

# Biophilic Architectural Design Approach: Holistic Way Towards Sustainability

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**Abstract** - Architectural design process needs to be human-centric as well as design-centric. It sets the impression on the perceiver, expressing the type of use within, demand & cultural background of the society in a particular period of time and also provides sensory pleasures.

In this modern era effects of human activity in terms of architectural design & development in construction impose major stress on ecological systems. This paper is about rethinking the designs of buildings with a holistic perspective considering biophilic co-evolution between human and nature to achieve synergy and symbiosis between the built and the natural environment, beyond technocrats' regulations or human - machine system interaction.

The paper also discusses about the challenges and opportunities in adopting a biophilic architectural approach, including design complexity, cost considerations, and regulatory frameworks. It insists for architectural thinking towards a more ecocentric and human-centered approach that prioritizes sustainability, resilience, and symbiosis with nature.

By synthesizing the practical examples, and critical analysis, this paper aims to contribute to the discourse on biophilic design's role in shaping resilient and regenerative built environments, offering insights for architects, designers, policymakers, and stakeholders involved in creating sustainable urban landscapes.

The paper delves in to how architectural designs of building should tackle the bigger problem of rising urban temperatures benefiting both the indoor & outdoor public sphere and public health. It emphasizes using vernacular and sustainable materials, adapting them to environmental and technological shifts for better performance.

**Key Words:** Biophilic Design<sup>1</sup>, Sustainability<sup>2</sup>, Biomimicry<sup>3</sup> Ecoliteracy<sup>4</sup> etc ...

## 1. INTRODUCTION

Humans have a mutual biological relationship with the natural world that was built over the years of living in the nature's traditional settings. It is also experienced that humans tend to work, learn more efficiently, easily in

structures closely knit with nature. Integrating elements of nature into the built environment by direct or indirect process has been observed to reduce stress, blood pressure levels and heart rates, while also increasing productivity, creativity, and wellbeing rates.

The integrated approach to design and architecture that prioritizes environmental sustainability and human well-being & which satisfy the needs of the humans to experience nature in the built environment proves more effective because it considers the interconnectedness of human activities with the environment, leading to solutions that are sustainable.

### 1.1 Understanding the Key Aspects of Integrated Approach Of Design

The main key aspects to achieve these type of designs are Biomimicry, Biophilia, Eco-literacy & adopting Sustainability in design.

In Biomimicry designer mimics the natural systems for integrated design, whereas in Biophilia designer tries to affiliate with Nature.

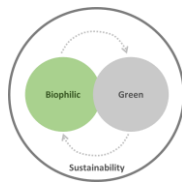
The basic elements like natural lighting, ventilation, landscapes, natural Materials, and other experiences of the natural world, when incorporated into the built environment the design is an extension of biophilia.

Biophilic architecture consists of spaces areas that grow together with green by protecting the biodiversity of their natural areas. Spaces designed with biophilic concept gives enhanced sensory contact with natural forms and materials & visual experience.

Biophilia, first introduced by social psychologist Eric Fromm in "The Heart of Man" (1964), gained widespread recognition through biologist Edward Wilson's book "Biophilia" (1984). Since then, it has permeated diverse disciplines like biology, psychology, neuroscience, and architecture. At its core, biophilia represents the innate human desire for a profound connection or reconnection with nature and its complex systems

**1.2 Basic Fundamental Principles For Biophilic Design:**

- Biophilic design requires constant, repeated & sustainable engagement with nature.
- Biophilic design focuses on human adaptations to the natural world that over evolutionary time have advanced people’s health, fitness and wellbeing.
- Biophilic design promotes positive interactions between people and nature that encourage an expanded sense of relationship and responsibility for coevolution of the human and nature. be used. Other font types may be used if needed for special purposes.



**Fig -1:** Interconnection of Biophilic , Green & Sustainability

**2. Biophilic Design Categories**

Three kinds of experience of nature represent the basic categories of biophilic design framework. These include

- the direct experience of nature, the indirect experience of nature, and the experience of space and place.

The direct experience of nature refers to actual contact with environmental features in the built environment including natural light, air, plants, animals, water, landscapes, and others that will be described.

