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Application of Biophilic Architecture Principles: a Case Study in the Design of Jemursari Hospital, Surabaya

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ABSTRACT

This study aims to examine the application of biophilic architectural principles in the design of healthcare facilities, specifically at RSI Jemursari Hospital in Surabaya. The background of this research is based on the significant role of the built environment in supporting the healing process of patients, both physically and psychologically. The biophilic design approach is selected as it integrates natural elements into architectural design to enhance spatial quality and user comfort.

The research employs a descriptive qualitative method, utilizing literature review and case study analysis as data collection techniques. The study is conducted based on the 14 patterns of biophilic design, which are used as analytical parameters to evaluate architectural elements within the case study object.

The results indicate that the implementation of biophilic principles in hospital design improves environmental quality through the optimization of natural lighting, air circulation, the presence of vegetation, and visual connections to nature. These elements contribute to creating a more comfortable environment, reducing patient stress levels, and supporting a more effective healing process.

In conclusion, the application of biophilic architecture in hospital design not only serves an aesthetic function but also plays a significant role in enhancing the health and well-being of building users.

Key Words: Biophilic Architecture, Tropical Hospital Design, Nature Integration, RSI Jemursari.

INTRODUCTION

Biophilic architecture is a design approach that focuses on integrating natural elements into the built environment to improve the health and tranquility of users (Browning et al., 2014). This strategy for biophilic application has been shown to have the potential to reduce patient stress and help speed up patient recovery, especially through natural light elements, vegetation, and organic materials (Zhong et al., 2022). The 14 Biophilic Design Patterns provide a comprehensive framework of analysis through three dimensions: *Nature in the Space, Natural Analogues, and Nature of the Space.*

Despite numerous studies on biophilic design in residential and office buildings in temperate zones, its application in tropical health facilities is still limited. This study fills this gap by examining RSI Jemursari Surabaya, a type C hospital in the urban tropics of Indonesia. Focusing on public areas of the lobby, corridors, and waiting rooms of the research using descriptive qualitative methods through field observation and photographic documentation to map biophilic patterns The main objective is to identify the implemented biophilic patterns and assess the consistency of their integration, providing practical guidance for the design of healthcare facilities in similar climate contexts.

LITERATURE REVIEW

Biophilic architecture is a design approach that emphasizes the interconnectedness between humans and nature through the integration of natural elements into the built environment. This concept was developed through 14 biophilic design patterns that include aspects of direct experience of nature, indirect experience, and the relationship between space and place. The application of these patterns aims to improve the quality of the spatial environment while having a positive impact on the health and welfare of users, both physically and psychologically. In the context of building design, this approach focuses not only on aesthetic aspects, but also on environmental performance such as natural lighting, ventilation, and energy efficiency that contribute to the comfort of the space (Ilmi et al., 2024)

In addition to the physical aspects of the environment, biophilic architecture is also closely related to the user's psychological response to the space. A humanely designed built environment is able to create a sense of security, comfort, and increase social interaction. This is especially important in users with vulnerable conditions, such as patients in healthcare facilities, who need environmental support for the emotional recovery process. Research shows that an architectural approach that considers psychological aspects can create a more inclusive space and support the overall well-being of users (Architecture et al., 2025).

In its application to health facilities, the principle of biophilic architecture has a strong connection with the concept *of healing environment*, which is a design approach that aims to create an environment that supports the healing process holistically. An environment that pays attention to natural lighting, air quality, access to natural elements, and visual and acoustic comfort has been proven to reduce stress levels and increase the effectiveness of the patient's recovery process. Thus, the integration of biophilic principles in hospital design not only improves the quality of the space physically, but also plays a role in supporting the mental and emotional health of the user (Rossa et al., 2025)

Although various studies have discussed environment-based architecture and the concept *of healing environment*, studies that specifically integrate 14 biophilic design patterns as analytical parameters in hospital case studies in Indonesia are still limited. Therefore, this study was conducted to examine the application of biophilic architecture principles at RSI Jemursari Hospital Surabaya in order to understand the contribution of design to improving environmental quality and user welfare.

