

MATERNITY AND CHILDREN'S HOSPITAL IN JEMBER REGENCY WITH A BIOPHILIC CONCEPT AND SMART BUILDING APPROACH

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ABSTRACT

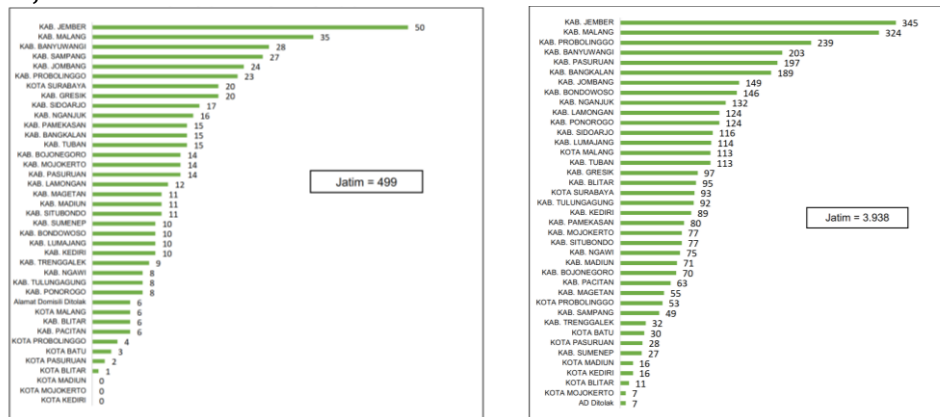
Maternal and child health is a crucial aspect of social development and community well-being. Jember Regency, as one of the regions with high maternal mortality (MMR) and infant mortality (IMR) rates, requires optimal and well-integrated healthcare facilities. Therefore, the Nurtura Maternity Hospital design project is proposed as a solution to provide holistic and innovative healthcare services. The main concept of this hospital design is the biophilic design approach, which integrates natural elements into the building environment to create a healthier, more comfortable atmosphere and accelerate the patient healing process. The design considers the placement of environmental sensors, automatic lighting systems, and smart ventilation that are harmoniously integrated with the building's structure and aesthetics. The outcome of this design is expected to serve as a model maternity and children's hospital that not only delivers high-quality medical services but also creates a healthy, comfortable, and sustainable healing environment.

Keywords: *Maternal and Child Health; Biophilic Design; Smart Building*

INTRODUCTION

Adequate healthcare services are a fundamental necessity in building a productive and prosperous society (Tambaip et al., 2023). Based on data from the East Java Provincial Health Office, the maternal mortality rate (MMR) in East Java reached 499 cases in 2023. Jember Regency recorded the highest distribution of maternal deaths, with 50 cases in 2023 (Dinkes, 2024). In addition, the infant mortality rate (IMR) in Jember Regency also ranked first, with 345 infant deaths (Dinkes, 2024). According to surveys, the locations where maternal and infant deaths occur typically include hospitals, community health centers, homes, and during transit to healthcare facilities across Jember Regency (Dinkes Kabupaten Jember, 2024). Based on the 2023 Jember Regency Health Profile, most maternal deaths in the region were caused by postpartum hemorrhage, eclampsia, and infection—conditions generally triggered by delays in medical treatment or referrals. Meanwhile, newborn deaths were predominantly caused by low birth weight (LBW), neonatal asphyxia, and neonatal infections. These conditions highlight the urgent need for adequate healthcare facilities to support optimal childbirth and postpartum care, particularly in rural and remote areas of Jember.

