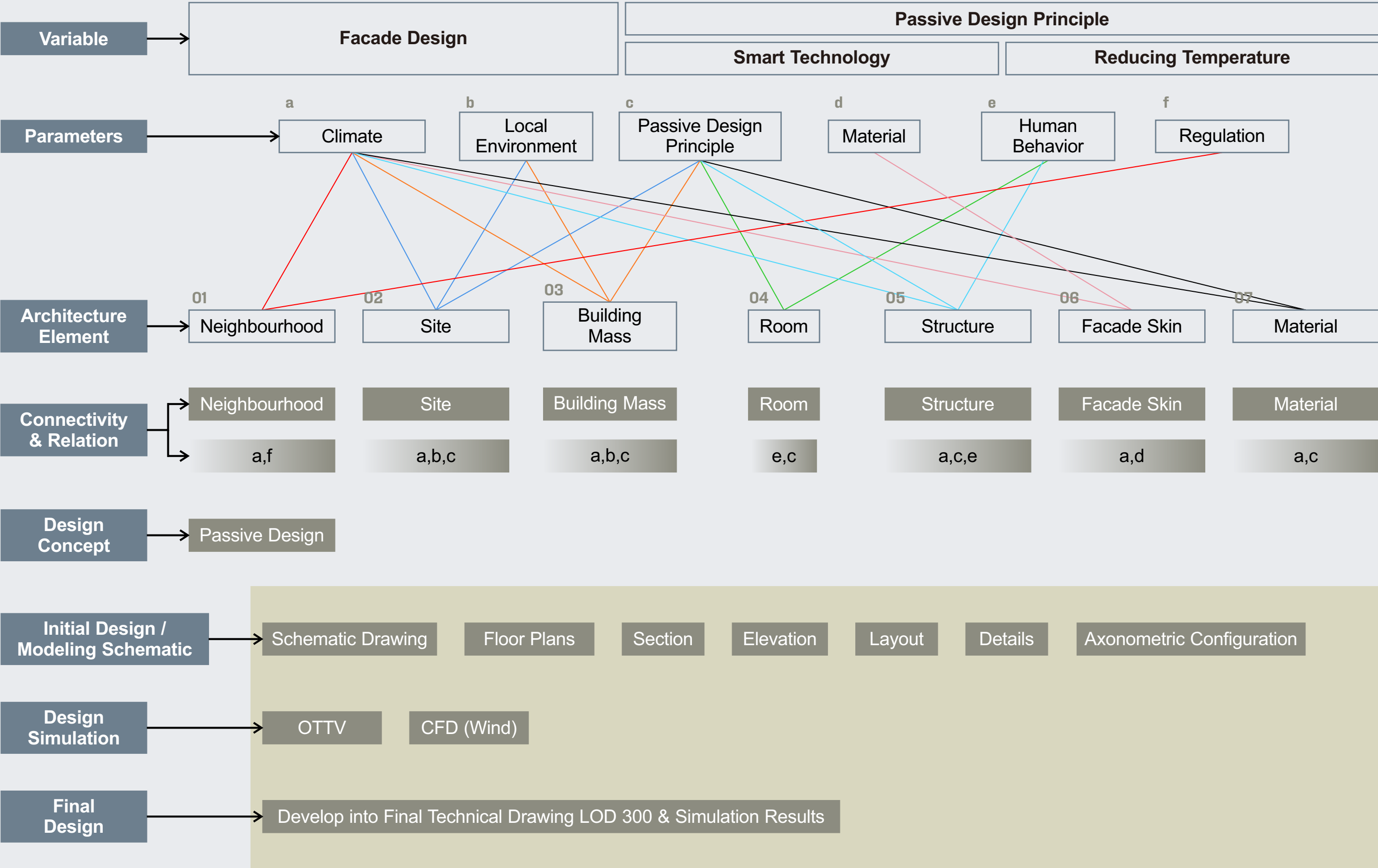


Preliminary design methods scheme
Source : Author, 2025

1.5 Design Framework



1.5 Design Framework



1.6 Literature Review, Originality & Novelty

Seno Pambudi (2020) designed a Luxury Apartment in the current conditions because the number of workers who can afford a luxury apartment is also increasing. This study uses a qualitative method with qualitative and descriptive literature studies as the basis for design analysis. The results of the study show that the demand for luxury apartments from young executives is increasing in demand. Other supporting facilities will pay attention to the aspect of social interaction between apartment users. A modern architectural approach will be applied in this design. Buildings that are symbiotic with the surrounding environment will prevent buildings from damaging existing layouts or regulations, so that the concept of a Sustainable City can continue to be applied to subsequent buildings.

Farzana (2020) in his research on high-rise apartment buildings in tropical climates, emphasized the importance of unit layout and facade design in supporting natural lighting. The arrangement of interior space and lighting integrated with the building's lighting design has been shown to maximize natural lighting without increasing excessive heat, which is very important for the comfort of its occupants. This strengthens the integration between vertical layout, facade design, and local climate factors in high-rise apartment design.

Larasati (2020) conducted a study on facade diversification to increase natural airflow in high-rise buildings in tropical areas. This study shows that diverse and adaptive facade designs to dominant wind directions can increase extensive ventilation and thermal comfort in residential units. Such designs are important in the context of dense tropical apartments, where natural air circulation is difficult to achieve without careful design of building heat.

Based on previous research to apartment tower and facade concluded that the design of high-rise apartments is increasingly directed at creating vertical residences that are not only luxurious in appearance, but also comfortable, healthy, and responsive to tropical climates. Facade elements play an important role as regulators of natural lighting, ventilation, and thermal protection, as well as the visual identity of the building. In a dense urban context, the facade also mediates between the residence and the larger city environment, bridging the needs of privacy, image, and sustainability.

TITLE	AUTHOR	PUBLICATION YEAR	APPROACH	SIMMILARITIES	DIFFERENCE
Apartment Di Jakarta Selatan Dengan Pendekatan Desain Berbasis Green Building	Hendrawan Adi Surya, Satrio Nugroho, Satriya Wahyu Firmandhani	2020	Ontrinsic (natural) with an environmentally conscious design approach (ecological design)	Apartment Building	Scale of the building context, and the energy efficient architechtrual approach
Effect Of Facade Components On Energy Efficiency In Office Building	Takeshi Ihara, Arild Gustaven, Bjørn Petter Jelle	2015	An approach for determining the effect of different facade components on energy saving in an office building in Tokyo, Japan	High Rise Building, Energy Efficiency	Scale of the building context, Function of the building (apartment)
Desain SuperBlok Mixed Use (Apartemen, Mall, Rental Office) Di Medan Dengan Konsep Arsitektur Ekologis	Muhammad Al Fadli, Cut Nur'aini, Husni Thamrin	2020	Ecological Architechture	Apartment Building	Scale of the building context, Ecological architechture approach
Mix Use Building Hotel, Rental Office, Dan Convention Di Manado	Juneidy J. Runtuwene, Pingkan Peggy Egam, Sonny Tilaar	2020	Futuristic Architechture	Facade concept approaches	Selection of building function and energy efficiency approaches

Table 1.1 Originality and Novelty
Source : Author, 2025

Design Study & Site Analysis

2.1 Precedents

2.1.1 Autograph Tower, Thamrin Nine



Figure 2.1.1 Autograph Tower
Source : KPF



Figure 2.1.2 Autograph Tower Survey
Source : Author, 2025

Autograph Tower, Thamrin Nine

Architect : Kohn Pedersen Fox Associates (KPF)
Location : Central Jakarta
Year : 2022

Autograph Tower is one of the super tall skyscrapers currently being built in the Sudirman Central Business District (SCBD), South Jakarta. This building is planned to be one of the tallest buildings in Indonesia, with a height of 383 meters and consisting of 75 floors. Autograph Tower is designed as a mixed-use development, combining office, residential, and hotel functions. Designed with futuristic and elegant architecture, reflecting the progress of urban Jakarta. The author took this tower as a precedent because the material of the facade design of this multi-storey building uses triple glass, with fin spider fitting to pursue the platinum bca predicate, which correlated with my design and on the refugee floor mezzanine also still complies with local regulations.

2.1.2 Sequis Tower



Figure 2.1.3 Sequis Tower
Source : KPF

Sequis Tower, KPF

Architect : Kohn Pedersen Fox Associates (KPF)
Location : South Jakarta, Indonesia
Year : 2019

Sequis Tower is an innovative example of a facade design that focuses on desirability and energy efficiency. The building's facade uses a series of fins and graded panels designed to measure solar radiation while optimizing natural lighting. This system contributed to its LEED Platinum certification, with a 36% improvement in energy efficiency compared to LEED standards.

The design concept is inspired by the banyan tree, with the tower consisting of four main tubes bundled and arranged asymmetrically to create structural stability and provide sky gardens at various heights. The density of the fins on the facade increases as the building rises, providing optimal shading without blocking the city views. In addition, the podium building has a cantilevered section that hangs over the pedestrian walkway, creating an outdoor public space that is shaded from Jakarta's tropical sun and seasonal rains.

2.1.3 District 8



Figure 2.1.4 Astha District 8 (1)
Source : district8jakarta.com



Figure 2.1.5 Astha District 8 (2)
Source : district8jakarta.com

Astha Residence, District 8

Architect : Airmas Asri
Location : South Jakarta, Indonesia
Year : 2020

ASTHA District 8, located in the Sudirman Central Business District (SCBD), South Jakarta, is a prominent example of modern high-rise architecture that integrates luxury and sustainability. The building is part of a mixed-use development comprising residential (apartment and hotel), commercial, and hospitality functions. The author selected Astha District 8 as a precedent due to its sophisticated facade design, which utilizes unitized curtain wall systems with double-glazed low-E glass and vertical fins. This combination enhances thermal performance, daylighting, and visual aesthetics supporting energy efficiency goals. The project also complies with local building regulations, including the integration of refuge floors, which aligns with the author's own design approach in terms of safety standards and sustainable architectural strategies.

2.2 Apartment Tower Typology

2.2.1 Definition of Apartment Tower

An apartment tower is a high-rise residential building that contains multiple self-contained housing units (apartments), typically stacked vertically across many floors. These buildings are designed to accommodate many residents in a dense urban setting.

2.2.2 Based on Building Height

Building typology refers to the classification based on form, function, and spatial arrangement. In the context of high-rise apartments, this typology relates to how the building is vertically designed, how housing units are arranged, and how access and circulation are planned. High-rise apartments are typically used to accommodate high population density in limited land areas, especially in urban environments.

- **Low-rise (1 - 4 floors):** Usually without elevator, with simpler circulation.
- **Mid-rise (5 - 8 floors):** Typically includes elevators and vertical circulation system.
- **High-rise (more than 8 floors):** Features more complex structural, circulation, and service system and requires higher safety standards.

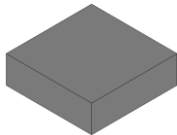


Figure 2.2.6 Low rise schematic
Source : Author,2025

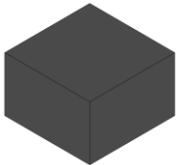


Figure 2.2.7 Mid rise schematic
Source : Author,2025

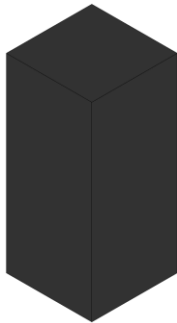


Figure 2.2.8 High rise schematic
Source : Author,2025

The author is currently directing the design of high-rise apartment buildings (high-rise apartment towers), especially for high-density accommodation on limited land in an urban context.

2.2 Apartment Tower Typology

2.2.3 Based on Room Types

In a residential tower, each room type plays a specific role and is affected differently by climate, sunlight, ventilation, and user behavior. Properly locating and designing these rooms improves both comfort and energy efficiency.

- **Studio:** A single open space with a separate bathroom.
- **2–3 Bedroom:** Units with separate bedrooms and shared living spaces.
- **Loft:** Includes a mezzanine or additional level within the unit.
- **Duplex/ Triplex:** Two or three-story units within the vertical building.
- **Penthouse:** more area per unit than typical apartment (located at the highest point of the building).

2.2.4 Based on Mass Arrangement

The building mass type determines how units are distributed and how individual rooms are exposed to sunlight and views.

- **Single Tower:** One vertical building mass.
- **Twin / Multiple Towers:** Multiple towers in one complex, possibly connected by a podium or skybridge.
- **Podium + Tower:** A podium at the base for commercial or shared facilities, with residential towers above.