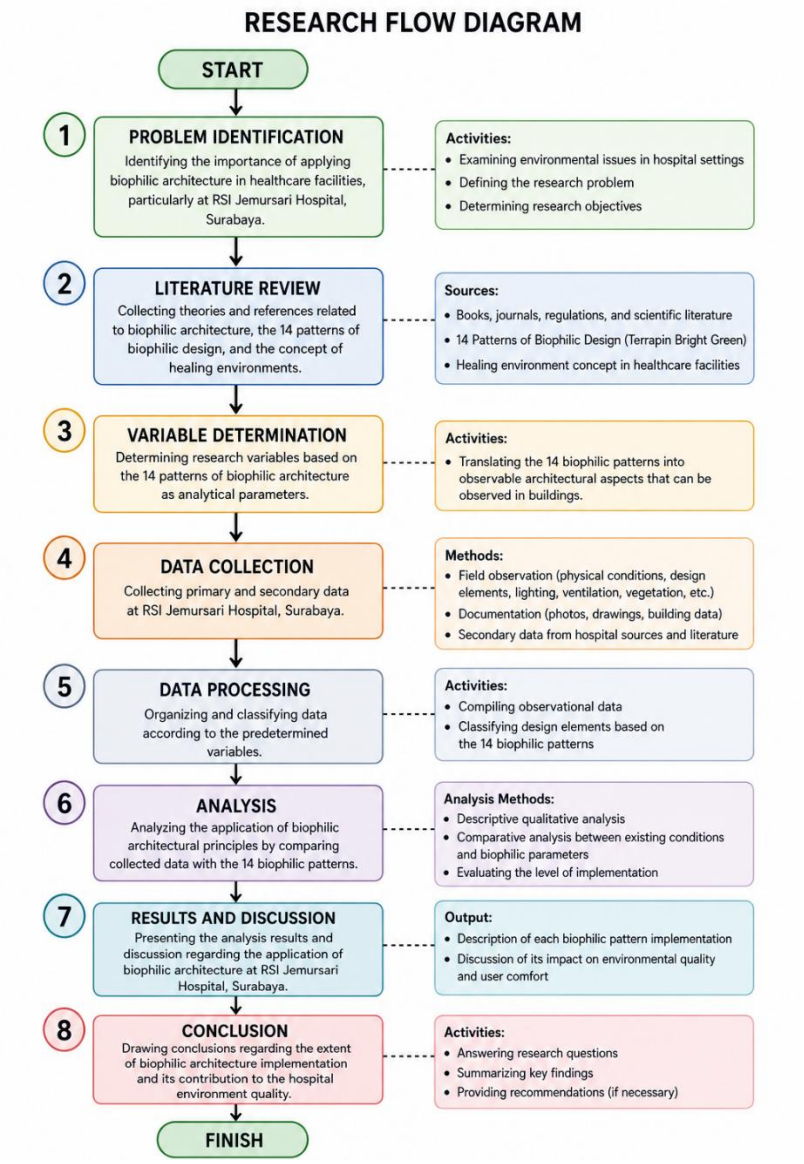
RESEARCH METHODS

This study uses a qualitative descriptive approach with the aim of examining the application of biophilic architectural principles in the building of RSI Jemursari Hospital Surabaya. This approach was chosen because it is able to provide an in-depth understanding of the phenomenon of architectural design through the analysis of existing conditions and interpretation based on relevant theories.

The data collection method is carried out through two stages, namely literature studies and case studies. A literature study was conducted to obtain a theoretical basis related to biophilic architecture, especially 14 biophilic design patterns, as well as the concept *of healing environment* in health facilities. Meanwhile, the case study was carried out by directly observing the research object, including the physical condition of the building, spatial layout, natural lighting, ventilation, and the connection of space with natural elements.

The data obtained was then analyzed using a comparative approach, namely by comparing the existing condition of the building to the parameters of 14 biophilic design patterns. Each architectural element found in the object of study is categorized and evaluated based on its conformity with biophilic principles, so that it can be known the extent to which the concept is applied in buildings.

The analysis stages are carried out systematically, starting from problem identification, data collection, data processing, to drawing conclusions. The results of the analysis were then used to interpret the contribution of the application of biophilic architecture to the quality of the spatial environment and its impact on the comfort and welfare of building users.



Gambar 1: Diagram Alur Penelitian

(Sumber: Analisa Penulis, 2025)

RESULTS AND DISCUSSION

Jemursari Islamic Hospital Surabaya is located on Jalan Jemursari No. 51-57, Wonocolo District, Surabaya City, a type C health facility that operates in a tropical urban environment. The ±12,000

m² building features modern architectural characteristics with the integration of natural elements in its public areas. Observations were focused on two main building levels that house non-clinical activities.

