
Biophilic Design in Green Buildings

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Abstract

The significant displacement of populations worldwide is continually creating a greater separation between humanity and the natural environment. This phenomenon has resulted in various negative impacts on the global ecosystem. The development of sustainable architecture and green buildings highlights the environmental impact of buildings through the implementation of strategies such as energy conservation, utilization of modern technology, and reduction of water consumption. However, to ensure long-term sustainability, the biophilic design must also be incorporated to establish a spiritual connection between the users and the buildings. The concept of biophilic design relates to the influence of natural elements on human beings. The many advantages of biophilic design, including stress reduction, enhanced well-being and productivity, heightened sense of tranquility, and improved concentration and relaxation, make it the most suitable design to be implemented. This study employs an extensive literature review methodology and utilizes photographic illustrations from various examples in order to explain the importance of biophilic design. Additionally, the study provides a brief introduction to the biophilic design models.

Keywords

Biophilic Design. Biophilic Design Models. Green Buildings. Sustainable Architecture. Biophilic Design Principles.

1. Introduction

The rapid expansion of cities worldwide caused the construction of new buildings, which has resulted in environmental degradation, and created an impact on global warming, pollution, and climate change (Söderlund, 2019). Human beings have distanced themselves from nature, disregarding their inherent connection to it. Negative impacts of human actions on the environment ultimately affect humans themselves (Williams et al., 2007). The sustainable construction of buildings is essential for environmental protection (Sassi, 2006). Sustainability is a way of life, and its impact is reflected in humanity. The concept of sustainability has been integrated into the field of architecture during the final years of the 20th century and has since become a crucial component of the discipline. The development of sustainable buildings and green building practices has resulted in the construction of structures that utilize renewable energy sources, incorporate advanced technological systems, and employ carefulness in water

consumption (Söderlund, 2019). However, it is noteworthy that the human element is not sufficiently considered in this design approach, as noted by Söderlund (2019). According to Almusaed (2011), users desire buildings that offer more than just basic functionalities such as living, working, dining, and socializing. They seek a higher level of comfort and a sense of connection with these structures (Larsen et al., 1998).

Lack of motivation among individuals to maintain the built environment can be attributed to the missing cultural and ecological affinity with the settings they occupy. In the process of constructing buildings, designers need to consider the aspect of long-term sustainability. This can be achieved by incorporating the principles of biophilic design into the construction process (Kellert et al., 2008). According to Kellert et al. (2008), an increasing number of researchers are proving the advantages of that specific approach to design. The objective of this study is to provide

a brief explanation of the concept of biophilia, which was introduced by Edward O. Wilson in 1984. According to Wilson, human well-being must maintain a connection with nature. Biophilic design has been identified as the most appropriate approach for creating a connection between humans and their surrounding environment, resulting in its preservation (Kellert et al., 2008).

The study also outlines the essential parameters that must be met to achieve a biophilic design. It includes examples from Turkey and other parts of the world, which have effectively incorporated biophilic design in various facilities. Terrapin Bright Green (2014) has proposed 14 patterns of biophilic design divided into three primary categories, which are Nature in the Space, Natural Analogues, and Nature of the Space. These models are intended to incorporate elements of nature

into the design of spaces (Browning et al, 2014). According to Söderlund's (2019) research, it has been demonstrated that biophilic design offers numerous advantages, including social, environmental, and economic benefits. The instances examined in this investigation function as a model for a better understanding of the application of biophilic design models.

2. Objective and scope

The purpose of this study is to further support the information that biophilic design has a very important role in increasing the lifespan of buildings. The principles of biophilic design practice will provide valuable information and inspiration on how to apply this approach when designing buildings. The scope of this study will begin with a general understanding of the concepts of biophilia and biophilic design. Followed by a review of the connections between biophilic design and Green buildings, along with a demonstration of the positive effects of biophilic design. This work includes a brief explanation of the principles behind the biophilic design.

3. Method

The methodology used in this study involved an extensive review of literature, including books, theses, research papers, articles, and documentaries. Additionally, photographs taken in the field were also applied. The present thesis illustrates the biophilic design models according to the "14

Patterns of Biophilic Design", a publication by the American company Terrapin Bright Green.