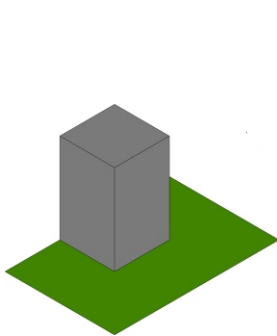


Figure 2.2.9 Single tower
Source : Author,2025

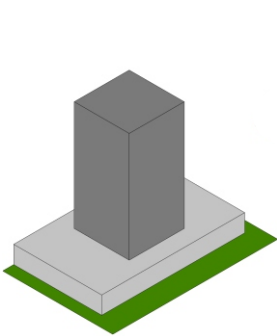


Figure 2.2.10 Single tower + podium
Source : Author,2025

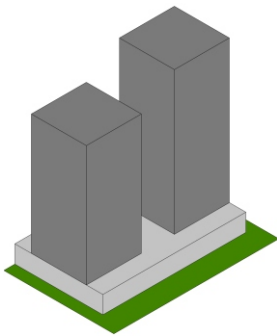


Figure 2.2.11 Twin tower + podium
Source : Author,2025

2.2.5 Based on Mixed Function

Mixed-function (mixed-use) apartment towers integrate multiple programs within one massing typically a combination of residential, commercial, recreational, and public/amenity spaces. These functions are vertically or horizontally layered, influencing the placement of rooms and their environmental performance.

- **Podium (Lower Floors – Public / Semi-Public)**

Typical Rooms / Functions:

Retail shops, cafés, co-working spacesLobbies, parking, gym, day-careCommunity meeting rooms

- **Mid Floors (Shared Amenities / Transitional Programs)**

Typical Rooms / Functions:Sky gardens, shared lounges, co-working, fitness roomsSemi-private circulation zonesUtility/service floors

- **Upper Floors (Private Residential Units)**

Typical Rooms / Functions:Apartment units (studio, 2BR, 3BR, penthouse)Private balconies, sky courtsUtility and storage rooms

2.2.6 Based on Height

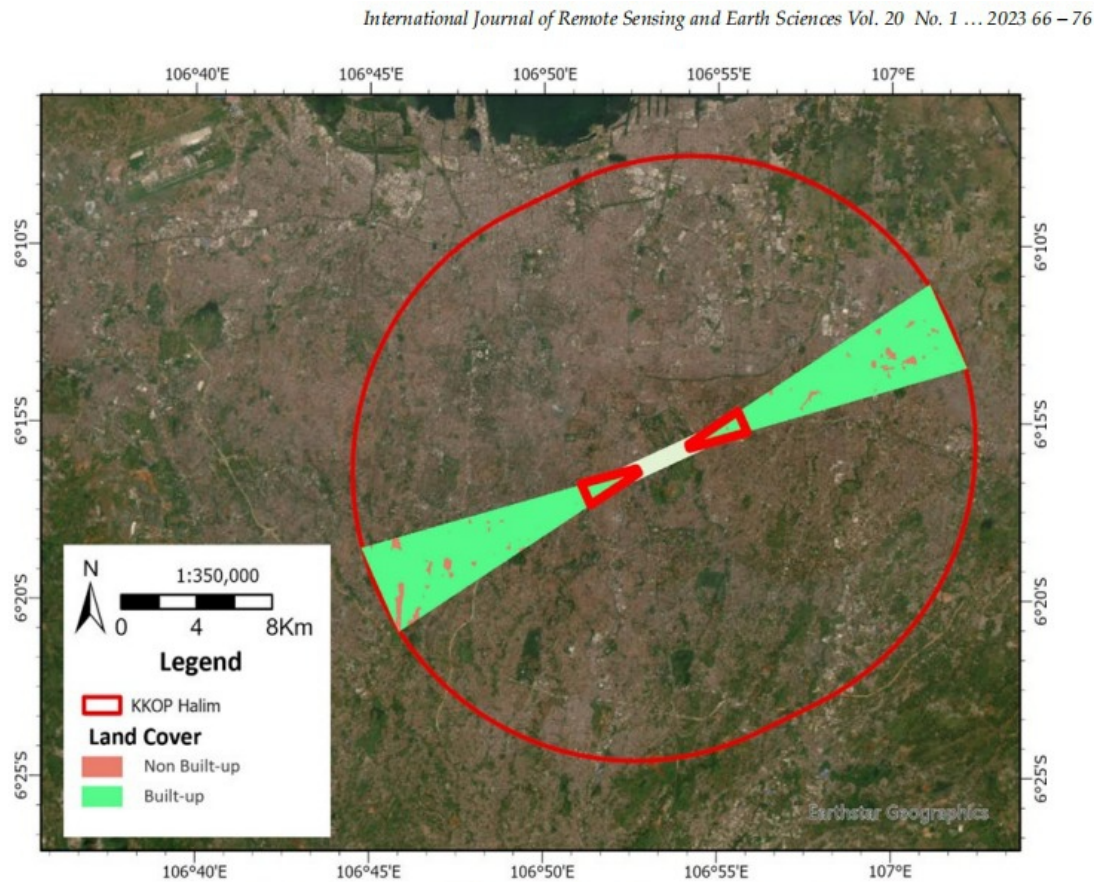


Figure 2.2.12 Building height regulations based on KKOP land cover Halim Perdana Kusuma
Source: International Journal of Remote Sensing and Earth Sciences Vol. 20 No.1 2023 66-76

The image shows a land cover map around the take-off area of Halim Perdana Kusuma Airport, Jakarta, displayed within the flight safety influence radius. The area outlined in bold red represents the Halim Flight Operations Control Area (KKOP). Green indicates built-up areas, while pink indicates non-built-up areas. It can be seen that the aircraft movement corridor (marked by elongated triangles in both directions of the runway) contains a significant amount of built-up area, including residential areas, public facilities, and urban buildings. This situation indicates potential vulnerability if development is not controlled, particularly regarding the height of buildings near the flight path.

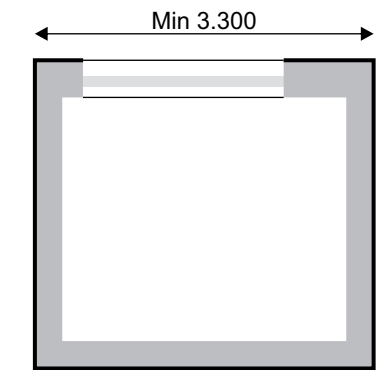
The correlation with high-rise buildings is important, as the presence of skyscrapers near the flight path can pose safety risks, both in the form of visual obstruction for pilots and the potential for collisions if they exceed the height limits stipulated in KKOP regulations. Therefore, the construction of high-rise buildings in East Jakarta and the surrounding area must comply with the maximum height provisions stipulated in the KKOP zone. With the increasing need for high-rise buildings in Jakarta, the aspect of synchronizing architectural design with aviation regulations must be a primary consideration, so that the existence of high-rise buildings not only pays attention to functional and aesthetic aspects, but also ensures the safety of civil aviation.

2.3 Minimum Requirements

Minimum requirements refer to the least acceptable standards that a space, system, or design must meet in order to be considered functional, legal, and safe according to regulations, codes, or design guidelines.

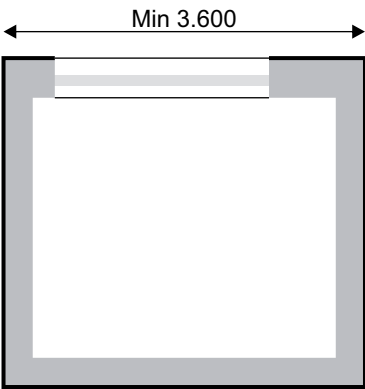
Combined Living Dining

All living rooms must be designed to accommodate the typical furniture based on the number of bed spaces provided, in addition to complying with the minimum room areas and widths set out in the Apartment Standards. As a minimum requirement combined living and dining rooms must accommodate the following furniture



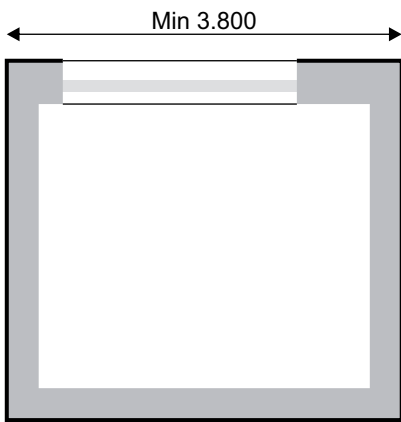
1 Bedroom

- A sofa or seating arrangement for three person
- A coffee table (500mm X 1050mm)
- A flat screen TV
- A table with dining space for four persons (800mm X 1200mm)
- A desk for home working (500mm X 1050mm)



2 Bedroom

- A sofa or seating for four persons
- A coffee table (500mm X 1050mm)
- A flat screen TV
- A table with dining space for four persons (800mm X 1200mm)
- A desk for home working (500mm X 1050mm)



3 Bedroom

- A sofa or seating arrangement for five persons
- A coffee table (500mm X 1050mm)
- A flat screen TV
- A table with dining space for six persons (800 X 1800mm)
- A desk for home working (500mm X 1050mm)

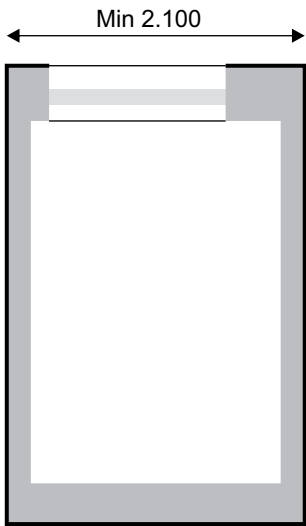
Figure 2.3.1 schematic plan
Source: Author, 2025

Bedroom

All bedrooms must be designed to accommodate the typical furniture based on the number of bed spaces provided, in addition to complying with the minimum room areas and widths set out in the Apartments Standards. As a minimum requirement bedrooms must accommodate the following furniture:

Single Bedroom

- Layout to accommodate a standard size single bed (1900mm X 900mm) with a 800mm clear zone to one side and foot of the bed.
- Layout to allow for one bedside lockers with minimum dimensions of 400mm x 400mm.
- Layout to accommodate a wardrobe with minimum dimensions of 900mm x 600mm with an allowance for doors to open without obstruction.
- Consider alternatives uses of single bedroom such as home office or separate dining room.



Double or Twin Bedroom

- Layout to accommodate a standard king size bed (2000mm X 1500mm) with a 800mm clear zone around the sides and foot of the bed.
- Layout to allow for two bedside locker with minimum dimensions of 400mm x 400mm.
- Layout to accommodate a wardrobe with minimum dimensions of 1200mm x 600mm with an allowance for doors to open without obstruction.
- Layout of twin bedroom to accommodate two standard size single beds (1900mm X 900mm) with a 800mm clear zone to one side and foot of the bed.

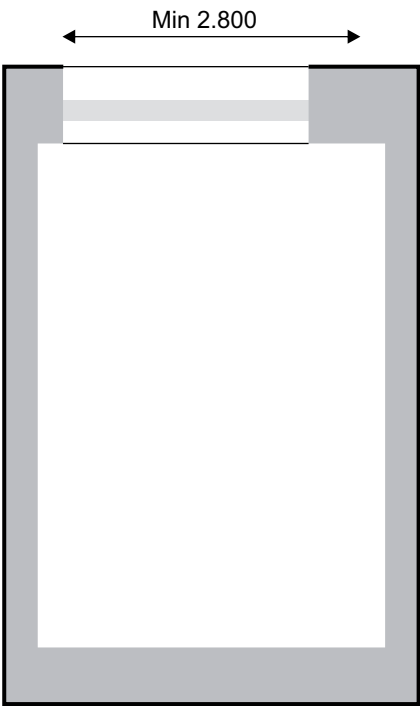


Figure 2.3.2 schematic plan
Source: Author, 2025

2.4 Typical Apartment

Studio Type 1A

	Minimum
Living, Kitchen, Dining, Bed-space	30m2
Storage	3m2
Apartment Area	37m2

One Bedroom Two Person Type 2A

	Minimum
Living, Kitchen, Dining, Bed-space	23m2
Double Bedroom	11.4m2
Storage	3m2
Apartment Area	45m2

Two Bedroom Three Person Type 3A

	Minimum
Living, Kitchen, Dining, Bed-space	28m2
Single Bedroom	7.1m2
Twin Bedroom	13m2
Storage	5m2
Apartment Area	63m2

Two Bedroom Four Person Type 4A

	Minimum
Living, Kitchen, Dining, Bed-space	30m2
Double Bedroom	11.4m2

Twin Bedroom	13m2
Storage	6m2
Apartment Area	73m2

Two Bedroom Four Person Type 4B

	Minimum
Living, Kitchen, Dining, Bed-space	30m2
Double Bedroom	11.4m2
Twin Bedroom	13m2
Storage	6m2
Apartment Area	73m2

Three Bedroom Five Person Type 5A

	Minimum
Living, Kitchen, Dining, Bed-space	34m2
Double Bedroom	11.4m2
Twin Bedroom	13m2
Single Bedroom	7.1m2
Storage	9m2
Apartment Area	90m2

Table 2.4 Typical Apartment Layouts
Source: Author, 2025

2.5 Architecture Element

2.5.1 Facade in General

The facade is the outer face of a building, often the front, that defines its appearance and architectural style.

