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# Integration of Biophilic Design to Promote Occupants' Wellness

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**Abstract: Urban built environments are increasingly associated with physical and psychological health challenges, often linked to limited interaction with natural systems. This study examines the role of biophilic design in enhancing the physical, psychological, and social wellbeing of occupants in urban contexts. Anchored in the Biophilia Hypothesis and Attention Restoration Theory, the research integrates insights from environmental psychology, public health, and architecture to explore how nature-based design strategies foster restorative experiences. A qualitative analysis of selected case studies and established biophilic design frameworks was conducted to identify core design principles that support wellbeing. The findings indicate that incorporating these strategies significantly improves indoor environmental quality, reduces stress, enhances cognitive functioning, and strengthens social interaction among occupants. The study further emphasizes the need to adapt biophilic interventions to local climatic conditions and cultural contexts to ensure effective and sustainable outcomes. By bridging theory and practical design application, this research contributes to the growing discourse on sustainable architecture and provides actionable guidance for architects, planners, and policymakers seeking to develop healthier urban environments.**

***Keywords:*** *Fenestration, Biomorphic Pattern, Sustainable Architecture, Buffer System, Indigenous Architecture, Neuroscience.*

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## I. INTRODUCTION

Rapid urbanization has led to a significant detachment between human populations and natural systems, as individuals in densely populated cities often remain indoors for about 80-90% of their time. (Lehmann, 2021). This indoor nature, characterized by physical presence of nature in a building like indoor plants, daylight reflections, water features like pool or fountain. Indirect nature that is stimulated or practical representation of nature like building finishes, its textures, biomSorphic patterns like organic curves, leaves shapes, artwork and landscape and spatial elements defines how emotionally responsive people are in a built environment. The concept of biophilic design, rooted in Edward O. Wilson's Biophilia Hypothesis among others, suggests that humans have a weaved in affinity for nature, advocating for built environments that extend rather than oppose ecological experiences. Despite this, modern architecture often prioritizes economic and efficiency factors over the psychological and physiological health of occupants.

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Hence, the research on integrating biophilic principles is vital for enhancing occupant wellness across physical, psychological, and social dimensions.

Table 1. Impacts of Biophilic Elements on Human Wellness.

| Biophilic Element | Psychological Effect | Wellness Outcome |
|---|---|---|
| Natural Light | Regulates mood | Deduces depression |
| Indoor Plants | Buffers stress | Low blood pressure |
| Natural Material | Sensory grounding | Creates emotional comfort |
| Water Features | Cognitive restoration | Improved cognitive performance |
| Biomorphic pattern | Encourages familiarity | Creates calmness |

## II. BIOPHILIC DESIGN

Biophilic is derived from the term ***"biophili"'*** and popularized by Edward O. Wilson which refers to the intrinsic human inclination to connect with nature and other living organisms. (Zhong, Schröder, & Bekkering, 2021). It essentially signifies the incorporation of nature into human environments to enhance overall well-being, by inherent human desire to link with nature and living things. (Gaekwad, Moslehian, Roös, & Walker, 2022).

Biophilic design is an approach to buildings which proposes reconnection of people with nature to support healthy responsiveness, and environmental performance. (Karaçar, 2025). It goes far beyond adding plants, aiming to embed natural elements, processes, and place-based meaning into everyday spaces. (Richardson, & Butler, 2021), this requires direct natural elements like plants, water, and sunlight, as well as indirect elements like natural materials, colors, and fractal patterns to be used to inspire spatial qualities for usage.

The tropical climate of Nigeria makes factors such as high heat gain, harmattan winds, urban heat islands, and flood vulnerability. This necessitates for effective biophilic strategies include cross ventilation, shaded spaces, vegetative buffer systems and water-sensitive urban design, (Aduwo, & Akinwole, 2020). Indigenous architecture, seen in traditional architecture naturally incorporates principles through passive cooling and the use of local materials, emphasizing the theoretical re-articulation of indigenous ecological intelligence in contemporary biophilic design practices.

## III. THEORETICAL WELLNESS INTEGRATION MODEL

➢ *Edward O. Wilson's Biophilia Hypothesis*

Edward O. Wilson proposed the Biophilia Hypothesis in 1984 to explain humans' innate connection with nature.

Through the hypothesis also known as the theoretical framework of biophilic design, humans have an inherent psychological need to affiliate with living systems and environmental psychology suggests that exposure to these natural settings reduces stress, improves attention, and fosters emotional balance. Biophilia therefore provides the theoretical grounding for understanding why nature-oriented environments evoke measurable wellbeing outcomes.