On the first level, the main lobby space becomes a striking entry point with the presence of a decorative fountain as the center of attention. This area is directly connected to the connecting corridor that leads to laboratories and radiology which creates semi-open circulation. On the east side of the building, the polyclinic waiting room is designed with wide openings that strategically overlook the internal garden.

The second level of the building is dominated by an adult and child inpatient corridor that runs along the north-south wing. The family lounge is placed in the transit area near the main elevator, the balcony at the west end provides an open view of the building's inner garden. This orientation takes advantage of the potential of the tropical climate through optimal ventilation and natural lighting.

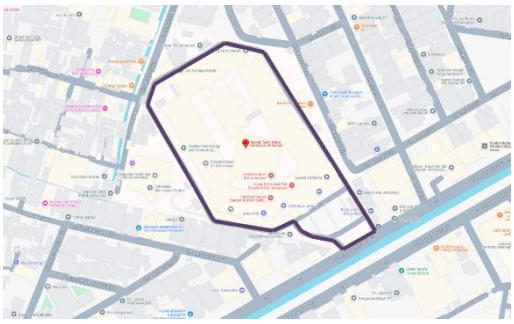


Figure 2: Location of RSI Jemursari Surabaya

(Source: Google Maps, 2025)

Figure 3: 1st Floor Plan

(Source: Researcher Documentation, 2025)

Figure 4: 2nd Floor Plan

(Source: Researcher Documentation, 2025)

Analysis of Nature in the Space

Visual Connection with Nature

This pattern is implemented through strategic architectural openings that connect the interior with the internal garden. In the waiting room of the 1st floor polyclinic, high windows provide unobstructed access to natural vegetation such as palms and ferns. This design fulfills the *principle of "prospect"* by maintaining a green field of view, according to the findings of Zhong et al. (2022) on stress reduction.

Gambar 5: Visual Connection in Waiting Room

(Sumber: Dokumentasi Peneliti, 2025)

Non-Visual Connection with Nature

Non-visual stimuli are presented through decorative fountains in the main lobby. The constant gurgling of water creates a natural soundscape covering the urban noise. This pattern is in accordance with the concept *of the "masking effect"* in the study of Sulaiman et al. (2022) which reduces patient anxiety.

Gambar 6: Water Feature

(Source: Researcher Documentation, 2025)

Non-Rhythmic Sensory Stimuli

Random sensory stimuli arise through the interaction of wind with vegetation. On the 2nd floor balcony (Figure 6), the changing movement of palm leaves and shadows creates visual dynamics. This effect is amplified by the reflection of light in the garden pond, meeting *Browning's* criteria of "ephemeral connection".

Gambar 7: Dynamic Shadows on Balcony

(Source: Researcher Documentation, 2025)

Thermal & Airflow Variability

Thermal variability is manifested through the jalousie windows system in the inpatient corridor (Figure 7). These vertical openings allow for cross-natural airflow, reducing the dependence on air conditioning in transit zones as per the study of Sahu & Jha (2021).

Figure 8: Natural Ventilation System

(Source: Researcher Documentation, 2025)

Presence of Water

The water element is present in the form of a reflection pond in the internal garden (Figure 8). This minimalist design utilizes the *principle of "mirroring effect"* to expand the perception of vegetation. In tropical climates, the surface of the water also serves as a natural evaporative cooler.

Gambar 9: Reflective Pool in Garden

(Source: Researcher Documentation, 2025)

Dynamic & Diffuse Light

Dynamic lighting is created through the interaction of sunlight with the lattice screen (Figure 9). The pattern of shadows that change every hour forms a *natural "light calendar"*, according to the concept *of temporal variability* in *the Kellert framework.*

Gambar 10: Light Patterns through Screen

(Source: Researcher Documentation, 2025)

Connection with Natural Systems

The connection with natural systems is manifested through vertical gardens on the walls of the corridor. This series of local tropical plants (ferns, ivory betel) creates an ecological microcosm as well as a natural air filter, in line with the findings of Zhao et al. (2022) in Chinese health facilities.

