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## A CRITICAL ANALYSIS OF BIOPHILIC DESIGN AND APPLICATION OF ITS PRINCIPLES FOR HEALTHIER WORK ENVIRONMENT

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### Abstract

*This paper offers a critical analysis of biophilic design and how it might be used to make workplaces healthier. Biophilic design, which has its roots in Edward O. Wilson's biophilia concept, incorporates natural aspects into the built environment to improve human health, well-being, and productivity. The study delves into the core ideas of biophilic design, such as the significance of naturalistic spatial arrangements and direct and indirect encounters with the natural world. It assesses the physiological and psychological advantages of biophilic design, including lowered stress levels, better memory, and better physical health. The use of biophilic design in the workplace is also covered in this study, with a focus on natural materials, indoor plants, natural light, and water elements. Studies showcasing biophilic design in contemporary workplaces show the benefits for worker productivity and well-being. The analysis also points out obstacles to using biophilic concepts, such as expense, upkeep, and possible change resistance. This study seeks to give a thorough understanding of how biophilic design can be used to produce healthier, more productive work environments by critically evaluating the state of the field and practical applications. In order to improve the human-nature connection in the workplace, the article ends with suggestions for incorporating biophilic features into office design. These emphasise the need of interdisciplinary teamwork and creative problem-solving.*

**Keywords: Biophilic design, workplace health, natural elements, employee well-being, productivity, sustainability.**

### Introduction

With the goal of creating spaces that enhance human well-being and productivity, biophilic design is an innovative technique that incorporates natural elements into constructed surroundings. Biophilic design aims to close the gap between the natural world and contemporary, urbanized living. It is based on the idea of biophilia, which implies an innate human attraction for nature. Recent years have seen a considerable increase in interest in this design concept, especially because of its potential to improve workplace quality of life. According to design professionals and researchers, there are three main pillars of the biophilic design: Nature in the space, nature of the space and Natural analogues. Biophilic designs also play a crucial role in enhancing the well-being and mental health of individuals and also lowering global emissions.

However, individuals are frequently subjected to elevated stress levels and sensory overload in contemporary workplaces, which may exacerbate a range of physical and psychological conditions. These issues can be made worse by traditional office designs, which are typified by artificial lighting, cramped quarters, which restrict the access to natural elements. In

contrast, biophilic design principles offer a holistic solution by incorporating features such as natural light, green spaces, natural materials, and views of nature (Gillis & Gatersleben 2015). These components create a more energizing and healthy work environment in addition to improving aesthetic appeal. By incorporating biophilic designs in our environments, we help in reducing carbon emissions considerably.

The fundamental ideas of biophilic design are examined in this critical examination along with how they might be used to create healthier work environments. The empirical data supporting the advantages of biophilic elements such as better air quality, happier moods, and higher productivities are examined. Additionally, the analysis considers challenges and limitations in implementing biophilic design, including cost, feasibility, and maintenance (Browning, Ryan & Clancy 2014). This study intends to emphasize the significance of incorporating nature into office spaces by examining the effects of biophilic design on workplace health and performance. Lastly, it also stresses the need for workplaces that promote human health and well-being, thereby calling for a paradigm shift in workplace design.

### **Concept of Biophilic design**

The phrase "biophilic design" originates from the term "biophilia," which was first used in the year (1964) to characterize the "love of life" by a social psychologist named Erich Fromm. The phrase described two essential characteristics of living things: their ability to positively integrate with one another and to survive in the face of adversity. The goal of biophilic design is to bring building occupants closer to the natural world. Natural lighting, ventilation, natural landscape elements, and other components are included into biophilically designed buildings to create a more conducive and healthier constructed environment for people. According to Amjad, Asaad and Asaad (2022) biophilic design is a new design approach that aims to connect the occupants of the architectural space in a complementary way with the natural environment so that they become a new living form, in which the modernity of the place and technology is mixed with the magic of nature and its features, which give the place a new psychological and material nature with high symbolism and create a healthier and more productive environment which seeks to optimize the use of the conditions of the place and establishes communication between the user of spaces and the external environment.