4. Theoretical background

What is biophilia?

The notion of Biophilia was first proposed by Edward O. Wilson in 1984. It is a term that originates from the Greek words "philia," meaning love, and "bio," meaning living things and life. Biophilia refers to humans' inherent tendency and affection towards the natural world, including all life forms and ecosystems. This concept has been extensively explored and discussed by Wilson in his works and Kellert and Wilson in their joint publication in 1993. The concept of biophilia posits that individuals carry a biological tendency and a desire to form a bond with the natural world.

What is biophilic design?

The integration of nature into the built environment, known as biophilic design, is achieved through the application of certain principles. This approach aims to protect human health, enhance overall well-being, and foster creativity in the spaces where individuals live and perform their professional activities. The incorporation of these factors, along with the utilization of organic materials and shapes in the design process, not only provides advantages to humans but also aids in protecting the environment (Wilson, 1984; Kellert & Wilson, 1993).

Sustainability: Biophilic Design and Green Buildings

Flora and fauna are disappearing at an enormous rate. By the end of this century, half of all species may disappear. At the beginning of the third century, the end of the planet is drawing nearer, and humanity is to blame for bringing about this dire situation. Edward O. Wilson's "The Future of Life" discusses the detrimental impact of human activities on the planet, including global warming, deforestation, environmental destruction, pollution, and overexploitation of resources. These factors have led to an environmental crisis that poses a threat to human existence. Wilson, emphasizes that the Earth is our home, and we should not treat it with such ignorance (Wilson, 2002). If humans treat it properly, the Earth is the chain of ecological survival, and its capacity for renewal is a fundamental component

in ensuring the continuity of human existence. (Almusaed, 2011).

Buildings have a big effect on the natural world when they are built, used, and deconstructed. Sustainable architecture can help and support people to live in a more environmentally friendly way (Sassi, 2006). Green buildings are part of sustainable design. They use eco-friendly materials, efficient use of water, and renewable energy, and reduce pollution and energy crisis (Williams et al., 2007). However, something is missing from this design that would make it more sustainable. Sustainability refers to the effect that buildings have on their surrounding natural environment. For buildings to be more sustainable, they need to establish a link between the environment and their occupants. This will ensure that the occupants will not abandon the building in the future. Because biophilic design is concerned with how humans are influenced by natural settings, it is the element that has been missing from the puzzle of sustainable design. The use of biophilic design in the construction of buildings

creates a link between those buildings and people, which in turn improves the well-being and health of the occupants, who are more likely to take care of the buildings and extend their lifespan (Kellert et al., 2008).

What are the benefits of biophilic design?

According to the World Urbanization Prospects of the United Nations (2014), by 2050, approximately 66% of the world's population will be living in cities. Consequently, more and more people are migrating away from nature (Söderlund, 2019). The findings reveal that individuals residing in North America allocate 93% of their time indoors, while those living in Europe spend 85-90% of their time indoors (Heath et al., 2018). The World Health Organization has identified stress as the "health epidemic of the 21st century" based on the aforementioned statistics. Individuals tend to recover from stress at a faster rate when exposed to natural systems as opposed to urban environments (Ulrich et al., 1991).

According to the concept of biophilia, humans exhibit an

Social	Environmental	Economic
<ul style="list-style-type: none"> - Increased well-being -Enhancing densification, walkability, and revitalization of cities -Stress reduction and stress recovery -Increased community engagement - Decreased violence and crime - Increased productivity and cognition - Increased healing rates - Increased retail sales - Aesthetic responses - Increased food security 	<ul style="list-style-type: none"> - Air conditions/ reduces the urban heat island - Water management - Biodiversity - Air quality - Indoors and outdoors - Air pollution - Reduced energy consumption - Carbon reduction - Noise attenuation 	<ul style="list-style-type: none"> - Future-proof buildings - Increased liveability – enabling higher density and decreased footprint - Decreased water management costs - Higher quality tenants and retention - Increased worker productivity and cognition, employee attraction and retention - Increased healing rates and health - Decreased energy consumption - Decreased violence and crime - Increased property value - Extended building life - Increased retail potential - Food security

Table 1. The multiple benefits of biophilic design (Söderlund, 2019)

inherent biological and evolutionary inclination toward the natural world. The natural environment is a crucial dependency for the human species. The preservation of human, emotional, and planetary welfare is reliant upon it. The surroundings in which humans reside can offer various benefits such as enjoyment, calm, ease, refreshment, motivation, and inspiration, particularly amid the monotony of urban existence (Beatley, 2011).

