

BIOPHILIA IN MODERN ARCHITECTURAL PRACTICE: RECOMMENDATIONS FOR SERBIA

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Abstract. *Architecture and its natural environment have always been inextricably intertwined throughout the centuries-old history of civil engineering development. Nowadays, when rapid development and accelerated technological innovations take place and the planet becomes everyday endangered as the result of human activities, nature is a main theme and support, in the focus of architectural creation more than ever. Biophilia in architecture represents an innovational method of architectural designing, in which the accent is on the role of nature in the quality of living and working in built areas. An architecture created based on this principle represents the architecture of the future. This architecture is imagined and created as a healthy and productive environment for a modern man, both in terms of indoor space and in the planning of local communities as active and sociable neighborhoods. By using an analytical descriptive methodology and research references, this paper focuses on contemporary experiences and analyzes selected case studies, in order to establish the elements of a possible model for architectural practice in Serbia.*

Key words: *architecture, nature, biophilia, designing*

1. INTRODUCTION

Many have experienced emotional satisfaction from viewing or being physically present in natural environments. The main problem mentioned in this paper is the drastic reduction of the modern world human exposure to nature. It is often that people actively seek contact with nature during their free time, but on the other hand, nature is frequently removed from their daily activities. The question asked is why is this alienation from nature problematic? Many have the sense that nature is good for people, or are essentially fascinated by it. In this

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article, we will argue that this intuition of nature being good for us is to a certain extent supported by many empirical types of research. Human behavior is not just a phenomenon of will or a phenomenon of culture but also of genetic behaviors. According to Appellton (1975), we are born not with a 'blank slate,' but with distinct preferences for how we would like the world to be structured.

Beginning in the 1980s these hypotheses started to undergo the empirical testing, and the results have since become rather conclusive. There is evidence that the progressive disappearance of nature from our daily lives is not insignificant but is very problematic because it has important physiological and psychological health effects. Kaplan (1995) claims that even brief exposures to natural landscapes have a variety of notable health benefits, among them a reduction of stress, the lowering of blood pressure, improvement in our ability to focus, and, indeed, giving us a brighter outlook on life. The American socio-biologist Edward O. Wilson defined this component of our biological structure as 'biophilia'.

Nature is an emotional element within the surrounding environment and has an important role of daily influence on everything around humans. Humans always communicate with nature. Since the start of building and using shelters, nature has been one important and basic part of the plans and designs. Right at the beginning, human beings started to notice the advantages of communicating with nature such as health benefits or less stress and sickness. Plants, greenery and green spaces, in general, can quite help in perfecting planning and safety in the cities and improvement of social relationships and interaction in residential environments (El-Ghobashy & Mosaad, 2016, Joue, 2007).

In this paper, the approach is essentially human-centered, in that there are reasons to believe that the inclusion of such elements positively contributes to certain indexes of the human wellbeing. We stand at the point of view that the problem of decreasing exposure to nature can be reduced by integrating actual natural elements in the built environment. Using the analytical descriptive methodology and research references, this paper focuses on contemporary world experiences and analyzes selected case studies, in order to determine the elements of a possible model for architectural practice in Serbia.

2. BIOPHILIA IN ARCHITECTURAL DESIGN

Bratman (2012) defines the nature as areas containing elements of living systems that include plants and non-human animals across a range of scales and degrees of human management—from a small urban park to 'pristine wilderness.' Nature experience for him is time spent being physically present within or viewing from afar, landscapes (or images of these landscapes). The distinction between physical and visual contact with nature is quite important. Wilson (1984) determines biophilia as 'the natural pleasure that comes from being surrounded by living organisms.' Theory from social psychology emphasizes the importance to the individual of belonging to a group, and Wilson argues that we have a similar need to feel connected to natural environments (Krcmarova, 2009). The major factors that contribute to the biophilic effect experienced by human beings are: sunlight, colour, water and living organisms. Salingaros (2015) is expanding that list with gravity, fractals, curves, and detail.

Biophilia, as a universal human feeling and innate love for the natural world, shapes up architectural spaces in different spheres of people's lives, the lives of the users of those spaces and can influence the concept of several types of architectural objects, such as: workspaces (Figure 1-a), educational buildings (Figure 1-b), health facilities (Figure 1-c), and living spaces etc (Figure 1-d).

