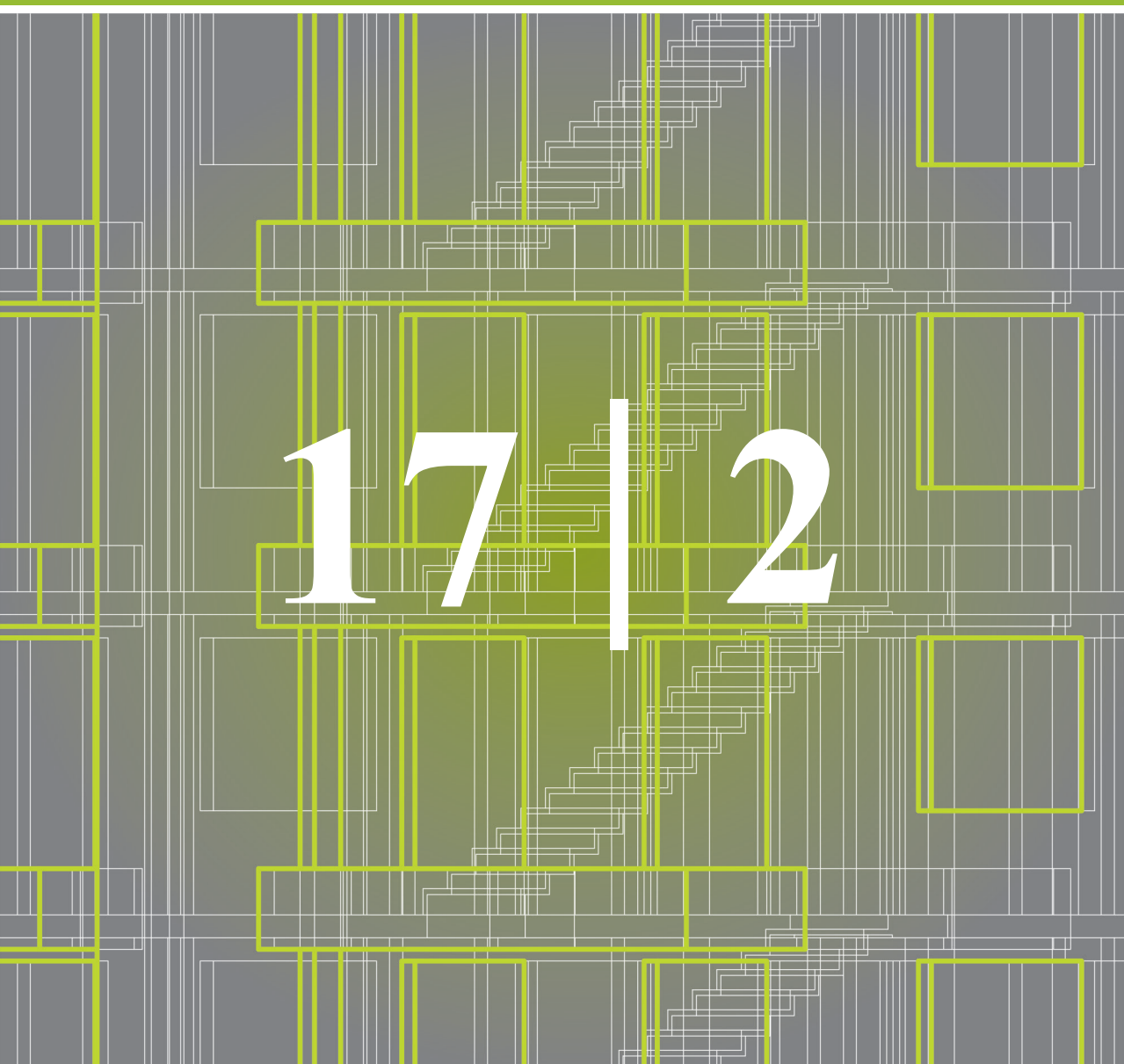
UNIVERSITY OF NIŠ

ISSN 0354-4605 (Print)
ISSN 2406-0860 (Online)
COBISS.SR-ID 98807559

FACTA UNIVERSITATIS

Series
ARCHITECTURE AND CIVIL ENGINEERING
Vol. 17, Nº 2, 2019



Scientific Journal **FACTA UNIVERSITATIS**
UNIVERSITY OF NIŠ
Univerzitetski trg 2, 18000 Niš, Serbia
Phone: +381 18 257 095 Telefax: +381 18 257 950
e-mail: facta@ni.ac.rs http://casopisi.junis.ni.ac.rs/

Scientific Journal FACTA UNIVERSITATIS publishes original high scientific level works in the fields classified accordingly into the following periodical and independent series:

Architecture and Civil Engineering
Automatic Control and Robotics
Economics and Organization
Electronics and Energetics
Law and Politics
Linguistics and Literature
Mathematics and Informatics
Mechanical Engineering
Medicine and Biology
Philosophy, Sociology, Psychology and History
Physical Education and Sport
Physics, Chemistry and Technology
Teaching, Learning and Teacher Education
Visual Arts and Music
Working and Living Environmental Protection

SERIES **ARCHITECTURE AND CIVIL ENGINEERING**

Publication frequency – one volume, three issues per year.
Published by the University of Niš, Serbia

Financial support: Ministry of Education, Science and Technological Development of the Republic of Serbia
Printed by "UNIGRAF-X-COPY" – Niš, Serbia

ISSN 0354 – 4605 (Print)
ISSN 2406 – 0860 (Online)
COBISS.SR-ID 98807559

FACTA UNIVERSITATIS

SERIES **ARCHITECTURE AND CIVIL ENGINEERING**
Vol. 17, N^{o} 2, 2019

UNIVERSITY OF NIŠ

INSTRUCTIONS FOR CONTRIBUTORS

Contributions should be (preferably) in English, French or German.
Under the paper title, the name(s) of the author(s) should be given while the full name, official title, institute or company affiliation and the like should be placed at the end of the paper together with the exact mail and e-mail address, as well as short (running) title of paper.
Manuscript format. A brief abstract of approximately 100 to 150 words in the same language and a list of up to six key words should precede the text body of the manuscript. All the authors apart from foreign ones should also submit a complete manuscript in Serbian. Manuscripts should be prepared as doc. file, Word version 6.0 or higher. Manuscript should be prepared using a Word template (downloaded from web address http://casopisi.junis.ni.ac.rs/index.php/FUArchCivEng/about/submissions#onlineSubmissions).
Manuscript length. Brief articles and discussions (10 pages or less) are encouraged. Otherwise, papers should present well-focused arguments of approximately 16 pages.
Style requirements. **Letters, figures and symbols** should be clearly denoted.
Equations should be typewritten and, with the number, placed in parentheses at the right margin. References to equations should be in the form "Eq. (2)" or simply (2). For equations that cannot be entered in a single line, use the Equation Editor in MS Word. In equations and in the text, *italicize* symbols that are used to represent variables or parameters, including subscripts and superscripts. Only use characters and symbols that are available in the Equation Editor, in the *Symbol font* or in *Times New Roman*.
All illustrations (figures, photographs, line drawings, graphs) should be numbered in series and all legends should be included at the bottom of each illustration. All figures, photographs, line drawings and graphs, should be prepared in electronic form and converted in TIFF or JPG (max quality) file types, in 300 dpi resolution, for superior reproduction. Figures, line drawings and graphs prepared using elements of MS Drawing or MS Graph must be converted in form of pictures and unchangeable. All illustrations should be planned in advance so as to allow reduction to 12.75 cm in column width. Please review all illustrations to ensure that they are readable.
All **tables** should be numbered with consecutive Arabic numbers. They should have descriptive captions at the top of each table and should be mentioned in the text.
The **references** should be numbered in the order in which they appear in the text, at the end of the manuscript, in the same way as the following examples:

1. Kollbruner C. F., Hajdin N., Stipanić B.: *Contribution to the Analysis of Cable-Stayed Bridges* N. 48, Schulthess Verlag, Zürich, 1980, pp. 66-77.
2. Đuranović P.: Organizacija upravljanja projektima, Izgradnja N^{o} 1/96, Beograd, 1996, str. 45-52.
3. Živković D.: Influence of front excavation on the state and deformity of montage lining of hydraulic pressure tunnels, Ph. D. University of Niš, 1988, pp. 95-108.
4. Kurtović-Folić N.: Typology of Architectural Forms-Strong and Weak Typological Characteristics, Facta Universitatis, University of Niš, Vol. 1, N^{o} 2, 1995, pp. 227-235.