Facade as Building Skin

As a building skin, the facade acts like a protective layer, controlling light, airflow, and temperature while contributing to the building's energy efficiency.

Facade of the Tower

In towers or high-rise buildings, the facade is a vertical envelope that responds to wind, heat, and light conditions, often designed for both aesthetics and high-performance energy control.



Figure 2.5.1 Heat reduction
Source: Morphogenesis.official

Facade Typology

Facade typology refers to the classification and characteristics of facade designs based on common patterns used in architecture. Facades are not only aesthetic elements, but also function as regulators of light, ventilation, privacy, and protection against local climate conditions.

Facade Typology Element

- Openings (windows/doors): Regulate natural lighting and cross ventilation.
- Shading Device: Such as canopies, lattices, or secondary skins to reduce solar heat.
- Material: Use of materials such as glass, exposed brick, concrete, wood, or metal panels that adapt to the climate and design concept.
- Rhythm & Composition: Placement of facade elements repeatedly or asymmetrically to form visual character.
- Color & Texture: Support the aesthetics and identity of the building.

Type Of Facade Typology (based on approach)

	Characteristic
Passive Facade	Adapts to climate, such as sun-controlled openings, insulated materials.
Active Facade	Uses technological systems such as smart glass or automatic ventilation.
Transparent Facade	Dominated by glass, maximum natural lighting, suitable for cold climates.
Closed Facade (massive)	Minimal openings, suitable for hot and private climates.
Layered Facade (double skin)	There is space between the two layers of the facade to regulate temperature and lighting.
Vernacular Facade	Adapts local/traditional elements to respond to cultural and climatic contexts.
Modular Facade	Uses regularly repeated panels or modules.

Table 2.5 Facade Typology
Source: Author, 2025

Facade Design Consideration

- Climate (sun direction, rainfall, air temperature).
- Function of space behind the facade.
- Context of the site and surrounding buildings.
- Sustainability and energy efficiency.
- Aesthetics and architectural identity

Facade Typology

Facade / Cladding																		
Material					Design		Installation					Interaction						
Metal & Glass	Precast/ GRC	Natural Stone	Membrane/ Textile	Metal Sheet	Standard	Custom	Window Wall			Curtain Wall			Static	Dynamic				
							Store Front	Store Front	Operable	Stick System	Semi Unitized	Unitized			Mechanical	Thermal	Solar	Electrical

Figure 2.5.2 Facade Typology
Source: PERAFI, 2025

Achieve Facade Performance

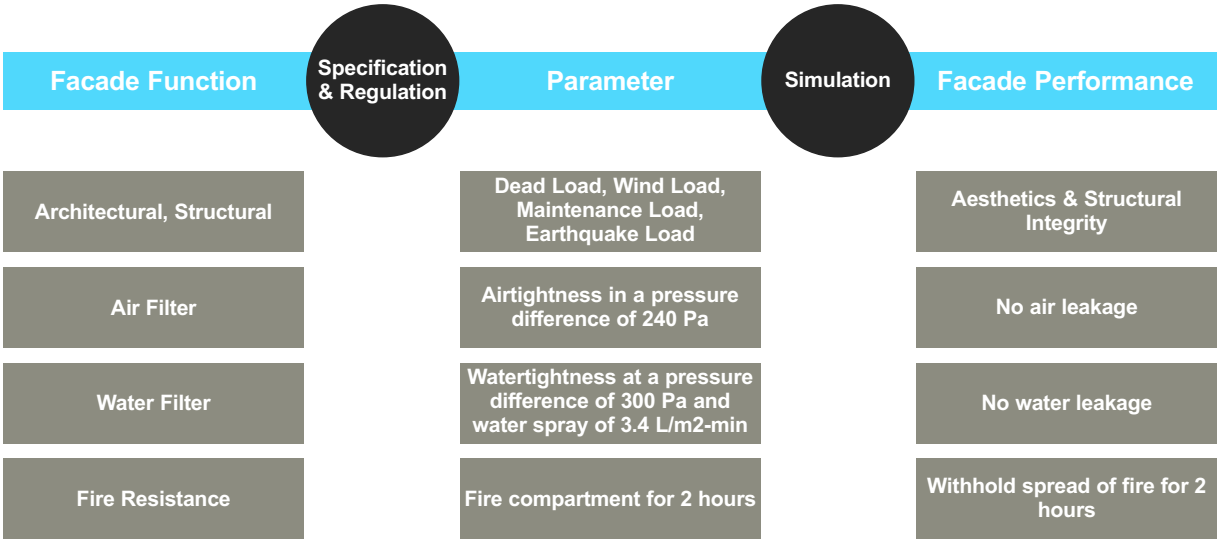


Figure 2.5.3 Achieve Facade Performance
Source: PERAFI, 2025

The main function of the facade as a filter requires detailed parameters to measure the success of its performance.

Facade Materials in Context of Energy Efficiency

Facade Material	Thermal Efficiency	Shading / Heat Reduction Ability	Natural Lighting Potential	Cross Ventilation Potential	Tropical Climate Suitable	Description
Exposed Brick	High (good thermal mass)	High (good thermal mass)	Medium (can be combined with shading)	Low	✓	Stores heat during the day, releases it at night, suitable for dense buildings.
Concrete Roster	Medium	High	Medium-High (diffused light)	High	✓✓	Allows natural ventilation while reducing direct sunlight
Wood (layered)	Medium	Medium-High (depends on design)	Medium	Medium	✓	Provides warm aesthetics, needs weather protection
Glass +Low-E Coating Glass	Low without technology, high with technology	High (if shading combined)	Medium	None	✓ (with solar control)	Should be combined with shading and insulation to reduce heat gain
Secondary Skin (lattice, Perforated metal	Depends on Main Structure	✓✓ High	Medium	Medium	✓✓	Acts as a protective outer layer against heat, ideal for west/east facades.
Exposed Concrete	✓ High	Medium (can be combined with canopoes)	Medium	None	✓	Durable, low-maintanance, absorbs heat.
Aluminium Composite Panel (ACP)	Medium - Low	Medium (with added insulation)	Medium	None	X (unsuitable without insulation)	Requires inner insulation for better thermal performance
Green Facade	✓✓ Very High	✓✓✓ Very High	Medium	Medium	✓✓✓	Naturally reduces heat, improves microclimate and air quality

Table 2.5 Facade Materials
Source: Author, 2025

In the context of energy efficient design, the selection of facade materials plays a crucial role in controlling heat gain, enabling natural ventilation, and optimizing daylight. Materials with high thermal mass, such as exposed brick and concrete, are effective at absorbing and releasing heat gradually, making them suitable for stabilizing indoor temperatures in tropical climates. Concrete vent blocks (roster) offer an excellent balance between shading and ventilation by allowing air flow while diffusing sunlight, reducing the need for artificial cooling. Wooden facades, when properly treated, provide natural insulation and aesthetic warmth but require maintenance in humid environments.

Glass with Low-E coating is ideal for maximizing natural light while minimizing solar heat gain, especially when combined with appropriate shading devices. Secondary skins, such as perforated metal or louver systems, act as a protective barrier against direct sunlight, especially on west- and east-facing facades, thereby enhancing both thermal comfort and aesthetic flexibility. Meanwhile, green facades offer the highest potential for energy efficiency by naturally insulating buildings, cooling the surrounding air through evapotranspiration, and improving microclimate conditions.

On the other hand, materials like Aluminium Composite Panels (ACP), while visually modern and lightweight, are less thermally efficient unless supported by additional insulation layers making them less ideal for unshaded tropical applications. Overall, combining materials based on their individual performance such as vent blocks for airflow, low-E glass for light, and vegetation for passive cooling yields the most effective energy efficient facade strategy in warm-humid climates.

Recommendation

- For energy efficient facades in tropical climates, material combinations:
- Concrete vent blocks + secondary skin = promotes cross ventilation and blocks direct heat.
 - Low-E glass + horizontal shading = maximizes daylight while preventing overheating.
 - Green facade + exposed concrete = natural insulation and microclimate cooling.
 - Exposed brick + canopy = passive thermal benefits + tropical / industrial aesthetics.

2.6 Site Location & Analysis

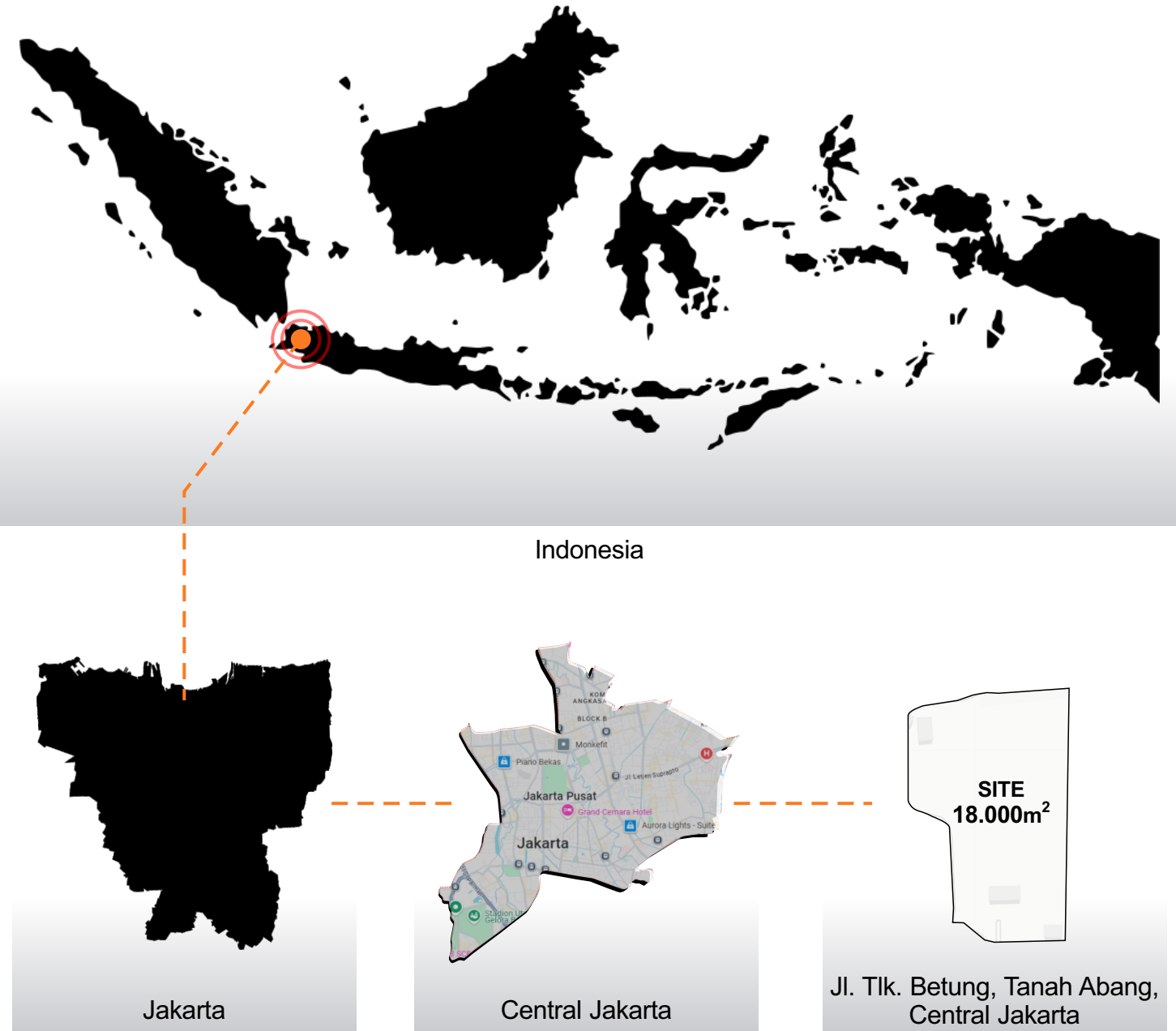


Figure 2.6.1 Macro - Micro Map
Source : Author, 2025

Jakarta is the capital city of Indonesia, experiencing rapid growth and development across various fields and sectors. Central Jakarta holds a strategic role as the center of government, economy, and transportation within both DKI Jakarta and Indonesia as a whole. This area is home to several important national institutions such as the Presidential Palace, the National Monument (Monas), and various government ministry offices, making it the administrative and political heart of the country. In addition, Central Jakarta is part of the Golden Triangle area, which serves as a hub for elite business and office centers, with numerous high-rise buildings, banks, and multinational company offices located along the Thamrin–Sudirman corridor. With excellent accessibility through public transportation such as KRL (commuter rail), MRT, and TransJakarta, the area functions as a major mobility node in the capital. Due to its highly strategic location and limited land availability, Central Jakarta has also experienced rapid vertical housing development to meet the growing demand for residences, especially among the urban workforce. This has led to a continuous influx of people from other regions seeking job opportunities in Jakarta, resulting in a steadily increasing population each year. Seeing this, the business potential for vertical housing such as apartments has become increasingly promising. The number of apartments in Jakarta is estimated to approach 200,000 units a figure that is still relatively small compared to Jakarta's population, which is nearing 25 million people.