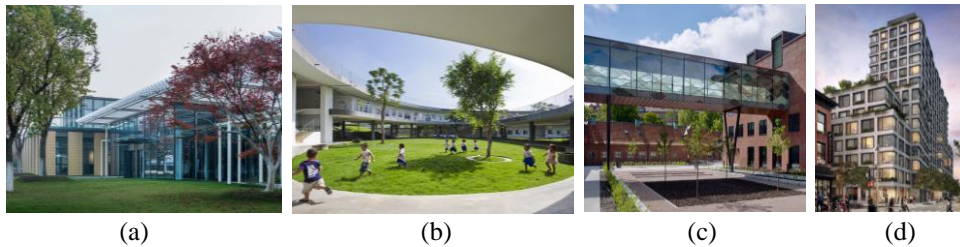


Fig. 1 (a) Workspaces, (b) Educational buildings, (c) Health facilities, and (d) Living spaces (source: <https://www.archdaily.com/907929/cat-new-headquarter-office-building-plan-architect>, accessed: 10.03.2019.)

Human activities in built indoor spaces over time and in collaboration with complex social relationships lead to certain psychological and emotional states of the users of space. In work areas, in the areas where educational processes take place, in health care institutions and in all housing environments, during the longer stay, pressure, stressful emotions and psychological fatigue occur. According to the research, contact with nature contributes to relaxation, psychological restoration, and normalization. According to Bratman (2012), there are three theories of restorative benefits of nature. These are: stress reduction theory (Ulrich, 1984) - reduction in stress during the experience in nature; attention restoration theory (Kaplan, 1995) - recovery from directed attention fatigue through experience in nature and the mediating effect of opinions about nature - our conscious opinions about nature relate to the impacts of nature experience on mood, and other aspects of cognitive function.

Evidence both from scientific sources and from traditional wisdom is giving rise to a healthier environment. Reconnecting humans with their surroundings applies the special power of nature to improve mental and physical nourishment. The aim is to lower the stresses on the human body, helping its built in defense to fight illness and to promote healing. For most of history, medicine took the environment seriously as a factor in health and healing. Unfortunately, the environment got ignored after the industrialized world adopted increasingly technological processes.

In one classic study of the mid-1980s, the psychologist Roger S. Ulrich underscored its architectural implications. In studying the records of 46 patients who had undergone gall-bladder surgery, he found that those patients recovering in a room with a view of a few trees had fewer complaints, took less medication, and were discharged one-day earlier than patients with a similar condition yet whose room had a view of an adjacent brick wall. Since this, the field of hospital design has become ever more specialized in its use of evidence-based design.

According to Söderlund & Newman (2015) a list of socio-psychological benefits can be: improved mental health, reduced stress, attention restoration, increased wellbeing, decreased violence and crime, faster healing rates in hospitals, and greater altruistic behaviour.

Therefore, people are increasingly demanding environments that lower stress: living and working spaces that act to keep us healthy. Architects can find design tools to help achieve this goal only by looking beyond mainstream architecture, which buys into the same overly technological worldview as conventional, intervention-focused medicine today (Salingaros, 2015).

Proposers of biophilic design have elaborated their design concepts. Biophilic architecture is becoming a new design theory about better contact with nature within and around buildings. Kellert (2005) have found seventy design attributes but he recently revised and simplified them (Kellert and Calabrese, 2015).

Heerwagen and Hase (2001) consider that a biophilic building has characteristics shown in the following table.

Table 1 Characteristics of biophilic buildings (Heerwagen and Hase, 2001)