Graph 1: Distribution of Maternal and Mortality Deaths by Regency/City in East Java Province, 2023



Source: Public Health Division, East Java Provincial Health Office, 2023

The Maternity and Children' Hospital is designed as a smart building for specialized spaces that require adaptive technology, focusing on systems that integrate digital technology, automation, sensor- and actuator-based adaptive systems, and energy efficiency to support comfort and sustainability (Shah et al., 2022). In the context of the salutogenic theory developed by Aaron Antonovsky, stress and depression in children can slow the healing process. According to Kellert, applying biophilic principles in hospital environments can reduce patient stress, accelerate recovery, and improve indoor air quality (Kellert & Calabrese, 2015). Therefore, the main concept in the hospital design is a biophilic design approach, which integrates natural elements such as sunlight, indoor plants, optimal air circulation, and sustainable, environmentally friendly materials (Lissimia et al., 2024). The stages of planning and design thinking for the maternity and children's hospital are as follows:

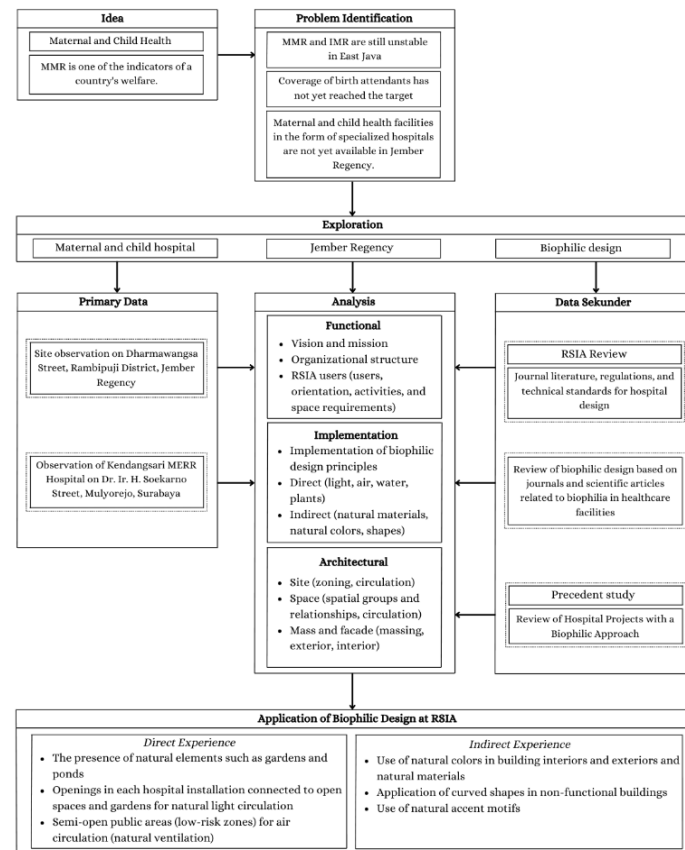


Figure 1. Conceptual framework

LOCATION DESCRIPTION

The site selection for the Maternity and Children's Hospital (RSIA) must comply with the provisions set forth in the Ministry of Health Regulation (Permenkes), taking into account various aspects such as population characteristics, land use, accessibility, availability of supporting facilities and infrastructure, surrounding environmental conditions, and applicable legal policies. The ideal location should be in areas with a high population and significant growth rates, particularly in regions dominated by the productive age group, to optimally meet maternal and child healthcare needs. In addition, the site must align with the designation in the Regional Spatial Plan (RTRW) and be free from disaster risks such as flooding and landslides. Jember Regency has an area of approximately 3,293.34 km², located in the eastern part of East Java Province, Indonesia, with coordinates around 7°59'–8°33' South Latitude (SL) and 113°14'–113°34' East Longitude (EL).

