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Implementation of Biophilic Architecture in Commercial Public Space (Study Case NKastil Cafe and NK Cafe Malang)

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ABSTRACT

Currently, more people are beginning to choose commercial spaces such as cafes that not only prioritize aesthetic value but also support mental health and comfort. In this context, the principles of biophilic architecture, which integrate natural elements into buildings, become a relevant approach when applied to commercial buildings. As an example, the buildings that will be used for this research are the commercial buildings NKastil Cafe and NK Café Malang. This research is conducted with the aim of identifying the principles of biophilic architecture applied in the commercial buildings NKastil Cafe and NK Café Malang. Both cafes were chosen as research subjects because they demonstrate excellence in the implementation of biophilic architecture principles when evaluated based on the 14 principles of biophilic architecture. The research method used is a qualitative descriptive method with a literature study to conduct an observational review of biophilic architecture, as well as direct observation to collect data on the research object. The results indicate that NKastil Cafe and NK Cafe have implemented several of the 14 biophilic design principles based on the 14 principles of biophilic architecture, with varying levels of application, featuring a more dominant use of natural elements in NK Cafe, and a space experience more dominant in NKastil Cafe. This study is expected to serve as a reference and source of knowledge regarding the application of biophilic architecture principles in building design.

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1. INTRODUCTION

Commercial public spaces such as cafes are currently experiencing increasing development. They are no longer merely places to eat and drink, nowadays, many cafes also serve as social spaces, alternative workplaces, and popular recreational destinations among urban communities. This is related to the interior and exterior design of cafés, which plays an important role in shaping the visitor experience, making cafés comfortable and enjoyable spaces for socializing, working, and recreation. Currently, cafes do not only focus on the taste of the food or drinks they sell, but also the ambiance and interior design of the cafe have become a focus of attention for the cafe owners. (Aryadamar, 2025). Therefore, biophilic architecture emerges as a concept that prioritizes the positive relationship between humans and nature. (Zahra & Satwikasari, 2023).

Biophilia is a term that states that humans will be healthier both physically and psychologically when in a natural environment. (Rahman & Lissimia, 2022). This approach comes as a design approach that connects humans with the natural environment, creating healthier and more sustainable living spaces. (Rachman & Muhsin, 2025). Biophilic itself also originates from a design theory that examines the phenomenon that, essentially, humans love natural environments. (Samodra et al., 2021). This approach has evolved into an architectural approach aimed at positively influencing the human psyche by fulfilling its instinctual need to affiliate with nature. (Rahman & Lissimia, 2024).

Biophilic architecture is an approach that emphasizes the importance of human interaction with nature in order to create built environments that not only provide physical comfort but also support mental health and psychological well-being. (Timbang et al., 2025). Biophilic design uses nature as the primary medium to reintroduce natural elements into buildings. (Putri & Subekti, 2021). This approach aims to support the health of building users primarily by connecting humans with nature. (Hans & Komala, 2025). By applying the concept of biophilic architectural design, it is expected to improve the quality of human life and the surrounding environment by integrating natural elements into spaces built by humans. (Bungawali & Satwikasari, 2024).

In practice, the application of biophilia theory will influence the resulting design, thereby being able to affect passengers' psychology through a connection with nature. (Alamsyah & Nasution, 2022). This approach also has advantages, including the ability to enhance users' creativity and clarity, reduce stress, and facilitate reciprocal interaction between humans and nature. (Nuha et al., 2023), simultaneously serving as a means capable of creating a healthy work environment, helping to reduce the surrounding stress levels, and supporting the achievement of a more optimal life function. (Pratiwi & Satwikasari, 2024). In addition, the biophilic concept helps advance urban sustainability and resilience. (Mellawati & Fahmi, 2024).

By combining natural elements such as visual and non-visual connections, water, natural light, fresh air, natural materials, as well as biomorphic shapes and patterns, it is possible to create a comfortable and refreshing atmosphere. (Ardyansyah & Zuhri, 2025). The integration of nature can be achieved by involving or incorporating nature through the use of natural elements, introducing natural lighting, and through spatial layout design. (Rahardjo & Widjaja, 2024). The implementation of this biophilic approach also includes the integration of local vegetation, the utilization of natural light and air, as well as the use of environmentally friendly materials to create spaces that are more harmonious with nature. (Koeswanto et al., 2025).

