

Exploring the Challenges and Opportunities of Implementing Biophilic Design in Built Environments

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Abstract—Over the past decade, the concept of “nature” and biophilic design has received widespread attention in the field of architecture, particularly in response to increasing environmental challenges. However, questions and ongoing debates remain regarding how “nature” is conceptualized and addressed in both practice and research. This study conducts a literature review to discuss biophilic design as a theoretical framework for interpreting “nature” in architecture. It aims to answer the following questions: (1) How did the concept of biophilic design emerge, and how can it be defined? (2) How can biophilic design contribute to the goals of sustainable architecture? (3) What are the main design strategies associated with biophilic design?. This paper identifies and compares the primary frameworks of biophilic design and explains its core elements. It then analyzes the benefits of biophilic design—such as enhancing health, well-being, productivity, biodiversity, and circularity—in promoting human and ecological wellness. The study seeks to highlight the challenges, opportunities, and research gaps related to applying biophilic design in interior spaces, with a focus on foundational concepts and architectural case studies that demonstrate the impact of this approach on quality of life. Findings suggest that biophilic design is far more complex and rich than merely incorporating vegetation into buildings; it expands the scope of diversity by encompassing different types of nature—ranging from physical, sensory, metaphorical, and formal, to spiritual dimensions. Moreover, knowledge gaps are identified to encourage future research and critical reflections on biophilic design practices.

Keywords—*Biophilic Design, Built Environments, Urban Environments, well-being, productivity, biodiversity.*

I. INTRODUCTION

"The relationship between humans and nature can be one of respect and affection rather than domination... The outcome... can be rich, satisfying, and sustainable in the long term, but only if both partners modify themselves through their mutual association to become more adapted to one another... With our knowledge and sense of responsibility... we can create new environments that are ecologically sound, aesthetically satisfying, and economically rewarding."
— René Dubos, *The Wooing of the Earth*.

The built environment is one of the most significant factors affecting human well-being, encompassing homes, offices, and public spaces where people live, work, and relax. Recent studies have increasingly highlighted the impact of the built

environment on health and well-being, especially through the design of spaces that integrate with nature.

Biophilic design is a relatively modern concept centered on enhancing the human-nature connection through architecture and urban planning. Sometimes referred to as "Biophilia Design", this approach aims to improve individual well-being by incorporating natural elements into environments where people spend most of their time—whether for work, living, or other daily activities. [1,2,3,4]

Rooted in the innate human affinity for nature, biophilic design has evolved into a social movement over several decades. Its conceptual foundation can be traced from Erich Fromm's early use of the term biophilia to Edward O. Wilson's seminal work *Biophilia*, and the subsequent *Biophilia Hypothesis* co-authored by Wilson and Stephen Kellert. The movement gained further momentum with the publication of the multi-author volume *Biophilic Design* in 2008. This evolution involved a series of meetings and discussions among individuals sharing a common understanding of the biological relationship between humans and nature, and a collective recognition of the need to reintroduce nature into the daily lives of urban residents.

This shared ethical vision of incorporating nature into urban design represents a communal goal that transcends individual interests. There was a growing awareness of urban issues such as disconnection from nature, urban heat island effects, and water and air pollution, which sparked a desire for transformative change. Numerous studies demonstrate the healing and restorative effects of biophilia—i.e., nature—in healthcare settings (see Figure 1). Similarly, biophilic elements such as green spaces play a significant role in fostering social and familial relationships in modern societies. They have been shown to benefit office workers in densely populated urban areas, as well as university students and staff, by reducing stress (see Figure 2). Söderlund and Newman (2015) examined the psychological and physiological evidence for humans' innate connection to nature, and assessed emerging research supporting the multiple social, environmental, and economic benefits of biophilia [5]. As Beatley (2016) noted, nature is not optional; it is a fundamental component of modern urban life [6]. Newman et al. (2017) further emphasized that incorporating biophilic elements into buildings and cities can help reduce reliance on fossil fuels and foster urban resilience. The



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essential benefits of biophilia urge us not only to conserve and restore critical natural elements but, more importantly, to develop innovative ways to cultivate and introduce new forms of nature into 21st-century urban life [7].