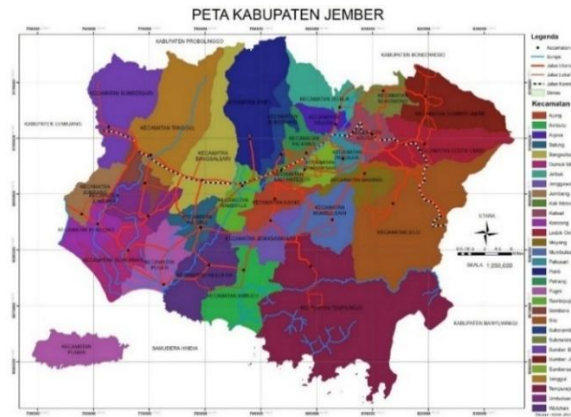


Figure 2. Administrative Map of Jember Regency

The selected site is located at Jl. Dharmawangsa No.7, Darungan, Jubung, Sukorambi District, Jember Regency, East Java, with a land area of 2,7 hectares. The site directly borders Jl. Dharmawangsa, shops, and restaurants to the north; a bus garage to the south; Jl. Bedadung, a hotel, and Tawang Alun Terminal to the east; and rice fields to the west. The site has a strategic location with several supporting facilities nearby, such as Tawang Alun Terminal and Hotel 99 Jember, approximately 200 meters away, Jubung Gas Station 210 meters, Muhajirin Mosque 750 meters, and Rambipuji Station at a distance of 2.5 kilometers.

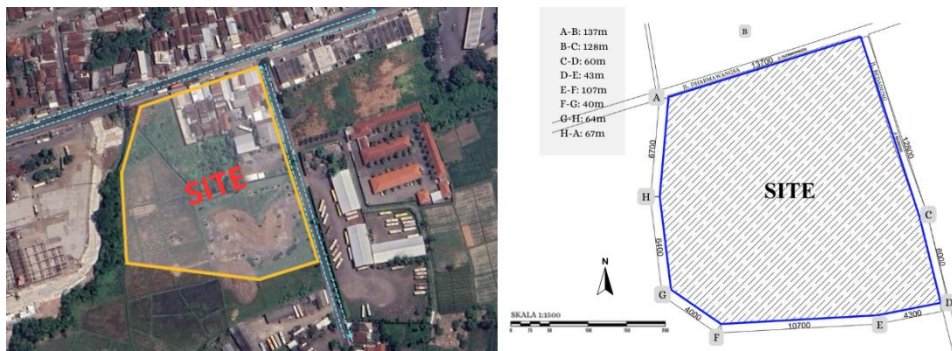


Figure 3. Site Description

The land use is designated as a mixed-use area, including residential, commercial and service functions, as well as public facilities, making it suitable for developing healthcare buildings such as a Maternity and Children's Hospital. According to land use regulations, the site has a Building

Coverage Ratio (BCR) of 60%, a Green Coverage Ratio (GCR) of 20%, and a Building Line Setback (BLS) of 5 meters. The main building is planned as a 6-story tower. **THE SITE ANALYSIS**

The following SWOT analysis illustrates the strengths, weaknesses, opportunities, and threats of the selected site. This evaluation provides a comprehensive understanding of the site's potential and limitations, serving as a foundation for informed decision-making in the planning and design of the Maternity and Children's Hospital.

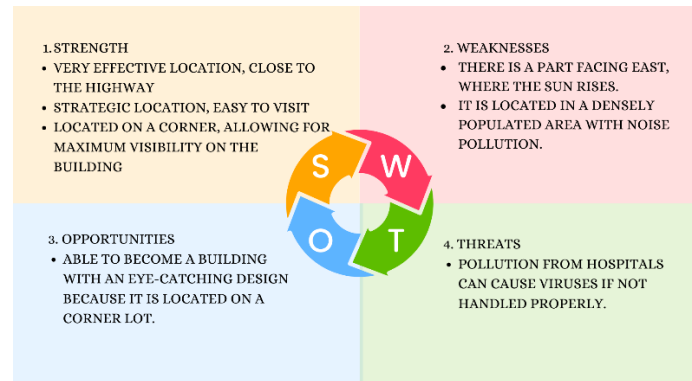


Figure 4. SWOT Analysis

Based on the design response to the site analysis, it can be concluded that the hospital site planning emphasizes the harmonization between the building, its environment, and user comfort. The building mass orientation maximizes natural lighting, cross-ventilation, and green views while minimizing heat exposure and noise. Climatology strategies and passive cooling are applied through wind direction management and tower configuration, while noise is mitigated using dense vegetation, proper zoning, and strategic placement of the building mass. The site infrastructure is designed to integrate natural elements for drainage, aesthetics, and sustainability, while also enhancing connectivity with the surrounding environment. Overall, the site design supports the creation of a healthy, comfortable, and adaptive environment for patients and visitors.