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Thus, the application of biophilic design in buildings is not only on the structure, but also encompasses the attributes and spatial experiences generated harmonious with nature. (Ratnasari et al., 2024). The need for natural space for biotic and abiotic elements affects psychological health and also serves as a form of preserving the natural environment around buildings. (Kinanti & Tatura, 2025). Therefore, biophilic design can also serve as an innovative way to design the places where we work, study, or live, reconnecting harmoniously with nature. (Primadewi et al., 2024).

There are 14 Biophilic Design Principles according to Terrapin Bright Green (Browning et al., 2014), which is often used as a reference in the analysis of the implementation of biophilic architecture principles. The 14 principles are as follows: Visual Connection with Nature (the user's visual connection with nature), Non-visual Connection with Nature (nature's connection with human senses other than sight), Non-rhythmic Sensory Stimuli (random interaction with nature), Thermal and Airflow Variability (natural ventilation), Presence of Water (the presence of water elements in design), Dynamic and Diffuse Lighting (lighting play), Connection with Natural System (existence of natural processes), Biomorphic Forms and Patterns (adopting natural forms or patterns), Material Connection with Nature (use of natural materials), Complexity and Order (application of symmetrical and geometric forms), Prospect (spacious and open areas), Refuge (providing a sense of safety, protection, and privacy), Mystery (gives a sense of curiosity), and Risk & Peril (a sense of danger or threat).

This research uses a case study of two commercial spaces, namely NKastil Cafe and NK Cafe, located in Malang. Both cafes are situated in the same location but have different premises. NKastil Cafe and NK Cafe were chosen as research subjects to identify the biophilic elements used in the exteriors and interiors of both buildings. The reason for selecting these two subjects is based on the consideration that both are considered to implement biophilic design in their building designs.

The purpose of this research is to analyze and compare the extent to which the concept of biophilic architecture is implemented in the commercial buildings NKastil Cafe and NK Cafe Malang, as well as to identify elements that support the principles of biophilic architecture. Through a comparative approach between these two research objects, the results of the study are expected to contribute to the development of greener commercial spaces and support user well-being.

2. RESEARCH METHODS

This research uses a qualitative descriptive research method by conducting a comparative study, which aims to compare the implementation of biophilic design in two different building objects. Both objects are still located in the same area, but are two different types of buildings. The research objects used have similar functions, namely as commercial public spaces. Comparative study method is used to observe the similarities and differences in the implementation of biophilic architecture principles in both research objects. Through this approach, it is expected that a deeper understanding can be gained regarding the extent to which the biophilic design concept is applied.

The data collection technique is carried out through direct observation, object documentation, as well as gathering literature studies. The first stage of data collection begins with conducting direct observation of both research objects. The second stage is documentation to collect visual data through photographs, which is conducted simultaneously during direct observation. The next stage is gathering literature studies to support the research.

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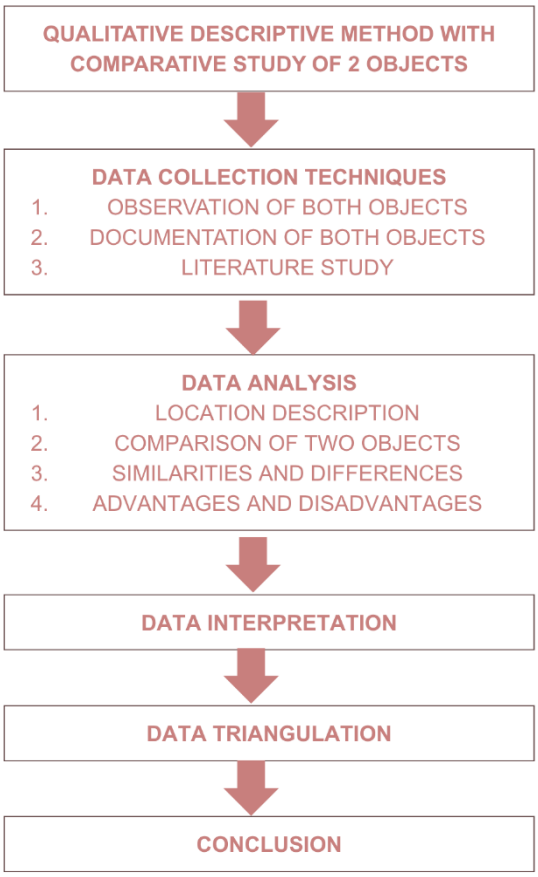

