EFFECTS OF BIOPHILIC DESIGN IN INTERIOR SPACE AND EVALUATION IN EDUCATIONAL BUILDINGS

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ABSTRACT

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Today, people's ideas about spaces, both at work and at home, are slowly starting to change. This change is based on the idea that the interior should adapt to the exterior in order to improve people's living spaces. There are many design approaches for strengthening this relationship. Biophilic design, which is a term raised by Stephen Kellert, is one of these design approaches. Considering the human-nature-space relationship, it is possible to say that the understanding of biophilia is based on the past. Biophilic design aims to combine our commitment to nature with the modern built environment. In addition, it is to contribute to the formation of satisfied individuals by creating the elements that exist in the natural world and contribute to productivity in built environments.

This thesis focuses on evaluating the connection between nature, human comfort and well-being in order to create sustainable and livable spaces that enrich and enhance our daily lives through the use of biophilic design. In addition, it focuses on answering the questions of how a connection is established between natural elements and schools in terms of biophilic design in educational buildings, how biophilic design emerges in a school, and what are the benefits of being in contact with nature for students and school staff.

In this study, the aim of the research is to set off with the question of how the design parameters developed for the application of biophilic design, which is one of the design approaches based on the relationship between nature and human beings, can be transferred to educational buildings, and a field study was carried out in this direction.

Çankaya University Faculty of Architecture Building, which is an educational structure, is analyzed as an indoor application area of biophilic design experiences/principles, which is one of the design approaches that try to establish the connection between nature and space. As a method, 14 biophilic design principles defined by Browning were used in the analysis. In the results section, it is discussed whether these principles overlap with the designs in the educational building and the applicability of the biophilic design to an existing building.

Keywords: Human and Nature, Biophilic Design, Interior Design, School Design

ÖZ

BİYOFİLİK TASARIMIN İÇ MEKANA ETKİSİ VE EĞİTİM BİNALARINDA DEĞERLENDİRİLMESİ

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Günümüzde insanların hem iş ortamlarında hem de evlerinde bulunan alanlar konusundaki fikirleri, yavaş yavaş değişmeye başladı. Bu değişim, kişilerin yaşam alanlarını iyileştirmek için iç mekânın, dış mekâna uyum sağlaması gerektiği fikri üzerinden ilerliyor. İnsan ve doğa arasındaki bağın güçlendirilmesine yönelik birçok tasarım anlayışı bulunmaktadır. Stephen Kellert'ın ortaya attığı bir terim olan biyofilik tasarım da bu tasarım anlayışlarından biridir. İnsan-doğa-mekân ilişkisine bakıldığında biyofi anlayışının eskiye dayalı olduğunu söylemek mümkündür. Biyofilik tasarım, doğaya olan bağlılığımızı modern yapılı çevrede buluşturmayı amaçlamaktadır. Ayrıca, doğal dünyada var olan ve üretkenliğe katkıda bulunan elemanları yapılı çevrelerde var ederek memnun bireyler oluşumuna katkıda bulunmaktır.

Bu tez çalışması biyofilik tasarım kullanımıyla günlük hayatımızı zenginleştiren geliştiren, sürdürülebilir ve yaşanabilir alanlar yaratmak için doğa, insan konforu ve refah arasındaki bağlantıyı değerlendirmeye odaklanmıştır. Bununla birlikte eğitim yapılarında biyofilik tasarım açısından doğal unsurlarla okullar arasında nasıl bir bağlantı kurulduğu, bir okulda biyofilik tasarımının nasıl ortaya çıktığını ve doğa ile temas halinde olmanın öğrenciler ve okul personeline

faydalarının neler olduğu sorularını yanıtlamaya odaklanmaktadır. Bu bağlamda araştırmanın amacı, doğa ve insan ilişkisini temel alan tasarım anlayışlarından biri olan biyofilik tasarımın, mimarlık alanında uygulanması adına geliştirilen tasarım parametrelerinin eğitim binalarına nasıl aktarılabileceği sorusu ile yola çıkıp, bu doğrultuda alan çalışması yapılacaktır.

Bu çalışmada iç mekânda uygulama alanı olarak Çankaya Üniversitesi Mimarlık Fakültesi Binası analiz edilmektedir. Yöntem olarak analizlerde Browning'in tanımladığı 14 biyofilik tasarım deneyimleri/ilkeleri esas alınmıştır. Bu ilkelere göre sonuçlar bölümünde bu deneyimlerin/ilkelerin seçilen binanın tasarımıyla örtüşüp örtüşmediği ve biyofilik tasarımının var olan binalara uygulanabilirliği tartışılmaktadır.

Anahtar Kelimeler: İnsan ve Doğa, Biyofilik Tasarım, İç Mekan Tasarımı, Okul Tasarımı

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CHAPTER 1
INTRODUCTION

The relationship between man and nature is clearly seen in the period from the existence of humanity to the present day. Human learns every formation he sees and observes in nature by going through mental processes and produces solutions by making inferences from these teachings when he needs it. People interpret the environment they live in with user's requirements and aesthetic concerns. In the most basis, architecture emerged with the concept of sheltering, then this concept developed and turned into spaces for people, and these spaces became places that broke the bond between human and nature due to the rapid development of the industry. It was seen that the buildings which are designed without considering the nature not only harm the world by reducing sustainability, but also negatively affect human psychology. In the current pandemic conditions, people stayed at houses for a long time, thus their orientation towards nature has increased by moving away from the indoor environment. The University of Vermont in the USA conducted a study with 400 people in 25 parks. In the study, the relationship of people with nature, especially during the pandemic period, was researched and it was determined that people who had been isolated for a long time due to the pandemic went to the park and spent time outdoors more often than previous years. It has been revealed that 26 percent of people who visited the parks in the first months of the COVID-19 pandemic had rarely or never visited nature compared to the previous year. It has also been stated by many scientists that the need to be in nature has increased during the pandemic. Walking and moving is an activity that affects and supports all organs, especially the brain. At the end of the study, it was emphasized that there will always be a need for green space in other virus outbreaks that may occur in the future. It is recommended to have more green areas when making city and architectural plans. Therefore, human-nature relations were questioned again within the scope of biophilic design and nature-human-space was tried to be reinterpreted and brought into the design (Selçuk 2021: 4). Biophilic Design was inspired from Biologist

Edward O.Wilson's "Biophilia Hypothesis", which was defined as "human's natal emotional affinity towards other living organisms". This field which was developed by Stephen Kellert and added to the architecture and design literature, searches the ways of maintaining human-nature interaction in the built environment (Masnavi 2021: 15). Its difference from sustainable design is to be more people-oriented and to aim bringing natural elements to the architectural space for the health and well-being of people. In sustainable design, the aim of "minimizing the damage to the built environment" provides an indirect contribution to the human-nature interaction in the space. Therefore, biophilic design is defined by Kellert as “the missing ring of sustainable design” (Kellert 2008: 26).

As a result of the researches, it has been determined that although there are many studies around the world on biophilic design, an awareness has emerged in this field in Turkey after the 2010s, and the research and studies conducted are limited in number. In the thesis, biophilic design principles prepared by Stephen Kellert for architectural design were re-evaluated from the perspective of interior design and a biophilic interior design guide was prepared.

Since the resources prepared for the application of biophilic architecture in educational areas are very limited in the literature review on the thesis topic, it is aimed to help eliminate the deficiencies in this study. It is aimed to contribute to the literature by examining the biophilic design principles on an existing building.

1.1. PURPOSE AND SCOPE OF THE THESIS

Living together with nature is not a personal choice. It is important to define criteria in order to raise awareness of living together with nature and to ensure a conscious and effective coexistence. This is only possible by raising awareness for a sustainable future in harmony with nature, starting from childhood with a biophilic design approach to be applied in educational buildings. Desired results can only be achieved when the aim of raising awareness is adopted not only as a teaching but also as a lifestyle. The consciousness to be gained from childhood should be settled first in the homes of the children, then in the schools where they will spend most of their time, and in the cities that complement their built environment. And this will ensure the formation of a cycle that will continue with the shaping of the future of healthy and prosperous children who live, learn and develop in a physical environment with biophilic design features. According to the lifelong learning

movement, the responsibility and importance of schools are increasing day by day. Developments and changes in today's societies in which schools are an important part, continue at an increasing pace (Aydoğan 2012: 29). Therefore, these conditions should also be taken into account while designing the physical environment of a school (Kirkeby 2002: 43). It seems possible that the consciousness that could not be gained in childhood can be gained in later ages, even if it is difficult. It seems more effective to develop this awareness, especially in educational buildings. It is not possible to interfere with people's living spaces other than education. Therefore, it is possible to list many concepts such as physical design, visual factors, auditory factors, touch and physical stimulation within the scope of biophilic design, which should be considered in the design of educational buildings (Bogerd 2020: 67).

It has been proven by different studies that spaces and structures that are compatible with nature have positive effects on people. In this context, it is aimed to prepare a guide by reevaluating the existing educational buildings from the interior architectural point of view of the biophilic design principles, which is one of the design understandings based on the nature and human relationship. In the study, first the parameters that are effective in this guide will be determined. It will be analyzed how the evaluation will be made according to the data and parameters to be obtained as a result of the literature review and an evaluation will be made on an education building in line with the guide. At the end of the study, renovation will be suggested in line with the biophilic principles with the changes to be made in the building.

1.2. RESEARCH METHODOLOGY

The data for the preparation of the biophilic assessment guide were mainly obtained by benefiting from the literature. In this context, theses, international and national articles, books on the subject, congress declarations, various educational videos were examined as a literature study for the thesis study. The literature between 2000 and 2022 was reached. In the study, firstly, design approaches based on human and nature interaction will be examined and each design approach will be compared among themselves in accordance with interior design principles. Then, Biophilic design will be explained with all its dimensions and architectural application examples will be presented for a clearer understanding. Afterwards, Biophilic design on educational buildings will be examined and importance and

priorities will be mentioned. At the end of the section, it is aimed to create a Biophilic Design guide within the scope of education areas.

As a field study, certain areas will be selected in the building of Çankaya University Faculty of Architecture in Ankara, and the interior design of the building will be examined and evaluated in line with the Biophilic principles, and then suggestions will be presented by discussing whether the selected areas overlap with the biophilic design principles.

CHAPTER 2

2.1. DESIGN APPROACHES BASED ON THE RELATIONSHIP BETWEEN HUMAN AND NATURE

Architecture first started as a response to the instinct of protection, which is a natural need of human beings and in time it evolved into the art of designing and constructing physical structures and science. The instinct of protection directs all living beings to a special building action in order to adapt to the conditions of the natural environment that affect life and development. Taking shelter, entering a covered place, hiding and making a home are universal and natural phenomena (Şenozan 2018: 37). The relationship between architectural design and untouched nature has a long history. For making the predicted connection between nature and design more understandable, firstly the relationship between human and nature should be mentioned. Because design is an intervention tool that shapes the interaction between human and nature. When considering the design of the built environment, today's approaches that include nature in this process with its wide scope and keep it in the foreground should be taken into account, especially climate changes should be brought to the agenda. The philosophy behind these approaches offers valuable insights into nature's complexity and nature-based design (Bayraktaroğlu 2013: 4).

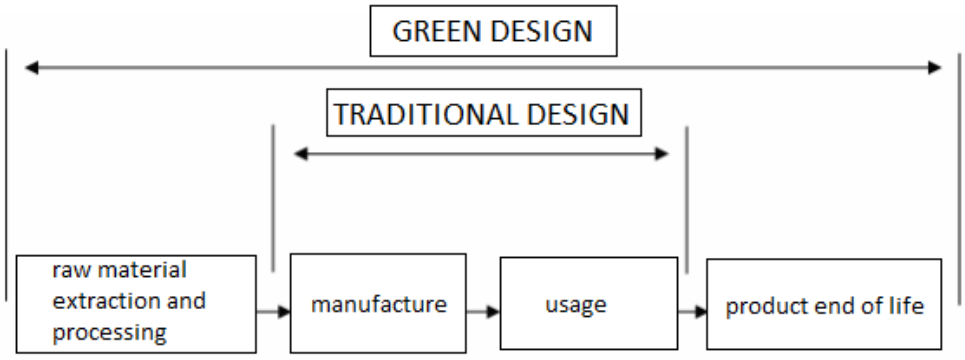
Therefore, the concepts such as green design, ecological design, biomimicry, regenerative design, etc should be analyzed and the principles of the approaches should be discussed in order to explain the context established between nature and design. At the end of this analysis, evaluation parameters will be obtained and will form the basis of the guide.

2.1.1. Green Design

Green Design is a concept that emerged in 1992 with the introduction of environmental awareness into the development of products in line with the efforts of the American Electronics Association (Sun 2003: 62). Green Design includes

methods of implementing changes in design or improvement strategies to reduce environmental impact and protect the environment. It is possible to define Green Design as a systematic process in which businesses design their products and processes with an environmentally sensitive understanding (Baumann 2002: 413). To mention it from a different perspective, Green Design is the systematic consideration of design issues associated with environmental health, human health and safety issues that span the entire life cycle of the product while developing a new product and process (Fiksel 2009: 87). Therefore, Green Design provides a broader perspective in which the entire life cycle of the product is taken into account, by integrating products and processes, and an environmentally friendly understanding by taking into account the factors as can be seen in Table 1.

Table 1: Green Design - Wide Perspective (Knight 2009: 56)



Green Design uses an integrated three-stage approach to reveal the relationship between product and environment (Kasap and Peker 2011: 104).

- The environmental effects of a product occur not only at a certain stage such as production but throughout the stages of raw material extraction and processing, production, distribution, use, reuse and disposal, in short, throughout the entire life cycle of the product. Therefore, the design is made by considering the entire life cycle of the product (Çaça 2016: 25).
- In order to improve the functionality of a product, all elements in the production process such as consumables and packaging must be taken into account. This means that the product is designed by considering it as a system.
- In order to avoid trade-offs between different environmental criteria (depletion of natural resources, greenhouse gas effect, toxicity, etc.), it is needed to use various simulation programs and make combinations with each other for the most of the

time in the design process to evaluate the environmental impacts that a product system may create during the product life cycle (Kasap and Peker 2011: 105).

Benefits of Green Design

Green Design provides benefits to businesses in many ways, as well as reducing the environmental impacts of the product throughout its entire life cycle. These benefits can be listed as follows: (Fiksel 1993: 19).

• Green Design helps businesses gain a competitive advantage against their competitors by reducing production and waste management costs.

• Green Design helps to utilize the raw materials and materials used at the highest level and to provide cost savings by reducing the amount of waste by ensuring the development of eco-efficiency.

• With Green Design, products are designed with the aim of realizing recycling applications (reuse, renewal, re-manufacturing, recycling) after their life cycles are over. Thus, the destruction of products that still carry a value even though their life cycle is over is prevented and by ensuring the reuse and/or recycling of parts and components, waste of natural resources is prevented.

• Green Design ensures that the economic costs of design interventions to improve the environmental performance of the product are controlled and limited.

• With Green Design, business value is improved by reducing the risk of legal liability related to waste and pollution and improving environmental performance, thus increasing the financial power of enterprises and their ability to influence investors.

• Green Design encourages the environmental improvement of an existing product's functions by reconsidering it. New ideas developed in this process may lead to the differentiation of products or the emergence of new products. This situation offers new market opportunities to businesses.

• Green Design helps businesses to improve their green image in society, as it reduces the environmental impact of products and enables businesses to improve their environmental performance.

Many of the environmental problems experienced today are the result of industrial waste and constitute 98% of the waste generated during the entire life of the product (DeMendonça 2001: 54). However, although the environmental activities carried out by focusing only on the wastes generated at the end of the production process are effective in improving the environmental performance of the enterprises,

it has been observed that they are not very effective in reducing the environmental problems. Reducing the environmental impacts of products throughout their entire life cycle is a process that begins with design. All kinds of activities, from the raw materials and materials to be used in its production, to all the processes it will go through even after completing its life, are evident while the product is still in the design phase. Green Design, which envisages design by integrating environmental and design issues, taking into account the entire life cycle of the product, ensures that many of the different environmental effects that occur at every stage of the product life cycle are reduced or completely eliminated (Kasap and Peker 2011: 106).

K2 Apartments (Figure 1) which are designed as the greenest sustainable housing estate in Australia, are an effective example of green design.

Figure 1: K2 Apartments, Windsor-Australia, 2007 (URL 1)

K2 Apartments has been named Australia's eco-friendly sustainable public housing project by the Victorian State Government and has won many design and sustainability awards. Four connected buildings use passive and active environmental design strategies to maximize daylight, summer coolness, winter warmth and natural ventilation (Lewis 2011: 76).

A product interacts with the environment throughout its entire life cycle, from the design stage to its disposal at the end of its life, and each product creates different environmental effects at different stages of its life cycle. Therefore, it is not possible

to reduce the environmental impact of a product or to eliminate it by focusing only on the waste generated after the production process. For this reason, it is necessary to adopt a holistic and proactive approach that takes into account the entire life cycle of the product, from the raw materials to be used in the product to the wastes generated during the production process, from the packaging used to the recycling of products that have expired. This will be possible with "Green Design", which provides the integration of product and process design with environmental issues (Kasap and Peker 2011: 109).

2.1.2. Ecological Design

The use of ecology as a science in space planning, design and management studies in general is quite new. Since the 1970s, sustainability has begun to be effective as a pioneering approach to design, and the importance of ecology as a factor that ensures sustainability in design has come to the fore. In the past, designs applied by ignoring nature and natural processes have led to the deterioration of the natural balance and the destruction of natural resources. For this reason, it has been understood that it is a necessity to consider not only people but also the ecosystem while designing (Todd 2003: 54).

Ecological design is a concept that requires an interdisciplinary approach to work in a way that supports social, cultural, economic and technological processes, especially ecological processes.

Ecological design is the design of a living environment that can be sustained without disturbing the natural balance, despite the nature in the natural environment (Yeang 2006: 67). According to Dushko Bogunovich; ecological design thinking means not only more nature, but also more clean and green technology, as well as more smart technology. When all or a part of the cities are designed, different disciplines in ecological design as a part of the sustainable city approach and the following persons have following roles;

- Architects: smart and green buildings, eco-friendly building design, the use of building materials in turns,
- Landscape architects: functional urban open-green spaces,
- Engineers: green infrastructure,
- Planners: spatial development strategies, modeling and continuous monitoring of urban metabolism (Bogunovich 2008: 39).

Ecological design is a holistic design process that includes social and psychological factors, highlights cultural preferences, emphasizes locality and symbolism, understands the internal dynamics of natural data and forms in harmony with it (Shu-Yang 2004: 35).

In the 1960s, the understanding of the limits of urban growth and the gradual decrease of natural resources changed the perspective on the environment. In the 1970s, the energy crisis in the West had a positive impact on planning and design; this situation has led;

• Less fossil fuel use,

• Limitation of urban expand and suburban development,

• Efforts to transform existing natural resources for reuse, and this energy crisis made it necessary to develop more environmentally responsible and sensitive methods in planning and design.

The city and life culture, which developed with respect to people, nature and natural resources until the 20th century, has left its place to the urbanization and living culture that exploits or ignores natural resources, pollutes the environment, and aims to gain income, with the wrong and intensive use of technological applications. The reflections of this negative process are felt more and more in the 21st century (Aklanoğlu 2009: 18).Mauritus Ecological Villa (Figure 2) designed by Foster and Partners is an effective example of ecological design.

Figure 2: Mauritius Ecological Villa, Foster and Partners, (URL 2).

The houses have rolling roofs that allow natural ventilation and airflow, and are mostly built from recyclable local materials. In addition, there are solar panels on the roof and rainwater collection systems in the building in the houses where energy efficient design is used. The residences which are designed as to be in harmony with a green environment while maintaining a contemporary look, also have tropical vegetation facades within their walls (Meinhold 2010: 6).

Ecological design is a process that covers every step from the design stage to the demolition of the building. It should be aimed that the effects of the buildings on the environment are minimal and they should be designed to be self-sufficient (Tönük 2001: 59). Ecological building design should be handled in a way that is sensitive to the environment, in accordance with sustainable principles, and to ensure a healthy cycle in the whole of ecology with optimum use of resources (Gürel and Eryıldız 2021: 43)

2.1.3. Biomimicry

It aims to develop creative solutions inspired from the nature by involving the biomimicry design and designer in the process (Moghaddamı 2019: 67). In this context, architecture can be named as the first field in which the technique of "inspiring / learning / adapting and / or applying from nature", which is widely applied in all fields of science today (Sorguç 2007: 32). Our ability to analyze Nature's 3.8 billion years of experience with the current tools and capabilities has increased (Volstad 2012: 192). Today, the importance given to concepts such as energy efficiency and sustainability explains the return to nature. Benyus, who has made important studies in this field, expresses biomimicry as a new science that examines, imitates and inspires the models of nature in order to find solutions to people's problems (Benyus 2008: 109) . In this direction, Benyus lists 9 basic features in the designs of nature:

1. Sunlight should be benefited
2. Sufficient energy should be used
3. A form suitable for the function should be created
4. Everything should be recycled
5. Rewarding of cooperation should be supported
6. Investment should be made in diversity
7. Local factors should be used

8. Excess should be avoided

9. Limits should be pushed

Within these principles, this natural design processes should be followed not only in products but also in infrastructures and processes (Mathews 2011: 269). Benyus (1997) refers nature as a model, benchmark and mentor (Shahda 2019: 73).