The book "The Emergence of Biophilic Design" by Söderlund (2019) examines the various social, environmental, and economic benefits of biophilic design.

Kellert (2005) highlights the following findings:

- Direct contact with nature (e.g., natural lighting, greenery) and representational and symbolic images of nature (e.g., photos) improve healing and recovery after illness and major surgery.
- Living near open spaces reduces health and social issues regardless of wealth, education, or location. Even grass and a few trees improve coping and adaptation.
- Natural lighting, ventilation, and other office characteristics boost worker performance, stress, and motivation. Nature improves focus and memory.
- Natural environments promote healthy childhood development.
- Natural sensory patterns and cues activate the brain.
- Communities with higher environmental quality have higher natural valuations, better quality of life, better neighborliness, and a stronger sense of place.

14 Patterns of Biophilic Design according to Terrapin Bright Green (2014)

Nature in the Space: design that is created by direct interaction with natural elements or processes (Heath et al., 2018).

1. Visual Connection with Nature
2. Non-Visual Connection with Nature
3. Non-Rhythmic Sensory Stimuli
4. Thermal & Airflow Variability
5. Presence of Water
6. Dynamic & Diffuse Light
7. Connection with Natural Systems

Natural Analogues: provides design approaches that incorporate references to or illustrations of nature (Heath et al., 2018).

8. Biomorphic Forms & Patterns
9. Material Connection with Nature
10. Complexity & Order

Nature of the Space: Mimicking spaces that replicate the spatial characteristics of natural environments to elicit or improve human reactions (Green, 2015).

11. Prospect
12. Refuge
13. Mystery
14. Risk/Peril

1 - Visual Connection with Nature

According to Terrapin Bright Green (Browning et al, 2014), the concept of a direct connection with nature has been observed to have significant effects on individuals' well-being. The presence of a good visual connection with nature can have both stimulating and calming effects, drawing attention and reducing stress levels. Such spaces that provide views of nature have been found to lower blood pressure, heart rate, as well as levels of anger and aggression in individuals (Terrapin Bright Green, 2014). It is worth noting that a direct connection with nature is considered to be more effective and preferable. However, a stimulated connection with nature is still better than no connection at all. The former type of connection is achieved through natural elements such as the natural flow of a body of water, fossils, animals, insects, terrain, soil, earth, and vegetation, among others (Browning et al, 2014).

On the other hand, a stimulated connection with nature can be attained through the mechanical flow of a body of water, an aquarium, a green wall, artwork depicting natural scenes, videos portraying natural scenes, and highly designed landscapes. While these means may not be as effective as a direct connection with nature, they are still capable of providing some of the positive effects associated with nature (Browning et al, 2014).

In conclusion, the presence of a direct connection with nature has been found to have various benefits, including

the reduction of stress levels. While such connections can be achieved through natural means, stimulated connections are also effective in providing some of the positive effects of nature on individuals' well-being (Browning et al, 2014).

Key Factors to Consider When Designing for a Strong Visual Connection with Nature:

When designing spaces, creating a good visual connection with nature is an essential consideration. While a direct connection with nature is always preferable to a stimulated one, a stimulated connection is still better than no connection at all. Therefore, designers should strive to incorporate nature into their designs in whatever way possible. It is important to provide spaces for exercises near green spaces where possible, as these spaces can enhance the experience of nature. Designers should aim to offer spaces that provide a visual connection with nature for at least 5-20 minutes a day. Furniture should also be planned in such a way that it does not hinder the visual connection and can be experienced even while sitting. It is worth noting that even small cases of visual connection with nature can be restorative. Digital media can be used to achieve some benefits of the visual connection with nature in spaces where it may be difficult to achieve a direct connection. However, it should be noted that the benefits of a direct connection with nature are still superior to those of a stimulated connection (Browning et al, 2014).