Figure 1. Research Metodology Flowchart
(Source: Author, 2026)

The image above explains that the data analysis process is carried out by describing the location of the research objects, then comparing the descriptive results of both objects to find similarities, differences, as well as strengths and weaknesses in the application of biophilic design in the two commercial public spaces. Next, an interpretation of the findings in both buildings was conducted. The categorized data were described in depth. To enhance the validity of the data, this study used source triangulation by comparing data from observations, documentation, and data from literature studies.

3. RESULTS AND DISCUSSION

3.1 Description of the Research Objects

NKastil Cafe and NK Cafe are located on Jl. Raya Kasin, Ampeldento, Karang Ploso District, Malang Regency, East Java 65152. These cafes are part of the "NK Wisata" destination developed in Karang Ploso, Malang. The area is surrounded by stretches of rice fields and natural vegetation, providing a natural atmosphere. The building design interprets a more modern design approach inspired by the form of European castles, and features a facade of exposed red brick walls adorned with climbing plants. NKastil Cafe uses materials that are more modern in its building design, such as concrete, iron, light steel, and glass. Unlike NKastil Cafe, the building design of NK Cafe uses natural materials such as wood, bamboo, and natural stone as the main materials in its building design.

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Figure 2. NKastil Cafe Malang
(Source: Personal Documentation, 2025)

Figure 3. NK Cafe Malang
(Source: Personal Documentation, 2025)

3.2 Implementation of Biophilic Architecture Principles in Research Objects

To determine the extent of biophilic design implementation in both research objects, an analysis was conducted based on the 14 principles of biophilic design according to (Browning et al., 2014). This analysis aims to identify the presence of biophilic elements in each research object, both from exterior and interior aspects. Based on the results of observation and documentation, the application of the 14 biophilic design principles at NKastil Cafe can be seen in the following table.

Table 1. Analysis of 14 Biophilic Design Principles at NKastil Cafe Malang

No	Biophilic Principles	Form of Implementations	Documentations
1.	Visual Connection with Nature (Category: Nature in the Space). The relationship between the user's visual senses and nature.	The large windows overlooking the landscape provide visual access for visitors to have a broad view of the external environment.	
2.	Non-Visual Connection with Nature (Category: Nature in the Space). The relationship of nature with the human senses except for the sense of sight.	The small river and swimming pool located near the Café building produce the sound of trickling water that can be heard inside the Café building, creating a calming soundscape.	
3.	Non-Rhythmic Sensory Stimuli (Category: Nature in the Space). Random interaction with nature.	The location of NKastil, which is situated on highlands and close to stretches of rice fields, allows visitors to hear random sounds such as passing birdsong, providing a soundscape experience for users. The building's design, which tends to be enclosed, means that this principle is not significantly applied to the building.	