On the other hand, lists the design principles of the biomimicry institute as follows, in addition to the basic work of;

1. Adapting to changing conditions

2. Develop to live

3. Harmonize growth with developments

4. Creating awareness and responsibility in local needs

5. Using chemistry that is compatible with nature

All these design principles actually have a system emphasis. It is the ability of systems to develop and adapt over time, to adapt their infrastructures within local conditions, to create more sustainable and ever-new designs without harming the environment and using less resources (Nkandu 2018: 84). For example, car tires that can regenerate themselves, such as the salamander animal, which can develop legs, tail and eyes on its own (Ginsberg 2013: 158) and arranging obsolete and worn-out systems, will also play an important role in the prevention of work accidents (Eryılmaz 2015: 471) .

As an example of biomimicry as an imitation of a process at the organism level, the water sciences building built by Matthew Parkes for the University of Namibia is taken as an example (Figure 3). The building which is composed of sloping partitions, is positioned behind a high curtain covered with a nylon sheet and captures the moisture in the air blowing from the ocean.

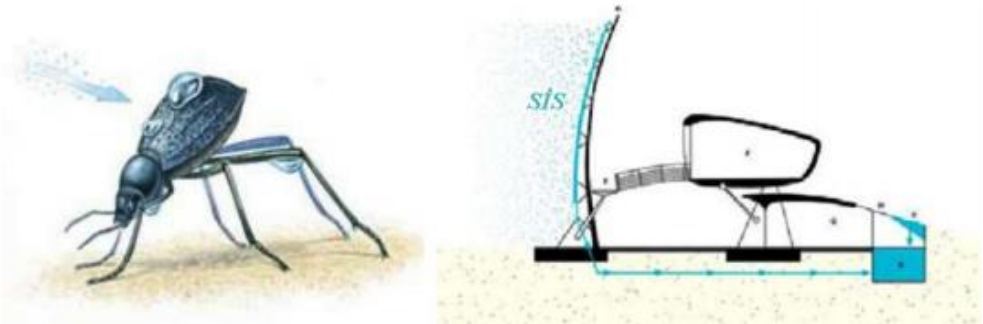


Figure 3: Aquatic Sciences Building, Matthew Parkes, Namibia. 2001 & Stenocara beetle – Biomimicry of process mimicry at the organism level. (URL3).

Stenocara insect has the feature of catching moisture by getting up on its feet inside the fog screen. Thanks to the hydrophilic-hydrophobic hard ground on the back and wings of the insect, water droplets generate and glide towards its mouth (Parker 2001: 33). Matthew Parkes from KSS architecture used insect-inspired organism-level process biomimicry in his fog-catching wall design for the University of Namibia's water science center (Figure 4).

Figure 4: Dragonfly and H5 Dragonfly (Parker 2001: 33).

Skorsky inspired from the dragonfly when designing the H5 Droganfly. They made analyses by examining the flight of the dragonfly. As a result of these analyses, they developed the helicopter (Inner 2019: 18).

There are many areas affected by biomimicry. For example, roof and structural systems are copied from trees, flower petals and human skeletons. Many transportation vehicles have been designed by examining the movement mechanisms and physiological structures of animals. By considering the sensitivities of horned vipers in the defense industry, the nervous systems of horned vipers have been analyzed in detail for developing missile detectors. After the entomologist French Rene-Antoine Reaumur showed that the use of wood pulp is better for bees' nest construction, paper manufacturers also started to use this material (Inner 2019: 18). While creating such solutions, it is possible to produce many solutions by examining animals, plants and organisms that have qualifications which are suitable for their performances.

Biomimicry is an economic and environmentally sensitive field of study to solve the problems of society and individuals. The systems in Nature are exemplary with their high efficiency, low waste and sustainable structures (Nkandu 2018: 87).

In our age when we consume nature and cannot replace it, nature must be allowed to live within its own balance, as it does for millions of years in order not to harm nature more; By taking samples from nature and observing how it lives, it can be seen that designs can be created without harming nature. It will be sustainable and economical in designs made by taking inspiration from the self-sustaining nature.

2.1.4. Regenerative Design

Regenerative design offers the potential to create a healthier environment through human activities and the built environment. It also includes the self-organizing and self-healing aspects of ecosystems to guide design criteria (Eisenberg 2003: 47). In this context, it can be thought that regenerative design emulates biophilic design through its association of space science with natural systems science. Moreover, like biomimicry, regenerative design includes a method of deeply analyzing the complexity of living systems (Darçın 2014: 52).

Various researchers criticize the concept of eco-efficiency, which aims to "produce more with less-resources", and the environmentally friendly / green / ecological artificial environment approach, which is the reflection of this concept on the artificial environment, in the context of environmental sustainability. With efforts to 'go beyond the green'; it is seen that the concept of innovative (regenerativeness) emerged based on approaches such as ecology, bio-regionalism and permanent culture. This concept redefines the human-nature relationship in a different way from the dominant mechanical approach and aims to achieve better than existing by integrating humans and nature within the framework of a peer-to-peer partnership with the fact that humans cannot live without nature and environmental systems, Although regenerative design, which wishes to bring a new order in the design, production, use and after use of the built environment, is not mature enough yet, it is a very comprehensive and extremely positive approach in terms of environmental sustainability (Attia 2017: 76).

In line with these considerations, this design approach can be defined as allowing nature to do some of the work by itself, while renewing people's environmental conditions, by providing appropriate resources to preserve the continuity of the existing system. Therefore, when the human-made environment-ecosystem relationship and conservation-renewal practices are considered, regenerative design can be called the next generation's new design approach based on

continuous transformation. An example of this approach is the Lloyd Crossing Sustainable Urban Design & Catalyst project (Figure 5). The Lloyd sustainable urban design and catalyst project in Portland, Oregon is an example of a project that has applied the concepts of space, adaptation, and time to its design.

Figure 5: Lloyd Crossing Bridge, PDC, Oregon, 2004 - habitat data (URL4).

While the catalyst project is a pilot project within the mixed-use lands in the region, it contains decisions that will guide the transformation of the region for the next 45 years.

The primary aim of the project is based on the principle of bringing the conditions that will arise as a result of development to the natural conditions of the land, taking into account the pre-settlement carbon cycle of the land. The project has the aim of transforming the land conditions in 2004 which is the date of the project, to the ecosystem conditions that were in the pre-settlement state by 2050, within the framework of certain strategies.

The project mentioned here is the one that has the most intended ecosystem-based approach among the reviews handled through the ecological guide. It constitutes an exemplary approach for a new ecosystem-based design model in terms of both meeting the water and sun needs of the land and carrying out the intervention with a controlled organizational scheme. However, the point to be noted here is that while regenerative design considers the ecosystem as a field of study, it only includes criteria on revitalization and improvement. This situation can be a guide for an architectural intervention intended to integrate with the ecosystem, but only provides a foresight for restoration purposes (Bayraktaroğlu 2013: 12).

Regenerative Design approach includes reducing the negative consequences of the built environment, improving past and current environmental damage and

contributing to the environment more than it consumes. It is necessary to protect and develop renewable resources in order to maximize the capacity of regenerative design with maximum sustainable efficiency. In particular, the objectives of regenerative design in architectural and urban design are the use of ecological building material wood, which reduces energy use, waste production and carbon emissions, and the formation of a neutral environment in terms of recycling systems and wastewater-water use (Attia 2017: 78)

2.1.5. Biophilic Design

Biophilic design argues that humans adapt better to environments where nature is more abundant. Biophilic design approach is shaped based on the fact that we feel better in environments where there is sunlight, we are in contact with animals, trees, flowers, running water, birds and natural processes (Orr 2002: 89).

Kellert (2005: 47) mentions that biophilic design has two main orientations: organic design and regional design.

Design which inspires from organic or biology, takes the forms or processes found in nature as the basis and these forms and processes include spatial characteristics such as water, trees, plants, field of view, and concepts such as color and light, which are related to the quality of perception.

It can be said that there is an interaction through the reading of culture, history and ecology in the understanding of regional design (Kellert 2005: 63).

These two orientations have great benefits on human behavior and space. These are the sense of appreciation for nature that is less appreciated by the design industry, but very important, with its positive and encouraging impact on people's productivity, emotional well-being, learning and recovery (Elmashharawi 2019: 74). As it is revealed here, when a person cannot comprehend that his/her deficiency as a spiritual being is a lack of natural experience, he/she cannot fully complete his/her development with an unreasonable pessimism. This situation turns into a process of disengagement from nature and therefore from the self, which is tried to be satisfied through the concepts of power and power.

The reason for explaining the concept of biophilia within the scope of an architectural approach is to underline that people will find the feeling of peace and security they really need in nature itself (Bayraktaroğlu 2013: 17). For example, ladder project in Hattersheim city of Germany of Herbert Dreiseitl who is one of the

designers working on urban hydrology projects, is a good example of the creative use of water. The standard square steps turned into a river right in the middle of the city (Figure 6). It creates a very attractive playground for children (Beatley 2008: 280).

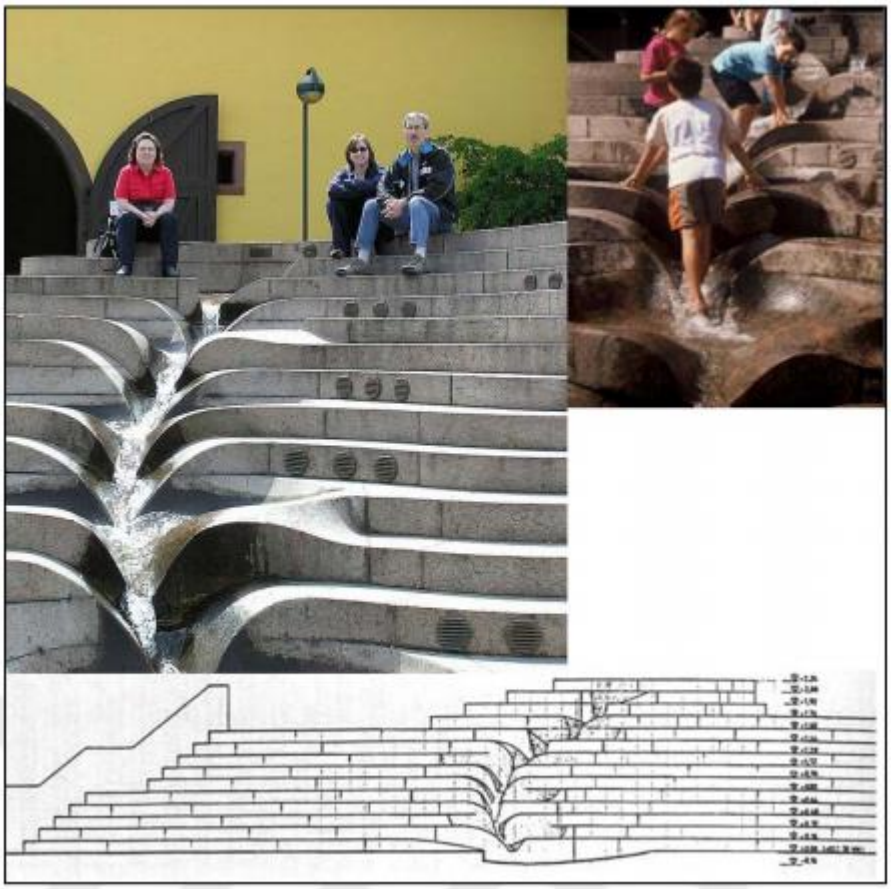


Figure 6: Herbert Dreiseitl's Ladder Project in Hattersheim (URL-5)

In addition to the presence of pedestrians in the city, elements that will enable them to socialize by getting out of their solitary life in their homes should be provided. These can be events such as public art events, street festivals, concerts in open spaces (Beatley 2008: 281). In urban life, there should be areas where children and adults can cultivate. Picking and eating the fruits and vegetables which they grow will be a different pleasure and will strengthen the bond with nature. This is also a very informative activity for children (Beatley 2008: 283).

These tendencies are condemned to weaken without learning, experience, and social support. The role of society is very important in terms of content, intensity and orientation in tendency regarding the establishment of a relationship with nature. Various forms of biophilia are found deep within our biology, and can be shaped by

individual experience and cultural influences, not simply reducing them to instinctive tendencies.

2.2. COMPARISON OF DESIGN APPROACHES BASED ON THE RELATIONSHIP BETWEEN HUMAN AND NATURE

Nature-based design approaches approach the human-nature relationship only with the understanding of mitigating the existing damage. It cannot go beyond the understanding of producing buildings that have the potential to alleviate the environmental effects of buildings and to offer a nature-like formation to their users thanks to their high technology. In contrast to today's building typologies, architecture has tended to imitate nature in most periods of human history. In this respect, although the biomimicry approach is important in terms of using the knowledge of nature in the building, it cannot be considered alone when evaluated for the purpose of the study, since it is incomplete in the 'human' interaction stage.

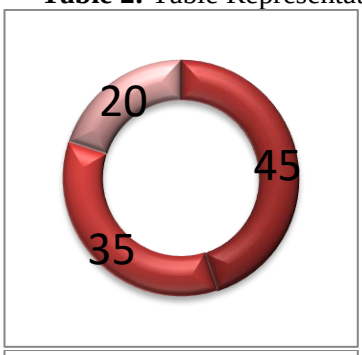
Biophilic design and ecological design come to the forefront as they are the two approaches that give the most importance to the human-nature relationship among design approaches. However, since the ecological design-human interaction concentrates more on space and energy relations and cannot provide sufficient relationship with human perception, emotion and psychology, the orientation towards biophilic design has been strengthened in line with the purpose of the study.

While green design and ecological design approach the natural processes required by humans with a physical and material focus, biophilic design draws attention to the emotional aspect of the need for interaction with natural elements.

Among all these nature-based approaches, it is foreseen that Biophilic Design is the understanding that will contribute in the long run in terms of keeping human nature and emotion in the foreground.

Biophilic Design is based on the human-nature relationship, and it is considered important with its features that enable to consolidate the human-nature-space interaction that can be created at the conscious level, and to transform this relationship into a culture, rather than being a solution proposal only in construction.

Table 2: Table Representation of Human-Space-Nature Interaction (Cramer 2008: 16).

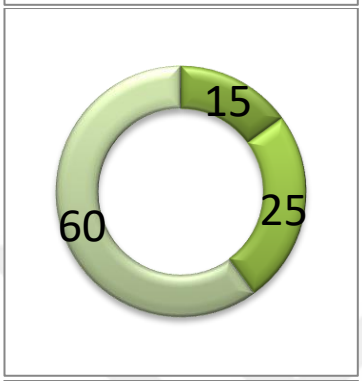


INTERACTION OF
NATURE AND SPACE

Biomimicry: 45 %

Ecological Design: 35 %

Biophilic Design: 20 %

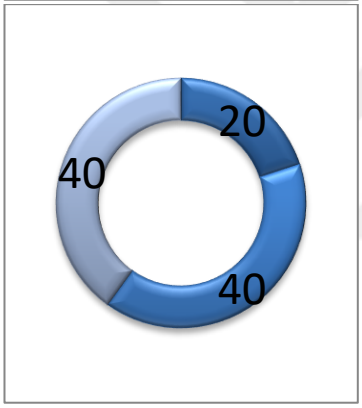


INTERACTION OF
HUMAN AND NATURE

Biomimicry: 15 %

Ecological Design: 25 %

Biophilic Design: 60 %



INTERACTION OF
HUMAN AND SPACE

Biomimicry: 20 %

Ecological Design: 40 %

Biophilic Design: 40 %

When nature-based design approaches are compared, Biophilic Design is observed as the design in which the human-nature effect is realized at the highest rate. This situation returns as a significant impact on human life. For this reason, in the next chapters, the human and nature-based design principles of Biophilic design are examined.

CHAPTER 3
BIOPHILIC DESIGN

3.1. CONCEPTUAL DEFINITION OF BIOPHILIC AND OBJECTIVE OF BIOPHILIC DESIGN

The biophilia word, which is defined as the love for life and living things in the dictionary, consists of the combination of the prefix "bio", which is used for life and living creatures, and the words "philia", which means to enjoy and love (Kaya 2019: 42).

It is claimed that this concept was used for the first time by the famous psychologist Erich Fromm. While explaining biophilia, Fromm expressed it as 'a strong love for life and living things (Fromm 1964: 65). Then, in his 1996 book titled “In Search of Nature”, Biologist Edward O. Wilson defined biophilia as "a natal disposition towards life and life-like processes". The concept of "Biophilic Design" was transferred to the architectural environment by being used in the study titled "Building for Life" of Wilson and Kellert and they expressed their ideas about biophilia in this study in 2005 (Kellert 2005: 67). Then, they wrote a book titled “Biophilic Design” with accompany with the researchers' articles on this subject in order to contribute to the concept of biophilic design (Kellert 2008: 89).

According to Wilson, biophilia is not only an aesthetic preference, but also an important need for humans such as water, food and air (Wilson, 1986 as cited in Amirov, 2017: 15). This hypothesis argues that humans are biologically designed to respond positively to contact with nature and, as Fromm (1964) previously stated, maintaining this dual relationship will help people become better intellectually, emotionally, and spiritually (Kellert and Wilson 1993: 92).

The aim of the biophilic design is to improve the general mood of the person by using the human-nature relationship, to reduce the stress level, and to prevent physical and psychological disorders caused by the rupture of this relationship (Gündüz 2019: 36). Kellert and Calabrese (2015) defined it more comprehensively and descriptively as “an approach that aims to improve people's feelings of physical

and mental health and well-being by re-establishing the relationship between human and nature in the modern urban area". The biophilia hypothesis, which forms the basis of the biophilic design approach, claims that human beings are instinctively connected to all other life systems and this bond should be maintained (Kaya 2019: 43).

The documentary titled "Biophilic Design: Architect of Life" prepared by design experts Finnegan and Kellert in 2011 has contributed to the scientific and social dissemination of the subject by revealing that buildings and living spaces with biophilic design bring people closer to nature.

Biophilic design aims to satisfy these internal adaptations related to nature in the modern built environment and, in doing so, improve people's physical and mental health and well-being (Kellert and Calabrese 2015: 76). Some principles have been defined that must be adhered to for the successful implementation of biophilic design. These principles cover the basic conditions for a truly effective biophilic design example. The five principles defined by Kellert and Calabrese (2015) are:

• Biophilic design requires a recurring and ongoing commitment to nature.

• Biophilic design focuses on human adaptation to the natural world that improves people's feelings of health, well-being and well-being in the evolutionary process.

• Biophilic design encourages an emotional attachment to certain environments and places.

• Biophilic design promotes positive interaction that fosters the spread of a sense of intimacy and responsibility for human and natural communities.

• Biophilic design promotes interconnected and integrated architectural solutions that are mutually reinforcing.

3.2. BIOPHILIC DESIGN PARAMETERS

According to Kellert (2008); The emotional, physical, mental health and productivity of human beings still maintain their commitment to the relationships they maintain with nature. For this reason, it is considered important to examine how this relationship can be maintained in the modern built environment and to put it into practice, and academic and scientific studies on this subject continue.

Research on the spatial dimension of the biophilia hypothesis focuses more on the response of buildings to natural environmental conditions. In this direction,

first Appleton (1975: 89) and then Heerwagen and Orians (1993: 114) prepared a 4-item list about the spatial patterns and physical elements that occur in preferred natural environments.

These items are stated as mystery, danger, shelter and surveillance, confusion and order (Çorakçı 2016: 14). In her study in 2003, Marissa Yao provided details for these articles and identified 14 biophilic main features.

"14 patterns of Biophilic Design" declaration was prepared by Browning for closing the gap between current research and practice regarding these 14 main features (Browning et al. 2014: 4).

The biophilic design parameters, which were examined in fourteen items, were grouped under 3 main headings and the effects of each on humans were discussed separately (Table 3). The fourteen design parameters which are developed through interdisciplinary research, are supported with the studies concluded by Christopher Alexander, Judith Heerwagen, Rachel and Stephen Kaplan, Stephen Kellert, Roger Ulrich, and other experts.

Table 3: Biophilic Design Experiences Identified (Browning 2014: 52).

Nature in the Space Patterns	Natural Analogues Patterns	Nature of the Space Patterns
1. Visual Connection with Nature	8. Biomorphic Forms & Patterns	11. Prospect
2. Non-Visual Connection with Nature	9. Material Connection with Nature	12. Refuge
3. Non-Rhythmic Sensory Stimuli	10. Complexity & Order	13. Mystery
4. Thermal & Airflow Variability		14. Risk/Peril
5. Presence of Water		
6. Dynamic & Diffuse Light		
7. Connection with Natural Systems		

The biophilic design approach, which is effective in different design and production areas, provides physical, mental and behavioral benefits when applied with the contribution of researches.

Physical effects include greater physical fitness, lower blood pressure, greater feelings of comfort and satisfaction, reduced symptoms of illness, and feeling healthier.

Mental benefits include increased feelings of satisfaction and motivation, reduced stress and anxiety, and improvement in problem solving and creativity.

Positive behavior change, better coping with events and mastery skills, increased attention and concentration, decreased feelings of hostility and aggression, and improved social interaction are the positive behavioral effects of biophilic design (Kellert and Calabrese 2015: 79). As a result of these effects, the Typology of Biophilic Design was created.

Utilitarian : The material use of nature. Physical sustainability, security.

Naturalistic : Happiness that arises from direct interaction with nature. Curiosity, mental and physical development.

Ecological-Scientific : Learning the laws of nature and its contribution to science. Knowledge, observational skill.

Aesthetic : The physical beauty and attractiveness of nature. Inspiration, harmony, creativity.

Symbolic : The use of symbols related to nature in language and communication. Communication, mental development.

Humanistic : The deep love and devotion of man towards nature and all living things. Commitment, sharing.

Moralistic : Our ethical responsibilities to protect nature. The meaning and order of life.

Dominionistic : Man taking control of nature in order to sustain his life. Mechanical skills, control.