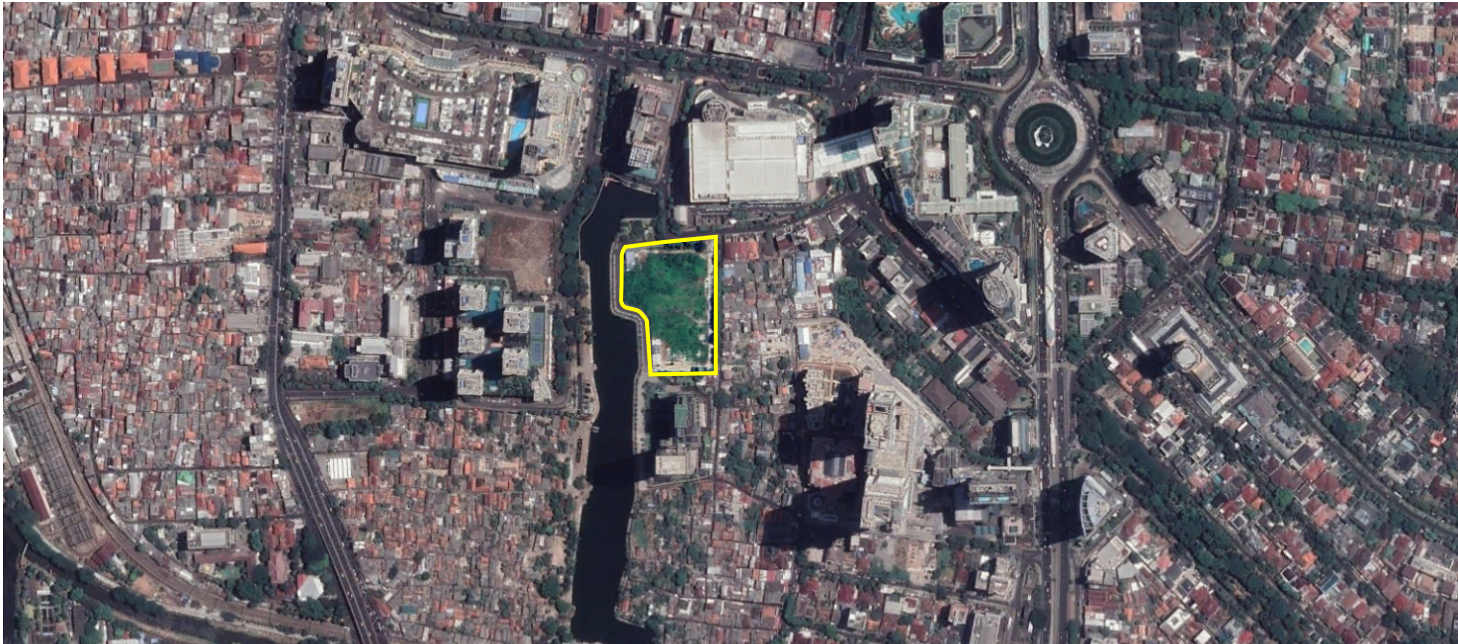


Figure 2.6.2 Site location
Source : earth.google.com



Figure 2.6.3 View vista site
Source : earth.google.com

2.6 Site Location & Analysis

Sun Data

In the picture, lines are visible according to the direction of the sun's arrival at each hour. As is known, the critical hours are from 09.00 to 15.00, so these hours must be avoided. The following is a sunchart graph obtained based on the data.

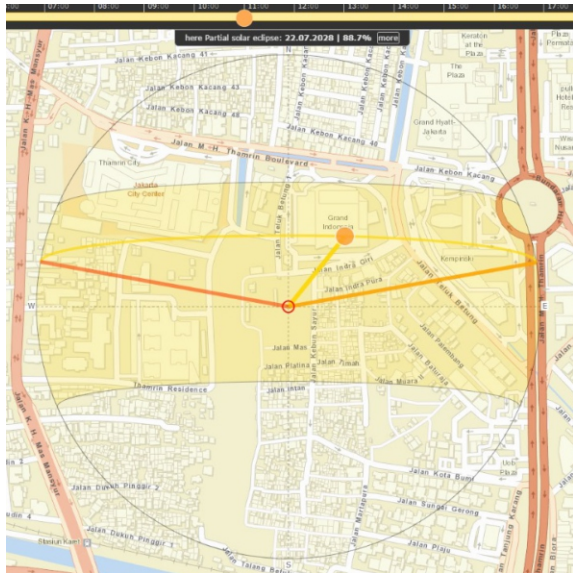


Figure 2.6.4 Sundata
Source : SunCalc.org

Average Temperature and Precipitation

The "mean daily maximum" (solid red line) shows the maximum temperature of an average day for every month for Jakarta. Likewise, "mean daily minimum" (solid blue line) shows the average minimum temperature. Hot days and cold nights (dashed red and blue lines) show the average of the hottest day and coldest night of each month of the last 30 years. For vacation planning, you can expect the mean temperatures, and be prepared for hotter and colder days. Wind speeds are not displayed per default, but can be enabled at the bottom of the graph.

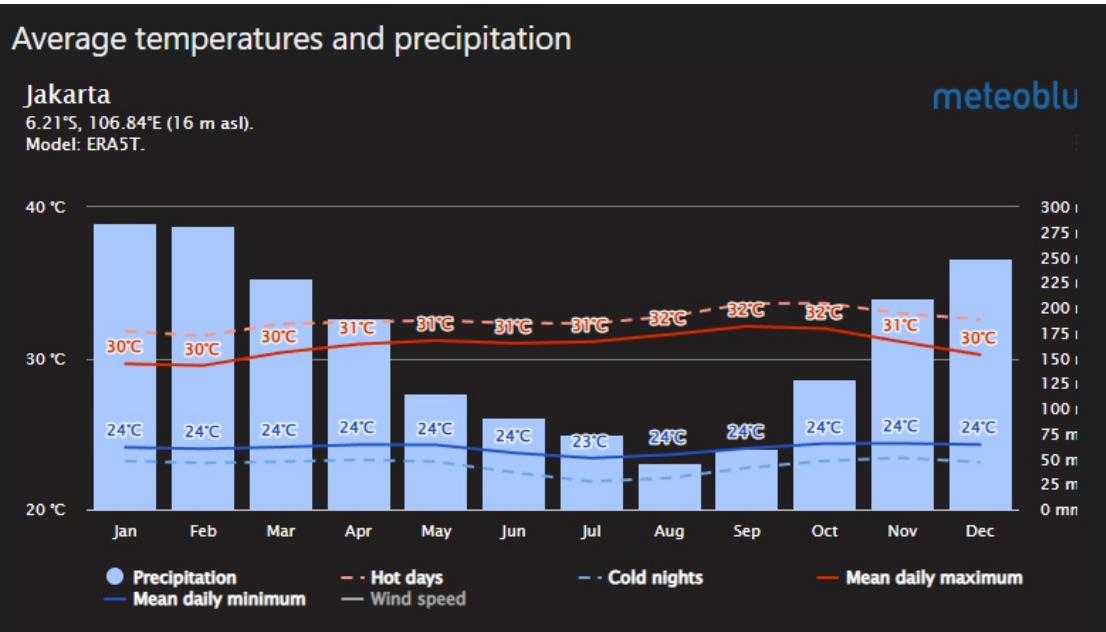


Figure 2.6.5 Average temperature and precipitation in Jakarta
Source : Meteoblue.com

Cloudy, Sunny, and Precipitation days

The graph shows the monthly number of sunny, partly cloudy, overcast and precipitation days. Days with less than 20% cloud cover are considered as sunny, with 20-80% cloud cover as partly cloudy and with more than 80% as overcast.

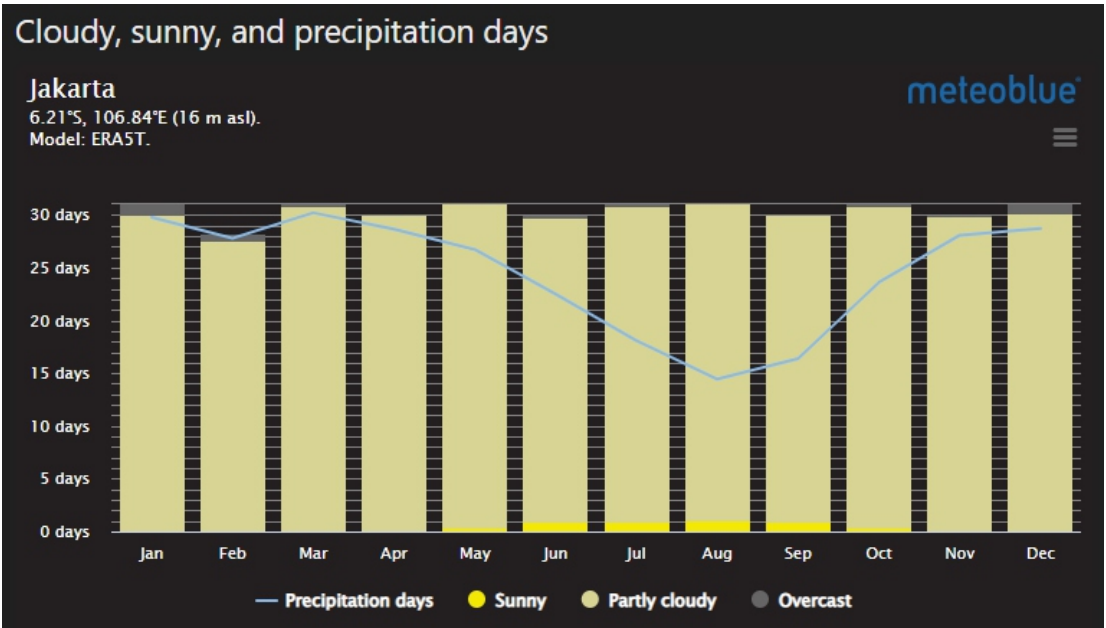


Figure 2.6.6 Cloudy, sunny and precipitation days in Jakarta
Source : Meteoblue.com

Maximum Temperatures

The maximum temperature diagram for Jakarta displays how many days per month reach certain temperatures.

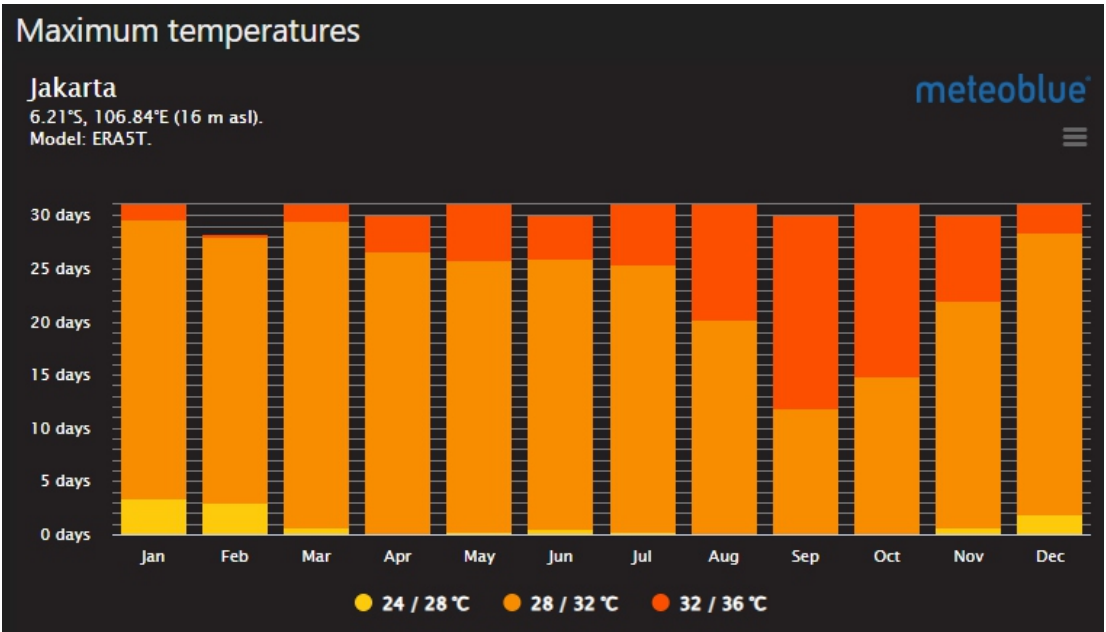


Figure 2.6.7 Maximum temperatures in Jakarta
Source : Meteoblue.com

2.6 Site Location & Analysis

Wind Speed

The diagram for Jakarta shows the days per month, during which the wind reaches a certain speed.