2 - Non-Visual Connection with Nature

According to Terrapin Bright Green (Browning et al, 2014), the incorporation of non-visual connections to nature in designed spaces has been shown to contribute to feelings of freshness, comfort, and balance. This is achieved through the stimulation of the auditory, tactile, olfactory, or gustatory senses, which evoke memories of natural systems or processes and recall the experience of being in nature (Terrapin Bright Green, 2014). Research indicates that exposure to these sensory stimuli can lead to the reduction of blood pressure and stress hormones, improve mental health, and offer a sense of tranquility. In particular, studies have shown that exposure to natural sounds can accelerate physiological and psychological recovery after experiencing stress by 37%, compared to exposure to indoor or urban noise (Browning et al, 2014).

Moreover, the olfactory system plays a powerful role in evoking memories and emotions. The act of smelling plants, for example, has been shown to strengthen the human immune system. As the olfactory system processes information in the brain, incorporating natural scents into designed spaces can contribute to a non-visual connection to nature and promote a sense of well-being (Browning et al, 2014).

Key Factors to Consider When Designing for a Strong Non-Visual Connection with Nature:

To ensure the successful integration of non-visual connections to nature in designed spaces, several key considerations should be prioritized. These include prioritizing natural sounds over urban ones, ensuring ease of accessibility from one or multiple locations, and striving for a daily experience of 5-20 minutes at the same time (Browning et al, 2014).

It is essential to integrate these non-visual connections to nature into the design to create a harmonious and seamless experience. By integrating multiple aspects of non-visual connections to nature into a single intervention, the overall impact can be significantly increased (Terrapin Bright Green, 2014). Moreover, the experience of non-visual connections to nature can be enhanced through the application of visual connections to nature. When implemented together, these connections can increase the health benefits and overall sense of well-being for individuals utilizing these spaces (Browning et al, 2014).

3 - Non-Rhythmic Sensory Stimuli

According to Terrapin Bright Green (Browning et al, 2014), a transitory connection with nature refers to a brief and unpredictable interaction with nature that provides a refreshing and stimulating distraction from daily tasks. Research suggests that such interactions with natural stimuli, such as the sounds of birds chirping or the movement of leaves, can improve the physiological system, including reducing eye strain, improving heart rate, and lowering blood pressure. These stimuli can be experienced naturally or stimulated through the movement of water, light, shadows, or the use of vegetable oils (Browning et al, 2014).

Considerations for incorporating Non-Rhythmic Sensory Stimuli in design:

According to Terrapin Bright Green (Browning et al, 2014), to create a good connection with non rhythmic sensory stimuli during design, it is important to activate the sensory stimuli approximately every 20 minutes or 20 seconds while ensuring that the visual stimuli are at least 20 feet away. Given that some natural stimuli are seasonal, it is crucial to adopt a strategy that ensures a sensory experience throughout the year. Additionally, it is essential to integrate the pattern of natural and non-visual connections with nature to maximize the experience, while ensuring that it remains unpredictable and transitory. Collaborating with a mechanical engineer to implement stimulated interventions is also necessary. When using this strategy, it is important to use plants that attract bees instead of using beehives, for example. Additionally, the impact of the experience is more significant when it is experienced indirectly, rather than directly. Hence, the use of constantly repeated stimuli such as the movement of clock hands or a stimulated aroma must be avoided in favor of unpredictable stimuli, such as the sudden appearance of a butterfly (Terrapin Bright Green, 2014).