In the building business, biophilic design makes use of space and location conditions, direct and indirect nature, and occupant connectivity to the natural world. Due to the belief that biophilic design has minimal negative effects and benefits both building occupants and urban surroundings in terms of health, the concept is used at the building and city-scale. As mentioned by Lopez (2023) biophilic design is a design philosophy that seeks to create buildings and spaces that connect people with nature. Biophilic design is about learning from nature and creating artificial environments that support and revive human biophilic nature by recreating, using, modeling, and extracting nature (Zhao, Zhan, and Xu, 2022). Besides, architecture and "nature" have always been intertwined. Moreover, the aim of biophilic design is to integrate our innate need to connect with nature into the contemporary built environment. Biophilic design in the built environment could be achieved by creating a good habitat for people as a biological organism (animal), in the modern cities and built environment, places where people live, work and reside (Ghazaal, Mohsen, Mohammad, Mohammad, 2021).



Fig 1: Example of biophilic designed buildings



Fig 2: Example of biophilic design buildings

### Concept of Healthy work Environment

An employee's physical workplace is known as their work environment. In contrast, a healthy work environment is one in which employers and employees work together to consistently safeguard and advance workers' wellbeing, safety, and health as well as the sustainability of the workplace. A healthy work environment takes into account employees' physical and mental health as well as their psychological and physical safety. According to Kodarlikar & Umale (2020), a healthy workplace (or environment) boosts' the employees' performance, and ultimately improve their productivity. In addition, a healthy work environment is a wise business decision that nurtures employee engagement through respect, which in turn promotes a high-performing culture that welcomes new ideas and inventiveness. The physical components of a safe working environment directly affect employees' performance, comfort, focus, job satisfaction, and morale in addition to their productivity and safety.

Nonetheless, a stress-free work atmosphere is essential for lowering anxiety, boosting engagement, and boosting employees' physical and mental well-being. Furthermore, a suitable and healthful work environment is also beneficial, as it nurtures enhancements in the physical and mental capacities of employees to carry out their daily tasks. Healthy work environments that are caring and supportive to health professionals, including nurses, within their respective health organizations are vital (Wei et al. 2018 cited in Mabona, Rooyen & Ham-Baloyi, 2022). Effective teamwork, professional autonomy, and effective communication are also essential elements of a positive work environment. Moreover, natural materials and concepts are also included in a healthy work environment to create a setting that promotes the mental, emotional, and physical health of both employers and employees. Through a closer relationship with nature, this environment actively promotes health, happiness, and productivity rather than just being free from injury or disease. On the other hand, biophilic designs create a healthy work environment by utilizing natural light, ventilation, air quality, plants, water features, natural materials, views of the outdoors, organic shapes and forms, sensory diversity, and the integration of indoor and outdoor spaces.

### Principles of biophilic design application

The goal of biophilic design is to improve human health, productivity, and well-being by incorporating natural components into constructed spaces. The implementation of biophilic design is based on the following principles:

**Environmental features:** Biophilic environments frequently incorporate well-known elements of the natural world. A more pleasant visual and tactile experience is produced by elements including flora, water, sunlight, and natural materials. Mackie (2024) explained that the environmental features, means to directly integrate natural elements into built spaces. This idea can be implemented on a variety of scales because it is simple to see how they could be combined.



Fig 3: principles of biophilic design application



Fig 4: principles of biophilic design application

**Natural shapes and forms:** Using forms and shapes found in nature is another aspect of biophilic design. Curves, spirals, arches, and botanical themes are few examples of these elements. However, mimicking or recreating natural forms can create a symbolic and subconscious connection to nature (Monson, 2022).

**Restorative patterns and processes:** According to Kellert (2015), indoor lighting and processed air have been made possible by advances in building technology and construction, as the trade-off, which has often been the occurrence of static conditions that can be physically and psychologically debilitating. However, processed air can also replicate characteristics of natural ventilation through changes in airflow, temperature, humidity, and barometric pressure. Artificial light can likewise be tailored to mirror the spectrum and dynamic features of natural light.