References should be quoted in the text by the corresponding number in square brackets.

Electronic submission. Papers for consideration should be submitted to the Series Editor in electronic form via the Journal's home page: http://casopisi.junis.ni.ac.rs/index.php/FUArchCivEng/index.

FACTA UNIVERSITATIS
Series: **Architecture and Civil Engineering** Vol. 17, N^{o} 2, 2019, pp. 133-143
https://doi.org/10.2298/FUACE190316007S

BIOPHILIA IN MODERN ARCHITECTURAL PRACTICE: RECOMMENDATIONS FOR SERBIA

UDC 502.15(497.11)

Danica Stankovic, Aleksandra Cvetanovic, Aleksandra Rancic, Vojislav Nikolic, Bojan Stankovic

University of Nis, Faculty of Civil Engineering and Architecture, Nis, Serbia

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

Received March 16, 2019 / Accepted June 22, 2019
Corresponding author: Danica Stankovic
Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, 18000 Niš, Serbia
E-mail: danica0611@gmail.com

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 Appelton (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).

(a) (b) (c) (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 as 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) Strategic viewing locations View corridors
Refuge (sense of enclosure or shelter)	Canopy effect (lowered ceilings, screening, branch like forms overhead) Variation in light levels (darkness suggests refuge) Enclosing surfaces (walls, partitions, screens) Penetrable barriers and surfaces for views out
Water (indoors or in view)	Glimmering or reflective surface (suggests clean water) Moving water (also suggests clean, aerated water) Symbolic forms of water
Biodiversity	Varied vegetation indoors and out (large trees, plants, flowers) Windows designed and placed to incorporate nature views Outdoor natural areas with rich vegetation and animals
Sensory Variability	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.

(a) (b) (c) (d)

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.

(a) (b) (c) (d)

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

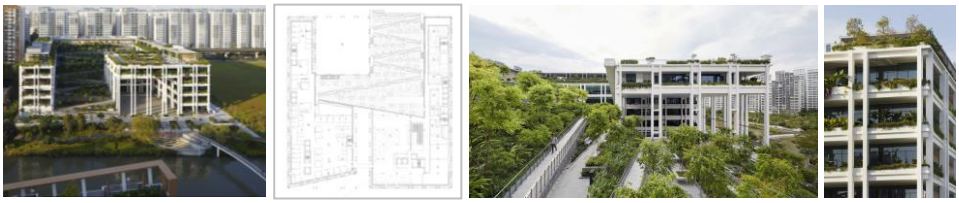
Maggie's Oldham is the 21st built Maggie's health-rehabilitation center in the UK (Figure 4). The center is strategically placed in the northern part of the complex of the Royal Hospital in Oldham, where the resting views to mountain range Pennine dominate. As the purpose of Maggie's Centers is to provide 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.

(a) (b) (c) (d)

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.



(a) (b) (c) (d)

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)

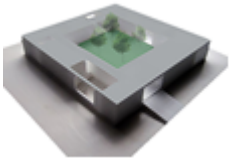
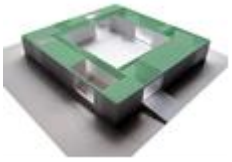
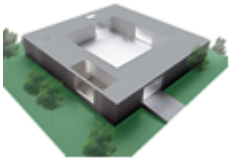
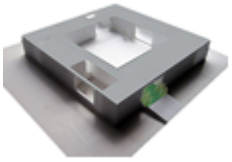
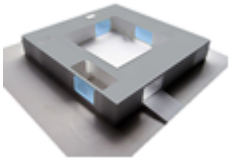
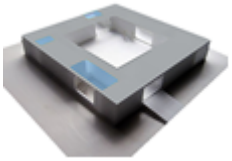
The example	Characteristics
A Hidden Garden behind the Concrete Walls 	▪ a reconstruction of an office space ▪ using of irregular curves for desks and bookshelves ▪ an open space with natural vitality and a sense of playfulness ▪ full use of sunny windows ▪ the area by the windows is free space for gathering ▪ 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
Titan Integrity Campus 	▪ 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
Maggie's Oldham 	▪ 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)
Punggol Neighbourhood and Polyclinic 	▪ 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.

Acknowledgement. *The paper was done in the scope of the scientific project No TR36045 funded by Republic of Serbia, Ministry of Education, Science and Technological Development.*

REFERENCES

1. J. Appleton, "The Experience of Landscape", Revised edition. Wiley: London, 1996.
2. G.N. Bratman, J.P. Hamilton and G.C. Daily, "The impacts of nature experience on human cognitive function and mental health", Annals of the New York Academy of Sciences, 1249 (2012). pp. 118–136, 2012.
3. S. El-Ghobashy and G. Mosaad, "Nature Influences on Architecture Interior Designs", Procedia Environmental Sciences, vol. 34, pp. 573 – 581, 2016.
4. J. Heerwagen and B. Hase, "Building Biophilia: Connecting People to Nature in Building Design", 2001. https://www.scribd.com/document/336462255/Docs-8543
5. Y. Joue, "Architectural Lessons From Environmental Psychology: The Case of Biophilic Architecture", Review of General Psychology, vol. 11, no. 4, pp.305–328, 2007.
6. S. Kaplan, "The Restorative Benefits of Nature: Toward an Integrative Framework", Journal of Environmental Psychology, vol. 15, pp.169–182, 1995.
7. S.R. Kellert, "Building for Life: Designing and Understanding the Human–Nature Connection", Island Press: Washington, 2005.
8. S.R. Kellert and E.E.Calabrese, "The practice of biofilic design", 2015, www.biofilic-design.com
9. J. Krcmarova, "E.O. Wilson's concept of biophilia and the environmental movement in the USA", Internet Journal of Historical Geography and Environmental History, vol.6, no. 1-2, pp. 4-17, 2009.
10. N.A. Salingaros, "Biophilia & Healing Environments: Healthy Principles for Designing the Built World", Terrapin Bright Green, LLC: New York, 2015.
11. J. Söderlund and P. Newman, "Biophilic architecture: a review of the rationale and outcomes", AIMS Environmental Science, vol.2 no.4, pp. 950-969, 2015.
12. R.S. Urlich, "View through a Window May Influence Recovery from Surgery", Science, New Series, vol. 224 (4647), pp. 420–421, 1984.
13. E.O. Wilson, "Biophilia", Reprint edition, Harvard University Press: Cambridge, 1984.

BIOFILIJA 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 aritektonskog stvaranja više nego ikada.