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No	Biophilic Principles	Form of Implementations	Documentations
4.	Thermal & Airflow Variability (Category: Nature in the Space). Natural ventilation.	The design of NKastil Cafe maximizes natural ventilation by implementing cross-ventilation on the first floor and an open design without a roof on the third floor. Meanwhile, on the second floor, it is equipped with an artificial ventilation system in the form of air conditioning units placed at certain points.	
5.	Presence of Water (Category: Nature in the Space).	There are no water elements such as ponds in the building design. However, the presence of a swimming pool and a small river very close to the building contributes to the sound of trickling water that can be heard inside the Cafe building.	
6.	Dynamic & Diffuse Light. (Category: Nature in the Space). Lighting play.	The presence of sunlight as natural lighting during the day, so during the day the building does not use much artificial lighting.	
7.	Connection with Natural System (Category: Nature in the Space). The existences of natural process.	On the 3rd floor of the building, which is open without a roof, visitors can directly experience natural weather changes such as sunlight, cloudy skies, or light rain. Plant elements in the Cafe area such as climbing plants or potted plants can provide indications of natural cycles such as leaf changes, or interactions with insects.	 
8.	Biomorphic Forms & Patterns (Category: Natural Analogues). Adopting the forms or patterns of nature.	The architectural form of the building is still predominantly geometric and massive with an exposed brick pattern; the application of the biomorphic concept is more dominant in the aspects of vegetation and natural texture, rather than in the building form that resembles organic natural shapes.	
9.	Material Connection with Nature (Category: Natural Analogues) The use of nature materials.	Natural materials such as wood are widely used in furniture and building floors, especially on the 3rd floor of the Café to give a natural impression. Natural materials such as stone are also used as design elements, such as the sink on the 3rd floor.	

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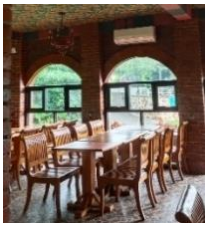
No	Biophilic Principles	Form of Implementations	Documentations
10.	Complexity and Order (Category: Natural Analogues). The applications of symmetrical and geometric forms.	Architectural design patterns on the facade and interior of the building are curved, resembling the shape of a European castle. The curved window shapes at the top follow the pattern of the curved facade.	 
11.	Prospect (Category: Nature of the Space). Spacious and open room.	A cafe space that has abundant natural lighting during the day, as well as a room layout that allows visitors to see the interior and outdoor space from large windows.	
12.	Refuge (Category: Nature of the Space). Providing a sense of security, protection, and privacy.	The seating areas on the 1st and 2nd floors, which are relatively enclosed, provide a sense of security and privacy for visitors, yet still allow them to see the natural scenery.	 
13.	Mystery (Category: Nature of the Space). Gives a sense of curiosity.	The building design does not significantly demonstrate the implementation of the mystery principle, however, there is a staircase leading to the next floor that evokes visitors' curiosity.	
14.	Risk/Peril (Category: Nature of the Space). Sense of danger or threat.	A rooftop area that has low barriers but remains safe. The principle of risk/peril is not widely applied in buildings.	

Source: Survey 2025

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Through direct observation as well as documentation conducted in the field, data was also obtained containing the forms of application of biophilic design principles at NK Cafe Malang, which is then categorized according to the 14 principles of biophilic design according to (Browning et al., 2014). The results of the analysis can be seen in detail in the following table.

Table 2. Analysis of 14 Biophilic Design Principles at NK Cafe Malang

No	Biophilic Principles	Form of Implementations	Documentations
1.	Visual Connection with Nature. (Category: Nature in the Space). The relationship between the user's visual senses and nature.	The layout design of NK Cafe, which directly faces the rice fields and natural scenery, provides visitors with the opportunity to enjoy the surrounding natural beauty.	
2.	Non-Visual Connection with Nature (Category: Nature in the Space). The relationship of nature with the human senses except for the sense of sight.	Visitors can enjoy natural sounds such as faint bird chirping, the rustling of leaves, the wind blowing through the trees, strong gusts of wind before the rain, as well as the sound of water in the pond.	-
3.	Non-Rhythmic Sensory Stimuli (Category: Nature in the Space). Random interaction with nature.	The location of NK Cafe, which is adjacent to rice fields, allows visitors to hear irregular natural sounds such as bird chirping, the sound of crickets, or the spontaneous blowing of the wind.	
4.	Thermal & Airflow Variability (Category: Nature in the Space). Natural ventilation.	The semi-open cafe design, accompanied by wide openings, allows air and temperature to flow freely within the space, creating natural thermal comfort without the need for artificial ventilation.	 