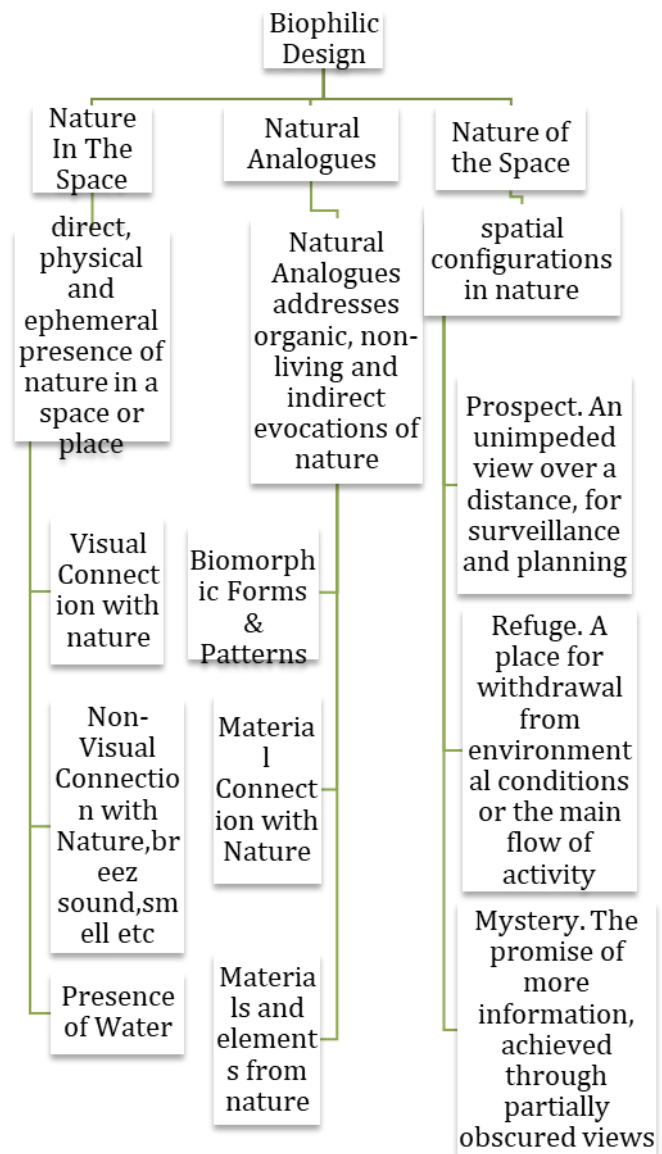
- The indirect experience of nature refers to contact with the representation or image of nature, the transformation of nature from its original condition, or exposure to particular patterns and processes characteristic of the natural world. These include pictures and artwork, natural materials such as wood furnishings and woolen fabrics, ornamentation inspired by shapes and forms occurring in nature, or environmental processes that have been important in human evolution such as aging and the passage of time, information richness, natural geometries, and others

- The experience of space and place refers to spatial features characteristic of the natural environment that have advanced human health and wellbeing. Experience can be in the form of prospect, peril & mystery.

- Conceive spaces with two complementary characteristics: open views/vistas (prospect), and under shelters/safe environments (refuge) Achieved inside and outside experiences through window vi

- Generate ‘peril’ using cantilevers, infinity edges, transparent facades, pathways under/over water, scenes defying gravity, etc.
- Create ‘mystery’ through winding paths, translucent materials, imperceptible sound sources, obscuring/curving the edges, etc

**Table -1: Biophilic design categories**



**Bio-philic designs framework & it’s Perception & Visual Experience:**

The perception of space is directly linked to the way biophilic design framework integrates with it. As per the category and framework of biophilic design it encompasses various elements such as plant life, water, animals, as well as sensory experiences like breezes, sounds, and scents. Examples range from potted plants and bird feeders to water

features and green walls. Different atmospheres can be perceived in the same physical environment. These elements contributes to the **layout of spaces** as a component of significance and therefore plays an important role in the discussion of performance in architecture

Integrating biophilic framework in design is considered positive, adding spatial qualities to the architectural artifact, we can see and specifically perceive spaces, sizes, form, depth and length.

**Biophilic Design Elements in Design & it's perception it's Visual Experience**

Natural lighting & ventilation:

**Fig -2: Visual Connection To The Natural Elements:**

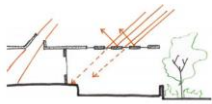


A space with good visual connection to the natural elements directly or indirectly grabs one's attention and stimulates the process of calming.