(a)



(b)

Fig. 1. (a): Hospital rooms dominated by medical technology, lacking any visual or sensory connection to nature. (b): Research indicates that exposure to natural environments can promote recovery from illness and surgery, as well as reduce the need for pain medication [1]



(a)



(b)

Fig. 2. (a): Many office environments in the United States lack windows and are often deprived of sensory stimulation. (b): Offices that incorporate natural light, natural materials, and indoor plants have been shown to enhance productivity, improve morale, and reduce absenteeism [1]

A. The Term “Biophilia” and “Biophilic Design”

The term “biophilia” was first introduced by the social psychologist Erich Fromm in his 1964 book *The Heart of Man*, and it was later popularized by the biologist Edward O. Wilson. Wilson, an American biologist and entomologist, was the first to highlight the evolutionary and psychological importance of the human-nature connection. He expanded on this idea in his book *Biophilia*, in which he defined the term as “the desire to affiliate with other forms of life.” Biophilia implies an innate human tendency to connect with living systems. For millions of years, our species was closely tied to the wild environment, resulting in an emotional dependence on connections with other living organisms. This ingrained need has come to be known as biophilia. The concept was further refined by Roger S. Ulrich and Stephen Kellert, who defined it as “the innate human tendency to affiliate with nature.”[8]

The concept of biophilic design emerged following the development of the biophilia hypothesis. Alexander (2002) defined biophilic design as the integration or manipulation of natural elements or systems to evoke a sense of “life” in the built environment. Biophilic design responds to humans’ innate need to connect with nature, which has been shown to enhance productivity in workplaces.

More recently, the concept has gained growing interest among practitioners and environmental psychologists. Stephen Kellert emphasized that biophilic design encourages designers and corporations to incorporate natural systems and processes into the built environment. Numerous studies have demonstrated the benefits of natural elements in buildings on human well-being. For instance, increasing access to natural daylight and windows has been shown to significantly improve participants’ mood. These effects are often associated with enhanced productivity, focus, and reduced stress. Even brief exposure to nature, or viewing natural scenes, can boost cognitive function and creativity. As global urbanization accelerates—with the United Nations projecting that 60% of the world’s population will live in urban areas by

2030 —these qualities of biophilic design will become increasingly essential.

Biophilic design is not merely a technical tool. While the framework presented here aims to offer a practical methodology for better built environments, its success ultimately depends on the adoption of a new awareness and relationship with nature, not just on implementing a design technique. Biophilia and biophilic design require the recognition that human physical and mental health depend on the quality of our relationship with the natural world, of which we remain an integral part [10].

B. Temporal Trend Analysis of the Emergence of the Biophilia Concept in the Built Environment

Biophilic design, inspired by nature, is an emerging design concept that is gaining increasing significance due to its positive impact on the human mood and productivity. However, conflicts may arise between energy efficiency and human well-being—such as the balance between natural ventilation and energy conservation. Biophilic design is rooted in the innate human tendency to connect with nature. In this framework, plants play a crucial role, and all sensory elements that facilitate interaction with natural components such as daylight, vegetation, or even certain animals like birds—are considered essential contributors to this connection. Biophilic design aims to create environments that are suitable for humans as biological beings living in modern urban environments, enhancing their health, fitness, and well-being. Scientific studies have shown that contact with nature significantly influences physical and mental health, cognitive performance, and overall well-being. This phenomenon is becoming increasingly important, especially in daily urban life, where meaningful interaction with nature is both essential and increasingly scarce.

According to source [11] (2018), numerous recent research efforts have focused on how the built environment affects human health, well-being, and quality of life. A total of 142 documents were systematically reviewed and chronologically categorized by year of publication for the purpose of analyzing the temporal trend and distribution of studies in this field.

As illustrated in Figure 1, the number of publications related to biophilic design has shown a steady increase over the last decade. The trendline highlights that only three studies on this subject were available as early as 2008, and between that year and 2009, only one additional publication was found. However, from 2011 onward, the total number of publications began to rise gradually, reaching its peak in 2017. Undoubtedly, the timeline analysis demonstrates a growing interest among researchers, confirming the initial claim of an upward trend in academic focus on biophilic design within the built environment [11].