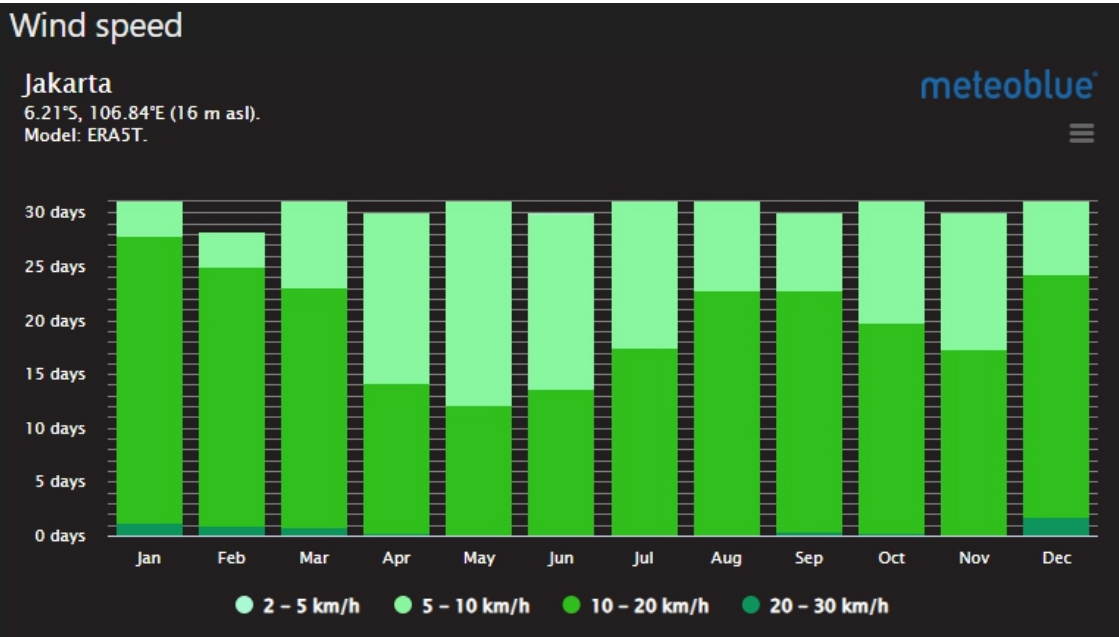


Figure 2.6.8 Wind speed in Jakarta
Source : Meteoblue.com

Wind Rose

The wind rose for Jakarta shows how many hours per year the wind blows from the indicated direction.

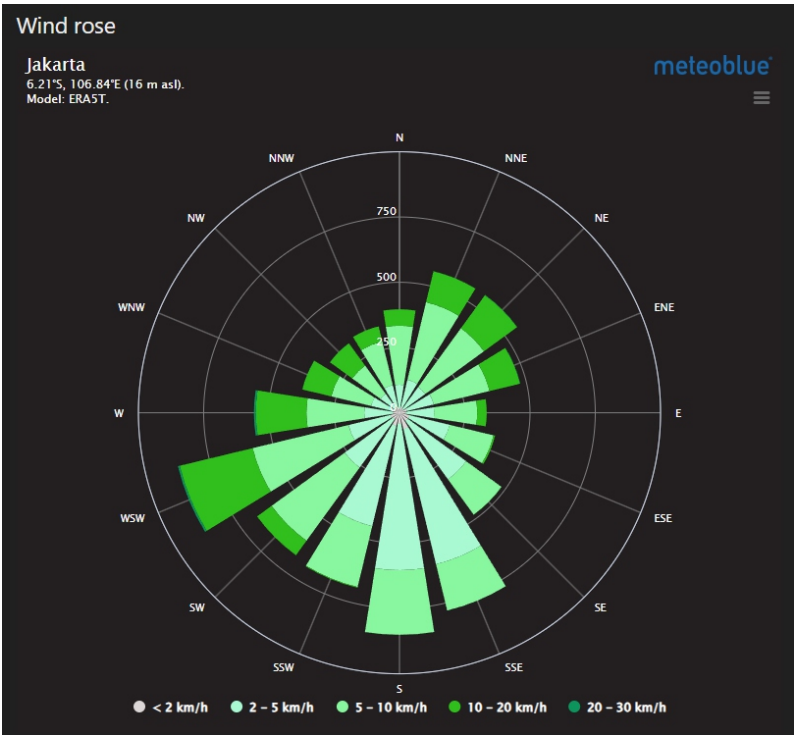


Figure 2.6.9 Wind rose in Jakarta
Source : Meteoblue.com

Design Concept

Apartment Tower

The apartment tower is designed as a sustainable vertical living solution that addresses both environmental challenges and urban population growth. With the city experiencing rapid increases in population every year, the tower provides optimized living spaces within a limited land area, making it a practical response to urban density.

- Sustainable identity
- Adaptive envelope
- Efficient land use

Facade

The facade design of the tower apartment prioritizes energy efficiency through an integrated and responsive strategy that considers site orientation, climate, and occupant comfort.

- Double-skin facade system
- External shading devices
- High-performance low-E glazing

Apartment Tower An Approach To Energy Efficiency Through Facade

Passive Design Principle

The facade design of the apartment tower is conceived as an integral part of a passive design strategy to enhance energy efficiency, thermal comfort, and indoor environmental quality.

- External shading devices
- Optimized window-to-wall ratio
- High-performance glazing
- Double-skin facade system

3.1.1 The concept of Neighborhood according to Climate

The movement of the sun at the project site is from east to west, in line with the daily rotation of the earth. This results in different exposure to sunlight on each side of the building throughout the day. The eastern side of the building will receive direct sunlight in the morning, while the western side will be exposed to the most intense solar radiation in the afternoon, which can significantly increase the indoor temperature. Understanding this pattern of solar movement is an important basis for designing a facade strategy that is responsive to tropical climates, such as the use of shading devices, placement of openings, and selection of facade materials that can minimize excess heat while still optimizing natural lighting.



Figure 3.1.1 Sun movement
Source: Author,2025

The dominant *wind direction* at the project site comes from the *east*, which is a common characteristic of the east monsoon wind that occurs in the Jakarta area and its surroundings. This wind direction has the potential to be utilized as a passive ventilation strategy to improve thermal comfort inside the building. Therefore, the orientation of the building mass and the design of the openings need to be adjusted to optimally capture the wind flow, as well as allow for cross ventilation inside the residential units. The utilization of this natural wind not only supports energy efficiency by reducing the artificial cooling load, but also provides better air quality for apartment residents.

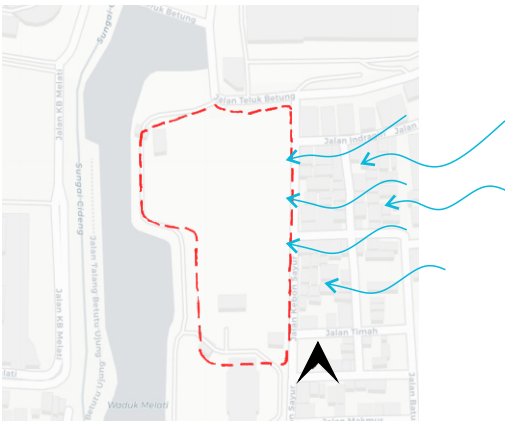


Figure 3.1.1.2 Wind direction (east-west)
Source: Author,2025

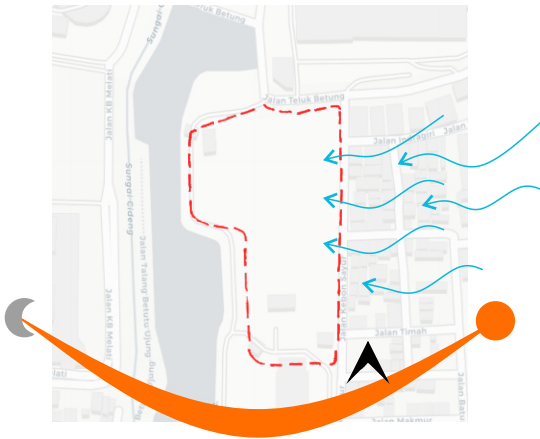


Figure 3.1.1.3 Sun movement & Wind direction
Source: Author,2025

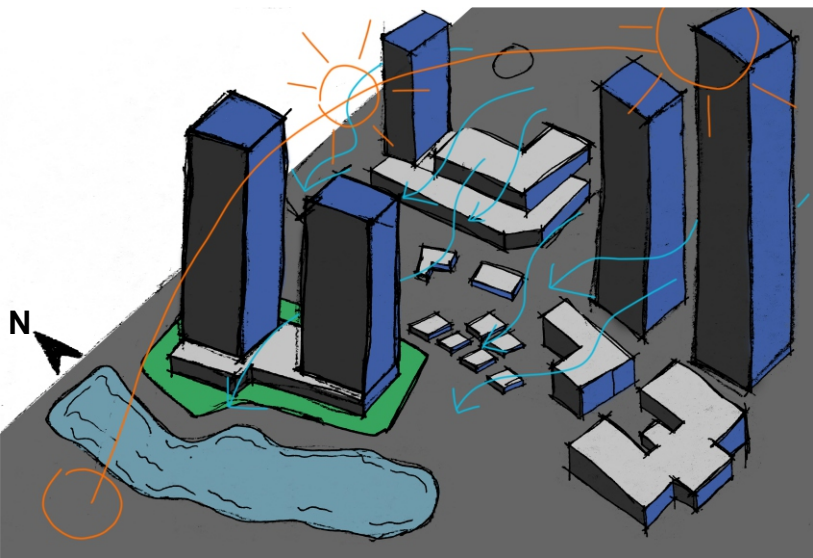


Figure 3.1.1.4 Axonometric sketch sun movement & Wind direction
Source: Author,2025

Neighborhood is dominated by tall buildings (skyscrapers) that create a shading on the site area for approximately 2-3 hours every day. This condition provides passive benefits for buildings on the site, especially in terms of reducing direct exposure to sunlight, which has an impact on reducing the building's heat load. Thus, the surrounding environmental elements can be utilized as a passive strategy to reduce cooling energy consumption during the day. The resulting shadow indirectly supports energy efficiency and thermal comfort inside the building, making it a characteristic of the environment.

3.1.2 The Concept of Neighborhood according to Regulation

According to Law No. 16 of 2021. Article 9 paragraph (1), the provisions of the laws and regulations include provisions on the Koefisien Dasar Bangunan (KDB), Koefisien Lantai Bangunan (KLB), Garis Sempadan Bangunan (GSB), and zoning provisions stipulated in Rencana Tata Ruang Wilayah (RTRW) and Rencana Detail Tata Ruang (RDTR). environmental concepts must be considered based on functional and aesthetic considerations. The project footprint refers to the provisions of building regulations listed in the Jakarta Satu system (*Pergub No. 31 Year 2022*), with a KDB of 55%, indicating that a maximum of 55% of the total land area can be covered by the building footprint. In addition, the KDH of 20% stipulates that a minimum of 20% of the land must be allocated for green open space as an infiltration area and supporting element for ecological balance. Meanwhile, the KLB of 11 limits the total floor area of the building that can be built vertically. These three parameters are important bases in designing building masses that not only comply with regulations, but also support efficient land use, thermal comfort, and environmental sustainability.

SITE AREA	BCR (KDB)	FAR (KLB)	GAR (KDH)
18.000m2 (1,8 hectares)	55% max. 9.900m2	11	20% min.
USED ON SITE			
SITE AREA	BCR (KDB)	FAR (KLB)	GAR (KDH)
18.000m2 (1,8 hectares)	55% 9.900m2	11	20%

Table 3.1 Regulations
Source: PERGUB No 31 Tahun 2022

Refers to **Article 9 paragraph 5**, dense locations are generally locations located in commercial areas/city centers and/or areas with a KDB of more than 60% (sixty percent).