Negativistic : Fear and alienation from natural elements. Security, protection.

More than five hundred publications have been produced on biophilic responses to identify parameters beneficial to human health, physiology and psychology in the built environment. The identified fourteen parameters have a wide range of applications for both indoor and outdoor environments and are intended to be flexible and adaptable for adaptability in projects (Browning et al. 2014: 6).

These fourteen biophilic design parameters includes psychological, physiological and cognitive benefits (Browning 2014: 12). Thus, parameters ensure they are not confused with other terms used to describe biophilic design, interdisciplinary accessibility is maximized by creating a known language (Kaya 2019: 45).

In the next part of the study, these biophilic design parameters, which are discussed in fourteen items, will be explained in more detail with examples.

3.2.1. Nature in the Space Patterns

Plant life includes sounds, smells, sunlight and other natural elements (Aly 2021: 53). For example, plants in houses, fountains, aquariums, water element, small gardens in courtyards, green walls can be counted (Browning 2014: 15Examples are potted plants, fountains, aquariums, aquatic elements, patio gardens, green walls, or vegetated roofs (Browning 2014: 15).

Nature in the space is discussed in seven items:

Visual Connection with Nature

Visual connection with nature includes visual interaction with natural elements, natural processes and living systems. A window with garden or sea view, potted plants, flower beds, courtyard gardens, green walls and green roofs are examples of this connection (Figure 7). Visual connection with nature reduces stress; lowers blood pressure and heart rate; reduces attention fatigue, sadness, anger and aggression; it has been found to improve mental focus/attention, behavior and general happiness (Browning 2014: 18).

Figure 7: Examples of visual connections with nature (URL-6)

SelgasCano office building, designed by architect Iwan Baan in Spain, is an architectural office built by company officials in the middle of the forest to get away from the noise, pollution and chaos of the city. The building, which has a transparent facade design and is designed in harmony with its surroundings, is an example of organic architecture with its camouflaged appearance in the forest. In the interior, the plain lines and the simplicity of colors are directly proportional to the calmness that is aimed to be emphasized in the design. Working areas located right next to the glass facades ensure the connection of employees with nature not indoors but outdoors (Figure 8). The permanent function of nature is reflected in the space by making the employees establish a visual connection with nature directly. It has been designed with the thought that continuous observation of the real state of nature, living systems and the natural processes of these elements by establishing a visual connection will increase the productivity of the employees in long working hours and intense working tempo (Yurtgün 2020: 67).

Figure 8: Selgas Cano - Madrid, Spain. (URL-6)

Non-Visual Connection with Nature

Tactile, auditory or olfactory connection with nature includes auditory, tactile, olfactory or gustatory stimuli that deliberately and positively give a reference to natural elements, natural processes and living systems (Aly 2021: 54).

Elements such as the sound of water, bird sounds, the smell of the sea, and gardening can be counted as examples (Figure 9). Studies have proven that it reduces blood pressure and stress hormones, as well as the positive effect of sound and vibration on cognitive performance. Every sensory system such as hearing and touch has a large research group to support it.

Figure 9: Example of tactile and olfactive connection with nature (URL-7)

The Slack office building, which was created by the re-functioning of the Carlton United Brewery building located on an area of 865 m² in 1904 in Australia, belongs to an interactive technology company designed to act as a bridge between a deep past and an innovative future. The technology building, designed by Breathe Architecture, was designed based on the idea of rainforests. The interior of the Slack office building is based on a green theme by using completely natural plants (Figure 10). Design team which aimed to establish a connection with nature indoors rather than outdoors, emphasized the function of the natural process by using the auditory, tactile and olfactorive stimuli of nature and elements with positive references to living systems in their work areas. Design team which transferred the biophilic design elements to the space using natural materials and patterns, created spaces that make the employees feel the energy of nature in dynamic spaces (Aly 2021: 54). The silence and tranquility of the rainforests were emphasized with the resting areas and whisper rooms with the idea that the connection with nature should be provided by close contact.

Figure 10: Slack Office Building – Australia. (URL-7)

Non-Rhythmic Sensory Stimuli

Irregular sensory stimuli are variable, random, and temporal connections in nature that can be statistically analyzed but not fully predicted (Figure 11). Examples of natural variables such as the movement of grass or leaves in the gentle breeze, and the undulation of the water surface (Browning 2014: 19).

Figure 11: Example of irregular sensory stimulus (URL-8)

Hiroshi Nakamura and Nap are the design team of the BT group companies architectural office building, which was completed in 2015 and has an area of approximately 1,680 m² in Tokyo. IT group companies common office space are designed as an open office system that can be constantly changed and renewed, which is organized with the possibility of joining more companies. The spatial architecture in IT has never been fully completed. The design team is constantly working on renewal and improvement in the physical areas of the personnel. Dominant materials were not used in order to connect with nature, and personnel was positioned in workspaces consisting of transparent glass lanterns produced with three-dimensional heat forming technology instead of placing them into closed, gloomy and narrow spaces in order to connect with nature in IT architecture office. The formal form of nature is transferred to the space with glass bell jars designed

with inspiration from water bubbles, emphasizing the principle of non-rhythmic sensory stimuli, one of the biophilic design elements (Figure 12).

Figure 12: IT Architecture Office – Tokyo. (URL-8)

Thermal & Airflow Variability

The use of mechanical windows, cross ventilation possibilities, shaded areas, seasonal planting can be preferred in practice (Figure 13).

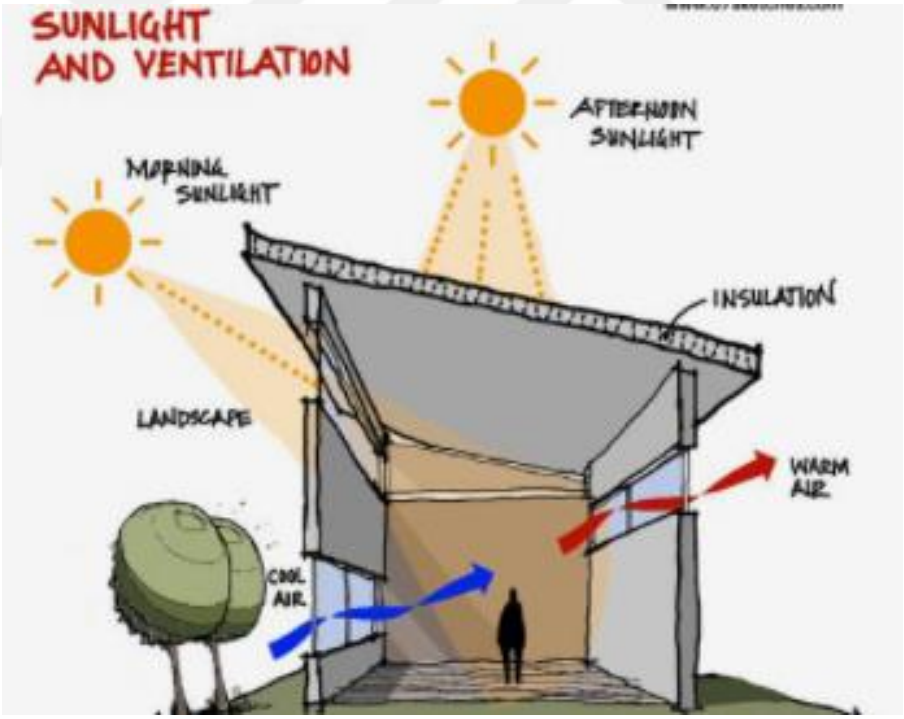


Figure 13: Example of temperature and airflow variability (URL-9)

The office building, which was completed in 2017 by the DWP architectural firm, is located in Dubai. The building, which has an area of 1800m², was designed with the concept of smart building. In the interior design, the designers were inspired by desert oases for their movement and fluidity and resorted to the formal expression

of nature by using organic forms (Figure 14). In addition, the functional feature of nature has been transferred to the space by using special ventilation systems that can adjust the indoor air quality at the desired level in the space designed by considering the heat and air flow variability of nature. Inside the building having Leed Gold certificate, an air-conditioning system has been used that imitates spatial air differences and temperature differences, relative humidity, air flow in the environment and air quality, allowing the users and visitors to feel the temperature differences indoors as well as outdoors, by separating the surface temperatures (Yurtgün 2020: 68).

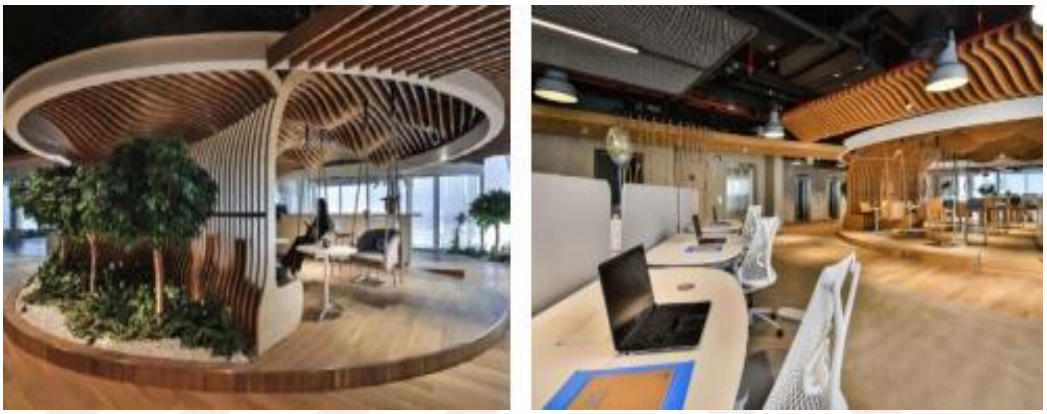


Figure 14: Smart Dubai Office – Dubai. (URL-9)

Presence of Water

Seeing, hearing and touching water has a calming effect. It has been proven by various studies that the places with the water element are more preferred and that these places reveal positive emotional reactions on people. Exposure to water features lowers heart rate and blood pressure, reduces stress, creates a feeling of satisfaction, strengthens concentration and memory, improves perception and psychological sensitivity (Browning 2014: 25).

Figure 15: Examples of water use in the space (URL-10)

Google founder Larry Page designed the Zurich office building on the motivation of the staff. Each each floor of the Google office building which is located in the Zurich - HürlimannAreal region and has more than 2000 employees, has been designed using different themes and colors. Its managers have created a recreation room consisting of five large aquariums in the office building (Figure16). In the specially designed room, a visual lighting system was arranged by using light bars, natural forms and patterns were formally transferred to the space thanks to the aquariums, thus creating a relaxing atmosphere that will enable the employees to feel themselves in the water. In addition, in the space where the principle of "existence of water" is used to reflect the nature, it is ensured that the nature is perceived sensorially by establishing a direct connection with the natural process, allowing the employees to get away from the workload of the day for a while (Figure16).

Figure 16: Google Office Building – Zurich. (URL-10)

Dynamic & Diffuse Light

Lighting design has been used for a long time to determine the mood of a space. The preferred lighting system in the space can cause different psychological reactions. In this context, the effect of daylight on performance, mood, and well-being has been studied for years. Sunlight constantly changes color from morning to evening and the human body responds to this change. When the preferred lighting in the space is independent of natural light, the daily rhythm is negatively affected and causes health problems such as decreased sleep quality, depressed mood, and fatigue (Figure 17). Therefore, the lighting conditions occurring in nature should be imitated with light and shadow intensities and natural light should be used as much as possible (Browning 2014: 27).

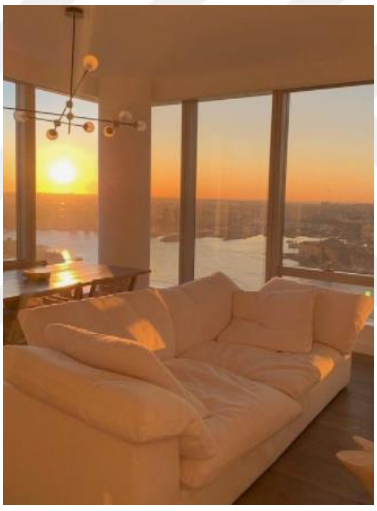


Figure 17: Natural and artificial directional diffuse light effect (URL-11)

The designer of healthcare products office building which is located in Hong Kong on an area of approximately 2600m², is Joe Ho Associates. Office managers have focused on solutions that will respond to the personnel's search for a peaceful working environment in space design. The design team of the building, whose motto is nature, comfort, passion and energy, draws attention to the benefits of benefiting from daylight by maximizing natural light into the space. In areas where daylight is not enough, they used lighting elements that are closest to natural light. Special lighting systems have been created with live and diffused light in the work areas, automatically timed light according to certain hours of the day, and light systems that can adjust the shade intensity arranged in order to give the effect of shadow formed in nature (Figure 18).

Figure 18 : H&H Group Offices – Hong Kong. (URL-11)

Connection with Natural Systems

Developing a deeper awareness of a functioning ecosystem is an important parameter for the continuity of mutual interaction. Spaces that have a good connection with natural systems often evoke relaxing, nostalgic, refreshing and deep feelings. Sometimes a flower grown in a pot, vegetables and fruits grown in pots can be counted as elements that enable to witness natural processes such as seasonal changes. The experience of interacting with the seasonal changes that the green roof of Cookfox Architects' building in New York brings to the residents can be seen in Figure 19 (Browning 2014: 27).

Figure 19 : Green roof of Cookfox Architects' building, New York, USA (Browning 2014: 27).

Indeed Specht office which is designed in collaboration with the Specht architecture team in Tokyo, Japan in 2019, has been interpreted as connecting with nature, experiencing natural processes, and observing and realizing the seasonal changes and characteristic features of the ecosystem. For this purpose, by analyzing special hobby areas, they created areas that will allow employees to grow plants for themselves and witness this natural development (Figure 20). Indeed Specht office building is designed to create a spatial oasis with plants, soft surfaces, colorful wallpapers, plain design and calming work areas. In addition, floor and wall surfaces

were created by using tatami mat, which is frequently encountered in Japanese culture, and coverings were made with cedar and cypress tree bark.

Figure 20 : Indeed Specht Architecture Office – Tokyo (URL-12)

3.2.2. Natural Analogues Patterns

Natural analogues deal with the organic, inanimate and indirect connotations of nature. In the built environment, it shows itself as a work of art, ornament, furniture, decor and textile (Figure 21).

Imitating the patterns of flowers and leaves, choosing colors in the natural environment or organically designed furniture provide an indirect connection with nature.

Figure 21 : Suites Avenue Aparthotel by Toyo Ito is an example of Natural Analoge Patterns with a facade renovation of Barcelona, Spain (Brown 2014:30).

Natural analogues cover 3 biophilic design parameters (Browning 2014: 28).

Biomorphic Forms & Patterns

The purpose of biomorphic forms and patterns is to provide representative design elements that enable users to connect with nature in the built environment. Thus, these design elements, as symbolic representations of life, help reduce stress, increase cognitive performance and contribute to the creation of a visually preferred space. It is represented by the symbolic transfer of patterns, shapes, textures or geometric arrangements found in nature to designs.

The forms of chairs, green grass-like carpet and rounded objects seen in Figure 22 are examples of designs that allow us to connect with nature (Browning 2014: 32).

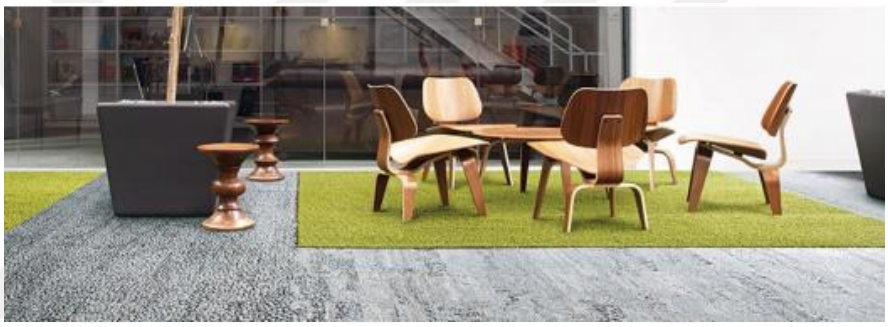


Figure 22 : An example of biomorphic form and pattern in the interior (Browning 2014: 30).

Contours Art office building in London is a light facility that explores the theme of exploration and nature in nature, one of Tableau's famous data visualization techniques. The texture representing the reverse topography of Washington's famous Mount Rainier was symbolized with parametric design by considering the pattern, texture, contour and numerical data of nature, and a reference to nature was made by moving this form to the space (Figure 23). With this design approach, which embodies the calming and dramatic effects of the natural landscape, the design team draws attention to the suppression of the sense of discovery, while satisfying the fascination with mountain ranges and the curiosity of conquering peaks.

Figure 23 : Contours Art Office – London (URL-13)

Material Connection with Nature

As a result of some scientific studies, it has been determined that the preferred natural materials reduce blood pressure, improve the sense of well-being and creativity (Figure 24) (Browning 2014: 34).

Figure 24 : Use of natural materials in the interior (URL-14)

Pons and Huot office building in Paris has a different design idea that gives a new form to the traditional workspace with its fittings built on a wooden horizontal plane that serves as both the ceiling and the table surface. The meeting room and resting rooms within the volumetric mass built from solid oak preserve the feeling of being connected to nature and receive optimum daylight at the highest level (Figure 25).

The designers have carried the space-nature relationship indoors by using equipment related to materials that reflect the regional ecology, aiming to create an unconventional sense of space with this approach.

Figure 25 : Pons and Hout Office Building – Paris. (URL-14)

Complexity & Order

This parameter includes reflecting the rich sensory information of symmetry, hierarchies and geometries in nature to the design in order to design spaces that are visually nutritious and create positive psychological or cognitive responses.

It has been determined that these design elements affect the perceptual and physiological stress positively and contribute to being visually preferred (Figure 26). The transfer of fractal geometry found in nature to design visually, formally or spatially can be considered as an example (Browning 2014: 36).

Figure 26 : The reflection of the complexity-order harmony of nature on the space (URL-15)

The design of the Medibank office building which located in Australia and built on an area of 47,750 m² in 2014, was designed to create a sense of complexity

with organic forms in nature. The main purpose of the designers is to emphasize that everything in nature, even chaos, is in order. The design team aimed to convey the sense of spatial hierarchy, which is similar to natural shapes, through structure (Figure 27). Design team which aims to create a living and breathing building, created two 25 m high green walls on the street-facing surface of the building, this idea helped to relieve the employees from workplace stress, improve indoor air quality, and transform the building's appearance from gray to green, without disconnecting the employees from nature. Despite the curvilinear forms in the interior design, the green wall applied vertically emphasizes the sharp contrast that exists in nature (Yurtgün 2020: 71).

Figure 27 : Medibank Office Building –Australia. (URL-15)

3.2.3. Nature of the Space Patterns

The nature of the space includes the spatial structures in nature. The nature of space focuses on the design of the inhabited natural world around us and how we connect with it (Figure 28).

The nature of the space encompasses four biophilic design parameters (Browning 2014: 37).

Figure 28 : Stepping stones at the Fort Worth Water Garden, Fort Worth, Texas. JayRaz/Flickr (Browning 2014: 37).

Prospect

Spaces with long-distance and unobstructed vision meet the need for control of people and make them feel safe (Blanusa 2021: 76). This parameter which is supported by research in different fields, reduces stress, boredom, restlessness, fatigue and insecurity, and increases the feeling of comfort. Large windows or skylights, mezzanine levels, open plan areas, glass and transparent partitions will be effective in transferring the design (Figure 29) (Browning 2014: 38).

Figure 29 : Spaces with wide field of view (URL-16)

Green office building which is located in Latvia and designed by Open Ad firm, has been one of the most striking examples of analyzing with open office logic by arranging work areas in the middle of wide openings.

The design team, who found it appropriate to keep the distances unimpeded for surveillance and layout planning, came up with a different design that emphasizes the idea of freedom, mobility and flexibility. In this way, employees were given the

opportunity to work with the person they needed, in the field they wanted, whenever they wanted (Figure 30).

Figure 30 : Green Office – Latvia. (URL-16)

Refugee

A sheltered area is defined as a retreat where the individual feels safe, usually behind and above, protected from environmental conditions or central areas of activity. It has been determined that it affects concentration, attention and safety perception positively (Blanusa 2021: 78). As the protective parts increase in the mentioned shelter area, the shelter situation also improves, but this area is not a completely closed area, for example, it should contain a window to communicate with the surroundings (Browning 2014: 39). Semi-closed workspaces designed from natural materials, seen in Figure 31, support their users to work more efficiently by offering a special shelter area.

Figure 31 : Places that create a feeling of refuge (URL-17)

BPX Energy building which designed by Stantec company in 2018 with an area of 118,000 m² in Colorado, is an interactive office building with areas where

staff can feel at home and get away from office stress when desired. BPX, which has a large working team, has produced many innovative solutions in order to increase the potential of its employees.

A space arrangement has been made by considering the need of every living thing in nature to take shelter and to be alone from time to time, refuge areas were designed with a view of the Platte River, which continue from floor to ceiling and are located next to glass facades, which can be removed if desired, so that employees can get away for a while from the work routine, intense activities or ambient conditions that are continuous during the day (Figure 32).

Figure 32 : BPX Energy Office – USA/ Colorado. (URL-17)

Mystery

Mystery covers space designs that include partially hidden viewing angles, long-distance disabled views, or sensory elements that arouse the curiosity of going deeper, and that promise more information (Figure 33). The purpose of this parameter is to design spaces that lead to research that will increase cognitive performance and reduce stress (Browning 2014: 41).