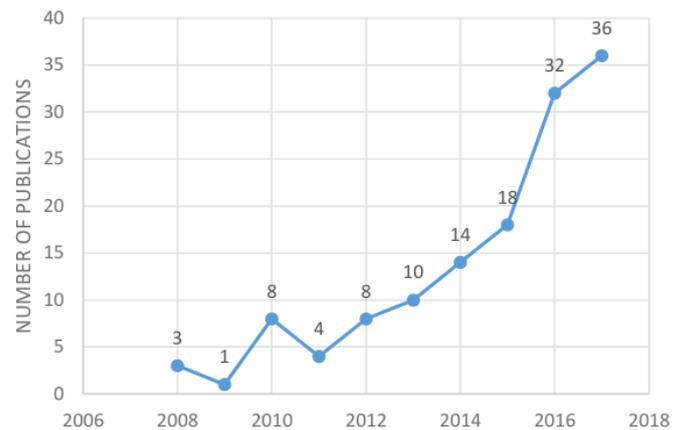


Fig. 3. Trend analysis: Number of publications on biophilic design and the built environment [1].

II. PRINCIPLES AND BENEFITS OF BIOPHILIC DESIGN

The challenge of biophilic design is to address the shortcomings of contemporary building and landscape practices by establishing a new framework for a satisfying experience of nature in the built environment. Biophilic design seeks to create an environment suitable for humans as living beings in the modern built environment, promoting their health, fitness, and well-being.

The successful application of biophilic design requires consistent adherence to specific core principles. These principles are essential conditions for effective biophilic design practice.

These principles include:

Biophilic design requires frequent and sustained interaction with nature.

Biophilic design focuses on human adaptations to the natural world that, over evolutionary time, have improved people's health, fitness, and well-being.

Biophilic design encourages emotional attachment to particular places and locations.

Biophilic design fosters positive interactions between people and nature, encouraging an expanded sense of connection and responsibility to human and natural communities.

Biophilic design encourages interconnected, integrated, and interdependent architectural solutions.

Biophilic design also seeks to maintain the productivity, function, and resilience of natural systems over time. Change in natural systems inevitably occurs as a result of major construction and development processes. Furthermore, all living organisms transform the natural environment as they inhabit it.

The question is not whether environmental change will occur, but whether the end result over time will be a more productive and resilient natural environment, as measured by indicators such as biodiversity levels, biomass, nutrient cycling, hydrological regulation, decomposition, pollination, and other essential ecosystem services. The application of biophilic design can alter the environmental conditions of a building or landscape in the short term, but in the long term, it should support a robust and ecologically sustainable natural community [12].

Successful application of biophilic design should also result in a wide range of physical, mental, and behavioral benefits.

Physical outcomes include improved fitness, lower blood pressure, increased comfort and satisfaction, reduced symptoms of disease, and improved well-being. Psychological benefits range from increased satisfaction and motivation, reduced stress and anxiety, and improved problem-solving and creativity. Positive behavioral change includes improved coping and mastery skills, increased attention and focus, improved social interaction, and reduced hostility and aggression (Figure 4).



Fig. 4. The integration of the vital elements of water, plants, organic forms and patterns, the richness of information, horizons, shelter, the imprint of time, and organized complexity contribute to the strong sense of place in this scene [1].

III. APPLICATIONS OF BIOPHILIC DESIGN

Biophilic design practice involves the application of diverse design strategies, which we refer to as experiences and themes. The choice of design applications inevitably varies depending on the project's circumstances and constraints, including building and landscape uses, project scale, varying economic, logistical, and regulatory factors, as well as cultural and environmental conditions. As emphasized, effective biophilic design practice requires adherence to the principles outlined above. Importantly, biophilic design should not be implemented in a fragmented or isolated manner, but rather in a way that reinforces and complements each other, resulting in an integrated ecosystem.

IV. EXPERIENCES AND ATTRIBUTES OF BIOPHILIC DESIGN

The various characteristics of biophilic design are experienced through a wide range of human senses, including sight, hearing, touch, smell, taste, and movement. Visual perception is the most widely used means of human perception and interaction with the natural world; viewing plants, animals, water, landscapes, and other environmental elements elicits diverse physical, emotional, and cognitive responses. Indirect visual interaction with nature—such as viewing aesthetic images, using natural materials, and organic forms—contributes to enhancing these responses. Aesthetic nature has a unique ability to stimulate attention, arouse curiosity, and stimulate human imagination and creativity. Conversely, the absence of natural elements from architectural spaces—such as enclosed environments lacking windows or natural details—can lead to a general sense of

boredom and stress, and in extreme cases, can even result in psychological and physical disorders. Although visual perception dominates, other senses such as hearing, touch, smell, taste, and movement are equally important in enhancing the human experience with nature. Natural sounds such as the sound of water, the feel of plants, the scent of flowers, and the movement of the air have a profound emotional and cognitive impact.