Biofilija u arhitekturi predstavlja inovativni metod arhitektonsko-urbanističkog projektovaja 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*

FACTA UNIVERSITATIS
Series: **Architecture and Civil Engineering** Vol. 17, N° 2, 2019, pp. 145-157
https://doi.org/10.2298/FUACE190312008V

BENEFITS OF SYNERGY OF URBAN GREEN INFRASTRUCTURE AND INTEGRATED STORMWATER MANAGEMENT APPROACHES: THEORETICAL PERSPECTIVE AND EXAMPLES FROM VIENNA

UDC 711.4(436.1)
628.116.2(436.1)

Magdalena Vasilevska, Ljiljana Vasilevska

Faculty of Civil Engineering and Architecture University of Nis, Serbia

Abstract. *This paper deals with multiple benefits and outcomes at a lower spatial-functional city levels generated by the synergy of Urban Green Infrastructure approach and integrated stormwater management approaches, resulting from their simultaneous application in the process of urban planning and design. The conducted research examines and analyzes key characteristics of Green Infrastructure and integrated stormwater management approaches, as well as their relationship in terms of principles, spatial-functional forms, types and benefits of their implementation. Since both of them are based on supporting and mimicking the natural environment in urban conditions, which makes them environmentally friendly and allows a greater presence of nature in many urban circumstances, the focus is on investigation of two common main principles and benefits of their implementation - closer connection with nature and increase of biodiversity in urban environment. The research platform consists of selected examples from Vienna which represent different types of lower spatial-functional levels in which both approaches are applied, making them suitable for examining the effects of their synergy.*

Key words: *Urban Green Infrastructure, integrated stormwater management approaches, implementation, synergy, benefits, Vienna*

1. INTRODUCTION

Cities across the globe have been facing a lot of social, economic, spatial and environmental problems and challenges caused and shaped by various factors, among which the most significant are rapid urbanization, mass migration, climate changes and economic

Received March 12, 2019 / Accepted April 11, 2019
Corresponding author: Magdalena Vasilevska
Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, 18000 Niš, Serbia
E-mail: magdalena.vasilevska@gaf.ni.ac.rs

development, especially industrialization. In addition, cities face challenges related to public safety, public health, modernizing water and transportation infrastructure, improving urban design, feeding growing populations, including communicating urgent, but less visible sustainability problems to stakeholders [1]. In the attempt to find sustainable solutions and responses to the arising challenges, in the last decades, several concepts and approaches to urban design and planning have been developed on a theoretical level and applied through urban practice. The most known are New Urbanism, Smart Growth, Compact City, Transit Oriented Development, Ecological Urbanism etc. At the same time, in order to solve the problems related to water management, particularly stormwater, several integrated stormwater management approaches have also been developed. The best known are Water Sensitive Urban Design (WSUD) in Australia, Sustainable Drainage System (SuDS) and Sustainable Urban Drainage System (SUDS) in Great Britain and Scotland, Best Management Practices (BMPs) and Low Impact Development (LID) in the United States, Alternative techniques (ATs) in French speaking countries and Source Control in Canada [2][3]. In addition to solving the problems of flooding and the problems of quantity and quality of rainwater, in the meantime, the third basic goal of most of them became to replace and/or increase the capacity of the existing drainage system in urban catchments by mimicking the natural environment [4]. This conceptual shift also led to their synergy with the most contemporary urban approaches, especially those based on the importance of the natural environment and an ecological approach to the urban planning and design, such us Ecological Urbanism [5] and interrelated movement - Green Urbanism, Urban Green Infrastructure, Green-Blue Infrastructure, Landscape Urbanism, Sustainable Urbanism: Design with Nature, etc. [6][7][8][9], while simultaneously achieving the primary goals of contemporary urban planning and design process - improving the quality of life and the quality of the built environment [10].

This research considers and investigates multiple outcomes and benefits at lower spatial-functional city levels generated by the synergy of Urban Green Infrastructure (hereinafter UGI) and integrated stormwater management approaches (hereinafter ISMA), resulting from their simultaneous application in the process of urban planning and design. Since the UGI and ISMA are based on the supporting and mimicking the natural environment in urban conditions, that makes them environmentally friendly and, among others, allows a greater presence of nature in urban areas. In line with this, the research focus is on the analysis of two significant principles/outcomes which are common for both approaches: 1) closer connection with nature, and 2) increase of biodiversity in urban environment, in terms of its forms, types of spatial-functional organization and possibilities for improving a quality of everyday life, i.e. benefits of their implementation.

Accordingly, the main research goals are the following: 1) to analyze the relationship between UGI and ISMA in terms of goals, principles, spatial-functional forms and general benefits of their implementation; and 2) to scrutinize the synergy effects and benefits resulting from simultaneous application of both concepts/approaches at lower spatial-functional city level through analysis of selected examples, with the focus on benefits achieved from the closer connection with nature and increase of biodiversity in urban environment. The selected examples from Vienna, Austria represent the research platform.

2. METHODOLOGY

In analyzing the connection and relationship between the UGI and ISMA, as well as in exploring their relationship in terms of goals, principles, spatial-functional forms and benefits of their implementation, the methodological framework is based on an analytical approach which relies on description and analysis. Several examples from Vienna are chosen as a research platform to scrutinize the synergy effects and benefits resulting from simultaneous application of UGI and ISMA at lower spatial-functional city scale. They represent lower spatial-functional scales with different functions: 1) housing/neighborhoods, 2) recreation/parks and inner courtyards, and 3) commercial/spaces for retailing and other services. In each of them, both approaches are applied, making them suitable for examining the effects and benefits of their synergy. In this part of the research are applied methods of analysis and observation. The observation was conducted during the second half of July in 2016, 2017 and 2018. In addition to considering the basic characteristics of chosen examples, it included identification and assessment of the impact on the quality of everyday life of both soil-based and building-based urban and architectural forms which are achieved by applying the principle of closer connection with nature and increasing biodiversity.

3. URBAN GREEN INFRASTRUCTURE AND INTEGRATED STORMWATER MANAGEMENT APPROACHES - SETTING THE CONTEXT

In order to understand the connection and relationship between UGI and ISMA, as well as the synergy effects resulting from their simultaneous application in the process of urban planning and design, it is necessary to explain their basic characteristics.

3.1. Urban Green Infrastructure (UGI)

The concept of UGI became increasingly important and prominent in the last decade across the different scientific disciplines, development and urban policies, as well as urban planning and design. There are different, often convergent, definitions of this concept. It is understood as a strategic approach to develop “an interconnected network of green space that conserves natural ecosystem values and functions, and that provides associated benefits to human populations” [9]. At the pan-European scale, this approach can be crucial for achieving the 2020 biodiversity target [11][12]. According to the GREEN SURGE project [13] and MEA [14], UGI is seen as a planning approach aimed at creating networks of multifunctional green space in urban environments.

Despite differences, the following is common to all of them - UGI can contribute to a sustainable future for cities by addressing major urban challenges, such us land use conflicts, climate change, biodiversity conservation, demographic changes, a greener economy, and human health and wellbeing. Urban green spaces (in further text UGS), with various and diverse typological characteristics, are a key physical and functional urban form in the implementation of UGI in urban practice. They play multiple roles in making cities more sustainable, well-functioning and livable: 1) providing recreation in everyday life, at different city scales; 2) contributing to the conservation of biodiversity; 3) contributing to the cultural identity; 4) help maintaining and improving the environmental quality; and 5) bringing natural solutions to technical problems, for example sewage treatment or stormwater treatment [15].

In addition, the increasing interest in UGS is also driven by several other factors such us: 1) widespread concern for the decline in the quality and condition of many parks and other UGS due, in part, to their generally low priority in the political agenda at both national and local levels; 2) growing emphasis on the need for more intensive development in urban areas, focused around the Compact city concept as the model for future cities in Europe, raising questions about the role of green space in this model which is based on the densely populated and compact physical structure; 3) parallel emphasis on the development of brownfield rather than greenfield land, and a recognition that more intensive urban development may sometimes involve the sacrifice of existing areas of UGS [16][17].

Due to various ways to classify UGS, the different typologies are present. For example, Swanwick et al. [16] recognize 25 UGS types, divided into four main groups (amenity green space, functional green space, semi-natural habitats, and linear green space) and 10 subgroups, while Bell et al. [18] under UGS considered parks and gardens, natural and semi-natural spaces, green corridors, allotments, community gardens and urban farms, outdoor sport facilities, amenity green spaces, provision for children and young people, cemeteries, disused churchyards and other burial grounds, as well as other public spaces, such as squares, pedestrian areas or cycling areas. Other typologies are based on usage [19], dimensions of green spaces that are important for urban consolidation, i.e. size, naturalness, activity types etc. [20], or cover informal UGS [21].

Although there are still present knowledge gaps and doubts how exactly UGI and UGS can help address the moderation of climate change effects and produce sustainable urban solutions, there is a consensus that their basic purpose is urban ecosystem services provision. Research findings indicate that a wide range of ecosystem services is provided through different, already recognized and/or suggested types of UGS [17]. The main categories of urban ecosystem services, the modes and purpose of providing services, as well as a connection with different types of UGS are shown in Table 1. Additionally, it also indicates a close connection between UGI and ISMA, in terms of purpose/function and types of green spaces.