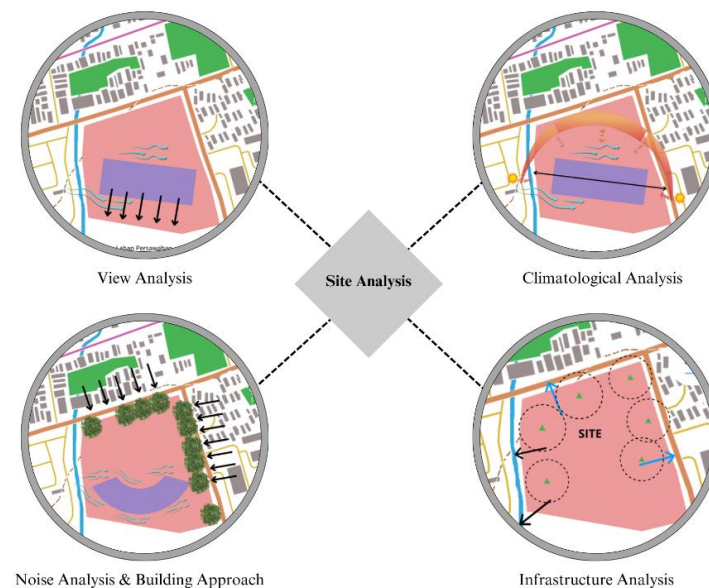


Figure 5. Site Analysis

CONCEPTUAL APPROACH AND WARFARE THEME

In the design of the Maternity and Children's Hospital, the primary focus is on creating a child- and mother-friendly environment as the main clients. In addition to providing healthcare services, the RSIA also offers various supporting facilities. These facilities include medical services, medical support, general support, and administrative services to create a more comfortable environment for patients (Arista et al., 2017).

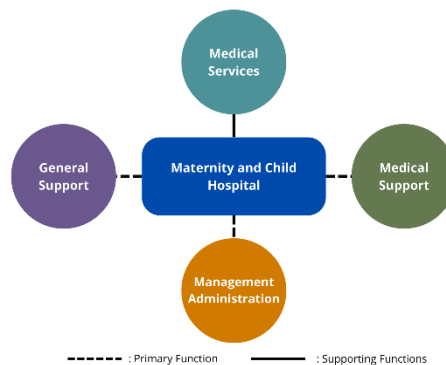


Figure 6. Maternity and Children's Hospital Functional Scheme

The references from Terrapin Bright Green (2014) and the works of Stephen R. Kellert were selected due to their high credibility and strong relevance in biophilic-based design. Terrapin Bright Green outlines 14 applicable biophilic design patterns suitable for healthcare buildings such as hospitals. Meanwhile, Stephen R. Kellert provides an integrative approach combining ecology, environmental psychology, and architectural practice, making his work a primary reference for the development and implementation of biophilic design concepts. To clarify its application, the following diagram presents the thematic criteria used in the design process.