Gambar 11 : Garden in Corridor

(Source: Researcher Documentation, 2025)

Analysis of Natural Analogues

Biomorphic Forms & Patterns

RSI Jemursari displays the application of inspiring biomorphic patterns through architectural elements that imitate the organic forms of nature. In the main lobby, the ceiling is designed with repeated geometric patterns inspired by the arrangement of tropical palm leaves, creating the impression of a soothing forest canopy. Fractal patterns with a repetition scale not only provide visual aesthetics but also reduce user stress by a large amount based on the findings of McGee & Park (2022).

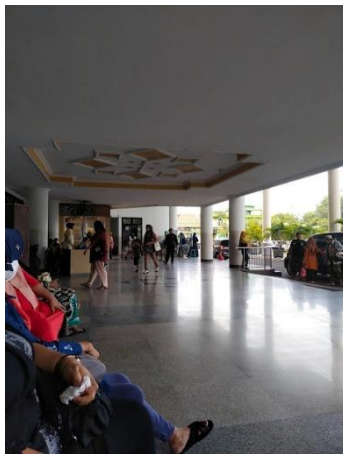


Figure 12: Biomorphic Pattern of Lobby Ceiling

(Source: Researcher Documentation, 2025)

Material Connection with Nature

The connection of materials with nature is manifested predominantly through the selection of natural materials. The lounge furniture uses solid wood with a natural finish that retains the original texture of the wood, providing tactile warmth and a distinctive wood scent. Natural stone materials are applied to the floors of the main corridor, creating a refreshing natural cold sensation in tropical climates. The study of Tsunetsugu et al. (2007) confirmed that natural wood materials can lower patients' systolic blood pressure, making them an ideal choice for healthcare facilities.

Figure 13: Wood Materials in Furniture

(Source: Researcher Documentation, 2025)

Complexity & Order

The principle of orderly complexity is implemented through design compositions that balance diversity and order. The garden in the inpatient corridor arranges several species of tropical plants in a rhythmic pattern that follows the Fibonacci sequence, creating a soothing visual rhythm.

Gambar 14: Garden in Corridor

(Source: Researcher Documentation, 2025)

Analysis of Nature of the Space

Prospect

RSI Jemursari implements the prospect pattern through the design of public spaces that offer a wide and unobstructed view of the natural environment. On the second-floor balcony, the unobstructed glass opening provides a full panoramic view of the internal tropical garden, allowing visitors and patients to observe the entire landscape from a height. The main lobby area is also designed with a vertical void that connects the ground floor with the atrium, creating a vertical perspective that reinforces the sense of spaciousness of space. The design conforms to *Browning's "unobstructed view"* principle which is proven to improve the user's sense of security and spatial orientation.

Gambar 15: Panoramic View from 2nd Floor Balcony

(Source: Researcher Documentation, 2025)

Refuge

The *refuge pattern* is realized through the design of a polyclinic waiting room with two key characteristics:

1. Spatial enclosure: This space is located in the east wing separate from the main circulation area, creating a semi-private zone with lower noise levels.
2. Psychological protection: Even without physical partitions, the aspect ratio of the space produces an index of sturdiness that triggers the perception of "enclosed feeling" according to the study of Stamps (2005).

The position of the waiting chair with its back to the solid wall and facing directly to the tropical garden fulfills the basic principle of Appleton's (1975) refuge-prospect theory. Patients gain a sense of security from the solid elements behind their body while remaining visually connected to nature.

Mystery

The element of mystery emerges through a circulation system that stimulates curiosity to explore space. The corridor connecting the laboratory is designed with a change of floor material that invites visitors to continue their journey. Sliding doors with frosting glass openings in the therapy room create the impression of space behind them without fully revealing the contents. The design of the tropical garden with winding paths and multi-layered vegetation also creates a gradual exploration experience that fulfills *Browning's* principle of "partial concealment."

Gambar 16: Corridor

(Source: Researcher Documentation, 2025)

Risk/Peril

The Risk/Peril pattern is implemented through the design of a semi-open space in the area of using wooden furniture (Figure 12). Despite being covered by a roof, this space allows for the exposure of rainwater to the user's circulation path, creating a sensation of "controlled risk" through direct contact with the natural elements. This design triggers a psychological response in the form of dynamic alertness without actual danger, according to Browning's (2014) concept of stimulated threat in safe contexts. The integration of solid wood as a flooring and furniture material reinforces this effect by increasing the risk of slip hazard when wet, but offset by the texture of the wood surface that provides natural traction. This combination of exposure to rain and wood materials forms a sensory experience typical of tropical climates that deepens human connection to nature.