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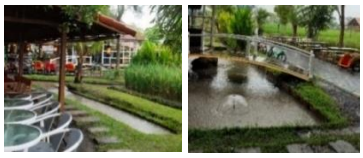
No	Biophilic Principles	Form of Implementations	Documentations
5.	Presence of Water (Category: Nature in the Space).	The presence of a small river beside the café as well as ornamental ponds can serve as visual elements and decorative features.	
6.	Dynamic & Diffuse Light. (Category: Nature in the Space). Lighting play.	The space is designed to be semi-open so that natural light can enter from various sides during the day. However, during the day, the Cafe still uses lighting with warm light as artificial illumination to complement the natural lighting.	
7.	Connection with Natural System (Category: Nature in the Space). The existences of natural process.	The seating area and visitor pathways that open directly onto the expanse of rice fields allow visitors to experience changes in the weather.	
8.	Biomorphic Forms & Patterns (Category: Natural Analogues). Adopting the forms or patterns of nature.	Having a geometric building form, the application of the biomorphic concept is more prominent through the integration of natural elements and an organic atmosphere, rather than through shapes or patterns that directly imitate natural structures.	
9.	Material Connection with Nature (Category: Natural Analogues) The use of nature materials.	The use of wooden materials dominates most of the building's structure and interior. This cafe also integrates natural materials such as stone into its design, creating harmony with the surrounding landscape.	
10.	Complexity and Order (Category: Natural Analogues). The applications of symmetrical and geometric forms.	Repetitive patterns such as rows of bamboo and wooden poles, ceiling patterns, and orderly stone pathways throughout the Cafe create a natural rhythm. NK Cafe also offers designs with different structures such as bamboo huts, gazebos, and semi-open seating areas that integrate hard and soft elements in its design.	
11.	Prospect (Category: Nature of the Space). Spacious and open room.	The seating area is designed with tables spread out widely and openly to maximize views of the surrounding landscape. There are no tall visual obstructions, allowing visitors to see the extensive area without hindrance.	

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No	Biophilic Principles	Form of Implementations	Documentations
12.	Refuge (Category: Nature of the Space). Providing a sense of security, protection, and privacy.	There are bamboo huts and gazebos that provide shaded seating surrounded by natural vegetation. Although designed with a semi-open concept, the seating area of the Cafe is largely equipped with a roof to provide protection from the outside.	
13.	Mystery (Category: Nature of the Space). Gives a sense of curiosity.	The winding pathway made of stone and soil along the Cafe can create a sense of curiosity in visitors to keep walking and exploring.	 
14.	Risk/Peril (Category: Nature of the Space). Sense of danger or threat.	There are several seating areas located near the shallow pool without barriers, yet they remain safe. This principle is not widely applied in the building design of NK Cafe.	

Source: Survey 2025

3.3 Comparison of the Implementation 14 of Biophilic Design Principles in Both Objects

After conducting an analysis of the application of 14 biophilic design principles at NKastil Cafe and NK Cafe, the next stage is to make a comparison between the two objects. This comparison aims to identify the similarities and differences, as well as the strengths and weaknesses in the application of biophilic elements in each building. The results of the analysis regarding the comparison of the application of biophilic design principles can be seen in detail in the following table.

Table 3. Comparison of the Implementation of 14 Biophilic Design Principles in NKastil Cafe and NK Cafe

No	Biophilic Principles	NKastil Cafe	NK Cafe
1.	Visual Connection with Nature (Nature in the Space)	Has implemented	Has implemented
2.	Non-Visual Connection with Nature (Nature in the Space)	Has implemented	Has implemented
3.	Non-Rhythmic Sensory Stimuli (Nature in the Space)	Does not show significant implementation.	Has implemented
4.	Thermal & Airflow Variability (Nature in the Space)	Has implemented	Has implemented