Key Dimension	Attributes and Qualities
Prospect (ability to see into the distance)	Brightness in the field of view (windows, bright walls)
	Visual distance
	Ability to get to a distant point for a better view
	Horizon/sky imagery (sun, distant mountains, clouds)
Refuge (sense of enclosure or shelter)	Strategic viewing locations
	View corridors
	Canopy effect (lowered ceilings, screening, branch like forms overhead)
	Variation in light levels (darkness suggests refuge)
Water (indoors or in view)	Enclosing surfaces (walls, partitions, screens)
	Penetrable barriers and surfaces for views out
	Glimmering or reflective surface (suggests clean water)
Biodiversity	Moving water (also suggests clean, aerated water)
	Symbolic forms of water
	Varied vegetation indoors and out (large trees, plants, flowers)
	Windows designed and placed to incorporate nature views
Sensory Variability	Outdoor natural areas with rich vegetation and animals
	Changes and variability in environmental color, temperature, air movement, textures, and light over time and space
Biomimicry	Design derived from nature
	Use of natural patterns, forms and textures
	Fractal characteristics (self similarity at different levels of scale with random variation in key features, rather than exact repetition)
A Sense of Playfulness	Incorporation of decor, artifacts, objects, spaces whose primary purpose is to delight, surprise and amuse
Enticement	Discovered complexity
	Information richness that encourages exploration
	Curvilinear surfaces that gradually open information to view

3. MODERN EXPERIENCES

In contemporary architectural practice, the biophilic design is in the expansion, especially when it comes to competition-conceptual solutions and planning of future facilities. In the current architectural realizations around the world, which are also growing in number, the following principles are applied as the dominant ones: green facades and rooftops, glass bulkheads and transparent membranes between the interior and the external natural environment, and elements of nature in the centers of the volume of objects and along the communications.

In the following sections of this article the examples from practice are analyzed with the aim of emphasizing the significance of the biophilic-design strategies used in architectural design.

3.1. A Hidden Garden behind the Concrete Walls/Muxin Design

This project is a reconstruction of an office into a place where staff can take a breath of nature. In order to maximize the utilization of space designers creatively applied some of the biophilic characteristics. By using irregular curves for desks and bookshelves they moved the “forest” into the office, making it an open space with natural vitality and a sense of playfulness (Figure 2). Continuous curve divides the office into different spaces, providing people a completely different transition experience and enticement in a way. Designers made full use of sunny windows, making the area by the windows into free space for exchange and sharing. In this, we can recognize an ability to see into the distance by using big windows, as well as bright colored walls and natural materials such as bright wood. Biodiversity is achieved with the introduction of plants. This brought rhythm to the office. Interior is designed as a peaceful and pleasant office garden, connecting the indoor and outdoor areas naturally and thus creating a new form of boundary. Here, people can escape the urban fog and haze and feel like working in a tranquil garden, which allows them to relax during intense work and that increases work efficiency. The plants interspersed between tables enable the employees to feel the atmosphere of nature, and at the same time, can effectively improve the indoor micro-climate and working environment. In this project, the office space is divided into various areas by trees and rocks, which makes the office more interesting and provides employees with a better experience.



Fig. 2 (a) Atmosphere of nature, (b) Floor Plan, (c) Curved desks and vegetation, and (d) Playfulness of the interior (source: <https://www.archdaily.com/786287/a-hidden-garden-behind-the-concrete-walls-muxin-design>, accessed: 10.03.2019.)

3.2. Titan Integrity Campus/Mindspace

The corporate office building is located on a 6.5-acre site which has a lake on its eastern side. The design has a very special connection with the site and the adjoining lake since water represents one of the main key characteristics of biophilic design (Figure 3). A bio lake is conceived towards the eastern side of the site, which response to the existing lake and would seem like an extension of it. The main goal for the office building was to be organized around this bio lake. The three-floor structure has a terrace garden at every level thus giving the ability for a better view. Free flowing cascading green terraces, which are inspired by rice fields, represent biomimicry on one hand, and on the other rich biodiversity. These terraces also provide insulation to office spaces below, create a sense of playfulness and enticement. Biophilic terraces not only allow one to work outdoors, but they also stimulate interaction amidst the flora and fauna. It is expected that over the years greenery on the receding terraces would cover almost the entire building. A green wall shields the usable spaces from the harsh western sun. The landscape design is imagined as a vertical park starting from the waterfront park at the ground level to the sky park at the roof level. The landscape spaces seamlessly merge from outside to inside thanks to the big windows designed and placed to incorporate views of rich vegetation.



Fig. 3 (a) The lake (water), (b) Floor plan, (c) Cascading terraces, and (d) Inside-outside connection (source: <https://www.archdaily.com/908221/titan-integrity-campus-mindspace>, accessed: 12.03.2019.)