According to Tidball (2012), humans evolved in natural settlements, by genetically predisposed to respond positively to and recognizing fertile land, plants, animals, safe environments, etc., the exposure to stress, improves cognitive performance, rapid urbanization and technology, and enhanced mood, and all affects the overall of wellbeing.

➢ *Attention Restoration Theory (ART)*

Attention Restoration Theory (ART), was formulated by Stephen Kaplan and Rachel Kaplan and elucidates how natural environments facilitate the recovery of depleted cognitive resources. Rooted in cognitive psychology, ART differentiates between directed attention that is effortful concentration essential for tasks like studying and problem-solving and involuntary attention, which engages effortlessly in pleasant environments. Prolonged reliance on directed attention can result in attention fatigue, manifesting as irritability, diminished focus, and decreased task performance.

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(Stack, & Shultis, 2013). This means that ART posits that natural environments offer restorative experiences that replenish directed attention, reducing mental fatigue.

➢ *Stress Reduction Theory (SRT)*

Stress Reduction Theory (SRT), developed by Roger Ulrich, emphasizes the physiological and emotional recovery associated with exposure to natural environments, in contrast to ART, which focuses on cognitive recovery. Rooted in evolutionary biology, SRT tells that human evolved in natural settings, responding positively to natural stimuli that indicate safety and survival. This interaction activates the parasympathetic nervous system, leading to relaxation and stress recovery. (Falk, D. A., Zedler, & Palmer, 2016).

Physiological benefits of interaction with nature include lower blood pressure, reduced heart rate, decreased cortisol levels, improved muscle relaxation, and diminished sympathetic nervous system activation. Ulrich's research, particularly a hospital study showing faster recovery rates for patients with views of nature versus brick walls, provides empirical support for the health advantages of nature exposure.

On an emotional and psychological level, SRT suggests that natural environments foster positive emotions, reduce anxiety, enhance mood, and promote emotional stability. Individuals tend to unconsciously appraise their surroundings, often finding natural settings more beneficial, in contrast to the stress-inducing features of urban landscapes.

Architectural designs informed by SRT advocate for elements such as visual access to greenery, water features, natural materials, organic shapes, and minimized sensory overload. In healthcare, this translates into designs like healing gardens and optimal patient-room placements, while in residential and workplace settings, it encourages environmental strategies that mitigate stress.

## IV. DIMENSIONS OF OCCUPANT WELLNESS

This means the physical, psychological, social, and environmental aspects in defining what affects users' health and comfort in the society. These includes;

➢ *Physical and Environmental Balance*

This dimension concerns the reciprocal relationship between the human body and its surrounding environment, emphasizing physiological stability, ecological quality, and spatial conditions that sustain life (Mewomo, Toyin, Iyiola, & Aluko, 2023).

- Physical Health Parameters: It emphasizes measurable aspects of physical health, including cardiovascular efficiency, respiratory function, musculoskeletal integrity, sleep regulation, and immune resilience. Also, environmental factors like air quality, lighting, thermal comfort, and noise levels are significantly known to impact these bodily systems. Poor environmental conditions can lead to stress, fatigue, and chronic illnesses.
- Environmental Quality and Ecological Integrity: This highlights the importance of access to clean air, safe drinking water, and green spaces while minimizing exposure to toxins.
- Safety and Risk Mitigation: It focuses on the necessity of physically supportive environment that reduces hazards through design. Design strategies such as adequate lighting, ergonomic design, and organized circulation patterns are essential for preventing injuries and ensuring occupant safety, enhancing their sense of security and physical comfort.
- Adaptive Environmental Control: The ability for occupants to control environmental elements; examples, like temperature, fenestration, and ventilation improves comfort and well-being. This dimension allows individuals to adjust their surroundings according to personal preferences, helping to mitigate stress and promote overall bodily equilibrium.

➢ *Health and Well-Being*

This is the holistic integration of physical, psychological, and emotional equilibrium in building. (Colenberg, Jylhä, & Arkesteijn, 2020). This is done by;

- Holistic Health Integration: Health is multidimensional, it means that it includes physical fitness, mental clarity, emotional stability, and spiritual balance.
- Preventive and Restorative Capacity: Well-being includes access to healthcare services, preventive health strategies like nutrition, exercise, restorative sleep, stress reduction, and supportive environments, and restorative environments that promote healing.

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- Psychological Stability: Mental health components include resilience, emotional regulation, reduced anxiety, and cognitive functioning. Environmental stressors such as overcrowding, noise, or poor lighting negatively affect psychological well-being. Conversely, environments that support autonomy and calmness improve mental resilience.
- Functional Performance: Health and well-being influence productivity, concentration, creativity, and daily functioning. Healthy individuals demonstrate higher engagement levels, better decision-making capacity, and improved energy levels.

