

Evaluating Biophilic Architecture Patterns in Urban Parks for Enhancing Quality of Life

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Abstract

Urban parks shape everyday experiences in cities, especially where tourism drives local activity. This study explores how visitors interpret their well-being in relation to the biophilic design features of Batu City Square, East Java. Five quality-of-life dimensions and fourteen biophilic patterns were assessed through structured visual observations and a perception survey (n = 36), then analyzed using Importance–Performance Analysis (IPA). Field observations showed that biophilic cues appear across most spatial elements, suggesting that natural characteristics are embedded into the square’s layout rather than functioning merely as decorative additions. Physical freshness (0.27) was the strongest well-being dimension, while social intimacy (0.13) was the weakest, indicating that the square supports individual comfort more consistently than social interaction. The IPA results revealed an even distribution between attributes regarded as strengths and those considered lower priorities, reflecting visitors’ tendency to value comfort-related features more than symbolic or ecological cues.

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INTRODUCTION

In Indonesia, Batu City, recognized as a tourism city in East Java, has continued to develop since it was appointed as an independent administrative city in 2001. The local government has promoted Batu as both an agricultural and tourism city. According to recent statistical data records, the number of tourists visiting increased to 10 million in 2024 (Badan Pusat Statistik Kota Batu, 2025). The steady growth of visitors has gradually shifted daily routines in the city; new residential clusters have emerged, and many local businesses now align their activities with tourism-related demand. Pambuku et al. (2024), explain how tourism can accelerate urbanization, by shifting land use and altering local economic priorities. This tendency is visible in Batu, where residential expansion has moved into former agricultural land and new villas have appeared in areas once dominated by farming. Spatial analysis by Reza et al. (2025) shows that, between 2013 and 2023, agricultural land in Batu City continued to decline, while residential areas expanded by roughly 56%. Taken together, these changes reflect Batu’s growing identity as a regional leisure destination and the increasing influence of property-driven development.

In earlier years, Batu City Square (Alun-alun Kota Batu) functioned mainly as a gathering place for local residents, serving everyday social activities and community interaction. As Batu developed into a growing tourism city, the role of the square gradually expanded as well. A space that had once been simple took on a new character over the years, becoming a hybrid setting, serving both as a landmark for visitors and as a central node for citizen activities. Today, the square’s role also began to broaden. Over time, the square changed from a modest communal space into a busier and more layered environment. It now functions both as a recognizable point for visitors and as an everyday meeting place for local residents. As the square function shifted toward becoming a tourism destination, Batu municipal government added several facilities to support these activities, such as a children’s playground, a central fountain, shaded seating areas, a Ferris wheel, and a culinary zone located near the square (Farkhan et al., 2022). These new facilities gradually changed how the square was arranged and used, allowing families, teenagers, vendors, and short-stay visitors to occupy and interact with the place in their own ways.

Although several improvements have been made to Batu City Square to enhance its public facilities, field observations and comments from visitors still point to several issues that remain unresolved. These include the limited availability of shaded areas and facilities that are still not fully accessible to visitors with special needs (Farkhan et al., 2022). This condition shows that physical upgrades alone are insufficient and that a design approach that gives greater attention to the overall user experience is required. A design direction that can support this goal is the application of biophilic architecture principles. Incorporating vegetation, natural forms, and visual contact with environmental elements can help create a more comfortable setting and strengthen the park's environmental performance. The literature also shows that these elements contribute to reducing heat exposure, enhancing thermal comfort, and supporting visitors' well-being (Ristianti et al., 2024).

Recent studies indicate that exposure to natural features—such as water, sunlight, and shaded areas—can help reduce stress and support visitors' physical well-being. Element such as fountains and tree canopies often make the space feel calmer, and in some cases can even influence basic physiological responses like blood pressure. Other research has shown that natural settings can influence the way people interact with others and how they interpret the space around them, which in many cases leads to a stronger sense of connection with the setting. These interactions often lead visitors to feel more connected to the environment (Barghchi et al., 2024; Y. Zhang et al., 2025). In addition to these physical benefits, evidence from Semarang further illustrates this point, where integrating biophilic elements into urban parks has been associated with a decrease in soil-surface temperatures of about 0.5°C (Ristianti et al., 2024). This is similar to what we observed directly in Batu, where shaded or densely vegetated spots tended to attract more people and kept them there longer.

Building on these insights, this study examines how biophilic design patterns appear in Batu City Square and how visitors perceive their relevance to everyday comfort and overall quality of life. The aim is to offer practical insights that can support future planning of tourism-oriented public spaces that stay environmentally responsive while still serving a wide range of users

LITERATURE REVIEW

Urban parks occupy a central place in the spatial fabric of many cities, not only because they sustain basic ecological processes, but also because they host everyday social and cultural practices. For many residents, especially those living in dense neighborhoods, parks often become the most reachable green environments available. Research in Beijing by Wang & Chang (2023) illustrates this point, noting that parks tend to offer stronger health benefits than other types of green spaces, particularly for older adults and low-income groups who depend heavily on accessible outdoor areas with adequate vegetation. At a practical level, however, the benefits felt by visitors often vary from one park to another, depending on how well the space is maintained and whether its ecological character remains intact. Beyond their ecological value, parks frequently operate as informal civic spaces where people gather, participate in small cultural activities, and express aspects of local identity (Muresan et al., 2021). These roles often emerge through simple daily routines—morning exercise, brief conversations in shaded corners, or small clusters of vendors that slowly give meaning to the space.