Figure 33 : Space design with a sense of mystery (URL-18)

Google office building in Dublin, with its motto of cooperation and innovation, has a completely different concept, includes numerous work areas, and has a plan that resembles a playground more than an office. Google office building which was only designed for developing the creativity of employees and creating a sense of discovery, allow individuals to travel deeper and engage in the environment of camouflaged things (Figure 34).

The designers, who are aware of the fact that navigating in nature with the forest concept workspace among various areas with many functions, highlights the feeling of discovery in people, have brought everything that can be discovered in nature to the office space.

Figure 34 : Google Office Building – Dublin. (URL-18)

Risk/Peril

This parameter covers the spaces designed by bringing together an identifiable threat element at certain levels, together with a reliable protection area. The harmless and controllable risk experience causes dopamine elevation and a sense of pleasure (Figure 35). In addition, high-level dopamine supports problem-solving ability, memory and motivation in adults (Browning 2014: 42).

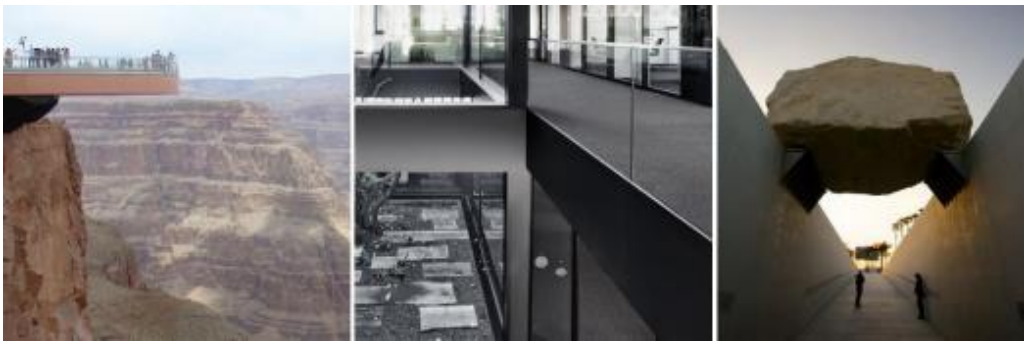


Figure 35 : Spaces that create a sense of risk and danger (Browning 2014: 44).

Evolable Asia Co. It is a tourism company operating in Vietnam. 07 Beach and Studio Happ jointly planned the design of the company's office building. They argue that the risks and threats experienced by living things in natural environments are a feeling that should be felt in human nature as well. Design team who thought that this feeling will keep people alive and alert, tried to emphasize that there is always an undefined threat against human security by arranging natural hills and lattice-shaped work areas in the office building (Figure 36).

Figure 36 : Evolable Office – Vietnam. (URL-19)

It is seen that different classifications are made in many studies examining the biophilic design in architectural structures and examining what kind of experiences it should allow. In this study, the above-mentioned 14 parameters were taken as basis.

Biophilic design uses 14 parameters to create a human-centered approach. When these parameters are applied in built environment designs, they greatly improve the spaces we live and work in today by providing numerous benefits to our health and well-being (Şenozan 2018: 58).

Stephen Kellert has listed the elements of biophilic design for this purpose (Table 4). Based on this table, a new table suitable for interior architecture was prepared.

Table 4: Biophilic design elements created by Kellert in 2008 (Şenozan 2018: 58).

Environmental Features	Natural Shapes and Forms	Natural Patterns and Processes
ColorBotanical motifs	Botanical motifs	Sensory variability
Water	Tree and columnar supports	Information richness
Air	Animal motifs	Age, change and the patina of time
Sunlight	Shells and spirals	Growth and afflorescence
Plants	Egg, oval and tubular forms	Central focal point
Animals	Arches, vaults, domes	Patterned wholes
Natural materials	Shapes resisting straight lines and right angles	Bounded spaces
Views and vistas	Simulation of natural features	Transitional spaces
Facade greening	Biomorphy	Linked series and chains
Geology and landscape	Geomorphology	Complementary contrasts
Habitats and ecosystems	Biomimicry	Dynamic balance and tension
Fire		Fractals
		Hierarchically organized rationd and scales
Light and Space	**Local (Contextual) Relationships**	**Evolutionary Human-Nature Relationships**
Natural light	Geographic connection to plae	Prospect and refuge
Filtered and diffused light	Historic connection to place	Order and complexity
Light and shadow	Ecological connection to place	Curiosity and enticement
Reflected light	Cultural connection to place	Change and metaporphosis
Light pools	Indigenous materials	Security and protection
Warn light	Landscape orientation	Mastery and control
Light as shape and form	Landscape features that define building form	Affection and attachment
Spaciousness	Landscape ecology	Attraction and beauty
patial variability	Integration of culture and ecology	Exploration and discovery
Space as shape and form	Spirit of place	Information and cognition
Spatial harmony	Avoiding placelessness	Fear and awe
Inside outside spaces		Reverence and spirituality

There are studies on biophilic design applications based on their experiences and features in space. The first of these is the study of Kellert (2008). In this very detailed study, a total of 72 features are defined under 6 headings (Table 4).

Kellert and Calabrese (2015) mainly focused on environmental and spatial features, and customized the framework of this classification and gathered 24 experiences under 3 main headings. The main headings in this classification are;

- Direct experience of nature,
- Indirect experience of nature,
- It is the experience of space and place.

The direct experience of nature refers to real contact with environmental features such as natural light, air, plants, animals, water, landscapes in the built environment.

It refers to the indirect experience of nature, the representation or image of nature, the transformation of nature, or exposure to certain patterns and processes that occur in nature. These include paintings, wooden furniture, natural materials, patterns inspired by shapes and forms that occur in nature, environmental processes such as the passage of time and a sense of antiquity.

The experience of space and place refers to the characteristic spatial features of the natural environment that promote human health and well-being. Spatial features such as landscape, shelter, integration of parts with the whole, mobility and way finding (Kellert 2015: 82).

The 24 biophilic design features identified in three categories are listed in Table 5.

Table 5: Biophilic design qualifications created by Kellert and Calabrese (Kaya 2019: 56).

1. Direct Experience of Nature	2. . Indirect Experience of Nature	3. Experience of Space and Place
Light	Images of nature	Prospect and refuce
Air	Natural materials	Organized complexity
Water	Natural colors	Integration of parts to whole
Plants	Simulating natural light and air	Transitional spaces
Animals	Naturalistic shapes and forms	Mobility and wayfinding
Weather	Evoking nature	Cultural and ecological attachment to place
Natural landscape and ecosystems	Information richness	
Fire	Age, change and the patina of time	
	Natural geommetries	
	Biomimicry	

Studies which were concluded till present day, support the measurable and positive effects of biophilic design on health and strengthen experimental findings in terms of human-nature interaction. It also increases the priority level of the subject in both design research and design practice.

This study acts in accordance with the researches for design applications through biophilic responses as a way to effectively promote health and well-being for individuals and society.

Biophilic design aims to meet the need of human beings to establish a one-to-one relationship with nature in the built environment. In doing so, it focuses on the growth struggle of natural life, contributing to human physical and psychological health and productivity (Aly 2021: 58). Accordingly, the inclusion of nature-inspired visual or sensory stimuli in the built environment and living spaces is within the scope of biophilic design. This approach, which offers in-depth solutions to problems and carries nature to architecture and interior architecture, can also be expressed as "the methods in which nature is infiltrated between the built environment".

Just as the concept of green architecture is to minimize the negative effects of buildings on the environment and people, biophilic design concept has the aim to strength the bond between nature and people in living spaces. The spatial dimension of biophilic design focuses more on human responses to natural environmental conditions. Apart from touching, feeling, smelling nature (active contact), people can also gain many benefits by establishing such as watching nature scenery (passive contact) (Yurtgün 2020: 74).

The explained parameters focus on how people react to the natural environment and how they benefit from natural parameters, as well as how these parameters will be applied in the space are mentioned.

3.3. EXAMPLES OF BIOPHILIC DESIGN APPLICATION

Biophilic design can be evaluated in many different scales such as urban design, architectural design, interior design and industrial design can be evaluated in many different scales. Each discipline has intersections. For example, on an architectural scale, green walls used in building design contribute to the urban texture when used frequently. Likewise, there are features where architecture-interior architecture, interior architecture-industrial design areas intersect and can be included in both areas (Çorakçı 2016: 17).

3.3.1. Biophilic Architecture

According to Kellert, the world's most admired buildings have distinctive biophilic features. Kellert mentioned that although these features have strong effects on us, we do not have enough awareness on this issue (Kellert 2005: 373).

Cramer and Browning emphasize that sustainable design principles such as low energy consumption and low environmental impact are not sufficient to realize biophilic architecture. It emphasizes that the next step of sustainable design should be to produce buildings that enrich life, strengthen the bond with nature and create healthy and satisfied people (Çorakçı 2016: 19).

- Bosco Verticale, Milan, Italy

An important recent example of biophilic architecture is the Bosco Verticale (Vertical Forest) project in Milan (Figure 37).

The construction of the building designed by Boeri Studio continued between 2009-2014. The first vertical forest in the world is located in a central area of Milan. The balconies of the two towers, 110m and 76m high, contain soil areas for trees and plants. A natural green facade with the same function has been created without using mechanical and technological sustainable design techniques. The building creates a vertical forest equivalent to 7000m² of green space, without wasting the city's surface area. The building contributes to the regeneration of the natural environment and biodiversity within the city. It creates a microclimate environment and reduces overheating around it. It offers a living environment to the diversity of birds and flies. 900 trees and 2000 plants at different heights have been specially grown here since the beginning of the project.

Plant types were placed in accordance with the placement of the building according to the sun. The plants in the building humidify the surrounding air, absorbing carbon dioxide and dust, while producing oxygen. It contributes to reduce the noise of the city. As the color of the plants changes according to the seasons, the visual effect of the building in the city changes (Çorakçı 2016: 21).

Figure 37: Bosco Verticale (Vertical Forest) Building in Milan (URL-20)

- Swarovski Kristallwelten, Austria

Figure 38: Swarovski game tower interiors, Austria (URL-21)

20M play tower building seen in Figure 38 which was designed by the Norwegian Snøhetta Architecture Office for Swarovski, offers an innovative and biophilic space experience to children by hosting different playgrounds than standard playgrounds. The 14-meter climbing net inside the four-storey building in the Swarovski Crystal World in Austria feeds the children's sense of freedom, excitement and discovery.

The transparent facade clad building prevents the indoor feeling for the users, and even the panoramic observation of the natural structure of the land gives confidence to the people inside and helps the exterior and interior space to be perceived as a whole.

The outdoor playground, which is surrounded by natural texture, made of steel and wood materials and designed in harmony with the existing topography,

offers children unlimited play experiences, freedom of movement in the open air and a variable view of the natural environment (Figure 39).

Figure 39: Outdoor playground adjacent to the Swarovski playground, Austria (URL-21)

Playgrounds designed for children to relax physically and spiritually create a real attraction for children when they are designed with the right design approaches. However, as seen above, accessing areas integrated with a natural environment only in rural areas away from urban centers creates difficulties in accessing. While planning urban areas, certain areas are arranged as natural green areas and this difficulty will be eliminated if the city-nature unity is ensured.

- Fuji Kindergarten, Tokyo, Japan

Figure 40: Fuji Kindergarten, Tokyo, Japan (URL-22)

The architectural structure of this school is designed in such a way that children can move as they wish and live their childhood freely.

While making this design, the architect of the school, Takaharu Tezuka, first observed his own children's motivation to create games and use their creativity and

was inspired by them. As a result, he built the most fun kindergarten a child could ever want to be in. The playground of the school is designed in the form of a circle so that children can run as much as they want (Figure 40). Thus, children can move freely in this endless loop, without the need for anyone to interfere and without the possibility of getting lost (Kivirauma 2007: 285).

In order to reduce the steps, the designers deliberately made a bump from the soil at the starting point of the stairs, but the children started to take these soils and turn them into playground balls, and when 600 children made balls, the bump started to disappear. Eventually, the school administration had to ask the construction company for reinforcements.

Figure 41: Fuji Kindergarten, Tokyo, Japan (URL-22)

When the soil hardened and the children stopped making balls, they started to slide down from there (Figure 41). Architect Tezuka; “Actually, I was not a fan of making slides. Kids love to slide, but we shouldn't tell them what to do. Without dictated materials, children have to use their creativity to think and play.” However, they eventually decided to keep the slide because they needed a fire exit.

There are roof windows above the classrooms. Depends on these windows, children get a lot of natural light indoors and communicate with the sky, while also having the opportunity to explore the space they live in from outside. Also, there are no walls between the classrooms and all sounds can be heard. The architect, who

thinks that noise is very important, explains the reason as follows; “Quiet environments can stress children more than you might imagine.” (Kivirauma 2007: 286). The architect emphasizes that instead of waiting for them to focus by placing the children in a quiet box, they should pay attention to the noise and states that they allow the noise to pass between the classrooms and outdoors (Figure 42).

Figure 42: Fuji Kindergarten, Tokyo, Japan (URL-22)

Children reach to their classrooms by climb trees added to the school in 2011 (Figure 43). If the child has enough strength, he can go to these classes without using any stairs (Kivirauma 2007: 287).

Figure 43: Fuji Kindergarten, Tokyo, Japan (URL-22)

In the PISA project, which is one of the international comparative studies, the outstanding achievement of Finnish students in the subject areas of mathematics,

science and reading skills in 2000, 2003 and 2006 has attracted great attention all over the world, especially in other OECD countries, which are at the bottom of these studies.

In addition to the fact that there are many factors in the success of Finnish students, such as the system applied, teacher training programs, the existence of the concepts of equality and freedom in school life, and taking responsibility data that emerged as a result of research showed that giving opportunities to develop their creativity and keeping them away from stress has a great effect. Within the scope of the study, it is aimed to associate these factors that increase students' productivity with biophilic design.

Another important factor behind Finland's success is that schools, whether located in the countryside or in the city centre, provide students with equal educational opportunities in an arrangement that makes them feel at home (Kivirauma 2007: 288).

Education in Finland has in the past followed a path based on cultural values. Today, the Finnish Education System is based on knowledge, creativity, flexibility and equality. In the research conducted by Schleicher in 2006, it was seen that Finnish students have effective learning.

Creativity was used while preparing the curriculum, a free learning environment was created and students were encouraged to learn by taking risks. It is obligatory to provide multidimensional education to the people we will train by taking into account the current needs.

In addition to activities that will improve the creativity of children in schools, it is observed that they are in close contact with nature, thus they experience experiences that will gain different perspectives by staying away from stress.

Some of the approaches used in the school are as follows:

- Children, including those in kindergardens, spend at least an hour outside a day.
- They provide transportation to school by bicycle, not by bus.
- Freedom, not fear, comes to the fore in education, the freedom is provided with classroom layouts which allow them to move around the classroom during the lesson.

- Gaining hand skills and daily practical knowledge is very important, and the materials and items they use consist of natural materials and colors.
- There are no garden walls that limit the school, students are brought up to take their own responsibilities.

With this system, which is very close to the biophilic design principles; it is seen that when children can be more intertwined with nature and are freed from exam anxiety, stress decreases, learning ability increases, and gaining different experiences brings positive results in terms of their creativity. Thus, it can be observed that the design and use of the education system and related educational structures is a very important turning point in the shaping of humanity and society when considered in the development of children. It can be ensured that children shed light on a healthy future and that this creates a solid cycle by settling in the consciousness of society, by freeing children from the natural environment and without getting away from their own nature (Şenozan 2018: 69).

- Canuanã Boarding School Brazil

A boarding school for poor children located in a remote forest region of Brazil won the award for best new school building in 2018. This school project is an example of the question of how architecture can stimulate its users and the surrounding society in a region rich in natural resources but poor in opportunity, education and economic resources.

The Canuanã boarding school, built prefabricated from sustainable wood, showed sensitivity to biophilic design principles while demonstrating the value of society and the importance of using natural resources consciously and sustainably (Figure 44).

Two villages, one for male students and the other for female students, with a total area of 23 thousand square meters, were designed with sustainable design principles. In this new campus project, instead of large dormitories, 45 units, each with 6 students, have been designed (Merdim 2018: 89).

Figure 44: Canuanã Boarding School Brazil (URL-23)

There are similar accommodation structures on either side of the school campus, one for boys and girls. Each of the structures is covered with a giant floating roof cover that rises on independent wooden structures (Figure 45).

The dormitory rooms that surround the garden on the school campus are separated from each other by their distinctive patterned door panels. The rooms, which are ventilated using a handmade perforated brickwork system, have specially designed furniture. A series of wooden stairs connects the upper floor walkways and balconies, allowing us to view the entire space and the entire courtyards from above.

Figure 45: Canuanã Boarding School Brazil (URL-23)

Supported by a lightweight wooden structure following a regular 5.90×5.90m grid, this thin white metallic roof pupils form an intermediate space between exterior

and interior spaces, beyond protection from sun and rain. The laminated eucalyptus wood used in the structural elements was preferred to speed up the construction process, to minimize the difficulties in the operation of the school and to benefit from its sustainable features (Figure 46).

Similarly, stabilized earth blocks made from local soil were chosen because of their optimal temperature characteristics and to eliminate long-distance transportation. The material is knitted solid in some parts of the building, and hollow in places where ventilation is required.

Figure 46: Canuanã Boarding School Brazil (URL-23)

The building, designed by the architectural firms Aleph Zero and Rosenbaum, received high praise from the award jury for its "modest prowess".

Gustavo Utrabo, one of the architects of Aleph Zero company, says that the building improves the quality of life of children. “We wanted to add a contemporary twist to traditional building in this part of Brazil and create a new feeling,” says Utrabo.

3.3.2. Biophilic Interior Architecture

Today, people spend 90% of their time inside buildings. The effects of the places they live in on people is an important issue. Architects are responsible for considering the effects of the buildings on human psychology. Biophilic Design is

also evaluated in interior architectural design, apart from the urban and architectural scale. Natural elements have certain advantages as they can be found indoors at less cost and in a shorter time (Aly 2021: 93)

Bringing nature indoors brings certain limitations. For example, the types of plants to be used indoors, the use of ultraviolet light in places that do not receive natural light, and irrigation techniques should be evaluated. In cases where the real nature cannot be brought into the space, the forms in nature, natural materials, nature pictures or systems simulating nature find a place in the design (Çorakçı 2016: 23).

- Khoo Teck Puat Hospital, Singaour, Malaysia

Khoo Teck Puat Hospital which was evaluated by considering the biophilic design parameters, was built in Singapore, the capital of Malaysia, and started to serve in 2010 (Figure47).

The land next to the Yishun pond was chosen for the residential area of the building, and it was aimed to perceive the hospital and the pond as a whole. The corridors of the hospital structure, which consists of four interconnected main buildings, are designed semi-open in harmony with the prevailing climate of the city. Gardens, courtyards and terraces designed with a natural ecosystem setup using a large number of tropical plants, water and natural materials; made the hospital a preferred habitat for the living species living in the surrounding area. The building which won many international awards, including the "Stephen R.Kellert Biophilic Design Award", not only serves the patients, but also serves as a social resting area by being opened to the public (Kaya and Selçuk 2018: 39).

Figure 47: Khoo Teck Puat Hospital (URL-24)

A natural ecosystem has been created around the building and integrated with circulation areas. The pond and natural environment next to the land area can be observed from the patient rooms.

- ✓ The material connection between interior and exterior;

Vitality, smell and noise formed where blue and green, local plant forms and water meet, has helped create an environment filled with sensory variability. A large number of creatures living in the created ecosystem have been identified (Selçuk 2021: 28).

Natural variables observed and felt around the building such as plants, insects, birds, water, waterfall, sky, sun, wind, water have a sensory stimulation effect.

- ✓ Natural ventilation ;

The facades are designed to be permeable to air flow to naturally ventilate the rooms. Aluminum wings or “wing walls” along the walls of the building are designed to direct the prevailing winds into the building by increasing the wind pressure on the facade.

Common areas such as the main lobby and corridor have been specially designed for optimum natural ventilation, thus reducing the need for mechanical ventilation.

✓ Access to water;

The social spaces of the hospital are designed to be located next to the pond. A waterfall connected to the pond has been constructed on the basement floor (Figure 48).

Figure 48: Khoo Teck Puat Hospital (URL-24)

✓ Dynamic and diffused light;

Light shelves and movable glass shutters are used on the façade. Facade elements and landscape greenery create patterns of light and shadow in the space (Figure 49). This situation is reflected in the interior as a temporal stimulus (Selçuk 2021: 32).

Figure 49: Khoo Teck Puat Hospital (URL-24)

✓ Local and natural material;

Inspired by the nature of the jungle, the landscape decks and terraces mimic the different layers of the tropical rainforest. Natural patterns are integrated into the ceilings of the elevators, the walls and the concrete floor (Figure 50).

Figure 50: Khoo Teck Puat Hospital (URL-24)

✓ Visual connection from interior to nature;

The transparent facade of the building has expanded the field of view of the patients and strengthened their communication with the outside (Figure 51). Transition areas such as decks, sky bridges, clinic waiting areas and pond promenade allow open and unrestricted observation of the surroundings (Selçuk 2021: 34).

Figure 51: Khoo Teck Puat Hospital (URL-24)

✓ Shelter;

Sky bridges, semi-open corridors and terraces have been designed so that they can observe the surroundings from afar (Figure 52). The building is designed not only as a healing space, but also as a quiet place where local people can attend conferences, exhibitions, educational programs. The building, which has become a part of the urban context, is also preferred as a recreational place for the people.

Figure 52: Khoo Teck Puat Hospital (URL-24)

✓ Mystery;

Tropical plants and landscape designs used in the courtyards have provided the area to gain a natural forest appearance (Figure 53).