Creating connections in the structure and the ecological, and cultural characteristics of the place always improves the comfort and performance of the people occupying those spaces

Non-Visual Connection with Nature, Air breeze, sound, smell etc

**Fig -3: Integrating Dynamic & Diffused Light in design**



Integration between the light, program, and mass. Transitions between the open and semi-open spaces. Use of direct sunlight penetrating through high windows and other lighting features can evoke a sense of being in the natural settings

Presence of Water: Artificial features like water wall, fountains, simulations, and the natural features such as streams, ponds, wetlands & rainfall .

**Fig -4: Integrating presence of water**



should be given visual as well as non-visual access.

Nature in space: water, air, light, landscape, weather, fire

To create a feel of movement over stagnancy.

A condition that enhances the experience of a place through seeing, hearing or touching water.

Incorporating water features creates soothing and cooling effects

Use of natural Materials:

**Fig -5: Integrating Material Connections with Nature**



Integrate development with growth

Place based relationship

Vernacular Materials: Use local materials and construction techniques

Material reflect the local ecology as well as the geology to create a familiar streetscape for the people.

Each place has its own uniqueness that can be enhanced or translated to the people using materials.

Nature in the Space emphasizes the tangible and fleeting existence of nature within a given environment.





Meaningful connections with these natural elements are key to enhancing the Nature in the Space experience. This can be achieved through diversity, movement, and multi-sensory interactions, fostering a deeper engagement with the surrounding environment

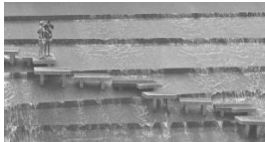


Landscape , Green Spaces and Parks:

**Fig -6: Integrating landscape, green spaces & parks**



Integrate well-maintained green areas for relaxation and community gatherings

Natural Analogues: forms ,shapes, geometry material connection	Pedestrian Infrastructure, Shade and Shelter , Transportation CommunityEngagement  <b>Fig -7: Integrating shade, shelter in design</b>  Design streets and sidewalks to prioritize pedestrians.  Use shading elements and outdoor seating for comfort  <ul style="list-style-type: none"> <li>Promote walking and cycling with dedicated lanes and bike-sharing programs, Involve residents in planning and maintenance</li> </ul> Adopt to changing conditions,Human nature relationship:
	Biomorphic Forms & Patterns  <b>Fig -8: Biomorphic forms &amp; patterns</b>   Biomorphic Forms & Patterns Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.
	Material Connection with Nature  <b>Fig -9: Integrating natural materials in design</b>   Material Connection with NatureMaterial and elements from nature that, through minimal processing, reflect the local ecology or geology to create a distinct sense of place.
	Complexity & OrderRich sensory information that adheres to a spatial hierarchy similar to those encountered in nature  Natural Analogues: Materials and elements from nature  <b>Fig -10: designing with natural complexity &amp; order</b> 

Nature of the Space	Complexity & Order Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature  spatial configurations in nature:  <b>Fig11Design integrating with complementary characteristic</b>  Prospect:An unimpeded view over a distance for surveillance and planning.  Conceive spaces with two complementary characteristics: open views/vistas (prospect), and under shelters/safe environments (refuge)
	<b>Fig12:Design with peril</b>  Risk/Peril An identifiable threat coupled with a reliable safeguard. Generate 'peril' using cantilevers, infinity edges, transparent facades, pathways under/over water, scenes defying gravity, etc  MysteryThe promise of more information achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.  'mystery'in design can be achieved through winding paths, translucent materials, imperceptible sound sources, obscuring/curving the edges, etc..
	<b>Fig13:Design with refuge</b>  RefugeA place for withdrawal, from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.

A few case study examples showing characteristics and effective use of **Biophilic framework in Architectural Design.**

Project Details

Creating focus :Project name: Pantheon Location: Rome,Slit Provision



Fig14:Pantheon

Recalling Feelings: Project Name: Church Of Light, Location: Baraki, Japan, Architect: Tadao Ando.



Fig15:Church of light

Perception of Space:Project name: Hall Of Nations,New Delhi.Architect: Raj Rewal.

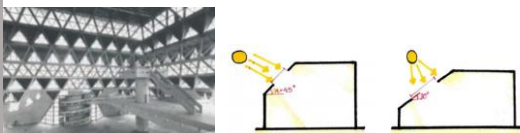


Fig16:Hall of Nations , Side Angled Lighting Technique Roofing

Reflection: Project Name: Kimbell Art Museum Piano Pavilion Location: Tex Renzo Piano USA

Architect: Louis I Kahn.