➢ *Comfort and Satisfaction*

This dimension addresses subjective perceptions of ease, pleasure, and fulfillment derived from one's environment and life conditions. (Awada, Becerik-Gerber, White, Hoque, O'Neill, Pedrielli, Wen, & Wu, 2021). It is done by;

- Thermal, Visual, and Acoustic Comfort: Comfort includes optimal temperature ranges, appropriate humidity, glare-free lighting, and acceptable noise levels. Excessive noise can elevate cortisol levels, while thermal discomfort can impair concentration, Visual comfort through daylighting enhances mood and cognitive performance.
- Ergonomic Suitability: Ergonomics relates to how well furniture, equipment, and spatial dimensions align with human anthropometry and biomechanics. Proper ergonomic design prevents musculoskeletal disorders and enhances long-term comfort.
- Emotional and Aesthetic Satisfaction: Aesthetic quality, compact spaces, color psychology, and landscaping significantly influence satisfaction. A meaningfully planned environment evokes positive emotional responses and fosters inclusiveness.
- Perceived Control and Personalization: This is the autonomy in modifying surroundings to enhance psychological comfort and reinforces identity expression. Satisfaction increases when individuals can personalize and control their spaces.

➢ *Social, Organized, and Behavioral*

This dimension examines the structural and relational aspects of wellness. (Marzban, Candido, Avazpour, Mackey, Zhang, Engelen, & Tjondronegoro, 2023). That is, how social systems, institutional organization, and behavioral patterns influence individual and collective well-being.

This is achieved through;

- Social Connectivity and Support: Strong interpersonal relationships contribute to reduced stress, increased longevity, and emotional security. Social wellness includes belongingness, trust, and communal interaction. Spatial design that fosters interaction enhances social capital.
- Organizational Structure and Institutional Support: Workplaces, educational institutions, and community systems influence wellness through policies, culture, and resource allocation. Transparent governance, equitable opportunities, and supportive leadership structures promote psychological safety and motivation.
- Behavioral Patterns and Lifestyle Choices: Habits such as physical activity, diet, sleep hygiene, and social engagement shape wellness outcomes. Environmental cues (walkable layouts, accessible recreational spaces) influence positive behavioral adoption.
- Cultural and Ethical Context: Social norms, cultural identity, and ethical frameworks shape wellness perception. Inclusive environments that respect diversity enhance dignity and social harmony.

## V. DESIGN STRATEGIES FOR INTEGRATING BIOPHILIC ELEMENTS

Integrated biophilic design requires strategic planning:

- Daylighting and Views: maximize access to natural light and outdoor vistas.
- Indoor Vegetation: vertical gardens and living walls that improve air quality and human comfort.
- Water Elements: fountains and reflective water to stimulate auditory and visual senses.
- Natural Materials: use of wood, stone, and tactile surfaces linked to nature's textures
- Spatial Sequencing: circulation and refuge points that evoke exploration and comfort.

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## VI. MEASUREMENT APPROACHES OF WELLNESS OUTCOMES

This includes:

- Post-Occupancy Evaluations (POE): This is the gathering of users' feedback on comfort and satisfaction.
- Physiological Metrics: This is the checking of heart rate variability, cortisol levels, and biometric indicators.
- Indoor Environmental Quality Data: This is the measurement of light levels, air quality, thermal comfort indexes.

## VII. IMPLEMENTATION BARRIERS ON BIOPHILIC DESIGN ON OCCUPANTS WELLNESS

The challenges biophilic design faces include:

- Its high-cost implications and maintenance demand.
- Climate limitations across different cities in the country.
- Cultural perceptions and acceptance differ in different parts of Nigeria.

## VIII. CONCLUSION

This article has critically examined the importance of biophilic design in architecture as a strategic approach to enhancing occupants' wellness within built environments.

The findings demonstrate that integrating natural elements such as daylight optimization, natural ventilation, vegetation, water features, biomorphic forms, and material authenticity significantly improves physical health parameters, psychological restoration, productivity, and social wellbeing. Beyond aesthetic enrichment, biophilic design functions as a performance-driven architectural strategy that reduces stress hormones, enhances concentration, supports immune resilience, and promotes overall environmental satisfaction.

Importantly, the study concludes that biophilic architecture is a regenerative design paradigm capable of addressing contemporary challenges such as urban stress due to rapid urban growth, climate responsiveness, and declining occupant wellbeing in dense metropolitan contexts. Therefore, embedding biophilic principles into architectural theory, policy frameworks, and professional practice is essential for creating restorative, resilient, and human-centered environments.

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