Several studies from Asian cities report that well-maintained parks can lower surrounding surface temperatures by roughly 1°C to 7°C (Lai et al., 2023). As urban areas continue to warm, these cooling effects become increasingly tangible in everyday life. Visitors often sense this immediately, which may be one reason some parks remain lively even on the hottest days. Many studies have shown that the presence of urban parks often becomes reflected in the property values of the surrounding area. Econometric analyses and earlier meta-studies consistently report a positive location premium, suggesting that ecological and social amenities offered by parks tend to be absorbed into land and housing price (Dubé et al., 2025; Hassett et al., 2025). In many cases this means that the perceived quality of nearby green space can influence how attractive a neighborhood feels, even shaping long-term development preferences.

In recent discussions on urban open spaces, biophilic architecture has gained attention as an approach that reintroduces natural elements into built environments. This direction is particularly relevant for cities undergoing rapid expansion or experiencing pressure from tourism. Browning et al. (2014) outline fourteen biophilic design patterns that can be adapted to various urban settings, including public squares. These ideas have become increasingly important for places such as Batu City Square, where tourism activity and spatial intensification have gradually reduced the presence of natural open areas. Patterns involving visual and non-visual connections with nature have been linked to lower stress levels, improved mood, and faster physical recovery among visitors (Aristizabal et al., 2021; Huntsman & Bulaj, 2022; O'Regan et al., 2021). In everyday situations, these responses often appear subtly—for instance, in the comfort people feel when sitting beneath trees or in the clarity experienced after stepping out of a crowded street into a greener zone.

Sensory-based experiences, which may be expressed through subtle variations in airflow, temperature, daylight, or natural sound, have also been associated with improvements in creativity, psychological restoration, and circadian

balance (Asojo & Hazazi, 2025; Zhong et al., 2022). Water features and biomorphic references further enhance restorative responses, contributing to reductions in anxiety, blood pressure, and physical fatigue (Suess et al., 2024; Yin et al., 2024). The use of natural materials or ecological motifs in design can also reinforce a sense of continuity between local cultural practices and the surrounding environment, which may be especially important in public squares that function as everyday social nodes (Alaskary & Alrobaee, 2022).

The spatial dimension of biophilic design also shapes how visitors experience public spaces. Elements such as open viewing areas (*Prospect*), sheltered corners (*refuge*), and spatial arrangements that evoke curiosity (*mystery*) can create a sense of safety and encourage exploration, often resulting in increased social interaction (Gray & Downie, 2024; Hung & Chang, 2024). In busy urban squares, these cues frequently influence where people pause, move quickly, or choose to stay. Meanwhile, design cues that introduce a mild sense of risk—although used sparingly—have been shown to heighten engagement when applied carefully (Dalay & Aytac, 2022; P. Zhang et al., 2024). Collectively, these studies highlight the relevance of biophilic principles for urban squares that are undergoing functional shifts, particularly in cities shaped by tourism and rapid spatial change.

METHODS

This study adopted a quantitative approach to explore how biophilic architectural patterns relate to visitors' everyday experiences and perceived quality of life in Batu City Square. Data collection was conducted in two parts: systematic visual observations of the square's physical elements and a perception-based assessment through a visitor survey. The study took place in Alun-Alun Kota Batu, East Java, and examined the application of fourteen biophilic design patterns (Browning et al., 2014), in relation to five quality-of-life (QoL) dimensions (Lefosse et al., 2023).

Data Collection

Two complementary strategies were used to gather data: field-based observations and a perception survey administered to visitors on site. A checklist was prepared beforehand to ensure that each spatial component of the square was assessed consistently and that the scoring process remained transparent. These components included eleven spatial elements commonly found in Batu City Square—such as entrances and fences (E1), pedestrian pathways (E2), rubbish bins (E3), signage (E4), water features (E5), small service buildings (E6), entertainment rides (E7), relaxation zones (E8), seating areas (E9), lighting (E10), and vegetation (E11). Each element was reviewed against fourteen biophilic architectural patterns:

1. Visual connection with nature
2. Non-visual connection
3. Non-rhythmic sensory stimuli
4. Thermal and airflow variability
5. Presence of water
6. Dynamic and diffuse lighting
7. Connection with natural systems
8. Biomorphic forms
9. Material connection with nature
10. Complexity and order
11. Prospect
12. Refuge
13. Mystery
14. Risk/peril

A simple binary scoring system (0 = absent, 1 = present) was applied, which is a common first-stage method in biophilic assessments because it minimizes subjective interpretation. This scoring choice focuses only on confirming whether a pattern is observable, rather than evaluating its strength, which helps reduce individual judgement differences. For example, the fountain located in the central plaza area was scored "1" under the presence of water, while signage (E4) received a "0" since no water-related features were present. Vegetation areas were assigned "1" for providing a clear visual connection with nature. After going through each element, the scores were simply added up, giving a clearer sense of which patterns appeared most frequently throughout the square.