**Light and space:** A key component of biophilic design is daylighting. Interior areas that receive lots of natural light have been shown to enhance mood, increase productivity, and support circadian cycles. The idea suggests diversified illumination in addition to conventional lighting tactics to replicate the way occupants experience light outdoors. The way that individuals use space is another aspect of this principle. Moreover, the natural light, filtered and diffused light, light and shadow, reflected light, warm light, spaciousness, spatial variety, and harmony are among the categories of the light and space principle.

**Place based relationship:** Mackie (2024) further explained that the place-based relationship as a scales out is to look at how we (individuals) relate to our surroundings, and how they influence our design. This idea encompasses the indigenous materials, the direction and aspects of the landscape, the cultural, ecological, historical, and geographic connections, as well as the spirit of the place that one has to connect with in order to feel at ease and at home (comfortable).



Fig 5: principles of biophilic design application

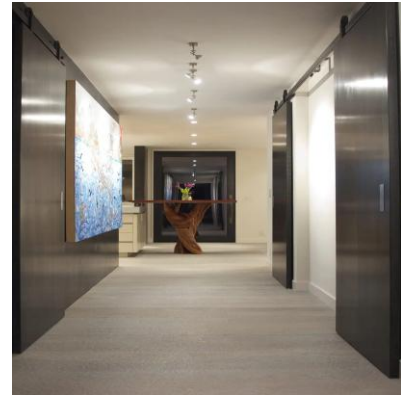


Fig 6: principles of biophilic design application

***Evolved human-nature relationship:*** The evolutionary link with nature and the process of recreating emotions in the constructed environment are the subjects of this principle. The evolution of the human-nature relationship involves designing spaces that appeal to a variety of senses, such as the sound of running water, the smell of plants, and the tactile experience of natural materials. It also involves incorporating natural processes into the design, such as rainwater harvesting systems, green roofs, and living walls that change with time, and using lighting that mimics natural light patterns throughout the day to help regulate circadian rhythms.

### **Sustainable and Eco-friendly (biophilic design)**

Using natural components into green construction concepts, sustainable and eco-friendly designs aim to establish a healthy relationship between residents and their surroundings. In doing so, it can contribute to lowering energy usage, minimizing carbon emissions, enhancing indoor air quality, and fostering a healthier atmosphere. These are the main biophilic designs for an environmentally friendly and sustainable setting:

***Biophilic Design for Healthier Work Environments:*** Biophilic designs include natural features to provide a more sustainable and eco-friendly work environment while also increasing productivity and employee satisfaction. As mentioned by Klotz & Bolino (2021), biophilic designs offers opportunities to increase exposure to nature during work, and aspects such as maximizing natural lighting in offices and including components like water and plants that can benefit workers' cognitive, emotional, and pro-social resources.

***Circular Economy Models in Architectural Design:*** The goal of circular economy models in architecture is to develop sustainable structures that maximize resource efficiency and reduce waste. This method focuses on creating structures and environments that are naturally regenerative, extending the life of materials and resources. Stojkovic, Petkovic, Krstic & Petrovic (2023), the circular economy is the antithesis of the current (so-called linear model of the economy) implies the unrestrained consumption of natural resources and the flow of materials from producer to user to landfill. Nonetheless, this strategy promotes environmental sustainability, innovation, social benefits, and economic efficiency.

***Climate Adaptive Urban Landscapes:*** Urban landscapes that are climate adaptive are created to address the problems brought about by climate change while improving the livability and resilience.

of metropolitan areas. To lessen the effects of climate change, such as rising temperatures, flooding, and extreme weather, these landscapes combine resilient infrastructure, sustainable practices, and natural remedies. However, because they contribute to enhancing public health and creating a sustainable and environmentally friendly environment, these methods include urban greening, permeable surfaces, flood-resistant designs, heat mitigation, integrated water management systems, and many more.

**Off-grid Living Solutions for Sustainable *Communities*:** Sustainable communities that opt for off-grid life prioritize environmental preservation, reduced reliance on centralized infrastructure, and self-sufficiency. This approach makes use of waste management, food production, water management, sustainable building techniques, renewable energy sources, communication, and connectivity in order to create an environmentally friendly and sustainable environment while also enhancing user health and well-being.