3.2.1 The concept of Site according to Climate

The sun comes from east till west, and the wind dominant comes from east to west. Based on this data, the author will use the Overall Thermal Transfer Value (OTTV) as a measure to quantify the amount of heat entering the site or building from the external environment through facade elements such as walls, windows, and roofs. To analyze and implement appropriate design strategies, I will use Suntool software to assess and determine the optimal facade orientation, building form, and facade materials. This approach will support the development of a thermally efficient building envelope that responds to both solar exposure and local climate conditions.

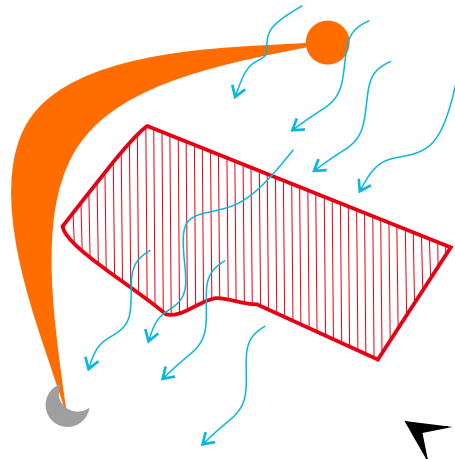


Figure 3.2.1 Site climate axonometric sketch
Source: Author, 2025

3.2.2 The concept of Site according to Local Environment

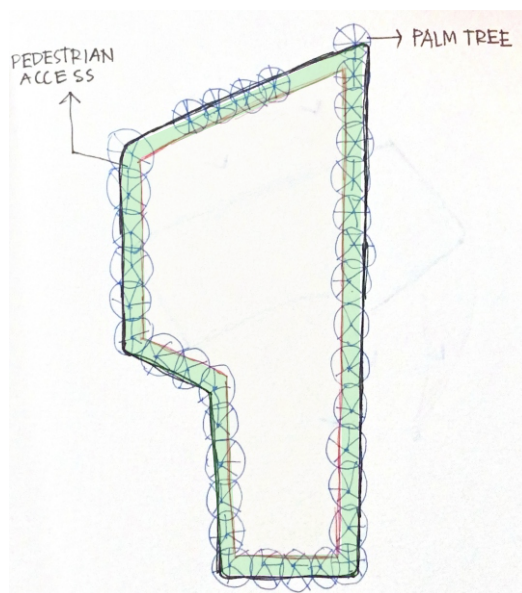


Figure 3.2.2 Site with vegetation and pedestrian sketch
Source: Author, 2025

The site is located in a dense urban area, with a humid tropical climate, and surrounded by tall buildings. This area has a formal, modern character, and intense pedestrian and vehicle circulation.

Reasons for Choosing Palm Trees

Adaptable to tropical climates

Palms are very resistant to heat, high humidity, and tropical rainfall such as in Jakarta. Suitable for withstanding heat and does not require intensive care.

Light but vertical visuals

The slender and tall shape fits side by side with the mass of tall buildings without blocking the view.

Light Penetration

Not too dense, so it still provides light shadows but does not block the circulation of natural light.

Supports pedestrian orientation and circulation

Ideal for walkways, drop-offs, or transition paths because they are not too wide and their roots do not damage paving.

Modern tropical symbol

Gives a tropical, elegant impression, and is suitable for contemporary design concepts with a local touch.

Application in Siteplan Pedestrian paths, planted in rows as a light canopy for pedestrians.

The use of palm trees as vegetation elements on your site creates a strong urban tropical identity, strengthening the character of the premium area. Supporting the principles of energy efficiency and microclimate comfort. Selecting the right type of palm can also increase the aesthetic value, symbolism, and appeal of outdoor spaces.

3.2.3 The Concept of Site according to Passive Design Principle

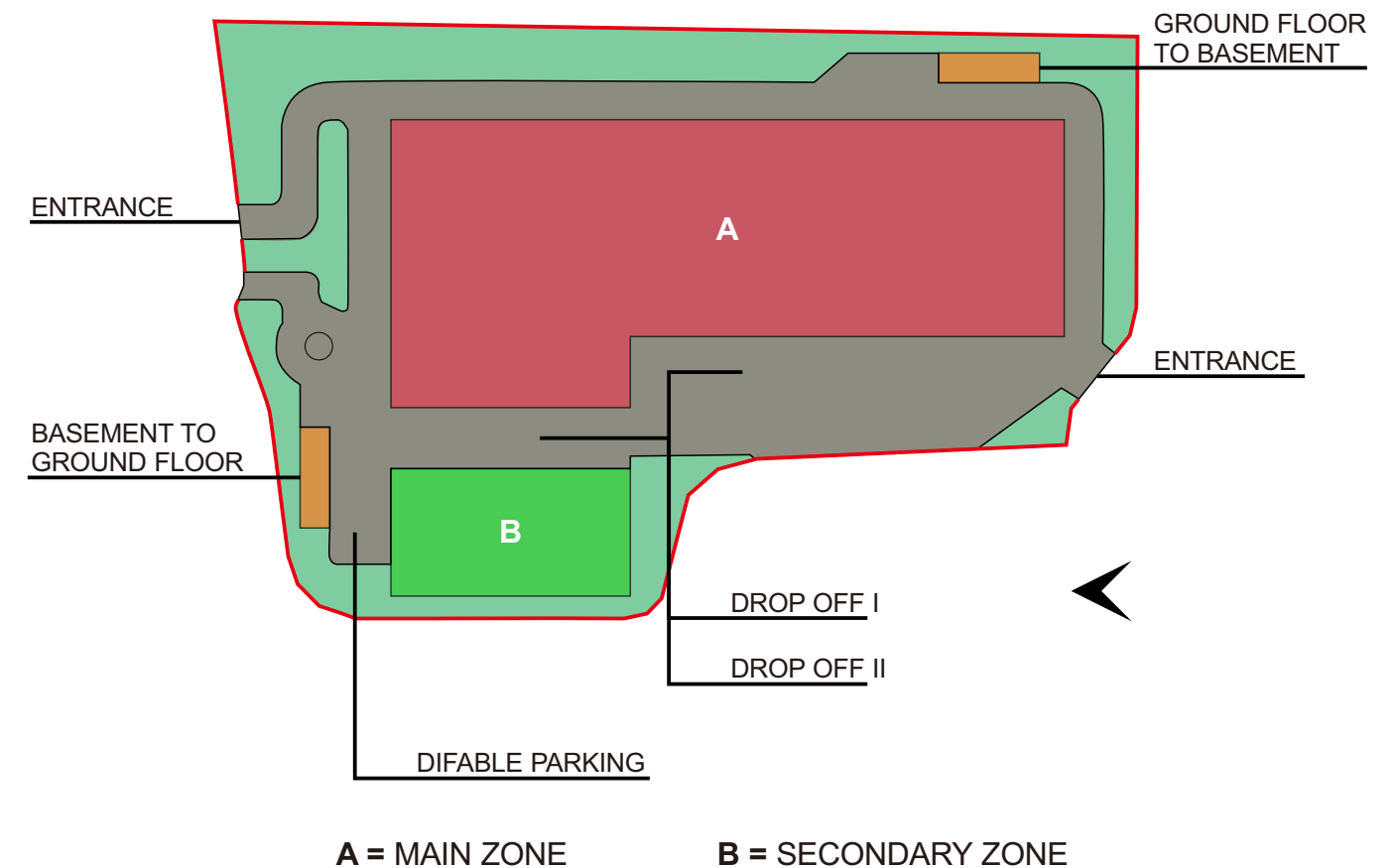


Figure 3.2.3 Site zoning according to Passive Design Principle
Source: Author, 2025

The second site sketch is selected based on its stronger alignment with passive design principles, particularly in optimizing natural ventilation, solar orientation, and functional zoning. In this layout, the main zone is oriented along the east west axis, minimizing excessive heat gain on the longer facades and allowing controlled daylight access. The drop-off zone is strategically placed on the shaded side of the site, ensuring thermal comfort and protection from afternoon heat. The yard and open green spaces are positioned to capture prevailing winds, enhancing cross-ventilation throughout the site. The parking zone is placed at the perimeter, reducing heat buildup near occupied areas and ensuring better airflow across the core zones. Compared to the first sketch, this alternative provides more effective zoning that supports thermal comfort, energy efficiency, and spatial clarity key goals of passive site design.

3.3.1 The concept of Building Mass according to Climate

In the alternative sketch of 1 tower, based on site data, it is known that the direction of the sun's movement is from east to west, and the dominant wind also comes from east to west. With this configuration, a single building (1 tower) will receive a fairly large wind coverage directly from the east side, thus potentially increasing natural ventilation. also can potentially overheat the building.

However, in the alternative 2-tower sketch, the building mass is divided into two, which allows for a more even distribution of sunlight and wind flow. This two-tower configuration also creates the potential for natural shading between buildings and a more comfortable wind path in the area between the towers.

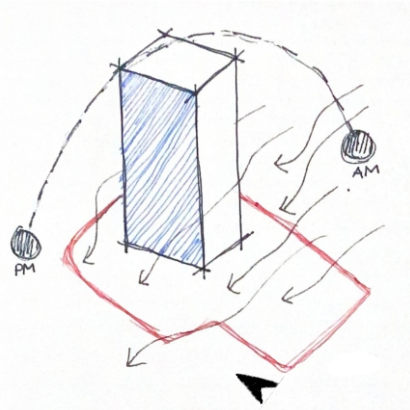


Figure 3.3.1 alternative 1 tower axonometric sketch
Source: Author, 2025

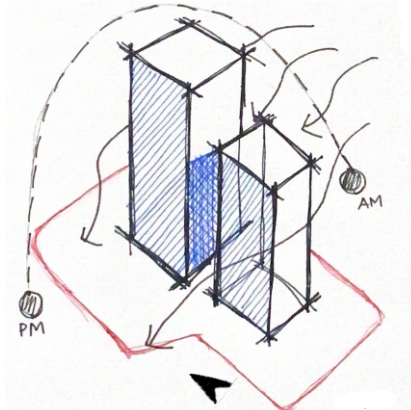


Figure 3.3.1.2 alternative 2 tower axonometric sketch
Source: Author, 2025

Benefits of choosing 2 tower:

- Reduce the potential for overheating on one side of the building.
- Increase thermal comfort in the outdoor space between towers.
- Form a natural wind tunnel (using CFD simulation).

The configuration of the two towers also allows the formation of space between buildings that functions as a wind corridor (wind tunnel), thus supporting the improvement of the thermal quality of public areas between the building masses. Potential facade design, The two-tower alternative also opens up opportunities for the application of different passive facade strategies on each side, according to the intensity of the sun.

Based on the two alternative building masses, the 2-tower configuration was chosen because it provides a more optimal climate response. Wind flow can be utilized for cross ventilation, while sunlight is spread and creates the potential for natural shading between buildings.

3.3.2 The concept of Building Mass according to Local Environment

In the process of designing the building mass, the author made two alternative sketches. The first sketch shows the configuration of one tower surrounded by vegetation in the form of palm trees around it. Palm trees function as natural shade that can filter direct sunlight and create a cooler microclimatic atmosphere around the building. However, because it only consists of one mass, the orientation of the building is more susceptible to direct exposure to sunlight from the east and west, and does not allow for the formation of an optimal wind corridor.

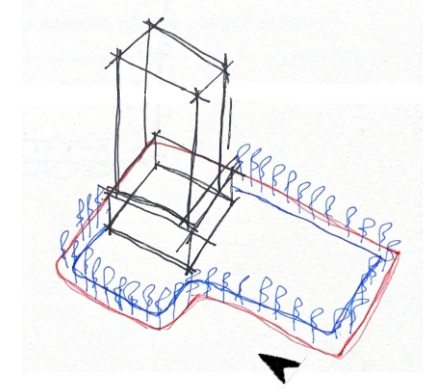


Figure 3.3.2.1 alternative 1 tower axonometric sketch
Source: Author, 2025

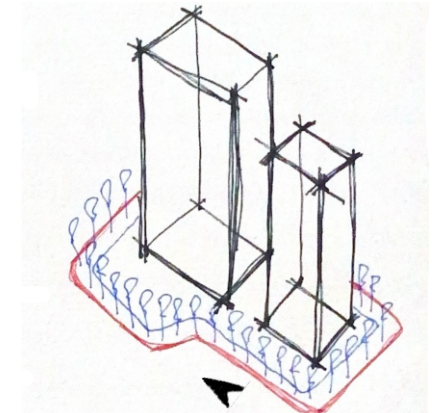


Figure 3.3.2.2 alternative 2 tower axonometric sketch
Source: Author, 2025

Meanwhile, the second sketch shows two towers placed separately on the site, also surrounded by palm trees. The configuration of the two towers creates a space between the masses that can be used as a wind corridor, allowing for natural cross ventilation and increasing thermal comfort in the open area between them. Palm tree vegetation still plays an important role in providing shade and adding to the visual and environmental quality around the building. Overall, the two tower sketch provides a better response to tropical climate conditions, both in terms of natural lighting, passive ventilation, and the formation of comfortable outdoor spaces.