Figure 53: Khoo Teck Puat Hospital (URL-24)

- Cano Lasso, Second Home, London, England

Madrid-based studio Cano Lasso which is evaluated within the scope of biophilic design principles,designed the last branch of Second Home in East London within the scope of biophilic principles(Figure54). With its translucent panel with circular openings on the façade, the building also houses a nursery and outdoor playground.

Figure 54: Cano Lasso, Second Home (URL-25)

Colorful interiors designed by Cano Lasso are located behind the facade of the London Fields building. On the ground level, there is a cafe and seating area that will be open to the public all day with its tangerine-colored flooring and polycarbonate walls. This space extends into a study with textured orange walls in the back. The study has ring-shaped "flying" tables that can be stored in circular recesses in the ceiling using a pulley assembly.

The first floor features a series of white curved tables separated by curved low partitions where members can work in a quieter and more concentrated atmosphere (Figure 55).

Figure 55: Cano Lasso, Second Home (URL-25)

The cork panels suspended above also help lighten the acoustics (Figure 56).

Figure 56: Cano Lasso, Second Home (URL-25)

The second and third floors feature studio-style workspaces that can accommodate teams of up to 40 people. More than 500 leafy plants and trees were included in the London Fields branch to create a healthier work environment and biophilic designs were created There are also multiple glazed window slots on the ground facing the lower floors (Figure 57).

Figure 57: Cano Lasso, Second Home (URL-25)

London Fields branch which was designed with the desire to be “the most family-friendly workspace in the city”, includes a nursery. This place is the first branch with a nursery. The nursery which is designed by Peckham-based architecture

studio Kennedy Woods,is furnished in soothing shades of pale gray and has fun features like house-shaped wooden storage units (Figure 58).

Figure 58: Cano Lasso, Second Home (URL-25)

The building's rooftop terrace features a playground complete with a small-scale racetrack and a waterboat for children to play.

- Discovery Elementary School, USA

Discovery Elementary School is the largest zero-energy school in the United States (Figure 59). In other words, the school produces all the energy it consumes from its own renewable energy sources. The sustainable school produces all the energy it consumes from its own renewable energy sources.

Figure 59: Discovery Elementary School / USA (URL-26)

The problem here was to place the entire array of solar panels on the roof, integrating a massive 9,100 square meters of building into the residential zone. The green school project, designed by VMDO Architecture, met the global goals by terracing the building mass towards a south-facing hill, making local goals for scale, community goals for maintaining horizontality, open spaces for recreation and ideal orientation for solar power generation.

Figure 60: Discovery Elementary School / USA (URL-26)

Discovery Elementary School in Arlington, Virginia provides a example of a solution to the climate change encourages and encourages students along the way with the expectation that they will become creative students in those solutions (Kaya and Selçuk 2018: 39).

The school which was built to meet the rapidly growing student enrollment in Arlington was designed to meet the larger goal of proving what it can truly achieve with a new school building (Figure 60). For this reason, care has been taken to design a school that supports students' learning process to be more enjoyable and effective areas (Kaya and Selçuk 2018: 39).

Figure 61: Discovery Elementary School / USA (URL-26)

Every corner of ecological school has been designed in accordance with biophilic design parameters.

There are direct and indirect biophilic approaches to spaces. While the natural colors and figures used in the space emphasize the indirect design, the natural materials used in the elements such as natural lighting are examples of direct biophilic design (Figure 61).

Green School was designed as a zero-energy building; this means that the annual amount of energy produced by the building's renewable energy sources is equal to the amount of energy consumed by the school annually. Programmable open spaces are preserved as much as possible by placing exactly one-third of the green building's footprint on existing slopes.

The school is placed on an existing hill to match the scale in the residential area and to minimize the perception of its size. The design of the Ecological School takes advantage of the site's topography to create separate, tiered academic zones and open playgrounds for the nursery, kindergarten and primary levels.

On the north side, the school uses playful arrangements of cool colors such as green and blue, reflecting the natural expression of moss growing on the north side of the trees. With the school, the first floor themed with animals in earth ecosystems and the second floor themed with sky elements, students' worlds grow throughout their school life (Kaya and Selçuk 2018: 39).

- Silkeborg High School, Denmark

"Nature's House" was designed by ReVærk for Silkeborg High School students. ReVærk with "Nature's House"; Beyond the functions, he aimed to design a space with atmosphere and inspiring (Figure 62). While designing a sustainable and contemporary building, attention was paid to adhere to historical roots (Figure 63).

Figure 62: Silkeborg High School, Denmark (URL-27)

The priority of the school is to create a sustainable, “living” space that connects closely with its environment. Structure is located between green area and dense forest. Being outdoors is thought to be a new beginning for teaching. To create the appropriate environment for this purpose; an invitation to connect the issues to their essence was also seen as a necessity.

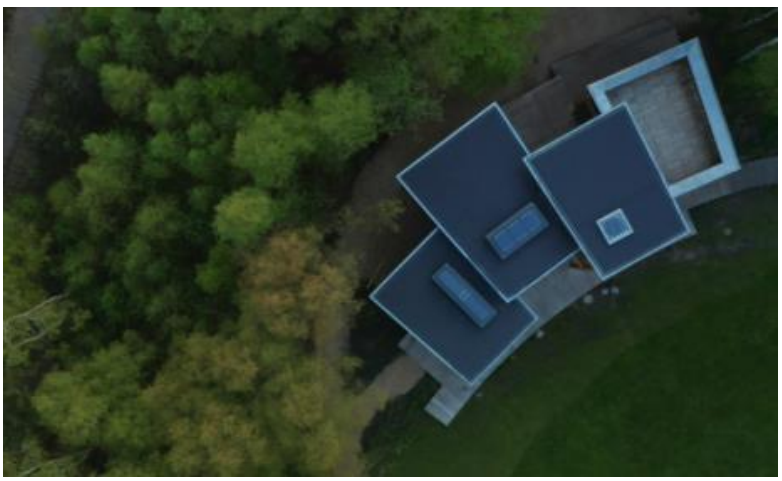


Figure 63: Silkeborg High School, Denmark (URL-27)

The design of Nature's House was inspired by the Danish timber-framed structure called the “bullade”, which dates back to the Viking Age. In the ventilation/heating system, Russia's 250-year old "fortochka" (ventilation) window, which creates natural integrated ventilation through thermal flotation, is taken as a reference.

Figure 64: Silkeborg High School, Denmark (URL-27)

Insulated construction with wood fiber obtained from wood residues was used in the building (Figure 64). The ground has a high level of groundwater and a large layer of organic soil. However, since building the foundation with concrete would result in inefficient and costly results, the building was placed on a screw pile foundation and thus its relationship with the environment was preserved. This allowed the structure to lie among the trees and interact with each part of the forest at different points.

Natural materials were used to bring the building as close as possible to its function and its surroundings: oak, fir logs and acacia were used for the exterior cladding of the structure. It was aimed to protect the quality of the work by extending the construction period. The structural and visual continuity of the wood is ensured in the area. Since the structure is demountable, it is possible to reuse it in different contexts.

- Eco Moyo Education Centre, Kenya

Eco Moyo Education Center which was designed by The Scarcity and Creativity Studio upon the request of the education-oriented organization Eco Moyo, has two classrooms and a farm belonging to the school (Figure 65).

Eco Moyo is an educational community-based organization that provides free education to children from underprivileged families in the Kilifi residential area in Kenya.

Figure 65: Eco Moyo Education Centre, Kenya (URL-28)

The team built a place for the accommodation of 20 students and teacher throughout 2017 and now plans to move their work to the new space.

The development plan of the Eco Moyo Education Center consists of two parts. The first of these is Eco Moyo Primary School, modeled on the Montessori education method, emphasizing practical approaches to issues with the help of green building principles and ethics, ecology, creative thinking and communication skills training.

In the second part, Eco Moyo Farm, permaculture principles have been adopted and it is planned to make food, wood and livestock (Figure 66). The goal has been to open the farm to locals and visitors while meeting the needs of students and staff.

Figure 66: Eco Moyo Education Centre, Kenya (URL-28)

Coral stones processed with 1/12 cement and local soil were used as materials for the building. There are light walls made of planed softwood that provide ventilation and controlled natural light penetration behind each classroom. Roof trusses are also constructed of soft wood and covered with corrugated metal sheet. The roof is also designed to divert rainwater to large water tanks at the rear. The textile ceiling covering, which is not yet completed, will be hung under the roof trusses in order to filter the radiation coming from the metal sheet.

This school, which was designed in line with low budget and limited opportunities, served the function by using basic data within the scope of biophilic design and simplified with a direct design approach.

The effects of school buildings and physical environmental conditions on learning and teaching processes are too great to be underestimated. Class sizes, the number of students in the classroom, the layout of the desks, the quality of the furniture and furnishings in the school, the technological devices of the school and the classroom, the size of the school building, the location of learning environments such as laboratories and libraries in the building, the location and quality of the teachers' room shapes educational activities and significantly affects the behaviors of students and employees. In addition, the characteristics of the school building in terms of heating, lighting and auditory affect the learning processes and the motivation of students and teachers deeply. For this reason, it is necessary to renew the existing school buildings according to the requirements of the day and to carefully plan and design the new buildings based on modern approaches.

3.4. ANALYSIS OF BIOPHILIC DESIGN ON EDUCATIONAL BUILDINGS

Education is a multidimensional phenomenon that develops under the influence of many factors. The physical conditions of educational buildings, one of these factors, play a very important role on the quality of education. On the other hand, education structures have an important place in the lives of students, as they spend more time at school with their teachers and friends than they spend at home and with their families (Bademcioğlu 2016: 184).

Schools are places that allow students to develop, provide a sense of community, and encourage collaboration. Learning, the most important activity in school structures, is a complex process related to student motivation and physical conditions. Teaching resources, the quality of the teacher and the curriculum have an important place in the education of the student (Lyons 2001: 15).

It is seen that the importance of sustainable design has been emphasized in the studies in recent years in which the environmental conditions desired to be possessed by schools have been defined. It is thought that a healthier and more productive environment can be created for children in school buildings where sustainable design principles are adopted. It is emphasized that the schools should be designed in a way that they are thermally comfortable; contact with fresh air, daylight and scenery; have acoustic conditions that support learning; provide sports facilities; able to use the environment as a learning resource; able to obtain good potable water; provide social opportunities that support friendship and social development and are sensitive to individual safety.

Biophilic design has an important place in the places where education services are offered due to its positive effect on human psychology. While most of the existing educational buildings are designed with a functional focus, the effect of these spaces on human psychology is discussed in the background (Kaya and Selçuk 2018: 37). The findings obtained from the studies carried out to date show that nature is an important helper in reducing stress, that nature develops positive emotions, and accelerates the learning process by increasing creativity and perception rate. Many studies reveal that there is an important relationship between the physical conditions of the school structure and student performance. In these studies, it was determined that the physical conditions of the educational buildings directly or indirectly affect the success of the students (Vandier 2011: 67).

In line with the research, it is seen that biophilic design is not only related to bringing natural elements to the space, but also to knowing the existence of nature. In this context, biophilic design is not only the process of obtaining visual results in interior design applications, but also an intellectual process that should be focused on human psychology. Therefore, the physical and psychological needs of people should be kept in the foreground in the design process, whose user is human. By closing the gaps of today's architecture and design understanding with biophilic design practices, reflecting the awareness of the strong bond that exists between human and nature in living spaces through sensory and visual stimuli will help to create new interior design fictions with human-nature interaction. The biophilic design approach, which aims to eliminate environmental problems in educational buildings that are a part of our lives, to ensure the awareness of the individual against his/her environment and to make the people more efficient by increasing the quality of life of the individual, also aims to create happier societies and to to ensure the continuation of the well-being of individuals.

The society formed by the school, is a complex structure of human relations, work plans, schedules, and daily activities. School buildings form a physical environment for this structure. Therefore, the probability of buildings to affect the activities taking place in the school is very high. School buildings have a restrictive or supportive effect on school activities (Tapanien 2006: 11). In other words; the physical environment of the school profoundly affects whether students like to be in school, the quality of teaching, and learning outcomes.

For this reason, the design of the school building and the school building should enable effective use. School campuses and buildings are an indicator of the importance given to education as a source of reputation in general. It reflects the values, behaviors and cultures of those in it; the structure of units such as floors, walls and toilets is formed in a social and cultural context. This reflects the level of knowledge, vision, interest and responsibility of the people in charge. If the environment is in bad condition, it creates a feeling of worthlessness and abandonment in students, teachers and parents. School building and campus features have the feature of affecting personal health, school climate, school life satisfaction and student success with all these variables (Şahin 2019: 46). When ergonomics sciences are considered, the physical environment; acoustic layout, light quality, ventilation, thermal/humidity features, colour, spaciousness, hygiene and noise affect

biological and psychological health, teaching and quality of life positively or negatively. All of these affect the physical, emotional, social and academic development of students through school climate and school life satisfaction (McGregor 2004: 15).

Students spend most of their time in the classroom by performing performances that include many activities such as listening and understanding the lessons, sitting in line, discussing the topic, writing (Corgnati 2007: 954). While performing all these activities, students interact with the physical environment elements without knowing that they can contribute to their performance, health and safety. In addition, there are many studies showing that basic physical values (air quality, temperature and noise, etc.) have an effect on learning (McGregor, 2004; Edwards 2006, Hunter, 2006; Earthman, 2011; Lyons, 2001). In this context, 14-item Biophilic Design Criteria revealed by Browning et al. is important in terms of being a guide for future educational buildings by evaluating the buildings from the perspective of interior architecture. Understanding and recognizing the behavior patterns arising from the relationship between human and nature will also be effective in putting forward educational structures suitable for human physiology. Having biophilic design elements while designing the interior will contribute to the success of the users as well as their physical and mental health.

3.4.1. Students' Relationship with Nature

Children interact directly and intimately with the physical environment. Being outdoors provides a more satisfying experience for children when compared to indoors (Davidson 2013: 56). Because the external environment is a diverse, constantly changing, very sensitive and lively environment. Early childhood is a critical period in which a love of nature and awareness of nature will be gained. Interaction with nature at an early age; In addition to the healthy development of the child, it leads to positive results in terms of awareness, commitment and ecological responsibility towards nature (Köşker 2019: 41).

In this period, awareness and love will be developed through nature activities, and the basis of nature consciousness will be formed, as well as the physical, cognitive, social and emotional development of the child will be supported. On the contrary, today, children are more drawn in closed spaces. These children, called “indoor children” or “digital natives” by Migliarese (2008), live far from nature and

natural consciousness (Migliarese 2008: 67). Nature consciousness should be gained through the use of natural elements and spaces in the child's living environment.

The idea of teaching nature education at school, as it is handled today, is insufficient since it does not include an application in life (Çukur 2008: 181) . It does not seem possible to carry out an education that targets ecological consciousness with object-oriented teaching activities that are not based on experience, rather than nature itself, which is confined to the classroom. In particular, activities that feed on children's sense of curiosity are important in terms of understanding nature and the relationship order in nature. The child's ability to learn about natural elements and the relationship between them depends on recognizing nature. In an education to be held in nature, the experiences gained by using all his senses will raise awareness to the child, and then they will turn into attitudes and behaviors that will form the basis of ecological consciousness (Moghaddamı 2019: 74). Biophilic design is an important guide in awakening these senses of children, which cannot find their full response in closed spaces.

While almost all of the adults who participated in a study in Israel stated that the places they valued most in their childhood were natural areas, most of the young people between the ages of fifteen and eighteen had different answers to the same question. One of the reasons for this difference in perception is the built environment approaches that have changed from past to present. When the children's play practices in the Netherlands in the 1950s and 1960s and the first years of the 21st century are compared, it has been determined that children play outside less frequently and for a shorter period of time, they have a more limited circulation area around their homes, and they have few playmates (Louv 2012: 93).

While increasing construction, formalized park and garden rules, environmental regulations, building regulations, community agreements and similar official rules limit the free spaces of young people, they indirectly document that the only way to spend time outside is standard shopping mall activities (Louv 2012: 93). Although the relationship of young people with the outside environment is quite limited in city centers, the built environment and environments that are preferred because they are safer and more controlled offer a life disconnected from the natural world.

The child's brain is formed by the genetic structure of the family, but the interaction of conditions and environment directs how the child's brain develops

(Louv 2012: 95). For this reason, biophilic design should be the dominant design principle in order to create a quality environment in activity areas such as schools, green areas around houses and botanical gardens where children spend most of their time (Moore 2008: 123).

3.4.2. Biophilic Design Effects in Educational Fields

In spaces designed for young people, features that stimulate the sense of curiosity and discovery are very important for their mental and physical development (Çorakçı 2016: 15).

Green building design policies should give equal importance to the school interior and garden. Behavioral needs of users should be considered as well as green technology requirements. In order to leave the planet healthy for the next generation, the practice of sustainable development should be integrated into the education system and reflected in the design of schools. It should be ensured that children not only learn nature, but also learn in nature (Moore 2008: 124). Louise Chawla from University of Colorado has made attempts to have children and natural design evaluation criteria in the LEED - Green building evaluation certificate. It should architecturally ensure that children interact between indoor and outdoor spaces during the day.

For this purpose, glazed botanical gardens can be built in very cold climates. In the interior, it is necessary to allow sufficient daylight through large windows and to provide indoor-outdoor transitions (Moore 2008: 127). Bringing the biophilic design to the spaces can be achieved in the first stage in a simple and inexpensive way, such as making more use of natural light, greening the building indoors and outdoors, using natural materials and colors in the space, and the right organization chart (Elzeyadi 2012: 56).

In a study conducted by Vivian Loftness at Carnegie Mellon, it was found that students brought 20-26% higher test results under natural light.

From a political perspective, greening educational institutions seems like a fairly simple step. Instead of investing only in manufactured tools and equipment, investments should also be made in trees, shrubs, perennials, and natural objects such as rocks and salvaged wood chips that are less expensive than them. To be successful, the greening strategy must first be taught to the education staff. However, many school educators are not trained in what to do with teenagers outdoors. To

address this situation, some centers have hired a gardener as an “outdoor teacher” to fill this lack of expertise. However, as long as open spaces continue to be labeled as “playgrounds” and are not seen as an integral part of the educational environment for both playing and learning, the proliferation of nature play will remain an elusive goal (Moore 2008: 128).

When the existing educational buildings are evaluated, it can be seen this area is not developed and even the simplest design principles cannot be applied. Basic functional requirements such as positioning windows at ground level in kindergartens, bringing daylight into the interior, and designing the transition between indoor and outdoor spaces to be more flexible are hardly met. Outdoors, traditional school equipment and repetition of static processes are preferred rather than a dynamic, natural learning environment that can offer new experiences every day (Moore 2008: 129).

Mental Well-Being

'Wellbeing' is not just a lack of pain, discomfort and incapacity, it is also a positive physical, social and mental state. It requires that basic needs be met, that individuals have a sense of purpose, and that they feel able to achieve important personal goals and participate in society (Saylam 2019: 28).

Human’s well-being status cannot be measured directly because it cannot be observed directly (McLeod 2007: 4). In this sense, it is useful to make a distinction between the objective and subjective dimensions of well-being. Objective dimensions reveal material and social characteristics that contribute to or take away from the well-being of the individual or society. These dimensions are the level of wealth, education and health conditions. It includes many basic human needs, economic needs, and environmental needs (factors considered important to the well-being of society) and is easily measured at the population level (Parris 2003: 564).

In contrast, subjective dimensions enable the individual to evaluate his own circumstances, what he thinks and feels. Well-being is an abstract concept that expresses the state of a person's life (Saylam 2019: 30). Subjective well-being research has been prominently discussed in the psychology literature lately (Layard 2005: 167).

The limbic system in the brain regulates stress levels and controls responses. When this area of the brain is triggered, more serotonin is released, a hormone found in all humans that helps our bodies focus and prepare for shock, pain, and fatigue.

(Barton 2010: 44). Serotonin also regulates mood. Low levels of this chemical can increase the onset of depression. Along with serotonin, other neuro-chemicals can affect a person's health positively or negatively (Kopec 2012: 184).

In this context, positive distractions are attributed to elements in the built environment that “hold attention and attention without burdening or stressing the individual, and therefore capable of inhibiting or reducing worrying thoughts.” (Saylam 2019: 31). Research on the positive effects of nature on human psychology has shown an increasing development in the last 30 years. A study which is considered one of the first studies in this subject, investigated the psychological benefits that people obtain from their gardens.

1. Firstly, the effects of visual landscape on the emotional states of stressed students who had passed the final exam, are analyzed. As a result of the research, it was observed that the stress of the students watching the nature landscapes decreased, while the students watching the built urban landscapes became more stressful than their situation at the end of the exam (Ulrich 1993: 82).

2. The effects of watching nature landscapes were re-explored by Ulrich (1993) in another study conducted in Sweden, and it was found that the psychological benefits of natural landscapes also occur in individuals who are not stressed.

3. In his third research on this subject, Ulrich (1991) measured the physiological and psycho-physiological responses (heart rate, blood pressure, muscle tension, brain waves) of individuals watching natural landscapes and proved that watching natural landscapes lowers the tension on the subjects and accelerates recovery in stressful situations and showed that nature has recovery effects among the values measuring stress (Ulrich 1991: 99).

4. In a similar study concluded among students living in university dormitories, it was found that students whose windows face natural areas have a stronger capacity for direct attention than students who stay in rooms lack of such views (Tennessen 1995: 81).

5. Another study concluded on this subject has shown that camping in the forest has positive effects on human psychology in the short and long term, and that people returning from the camp have a constant desire for the green environment and their feelings during camping (Ulrich 1993: 84).