Multisensory interaction with natural elements within the built environment contributes to enhanced psychological comfort, overall satisfaction, and a sense of enjoyment, as well as improved cognitive performance. Therefore, it is recommended to integrate such sensory experiences into architectural designs whenever possible.[12]

The following is a brief overview of the key characteristics of biophilic design.

A. Direct Experience of Nature

Light: Natural light helps regulate human biorhythms and enhances psychological and physical health. The contrast of light and shadow creates a rich visual environment that enhances the quality of spatial experience.

Air: Natural ventilation enhances comfort and productivity through variations in air, humidity, and temperature. This can be achieved through controllable vents or advanced design systems.

Water: The presence of water in the built environment reduces stress and improves mood when activated visually, aurally, and tactilely. Strategies include fountains, ponds, and moving water features.

Plants: Vegetation nurtures sensory abundance and improves psychological and physical health, especially when native plants are used abundantly and ecologically interconnected inside and outside buildings.

Animals: Interacting with animals strengthens the connection to nature, especially when native species are included directly or through technologies such as surveillance cameras or fish tanks.

Weather: Perceiving weather changes provides a rich sensory interaction and increases the user's connection to the environment. This can be activated through balconies, open windows, and indoor environmental simulations. Landscapes and Ecosystems: Humans prefer landscapes that mimic the biodiverse savanna environment. Self-sustaining ecosystems can be introduced through urban forests and green roofs.

Fire: Fire evokes feelings of comfort and attention and can be evoked through fireplaces or simulated using light, color, and materials with varying thermal conductivity [13].

B. Indirect Experience of Nature

Images of Nature: Visually representing nature (photographs, murals, videos) enhances psychological and cognitive comfort. To achieve the desired effect, these images must be repetitive, rich, and thematically interconnected.

Natural Materials: Organic materials such as wood and stone evoke sensory responses that cannot be artificially simulated. These materials reflect temporal shifts and adaptation to the environment, enhancing emotional connection to space.

Natural Colors: Earthy colors derived from nature promote balance and a comfortable perception. It is

preferable to avoid garish artificial colors and use only bright ones to simulate striking environmental elements.

Simulation of Light and Air: Artificial lighting and ventilation can simulate natural dynamics. This recreates the sense of temporal change and comfort associated with a diverse natural environment.

Natural Shapes and Patterns: Models inspired by nature (leaves, animals) give a lively and dynamic character to the design. These patterns enhance visual perception and user interaction with space.

Evoking Nature: Nature can be expressed through abstract symbols that don't directly represent it, such as wings or flowers. This symbolic use reflects the essence of nature without literally imitating it.

Richness of Information: Natural environments are rich in visual and sensory information that stimulates perception and interaction. It is preferable for this information to be organized and interconnected to avoid cognitive clutter.

Age and Time: Biological design reflects the changes of time through the use of materials that age naturally. This sense of time generates a deep connection with natural and existential transformations.

Natural Architecture: Geometric shapes are inspired by nature, such as hierarchical repetition. These patterns create a sense of balance and harmony through varied, organized repetition.

Biomimicry: Translating the functions and forms of living organisms into effective and sustainable design solutions. This mimicry integrates natural creativity with technology to serve humanity and the environment.[14]

C. The Experience of Space and Place

Perspective and Refuge

Successful environments balance a comprehensive view of the surroundings (perspective) with the presence of safe spaces (refuge). This can be achieved through vision portholes and protected spaces that foster a sense of comfort and security.

Organized Complexity

People prefer environments that are rich in information and variety, provided they are not chaotic. Visual organization and a logical sequence of elements are crucial to making complexity satisfying.

Integration of Parts into the Whole

Successful design connects different parts to form a coherent system. This integration is enhanced by a functional visual sequence, clear boundaries, or a unifying focal point.

Transitional Spaces

Pass ways, thresholds, and dividers between interior and exterior spaces contribute to the clarity of spatial organization. These areas help understand the overall structure of space and promote ease of movement.

Navigation and Wayfinding

Effective navigation requires clear visual guidance through paths, entrances, and exits. Thoughtful design reduces confusion and enhances a sense of control and comfort. 6. Cultural and Environmental Connection to Place.

