ARCHDESIGN '19
CONFERENCE PROCEEDINGS

Özgür Öztürk DAKAM YAYINLARI
March 2019, İstanbul.
www.dakam.org
Firuzağa Mah. Boğazkesen Cad., No:76/8, 34425, Beyoğlu, İstanbul
ARCHDESIGN '19 / VI. INTERNATIONAL ARCHITECTURAL DESIGN CONFERENCE PROCEEDINGS

Cover Design: D/GD (DAKAM Graphic Design)
Print: Metin Copy Plus, Mollafenari Mah., Türkocağı Cad. 3/1, Mahmutpaşa/ Istanbul, Turkey
ISBN: 978-605-81019-2-0

VI. INTERNATIONAL ARCHITECTURAL DESIGN CONFERENCE

ARCHDESIGN '19
CONFERENCE PROCEEDINGS

Özgür Öztürk DAKAM YAYINLARI

CONTENTS

BIOPHILIC ARCHITECTURE: NATURE-BASED DESIGN SOLUTIONS FOR HEALTH AND WELL-BEING IN LIVING SPACES

VLADAN DJOKIC
Ph.D., University of Belgrade – Faculty of Architecture

JELENA RISTIC TRAJKOVIC
Ph.D., University of Belgrade – Faculty of Architecture

ANA NIKEZIC
Ph.D., University of Belgrade – Faculty of Architecture

MILENA KORDIC
Ph.D., University of Belgrade – Faculty of Architecture

Abstract

This research focuses on improving the well-being and health of citizens in terms of design and development of living spaces in harmony with nature. In the contemporary moment the most cities suffer from health and environmental problems. Also, the growing awareness of climate changes issues make it even more apparent and essential to bring nature into our living spaces. Scientific studies have pointed out on a multiplicity of benefits of nature for people, especially for children and older populations. Bringing nature indoor causes increased participation in physical activities, improved mental health and cognitive function and an increase in social interaction between people. Nature and its elements have great power on the human body. The concept of biophilia advocates that there is an innate connection between humans and nature and that people tend to show a positive response when they experience a connection with nature. Accordingly, biophilic design is the design of spaces that promotes and encourages the interaction of humans with nature and natural systems. This paper researches different design methodologies, strategies, principles, scales, concepts according to patterns of

biophilic design and with a focus on their influence on the health and well-being of users. The research also opens further discussions about the potentials of sensitive and responsive biophilic design to improve health and environmental problems of contemporary urban areas.

Keywords: biophilia, well-being, architecture design, interior design, urbanity

Introduction

This research focuses on improving the well-being and health of citizens in terms of design and development of living spaces in harmony with nature. In the contemporary moment the most cities suffer from health and environmental problems. Also, the growing awareness of climate changes issues make it even more apparent and essential to bring nature into our living spaces. Scientific studies have pointed out on a multiplicity of benefits of nature for people, especially for children and older populations. Bringing nature into the built environment causes increased participation in physical activities, improved mental health, and cognitive function and an increase in social interaction between people. Nature and its elements have great power on the human body. The concept of biophilia advocates that there is an innate connection between humans and nature and that people tend to show a positive response when they experience a connection with nature. Accordingly, biophilic design is the design of spaces that promotes and encourages the interaction of humans with nature and natural systems.

Within the Design studio courses at University Belgrade – Faculty of Architecture students get acquainted with different Nature-Based design frameworks such as Biophilic Design, Regenerative Design, Resilient Design etc. In the first phase of the design they critically research relevant case studies how different Nature-Based design is applied, from the scale of the city to the scale of the singular object. In this way using Integral approach students get acquainted how to implement resilient and sustainable solutions that aim at a wide range of societal, ecological and economic challenges and problems. This approach enables them to integrate Nature-Based design within their own projects.

This paper researches different educational design methodologies, strategies, principles, scales, concepts according to patterns of biophilic design. The research also opens further discussions about the potentials of sensitive and responsive biophilic design to improve health and environmental problems of contemporary urban areas.