6. Hartig (1991) has provided relatively strong evidence that being in natural areas facilitates recovery from mental fatigue. In the research that made a comparison between three groups who went on a nature trip, took a vacation in the city and did not take a vacation, the groups were asked to correct the mistakes on a reading piece and as a result, the group that went on a nature trip got the best score.

Physical well-being

Researches carried out in recent years have begun to draw attention to the relationship between the quality of the visual environment and the physical health of people. Many studies in this field have shown that watching nature can positively affect people's physical health (Abdelaal, 2019) . Although the mechanism in such associations is speculative, they are likely attributed to the relationship between stress and the immune system.

The most controversial one among them is a study conducted by Ulrich (1984) in a hospital in Pennsylvania on patients who had gallbladder surgery.

1. Patients in the same post-operative recovery period, who stayed in a room with windows facing the forest, requested less pain-killers, showed more positive behavior towards the surgery, recovered more quickly, and were discharged earlier when compared to the patients who stayed in a room with windows facing the hospital wall (Ulrich 1984: 420).

2. Another study (Verderber 1986) concluded among patients with severe disability as a result of accident or certain illness also showed that such patients preferred landscapes containing natural areas or trees over others.

3. Moore (1982) showed that prisoners whose cell windows face nature are less likely to suffer from digestive system diseases, headaches, and some other ailments, which are considered symptoms of prison stress.

4. The role of nature on human psychology and therefore on physical health has also been investigated in the work environment (Kaplan 1988: 69). It has been determined that people who have the opportunity to watch natural objects such as trees, flowers, forests from their workplaces, have less work stress than those who do not have the opportunity to see such areas and are more satisfied with their work, and complain less about headaches and other diseases.

5. In another study concluded regarding employees working in an office, it was seen that peers who could not see the outside environment equipped their desks

and surroundings with nature views more than those sitting by the window (Heerwagen 1990: 89) .

As a result, mental fatigue is a fact of life in a world full of information.

Finding ways to improve is greatly aided by the availability of restorative environments and experiences. In addition, it is possible to design and manage natural environments in ways that promote recovery from mental fatigue (Saylam 2019: 33).

The Effects of Biophilic Design in Supporting Well-Being Mood

Our admiration to nature arises not only from the natural elements, but also from the qualities and characteristics of natural environments that people find particularly attractive and aesthetically pleasing. The goal of biophilic design is to create spaces filled with positive emotional experiences (pleasure, satisfaction, interest, admiration and curiosity). These experiences are the pioneers of caring for the place, which gives people a commitment to the place (Gillis 2015: 957).

While the human survival instinct compels people to find the means to live, achieving a “feel-good” state promotes well-being, productivity, and efficiency in society. This optimal condition elevates human behavior, encouraging them to do more and be better. When people experience a state of well-being, they come together with a greater sense of dignity and pride in the environments for which they were designed. But design to improve it; should encourage intangible factors such as trust and respect. Successful design therefore relies not only on artistic elements, but also on factors that help define an individual's place in the world to a large extent. Obviously, most designs do not achieve this end. One reason may be the degree to which a medium is still preoccupied with formal or stylistic influences on creating beauty, without paying attention to how it supports the wearer. Beauty is integral to human well-being, but it alone does not produce (Caan 2011: 147).

Design that arouses or encourages a sense of satisfaction, arousing passion, enthusiasm, or desire with something that satisfies or stimulates, will also satisfy the human need for well-being. This is difficult to achieve because feeling good is not a single goal or a consistent experience, even for the same person. Rather, it is a constant benchmark based on changing conditions. Design can respond to this situation by actively excluding harmful elements and actively including factors known to contribute to happiness (Caan 2011: 149).

Biophilic design reflects an ancient understanding and its principles are revealed in prominent buildings throughout human history. Indeed, the world's most admired buildings and designs have strong affinities with the natural world (eg: Glass House, Falling Water). As psychologist Judith Heerwagen mentions: “Many of the world's most respected buildings contain biophilic features. In other words, they contain the essence of natural objects without an exact copy. They draw the design principles of natural forms (Heerwagen 2001: 42).

According to Biophilic designer Oliver Heath in 'Designcurial' website: ‘Biophilic design' is not just about bringing the outside in, it's about connecting and empowering many aspects of nature. All thoughts on natural light, nature, plants, natural materials, textures and patterns (Health 2019: 105).

In a study, Dr. William Bird states “We spend millions creating ideal conditions for horticultural crops, balancing the right vegetation with the right amount of shade and humidity, while still allowing our children to grow up in a hostile urban desert without concrete walkways, heavy traffic and contact with nature.” (Bird 2007: 196) .

Kellert (2008) also discusses the transition to restorative environmental design, which reduces the impact on the environment and has a connection with nature.

Biophilic design brings about psychological and physiological well-being, while at the same time it is a channel for connecting with the built environment and at the same time increasing the sense of responsibility towards the environment through the increasing connection of people to their environment (Kellert S. R., 2008) . Design strategies based on the biophilia hypothesis predict that experiences that support our health and well-being can be produced in environments created by adapting over millions of years, using the knowledge of our closeness to nature. With this approach, people can be more comfortable and productive in their work environment, feel more harmonious at home, and public spaces can become more inclusive; therefore, it supports that design can offer a sense of belonging, security and well-being to a wider audience of people (Heerwagen 2009: 47). In this context, the foundations that establish biophilic design strategies are also compatible with the results obtained from scientific research and findings.

Important Studies in Biophilic Design reveal that the most consistent benefits are nature themes regardless of the existence of improved moods and reduced stress,

controlled lab experiments or field studies. Also, contact with nature can be visual or sensory, active participation (walking, running, gardening) or passive participation (viewing only). Benefits can be found in many fields, cultures, and age ranges from early childhood to late adulthood (Güngör 2020: 123).

When we look at our biological connection to life, in other words, when biophilic needs are considered as an adaptive state of human biology rather than an unrelated past, it can be said that the satisfaction of our biophilic impulses is associated with human health, productivity, and well-being. Evidence and data to support this link are few and varied, but the body of knowledge supporting the role of relationships with nature in human health and productivity is growing. The following findings are noteworthy on this subject, which has been extensively discussed by many researchers, especially Ulrich, Hartig, Framkin (Kellert 2005: 367).

1. It has been determined that contacting with nature, either directly or including through representations and symbolic depictions of nature, is helpful in curing illness and healing the patient (Kellert 2005: 368).

2. People living in areas close to open spaces report less health and social problems, and this is defined independently of rural and urban residence, education level and income level.

Even the presence of a limited amount of plants, such as grass and a few trees, has been associated with coping and adapting behavior (Kellert 2005: 368).

3. It has been determined that office arrangements including natural lighting, natural ventilation and other natural environmental features lead to increased employee performance, lower stress and more motivation (Kellert 2005: 369).

4. Contacting with nature has been associated with cognitive functions in relation to tasks that require concentration and memory (Kellert 2005: 370).

5. Healthy childhood maturation and development has been associated with natural characteristics (Kellert 2005: 371).

6. The human brain has been found to functionally respond to sensory patterns and cues from the natural environment (Kellert 2005: 371).

7. Communities with environments with higher environmental qualities have a stronger sense of place than communities with more positive values of nature, superior quality of life, greater neighborhood and lower environmental quality. These

findings can also be detected in both poorer cities and more affluent and suburban neighborhoods (Kellert 2005: 372).

It is clear that nature-related services can play an important role in basic human well-being needs. From a minor role in employment to a major role in childhood development, the role of nature experiences in well-being cannot be overlooked.

CHAPTER 4
FIELD STUDY ANALYSIS AND FINDINGS

It has been stated many times in the studies that the quality of the facilities at the school will increase the performance of the students and teachers and that the schools of the future cannot be one type and one style schools that can fit all societies (Elmashharawi 2019: 76)

Çankaya University Faculty of Architecture was selected as the field of this study, which is based on examining the applicability of biophilic design in interior architecture through an educational structure. The faculty building was privatized within itself and for field work,

- The common lecture hall used by the Faculty of Architecture and the Faculty of Law and located in the basement of the campus,
- Gallery space and seating area corner on the ground floor,
- Studio classrooms on the first floor were selected.

The reason for choosing these areas is that they are common areas and everyone in the school can easily access and experience the space. The selected project was found valuable in terms of understanding how the biophilic design approach can be widely used in educational buildings.

The method in the study was based on the classification of Browning et al. (2014), who gathered biophilic design under 14 items. The reason is that this study focuses on studies investigating the cognitive, psychological and physiological effects of biophilic design on humans. Browning et al. argues that biophilic design in architecture can be a tool to establish a connection between man and nature, as satisfaction with the built environment can reduce stress, increase creativity and thinking capacity, and thus positively affect or accelerate the level of success and focus. For this purpose, 14 experiences presented by Browning et al. (2014) for architectural applications under 3 headings were analyzed in this school.

First of all, each experience was explained as defined by Browning et al. (2014), and then how these experiences were reflected in the examined school design was interpreted by supporting with visuals.

In the conclusions section, this relationship is discussed by creating a table based on the senses perceived while experiencing the space.

4.1. RELATIONSHIP BETWEEN BUILDING OF ÇANKAYA UNIVERSITY, FACULTY OF ARCHITECTURE AND BIOPHILIIC DESIGN

Planning and design of the Çankaya University New Campus, on the 28th km of the Ankara-Eskişehir Highway, began in 2007 (Figure 67). In the facilities, which were constructed in short stages, education started in the 2011 - 2012 academic year with a preparatory school, 3 faculties, rectorate, library and social facilities.

Figure 67: Cankaya University location in Ankara (Google Earth)

Çankaya University Faculty of Architecture building which was designed by Erkal Architecture, was built in 2021 and started to be used (İtez 2022: 134).

The new building, in which the Faculty of Architecture was moved, within the Çankaya University Main Campus, is positioned as the first high-rise at the eastern end of the campus. Thus, with its location and height on the Eskişehir road, it was the first building to introduce the campus when leaving Ankara. Its volumes, consisting of 8 large studios of 200 m², 4 small studios of 100 m², offices, department and faculty management units, classrooms, lecture hall and laboratories in the faculty structure were designed to be connected to their neighbors at three different levels. The two ground floors, to which the roads on the north and south facades are connected, and the basement, just below the open spaces on the surface,

organize the entrances to the building from its surroundings. One of the first common areas chosen at the school is the cafeteria area used jointly by the Faculty of Law and the Faculty of Architecture. Figure 68 shows the plan of the area.

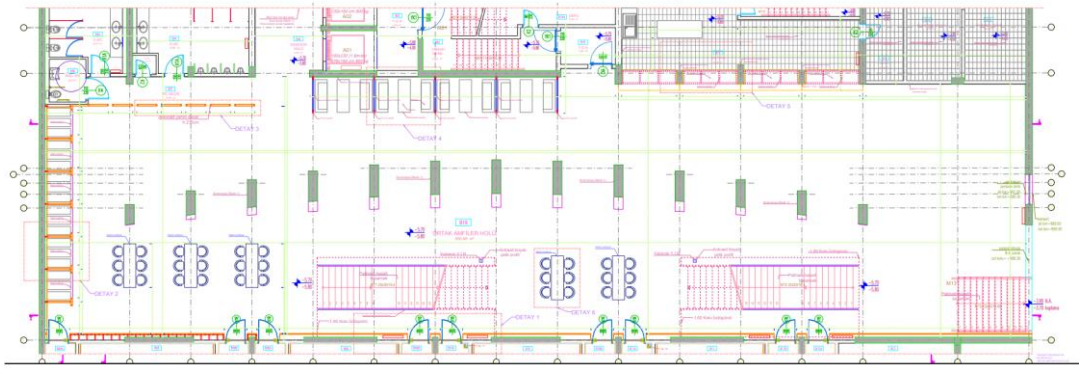


Figure 68: In the plan of the common hall used by the Faculty of Architecture and the Faculty of Law and located in the basement of the campus, the stairs are located on the south side of the building

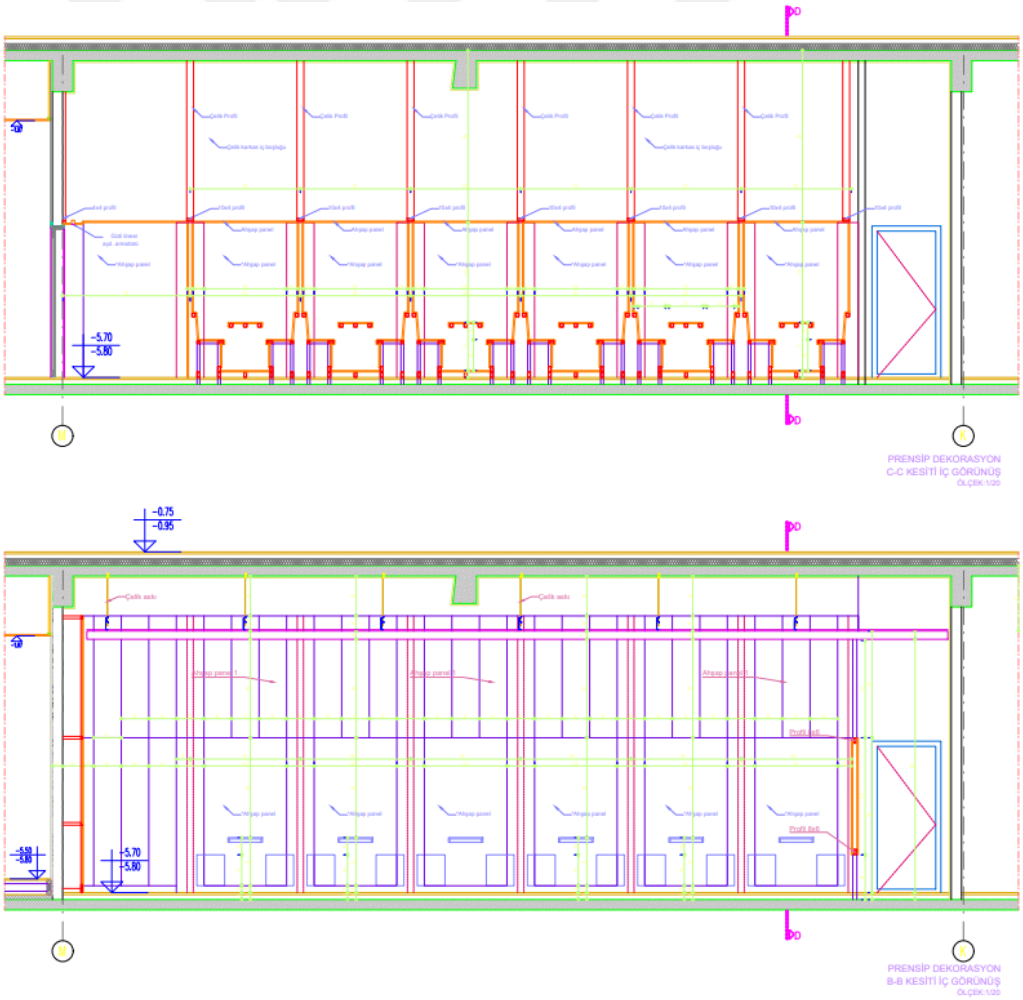


Figure 69: The sitting areas used by the Faculty of Architecture and the Faculty of Law and seen in the section of the common amphitheater located in the basement of the campus are located on the east facade.

The second area evaluated within the scope of biophilic design parameters is the common socialization area in the gallery space (Figure 70).

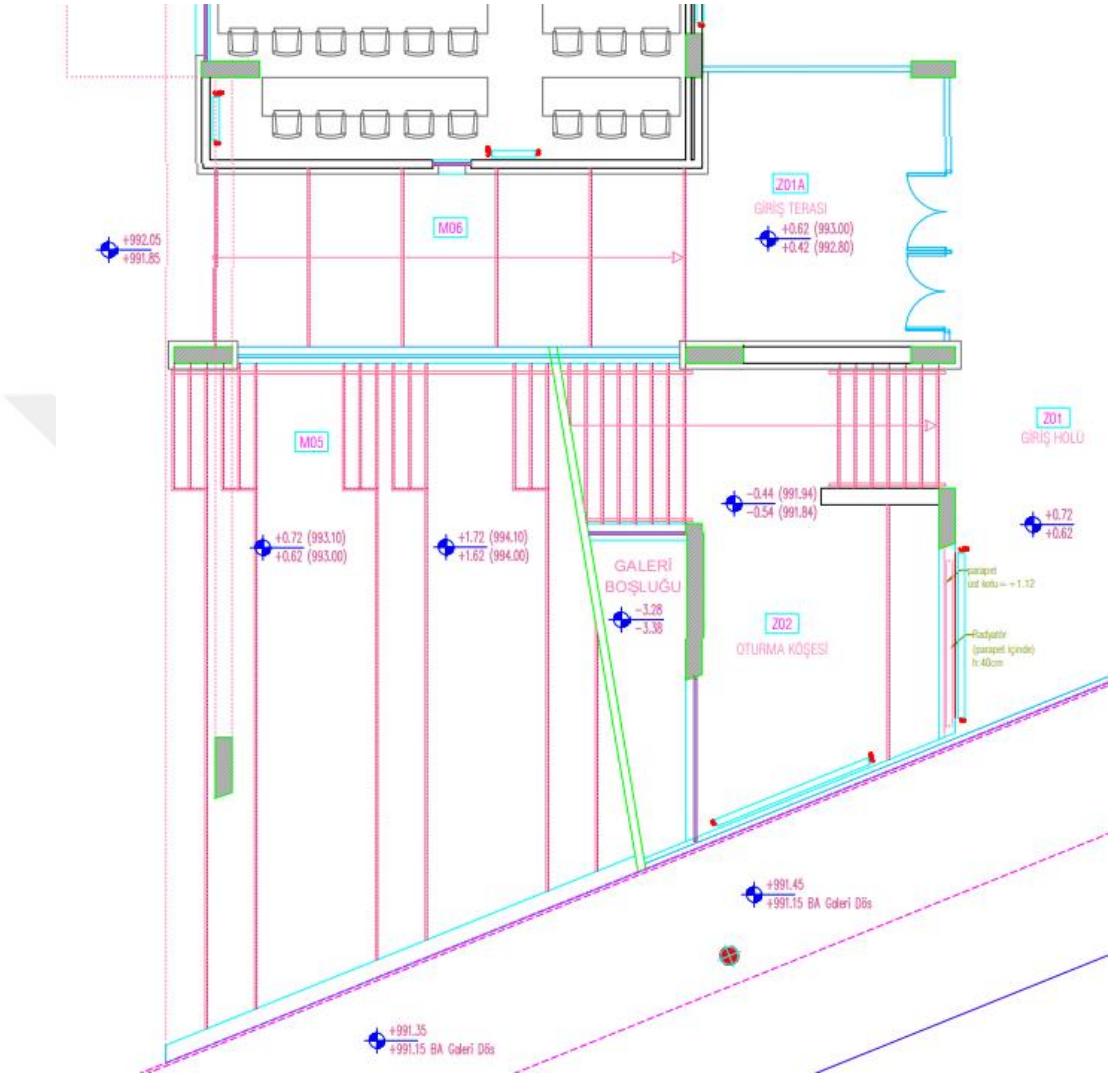


Figure 70: On the ground floor, the gallery area and the seating area corner plan are positioned on the south facade

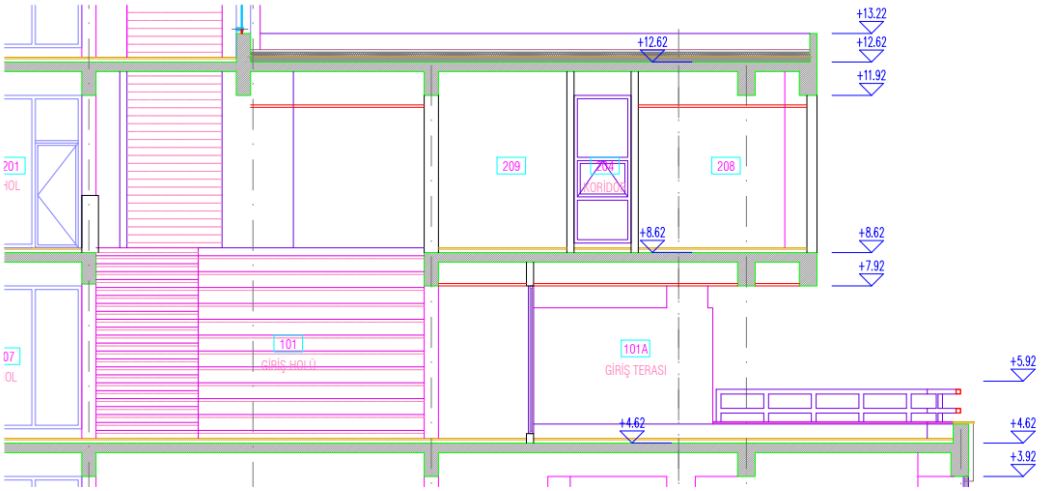


Figure 71: The section of gallery space and seating area corner on the ground floor

The last area to be evaluated is the classrooms where architectural design studios are located on the first floor (Figure 72).