The author chose alternative sketch 2 because the two-tower configuration provides a more optimal response to the tropical climate conditions in Jakarta. With the presence of two separate building masses, a space is formed between them that functions as a wind corridor, allowing for natural cross ventilation and increasing thermal comfort both inside the building and in the outdoor area. In addition, this configuration creates a natural shadow effect between the towers (self-shading) which helps reduce direct exposure to sunlight and heat loads on the building facade. The presence of vegetation in the form of palm trees around the site also strengthens the microclimatic quality of the site, creating a shady atmosphere. the two-tower alternative not only supports the principle of passive design, but also provides spatial flexibility, better environmental quality, and the potential for integrating open spaces that are more integrated with the natural elements of the site.

3.3.3 The Concept of Building Mass according to Passive Design Principle

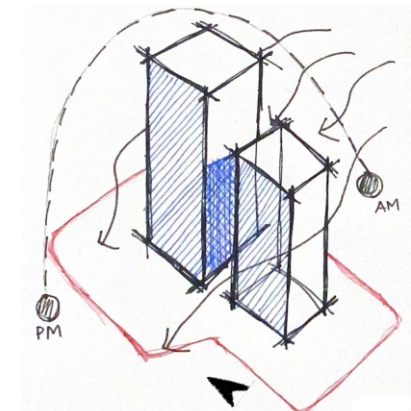


Figure 3.3.3.1 alternative 2 tower axonometric sketch
Source: Author, 2025

The orientation of the building mass extending north-south and facing east and west was chosen as a strategy to respond to the tropical climate conditions in Jakarta. This orientation aims to reduce direct exposure to sunlight on the east and west sides of the building, which tend to receive the highest heat radiation in the morning and afternoon. This orientation allows the use of dominant winds from the east-west direction to create natural cross ventilation between spaces, especially if the openings and mass composition are strategically arranged. This is in line with the principle of passive design, where buildings utilize the natural conditions of the environment to create thermal comfort.

3.4.1 The concept of Room according to Passive Design Principle

A room designed with passive principles is oriented, lit, and thermally regulated naturally. Its layout, openings, materials, and shading work together to ensure comfort while reducing energy consumption. Rooms designed with passive principles are adaptable, they maintain comfort across different times of day and seasons without mechanical systems.

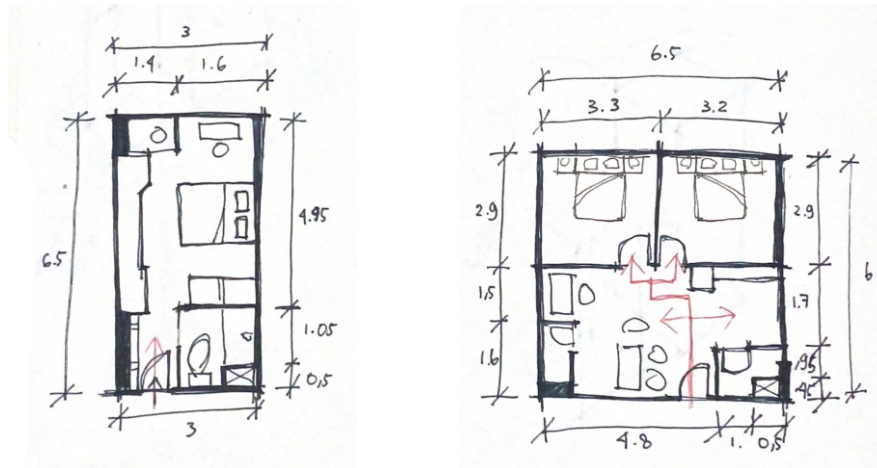


Figure 3.4.1 one bedroom plan sketch
Source: Author, 2025

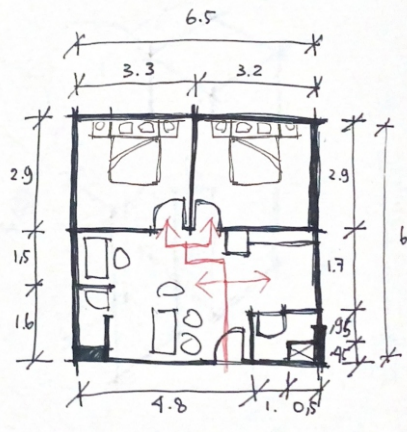


Figure 3.4.1.2 two bedroom plan sketch
Source: Author, 2025

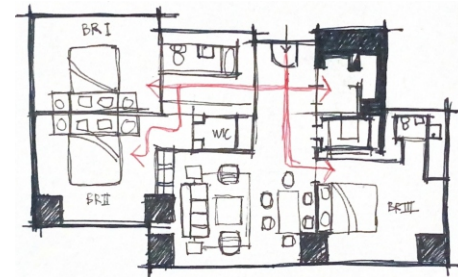


Figure 3.4.1.3 three bedroom plan sketch
Source: Author, 2025

The concept of the rooms in these layouts follows passive design principles, emphasizing natural ventilation, daylighting, and thermal comfort. In the one-bedroom unit, the narrow width also helps daylight penetrate deep into the space, reducing dependence on artificial lighting, while the bathroom is strategically placed near the entrance to avoid excess humidity in the sleeping area. In the two-bedroom unit, openings in both bedrooms and the living area create an effective airflow channel, as shown by the circulation arrows. Each bedroom benefits from its own window, while the living space receives daylight through shared openings. Thermal zoning is achieved by placing the bathroom and kitchen compactly, ensuring the living room acts as a buffer between service and private areas. The three-bedroom unit enhances these principles further by providing windows on multiple facades, enabling strong cross ventilation and sufficient daylight for every bedroom. The living and dining area in the center functions as a climatic core where airflow converges, preventing heat buildup. Bathrooms are kept near circulation areas to avoid obstructing ventilation in private zones. Across all three layouts, passive design is achieved through cross ventilation, well-placed windows for daylighting, compact planning that minimizes wasted space, and thermal zoning that separates hot and humid areas from living and sleeping zones, ultimately creating energy-efficient and comfortable living environments.

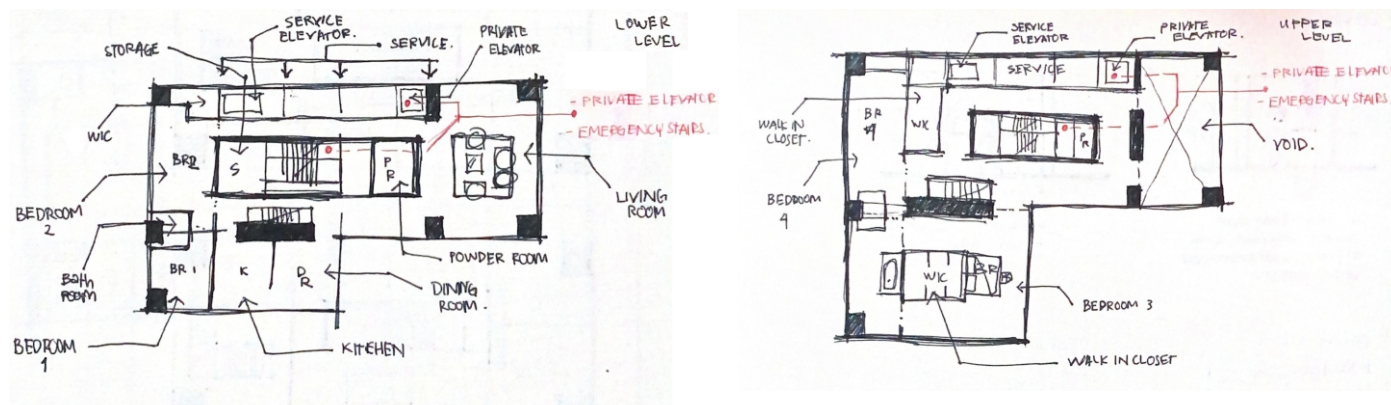


Figure 3.4.1.4 four bedroom plan sketch
Source: Author, 2025

The four-bedroom exclusive unit is designed with a larger layout to provide both comfort and privacy while still applying passive design principles. Each bedroom is positioned along the building's perimeter, allowing direct access to natural light through well-placed windows. The living and dining areas are placed at the center as the social hub of the unit, supported by wide openings to ensure continuous airflow and sufficient daylight penetration. Thermal zoning is carefully organized, with public areas such as the living and entertainment spaces clearly separated from the private bedrooms, while service spaces like the kitchen, laundry, and maid's room are located in a designated area to prevent heat and humidity from affecting the main living zones. In addition, features such as large windows, or even double facades are often integrated to control solar gain and reduce overheating, enhancing overall thermal comfort. By combining thoughtful zoning, cross ventilation, and natural lighting strategies, the four-bedroom exclusive unit achieves both energy efficiency and a high-quality, sustainable living environment tailored for premium users.

3.4.2 The concept of Room according to Human Behavior

The concept of a room according to human behavior emphasizes that spatial design should not only serve functional needs but also respond to the psychological, social of its users. A room is not merely a physical enclosure, it is a setting where activities, interactions, and emotions take place. For example, a bedroom is designed as a private space that supports rest, intimacy, and a sense of security, while a living room is arranged to encourage social interaction, relaxation, and togetherness. Human behavior also shapes the spatial organization introverted users may prefer enclosed and quiet rooms for concentration, while extroverted users may be more comfortable in open-plan layouts that facilitate communication. Cultural background further influences room concepts, such as communal dining in some societies versus individualized dining in others. In this way, the design of rooms must align with patterns of movement, privacy needs, sensory comfort (light, sound, temperature), and social interaction to create spaces that truly support human well-being.

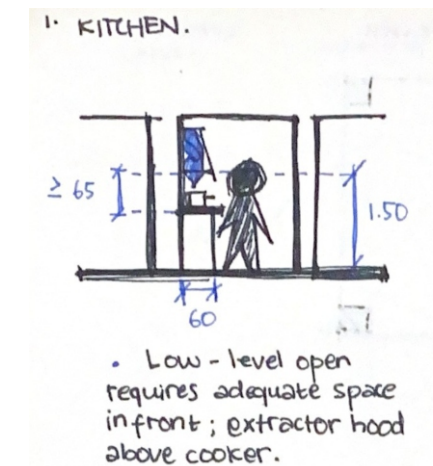


Figure 3.4.2 Kitchen dimension sketch (1)
Source: Author, 2025

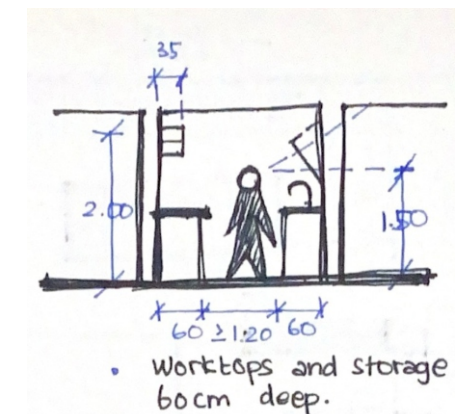


Figure 3.4.2.2 Kitchen dimension sketch (2)
Source: Author, 2025

The drawings illustrate the ergonomic considerations of a kitchen layout based on human scale and behavior. In the cooking area, the countertop depth is set at 60 cm with a working height of around 1.50 m, ensuring comfort during food preparation. An extractor hood is placed above the cooker with a minimum clearance of 65 cm to safely remove smoke and steam without obstructing movement. In the preparation and storage area, the worktops also have a depth of 60 cm, while overhead storage cabinets are installed at a height of 2.00 m with a depth of 35 cm to remain within comfortable reach. The circulation space between opposing table is designed with a minimum width of 1.20 m, allowing users to move freely and even accommodate more than one person working in the kitchen at the same time. Together, these proportions create an efficient and user-friendly kitchen by balancing functional needs with human comfort, ensuring that activities such as cooking, cleaning, and storing can be carried out effectively within a safe and ergonomic environment.