4 - Thermal & Airflow Variability

According to Terrapin Bright Green (Browning et al, 2014), Thermal and Airflow Variability can be considered a model for creating comfortable indoor environments. It encompasses the importance of air temperature, humidity, and surface temperature in relation to the natural environment. Spaces that offer thermal comfort and good natural ventilation are deemed to be highly comfortable and refreshing, leading to increased productivity and focus. Research has shown that a lack of variability in air flow can result in boredom and passivity. To achieve such a natural environment, it is important to consider factors such as the orientation of spaces, sunlight exposure, the presence of vegetation, and the use of radiating surface materials and shadows. Stimulated ways of achieving this can be through indirect ventilation, system controls, and window and shield placement (Browning et al, 2014).

Design Considerations for Achieving Thermal Comfort and Airflow Variability in Indoor Spaces according to Terrapin Bright Green (2014):

- The incorporation of shields, mechanical ventilation, temperature variability in materials, and natural lighting can aid in distributing variability in time and space in a designed environment.

- This pattern serves as a common component between biophilic and sustainable design, as the orientation of spaces and thermal comfort can reduce the need for energy consumption during heating and cooling.

- The design of spaces that allow users to modify their thermal conditions can also contribute to achieving the goal of thermal and airflow variability.

- Coordination between architects and engineers is necessary to establish effective design strategies for achieving the desired level of thermal and airflow variability in space.

5 - Presence of water

According to Terrapin Bright Green (Browning et al, 2014), water can evoke stimulating, fascinating, and refreshing experiences in space through various sensory channels such as touch, sound, and sight. Research has found that the presence of water in space has many benefits, as it can stimulate multiple senses simultaneously, improve physiological and psychological reactions, induce a sense of calmness, lower heart rate, and reduce stress hormones and blood pressure. Natural sources of water such as streams, rivers, oceans, and ponds are examples of how water can be present in a space. Meanwhile, stimulated sources of water like aquariums, water walls, reflections, images, and built ponds are also employed to create these experiences (Browning et al, 2014).

Design Considerations for Enhancing the Positive Impacts of Water Presence in Built Environments:

According to Terrapin Bright Green (Browning et al, 2014), when designing a water space, several factors must be considered to optimize the potential positive impacts of its presence. Firstly, it is important to prioritize experiences that involve multiple senses to achieve the most beneficial outcome. Secondly, the natural flow of water should take priority over planned movements, as natural fluctuations can provide a more engaging and dynamic experience. Care must also be taken with the volume and turbulence of the water, as high volumes or turbulence can create acoustic discomfort

or impact humidity levels, particularly nearby. Finally, in locations where water is scarce, shading or shielding of the water should be considered to minimize water loss through evaporation and create a biophilic experience. By considering these design elements, water spaces can effectively stimulate physiological and psychological reactions, promote a sense of calm, and reduce stress hormones and blood pressure (Browning et al, 2014).

6 - Dynamic & Diffuse Light

According to Terrapin Bright Green (Browning et al, 2014), lighting is an essential aspect of creating a comfortable and peaceful environment. The use of varying intensities of light can create a dynamic interplay of shadows and light, much like the natural changes in lighting that occur over time. Well-lit spaces have been shown to provide numerous benefits, such as increased sales in retail spaces and improved academic performance in well-lit classrooms. The purpose of this pattern is to introduce variable lighting into space to avoid monotony and to maintain a high level of interest and energy, whether for work or other activities. Adequate lighting has a positive effect on the mood and well-being of users. Natural light can be incorporated into space through the use of different window angles, direct sunlight, and seasonal and daily light cycles, as well as moonlight and starlight at night. Artificial light sources such as wall and ceiling fixtures, light intensity controllers, and daylight-preserving windows can also be used to enhance the lighting in a space (Browning et al, 2014).

Design Considerations for Achieving Optimal Dynamic and Diffuse Light Conditions in Interior Spaces:

According to Terrapin Bright Green (Browning et al, 2014), the use of lighting plays a critical role in establishing a sense of comfort and functionality within interior spaces. To achieve an optimal dynamic and diffuse light condition, several design considerations must be taken into account. Firstly, the use of dynamic light can aid in creating a smooth transition between internal and external spaces. In contrast, the implementation of high contrasts, color variability, and a variety of light tones may not be appropriate in areas that require higher concentration. Secondly, in spaces where longer stays are anticipated, the dynamics of light are essential in maintaining an engaging environment that keeps

the occupant's interest and energy at their highest level. Overall, striking a balance between dynamic and diffuse lighting conditions is key to establishing a comfortable and productive interior space (Browning et al, 2014).