The second data source came from a visitor survey conducted using the Importance–Performance Analysis (IPA) method. Respondents evaluated each attribute using a five-point Likert scale, rating both its importance and how well they felt it was currently performed. The total score for each attribute was obtained by multiplying the mean rating by the number of respondents, after which a compatibility score was derived using $(\text{Performance} \div \text{Importance}) \times 100$.

A total of 36 visitors, including both residents and tourists aged 15–64, participated in the survey during their visit to the square. Although perceptions may differ across demographic groups, all respondents were treated as a single analytical group given the exploratory nature of the study. Surveys were conducted during two activity periods—morning (07:00–10:00) and late afternoon (17:00–20:00), which are also the times when changes in lighting and temperature are most noticeable to people using the space.

Data Analysis

The analysis unfolded in three interrelated steps to connect what was physically observable on the site with how visitors experienced it. The first step involved reviewing a visual analysis was performed to evaluate how each of the eleven spatial elements in Batu City Square corresponds to the 14 biophilic design patterns defined by Browning et al. (2014). Each observation produced a binary score (0 = absent, 1 = present), and all scores were summed to identify the relative dominance of each pattern across the site. Parallel to this, each spatial element was assessed based on its contribution to the five QoL indicators—physical freshness, mental health, peace of mind, social intimacy, and ecological (Lefosse et al., 2023). These QoL-related scores were subsequently normalized by dividing each score by the total cumulative score, which helped place all dimensions on a similar footing so the differences between them could be read more easily.

Second, visitor perceptions of the same 14 biophilic attributes were analyzed using the Importance–Performance Analysis (IPA) framework. Respondents rated the importance and performance of each attribute on a five-point Likert scale, and total scores were computed by multiplying the mean values by the number of respondents. Compatibility values were calculated using $(\text{Performance} \div \text{Importance}) \times 100$ to determine the degree of alignment between visitor expectations and existing conditions. IPA is a widely adopted tool for mapping the relationship between the perceived importance and performance of environmental attributes, which enables the classification of variables into four strategic quadrants: "Keep Up the Good Work," "Low Priority," "Possible Overkill," and "Concentrate Here" (Martilla & James, 1977). In this study, IPA served not only as an analytical tool but also as a practical guide, highlighting which biophilic features visitors valued most and which ones appeared to require further improvement.

The final step compared the proportional values of both datasets side by side to highlight convergences—where observed patterns matched visitor expectations—and divergences, where physical conditions did not fully align with how visitors interpreted the space. This proportional transformation functioned not as a separate analytical technique, but as a practical step to ensure that attributes with different scoring ranges could be interpreted on a common scale. The proportional values were organized from the highest to the lowest within each dataset, allowing points of convergence and divergence to be identified between the physical dominance of biophilic attributes and their perceived importance or influence on QoL. The same comparative logic was applied to the five QoL dimensions, enabling the study to examine how spatial characteristics observed on site were translated into experiential outcomes such as peace of mind, physical freshness, or ecological closeness. Bringing these three layers together enabled the study to build a more grounded interpretation of how biophilic design patterns influence visitor well-being in Batu City Square (Kim et al., 2019; Lefosse et al., 2023).

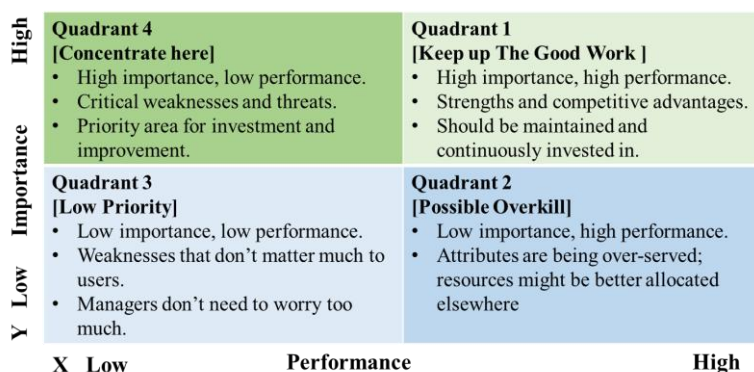


Fig. 1. Importance Performance Analysis (IPA) Matrix
 Source: Chi et al., 2025; Martilla & James, 1977

RESULTS AND DISCUSSION

Batu City Square in East Java occupies approximately 8,722 m² and functions as a central public space for tourism and community activities. The square contains pedestrian areas, water features, seating, play areas, service buildings, and vegetation, forming the basis for biophilic assessment (Fig. 2).