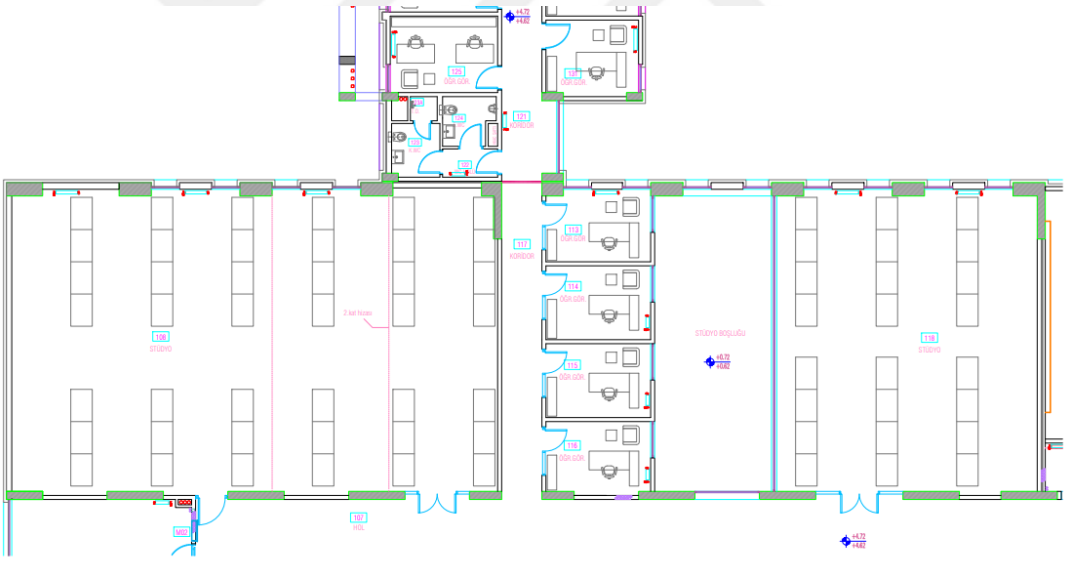


Figure 72: The plan of the studio classrooms on the first floor is positioned on the north facade.

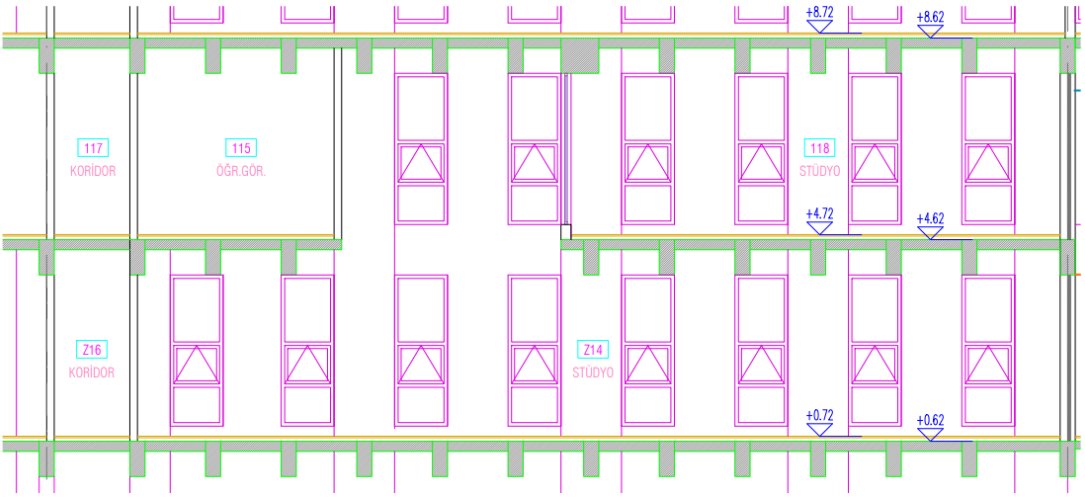


Figure 73: The section of studio classrooms on the first floor

14 experiences defined for the healing and dynamic power of the biophilic design in the built environment are grouped under 3 main headings: the direct experience of nature in the space, the transformation of nature-inspired forms into design within the building, and the feeling of the atmosphere created by the space itself on people (Browning et al. 2014: 23).

Although each experience has its own specific determinants, it is also related to other experiences. 3 main titles are the nature in space, natural similarities and the nature of space.

Nature in the space includes visual connections with nature, non-visual connections with nature, variable natural sensory stimuli, thermal and air flow, presence of water, dynamic and diffuse light, connection experiences with natural ecosystems.

Natural similarities include bioformic forms and patterns, material connections with nature, hierarchical order experiences encountered in nature.

The nature of the space includes the expectations from the space, the need for shelter and shelter, the mystery of the space, the experiences of danger and risks. Each of these main topics, which are determined as experience for biophilic design, are discussed and explained one by one. Then, sub-headings were also defined and the application area and how this experience was provided were supported and interpreted with visuals.

Nature in Space

The nature in the space can be defined by its direct physical experience or presence in the space. As nature can take place directly in the building (potted plants, green walls, courtyard gardens, vegetated roofs, cage animals, aquarium, water elements, fireplace, etc.), it can also exist sensorially such as natural light, air, sound, smell. In this sense, it is possible to experience nature directly in the space. In addition, visual elements that remind nature can also be included in this article. The nature in the space is given under 7 subtitles (Browning et al. 2014: 9).

4.1.1. Visual Connection with Nature

It is the physical presence and use of nature in space (Browning et al. 2014: 24). The building stain was shaped by the consequences of environmental conditions in the faculty of architecture: The Faculty of Law and the Heating Center structures define the boundaries of the settlement between the inner roads of the campus and a cluster of trees. Despite the harsh climatic conditions and variable ground structure, there is no focused greening work on interior spaces or terraces, except for the protection of the tree cluster, which has managed to grow on its own at this point of the steppe.

Figure 74: Faculty of Architecture South Facade View (İtez 2022: 137).

In order to increase the visual connection of the building with nature, it is inevitable to carry out greening works suitable for the climate around the building and on the terraces on the middle floors. Pendant greenings can be added to the architectural interior planning, so that the building is not a stand-alone mass without

disturbing the simple concept of the design, and it can be brought one step closer to nature (Figure 75,76).

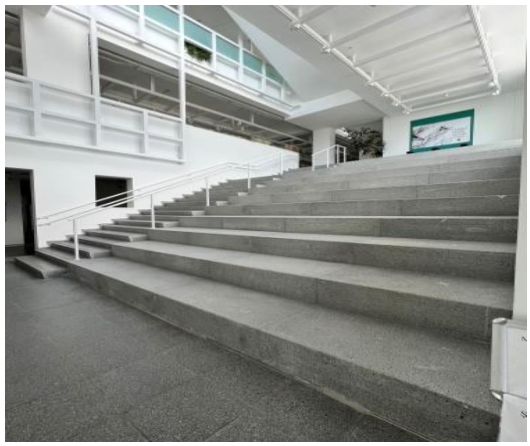


Figure 75: Faculty of Architecture Gallery space and Seating Area (Author's Archive)

Figure 76: Clarity in visual connection with nature in Faculty of Architecture Gallery space and Seating Area (Parameter 1) (Author's Archive)

Figure 77: Integration of visual connection with nature into the interior plan in Faculty of Architecture Interior Space Biophilic Design Applied (Parameter 1) (3D Render)

Figure 78: Integration of visual connection with nature into the interior plan in Faculty of Architecture Interior Space Biophilic Design Applied (3D Render)

Defining seating areas with natural materials creates an approach suitable for biophilic design in terms of user comfort and visual comfort (Figure77,78).

4.1.2. Non-Visual Connection with Nature

They are artificial/physical images of nature in space (Browning et al. 2014: 26). The sounds, aromas and textures are simultaneously familiar and comfortable, like outdoors in nature (Browning 2014: 58).

Instead of using artificial plants and paintings in the building, the student projects that are placed in the corridor areas by obtaining a gradual image between the layers reflect the colors in nature in a complex order, and nature interaction is ensured by being renewed every semester (Figure 79).

The building's large windows and high ceilings provide a spacious and bright feeling, representing the feeling of open space in nature.

Figure 79: Integration of the non-visual connection with nature into the interior plan in Faculty of Architecture Gallery Space (Parameter 2) (Author's Archive)

4.1.3. Non-Rhythmic Sensory Stimuli

Since nature is never static, it always moves, grows and accommodates, instant sensory perception of natural sounds and smells has positive effects on human physiology (Browning et al. 2014: 28).

Figure 80: Use of Non-Rhythmic Sensory Stimuli in the Common Area Used by Faculty of Architecture and Faculty of Law (Parameter 3) (Author's Archive)

This area which has non-rhythmic sensory stimulation, instantly creates a fresh, interesting, stimulating and energetic perception in the user that there is something special. These temporary seating areas were a brief but pleasant distraction in the space (Figure80).

4.1.4. Thermal & Airflow Variability

It is the feeling of the natural air flow in the space (Browning et al. 2014: 30). A space with thermal and airflow variability makes people feel refreshing, active, alive, invigorating and relaxed. Space gives a sense of flexibility and control.

Natural ventilation is used in the building, classrooms and studios. The windows of the studios are openable and studios have an active and refreshing atmosphere due to their high ceilings. Natural air flow is provided by terrace exits from the waiting and corridor areas (Figure 81).

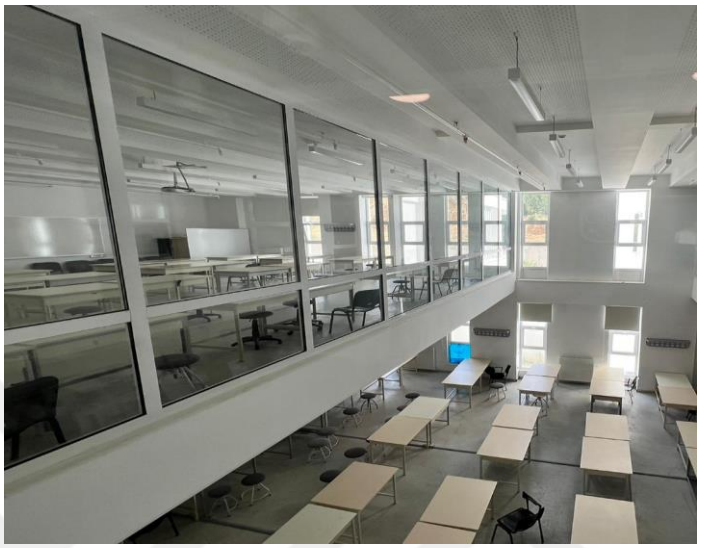


Figure 81: Giving Thermal and Air Flow Variability in classrooms with high ceilings and windows (Parameter 4) (Author's Archive)

In the basement area where the common amphitheater is located, natural ventilation is provided only by the large windows at the entrance and the entrance, but it is difficult to prevent the smell of food caused by the cafeteria area on the lower floor and the fresh air flow in the place is not sufficient (Figure82). Considering that the location of the dining area on the basement floor cannot change, support from artificial ventilation elements should be increased.

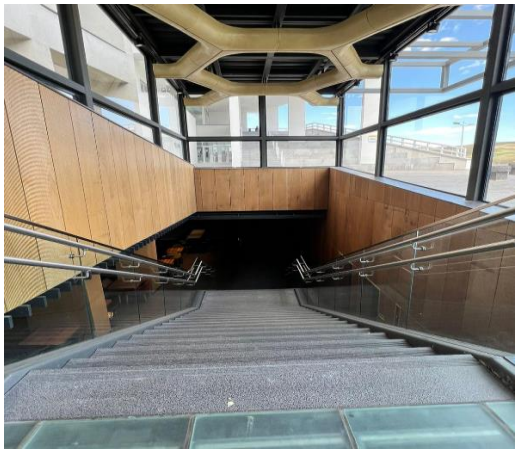


Figure 82: Giving Thermal and Air Flow Variability with layer differences and large glass openings.in the Common Area Used by Faculty of Architecture and Faculty of Law (Parameter 4) (Author's Archive)

4.1.5. Presence of Water

In order to benefit from the calming and healing power of water, it is necessary to experience it by seeing, hearing or touching (Browning et al. 2014: 32). Flow, sound, lighting, proximity, and accessibility all contribute to making a space stimulating, calming. Water or water reminders were not used in the design of the faculty (Figure 83).

Suggestion: Since there is not enough horizontal space on the surface of the space, water walls can be created on vertical surfaces (Figure 84). The water to be used in these walls can be used by supplying it from rain water and taking it into the window sills. Experiencing the flow of this water indoors on days when it rains seasonally can contribute to the strengthening of the perception of indoor and outdoor space (Figure85).

Figure 83: Faculty of Architecture in the Gallery Space area where the water access parameter can be applied (Parameter 5) (Author's Archive)

Figure 84: Implementation recommendation of the water access parameter in Faculty of Architecture in the Gallery Space (3D Render)

Figure 85: Implementation recommendation of the water access parameter in Faculty of Architecture in the Gallery Space (Parameter 5) (3D Render)

4.1.6. Dynamic & Diffuse Light

It is the maximum use of daylight in the space (Browning et al. 2014: 34). Lighting design is used to create the ambiance of a space, and at the same time, different lighting conditions reveal different psychological responses.

Daylight is felt strongly in the building thanks to the large windows that include the gallery space and studio areas that continue from the entrance. In addition, due to the linear planning, all corridors receive natural light (Figure 86).

Figure 86: Image of Dynamic and Diffused Light in common space in Faculty of Architecture Interior Space (Paramter 6) (Author's Archive)

The studios were placed along the northern facade instead of facing the Eskişehir road along the southern facade, which is exposed to highway noise, resulting in an abstract natural light that does not cast sharp shadows during the day (Figure 87).

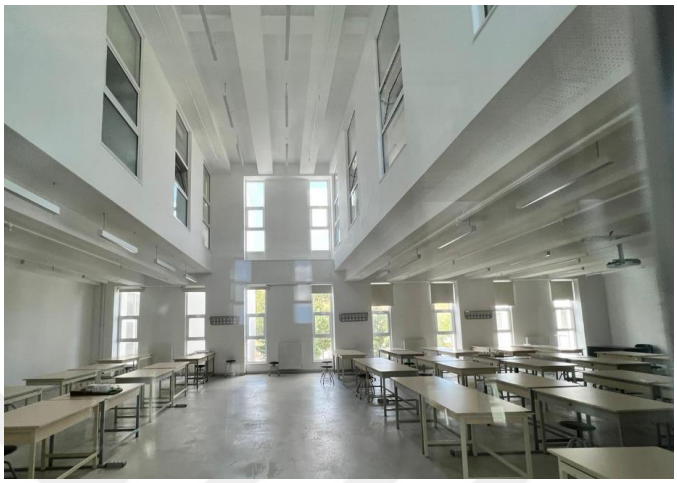


Figure 87: Reflection of Dynamic and Diffused Light through the windows in Faculty of Architecture Studio Classrooms (Author's Archive)

Due to the physical location of the space and other factors to be emphasized in the design, the common amphitheater on the basement floor cannot receive sufficient natural lighting, but the quality of the space is provided with diffused light and artificial lighting (Figure 88).

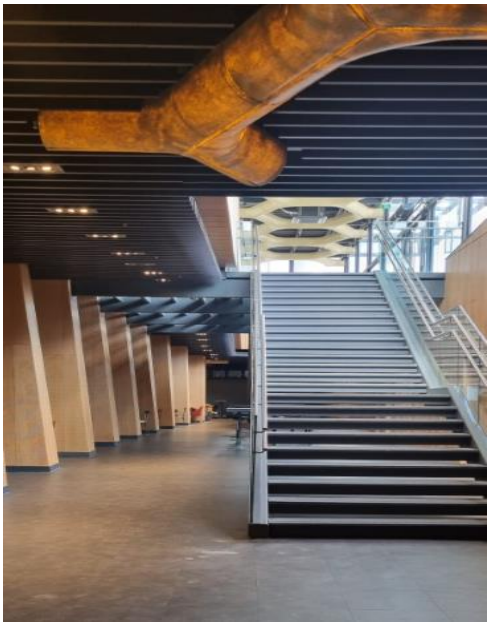


Figure 88: Reflection of Dynamic and Diffused Light from stairwells to the space in the Common Area Used by Faculty of Architecture and Faculty of Law (Parameter6) (Author's Archive)

4.1.7. Connection with Natural Systems

Experiences evaluated under separate headings such as solar energy, wind energy, collection, treatment or evaluation of rain water/wastewater, the use of sustainable materials, natural ventilation and natural light form the connection with ecosystems (Browning et al. 2014: 36).

Natural connection points with ecosystems in the building are natural ventilation, natural lighting and natural materials. In order to include sustainability techniques and preferences, the design team tried to include architectural, mechanical, electrical and lighting techniques at a feasible rate.

The idea of sustainability has been followed in the direction of avoiding lossy choices in the basic principles that construct life, not in the direction of finding solutions to losses through the use of resources in technical systems (İtez 2022: 139).

Natural Similarities

Natural similarities are the use of forms found in nature in fabric, carpet, wallpaper, surface, design and furniture details. It can be mentioned with the organic, inanimate and indirect connotations of nature. This association can be through object, material, color, shape, series and patterns, nature, artwork, ornament, furniture, decor, textile. Especially organically shaped shells, furniture, processed natural materials are the elements that strengthen this connection. In this sense, biophilic forms and patterns are experienced under 2 sub-headings such as the use of natural materials and the use of hierarchical order in nature (Browning et al. 2014: 10).

4.1.8. Biomorphic Forms & Patterns

The golden ratio and Fibonacci numbers, which are revealed by examining the proportions of the forms in nature, are frequently used in architecture under the title of rhythm and order, one of the design principles. The reason for using these is that people feel more comfortable when they see the order they perceive in nature in an object or form made by human hands. The purpose of using bioformic forms and patterns is to provide this representation (Browning et al. 2014: 38).

In this sense, two types of usage can be mentioned in the structure. The first is bioformic forms, and the second is patterns inspired by nature. Bioformic forms are intensely felt in the structures created in the interior of the building, ceiling details and reinforcements (Figure 89). Patterns inspired by nature also draw the attention in ceiling designs (Figure 90).

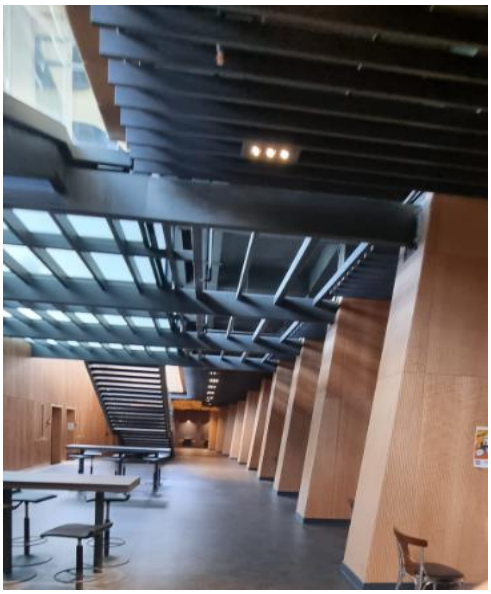


Figure 89: Ceiling tiles and the use of column angles in the Faculty of Architecture Interior Place & Common Space Used by Faculty of Architecture and Faculty of Law (Parameter 8) (Author's Archive)

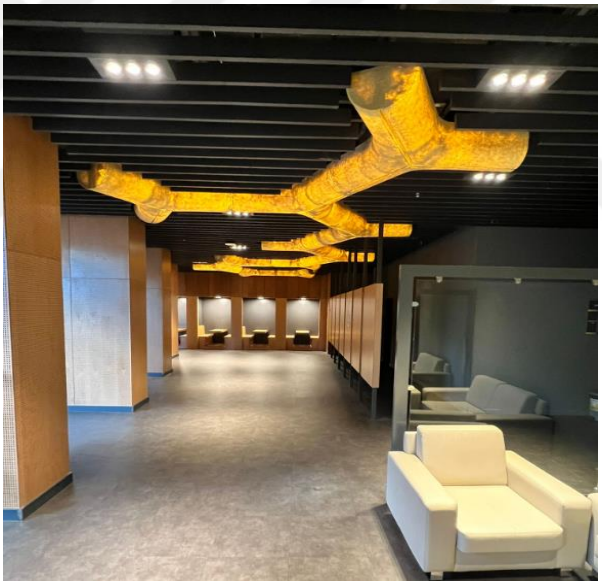


Figure 90: The forms on the ceiling tiles are suitable for biomorphic patterns in Common Area Used by Faculty of Architecture and Faculty of Law (Parameter 8) (Author's Archive)

4.1.9. Material Connection with Nature

Natural materials, natural color palettes and natural textures evoke nature even though they do not have a direct relationship with nature. This connection can be achieved by the use of leather, stone, wood texture, earth colors, especially white, and natural materials such as stone, wood, and marble used in the space (Browning et al. 2014: 40). In the interior of the building, wood, stone and marble are used with

their natural colors and textures (Figure 91, 92). Accordingly, the colors of the floor coverings, furniture and coverings are in earth tones.

Figure 91: The wood panel surface coating texture on the columns is a material connection with nature in the Common Area Used by Faculty of Architecture and Faculty of Law (Parameter 9) (Author's Archive)

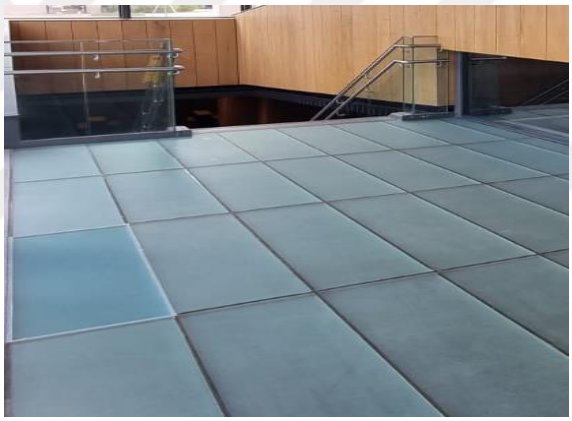


Figure 92: The use of glass surface on the floor creates the material connection with color and transparency.in the Common Area Used by Faculty of Architecture and Faculty of Law (Parameter 9) (Author's Archive)

4.1.10. Complexity & Order

Since fractal geometries in architecture and their unlimited correlation represent nature in the built environment, it establishes a relationship with nature. These geometries produced with spatial hierarchy can have positive effects on human psychology. However, the use of these fractals can cause discomfort as the dose increases. Therefore, it should be used in its dose and decision (Browning et al. 2014: 42).