3.2. Integrated stormwater management approaches (ISMA)

Prerequisites for the development and later evolution of ISMA originated in the 1980s when the general shift happened from the concept of water as "urban and city life enemy" and "hidden elements behind pipes" to water as "an element that contributes to the quality of life" and "the location factor at the city level". New paradigm "living with water" was a part of a wider social discourse, established under the influence of the movement of Ecological Urbanism [6] [22] [23].

In addition to creating new approaches to stormwater management, these circumstances created opportunities for their integration into the urban planning and design process and, moreover, led to radical changes of the urban planning and design paradigm [24], primarily in terms of the evolution of the role of urban stormwater management in planning process, their conceptual and methodological framework and cumulative socio-economic effects.

New approaches to stormwater management are conceptually quite different from the traditional approach (Table 2). The basic intention of most of them is to establish a greater harmony between water as a key resource and the community, in a sustainable, socially rational and responsible way [25]. Consequently, close connection with nature and its involvement into the urban environment are at the core of paradigm shift which generated a new, ISMA.

Table 1 Urban ecosystem services provision as a basic role of Urban Green Infrastructure: Urban ecosystem services and accompanied types of urban green spaces

Main category of urban ecosystem services	Type of and purpose/role of ecosystems (ESs)	Type of urban green spaces and type of ESs
1. Provisioning services *The services that describe the material or energy outputs from ecosystems*	Raw materials (RM) *ESs provide a diversity of materials for fuel and construction* Fresh water (FW) *ESs regulate the flow and purification of water (vital role in the global hydrological cycle)* Food (F) *ESs provide the conditions for growing food* Medicinal resources (MR) *ESs provide plants used as traditional medicines and raw materials for the pharmaceutical industry*	Green roof (F, MR) Courtyard (F) Gardens (F) Community garden (F) Plot (F) Forest (F and RM) Lake, pond (F)
2. Regulating services *The services that ecosystems provide by acting as regulators*	Local climate and air quality (LCAQ) *ESs regulate air quality, provide shade and influence rainfall and water availability, removing pollutants from the atmosphere* Carbon sequestration and storage (CSS) *ESs store and sequester greenhouse gases, remove carbon dioxide from the atmosphere, improve the capacity to adapt to the effects of climate change* Moderation of extreme events (MEE) *ESs moderate extreme weather events or natural hazards, such us storms, tsunamis, floods, avalanches etc. ESs and living organisms create buffers against natural disasters* Waste-water treatment (WWT) *ESs filter both animal and human waste and act as a natural buffer to the surrounding environment*	Green wall (LCAQ) Green roof (LCAQ, MEE, WWT) Bioswale (MEE, WWT, LCAQ) Tree alley and street tree, hedge (LCAQ, CSS, MEE) House garden (CSS, LCAQ, MEE) Park, neighborhood park (LCAQ, CSS, MEE) Forest (LCAQ, CSS) Wetland (CSS,MEE, WWT)
3. Cultural services *The services which include the non-material, socio-ecological benefits (including psychological and cognitive benefits) people obtain from contact with the environment*	Recreation (R) *ESs provide physical and mental health, as well as socio-ecological and economic benefits* Tourism (T) *ESs provide physical and mental health, as well as socio-ecological and economic benefits* Aesthetic appreciation and inspiration for culture, art and design (AAD) *ESs provide physical and mental health, as well as socio-ecological and economic benefits* Spiritual experience and sense of place (SP) *ESs provide physical and mental health, as well as social and economic benefits*	Green roof (R, AAD) House garden (R, AAD, SP) Park (R, T, AAD) Neighborhood park (R, SP) Community garden (R, SP) Forest (R, T, AAD, SP) Lake, pond (R, T, SP)
4. Habitat and supporting services *The services which underpin almost all other services by providing living spaces*	Habitats for species (HfS) *ESs provide biodiversity and closer connection with nature* Maintenance of genetic diversity *ESs provide biodiversity and closer connection with nature*	Balcony (HfS) Green roof (HfS) Bioswale (HfS) Tree alley (HfS) Forest, park, garden, plot (HfS)

Source: Authors, based on EASAC [26] and TEEB [27] typology of urban ecosystem services

In line with this, ISMA offer a set of different technologies and treatment modes, which also represent evolution and innovation in relation to the traditional approach [28]. The following four basic modes of runoff treatment are recognized: 1) infiltration; 2) disposal; 3) storage; and/or 4) re-use [29]. They can be applied separately or in combination, where each of them implies implementation of different technical elements. Although the typology and significance of a particular element varies depending on the approach, in general, technical elements within them are similar and serve the same purpose. The most known technical elements are: 1) swales (dry or wet); 2) bioretetions; 3) trenches; 4) sand filters; 5) ponds and lakes; 6) porous paving; 7) wetlands; 8) rainwater tanks; 9) elements of landscape architecture (green walls, for example) etc. Green roofs are not a mandatory technical element, but their application proved to be very useful in the treatment of rainfall, so they became an unavoidable technical element of all modern stormwater approaches in many urban situations - the third most widely used technical element after bioretentions and porous paving.

Table 2 Integrated vs. traditional stormwater management

	Traditional stormwater management	Integrated stormwater management
Goal	Remove runoff quickly	Reduce runoff volume Maximize all watershed values
Approach	Engineering	Holistic
Scale	Sewer system	Watershed
Action	Reactive	Proactive

Source: Adapted by authors

Conceiving of modern approaches on the application of measures that imply or support the natural environment allows greater presence and involvement of nature in urban areas. Previously conducted research by the authors [30], which refers to the relationship between different types of technical elements and the expected elements of the natural environment that their application allows, indicate the following: 1) strong relationship between the most technical elements and the elements of nature environment; 2) application of one technical element often involves several elements of nature; and 3) beside the main characteristic of each technical element and its role in stormwater management approach, the intensity of connections between the technical element and certain elements of nature depends primarily on the design approach, climate conditions and spatial-functional capacity of a particular location. Consequently, each of the mentioned technical elements and accompanying elements of natural environment are actively involved in creating of usable and morphological potential of a particular location or urban area. As most of ISMA support environmentally friendly lifestyle, the synergy between technical elements and accompanying natural elements directly affects the quality of life, as well as the quality of the built environment. Each of the characteristics is accompanied by a set of measurable indicators. For example, ecological comfort can be evaluated through indicators such as: a) physical isolation from streets and other sources of noise and pollution, b) amount of greenery, c) disposition, form and type of greenery, d) biodiversity, etc. Safety and privacy, which are of great importance especially in residential areas, can be evaluated through indicators such as: a) applied construction materials for outdoor surfaces and

communications, b) intensity of presence and types/forms of visual and physical protection and barriers, c) distance and size of the area that is isolated from access to the motor traffic, d) distance and size of the area that is isolated from access and views from the primary pedestrian communication, etc.

3.3. Relationship between Urban Green Infrastructure and integrated stormwater management approaches

Conducted analysis indicates a close connection and strong, multifunctional links between UGI and ISMA. The links can be recognized on the conceptual level and translated more obviously on the functional and technical level. Namely, both approaches serve to provide an ecological framework for social, economic and environmental health in the urban conditions. In this context, multifunctionality refers to the integration and interaction of different functions or activities on the same urban site, designed and covered by elements and forms of both approaches which support or mimic natural environment. In addition, one of the main role of UGI is stormwater management in urban circumstances and vice versa, UGI can be a component of WSUD, SuDS or SUDS, designed to manage water quality and quantity, while at the same time provide improvements related to biodiversity and amenity [31]. Elements of nature, including UGS, can be used within UGI to provide important ecological services for communities, simultaneously protecting them from flooding. The analysis of the typologies of UGS also confirms this, since the technical elements of ISMA (bioretension, wetland, etc.) are often identified as one of the key types of UGS [17].

The synergy of UGI approach and ISMA, resulting from their simultaneous application in the process of urban planning and design, can lead to many economic, ecological and social benefits. Some of them are thoroughly analyzed on the examples in the next section of this paper.