3.3. Maggie's Oldham/dRMM

Maggie's Oldham is the 21st built Maggie's health-rehabilitation center in the UK (Figure 4). The center is strategically placed in the northern part of the complex of the Royal Hospital in Oldham, where the resting views to mountain range Pennine dominate. As the purpose of Maggie's Centers is to provide hope to cancer patients with a relationship of built environment towards users, the building is conceived as a union of healthy inner and outer ambient, primarily using bright colors, natural and renewable materials which create sensory variability. The main mass of the building is raised above the ground and the garden and this creates a sense of shelter for patients. From the garden, the deep entrance porch of the building, which is there for the stay of the users in the open and enjoying the views, is accessed through an open exterior staircase. Upon entering the building, there are undisturbed views to the central atrium, the sky and the mountain range on the horizon. Formed interior ambient is eager to delight, support, and cheer.

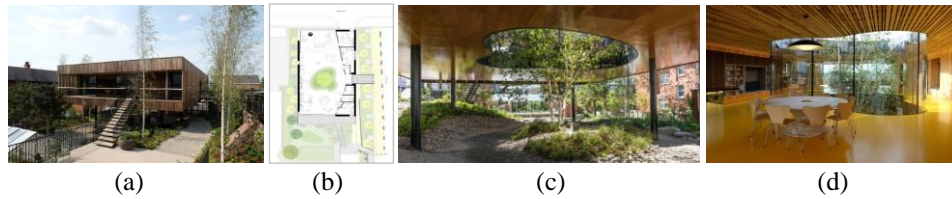


Fig. 4 (a) Entrance porch, (b) Floor plan, (c) Garden, and (d) The central atrium and bright colors and materials (source: <https://www.archdaily.com/874795/maggies-oldham-drmm>, accessed: 10.03.2019.)

3.4. Punggol Neighbourhood and Polyclinic/Serie Architects + Multiply Architects

Oasis Terrace represents a new generation of community centers. The design utilizes a series of lush garden terraces that slope towards the waterway as one of the key elements characteristic to biophilic design (Figure 5). These biophilic gardens act as communal spaces, children's playgrounds, and a natural amphitheater. The roof is also heavily landscaped and features planting beds for urban farming. The gardens play more than just an aesthetic role in the community; they are a collective horticultural project which creates changes and variability in environmental color, temperature, and air. Every visible elevation of the building is covered with lush plating. Together with the veranda spaces that wrap around the restaurants and polyclinic, the plants act as an environmental filter between the exterior and interior spaces. The building also has big glass surfaces for the indoor-outdoor connection and with the terraces is clear the attempt to mimic natural forms and textures.

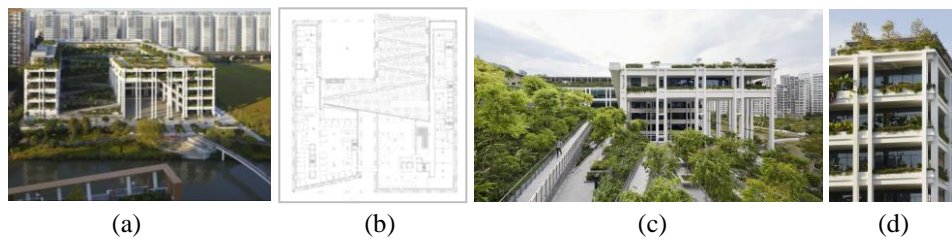


Fig. 5 (a) Elevations covered with planting, (b) Floor plan, (c), Garden terraces, and (d) Green frame (source: <https://www.archdaily.com/909142/punggol-neighbourhood-and-polyclinic-serie-architects-plus-multiply-architects>, accessed: 12.03.2019.)

3.5. Characteristics of analyzed examples

In the sections above were analyzed some world examples in order to emphasize the importance of the biophilic principles used in their architectural design. In A Hidden Garden Behind the Concrete Walls, Titan Integrity Campus, Maggie's Oldham, and Punggol Neighbourhood and Polyclinic some of the dominant biophilic design characteristics were: the creation of a sense of playfulness through creatively organized space, the introduction of plants and greenery, big windows placed to incorporate views, strategically placing of the building on site, and biomimicry (Table 2).