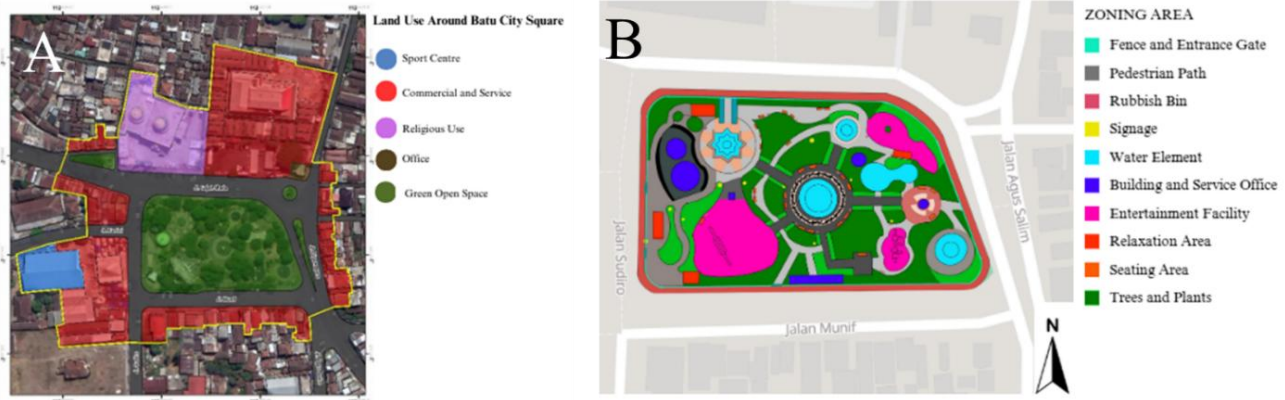


Fig. 2.A. Land Use Around Batu City Square; B. Zoning Area of Batu City Square
Source: Farkhan et al., 2022

Visual Analysis of Landscape Element to 14 Biophilic Design Patterns

The quantitative assessment used a structured checklist to record whether each of the 14 biophilic architectural patterns was present within the park’s spatial components. The elements assessed were coded as follows: E1 Fence and entrance, E2 Pedestrian paths, E3 Rubbish bin, E4 Signage, E5 Water elements, E6 Buildings and service offices, E7 Entertainment facilities, E8 Relaxation areas, E9 Seating, E10 Lighting, and E11 Trees and plants. Because the checklist applied a binary scoring system (1 = present, 0 = absent), the totals reflect the frequency with which each pattern appeared, not the strength or intensity of its expression (Table 1).

Visual observation showed that the order of biophilic architectural patterns, from the most to the least frequently applied, was: visual connection with nature (32 points); thermal and airflow variability (26 points); Prospect (26 points); connection to natural systems (25 points); Patterns such as presence of water and material connection appeared infrequently (5 each points).

Among spatial elements, water features (E5), entertainment facilities (E7), pedestrian paths (E2), and vegetation (E11) exhibited the highest concentration of biophilic patterns, while signage (E4) and rubbish bins (E3) showed minimal application.

Table 1. The Sequence of Biophilic Architectural Patterns on Each Element

No	Biophilic Architectural Patterns	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	Total
1	Visual connection with nature	2	3	0	2	4	3	3	4	4	3	4	32
2	Thermal and airflow variability	0	4	0	0	4	3	4	4	4	0	3	26
3	Prospect	3	3	0	0	3	2	3	3	3	3	3	26
4	Connection with natural systems	3	3	0	0	4	0	3	4	4	0	4	25
5	Non-visual connection with nature	0	2	1	0	3	0	2	4	4	0	4	20
6	Non-rhythmic sensory stimuli	0	3	1	0	4	0	4	0	2	2	4	20
7	Biomorphic forms and patterns	1	3	0	0	4	4	3	0	0	3	0	18
8	Complexity and order of nature	0	4	0	0	3	0	0	0	0	2	4	13
9	Mystery	0	2	0	0	3	1	3	0	0	1	3	13
10	Dynamic and diffuse lighting	0	4	0	0	2	0	3	0	0	2	0	11
11	Refuge	0	0	0	0	0	4	2	4	0	0	0	10
12	Risk /Peril	0	0	0	0	3	0	4	0	0	0	0	7
13	Presence of water	0	0	0	0	4	1	0	0	0	0	0	5
14	Material connection with nature	0	2	0	0	3	0	0	0	0	0	0	5
Total		9	33	2	2	44	18	34	23	21	16	29	

Analysis of Quality of Life in Batu City Square

Figure 3 illustrates the proportional distribution of the five QoL dimensions, while Table 2 shows how each spatial element contributes to these dimensions. Together, both outputs explain how observed spatial characteristics translate into QoL outcomes. Key elements, such as green open spaces and play areas, contribute to both physical and mental health. The aesthetic and biophilic design elements in the Batu City Square also play a role in improving the comfort and experience of visitors. The presence of water elements, such as fountains, provides a relaxing effect, while green landscapes and organic patterns create a visually refreshing atmosphere.