4. Synergy of Urban Green Infrastructure and Integrated Stormwater Management Approaches - Best Practice Examples from Vienna

As a model of sustainable urban development and best practice examples by many other cities, among others, Vienna applies UGI and ISMA in the current urban practice in a systematic and institutionally supported way, in order to achieve sustainable and efficient urban development that leads to a better quality of life. In a broader sense, both approaches are targeted as a part of The Smart City Wien framework strategy [32], adopted on 2014, which defines goals for the development of a city that assigns priority to, and interlinks, the issues of energy, mobility, buildings and infrastructure. The framework strategy defines one meta goal for 2050:"The best quality of life for all inhabitants of Vienna, while minimizing the consumption of resources. This will be realized through comprehensive innovation." In addition, the stormwater management is also targeted within several strategies, documents and guidelines adopted by the city of Vienna, such as Urban Heat Islands (UHI) - Strategieplan Wien [33], Integratives Regenwassermanagement – Motivenbericht, Beispielsammmlung [34], Regenwassermanagement. Nachhaltiger Umgang mit wertvollem Regenwasser [35], etc.

UGI and ISMA are applied at different spatial-functional levels across the city, both in newly developed areas and in those that are undergoing urban regeneration. The selected examples represent both cases on the lower spatial-functional city levels - neighbourhoods

and sites. In addition to identification of elements and forms of nature made by applying both approaches, shaped by planning framework, site conditions, implemented measures, and urban, landscape and architectural design, the multiple benefits of the simultaneous application of both approaches are considered.

4.1. Autofreie Mustersiedlung

Experimental building, often in form of 'theme-oriented' estates with topics pre-determined by the city, has a major share in the qualitative development of Vienna social housing in the 1990-es. The largest of this kind in Europe, with building lot size approx. 11.400m^2, is the Autofreie Mustersiedlung (car-free model estate), planned in 1994 by architects Schindler, Szedenik, Lautner and Scheifinger, completed in 1999/2000 (Fig. 1a). This neighborhood transferred the means needed normally for the construction of car parks into an environmentally friendly infrastructure that include greened roof-gardens, parking lots for bicycles, internet-cafe, meeting rooms, children's day-care centre, etc. A comprehensive ecological concept was realized: low energy consumption level, use of solar energy, a loading station for electric cars, heat recovery from waste water, a grey water system, runoff treatment, green areas with humid biotopes and intensive planting, including pond green walls (Fig. 1b and 1d).

Fig. 1 Autofreie Mustersiedlung. (a) Plan. (b) Pond and surrounding greenery in the inner courtyard. (c) Green roof - rooftop farming. (d) Green wall. Sources: (a) http://www.gewog-wohnen.at/media/1044/af_broschure.pdf.; (b), (c) and (d) Authors

The main technical element for stormwater treatment is a green roof. Three roofs are intensively planted for the general use, two roofs are with raised beds and intensively landscaped, while two roofs on which solar panels are attached are designed as gravel roofs (Fig. 1c). At the same time, greened roof-gardens provide additional, multiple benefits - possibilities for urban agriculture (Fig. 1c), children education, social interactions, they improve ecological comfort/microclimate and create healthy and pleasant urban environment. The decorative pond is in a focus point in one of two courtyards within the housing area (Fig. 1a and 1b). The feeding of the decorative pond as well as the irrigation takes place via a water well, the water is cleaned by UV irradiation. The pond has a seepage pit for the excess water bellow.

4.2. Hagedornweg

Hagedornweg is as social housing neighborhood built-up in twenty-second Vienna's district, designed by Göth and Guttmann (DonauConsult KT), completed in 1996. Building lot size is approx. 26.000m^2. The greenery and biotope pond, with total size approx. 2600m^2, are in the focus of the central courtyard (Fig. 2a), as well as of the whole urban composition (2a, 2b and 2c). The feeding of the biotope pond as well as the irrigation takes place via a water well, while the water is cleaned by UV irradiation. The pond has a seepage pit for the excess water bellow (with circulation pumping system).

The original intention to discharge the roof rainwater into the biotope pond was not realized due to the long-term planning and relatively dense buildings accumulating the water, which led to large water level fluctuations in the pond. Extreme rainfall and excess water infiltration takes place in a swale adjacent to the pond. However, as the most important element that mimics the natural environment, pond provides additional benefits such as a healthy and pleasant environment, close connection with nature, improves biodiversity, mitigates urban heat island, provides diversification of use (recreation, leisure) and provides a powerful aesthetic experience (Fig. 2a and 2b).

Fig. 2 Hagedornweg. (a) Plan. (b) and (c) Pond/Biotope and surrounding greenery in inner courtyard. Sources: (a) Stadt Wien – Vienna GIS. www.wien.gv.at/viennagis/; (b) and (c) Authors

4.3. Spar Supermarket, Engerthstrasse

Spar Supermarket in Engerthstrasse was built in 2010 within an existing park in the densely built-up housing and mix-use area in the second district. It is an example of good practice that utilizes a green roof as a type of UGS and as a technical element of stormwater management in order to compensate for greenery in the limited spatial conditions, as well as to maintain the existing ratio between built and green areas within the residential area (Fig. 3a). Building lot size is 2.526m^2. Plant size is approx. 1500m^2, where the green roof surface participates with 921m^2, and the area under slopes with 629 m². The supermarket is built mostly under a gently rising artificial hill (Fig. 3b). The roof area and the slopes were planted with waves form of lavender and grass leaking into the adjacent green area (Fig. 3a and 3c). Multiple use and ecological benefits are recognized in the following: more public open space in limited urban conditions, more greenery, quality landscape design which supports the natural environment, improvement of microclimate, improvement of air quality, improvement of biodiversity, creating possibilities for recreation, leisure and social interaction, and reduction of energy demand.

Fig. 3 Spar Supermarket in Engerthstrasse. (a) Plan. (b) and (c) Intensive green roof. Sources: (a) K. Grimm; (b) and (c) Authors

4.4. Boutiquehotel Stadthalle

Boutiquehotel Stadthalle was built in 2009 in a densely built-up housing and mix-use area in the fifteenth district (Fig. 4a). It is designed as a passive house and represent the first city hotel with a zero-energy balance, which is made possible by the use of solar panels, photovoltaic panels (Fig. 4b and 4d), water-heat pump as well as LED and light bulbs. Environmental friendliness and sustainable tourism are also supported by implementation of 145m^2 intensive green roof "Lavendeldach" (Fig. 4b), 140m^2 extensive green roof, courtyard garden, as well as green walls, both from the street side and inner courtyard (Fig. 4c and 4d), providing the natural cooling. For the contributions to the CO_2 emission reduction, the hotel has already been awarded numerous prizes.

Fig. 4 Boutiquehotel Stadhalle. (a) Plan. (b) Extensive green roof - *Lavanderdach*, green wall and photovoltaic panels. (c) Green wall - street facade. (d) Green wall - inner courtyard. Sources: (a) and (b) https://www.google.com/maps, (c) and (d) Authors

4.5. Synergetic effects and benefits resulting from simultaneous application of Urban Green Infrastructure and integrated stormwater management approaches in the chosen best practice examples

An analysis of a chosen best practice examples provides an opportunity to assess the impact of the application of the principles of closer connection with nature and the increasing biodiversity, which is common to UGI and ISMA, as well as the effects of their simultaneous application in the process of urban planning and design. In addition to the closer connection with nature and the increase of biodiversity, which was achieved in all observed examples by applying the appropriate UGI and ISMA technical elements and

forms (green roofs, green walls, bioswales, ponds), the conducted analysis also indicates additionally economic, ecological and social benefits, both in newly developed areas (Autofreie Mustersiedlung, Hagedornweg) and in those that are undergoing urban regeneration (Spar Supermarket in Engerthstrasse, Boutiquehotel Stadhalle). The following benefits are recognized: more public open space in the limited urban conditions, more greenery, quality landscape design, improvement of microclimate, improvement of air quality, creating possibilities for recreation, leisure and social interaction, creating possibilities for new jobs, and reduction of energy demand.