Table 2 Summarized characteristics of analyzed examples (Source: Authors)

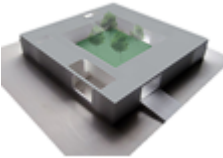
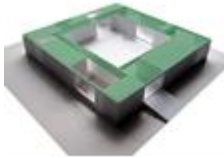
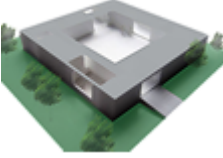
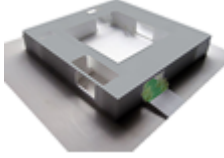
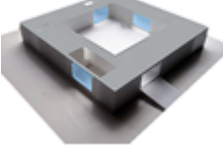
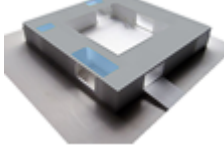
The example	Characteristics
<p>A Hidden Garden behind the Concrete Walls</p> 	<ul style="list-style-type: none"> ▪ a reconstruction of an office space ▪ using of irregular curves for desks and bookshelves ▪ an open space with natural vitality and a sense of playfulness ▪ full use of sunny windows ▪ the area by the windows is free space for gathering ▪ an ability to see into the distance ▪ big windows, bright colored walls, and natural materials ▪ biodiversity, plants, office garden, an atmosphere of nature ▪ the natural connection between indoor and outdoor areas
<p>Titan Integrity Campus</p> 	<ul style="list-style-type: none"> ▪ corporate office building on a 6.5-acre site ▪ the connection between the site with the lake and the design ▪ the main goal was to organize the building around bio lake ▪ the three-floor structure has a terrace garden at every level ▪ biomimicry and rich biodiversity are present ▪ a sense of playfulness and enticement ▪ the spaces merge from outside to inside, the big windows
<p>Maggie's Oldham</p> 	<ul style="list-style-type: none"> ▪ the 21st built a health-rehabilitation center in the UK ▪ strategically placed in the northern part of the complex, where the resting views to mountain range Pennine dominate ▪ the building is a union of healthy inner and outer ambient ▪ using bright colors, natural and renewable materials which create sensory variability ▪ the main mass is raised above the ground and the garden ▪ undisturbed views (central atrium, the sky, the mountains)
<p>Punggol Neighbourhood and Polyclinic</p> 	<ul style="list-style-type: none"> ▪ a new generation of community centers ▪ a series of garden terraces that slope towards the waterway ▪ biophilic gardens have many purposes ▪ the roof is heavily landscaped, the potential for urban farming ▪ changes in environmental color, temperature, and air ▪ every elevation of the building is covered with lush plating ▪ the plants are an environmental filter between the exterior and interior spaces ▪ big glass surfaces for the indoor-outdoor connection

4. DISCUSSION AND PATTERN FOR APPLICATION IN SERBIA

In Serbia, biophilic design exists only in a rudimentary form. Among the buildings of the recent date, only in individual cases certain elements and architectural ideas, which can be said to respect the logic of the biophilic approach, are applied to design and construction. The tradition of Serbian and sometimes Yugoslav architectural practice also nurtured certain forms of biophilic concepts.

Spacious atriums in the centers of buildings of educational, administrative and medical purposes, were positive examples in realized projects, which in the exploitation proved to be a factor in raising the quality of stay for the surrounding areas. Always present demand for orientation with a lot of light when it comes to educational processes and spaces for children, regularly imposes the need for multiplying the series of spaces of the same orientation by inserting atriums or forming green pockets. The similar case is with all those facilities whose function implies unilateral orientation of a number of units along the communication, such as office spaces or rooms with different users from patients in hospitals and elderly in a nursing home to student dormitories. Similar needs for lighting and going out into an open green environment also has collective housing, and especially family facilities in which there is a long and famous tradition of atrium designing. Green roofs, terraces, and facades, although from recently, are ubiquitous in the architectural expression of today (Table 3).