7 - Connection with Natural Systems

Terrapin Bright Green (Browning et al, 2014), emphasizes that creating a connection between indoor spaces and natural systems is an effective strategy for enhancing users' sense of time and promoting positive emotions such as nostalgia, calmness, and positivity. Such a connection can be established by incorporating natural elements such as deciduous trees, gardens, and rain gardens into the design of spaces. Awareness of the natural properties of these elements is crucial for their successful integration. Natural systems can also be experienced through climate and weather conditions, water sources, animal behavior, plants, insects, natural lighting, and the night sky, including the moon and stars, as well as seasonal changes. In addition, simulated natural systems such as gardens, small water wells, birdhouses, and lighting systems can be created to mimic natural cycles and enhance the connection between indoor spaces and nature. Ultimately, a successful connection with natural systems can provide users with a sense of predictability, nostalgia, and serenity, while also promoting a greater appreciation for and understanding of the natural world (Browning et al, 2014).

Design Considerations:

When designing a space, it is important to consider ways to establish a connection with natural systems. This can be achieved through various design elements, such as rainwater treatment features like rain gardens, incorporating views of surrounding gardens through openings and creating interactive opportunities for all age groups. By implementing such design strategies, the space can promote an enhanced sense of natural surroundings, and provide a way to connect with the environment. Additionally, these design elements may contribute to increased environmental sustainability and create a more meaningful and holistic experience for users (Browning et al, 2014).

8 - Biomorphic Forms & Patterns

According to Terrapin Bright Green (Browning et al, 2014), the model Biomorphic Forms & Patterns incorporates the use of natural forms or textures to create a connection between the built environment and nature. By mimicking patterns found in nature, these spaces become more visually appealing, interesting, and comfortable, resulting in reduced stress levels for their users. Examples of natural forms in design can include decorative elements such as carpets, sculptures, paintings, and wallpaper designs, as well as structural elements like columns, furniture, and corridors. However, it is important to exercise restraint when incorporating biomorphic forms & patterns to avoid overwhelming the space and creating a toxic environment (Browning et al, 2014).

9 - Material Connection with Nature

According to Terrapin Bright Green (Browning et al, 2014), this pattern involves the use of natural materials that undergo minimal processing. The resulting spaces are characterized by a tactile experience that stimulates the senses, creating a rich, warm, and beautiful environment. The use of natural materials can serve both functional and decorative purposes. Decoratively, this pattern can manifest in the form of wallpapers featuring natural colors such as green, natural-looking furniture, and various nature-inspired decorative elements. Functionally, natural materials can be used in constructive systems, and even in the facades of buildings (Terrapin Bright Green, 2014). It is worth noting that natural materials are preferred over artificial imitations, as the human brain can distinguish between the two with ease. Consequently, this pattern emphasizes the importance of using genuine natural materials, which can imbue a space with a unique and timeless quality (Browning et al, 2014).

10 - Complexity & Order

According to Terrapin Bright Green (Browning et al, 2014), this design model emphasizes the utilization of hierarchical and orderly arrangements that are evident in natural environments. Spaces that incorporate more intricate and sophisticated designs or decorations are more engaging and, according to research, they influence the environment to not appear monotonous, leading to a reduction of stress

among occupants. Complexity and order can be manifested in the form of decorations or functions. Decorative elements may include wall coverings, material textures and shapes, acoustic stimuli, window and glass designs, and vegetation, among others. In contrast, functional elements may include the hierarchy of windows, facades, or lamps, exposed structural or mechanical systems, and other similar design features that reinforce the hierarchy and order of the space (Browning et al, 2014).