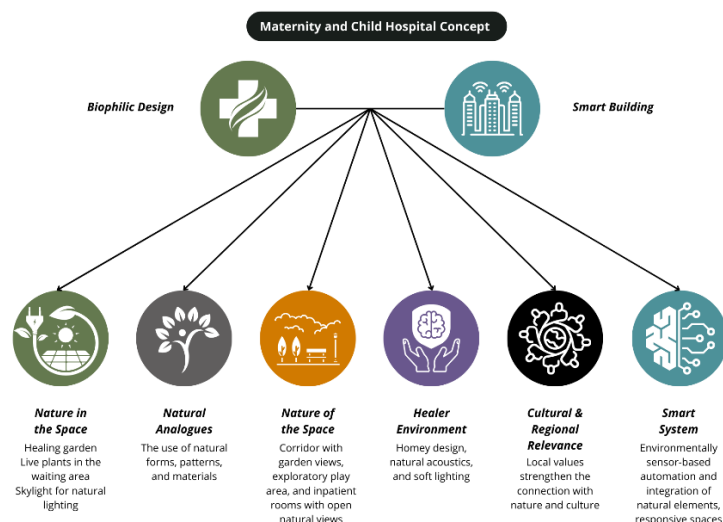


Figure 7. Design Concept and Theme Approach Criteria

The building mass form is the result of a metaphorical transformation of a mother's embracing gesture, curved and enveloping. This gesture is expressed architecturally through flowing forms that create interconnected spaces, conveying warmth, protection, and emotional closeness. The concept represents a sense of safety and affection, which are the core essence of maternity and child hospital services, while also reinforcing a human-centered approach in building design.

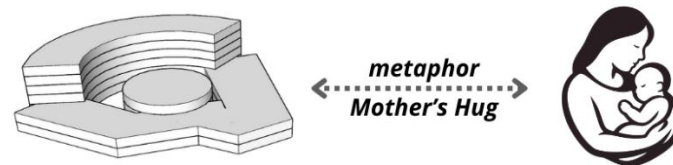


Figure 8. Building Mass Form Concept

DESIGN THEME

The biophilic approach aims to create a strong connection between humans and nature through natural lighting, cross-ventilation, and green landscape views, while maintaining patient privacy to foster a holistic and calming healing environment. By combining solid-void massing and orienting the beds at a 28° angle, each inpatient room is designed to provide patients with direct views of nature through openings on three sides of the room.

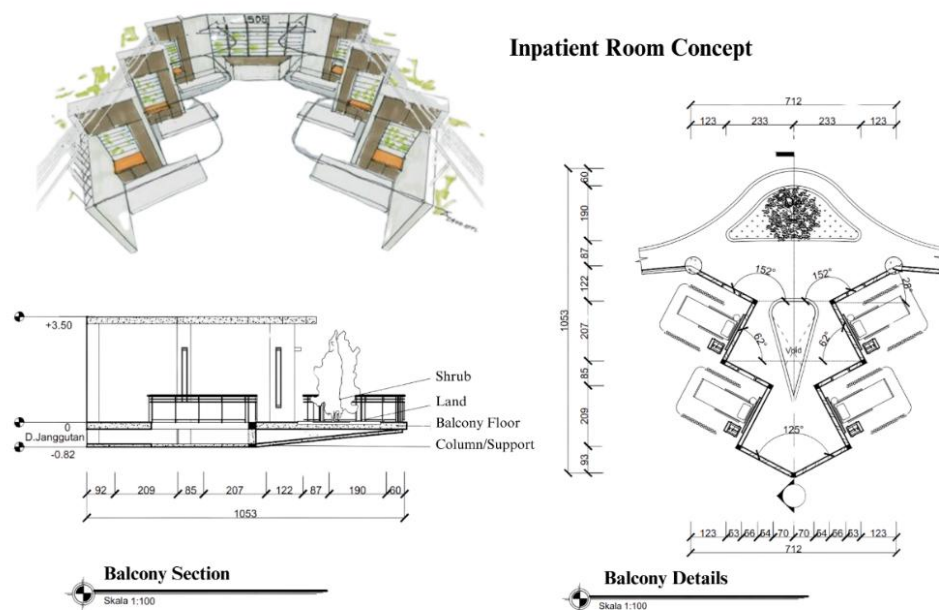


Figure 9. Biophilic concept



Figure 10. Type of Plants

The garden irrigation and drainage system in this building is designed using a subsurface water management system. According to Satyanto Krido Saptomo, a professor at the Faculty of Agricultural Technology, IPB University, a subsurface water system is an innovative solution that can enhance water use efficiency. Unlike conventional systems that distribute water over the surface, this system utilizes soil pores and perforated pipes installed beneath the ground to evenly distribute water across the garden area. Its implementation in the building serves a dual function as plant irrigation, maintaining optimal soil moisture and preventing waterlogging.