Nature-Based Design Solutions

In 2015 the European Commission published the report titled "Towards an EU Research and Innovation policy agenda for Nature-Based Solutions and Re-Naturing Cities". In this report Nature-Based solutions are defined as follows:

"Nature-Based solutions aim to help societies address a variety of environmental, social and economic challenges in sustainable ways. They are actions inspired by, supported by or copied from nature; both using and enhancing existing solutions to challenges, as well as exploring more novel solutions, for example, mimicking how non-human organisms and communities cope with environmental extremes. Nature-Based solutions use the features and complex system processes of nature,

such as its ability to store carbon and regulate water flows, in order to achieve desired outcomes, such as reduced disaster risk and an environment that improves human well-being and socially inclusive green growth" (European Commission, 2015 p.24).

The report referred on many research and innovation possibilities that are linked to the new design strategies which are relied on natural components as an important material and tool for improving health and wellbeing of living spaces in cities and supporting building resilience. The focus of this research are Nature-Based solutions resilient to change and adapted to local conditions. With reference to the four priority goals (in the same report) to be pursued this research focuses on the implementation of Nature-Based solutions: 1 – to regenerate urban contexts and 2 – to improve wellbeing in urban contexts.

Besides this report the document from 2017 titled "The city of the future. Manifesto of green economy for architecture and urban planning" created by the "Working Group of the States General of the Green economy" also states that Nature-Based Solutions have a key role in developing new action models capable of combining environmental needs with social and economic needs (Working Group of the States General of the Green economy, 2017).

Nature-Based Design implies an understanding of the structure and functioning of ecosystems, including human behaviour, experience, activities etc. It recognises the importance of nature for contemporary cities and requires systematic changes in environmental action and understanding of our environment. Many of contemporary health and environmental problems are a consequence of our incorrect careless behaviour that failed to recognize ecological limitations and the inseparable connection of people with nature. Nature-Based Design is seen as a step in changing this kind of action, an alternative that is found in looking at nature as design inspiration and process knowledge.

It is very important to emphasize that this is a multilevel approach that can be utilised for interventions at different levels and scales, ranging from single objects and lots to the community, city, the region and wider, operating synergistically among the various levels and scales. At an architectural level, both in buildings and within open spaces, nature components enable benefits which could hardly be achieved with traditional principles and techniques. To implement Nature-Based solutions implies to use the various strategies and principles which view "natural capital" and ecosystem services as founding elements of new urban models. Nature-Based Solutions consist in substituting or integrating functions generally offered by non-renewable resources with those provided by ecological systems (Mussinellia, et al., 2018). Another very important characteristic of Nature-Based Design Solutions is that they are locally sensitive and place-based. Interventions depend on recognising and identifying the correct balance between performance/ functional needs and whether-climate/environmental characteristics of the site of intervention (Mussinellia, et al., 2018)

Biophilic Design

Biophilic design promotes and encourages the interaction of humans with nature and natural systems. Besides visual and aesthetic qualities, it's great importance from the aspect of sustainability and health is the fact that it can reduce stress,

improve cognitive function and creativity, improve our well-being and expedite healing; as the world population continues to urbanize, these qualities are ever more important. Biophilic design reconnects us with nature and it is essential for providing people opportunities to live and work in healthy places and spaces with less stress and greater overall health and well-being (Browning, at al., 2014, p. 4).

The biophilia hypothesis suggests that there is an innate connection between humans and nature and that people tend to show a positive response when they experience a connection with nature. It states that since humans originated from savannah-like environments they have "the urge to affiliate with other forms of life". When connected with nature and natural systems, humans can feel more emotionally content, and this has the potential to increase their life span (Wilson, 1984, p. 85).