**Designing for Air Quality Improvement in Urban Areas:** In order to lower air pollution and improve the health and well-being of urban populations, designing for improved air quality in urban settings entails incorporating a variety of techniques and technology. Furthermore, one environmental issue that is frequently present in metropolitan settings is air pollution. In order to mitigate these air pollutant problems, the use of urban vegetation is often promoted as an effective measure to reduce concentrations and improve air quality (Vos & Janssen, 2013).

### **Sustainable materials for biophilic designs**

The integration of nature into constructed spaces is emphasized by biophilic design, which strengthens the bond between humans and the natural world. Various challenges of sustainable architecture are identified to reflect different design goals, and the benefits of biophilic design are reviewed to investigate the effective design elements (Zhong & Bekkering, 2022). Moreover, biophilic designs are the appropriate instrument needed when looking for healthy, sustainable, and resilient environments (Cacique & Ou, 2022). Using sustainable resources is essential to reaching this objective. The sustainable materials required for biophilic designs are as follows:

**Wood:** Wood comes from factories, barns, and ancient buildings. In addition to adding individuality and a natural appearance to the interiors of the biophilic designs, it helps to minimize deforestation and reduce the demand for new timber.

**Bamboo:** Bamboo grows quickly and is a very renewable resource. It has a minimal carbon footprint and is robust and adaptable for use as structural parts, flooring, and furniture.

**Cork:** Cork is naturally renewable and biodegradable, and it provides great insulation and acoustic properties for a sustainable biophilic design. It is obtained from the bark of cork oak trees without causing harm to the tree.

**Natural Stone:** Because it is locally available to cut down on transportation-related emissions, the natural stone material is a strong and long-lasting material for biophilic designs. On the other hand, it offers a link to the natural world.

**Green Walls and Roofs:** By incorporating live plants into the framework of the building, it enhances biodiversity, lowers heat islands, and improves air quality. Green roofs and walls improve mental health by giving the occupants (individuals) a visual link to the natural world. — .

***Sustainably Sourced Fabrics:*** The sustainably sourced fabrics covers hemp, wool, linen, and organic cotton. Because it is made without dangerous chemicals or pesticides, interior air quality is improved, and the biophilic designs feel more natural.

***Hempcrete:*** Lime is combined with the inner fibers of the hemp plant to make hempcrete. Along with being lightweight, insulating, carbon-negative, and biodegradable, they also contribute a naturally beautiful appearance to biophilic designs.

***Biodegradable Composites:*** They are manufactured using biodegradable resins in combination with natural fibers like jute, hemp, or flax. By using biodegradable composites in furniture, panels, and other uses, the biophilic design is less dependent on petroleum-based resources.

### **Biophilic Design Theory by E. O. Wilson (1984)**

The term "biophilia" was popularized by biologist E.O. Wilson in his book "Biophilia" (1984), where he proposed that "humans have an innate affinity for nature due to our evolutionary history of living in natural environments". This affinity is believed to contribute to our physical and psychological well-being. The Biophilic design theory is a concept that emerged from the observation that humans have an innate connection to nature, and integrating natural elements into built environments can enhance well-being and quality of life (Kellert, Heerwagen & Mador 2018). This design philosophy places a strong emphasis on the value of using components like natural light, plants, and natural materials to create environments that are not only aesthetically pleasing but also beneficial to human health and productivity. This idea is expanded upon by biophilic design, which purposefully incorporates natural aspects into urban and architectural environments. However, research has shown that biophilic design can have significant benefits across various settings. For instance, studies indicate that exposure to natural elements in healthcare facilities can accelerate healing rates and reduce the need for pain medication (Browning, Ryan & Clancy 2014). In terms of the environment, biophilic design encourages sustainability by lowering the ecological footprint of buildings and promoting the use of renewable resources. This design approach emphasizes more sustainable lives and stewardship of the natural world by promoting a closer connection to the natural world.