Interaction with local cultural and natural characteristics forms the basis of attachment to place. This connection supports identity and environmental awareness and

encourages the protection and sustainability of the built and natural environment.[15]

V. BIOPHILIC DESIGN STRATEGIES

Based on the concept of biophilic design, 25 biophilic design strategies were identified through consideration of relevant references. The main biophilic design strategies were analyzed and summarized, as shown in the table below, based on the sources cited in the table 1.

Table 1. Main strategies for biophilic design [1].

	Strategies	Indicators	Aspects of Biophilic Design
1	Increasing the coverage of green spaces.	1. A Biophilia rate	1. Biophilic infrastructure
2	Enhancing the formation of a plant canopy for shade and protection.		
3	Enhancing the proportion of native species.		
4	Enhancing the level of biodiversity.		
5	Expanding the water area.		
6	Diversifying the composition and appearance of water.		
7	Enhance landscapes with minimal management	2. B Biophilia Management	
8	Permeable surfaces for rainwater management		
9	Improve natural ventilation and airflow design		
10	Improve daylighting and shade design		
11	Improving windows' views of natural landscapes, such as forests and seascapes, etc.	2.A Visual contact with nature	1- Sensory design
12	Improving windows' views of weather changes, such as sunlight, rain, and snow.		
13	Providing indoor plants for potted planting.		
14	Providing indoor green walls.		
15	Providing visual artwork, such as painting, sculpture, etc.		
16	Natural sound design, such as wind sounds, bird and insect chirping, etc.	2.B Invisible Communication	
17	Aromatic plant design		
18	Urban agriculture, plant touch and tasting activities		

19	Openable window for natural ventilation	2.C Thermal comfort and air flow	2- Biophile environment and performance
20	Control thermal comfort by adjusting air temperature and humidity		
21	Biodynamic building shapes and facades to reduce energy costs	3.A Biomorphic forms and patterns	
22	Biodynamic ornamental design		
23	Designing roof patterns from the natural environment		
24	Choose natural materials such as wood, bamboo, rocks, etc.	3.B Design of natural materials and colors	
25	Choose colors to enhance creative environments.		

their typical wooden sailboats, enjoying the climate effect of the pool.



Fig. 5. Water use in the Luxembourg Gardens in Paris [1].

Below is a brief explanation of the biophilic design strategies included, according to the aspects of biophilic design:

A. The biophilic infrastructure aspect includes biophilic ratio and biophilic management.

Biophilia ratio is the percentage or quantity of natural elements available to users, including the percentage of green space coverage, plant canopy composition, proportion of native species, level of biodiversity, and watershed and its appearance.

Biophilic management measures the quality of elements, such as the extent to which landscapes require minimal management: the availability of permeable surfaces to manage stormwater, the use of natural ventilation and airflow, and the design of daylight and shade. Biophilic infrastructure is more about quality than quantity.

B. The sensory design aspect

includes visual and non-visual communication, thermal comfort, and airflow. Visual connections with nature are among the most obvious approaches to biophilic design and can be achieved through window views of the landscape. Non-visual connections with nature engage other senses, such as natural sound design, aromatic plant design, natural elements, and related artwork. Natural ventilation is another factor that allows people to feel connected to nature.

C. The environmental and biophilic

The performance aspect includes natural shapes, patterns, materials, and colors.

This creates a visual connection with nature, in addition to other benefits such as enhancing creativity. The visual connection with nature is an important strategy in the field of art, given its relative ease of implementation.

Recently, there has been a growing demand for artwork inspired by natural systems, particularly those that combine natural daylight with nature-inspired artwork. Stained glass, designed based on the structure of natural cells, is used as a contemporary artwork in public spaces, as illustrated in the example in Figure 1. It is visually linked to the element of water, reflecting light and weather conditions from above, inviting passersby to touch it, as in the Luxembourg Gardens in Paris in Figure 4. Children and adults spend time floating