5. CONCLUSION

In relation to the first research goal - *to analyze the relationship between UGI and ISMA*, the conducted research indicates a strong relationship between approaches on the conceptual, functional, organizational, implementation and technical level, since both approaches serve the same broad goal - to provide an ecological framework for social, economic and environmental health in the urban conditions. The research also indicated a high degree of their compatibility, since one of the main purposes of UGI is to manage stormwater, just as UGI is often seen as a component of WSUD, SuDS or SUDS.

In relation to the second research goal - *to scrutinize the synergy effects and benefits resulting from simultaneous application of both concepts/approaches at lower spatial-functional city level in the process of urban planning and design*, conducted analysis of selected examples in Vienna indicates a strong synergy effects and benefits. As the most significant can be recognized the following: 1) creating a healthy and pleasant urban environment; 2) providing a close relationship with nature; 3) improving biodiversity; 4) improving air quality; 5) mitigating urban heat island; 6) improving the usability of the site in limited urban conditions; 7) providing diversification of use - recreation, leisure, education, urban agriculture etc., 8) creating opportunities for social interaction, and 9) creating economic benefits.

The research also points out that the multiple benefits of simultaneous application of UGI and ISMA can be most efficiently generated within the process of urban planning and design, as well as urban regeneration, since they simultaneously serve main goals - improving the quality of life and quality of the built environment in altered urban conditions. The main purpose of integration of UGI and ISMA in the process of urban planning and design is to create an attractive, functional and "environmentally-friendly" urban structure whose physical and functional substructures would be adapted to future challenges caused by rapid urbanization, environmental protection and climate changes. However, research indicates that the application of UGI and ISMA is possible only in conditions when urban planning framework is based on the shift in the urban planning processes based on radical changes of the urban planning and design paradigm, primarily in terms of the evolution of the role of urban greenery and urban stormwater management in planning process, their conceptual and methodological framework and cumulative socio-economic effects. Namely, the principles of traditional urban planning and the accompanying methodological framework are often based on sectoral and *ex post* consideration of the urban green infrastructure and stormwater management issues, which causes in practice many conflicts and does not allow the realization of wide range of UGI and ISMA potentials. In order to

contribute to a sustainable future for cities by addressing major urban challenges in a sustainable, socially rational and responsible way, the new urban planning and design framework must be both conceptually and methodologically more *ex ante* "green and water sensitive". In line with this, future research will address the investigation and elaboration of models and methodology of implementation of UGI and ISMA in urban planning and design processes, in an attempt to find an answers how exactly UGI and ISMA, as a part of urban planning, could produce sustainable urban solutions and help solve the problems of rapid urbanization and climate change.

Acknowledgement. *The paper is a part of the research done within the projects TR 36042 and TR 36037.*

REFERENCES

1. M. Hower, "The 5 toughest challenges tomorrow's cities face", GreenBiz Group, April 27th 2016.
2. A. Roy, S. Wenger, T. Fletcher, C. Walsh, A. Ladson, W. Shuster, H. Thurston and A. Brown, Impediments and Solutions to Sustainable, Watershed-Scale Urban Stormwater Management: Lessons from Australia and the United States", Environmental Management, vol. 42. pp. 344–359, 2008.
3. T. Fletcher, W. Shuster, W. Hunt, R. Ashley, D. Butler, S. Arthur, S. Trowsdale, S. Barraud, A. Semadeni-Davies, J. Bertrand-Krajewski, P. Steen Mikkelsen, G. Rivard, M. Uhl, D. Dagenais, and M. Viklander,"SUDS, LID, BMPs, WSUD and more – The evolution and application of terminology surrounding urban drainage", Urban Water Journal 12 (7), pp. 525–542, 2015.
4 A. Cooper, "Stormwater Management Opportunities with Urban Re-development", Water New Zealand 7th South Pacific Stormwater Conference, 2011.
5. M. Mostafavi, and G. Doherty, "Ecological Urbanism", Baden, Switzerland: Lars Müller, 2010.
6. M. Hough, "City Form and Natural Process", London: Croom Helm, 1984.
7. T. Beatley, "Green Urbanism: Learning from European Cities", Washington, D.C.: Island Press, 2000.
8. M. Mostafavi and C. Najle, "Landscape Urbanism", London: Architectural Association, 2003.
9. M. A. Benedict and E. T. McMahon, "Green Infrastructure", Sprawl Watch Clearinghouse Monograph Series, 2001.
10. A. Cettner, R. Ashley, M. Viklander, and K. Nilsson, "Stormwater management and urban planning: Lessons from 40 years of innovation", Journal of Environmental Planning and Management, 56(6), pp. 786–801, 2013.
11. Science Communication Unit – University of the West of England (SCU-UWE), Bristol, 2012.
12. European Union: Building a Green Infrastructure for Europe, 2013.
13. University of Copenhagen, The GREEN SURGE Handbook
14. MEA – Millennium ecosystem assessment, Ecosystems and human well-being: Synthesis, Island Press, Washington DC, 2005.
15. G. U. Sandström, "Green infrastructure planning in urban Sweden", Planning practice and Research, vol. 17, No. 4 pp. 373-385, 2002.
16. C. Swanwick, N. Dunnett, and H. Woolley, "Nature, role and value of green space in towns and cities: an overview", Built Environment, 29(2), pp. 94–106, 2003.
17. Report D 3.1 - "A typology of urban green spaces, ecosystem services provisioning services and demands", GREEN SURGE project, 2015.
18. S. Bell, A. Montarzino, P. Travlou, "Mapping research priorities for green public urban space in UK" Urban Forestry and Urban Greening, vol. 6, No. 2, pp. 103–115, 2007.
19. M. Hofmann, T. Gerstenberg, "A user-generated typology of urban green spaces", 17th International Conference of the European Forum on Urban Forestry (EFUF), Lausanne, Switzerland, 3–7 June 2014.
20. J. Byrne and N. Sipe, "Green and open space planning for urban consolidation – A review of the literature and best practice", Urban Research Program, Issues Paper 11, Griffith University Brisbane, 2010.

21. C. D. D. Rupprecht and J. A. Byrne, “Informal urban green space: A typology and trilingual systematic review of its role for urban residents and trends in the literature”, Urban Forestry & Urban Greening 13, pp. 597-611, 2014.
22. J. Jacobs, “The Death and Life of Great American Cities”, New York: Vintage, 1961.
23. C. Swanwick, N. Dunnett, and H. Woolley, “Nature, role and value of green space in towns and cities: an overview”, Built Environment, 29(2), pp. 94–106, 2003.
24. P. Brown, H. Keath and T. Wong, “Urban water management in cities: Historical, current and future regimes”, Water Science and Technology, 59(5), pp. 847–855, 2009.
25. M. Vasilevska and Lj. Vasilevska, “Modern stormwater management approaches in urban regeneration” Conference proceedings 6th International conference Contemporary achievements in civil engineering, Subotica, Serbia. pp. 525 -534, 2018.
26. EASAC - European Academies Science Advisory Council, Policy report 09, London, 2009.
27. TEEB – The Economics of Ecosystems and Biodiversity, TEEB Manual for Cities: Ecosystem Services in Urban Management, 2011.
28. Lj. Vasilevska, and B. Blagojević, “Morphologic effects of stormwater management application in the urban design process”, Proceedings of International conference Instalacije i arhitektura 2014, Faculty of Architecture University of Belgrade, Belgrade, pp. 71-77, 2014.
29. S. Gordon-Walker, T. Harle, and I. Naismith, “Using science to create a better place. Cost-benefit of SUDS retrofit in urban areas” Science Report – SC060024. Bristol: Environmental Agency, 2017.
30. Lj. Vasilevska and M. Vasilevska, “Bringing nature into urban areas through implementation of modern stormwater management approaches: examples from Vienna's neighbourhoods” of ICUP2018 2nd International Conference on Urban planning, Faculty of Civil Engineering and Architecture, University of Nis, Nis, pp. 113-121, 14-17 November 2018.
31. Woods-Ballard et al., The SuDS Manual, 2015.
32. Smart City Wien framework strategy, 2014.
33. Magistrat der Stadt Wien, “Urban Heat Islands (UHI) - Strategieplan Wien”, Wiener Umweltschutzabteilung – Magistratsabteilung 22, 2015.
34. K. Grimm, “Integratives Regenwassermanagement – Motivenbericht”, Beispielsammmlung, Magistrat der Stadt Wien, Wiener Umweltschutzabteilung – MA 22, 2010.
35. Magistrat der Stadt Wien, “Regenwassermanagement. Nachhaltiger Umgang mit wertvollem Regenwasser”, 2013.