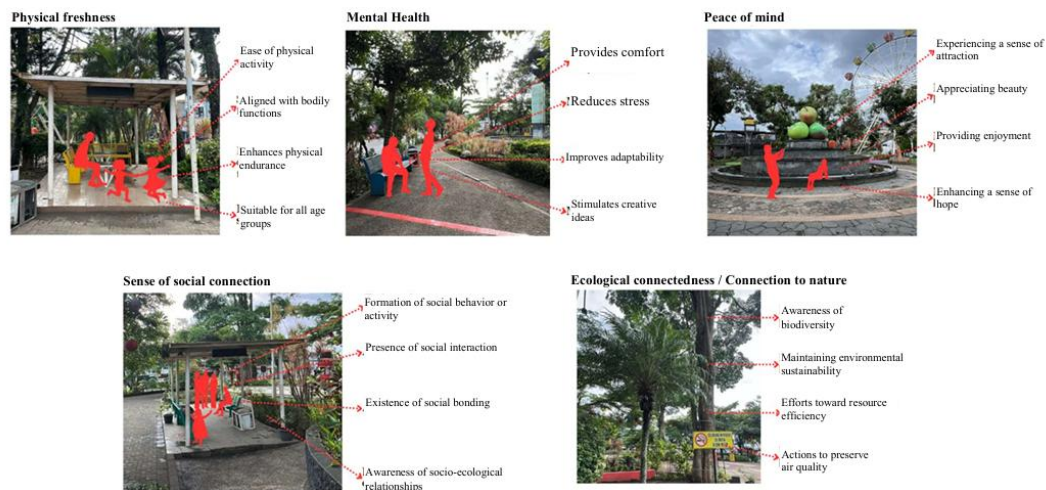


Fig. 3 Five-Dimensional Quality of Life in Batu City Square
Source: author, 2025

Additionally, a well-organized layout provides easy orientation and movement within the square area. These spatial characteristics help support restorative experiences, which are reflected in the dominance of the peace of mind and physical freshness dimensions in Table 2. The five criteria from Lefosse et al. (2023) have been used to assess the quality of life in Batu City Square.

The visual assessment shows that the five QoL dimensions are not equally represented in the square. In aggregate, the scores from highest to lowest are peace of mind (30 points;0.27), physical freshness (25 points;0.22), mental health (23 points;0.20), ecological proximity (18;0.16) and social intimacy (17 points;0.15). In addition, the ranking of spatial elements based on their contribution to the five QoL dimensions shows that E5 Water elements (16 points), E9 Seating (16 points), and E11 Trees and plants (16 points) are the strongest contributors, while elements such as E1 Fence and entrance (2 points), and E3 Rubbish bin (1 point) make relatively minor contributions.

Table 2. Quality of Life Sequence on Each Element Based on the Observation

No	Quality of Life	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	Total	Normalized Value
1	Peace of Mind	2	3	0	1	4	3	3	4	4	2	4	30	0.27
2	Physical Freshness	0	3	0	1	4	1	3	4	4	2	3	25	0.22
3	Mental Health	0	3	0	0	4	0	4	2	3	3	4	23	0.20
4	Ecological Proximity	0	3	0	0	2	2	3	3	4	0	1	18	0.16
5	Social Intimacy	0	2	1	3	2	0	1	2	1	1	4	17	0.15
	Total	2	14	1	5	16	6	14	15	16	8	16	113	1

To understand the contribution of each dimension of quality of life to the visitor experience in Batu City Square, this study conducted an analysis based on the results of a perception survey. Respondents were asked to rate five key dimensions of quality of life—peace of mind, physical freshness, mental health, ecological closeness, and social closeness—using a Likert scale of 1–5. The scores of the 36 respondents were then summed and normalized to the overall total, resulting in proportions that describe the relative strength of each dimension. The results of the recapitulation are presented in the following Table 3.

Table 3. Quality of Life Sequence on Each Element Based on the Visitors' Perception

No	Quality of Life	Total	Normalized Value
1	Peace of Mind	165	0.27
2	Physical Freshness	150	0.24
3	Mental Health	122	0.20
4	Ecological Proximity	101	0.16
5	Social Intimacy	77	0.13
	Total	615	1

The results of the questionnaire showed that the top-ranked dimension of success most strongly felt by respondents was peace of mind, with a total score of 165 (0.27). This pattern is consistent with the characteristics of Batu City Square, which attract respondents to the space, allow them to enjoy its beauty, and appreciate the natural atmosphere, thereby providing happiness and reducing mental burdens. The second-ranked dimension of success was

physical freshness, with a total score of 150 (0.24). This reflects visitors’ experiences of ease in carrying out activities, fresh air that makes the body feel more relaxed, and physical activity that improves fitness and endurance.