In order to create places that promote wellbeing and a sense of connection with nature, biophilic design theory incorporates natural elements into man-made habitats. Rooted in the idea "that humans have an innate connection to nature", this design strategy aims to improve productivity, general quality of life, mental and physical health. Using natural elements like plants, light, water features, and natural materials like stone and wood is essential to biophilic design. By leveraging natural ventilation, daylighting strategies, and sustainable materials, biophilic designs can reduce energy consumption and create healthier indoor environments (Beatley, 2011). Furthermore, biophilic design offers significant psychological advantages. Research indicates that being in natural environments can improve one's ability to think clearly, be creative, and focus. By lowering contaminants in the air, indoor plants can enhance air quality and provide a healthier interior atmosphere. Biophilic design seeks to satisfy these inherent adaptations to nature in the modern built environment and, in doing so, enhance people's physical and mental health and fitness.

Natural light, greenery, and natural materials make an office space more pleasant and exciting, which encourages creativity and lowers absenteeism. Human health, well-being, and environmental sustainability are given top priority in architecture and urban planning according to

the notion of biophilic design. The biophilic designs also helps to promote a more positive and healthy interaction between humans and nature.

### **The Strength of the biophilic design theory**

The biophilic design theory has many advantages that make it an appealing method for planning cities and buildings. These include the general quality of life, environmental sustainability, human health and well-being. The following are the strengths of the biophilic design theory:

**Enhanced Well-being:** The capacity of biophilic design to improve human well-being is one of its main advantages. It has been demonstrated that exposure to natural factors including sunlight, greenery, and organic materials lowers blood pressure, improves general mental health, and reduces stress. Indoor settings with biophilic components can encourage rest, creativity, and cognitive function, which can boost occupant satisfaction and productivity.

**Connection to Nature:** Biophilic design incorporates natural features into constructed habitats to promote a closer relationship with the natural world. Because it satisfies individual's intrinsic biophilic tendencies, or liking for nature, which can be traced back to our evolutionary history, this connection is crucial for human psychological and emotional wellness. Biophilic design helps lessen the negative consequences of urbanization and promoting a more harmonious relationship between humans and the natural world by bringing nature closer to people in urban areas.

**Environmental Sustainability:** By promoting the use of renewable resources, minimizing energy consumption through the use of natural lighting and ventilation techniques, and lowering the carbon footprint of buildings, biophilic design supports environmental sustainability. Urban green spaces, living walls, and green roofs not only improve air quality and lessen the effects of urban heat islands, but they also increase biodiversity in urban settings. This environmentally friendly strategy supports international initiatives to reduce climate change and build more resilient cities.

**Health Benefits:** Biophilic design has been associated with increases in physical health in addition to mental health advantages. For instance, having access to natural light promotes improved sleep and general wellness by regulating circadian cycles. By eliminating dangerous chemicals from the air, indoor plants can filter the air and improve indoor air quality. By incorporating biophilic concepts, hospitals and other healthcare institutions have observed quicker patient recoveries and less patient stress, highlighting the therapeutic value of nature in restorative settings.

**Cultural and Aesthetic Appeal:** By showcasing natural shapes, textures, and patterns, biophilic design enhances cultural and aesthetic experiences. It supports creative design that blends in with regional ecosystems and cultural settings, creating a feeling of place and identity. Urban designers and architects can create aesthetically pleasing and culturally significant locations that are relevant to both locals and tourists by incorporating biophilic aspects into their designs.

### **The Weakness of the biophilic design theory**

Although biophilic design theory has many advantages, it also has a number of weaknesses and difficulties that may affect how well it is applied. They include:

**Cost Considerations:** The possible expense of biophilic design is one of its main obstacles. When compared to traditional building materials and systems, incorporating natural components like green roofs, elaborate natural lighting systems, or high-quality natural materials might be more



expensive up front. This cost barrier may deter developers and homeowners from adopting biophilic design principles, especially in economically constrained environments (Kellert et al, 2018)

**Maintenance Requirements:** Plants and water features which are the two examples of natural elements incorporated into buildings need constant upkeep to survive and continue to function. To guarantee the longevity and well-being of these components, routine irrigation, trimming, and pest management are required. Biophilic features could deteriorate over time or stop providing the desired benefits if they are not properly maintained, which could make people lose faith in the strategy.