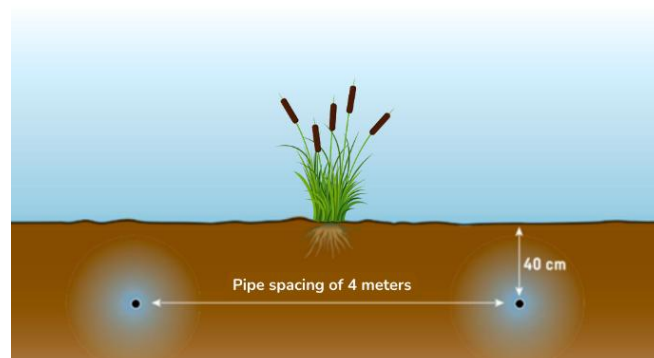


Figure 11. Subsurface Water Management System

The Remote Telemetry Control Unit (RTCU) system is implemented to monitor water levels, soil moisture, and irrigation and drainage activities in gardens powered by solar energy. With the support of a remote control and telemetry unit, this system can automatically regulate the water level according to the conditions and irrigation needs of the gardens within the building.

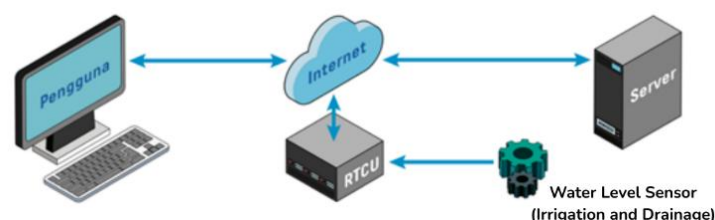


Figure 12. Automatic Water Level Control System with Telemetry and Remote Control Unit

IMPLEMENTATION OF CONCEPT IN DESIGN

The following illustration demonstrates the implementation of the design concept, showing how the principles of biophilic design and smart building strategies are integrated into the Maternity and Children's Hospital. It highlights the translation of conceptual ideas into spatial arrangements, building orientation, environmental strategies, and technological applications to create a functional, comfortable, and sustainable healthcare environment.



Figure 13. Implementation of concept in design

The site plan for the drop-off area shows a separated circulation arrangement to ensure smooth traffic flow and patient safety. The emergency department (ED) drop-off area is positioned close to the emergency entrance to expedite medical handling. The main lobby has a separate drop-off access for general visitors and outpatients, preventing interference with the ED circulation. The patient pickup area is placed in a designated zone to facilitate pick-up without obstructing other vehicles. The infectious patient drop-off has an isolated route leading directly to the isolation room to prevent transmission. Meanwhile, the mortuary pickup area is completely separated from public access to maintain privacy and provide comfort for the patient's family.



Figure 14. Separate Drop-Off for Main Lobby



Figure 15. Separate Drop-Off Emergency Department

The façade design of the multi-story inpatient building features staggered balconies with organically curved forms, creating a dynamic yet aesthetically pleasing appearance. Each balcony contains plants and small trees as vertical greenery elements, serving to provide access to natural views from every patient window, improve air quality, and bring a natural ambiance in harmony with the biophilic design concept. The placement of vegetation on the balconies also helps reduce direct sunlight, enhance privacy, and create a more comfortable environment for occupants or patients.