The third-ranked dimension was mental health, with a total score of 122 (0.20). This outcome likely reflects the role of natural elements in Batu City Square, which provide comfort, reduce stress levels, enhance adaptability, and create multisensory experiences that can stimulate creativity. The fourth-ranked dimension was ecological proximity, with a total score of 101 (0.16). This result appears to be linked to respondents’ awareness of air-quality benefits, resource efficiency, environmental sustainability, and the presence of local biodiversity. Lastly, the fifth-ranked dimension was social intimacy, with a total score of 77 (0.13). Its relatively low score suggests that visitors perceive weaker levels of social interaction, bonding, and socio-ecological engagement compared with the other dimensions.

Importance Performance Analysis (IPA) Analysis

Table 4 presents the performance and importance values of biophilic architectural patterns from visitor perceptions. The attribute of visual connection with nature holds the highest importance value, with a total score of 181, and also achieves the highest performance, with a total score of 179. This pattern likely reflects the presence of various plant types, including shade trees and ornamental plants, which enhance the quality of the experience at Batu City Square. The attributes of biomorphic shapes and patterns had the lowest importance and performance values, with a total score of 145. In contrast, the relatively low scores for biomorphic shapes and patterns are probably related to design elements that resemble natural forms (organic patterns, soft curves, and nature-like textures) but are applied inconsistently and sometimes appear vague, which can weaken visitors’ perception of these patterns.

Table 4. Performance and Important Analysis of the Biophilic Architectural Pattern from Visitor Perception

Code	Attribute	Total Performance Value	Total Importance Value	Level of compatibility (%)	Average	
					Performance (X)	Importance (Y)
P1	Visual connection with nature	179	181	98,57%	4,36	4,42
P2	Thermal and airflow variability	173	174	98,97%	4,21	4,25
P3	Prospect	161	162	99,51%	3,93	3,95
P4	Connection with natural systems	166	167	99,28%	4,05	4,08
P5	Non-visual connection with nature	163	163	100,12%	3,98	3,98
P6	Non-rhythmic sensory stimuli	163	165	99,03%	3,98	4,02
P7	Biomorphic forms and patterns	155	156	99,61%	3,79	3,80
P8	Complexity and order of nature	145	145	99,72%	3,53	3,54
P9	Mystery	154	154	100,13%	3,77	3,76
P10	Dynamic and diffuse lighting	173	175	98,86%	4,22	4,27
P11	Refuge	170	174	98,16%	4,16	4,23
P12	Risk /Peril	172	175	98,17%	4,19	4,26
P13	Presence of water	155	154	100,78%	3,78	3,75
P14	Material connection with nature	156	158	98,48%	3,80	3,85
Average		163	165	99,24%	3,98	4,01

Overall, Batu City Square has a balanced implementation of 14 biophilic architectural patterns, with performance closely aligned with perceived importance. Some attributes have high importance (>4.01) and relatively high performance (>3.98), such as visual connection with nature (4.36 vs. 4.42, 98.57%), thermal & airflow variability (4.21 vs. 4.25, 98.97%), connection with natural systems (4.05 vs. 4.08, 99.28%), dynamic & diffuse lighting (4.22 vs. 4.27, 98.86%), refuge (4.16 vs. 4.23, 98.16%), and risk/peril (4.19 vs. 4.26, 98.17%). Attributes where performance equals importance, often at 100% compatibility, indicate stability, with no urgent intervention needed, such as non-visual connection (3.98 vs. 3.98, 100.12%), non-rhythmic sensory stimuli (3.98 vs. 4.02, 99.03%), P13 – Presence of water (3.78 vs. 3.75, 100.78%), and Mystery (3.77 vs. 3.76, 100.13%). Attributes with

lower average scores (<3.98 performance, <4.01 importance) were: Prospect (3.93 vs. 3.95, 99.51%), Biomorphic forms & patterns (3.79 vs. 3.80, 99.61%), Complexity & order (3.53 vs. 3.54, 99.72%), and Material connection with nature (3.80 vs. 3.85, 98.48%).