**Design Integration Challenges:** It is frequently necessary to carefully integrate engineering and architecture with biophilic design. During the design stage, meticulous planning and coordination are necessary to achieve the best possible daylighting, ventilation, and thermal comfort using natural methods. Balancing biophilic principles with other design factors like structural soundness, building rules, and energy efficiency needs can present technical hurdles for designers and architects.

**Climate and Context Sensitivity:** It is possible that the concepts of biophilic design are not always transferable to other environments and climates. For instance, keeping indoor plants alive in dry climates could need a lot of water, which goes against the objectives of sustainability. Customized methods that take into account the local climate, ecology, and community demands are necessary to adapt biophilic tactics to a variety of environmental circumstances and cultural preferences.

**Long-term Effectiveness Studies:** Although the benefits of biophilic design on human health and well-being are becoming more widely supported, more long-term research are required to evaluate these benefits. Comprehending the long-term behavior of biophilic materials in various environments and temperatures might yield important information about how best to optimize design approaches and mitigate drawbacks.

### **How does biophilic design improve health?**

To promote a relationship between humans and environment, biophilic design incorporates natural aspects into constructed habitats. This method is becoming more widely acknowledged for its capacity to enhance social, emotional, and physical well-being. However, the following are some ways that biophilic design enhances health:

**Physical Health Benefits:** Natural light exposure and visual connection with nature is essential because it balances circadian rhythms, improve heart rate and lowers blood pressure which improves sleep quality and general health. By lowering pollutants and raising oxygen levels, adding plants and greenery to indoor spaces can help enhance air quality. Zhao, Zhan and Xu (2022) mentioned that nature has long been discussed to have a therapeutic effect on physical and mental health of individuals.

**Mental Health Benefits:** Biophilic design improves mental health engagement, attentiveness, positive impact attitude, overall happiness and lowers stress, which has a substantial positive effect on mental health. Natural components that are present, such plants and water features, can have a relaxing impact and lessen anxiety. A study by Lee et al. (2015) demonstrated that individuals who spent time in environments with natural elements reported lower levels of stress and higher levels of overall well-being (Lee et al. 2015). Furthermore, studies have shown a correlation between enhanced cognitive performance and productivity with views of nature, whether through windows

or indoor gardens. Research by Browning et al. (2014) suggests that biophilic environments can enhance attention and memory, leading to better performance in tasks requiring concentration. Biophilic architecture has a significant impact on sustainability, ecology, and human health. Natural settings, such as gardens and parks, have been demonstrated in studies to assist people manage stress and satisfy other non-stressful needs. Psychosomatic research has shown that effect of the natural view holds the viewers' concentration, deprives them of their self-awareness, and thus improves health (Sahu and Jha, 2021).

**Social Benefits:** Biophilic design also supports social engagement and community well-being. Natural surroundings and green areas encourage social activities and interactions, contributing to a sense of community and social cohesiveness. A study by Holt-Lunstad et al. (2015) found that individuals with stronger social connections have a 50% increased likelihood of survival, emphasizing the importance of social interactions in health (Holt-Lunstad et al., 2015).

## Conclusion

Biophilic design occurs as a transformative approach for creating healthier work environments by integrating natural elements that enhance well-being and productivity. The principles of biophilic design, supported by empirical evidence, demonstrate significant benefits such as improved air quality, mood, and workplace performance. Despite challenges in implementation, including cost and feasibility, the potential gains in employee health and satisfaction make it a valuable investment. Advocating for the widespread adoption of biophilic design in office spaces is essential for nurturing environments that prioritize human health and well-being, ultimately leading to more productive and fulfilling work experiences.

## Recommendation

1. It is advisable to begin with a clear definition of biophilic design and its principles and explore its origins and how it integrates nature into built environments.
2. Analyzing recent publications and case studies that highlight successful implementations of biophilic principles in workspaces is encouraged.
3. It is advisable to explore the impact of biophilic design on stress reduction, mood enhancement, and overall mental well-being.

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