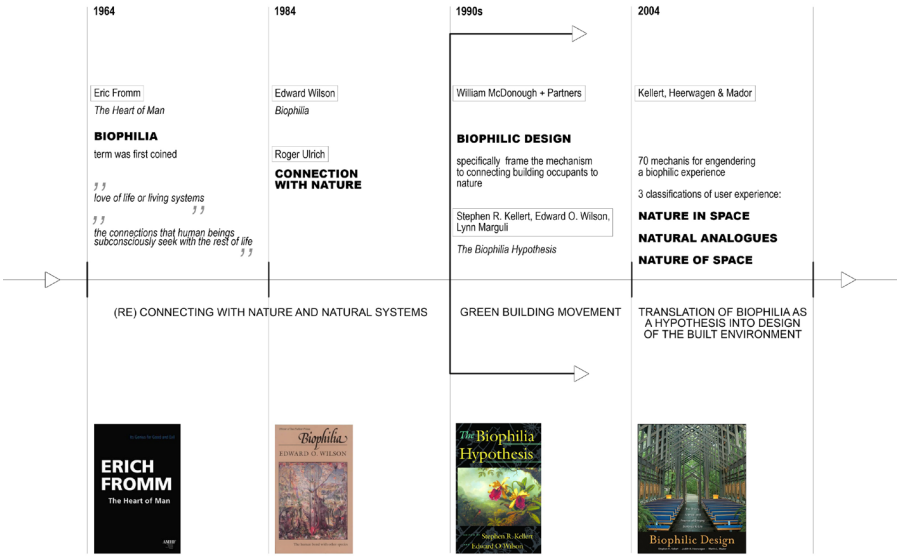

Figure 1. Scheme – Translation of the biophilia hypothesis into the design

Regarding the translation of the biophilia hypothesis into the design it is very important to mention conference on biophilic design organized in 2004 and subsequent book with the same topic. It this book Kellert identified more than 70 different mechanisms for engendering a biophilic experience while contributing authors Browning and Seal-Cramer emphasized three classifications of user experience: Nature in the Space, Natural Analogues, and Nature of the Space (Kellert, at al., 2008).

Multiple scientific studies have pointed out the benefits and importance of nature for people, and especially for children and older populations. New research supports measurable, positive impacts of biophilic design on health, strengthening the empirical evidence for the human-nature connection and raising its priority

level within both design research and design practice; however, little guidance for implementation. In the recent moment, there is an increase in interest in the relationship between neuroscience and architecture both in research and in practice. Also, green building standards have begun to incorporate biophilia, predominantly for its contribution to indoor environmental quality and connection to place (Browning, at al., 2014).

Nature – Design Relationships

As already explained in the preceding paragraphs biophilic design can be organized into three categories – Nature in the Space, Natural Analogues, and Nature of the Space. This classification provides a framework for understanding and enabling thoughtful incorporation of a rich diversity of strategies into the built environment (Browning, at al., 2014). Each category encompasses different biophilic design patterns. These 14 patterns have a wide range of applications both in interior and exterior environments. They should be flexible and adaptive in order to provide an appropriate implementation.

As one of the Nature-Based design frameworks, biophilic design should be locally sensitive. In that sense, the great advantage of these biophilic design patterns is the fact that they can be scaled and adjusted to the surrounding environment. Patterns can be applied at very different scales from the micro to the macro environment, from the scale of a singular room, a building, a neighborhood or settlement, to a scale of the city. Each of these scale requests different design approaches and challenges depending on the programming, users, climate, culture, and various physical contexts and parameters.

This paper presents research that was done at University of Belgrade – Faculty of Architecture within the course Studio Project. The examples of students work within this studio-based education are directed towards the elaboration of conceptual projects which incorporate program and spatial complexity with specific qualities regarding biophilic design and the implementation of Nature-Based design solutions. In relation to the structure of spatial frameworks, specific context, these examples show a diverse opus of design research questions and approaches. In this sense, it is required from students to study both design and program, as well as all other (sociological, historical, technological, technical, behavioral, economic...) determinants that define the identity of specific place.

In the first phase in order to be capable to recognize and identify appropriate design strategies and interventions students should understand this specific theoretical background, especially from the point of health and well-being in living spaces. They should understand that there are countless combinations of design patterns and interventions and that health-related priorities will help focus the design process. Incorporating a diverse range of design strategies can satisfy the needs of various user groups from differing cultures and demographics and create an environment that is psycho-physiologically and cognitively restorative (Browning, at al., 2014).

The shown examples of student work are proof that each context supports a platform for myriad opportunities for integrative biophilic design and mainstreaming healthy building practices for people and society. In the following paragraphs are shown in brief some key results, principles, and ideas that may help focus the

design process.