11 - Prospect

According to Terrapin Bright Green (Browning et al, 2014), the Prospect model refers to the view from a certain height, typically from balconies or elevated spaces, to observe natural sights or to plan something. The desire to have a greater connection with nature has led to the emergence of this model, which has been found to reduce stress, alleviate fatigue, and alleviate boredom. This model can be achieved through the incorporation of balconies or the placement of stairs with glass facades around the perimeter of the building. The main goal of this model is to provide users with a highly engaging and memorable experience of the natural environment (Browning et al, 2014).

12 - Refuge

According to Terrapin Bright Green (Browning et al, 2014), a refuge is a space intended for the withdrawal of an individual from the surrounding environment, whether due to unfavorable environmental conditions or excessive activity. It provides a sense of protection from potential danger or discomfort, particularly from above and behind. Refuge, whether from climatic conditions or physical danger, can have a profound impact on an individual's well-being. Such a retreat can evoke feelings of safety and security, alleviate irritations, and even lower blood pressure, leading to improved concentration and reduced stress levels. The primary condition for creating such a space is that it must make the individual feel protected and sheltered, particularly from above. The secondary condition involves limiting visual access and strategic orientation to enhance the user's experience. These spaces can be used for various purposes, such as private conversations, meditation, reading, complex tasks, or simply for rest (Browning et al, 2014).

13 - Mystery

According to Terrapin Bright Green (2014), the Mystery model is based on the principle that human beings have an inherent need to explore and investigate their surroundings, and therefore incorporate darker spaces that offer a sense of discovery and the promise of reward through new perspectives. This model emphasizes the creation of partially obscured views, enticing corridors, and pathways that encourage exploration of the environment. It can be achieved through the use of various sensory elements such as sound, scent, and works of art or installations, all of which contribute to the overall experience of the space. The goal is to create an environment that fosters curiosity and a sense of wonder, encouraging users to engage with their surroundings and discover new perspectives (Browning et al, 2014).

According to Terrapin Bright Green (2014), when designing spaces to create mystery, several factors should be considered. Firstly, paths with curved edges should be prioritized over those with corners. This is because curved paths entice exploration and offer an element of surprise, contributing to the overall sense of mystery. Secondly, dark shadows should be incorporated as part of the design strategy to create a feeling of exploration and investigation. However, it is important to be cautious as these dark shadow strategies can evoke fear and discomfort, and should therefore be carefully planned and implemented. By considering these factors, designers can create spaces that effectively evoke a sense of mystery and encourage users to engage with their surroundings in a curious and explorative manner (Browning et al, 2014).

14 - Risk/Peril

According to Terrapin Bright Green (2014), the Risk/Peril model is designed to address potential risks associated with a given space, while also providing a reliable source of protection. By creating an element of intrigue and curiosity, this model encourages users to explore and engage with the space. Examples of this model include the incorporation of glass floors or stairs, transparent ceilings, or elements that require navigating over or under water. The goal of the Risk/Peril model is to create a sense of excitement and adventure, while still maintaining a safe and secure environment for users (Browning et al, 2014).

5. Conclusion

The rise in population in urban areas has come along with the beginning of a large number of construction projects that contribute to pollution and other issues on a worldwide scale. The use of Green Buildings principles with the goal of reducing the adverse effects of structures on the surrounding environment is not sufficient to achieve a design with long-term sustainability. The absence of biophilic design in these structures prevents people from connecting with them, which reduces the chances that they will be maintained and encourages people to abandon them instead. The biophilic design makes it possible for people to interact with nature, but at the same time, it affects the protection of nature from pollution. The application of this kind of design has been shown to have benefits to society as well as the economy and the environment. The models that serve as the foundation for biophilic design were discussed, and it was demonstrated that a connection with nature can be established in a direct manner by establishing visual connections with natural systems, but that this connection can be strengthened even further through the incorporation of patterns in an indirect and stimulated manner using shapes, paintings with natural motifs, textures, stimulated sounds of the natural world in indoor environments, and so on.

Biophilic design has been examined to demonstrate how the use of natural materials, textures, shapes, and patterns found in nature, and the inclusion of vegetation and water in their design, which make the users experience multisensory stimuli, not only influence people's well-being but also affects the aesthetics of these facilities.

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