Fig17:Kimbell art Museum

Texture:Overhang Method Salk Institute Location: Texas, Architect:Louis I. khan



Fig18:Salk institute

Shadow : top lighting creepers screening

Project Name: Indian Institute of Management Location: Bengaluru,Architect: Balkrishna Doshi.



Fig19:IIM Bangalore

Eco Skyscraper by Vikas Pawar: Eco Skyscraper would be a full fledged vertical community that makes use of renewable sources like the wind and sun for power.

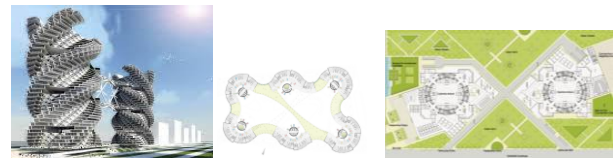


Fig20:Eco sky scrapper

**Impact of Incorporating Biophilic Design Framework on Outdoor & Indoor Environment:**

**Resilience to** withstand and adapt to climate change is more as structures are designed by incorporating & with the understanding of nature .

**Health and Well-being of the users can be achieved due to** biophilic elements such as improved indoor air quality, access to natural light, and spaces that promote physical activity and connection with nature

**Long-term Cost Savings:** Sometimes upfront costs for these type of designs may be higher but the long-term cost savings can be significant.

**Environmental Impact** can be minimized by using sustainable materials, reducing energy consumption, and considering the lifecycle of products and buildings. This approach helps in conserving natural resources and reducing pollution and waste generation

**Aesthetic Value:** Integrating natural elements into architecture and urban design enhances the aesthetic appeal of the built environment. Green spaces, water features, and natural materials create visually pleasing surroundings that can improve the overall attractiveness of cities and communities.

**Economic Advantages:** Investing in green infrastructure and sustainable design practices can result in long-term cost

savings. Energy-efficient buildings, for example, require less energy for heating and cooling, leading to reduced utility bills. Additionally, green spaces can increase property values and attract businesses and tourists to an area.

**Biodiversity Preservation;** Incorporating natural habitats within urban areas supports local biodiversity. Green spaces provide habitats for plants, animals, and insects, helping to maintain ecological balance and support native species.

**Regenerative Potential:** Ecocentric design goes beyond sustainability to embrace regenerative principles. This means designing in a way that restores and enhances ecosystems, rather than just minimizing harm. For example, using green infrastructure like rain gardens can help manage storm water while supporting biodiversity. The idea of regenerative sustainability – one that promotes systems resilience and adaptive capacity – reflects an eco-centric view.

**Community Benefits:** Eco centric design can have positive impacts on communities as well. Green spaces and sustainable transportation options can improve quality of life, promote social interaction, and contribute to a sense of place and belonging

#### **Biophilic Architecture & Sustainability:**

The nature of contemporary architecture with critical uncertainties can be very well resolved if we understand and find joint-solutions, that benefit both social systems and ecosystems. This can be achieved by understanding the role of ecological literacy & Biophilic design, also the way built mass & nature exchange energy, resources, the user's relationship as part of building performance & Evaluation etc.

The main challenges of these type of architecture rest with how designers navigate the multiple interfaces between nature, occupants and built form.

For minimizing the carbon footprint & Creating the comfortable outdoor areas for sustainable, resilient, and livable communities through building design involves strategies like integrating green spaces and urban parks, green roofs, rainwater harvesting systems, and natural ventilation, prioritizing pedestrian-friendly infrastructure, promoting active transportation, incorporating shade and shelter design, utilizing water features for urban cooling.

#### **Conclusion**

Biophilic design considers the interconnectedness of human activities with the environment, leading to solutions that are not only sustainable but also beneficial for people and the planet in the long run. This design approach has a more sustainable future as it helps to conserve natural resources, reduce pollution, minimize negative environmental impacts

and minimize waste generation, encourage regenerative forms of sustainability, and identify opportunities for energy, resources and information exchange among the building, user, and context.

The Need of the day is Architects, engineers, biologists, and designers should form interdisciplinary teams that breathe life into projects by integrating scientific insights with innovative design concepts.

These partnerships will foster creativity and deliver solutions which not only align with the principles of sustainability but will set the stage for groundbreaking ventures and industry recognition. Working in teams instead of silos will also allows for cross-design practices that allow the entire vision to embed with, and within nature .

With this sustainable & holistic biophilic architecture design approach, we can achieve synergy and symbiosis between the built environment and the natural environment.

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