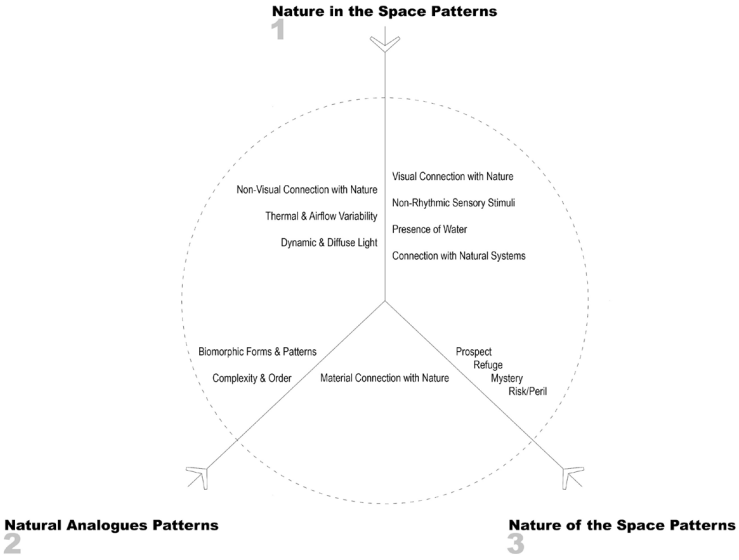

Figure 2. Scheme – Classification of biophilic design on categories and patterns. According to (Browning, at all.)

Nature in the Space Patterns

"Nature in the Space addresses the direct, physical and ephemeral presence of nature in a space or place. This includes plant life, water and animals, as well as breezes, sounds, scents, and other natural elements. Common examples include potted plants, flowerbeds, bird feeders, butterfly gardens, water features, fountains, aquariums, courtyard gardens, and green walls or vegetated roofs. The strongest Nature in the Space experiences are achieved through the creation of meaningful, direct connections with these natural elements, particularly through diversity, movement, and multi-sensory interactions." (Browning, at al., 2014).

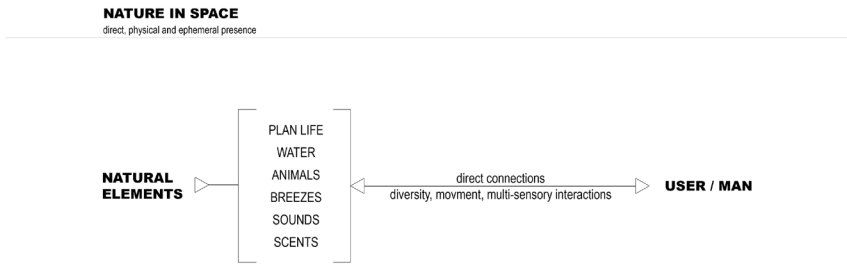

Figure 3. Nature in space relations

There are 7 specific Patterns to this first category of Nature in the Space:

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

Although most natural elements in modern society urban areas are designed, they can provide us various experiences and benefits. According to "14 patterns of biophilic design" complex and variable views to nature, living systems and natural processes, as well as different auditory, haptic, olfactory, or gustatory stimuli can provide a deliberate and positive filling, reduce stress and enhance well-being characteristic of the space. Also, subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments and change over time are welcome. (Browning, at al., 2014)

Students examine in their designs how movement and varying intensities of light and shadow in interior space can simulate some effects of natural conditions. Experiencing those effects users associate interior space with natural qualities and that connection improve the comfort of the space. Some works investigate how bringing water indoors in a form that resembles some natural conditions (such as water with biofilters – plants that purify the water) can shape the way people think about the environment even in the isolated and artificial space. Other works are focusing on temporal change in elements of interior space, and in that way bring the awareness of natural processes, especially seasonal and temporal changes. Finally, some works deal with programmatic compatibility of growing plants, with other standard parts of acquired programs.

Figure 4. Student's work - Petar Tatić. Biophilic design patterns: Thermal & Airflow Variability and Presence of Water

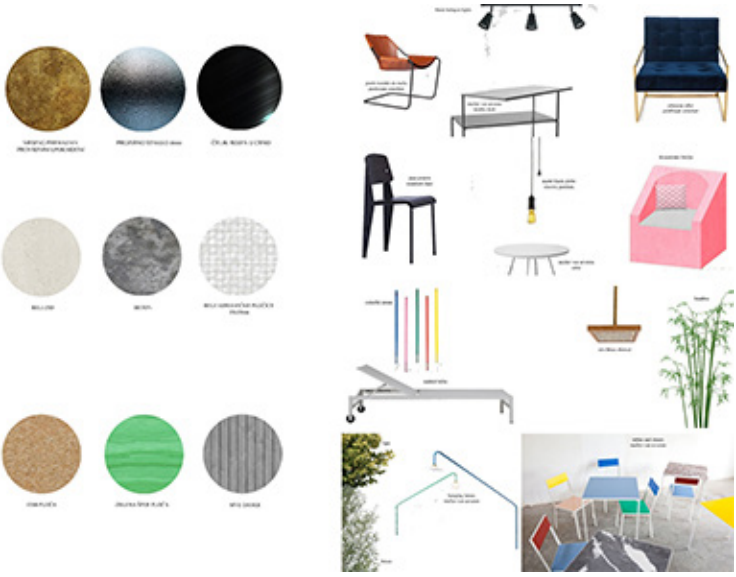

Figure 5. Student's work - Petar Tatić. Biophilic design patterns: Non-Visual Connection with Nature