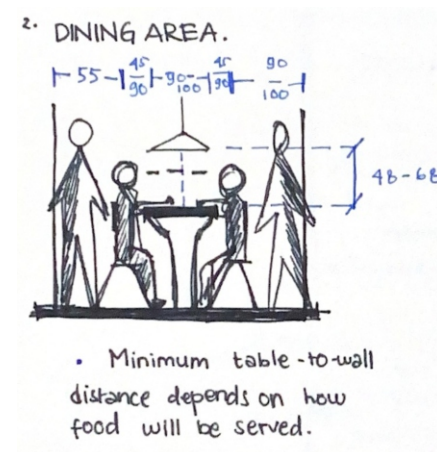


Figure 3.4.2.3 Dining table dimension sketch
Source: Author, 2025

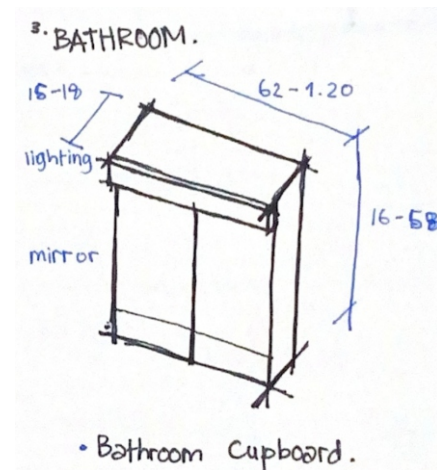


Figure 3.4.2.4 Bathroom cupboard dimension sketch
Source: Author, 2025

The drawings illustrate the ergonomic considerations for dining and bathroom areas based on human behavior and comfort. In the dining area, the minimum distance between the table and the wall depends on how food will be served: around 55–60 cm is sufficient for pulling out chairs and seating comfortably, while 90–100 cm is needed if circulation is required behind seated diners. The standard seat height ranges from 48–68 cm, and lighting is placed directly above the dining table to provide balanced illumination. Meanwhile, the bathroom sketch shows a cupboard with an integrated mirror and lighting designed at ergonomic heights. The mirror is positioned at approximately 165–185 cm above the floor to align with eye level, while lighting is installed 15–19 cm above the mirror to avoid shadows on the face. The cupboard width varies between 62–120 cm, offering flexibility depending on the bathroom size. Together, these drawings emphasize how proper dimensions, circulation clearances, and lighting placement create functional and comfortable spaces that support everyday activities. The behavior responsive room concept prioritizes how people live, move, and feel within a space promoting comfort, interaction, and well-being through spatial planning that align with everyday pattern and life.

STRUCTURE

Refers to **attachment VI** of the **regulation of the Governor of the Special Capital Region of Jakarta Number 20 of 2024** concerning building planning provisions.

3.5.1 The concept of Structure following the Climate

Building structures not only function as load-bearing elements but also as mediators between the building and its surrounding climate. This concept emphasizes that structural systems must be able to adapt to environmental conditions such as heat, rain, wind, humidity, and even earthquakes, thereby increasing comfort, energy efficiency, and building resilience. The concept of climate-responsive structures highlights how structural forms and systems are determined not only by functional and aesthetic considerations, but also by the environmental conditions at the building site. In hot-humid climates, for example, structures are designed to increase airflow and reduce heat gain by using lightweight construction, raised floors, and wide roofs that provide shade and protect against heavy rainfall. Meanwhile, in dry and hot climates, massive structures with thick walls of stone, brick, or concrete are preferred because they can absorb heat during the day and release it at night, thus maintaining stable indoor temperatures. By aligning structural design with local climate characteristics, buildings not only achieve energy efficiency and thermal comfort but also have greater resilience, demonstrating the structure's role as a physical support system and environmental mediator.

In the context of towers in humid tropical climates (like Jakarta), structures serve not only as load-bearing elements but also as elements that contribute to climate performance and energy efficiency. Here are some types of structures commonly used:

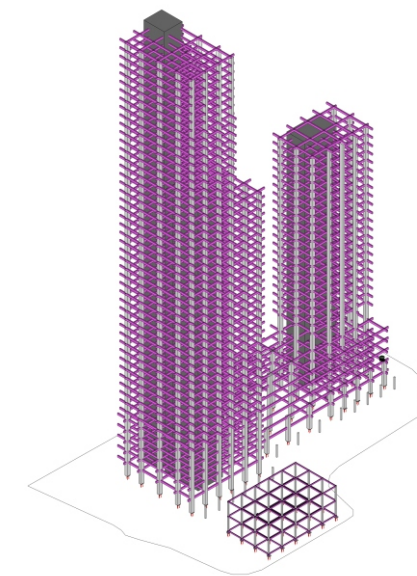


Figure 3.5.1 Axonometric Structure Scheme
Source: Author, 2025

Core Structure as strongest structure (Shear Wall & Lift Core) Placed in the side where the wind direction is strongest to resist lateral forces (wind, earthquakes) and to provide vertical circulation. In tropical climates, the core also functions as a buffer zone, reducing direct heat transfer to the main space. The image above is an axonometric view of the tower building structure using a core in each tower, using a main column with a diameter of 1,500 x 2,000, a main beam of 1,000 x 0,600, a secondary beam of 0,800 x 0,500, and a bore pile foundation. The core wall thickness is 400mm.

3.5.2 The concept of Structure following the Passive Design Principle

The structure of a building, when designed according to passive design principles, serves not only as a load-bearing system but also as an integral component that supports energy efficiency and thermal comfort. This concept emphasizes that the structural system should contribute to natural climate control by reducing reliance on mechanical heating, cooling, and lighting systems.

Furthermore, the orientation and configuration of structural elements can optimize daylight penetration while controlling glare, as well as channel prevailing winds to improve natural airflow within the building. In this way, structure is not merely a technical necessity but also an active element of passive design, creating a building that is resilient, energy-efficient, and responsive to its environmental context.

3.5.3 The concept of Structure following the Human Behavior

The concept of structure following human behavior highlights that the physical framework of a building should not only respond to technical and aesthetic requirements but also to the way people use and interact with spaces. Structures are designed to accommodate patterns of movement, social interaction, privacy, safety, and comfort, ensuring that the built environment supports human activities in a natural and intuitive manner. Such as column and spans are arranged to create open and flexible layouts, allowing spaces to adapt to various functions such as gatherings, work, or rest. Structural height and proportions are also aligned with human scale, creating environments that feel comfortable and psychologically supportive.

In public and communal areas, structures may emphasize openness and connectivity, encouraging interaction and a sense of community, while in private areas they provide enclosure and protection to maintain personal boundaries. Structural elements such as beams, floors, and walls can also be strategically designed to reduce noise transmission, enhance safety during emergencies, and ensure accessibility for all users, including children, the elderly, and people with disabilities. By aligning structural design with human behavior, the building becomes more than just a shelter; it transforms into a living environment that enhances well-being, productivity, and social cohesion.

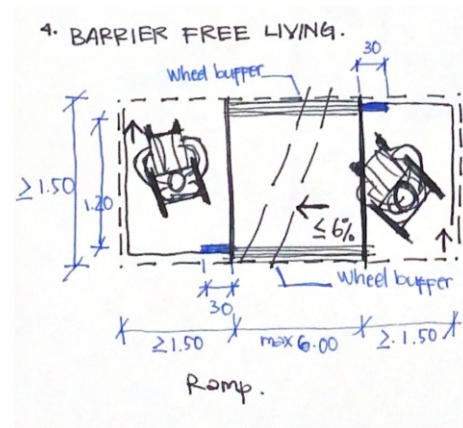


Figure 3.5.3.1 Barrier free ramp dimension
Source: Author, 2025

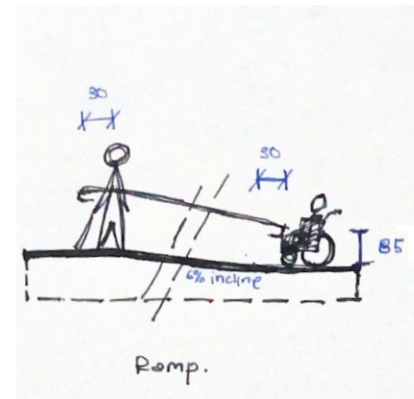


Figure 3.5.3.2 Section ramp dimension
Source: Author, 2025

This image illustrates the concept of a barrier-free ramp design aimed at supporting universal accessibility, particularly for wheelchair users and individuals with mobility limitations. The first sketch shows the top view of a ramp, highlighting the circulation space that allows wheelchairs to move safely and turn when needed. The second sketch presents the side view, explaining the use of a gentle incline that enables users to move up and down without requiring excessive effort. Additional elements, such as edge protection and handrails, further ensure safety and usability for both wheelchair users and pedestrians. The positive aspects of this design are that it provides independence, safety, and inclusivity, allowing equal access for people with disabilities. It creates a more user-friendly environment not only in small-scale buildings but also in high-rise developments where accessibility is crucial. On the other hand, the negative aspects include the large amount of space required to accommodate proper slopes and turning areas, which may not always be feasible in dense urban sites. Additionally, the construction costs can be higher due to the need for longer ramps and additional safety features.

Facade refers to **SNI 03-6389-2011** – disaster energy conservation of buildings in buildings and/or their changes;

3.6.1 The concept of Facade Skin according to Climate

The concept of facade skin according to climate is essentially about how the building envelope (the skin/facade) functions as a mediator between the external environment and the indoor space, in order to provide comfort, efficiency, and sustainability.

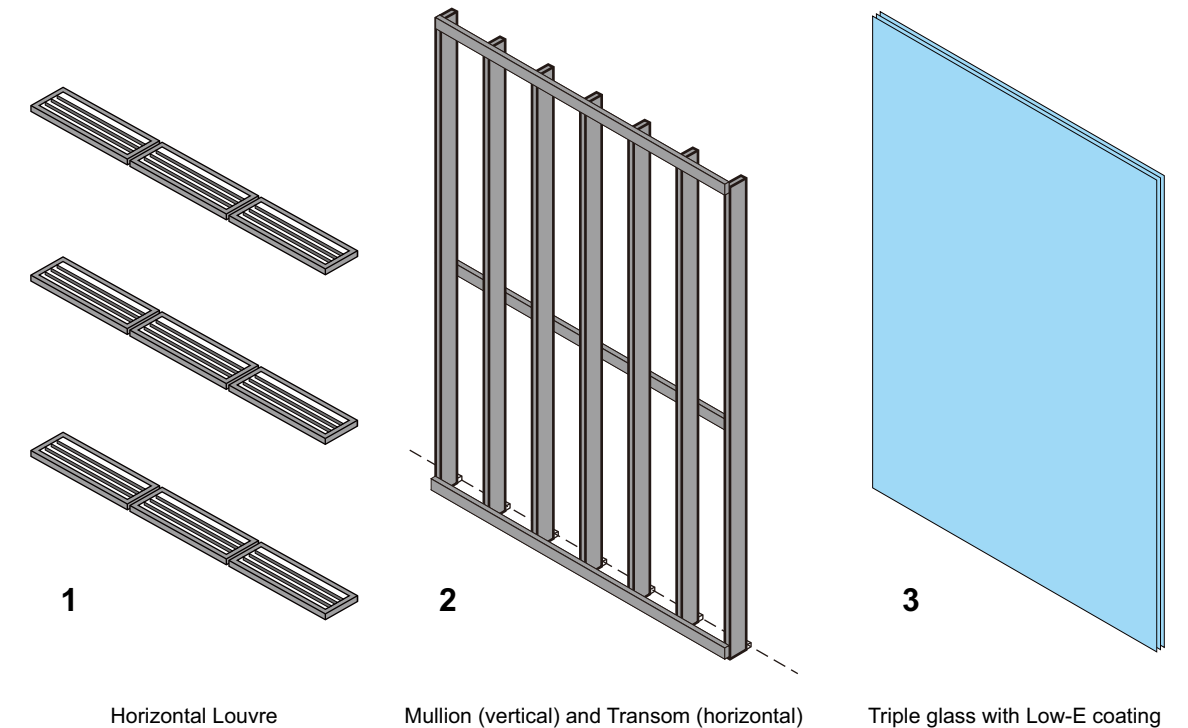


Figure 3.6.1.1 Scheme of Horizontal Louvre
Source: Author, 2025

This facade skin integrates a curtain wall system with triple glass Low-E and aluminium mullions, complemented by horizontal louvres as external shading. The Low-E glazing reduces solar heat gain and improves indoor comfort, while the louvres block direct radiation from high-angle sun typical of tropical climates. This combination ensures thermal efficiency, optimal daylighting, and reduced reliance on mechanical cooling, demonstrating how facade skin can respond adaptively to local climate conditions.

1. Horizontal Louvres

- Installed as external shading devices in front of the glass.
- Block direct solar radiation (especially at high sun angles) before it strikes the glass surface.
- Reduce glare and heat gain, while still allowing diffuse daylight and outward views.
- In tropical rainy climates, louvres can also deflect rainwater from hitting the glazing directly.

2. Aluminium Mullions

- Act as the main structural frame supporting the glass.
- Transfer loads (glass weight, wind pressure) to the building's primary structure.
- Often designed with thermal breaks to prevent heat conduction through aluminium.
- Integration slots for louvres and drainage channels.