VI. GLOBAL BIOPHILIC DESIGN EXAMPLE (AMAZON SPHERES). THE SPHERES" PROJECT IN SEATTLE, USA – NBB_2018

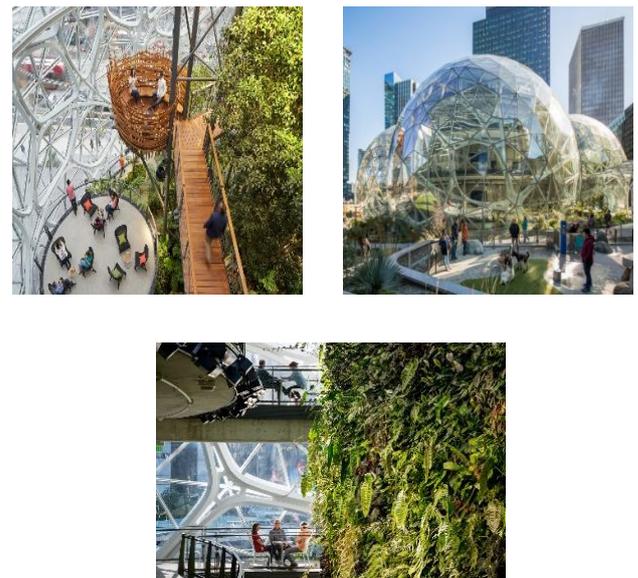


Fig.6. Pictures of the Seattle project (The Spheres)

The Spheres is Amazon's innovative 67,000-square-meter headquarters, designed to be a nature-inspired workspace. It consists of three glass domes containing more than 40,000 plants from 30 countries, with trees, waterfalls, and lush greenery simulating a tropical forest. The goal is to enhance employee creativity and well-being through connection with nature, as well as improve air quality, reduce stress, and increase employee productivity. Located within the geometrically designed headquarters, the "spheres" are a building within a garden and a garden within a building. The plants represent approximately 400 species, some extinct in the wild and others very rare. To select, nurture, and care for the plants, Amazon hired a full-time horticulturalist, Ron

Gagliardo, formerly of the Atlanta Botanical Garden. The plant collection, which will evolve, includes a 55-foot-tall fig tree named Ruby, a 40-foot-tall Australian fern, orchids from Ecuador, and carnivorous pitcher plants.

Waterfalls and a pair of densely planted living walls create a forest feel. To maintain these plants, the spheres' climate is set at 72 degrees Fahrenheit and 60% humidity during the day, then shifts to 55 degrees and 90% humidity at night. The 67,000-square-foot spheres represent only 2% of the Amazon project, but they are a popular gathering place. They are open to Amazon employees and offer a variety of spaces to meet, work, and eat—from a wooden "bird's nest" to terraces with benches and chairs.



Fig. 7. Pictures of the Seattle project (The Spheres)

A. Biophile design elements in the building:

- ❖ Abundant indoor plants: Create an indoor forest environment.
- ❖ Natural lighting: Use clear glass to allow sunlight in.
- ❖ Natural materials: Use wood and stone in interior design.
- ❖ Water: Waterfalls and streams provide soothing natural sounds.



Fig. 8. Interior photos of the Seattle project (The Spheres)

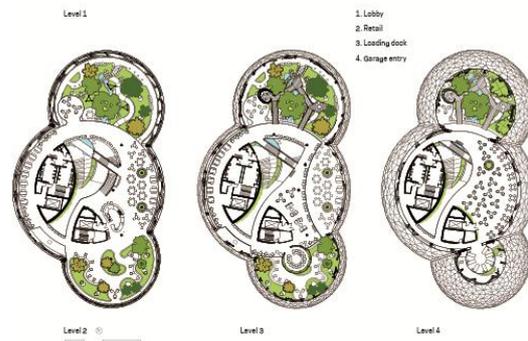
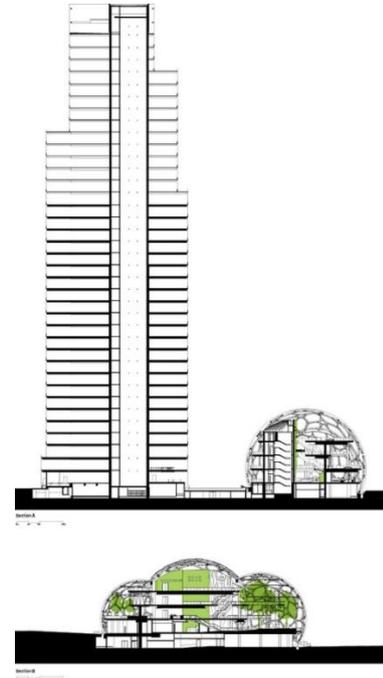


Fig. 9. Architectural plans for the Seattle project (The Spheres)