KORISTI SINERGIJE URBANE ZELENE INFRASTRUKTURE I INTEGRISANIH PRISTUPA UPRAVLJANJU KIŠNIM OTICAJEM: TEORETSKI OSVRT I PRIMERI IZ BEČA

Rad se bavi višestrukim koristima sinergije koncepta Urbane zelene infrastrukture i integrisanih pristupa upravljanja kišnim oticajem na nižim prostorno- funkcionalnim nivoima organizacije grada, generisanim njihovom istovremenom primenom u procesu urbanističkog planiranja i projektovanja. U okviru sprovedenog istraživanja se analiziraju njihove ključne karakteristike i ispituju međusobni odnosi sa aspekta principa, prostorno-funkcionalnih formi, tipova i koristi njihove primene. Budući da se oba pristupa zasnivaju na podržavanju i oponašanju prirodnog okruženja u urbanim uslovima, što ih čini ekološki prijateljskim i omogućava veće prisustvo prirode u urbanoj sredini, fokus istraživanja je na koristima primene dva zajednička principa - bliže povezanosti sa prirodom i povećanja biodiverziteta. Istraživačku platformu čine selektovani primeri iz Beča koji reprezentuju različite tipovi nižih prostorno-funkcionalnih nivoa, što ih čini pogodnim za ispitivanje efekata sinergije.

Ključne reči: *Urbana zelena infrastruktura, integrisani pristupi upravljanju kišnim oticajem, primena, sinergija, koristi, Beč*

FACTA UNIVERSITATIS
Series: **Architecture and Civil Engineering** Vol. 17, N^{o} 2, 2019, pp. 159-171
https://doi.org/10.2298/FUACE190320009N

EXISTING POLICY FRAMEWORK TO SUPPORT THE ACTIVE MOBILITY IN BULGARIA. STRATEGIES AND REGULATIONS IN VARNA

UDC 796.51(497.211)
796.61(497.211)
349.44(497.211)

Boryana Nozharova, Peter Nikolov

VFU "Chernorizets Hrabar", Faculty of Architecture, Department of Architecture and Urban Studies, Chaika Resort, Varna 9007, Bulgaria

Abstract. *Active mobility, active travel, active transport, and active transportation are synonyms of transport of people that only use their physical activity for the need to travel. The most known forms of active mobility are walking and cycling, though the skateboard, kick scooter or roller skates are also a form of active mobility. The city of Varna is the third largest city in Bulgaria and the largest seaside city in the country. In the high tourist season, the city shows much more street problems than usual. The congestion seems to be greater each and every year and this affects active transportation. As a result of the dominant character of the private car in our everyday life, it seems that the active forms of transport are being neglected. To change this trend an integrated transport policy is required where the pedestrians will be placed in the center of the daily agenda. One of the very important components to support active mobility is the policy framework. It should guarantee that all forms of active mobility have also rights as users of the streets and are not neglected in the planning process. The current study aims to analyze the existing relevant national and local (for the city of Varna) regulations regarding walking and cycling and to evaluate the degree of policy support in order to respect their rights and needs. The existences of the relevant policies and how they are implemented is a matter of the study. The collected data about the regulatory framework is evaluated using the content analysis method.*

Key words: *active mobility, pedestrian and cyclists rights, policy framework*

Received March 20, 2019 / Accepted May 24, 2019
Corresponding author: Boryana Nozharova
VFU "Chernorizets Hrabar", Faculty of Architecture, Department of Architecture and Urban Studies, Chaika Resort, Varna 9007, Bulgaria
E-mail: boriana_nozharova@abv.bg

1. INTRODUCTION

Walking is traditionally one of the most underestimated and underrepresented modes of transport available, including its importance in creating liveable cities. Walkability components consist of convenience, safety and security, and policy support. The policy support ensures that the users have the same rights in order to use the public space such as a street corridor. The policy support on walkability is aimed to guarantee the pedestrians' rights as the users of the street corridor (ARUP, 2015).

On 12th of October 1988, more than 30 years ago, the European Parliament adopted a European Charter of Pedestrians' Rights as a first major step toward a more pedestrian-friendly urban environment. Since the start of the 2000s, several EC documents (e.g., the 2001 Transport White Paper, the 2007 Green Paper, and the 2011 White Paper) highlight the main directions and guidelines for enhancing the sustainability of urban mobility (Nozharova, Nikolov, 2018; Kovachev et al, 2018). With the help of the above documents and with many ongoing European programs and projects the European Union stimulates countries in the implementation of sustainable urban mobility mechanisms. However, according to the provisions of the Action Plan on Urban Mobility national and local authorities are responsible for incorporating the above principles into the national and local legal framework. Decisions adopted at the local level should be taken within the national, regional and European policy framework. European Commission continues every year the efforts for promoting sustainable urban mobility and, in particular, the active forms of transport. Despite this nowadays most of the provisions of the above-mentioned documents are still far from being implemented in some of the Member states.

In Bulgaria, as in most of the European cities, motorized transport dominates among all other modes of passenger transport. For the last 25 years, the number of vehicles has increased almost 3 times and the motorization level already got beyond 455/1,000 (Ministry of the Interior, 2018). To change the described situation, an integrated transport policy framework is required, in which active transportation becomes the priority for cities urban development (Papaioannou et al, 2010).

The city of Varna is the third largest city in Bulgaria and the largest seaside city in the country. In the high tourist season, the city shows much more street problems than usual. The congestion seems to be greater each and every year and this affects active transportation too. According to estimations made by the authors (based on data from the Master Urban Plan of Varna and statistics) the rate of motorization in Varna now exceeds 485/1,000 and the provisions of the Master Plan are for a level of 585/1000 for the year 2030. Despite the dominant character of the private car in our everyday life pedestrian and cycling activities in Bulgaria and Varna, in particular, are slowly gaining popularity. As opposed to other modes of transportation, road congestion is not a problem for walking and cycling mobility, but often a requirement for pedestrians and cyclists to feel safe to walk or cycle through urban roads (Nourian et al, 2018). One of the very important components to support the active mobility and to help in giving the streets back to people is the policy and regulatory framework. Strategies on a national and local level should guarantee that pedestrians are not neglected in the planning process. To solve these problems, Varna, like many other cities, would obviously need relevant strategic documents and specific norms that should identify the directions to overcome the barriers to sustainable traffic modes and improve streets' attractiveness and accessibility for walking.

2. An empirical Study of the Bulgarian Policy Framework

The main documents, used as a basis for this analysis at national and local (for the city of Varna) level are those related to the problems of active mobility: strategic and legislative documents, reports and analyzes, norms and regulations. For the purposes of the current study, the authors used the following methods: monitoring methods (monitoring), description, logical and comparative analysis.

2.1. Main regulatory documents concerning active mobility on the national level

According to the preliminary review of the regulations related to the problems of planning and design of the transport infrastructure in urban territories, the authors found that two of these legislative documents are relevant to the current study. Generally, the legislation and the existing regulatory framework in Bulgaria may be divided into two categories which have relation to urban planning and development, as well as to the rights and obligations of the participants in the traffic movement (Table 1).

Table 1 Categories

The first category - documents reflecting the needs of pedestrians and cyclists regarding the planning and design of transport communication systems in urban territories.	**Second category** - laws, and ordinances regulating the way of movement and the rights of pedestrians and cyclists.
Ordinance No. RD-02-20-2 (prom.20.12.2017) for planning and designing the communication-transport systems of the urbanized territories	Road traffic act (prom. sg. 20/5 Mar 1999)
Ordinance No. 4(prom. 1.07.2009) for the design, execution, and maintenance of buildings in accordance with the requirements for an accessible environment for the population, including for people with disabilities.	