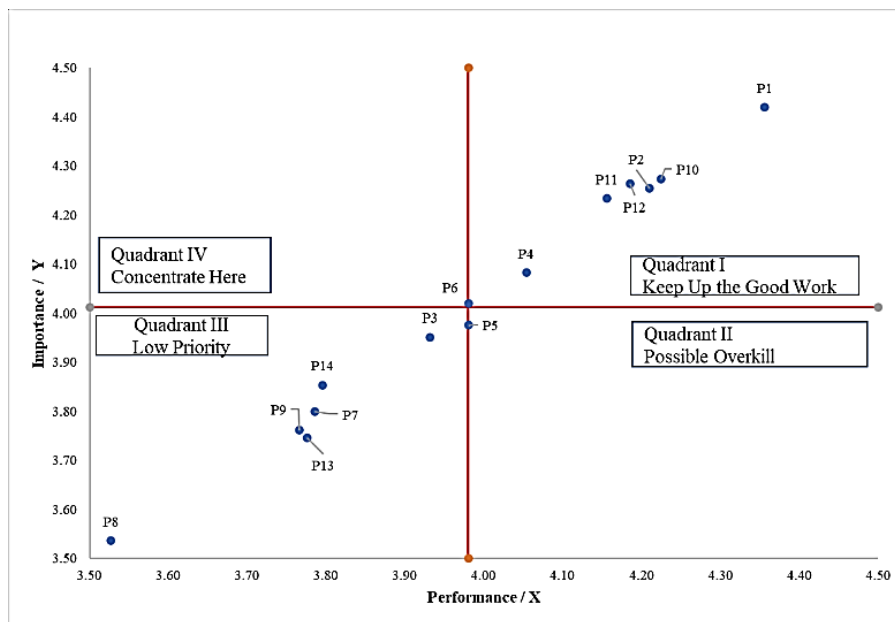


Fig. 4 Importance Performance Analysis Diagram of Batu City Square
Source: author, 2025

Based on the Importance–Performance Analysis (IPA) diagram in Fig. 4, seven biophilic pattern attributes are positioned in Quadrant I (Keep Up the Good Work). These include visual connection with nature (P1), thermal and airflow variability (P2), dynamic and diffuse lighting (P10), refuge (P11), risk/peril (P12), connection with natural systems (P4), and non-rhythmic sensory stimuli (P6). These attributes are considered highly important by visitors and demonstrate strong performance in practice. They represent the core strengths of Batu City Square and should be consistently maintained or enhanced to preserve visitor satisfaction and competitive advantage.

In contrast, the other seven attributes are grouped in Quadrant III (Low Priority), namely non-visual connection with nature (P5), Prospect (P3), material connection with nature (P14), biomorphic forms and patterns (P7), complexity and order of nature (P8), mystery (P9), and presence of water (P13). These attributes show relatively lower performance and are perceived as less important by visitors, thus requiring less managerial attention. Among them, complexity and order of nature (P8) appear as the weakest attributes overall and could be selectively improved if resources are available. However, given their low importance, efforts to enhance these attributes should be considered secondary compared to maintaining the core strengths in Quadrant I.

Juxtaposing Visual and Perception Analysis

A more comprehensive understanding of the application of architectural patterns in Batu City Square can be gained by comparing the researcher's visual observations with the results of the visitor perception questionnaire. Visual observations were conducted by the researcher to directly identify the existence and characteristics of biophilic architectural patterns and the quality of life in each element. In addition, the questionnaire was distributed and completed by respondents directly (on the spot) at the research location, providing an overview of visitors' actual perceptions of biophilic architectural patterns and quality of life in Batu City Square.

Table 5 presents a comparison between the results of visual observations and those of the visitor perception questionnaire. There are similarities and differences in the results due to the difference in viewpoints between the researcher and the respondent. The researcher assesses based on measurable and theoretically identified visual indicators, while visitors assess based on their subjective experiences, comfort, and individual perceptions and preferences. The results of the comparison of biophilic architectural patterns based on visual analysis and visitor perception are as follows.

The juxtaposition between visual analysis and perception analysis in the interpretation of biophilic architectural patterns in the study area is shown in Table 5. Notably, only Order 1, which involves a visual connection with nature, shows that visitors' perceptions and observations were fully aligned. This research emphasizes its essential and widely acknowledged function in biophilic design, supporting earlier findings that one of the most significant factors

influencing human comfort and psychological recovery is direct visual access to natural elements (Browning et al., 2014; Kellert, 2008; Ulrich et al., 1991).

The majority of other attributes, however, exhibit varied degrees of subversion. For example, while thermal and airflow variability and Prospect (Orders 2 and 3) ranked highly in the visual analysis, visitors tended to emphasize dynamic and diffuse lighting and thermal and airflow variability instead. Similarly, what observers identified as a connection with natural systems was perceived as being of the same order as risk/peril (Order 4). Other inversions include mystery and complexity and order of nature (Orders 13 and 14), which appeared less dominant in perception, while features such as presence of water and material connection with nature, though visually minimal, were still recognized in the user experience.

Table 5. Juxtaposing Visual Analysis and Perception of Biophilic Architectural Patterns

Order	Visual Analysis of Biophilic Architecture Patterns			Perception Analysis of Biophilic Architecture Patterns
1	Visual connection with nature	0.139	0.078	Visual connection with nature
2	Thermal and airflow variability	0.113	0.076	Dynamic and diffuse lighting
3	Prospect	0.113	0.076	Thermal and airflow variability
4	Connection with natural systems	0.108	0.076	Risk /Peril
5	Non-visual connection with nature	0.087	0.075	Refuge
6	Non-rhythmic sensory stimuli	0.087	0.073	Connection with natural systems
7	Biomorphic forms and patterns	0.078	0.071	Non-rhythmic sensory stimuli
8	Complexity and order of nature	0.056	0.071	Non-visual connection with nature
9	Mystery	0.056	0.070	Prospect
10	Dynamic and diffuse lighting	0.048	0.068	Material connection with nature
11	Refuge	0.043	0.068	Biomorphic forms and patterns
12	Risk/Peril	0.030	0.067	Presence of water
13	Presence of water	0.022	0.067	Mystery
14	Material connection with nature	0.022	0.063	Complexity and order of nature