Figure 6. Student's work - Jelena Bošnjak. Biophilic design patterns: Dynamic & Diffuse Light, Connection with Natural Systems

Figure 7. Student's work - Marta Mrkobrada. Biophilic design patterns: Visual Connection with Nature

Figure 8. Student's work - Marta Mrkobrada. Biophilic design patterns: Non-Rhythmic Sensory Stimuli

Nature Analogues Patterns

"Natural Analogues addresses organic, non-living and indirect evocations of nature. Objects, materials, colors, shapes, sequences, and patterns found in nature, manifest as artwork, ornamentation, furniture, décor, and textiles in the built environment. Mimicry of shells and leaves, furniture with organic shapes, and natural materials that have been processed or extensively altered (e.g., wood planks, granite tabletops), each provide an indirect connection with nature: while

they are real, they are only analogous of the items in their 'natural' state. The strongest Natural Analogue experiences are achieved by providing information richness in an organized and sometimes evolving manner." (Browning, at al., 2014)

Natural Analogues implies three patterns of biophilic design:

1. Biomorphic Forms & Patterns,
2. Material Connection with Nature,
3. Complexity & Order.

There are researches that show that people have a visual preference for organic and biomorphic forms. Contoured, patterned, textured or numerical arrangements that persist in nature have symbolic meanings and associations. Use of materials and elements from nature reflect the local ecology or geology and create a distinct sense of place. Natural textures and colours enhance creative performance and comfort, decrease diastolic blood pressure and enhance calm. Spatial hierarchies found in nature have very characteristic complexity and order. Including rich sensory information in architectural design, that adheres to a spatial hierarchy similar to those found in nature, has a role in enhancing health and reduce stress in living spaces.

Students were searching for possibilities of organic and biomorphic forms in their designs. The search was for metaphoric, not literal, means of contoured, patterned, textured or numerical arrangements that persist in nature and have symbolic meanings and associations. Use of materials and elements from nature reflect the local ecology or geology and create a distinct sense of place. Natural textures and colours enhance creative performance and comfort, decrease diastolic blood pressure and enhance calm. Spatial hierarchies found in nature have very characteristic complexity and order. Including all this rich sensory information in architectural design, students examined how constructing a spatial hierarchy like those found in nature can reduce stress in living spaces. (Browning, at al., 2014)

Figure 9. Student's work - Jovana Radujko. Biophilic design patterns: Material Connection with Nature

Figure 10. Student's work - Jovana Radujko. Biophilic design patterns: Material Connection with Nature

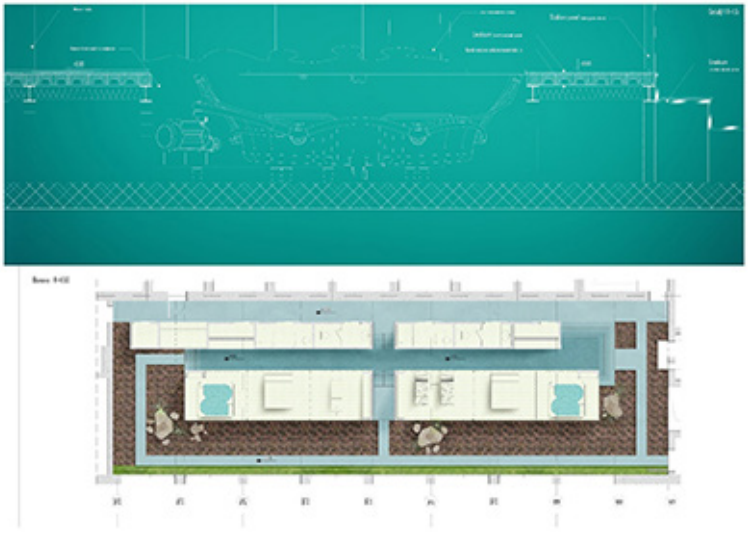

Figure 11. Student's work - Milutin Jovanović. Biophilic design patterns: Complexity & Order