Table 3 Building - nature connection (Source: Authors)

Outside the building	Inside of the building	
	Atrium	Green roof
Open space		
	On the ground	Terrace
Semi-open space		
	Facade glazing	Zenith glazing
Visual connection		

The domination of glass facades in architecture contributed to the complete opening of visions in the overall width and height of the front to the surrounding greenery and the sky, from the space of the classroom, hospital rooms, and offices, traditionally characterized by full parapets and facade masses. The extreme are examples of glazed longitudinal faces of gymnasiums in schools, but on the other hand that is a wonderful example of the environment in which children's physical activities take place in conditions similar to open space.

The introduction of sunlight through roof glazing, most often in the zone of central expansion in buildings or when needed along the communications, is one of the principles of

biophilia, but also one of the qualities of the interior spaces in which the penetration of natural light makes a special atmosphere, and sometimes has significant symbolism.

3. CONCLUSION

In Serbia, the biophilic design exists only in an elementary form. Among the recent date buildings, only in individual cases certain elements and architectural ideas, which can be said to follow the biophilic approach, are applied to design and construction. In some cases, the tradition of Serbian and sometimes Yugoslav architectural practice nurtured certain characteristics of biophilic concepts.

Spacious atriums in the centers of educational, administrative and medical buildings, were, for instance, some positive examples in realized projects. This biophilic aspect, in the exploitation period, proved to be a factor in improving the quality of stay for the surrounding areas. The demand for orientation with a lot of light is always present when it comes to educational processes and spaces for children, thus regularly imposing the need for multiplying the series of spaces of the same orientation by inserting atriums or forming green pockets. The similar case is with all those facilities whose function implies unilateral orientation of a number of units along the corridor, such as office spaces or rooms with different users, from patients in hospitals and elderly in a nursing home to student dormitories. Similar lighting needs and requirements for the opening into some green environment also has collective housing, and especially family buildings in which there is a long and well-known tradition of atrium designing. Green roofs, terraces, and facades, although from recently, are ubiquitous in the architectural expression of today.

The growing presence of glass facades in architecture contributed to the complete opening of visions in the overall width and height of the front to the surrounding greenery and the sky. The classroom space, hospital rooms, and offices, traditionally characterized by full parapets and facade masses now have views and connection with surrounding nature. One can say that the extremes are examples of glazed longitudinal faces of gymnasiums in schools, but on the other hand that is a great example of the environment in which children's physical activities take place in conditions similar to open space.

The introduction of sunlight through roof glazing, most often in the central zone of buildings or when needed along the communications, represents one of the principles of biophilia but also is one of the qualities of the interior spaces. The penetration of natural light makes a unique atmosphere and sometimes has significant symbolism in interiors. Based on the analysis of foreign experiences, the paper has summarized and classified design principles relating to the interconnection between the building and the open space, the link with the semi-open surfaces and the possibilities of visual contact with the natural environment, which can serve as a model for the application in architecture in Serbia.

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BIOFILIJU U SAVREMENOJ ARHITEKTONSKOJ PRAKSI: PREPORUKE ZA SRBIJU

Arhitektura i njeno prirodno okruženje oduvek su bili neraskidivo povezani kroz vekovnu istoriju razvoja građevinarstva. Danas, u vreme ubrzanog razvoja i tehnoloških inovacija, a planeta postaje svakim danom ugroženija posledicama ljudskog delovanja, priroda je glavna tema i oslonac, u fokusu arhitektonskog stvaranja više nego ikada.

Biofilija u arhitekturi predstavlja inovativni metod arhitektonsko-urbanističkog projektovanja sa akcentom na ulozi prirode u kvalitetu boravka, života i rada čoveka u izgrađenim prostorima. Arhitektura zasnovana na ovim principima predstavlja arhitekturu budućnosti. Ovakva arhitektura je koncipirana i kreirana kao zdrava i produktivna sredina savremenog čoveka, kako kada je u pitanju zatvoreni prostor, tako i u planiranju lokalnih zajednica kao aktivnih i društvenih susedstava.

Koristeći analitičko-deskriptivnu metodologiju i istraživačku literaturu, ovaj rad se fokusira na savremena iskustva i analizira odabrane studije slučaja, kako bi se utvrdili elementi mogućeg modela kao uzora za arhitektonsku praksu u Srbiji.

Ključne reči: *arhitektura, priroda, biofilija, projektovanje*