Table 2. Aspect of Biophilic Design

Strategy	Indicator	Aspect of Biophilic Design
✓ Increase the coverage of green spaces	1	1-A: Biophilia Ratio
✓ Form a plant canopy for shading	2	1-A: Biophilia Ratio
✓ Enhance biodiversity	4	1-A: Biophilia Ratio
✓ Improve daylight and shadow design	10	1-B: Biophilia Management
✓ Provide indoor potted plants	13	2-A: Visual Connection with Nature
✓ Provide indoor green walls	14	2-A: Visual Connection with Nature
✓ Provide visible artwork	15	2-A: Visual Connection with Nature
✓ Design natural sounds (water, wind, etc.)	16	2-B: Non-Visual Connection
✓ Provide partially aromatic plants	17	2-B: Non-Visual Connection
✓ Activities involving touching	18	2-B: Non-Visual Connection

plants & interaction		
✓ Control of thermal comfort and humidity	20	2-C: Thermal Comfort & Airflow
✓ Design facades and forms with biophilic shapes	21	3-A: Biomorphic Forms and Patterns
✓ Nature-inspired ornaments	22	3-A: Biomorphic Forms and Patterns
✓ Patterns and textures from natural environments	23	3-A: Biomorphic Forms and Patterns
✓ Use of natural materials such as wood	24	3-B: Natural Materials and Colors
✓ Select colors that stimulate creativity	25	3-B: Natural Materials and Colors

VII. CONCLUSIONS

The analysis of the studies reveals that biophilic design represents a growing trend that reflects a shift in understanding the relationship between humans and the built environment. However, there is a pressing need to strengthen research methodologies and expand the scope of applied studies within diverse cultural and climatic frameworks. More accurate assessment tools should also be developed to measure the health, psychological, and environmental impacts of biophilic design, supporting its more effective integration into sustainable design strategies and international building standards.

A. Proposed Recommendations

1. Biophilia from an Evolutionary Perspective

- Enhancing Connection with Nature: Nature should be further integrated into daily life, both in urban and

professional settings, to enhance individuals' physical and mental health.

- Leveraging Biophilia in Education and Pedagogy: Biophilia should be integrated into educational curricula to promote interaction with nature from childhood.

- Promoting Environmental Awareness: Raising awareness about the importance of nature in human health through educational campaigns and awareness programs.

2. Biophilic Design in Healthcare

- Better Integration of Indoor Plants: The use of indoor plants in healthcare facility design should be increased to enhance patient well-being and reduce stress.

- Conducting Further Research Studies: Conducting in-depth research to provide more scientific evidence on the health effects of indoor plants and identifying best practices for their application in healthcare.

- Balancing Costs and Benefits: Design strategies should consider the cost while preserving the health benefits of integrating plants and natural environments into healthcare.

3. Shared Spaces and Biodiversity

- Increase green spaces in cities: Expand parks and green spaces to promote social cohesion and the emotional and physical development of city residents.

- Promote biodiversity in the urban environment: Cities must support biodiversity conservation by creating biomes that support diverse fauna and flora.

- Support community projects that include nature: Encourage community projects that utilize nature and enhance the overall well-being of the community.

4. Research Gaps in Biophilic Prison Design

- Integrating biophilia into prisons: Nature-friendly environmental designs should be used in prisons to improve prisoners' mental health and support the rehabilitation process.

- Pilot studies in prison environments: Further research is needed to identify best practices for implementing biophilia in prisons.

- Redesigning prisons to promote well-being: Focusing on creating natural environments within prisons can contribute to reducing violence and improving prisoner well-being.

5. The Effects of Biophilic Design in Restorative Environments

- Providing strategies to reduce stress in work environments: Directing biophilic design toward reducing stress and mental fatigue in places where individuals are exposed to stress, such as workplaces.

- Using natural materials in therapeutic spaces: Encouraging the use of natural materials such as wood, water, and plants to create environments that aid restoration and recovery.

- Supporting long-term research: Research into the long-term effects of biophilic design in diverse settings must be strengthened to ensure its effectiveness in improving public health.

6. Research on Biophilic Design in Urban Construction

- Developing urban environmental strategies: City planners and developers should integrate biophilic design into urban infrastructure to enhance the health of residents.

- Increasing public green spaces: More public green spaces should be allocated to enhance citizen well-being and reduce pollution.

- Continuous research and environmental assessment: Continuing research into how to integrate biophilic design with environmental sustainability in urban buildings and promoting the use of modern technologies to improve environmental performance.

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