Figure 12. Student's work - Milutin Jovanović. Biophilic design patterns: Complexity & Order

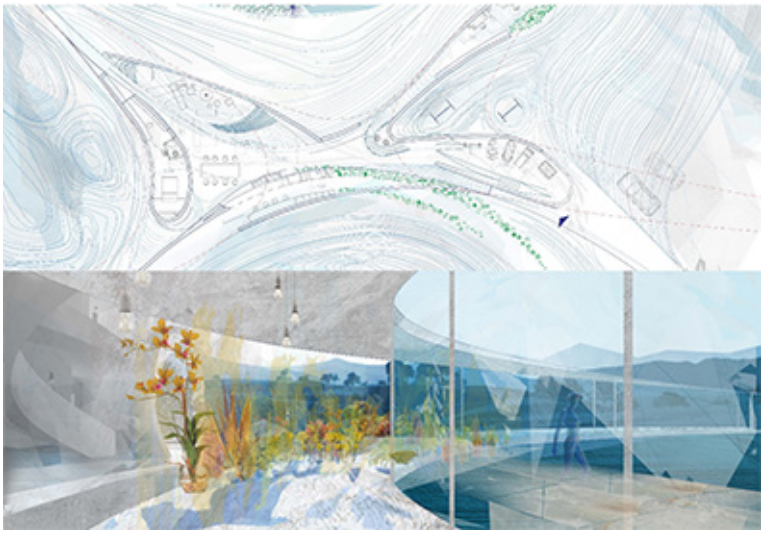

Figure 13. Student's work - Teodora Arsenijević. Biophilic design patterns: Biomorphic Forms & Patterns

Nature of the Space Patterns

"Nature of the Space addresses spatial configurations in nature. This includes our innate and learned desire to be able to see beyond our immediate surroundings, our fascination with the slightly dangerous or unknown; obscured views and revelatory moments; and sometimes even phobia-inducing properties when they include a trusted element of safety. The strongest Nature of the Space experiences are achieved through the creation of deliberate and engaging spatial configurations

commingled with patterns of Nature in the Space and Natural Analogues". (Browning, at al., 2014)

The 4 Patterns of this category:

1. Prospect,
2. Refuge,-
3. Mystery,
4. Risk/Peril.

The Prospect implies an unimpeded view over a distance. This pattern refers to characteristics of a space such are a sense of safety and control. Comfort with good Prospect has its roots in our beginnings on a savannah, an environment with an open landscape and groups of shade trees for safety. Implementation of common feature such are transparent materials, open floor plans, elevated planes, and views including shade trees, bodies of water or evidence of human habitation are examples of ways to optimize visual comfort and enhance the Prospect.

In students works presented below, the subject of refuge was examined. A refuge is a place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead. This is a private space were user feels separate or special, and away from the primary environment. Design in this way has a role in reducing blood pressure and heart rate as well.

Mystery space encourages exploration and promises more information achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment. Mystery implies participation and excitement of the user.

Finally, the Risk/Peril pattern is defined as an identifiable threat, coupled with a reliable safeguard. For example common features in architectural design to reach this pattern are: double-height atrium with balcony or catwalk; architectural cantilevers; infinity edges; facades with floor-to-ceiling transparency; experiences or objects that are perceived to be defying or testing gravity; transparent railing or floor plane; passing under, over or through water; proximity to an active honeybee apiary or predatory animals; life-sized photography of spiders or snakes etc. (Browning, at al., 2014)