Figure 16. Vertical Plants in Inpatient Balcony Area

The green roof is integrated with the design of the multi-story building, creating a green space that serves both aesthetic and ecological functions. The garden roof surface is shaped with terraced contours filled with vegetation, trees, and pedestrian pathways, providing areas for interaction and relaxation for users. This design not only enhances the site's visual appeal but also contributes to improving air quality, reducing the heat island effect, and supporting the principles of biophilic design by bringing a calming natural atmosphere to the hospital environment.



Figure 17. Vertical Plants in Inpatient Balcony Area

The interior of the Maternity and Children's Hospital, designed with a **biophilic design** concept, is intended to create a natural and calming atmosphere that supports the patient's healing process. Natural lighting is maximized through wide openings and skylights, while cross ventilation ensures a steady flow of fresh air throughout the rooms. Eco-friendly materials such as wood, natural stone, and textured finishes are used to provide visual warmth as well as thermal comfort. Green elements, including indoor gardens, vertical plant walls, and potted plants, are strategically placed in public areas and patient rooms to offer positive visual stimulation and improve air quality. The combination of natural elements, soft lighting, and spacious layouts makes the hospital's interior more humane, welcoming for mothers and children, and aligned with the principles of holistic healing.

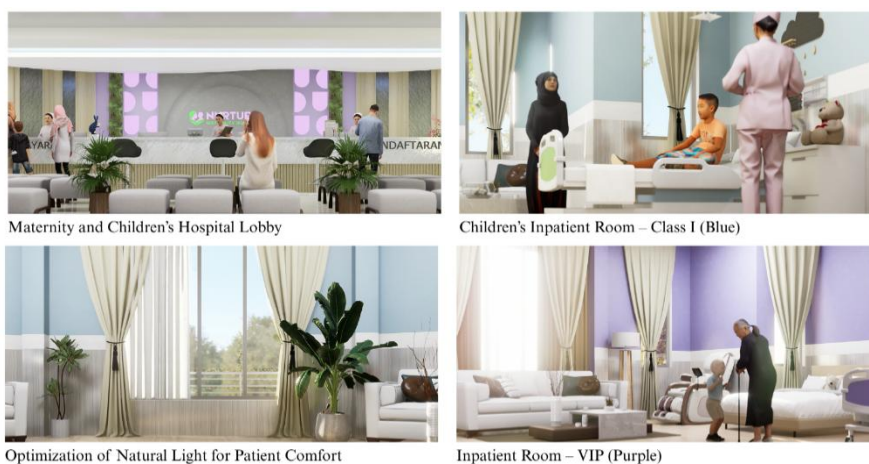


Figure 18. Interior Visualization of Maternity and Children's Hospital: Lobby, Inpatient Rooms, and Natural Lighting

The overall façade of the building is designed with a biophilic approach, combining natural and modern elements to create a healthy and environmentally friendly atmosphere. The curved building mass gives a dynamic impression while maximizing natural lighting throughout the rooms. Green vertical elements on both sides of the towers function as sunshades as well as planting areas that help filter the air and reduce surface temperature. Organic line patterns on the balconies and shading create a visual rhythm in harmony with the concept of nature. Neutral-

colored materials such as beige and gray are combined with green accents to enhance the natural impression. Glass transparency in certain areas extends the view and maximizes daylight, while the surrounding vegetation provides a smooth transition between architecture and landscape.



Figure 19. Main Facade Perspective of the Maternity and Children's Hospital with a Biophilic Approach

CONCLUSION AND SUGGESTIONS

This Maternity and Children's Hospital design responds to the high maternal and infant mortality rates (MMR and IMR) in Jember by creating a comfortable and efficient healing environment. Inpatient rooms are designed with a solid-void configuration and a 28° bed arrangement to provide visual access to the outside from three sides without compromising privacy. Solar-powered RTCU technology is applied to automatically manage garden irrigation and drainage, maintaining soil moisture and water levels in real time.

This design is expected to help reduce maternal and infant mortality rates (MMR and IMR) through a biophilic and smart building approach, as well as serve as a model for a healthy, responsive, and sustainable hospital in developing regions such as Jember.

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