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No	Biophilic Principles	NKastil Cafe	NK Cafe
5.	Presence of Water (Nature in the Space)	Does not show significant implementation, only the trickle of water from the river and swimming pool can be heard from inside the building.	Has implemented
6.	Dynamic & Diffuse Light (Nature in the Space)	Has implemented	Has implemented
7.	Connection with Natural System (Nature in the Space)	Has implemented	Has implemented
8.	Biomorphic Forms & Patterns (Natural Analogues)	Applying biomorphic concepts in a limited manner, only through vegetation on the building facade.	Applying the biomorphic concept in a limited manner.
9.	Material Connection with Nature (Natural Analogues)	Has implemented	Has implemented
10.	Complexity and Order (Natural Analogues)	Has implemented	Has implemented
11.	Prospect (Nature of the Space)	Has implemented	Has implemented
12.	Refuge (Nature of the Space)	Has implemented	Has implemented
13.	Mystery (Nature of the Space)	Does not show significant implementation	Several elements convey a sense of mystery, such as the stone pathway elements arranged leading through the Cafe.
14.	Risk/Peril (Nature of the Space)	Does not show significant implementation	Does not show significant implementation

Source: Survey 2025

Based on the results of observations and field analysis on NKastil Cafe and NK Cafe Malang, several important findings were obtained that can serve as a basis for comparison regarding the effectiveness of implementing the 14 principles of biophilic design, including:

1. The level of success in applying principles, NK Cafe demonstrates a more comprehensive implementation of biophilic principles, one example being the extensive use of natural materials such as wood as the primary material, whereas at NKastil Cafe, the biophilic principles tend to be interpreted more indirectly, relying on visual experiences with seating areas that offer landscape views.
2. The most dominant category of principles, NK Cafe excels in the application of the aspects of Nature in the space and natural analogues, with an emphasis on the use of natural materials as the main materials, as well as numerous natural openings. NKastil Cafe consistently applies several aspects of the Nature of the Space and natural analogues, one of which is through the integration of natural vegetation elements such as potted plants placed inside the building and vertical plants on the building's facade, as well as the use of wood materials for visitor tables and chairs.
3. Offering different spatial experiences, NK Cafe provides a more open and organic experience, whereas NKastil Cafe offers a more enclosed space, while still taking into account the view of the surrounding landscape, natural lighting, as well as the use of natural materials such as wood applied to certain aspects like furniture and flooring on the 3rd floor.

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4. NKastil Cafe has advantages in terms of natural lighting and good ventilation through large openings. However, this building still has shortcomings in the presence of water elements inside the building, as well as a lack of application of the principle of mystery in the building's design.
5. NK Cafe has advantages in the use of natural materials such as wood and stones as building materials. However, there are still shortcomings in the Nature of the Space aspect at NK Cafe that have not been fully optimized, namely the Risk/Peril principle.

4. CONCLUSION

Based on the research findings presented above, it can be concluded that NKastil Cafe and NK Cafe have applied 14 principles of biophilic architecture, with varying degrees of implementation across different aspects. NKastil Cafe features a more enclosed design, utilizing more modern materials for the building structure; however, the biophilic design can be observed through the integration of climbing plants on the facade and potted plants strategically placed throughout the interior. NKastil Cafe's design also emphasizes natural ventilation on the first floor through cross-ventilation and an open roof design on the third floor. On the other hand, the design of NK Cafe tends to use natural materials such as wood and bamboo for the building structure, with a more open building design to maximize natural ventilation, providing visitors with an experience that allows them to connect directly with nature.

Research findings on both objects indicate that the quality of spatial experience is influenced not only by the physical presence of natural elements, but also by how these elements are manipulated to achieve a spatial experience, such as the rhythm of openings, the transition between interior and exterior spaces, and the creation of a dynamic atmosphere. Variations in natural lighting levels and shadows provide a more vivid visual effect and enhance users' comfort in carrying out activities. Other findings indicate that the principles of biophilic architecture can be applied flexibly to various architectural styles, both modern and more natural.

As for the research recommendations that can be provided, in the design of commercial public spaces, the design should prioritize passive strategies such as cross ventilation, wide openings, and semi-open spaces to enhance thermal comfort and reduce dependence on artificial systems.

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