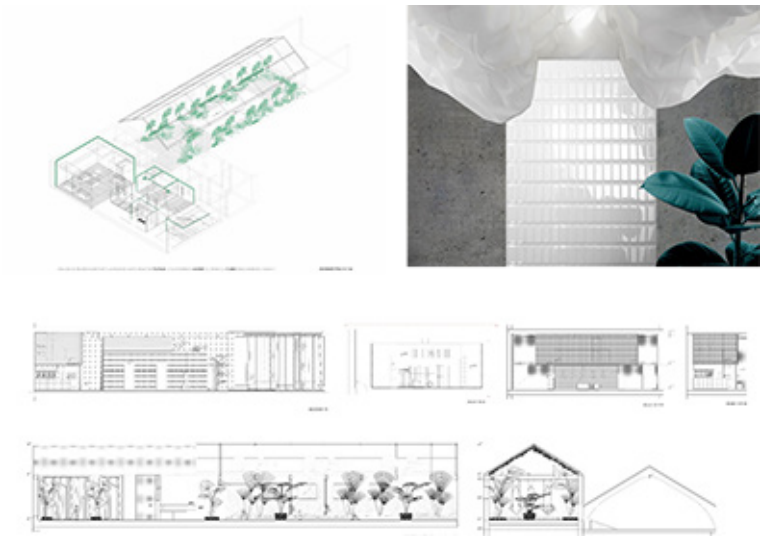

Figure 14. Student’s work - Jelena Aksentijević. Biophilic design patterns: Prospect

Figure 15. Student’s work - Jelena Aksentijević. Biophilic design patterns: Refuge

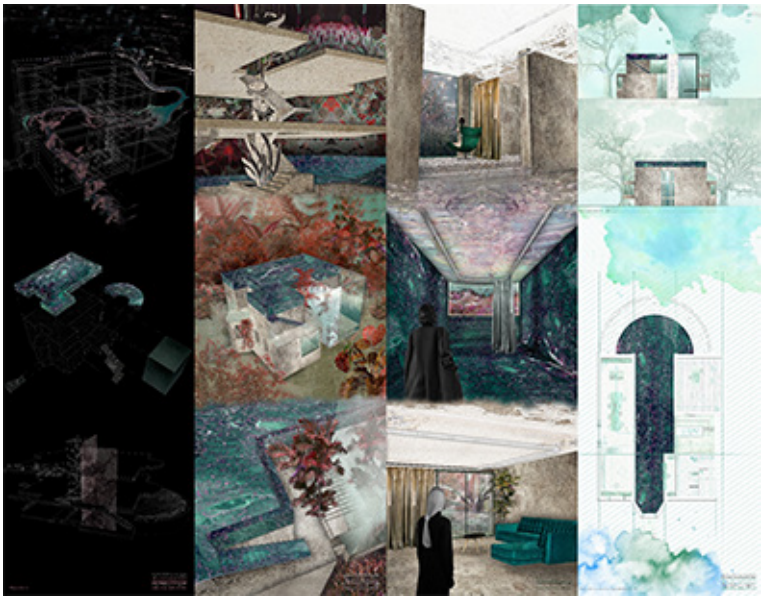

Figure 16. Student's work - Jovana Radujko. Biophilic design patterns: Mystery

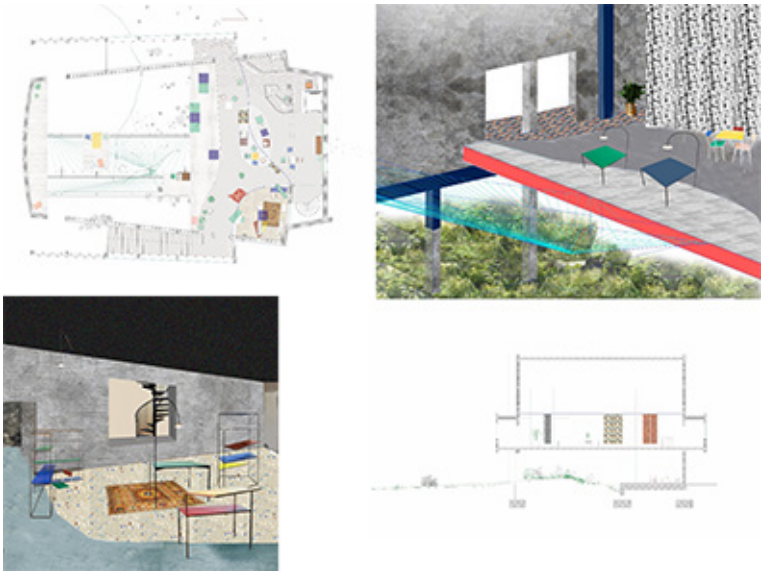

Figure 17. Student's work - Petar Tatić. Biophilic design patterns: Risk

Final remarks

This research indicates to the necessity for thinking more critically about the human connection with nature and how biophilic design patterns can be used as a tool for improving health and well-being of our living spaces, either on the scale of the singular objects and spaces either on the scale of the city. It is required to understand the identity of a specific place, not just from the aspect of climate, but