These contrasts imply that visitors often reinterpret sensory-based or ecological attributes into psychological or abstract categories. For instance, patterns linked to stimuli and airflow were perceived in terms of comfort, refuge, or vitality, showing that users integrate environmental cues into holistic impressions rather than identifying them through technical distinctions (Lefosse et al., 2023; Fang et al., 2024; J. Li et al., 2018). Overall, the juxtaposition demonstrates that while visual analysis captures physical dominance, perception analysis reveals how users reconstruct these patterns experientially, underscoring the need for both perspectives in evaluating biophilic design performance.

In addition, the researcher also evaluated the quality of life based on the results of the researcher's visual observations and the visitor perception questionnaire, to understand how visual/architectural qualities translate into lived experiences of quality of life, as shown in Table 6.

Table 6. Juxtaposing Visual Analysis and Perception of Quality-of-Life

Order	Visual Analysis of Quality of Life			Perception Analysis of Quality of Life
1	Peace of Mind	0.27	0.27	Peace of Mind
2	Physical Freshness	0.22	0.24	Physical Freshness
3	Mental Health	0.20	0.20	Mental Health
4	Ecological Proximity	0.16	0.16	Ecological Proximity
5	Social Intimacy	0.15	0.13	Social Intimacy

As shown in Table 6, the juxtaposition of visual analysis and visitor perception of quality of life reveals a strong consistency across all five dimensions. Both the researcher's observations and visitor perceptions identified peace of mind and physical freshness as the most dominant dimensions, followed by mental health. At the same time, ecological proximity and social intimacy were consistently ranked lower. This alignment suggests that the spatial qualities observed in the square correspond closely with how visitors experience the environment, reinforcing the validity of the findings.

The consistency between observation and perception highlights that Batu City Square primarily functions as a restorative environment, supporting relaxation, physical vitality, and psychological well-being. At the same time, the relatively lower positions of ecological proximity and social intimacy indicate that the square has yet to fully optimize its role in strengthening ecological awareness and social interaction. These results align with earlier studies noting that urban green spaces are particularly effective in promoting mental and physical health benefits, while their contribution to social cohesion and ecological attachment often requires more intentional design interventions (Lefosse et al., 2023).

CONCLUSION

This study explored how biophilic architectural patterns are expressed in Batu City Square and how these features shape visitors' perceived quality of life. The analysis combined structured visual observations with a perception-based survey, allowing the study to capture both the physical presence of biophilic cues and the ways visitors interpreted them during their time in the square. Observations showed that biophilic elements appeared across many parts of the site, including water features, vegetation, pedestrian paths, lighting, recreational areas, and seating zones. A diverse set of patterns—such as visual and non-visual connections with nature, airflow variability, water presence, refuge and prospect, natural materials, and sensory stimuli—were identified across different spatial components.

The Importance–Performance Analysis (IPA) provided additional insight into how visitors assessed these features. Seven attributes, including visual greenery, airflow variability, diffuse lighting, refuge, risk/peril, natural system cues, and intermittent sensory stimuli, were placed in Quadrant I, indicating strong performance relative to their perceived importance. Another group of seven patterns fell into the “Low Priority” category, meaning they were present but not considered essential by visitors. No attributes appeared in the “Concentrate Here” or “Possible Overkill” quadrants, suggesting that the square has no critical shortcomings from a biophilic design perspective.

Comparing observational findings with visitor perceptions revealed several interesting nuances. While visual greenery was consistently recognized, other patterns were interpreted in more subjective ways, often tied to feelings of comfort, curiosity, or safety rather than to strictly visual cues. When connected with the five quality-of-life dimensions, the analysis showed that peace of mind, physical freshness, and mental health stood out as the most strongly perceived benefits. Ecological proximity and social intimacy appeared weaker, indicating that certain experiential aspects of the square may be less pronounced or less actively perceived by visitors. These findings suggest that the restorative qualities of the square are not only embedded in its design but are also felt directly through everyday use of the space.

Several limitations should be considered. The survey grouped respondents aged 15–64 together, potentially obscuring demographic variation in perception. The visual audit relied on a binary scoring method, which records presence but not the strength or quality of each feature. Data collection was limited to one period, meaning that seasonal or temporal fluctuations were not captured.

Future research could apply stratified sampling, examine seasonal or diurnal changes, or adopt multi-level scoring systems to better reflect the complexity of biophilic features. Comparative assessments across multiple urban parks or the integration of behavioural or physiological indicators could deepen understanding of how biophilic design supports social, psychological, and ecological well-being in public environments.

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