On various surfaces in the interior of the building; it has been used effectively in the texture of ceiling, wall and floor (Figure 93, 94).

Figure 93: Perception of complexity and order in the space with the angular harmony of ceiling and column in the Common Area Used by Faculty of Architecture and Faculty of Law (Parameter 10) (Author's Archive)

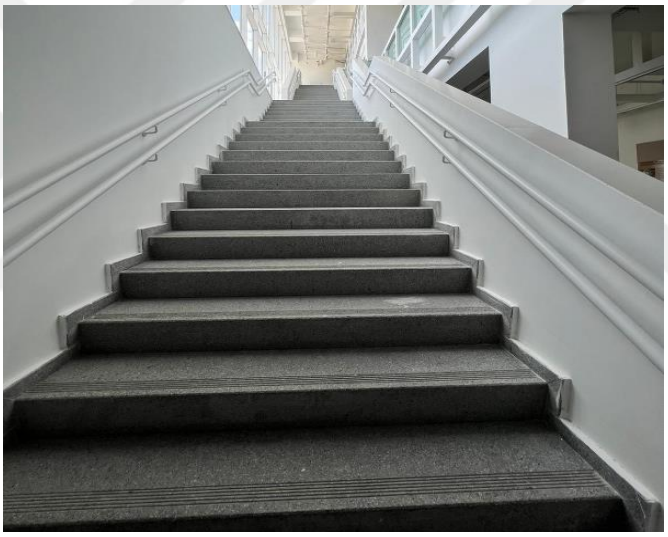


Figure 94: Fractal textures in the Gallery space (Parameter 10) (Author's Archive)

Nature of the Place

The nature of the space is the reflection of the spatial structuring in nature within the space. It is the desire to explore the place where people live by thinking of it as a natural environment and to learn one step beyond their environment. For this reason, it includes elements such as the innate desire of man to explore nature, his curiosity about the dangerous and unknown, the mystery of nature and at the same time the feeling of being safe (Browning et al. 2014: 10).

Under this title, 4 experiences were defined under the expectations of the place, the need for shelter and shelter, mystery, danger and risks.

4.1.11. Prospect

Considering the requirements for the continuation of life in nature, they are the elements that are desired in a place to meet human needs. It aims to provide the experience of nature with cultural anthropology, evolutionary psychology and architectural analysis, as well as the needs related to the basic spatial function. Based on the feeling of open and free spaces in nature, it recommends making arrangements to ensure visual continuity in the interior. In order to achieve this, elements such as open wide spaces, landscape openings, transparent, semi-transparent or lowered walls, landscapes evoking nature, and art can be used (Browning et al. 2014: 44). The building has already proven that it functionally meets the expectations from the space.

4.1.12. Refuge

People want to protect their privacy, meet their personal needs and feel safe indoors. For this reason, interior design should allow to be alone without being away from the environment, but at the same time. For this purpose, modular shelters such as high-backed chairs, overhead cages, partial shelters such as reading corners, cabin seating, canopies, or comprehensive shelters such as reading/telephone/sleeping cabins and meeting rooms can be designed (Browning et al. 2014: 46).

The need for shelter and refuge here can be explained as strengthening the sense of belonging felt in the space. The more the user can relate to the space, the more he can feel this experience. Apart from the studio classrooms and common areas of the faculty, catering counters, study corners in many waiting points meet the shelter and refuge needs. Individual resting areas, especially designed with a sense of privacy, meet this experience strongly (Figure 95, 96).

Figure 95: The spaces created within themselves create a sense of shelter in the Common Space Used by Faculty of Architecture and Faculty of Law (Parameter 12) (Author's Archive)

Figure 96: Examples of Shelter and Refuge Corners in the Interior Faculty of Architecture Interior Place & Common Space Used by Faculty of Architecture and Faculty of Law (Parameter 12) (Author's Archive)

4.1.13. Mystery

The purpose of the mystery experience is to reduce stress and promote cognitive exploration while providing a functional environment. Auditory and visual stimuli designed for this purpose are important both in terms of making the space easier to read and arousing a sense of curiosity (Browning et al. 2014: 48). Light and shadow plays in the corridors, works of art, music, translucent materials, and surprising openings that arouse curiosity are evaluated under this title.

Light and shadow plays in the corridors, translucent materials, surprising openings that arouse curiosity are evaluated under this title (Figure 97,98).

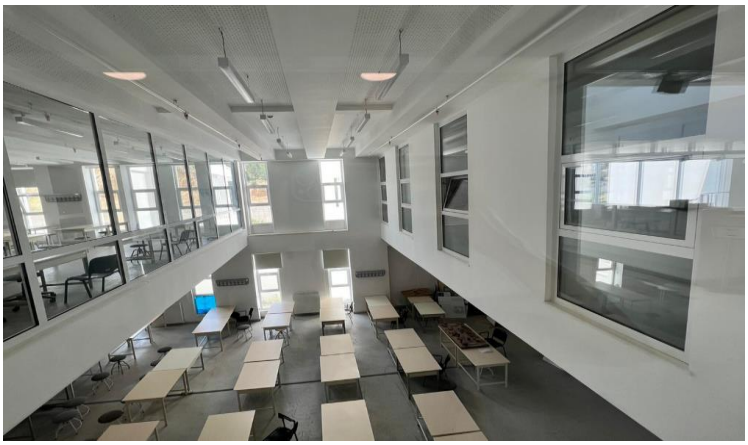


Figure 97: The common spaces under the rooms create a sense of mystery in the Studios (Parameter 13) (Author's Archive)

Figure 98: The separators dividing the two spaces give a sense of mystery for the space left behind areas in the Common Area Used by Faculty of Architecture and Faculty of Law (Parameter 13) (Author's Archive)

4.1.14. Risk/Peril

The definer difference between danger and risk from fear is the perceived threat and level of control. Having a controllable level of threat or risk awareness can trigger positive experiences.

The purpose of the Risk/Peril model is to arouse attention and curiosity, to stimulate memory and problem-solving skills to solve. During the design process, precautions that protect the user from harm and concepts that give a sense of trust provide this experience (Browning et al. 2014: 50).

The resting areas located in the common lecture hall of the faculty are placed under the semi-permeable glass stairs and gives this experience to the users (Figure 94). The ceiling of the faculty's gallery space as well as the seating areas is designed as a staircase leading to the other floors. Depth perception due to angles is compatible with the biophilic design concept (Figure99).

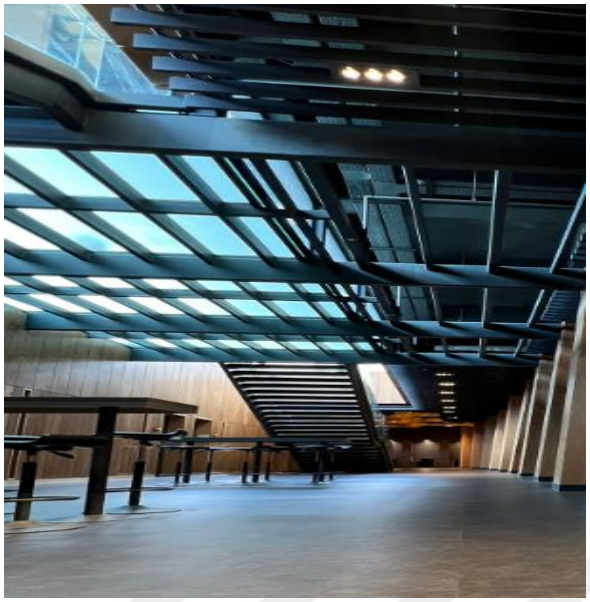


Figure 99: The reflection of people in the transparent area on the stairs makes the space feel mysterious and risky in the Faculty of Architecture Interior Place & Common Space Used by Faculty of Architecture and Faculty of Law (Parameter 14) (Author's Archive)

4.2. FINDINGS AND DISCUSSION

In this section, the analyzes and theoretical examinations made in the previous sections of the thesis are presented. According to considerations and analyses, special biophilic design criteria have been developed for educational buildings.

The first set of criteria included in the table of design criteria is site selection. As it is known, one of the most important reasons for the successful design of biophilic schools is to choose the right location. It should be a place that is close to nature, yet adequately protected from potential hazards.

Its building and topography, habitat and vegetation should also be protected in this respect. However, if the vegetation is not sufficient, it should be enriched. It should be noted that in dense green environments, in addition to flora, there is also a fauna that should not be destroyed in any case. With the site selection criteria, the habitat and ecosystem will be protected and the location chosen accordingly will become a suitable location for an education building.

The second set of criteria includes architectural design features. These include designing large openings such as windows, doors and glass walls to provide a good view of nature, using natural materials to blend in with the surroundings, designing

multiple blocks if possible instead of a single block with deep plans (so that spaces are not sufficiently penetrated by sunlight).

Building in the form of a single large block should be avoided and if possible separate blocks, bridges, tunnels, etc. to each other. It should be connected with a bridge and should be several stories high for a better view of nature. Also, an important point in the design process was to locate the building in the south-east of the area to make maximum use of the sunlight inside. If possible, it is recommended to design green terraces that will be available to students for better contact with nature. The next criterion is the greening of the facades of schools, if this can be enabled in the design. If one block is substantially higher than the other, attention should also be paid to the relationship and proportion of the shapes of the blocks so as not to create shadow and inaccessibility to nature. Geometric forms inspired by nature should be designed indoors and outdoors. There are various geometric shapes and motifs in nature that can be a good source of inspiration for the architect. During architectural and interior design, geometric forms inspired by nature should be used.

The third set of criteria is the set of structural and material design criteria. In line with the concept of sustainable architecture, it is recommended to use organic building materials that will not harm humans and nature for a better biophilic effect.

The last set of criteria are related to the aesthetics of the building's interior and exterior. It is nature's use of restorative landscapes to provide its restorative benefit. The nature landscape is one of the basic elements of rapid and effective learning, improving human mental, physical and physiological health.

In this sense, the term "biophilic architecture" means adapting a building to its environment and designing it accordingly. The applicability of biophilic design experiences, which have become more important in educational buildings, has been examined in this study, especially in the sample of Çankaya University Faculty of Architecture. How these design experiences, which are given under the titles of nature in the space, natural similarities and the nature of the space, are reflected on the educational buildings are evaluated by supporting them with visuals. In order to meet the 14 experiences of biophilic design revealed by Browning et al. (2014), the applications made in interior design specific to Çankaya University Faculty of Architecture are given in Table 6.

Table 6: Çankaya University Faculty of Architecture Evaluation Table According to Biophilic Design Parameters

Nature in the Space Patterns	Natural Analogues Patterns	Nature of the Space Patterns
1. Visual Connection with Nature	**8. Biomorphic Forms & Patterns**	**11. Prospect**
*floor gardens *terraces	*Organic forms *Design textures *Material textures *Surface designs	*Large spaces * Continuity of the landscape * Plant use *Water use *Nature pictures *Use of natural materials *Music use
2. Non-Visual Connection with Nature	**9. Material Connection with Nature**	**12. Refuge**
* Nature view between glass layers * Use of natural color	*Natural materials *Natural colors *Material textures	* Rest / study corners * Waiting areas * Beverage vending machines
3. Non-Rhythmic Sensory Stimuli	**10. Complexity & Order**	**13. Mystery**
* Outdoor sitting areas	*Organic forms *Design textures *Material textures *Surface designs *Artificial light	*light/shadow *Translucent walls
4. Thermal & Airflow Variability		**14. Risk/Peril**
* Pop-up windows *Exit to the terrace		*Recreation/work areas *Gallery spaces/common areas
5. Presence of Water		
6. Dynamic & Diffuse Light		
*Linear plan design *Large windows *Glass ceiling		
7. Connection with Natural Systems		
*Sustainable material *Natural material *Natural ventilation		

When these applications are evaluated in terms of Çankaya University, it can be mentioned that there are deficiencies under two headings. The first of these; the absence of studies such as solar energy, wind energy, collection, treatment or evaluation of rain water / waste water at the connection point with natural ecosystems, the lack of certification of the materials and furniture used, depending on the companies, although attention is paid to the use of sustainable materials. The second is the water access header. However, since this educational structure was not designed with the water factor in mind, within the scope of the biophilic design parameters, water walls can be integrated into the space afterwards, allowing access to water in the interior. A general assessment can be reached when a comparison is made regarding the rate of implementation of the parameters in the studied school. Table 7 illustrates this situation.

Table 7: Comparison Table of the Application of Biophilic Design Parameters of 3 selected common spaces at Çankaya University

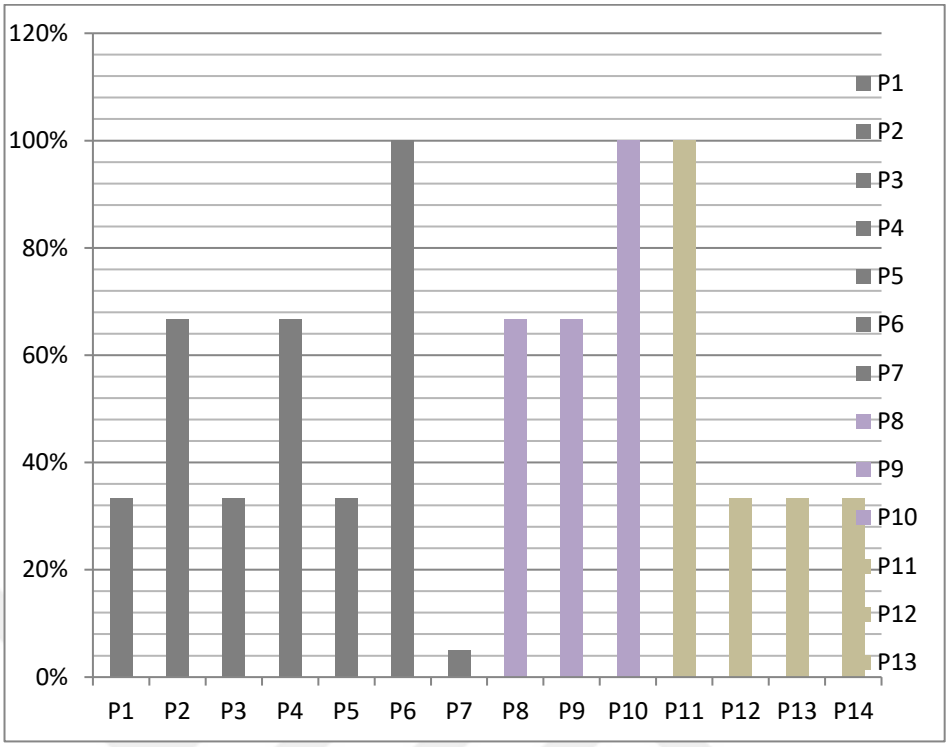
Applied
Applicable
Not applicable



		14 PARAMETERS OF BIOPHILIC DESIGN	Location: The common lecture hall used by the Faculty of Architecture and the Faculty of Law and located in the basement of the campus	Location: Gallery space and seating area corner on the ground floor	Location: Studio classrooms on the first floor	RATE
Nature in the Space Patterns	P1	Visual Connection with Nature	●	●	●	0/3
	P2	Non-Visual Connection with Nature	●	●	●	2/3
	P3	Non-Rhythmic Sensory Stimuli	●	●	●	1/3
	P4	Thermal & Airflow Variability	●	●	●	2/3
	P5	Presence of Water	●	●	●	0/3
	P6	Dynamic & Diffuse Light	●	●	●	3/3
	P7	Connection with Natural Systems	●	●	●	0/3
Natural Analogues Patterns	P8	Biomorphic Forms & Patterns	●	●	●	2/3
	P9	Material Connection with Nature	●	●	●	2/3
	P10	Complexity & Order	●	●	●	3/3
Nature of the Space Patterns	P11	Prospect	●	●	●	3/3
	P12	Refuge	●	●	●	1/3
	P13	Mystery	●	●	●	2/3
	P14	Risk/Peril	●	●	●	2/3
RATE			10/14	8/14	5/14	

The ones marked in green in the Table 7 are the areas where the biophilic design is applied. Other than that, the ones marked with blue indicate that the biophilic design can be applied and the ones marked red indicate that the building is not suitable for that item.

Table 8: Application of Biophilic Parameters by School Analyzed Percentage



The diagram above shows the percentage of each of the parameters in accordance with the design of the analyzed school (Table 8).

Dynamic and diffused light (P6) was applied at the highest rate in the first group (P1-P7) Nature in the Space Pattern. However, Connection with Natural Systems (P7) is a parameter that can be integrated into the building later, even if it is not applied in the building as a design. Visual Connection with Nature (P1), Thermal Airflow Variability (P4) and Presence of Water (P5) are not parameters that can be applied for every space, but suggestions are presented for the Presence of Water (P5) parameter.

In the second group, Natural Analogues Patterns (P8-P10), there are design approaches that are more suitable and applicable to spaces. Complexity and Order (P10) has come to the fore in the design of the building and is one of the most applied parameters in terms of ratio. The Biomorphic Forms & Pattern (P8) and Material Connection with Nature (P9) parameters are equally applied to the building and can be applied later.

In the third and last group, Nature of the Space Patterns (P11-14), the Prospect (P11) parameter was applied with the highest rate in the school design. Although the Refuge (P12) parameter is applied only in one area, it is applicable in the remaining selected areas of the school. While the Risk/Peril (P14) parameter is applied in two selected areas, it is not recommended to apply this parameter in studio classrooms because it has a distracting effect.

According to the findings, architectural biophilic design guide proposal was made for educational buildings. The design guide is based on the current parameters valid for all categories of architectural buildings.

CHAPTER 5
CONCLUSION AND SUGGESTIONS

In the last fifteen years, awareness of the importance of sustainable architecture in Turkey has increased both at the individual and institutional level. Economic use of resources such as energy, water, waste recycling is a part of this sustainable architecture. However, it is stated that biophilia, as a tendency to establish a connection between human and nature, is the missing part of this applied sustainable architecture. For this reason, biophilic architectural design is defined as a missing link in the concept of sustainable architecture.

This connection with nature, which seems to have been forgotten in recent years, has been in human genes since early Paleolithic times. For this reason, biophilia, as a kind of new thinking and perspective on the future, should be examined in every field, as in architecture, and more specifically, in healthcare facilities. Educational buildings are one of the biggest environmental hazards due to their functions and the need to dispose of large amounts of energy and waste. Therefore, when it comes to the term sustainable architecture for educational buildings, it is thought that the Ministry of National Education and other relevant institutions should pay more attention to this issue.

The main purpose of this thesis is to clarify how to design biophilic schools, which will contribute more to both the environment and people, and the education system will be strengthened by designing healthy educational structures. Today, there are biophilic schools in the world that can be taken as an example. However, although there has been a great improvement with the construction of new schools in Turkey, the number of biophilic schools has not been found at a sufficient level as could be determined during this study. During the research, it was determined that the number of schools showing biophilic characteristics is still very few in Turkey. At the same time, the design criteria for biophilic schools have not yet been established. However, there is not enough academic work in this field to guide the design of biophilic schools for designers in the architectural discipline.

For all these reasons, in the fourth part of the thesis, a design criteria and guideline proposal has been developed for biophilic schools.

It should be emphasized that biophilic design is not only about greening newly designed schools or simply adding trees and shrubs to increase their aesthetic appeal, but also that successful results can be achieved by applying it to an existing building.

As a general result of the study, in order to apply biophilic design experiences in interior spaces, in addition to general design principles, all kinds of natural forms, materials, colors, surfaces, textures, objects, art and installation works such as air, water, plant, natural light. It can be said that designs that activate sensory stimuli such as physical, smell, hearing, sight and touch should be made. Moreover, the purpose of biophilia is to show the role of man in nature, the role of nature in human life, that reciprocity, respect and enrichment of nature can exist at all levels.

It is expected that this study will contribute to the development of sustainable environmental architecture and biophilia as a discipline and to take sustainable architecture into other departments. In addition, it is expected that the criteria mentioned above and the biophilic design guide in schools will contribute to the increase in the number of biophilic schools in Turkey, thus increasing the efficiency and motivation of the students and staff who can provide more efficient education in schools and who are happy to be in them.

By considering that humans are also a part of nature, it is important to look at and understand the benefits and restorative effects of the natural environment from a broader perspective. Biophilic design experiences, which ensure the integration of nature into the interior, both meet people's need to connect with nature and increase the healing power of nature in the built environment. Applying these design experiences, which have been demonstrated by many studies that help to heal stress and mental fatigue, not only in educational buildings but also in all built environments, can be a way to increase the continuity of healthy generations and increase work efficiency. These connections can be provided with new arrangements in existing spaces, especially in education and office buildings, and can be applied as a model during the design phase. It should not be forgotten that today, designs that strengthen the relationship between nature and human in the built environment are not a luxury but a necessity. At the core of biophilic design is restoring the existing bond with nature rather than strengthening the connection with nature.

For this reason, it is necessary to adapt the existing buildings to the biophilic design principles and to adopt a design approach integrated with nature in the design process of the buildings to be built from now on, in order to increase the future living standards.

It is believed that the thesis work will greatly improve the concepts of sustainable, biophilic and restorative environmental design. However, it is known that when designing educational buildings, more needs to be learned about the unattainable expression of the inner human need in order to be compatible with nature. It is expected that they will be included in the main circulars published by the Ministry of National Education with the help of the criteria and guide proposal on how to get biophilic schools in Turkey, and will guide architects, interior architects and designers on how to design biophilic education buildings.

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