Category	**Pola Biofilik**	**Implementation at RSI Jemursari**
Nature in the Space	*Visual Connection with Nature*	Wide window opening in the polyclinic waiting room overlooking the garden
	Non-Visual Connection	Decorative pools create a natural soundscape
	Non-Rhythmic Sensory Stimuli	Movement of palm leaves and dynamic shadows on the balcony
	Thermal & Airflow Variability	Jalousie windows in the 2nd floor corridor allow natural ventilation
	Presence of Water	Minimalist pool in the internal garden as an evaporative cooler
	Dynamic & Diffuse Light	The shadow pattern changes through *the lattice screen* in the corridor
	Connection with Natural Systems	Garden with a mini-ecosystem of local tropical plants
Natural Analogues	*Biomorphic Forms & Patterns*	The pattern of palm leaves on the lobby ceiling imitates the organic structure of nature
	Material Connection	Wooden furniture in the waiting room
	Complexity & Order	Composition of the garden with the *Fibonacci pattern*
Nature of the Space	*Prospect*	Panoramic view of the garden from the balcony of the 2nd floor
	Refuge	Polyclinic waiting room: chair with its back to solid walls + aspect ratio
	Mystery	The corridor winds to the laboratory with a change of floor material
	Risk/Peril	Semi-open area of wooden furniture: controlled exposure to rainwater

Source: Analysis results, 2025

Pola Biofilik	Implementation	Status	Remarks
Visual Connection with Nature	View is directed to RTH	Fulfilled	Strong visual connection
Non-Visual Connection	The sound of water & wind	Fulfilled	Sensory stimulus is present
Non-Rhythmic Sensory	Water ripples, fish	Fulfilled	Natural dynamic elements
Thermal & Airflow	Cross ventilation	Fulfilled	Supports thermal comfort
Presence of Water	Pond / onsen	Fulfilled	Dominant water element
Dynamic Light	North-south opening	Fulfilled	Optimal natural light
Natural Systems	Path follows contour	Fulfilled	Response to nature
Biomorphic Forms	Bamboo & wave patterns	Fulfilled	Natural shape inspiration
Material Nature	Wood, stone	Fulfilled	Dominant natural materials
Complexity & Order	Mass Rhythm	Fulfilled	Structured patterns
Prospect	View luas	Fulfilled	Open view
Refuge	Private terrace	Fulfilled	A sense of security achieved
Mystery	(not explained strongly)	Less	Not yet exploratory
Risk/Peril	(none)	No	Not found

Source: Analysis results, 2025

Based on the results of the evaluation of 14 biophilic design patterns, it is known that as many as 12 patterns (86%) have been met, 1 pattern (7%) is classified as poorly met, and 1 pattern (7%) is not met. This shows that the application of biophilic architecture to the object of study has been carried out optimally, especially in the aspect of direct connection with nature, both visually and non-visually. However, there is still potential for development in aspects of spatial experience such as *mystery* and other exploratory elements.

CONCLUSION

Based on the results of the analysis of the application of 14 biophilic design patterns at RSI Jemursari Hospital Surabaya, it is known that most of the principles of biophilic architecture have been applied well. The results of the evaluation showed that about 86% of the biophilic patterns had been met, while a small fraction of the others were still classified as poorly fulfilled and had not been optimally met. This shows that building design has a strong tendency to integrate natural elements into the built environment, both through visual, non-visual, and spatial elements that are responsive to environmental conditions.

The application of these elements has been proven to contribute to improving the quality of the space environment, especially in terms of thermal comfort, natural lighting, and user connection with nature. These findings are in line with previous research that states that an environment-based design approach is able to improve space quality and building efficiency (Ilmi et al., 2024), as well as support the psychological well-being of users through a more humane built environment (Architecture et al., 2025). In addition, in the context of health facilities, the application of the concept *of healing environment* through the integration of natural elements has also been proven to be able to reduce stress and support the patient's recovery process more effectively (Rossa et al., 2025).

However, there are still some aspects that need to be optimized, especially in patterns related to more exploratory space experiences such as *mystery* and controlled risk elements, which have not been fully implemented in the design. Therefore, this study shows that the application of biophilic architecture in healthcare facilities is not only important as a design approach, but also as a strategy to improve the quality of health and well-being of users. In the future, design development can be more focused on strengthening aspects of the space experience to create a more holistic and interactive environment.

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