also from all other relevant aspects (sociological, historical, technological, technical, behavioral, economic...). Also, it is necessary to understand the character and density of specific place: rural, suburban and urban environments. For example, in suburban settings, biophilic design patterns and principles are typically intuitively applied, while the potential human health benefits are underappreciated in high-density urban settings. Therefore, students' projects should find its usefulness primarily in the specificities and characteristics of a place and in a more responsible relationship with the natural, artificial, tangible and intangible components of the architecture. Use of Nature-Based Solutions enables achieving of various benefits and values, not only environmental but also cultural, economic etc. Furthermore, the design concept is usually based on a very dynamic context, defined not only by physical elements but also and especially by cultural and socioeconomic ones.

"Nature-Based Solutions – being ontologically founded on the use of living elements, thus in progressive transformation and with the ability to adapt to the changeable conditions of the surroundings – represent a consistent solution that relates to a said complex scenario in a correct and adaptive manner (Mussinelli, at al., 2018)." Accordingly, this approach is very important for the process of planning and design of our living environments.

The research stimulates further discussions about the question of how bringing nature into the design (at different scales) can improve well-being and health. High-quality design solutions should be defined by the richness of program, user accessibility, sensitivity and, as mentioned before, diversity of strategies. This implies creating a sensitive and responsive design that highlights a) visual connection to nature, b) palpability and soundness of nature and c) nurturing a sense of place, a community in which the role of aesthetics is crucial for behavioural change.

Acknowledgments

This paper was written as a part of the projects "Research and systematization of housing development in Serbia in the context of globalization and European integrations for the purpose of improving housing quality and standards" (TR36034), "Studying climate change and its influence on the environment: impacts, adaptation and mitigation" (43007), financed by the Ministry of Education and Science of the Republic of Serbia.

References

Browning, W.D., Ryan, C.O., Clancy, J.O. 2014. *14 Patterns of Biophilic Design*. New York: Terrapin Bright Green, LLC.

European Commission. 2015. F*inal Report of the Horizon 2020 Expert Group on 'Nature-Based Solutions and Re-Naturing Cities'. Towards an EU Research and Innovation policy agenda for Nature-Based Solutions & Re-Naturing Cities.* Luxembourg: Publications Office of the European Union.

Heerwagen, J.H. & Hase B. 2001. *Building Biophilia: Connecting People to Nature in Building Design*. US Green Building Council. Posted March 8, 2001. http://www.usgbc.org/Docs/Archive/External/Docs8543.pdf. Web. 19 July 2018.

Joye, Y. 2007. Architectural Lessons From Environmental Psychology: The Case of Biophilic Architecture. *Review of General Psychology*, 11 (4), 305-328.

Kellert, S.F., J.H. Heerwagen, & M.L. Mador Eds. 2008. *Biophilic Design: The*

Theory, Science & Practice of Bringing Buildings to Life. Hoboken, NJ: John Wiley & Sons.

Kellert, S. R, Wilson, E. O. 2013. *The biophilia hypothesis*. Washington, DC: Island Press.

Mussinellia, E., Tartagliaa, A., Bisogni, L. & Malcevschic, S., 2018. The role of Nature-Based Solutions in architectural and urban design. *Techne*, Issue 15, pp. 116-123.

Ristić-Trajković, Jelena. 2016. *Architecture and nature: The application of environment-behavior theories in architectural design*. Ph.D. Thesis. University of Belgrade – Faculty of Architecture.

Ryan, C.O., W.D. Browning, J.O. Clancy, S.L. Andrews, & N.B. Kallianpurkar. 2014. Biophilic Design Patterns: Emerging Nature-Based Parameters for Health and Well-Being in the Built Environment. *Archnet International Journal of Architectural Research*, 8 (2), 62-76.

Sternberg, E.M. 2009. *Healing Space*s. Cambridge: Bleknap Harvard University Press

Van den Berg, A.E., Hartig, T. & Staats, H. 2007. Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability. *Journal of Social Issues*, 63 (1), 79-96.

Wilson, E.O. 1984. *Biophilia*. Cambridge, Massachusetts, and London: Harvard University Press.

Working Group of the States General of the Green economy. 2017. *The city of the future. Manifesto of green economy for architecture and urban planning*. http://www.statigenerali.org/manifesto-green-economy-citta-futura/