2.1.1. Main regulatory documents related to the planning and design of the communication - transport systems in urban territories.

One of the basic laws that directly regulate the public needs in relation to the spatial planning, investment design and construction of the Republic of Bulgaria, is the Spatial Planning Act (SPA). In its essence, the SPA defines the basic rules and establishes the legal grounds for additional regulations, defining specifically the planning and designing of the urban fabric. Following above guidelines, additional regulations for the Transport Communication Systems (TCS) in the urbanized territories (Art.75al (5)) and the Ordinance for a Public Accessible Environment have been created, defining the norms and methods in the planning of the urbanized territories.

The main document, concerning the rules and planning for the urban street system in Bulgaria, is Ordinance No RD-02-20-2 from 20 Dec. 2017. This ordinance defines the principles, criteria, norms, and rules for planning and designing of TCS in urbanized areas, including the street network, public transport for passenger transport, pedestrian traffic, cycling, parking, transport service facilities (workshops, etc.) and traffic management. The

requirements of the Ordinance apply both to the planning and design of new TCSs, as well as the reconstruction, major repairs and ongoing maintenance of existing streets.

According to the Ordinance, the TCS and its elements have to be designed in accordance with the structure and needs of an urbanized and adjacent territory. In order of importance, they are as follows - pedestrians; passengers using public transport; cyclists; cars; cargo vehicle; transit car traffic. They must be also in accordance with the projections of the spatial development concepts and spatial plans. The general provisions of the Regulation have developed texts that define the scope and content of sustainable urban mobility plans. In this section are also the main texts that specifically reflect the integrated policy of the state and its principles of sustainable urban mobility. The main objectives and tasks of the planning and design of the TCS, which are set forth directly in this Ordinance are clearly seen from Table 2.

Table 2 Main objectives and tasks set in Ordinance No RD-02-20-2

Objectives	Tasks
1. Ensuring the effective use of the territory of the urbanized areas according to the parameters and the projections of the Master plan;	1. To offer optimal opportunities for the development of the different types of movement in the urbanized territory, ranking by the following priority: (a) pedestrian (traffic); (b) public transport; (c) cycling (traffic); (d) the movement of passenger cars; (e) freight traffic; (f) transit carriage for the urban territory;
2. Providing fast and convenient transport links between the different parts of the urban territory and the municipalities as well as their connection with the republican and municipal road network;	2. To provide an opportunity for co-modality through quick, easy and convenient transfer;
3. Creating premises for the economic development of the territory;	3. To move (To guide) out transit traffic outside urban areas;
4. Enhancing sustainable mobility by encouraging the use of public transport, supporting pedestrian and bicycle traffic, creating preconditions for reducing the use of cars, motorcycles, mopeds and other motor vehicles causing air and noise pollution in urban areas;	4. To offer alternative roadway activities, depending on the time, weekly and seasonal characteristics of the traffic.
5. Achieving maximum safety and security for all road users, reducing and limiting potential road accidents;	
6. Ensuring public health by reducing noise, vibration, and harmful gases;	
7. Providing effective design, based on international standards for sustainable, green and mobile urban environments;	
8. Reporting, preservation, and development of the existing architectural, historical and cultural environment (especially for city centers and areas of cultural and historical heritage).	

The Ordinance has applications, which are expanded and supplemented with graphs explaining the clearly defined requirements, precluding misinterpretation in planning and designing of the TCS.

In conjunction with the Ordinance for planning and designing the TCS of the urbanized territories was issued the next Ordinance № 4 of 1 July 2009 - for the design, execution and maintenance of buildings and structures in accordance with the requirements for an accessible environment for the population, including for people with disabilities, which has a direct relation to the mobility needs of the citizens.

Currently, the Ordinance defines the requirements for the design, implementation, and maintenance of the elements of the urbanized territory, to ensure an accessible architectural environment for the entire population, considering the specific needs of the people with reduced mobility, incl. people with disabilities. The Ordinance complies at the same time with the requirements of the normative acts on the scope and content of the spatial planning schemes and plans that are essential for sustainable and integrated urban planning.

2.1.2. Main regulatory documents regulating the way of movement in urban territories and the rights of pedestrians and cyclists on the national level

In Bulgaria, the legal basis for road traffic regulation, including pedestrian and bicycle movements (elements of "active mobility"), is the Road Traffic Act and its Implementing Rules. They define the rights and obligations of all road users, thus including pedestrians and cyclists, both in and outside of urban territories. Road Traffic Law is the only one that directly defines the term "pedestrian" as any road user who is on the road outside a vehicle (for example, a car) and does not work on the road (doing road repairs, etc). Pedestrians are also people who push or pull a stroller or wheelchair (including a wheelchair driven by a pedestrian-speed motor), as well as cyclists and motorcyclists who have dismounted their respective vehicles and push them on foot. Other definitions limited in the law and its statutes, which concern "active mobility", are the definitions of bicycles. It can be argued that the law has summed up all other forms of active mobility such as skateboarding, roller skating, jogging, or all other means of movement with the use of muscle power. According to the law, anyone who pushes or pulls another vehicle without a motor which has a width less than one meter is considered a pedestrian.

The current Road Traffic Act, adopted by the National Assembly in 1999, is more than 150 pages. There are only two sections dealing with all fundamental rights and obligations of the pedestrians and cyclists. By making a detailed review of the law, it is obvious that there is a negligent attitude towards active forms of mobility. In all of the 78 amendments and additions to its adoption on September 1st, 1999 until the last change of 27th of July 2018, only one is related to the pedestrians (Article 119, paragraph 5, new in force from 26/01/2017) and a single one related to the cyclists (Article 80, Amended, SG No. 60/2012, in force as of 07/08/2012). This, in view of the content of the law, unfortunately, does not mean that in the above aspects the legislator has exhausted all the problems related to the active forms of transport, and in this case, shows a tendency to neglect the problems and needs of those traffic participants. Although Ordinance № RD-02-20-2 changed the status quo, giving priority to the pedestrians, according to the Road Traffic Act, the motor vehicles continue to be the dominant form of transport in the cities of Bulgaria.

3. Main regulatory Documents Concerning the Active Mobility on a Local Level: Strategic Policy for Walkability in Varna

At the national strategic level, the municipalities are responsible for the policy and decision-making related to the urban planning and development of the municipal territory. According to the Self-government and Local Administration Act (art.21(1)12), The Municipal Council shall adopt municipal development strategies, projects, programs and plans. Contemporary urban management in the Republic of Bulgaria includes long-term, medium-term and short-term strategic planning documents. The executive period of the long - term documents covers over 10 years, the duration of the medium - term documents are from 3 up to 9 years, and the short-term ones have an implementation period of 1 to 3 years. According to the object of management, strategies are considered as complex and focused. The complex ones deal with a broad spectrum of objectives, tasks, and actions. They are composed to predict the long-term consequences of the overall management (activity) of the organization (the municipality). Focused strategic documents are aimed primarily to locate specific problems to be solved on a functional level.

3.1. Complex strategies and regulations in Varna

Bulgaria's strategic planning for regional development covers the development and updating of a system of documents to achieve a sustainable integrated regional and local development, including the development of cross-border, transnational and interregional cooperation. According to the Regional Development Act /RDA/ and the Spatial Planning Act, municipalities of every city in Bulgaria must prepare and adopt three main documents (Table 3) related to the urban planning and urban development.

Table 3 Main objectives of the three main strategic documents on the local level

Name of the document	Main objectives
Municipal Development Plan (MDP) RDA art. 9 (1) and (2))	▪ To identify current problems, needs, and potentials for development of municipalities and cities; ▪ To identify projects contributing to the achievement of national, regional and local development priorities;
Integrated Urban Recovery and Development Plan (IPGVR)	▪ To provide spatial and factual coordination and integration of various policies and planned resources ▪ To meet the goals of sustained improvement of the economic, social and environmental status of a given urban area.
Master Urban Plan	Specifies: ▪ the general structure of the territory of the municipality, with the relevant rules and regulations; ▪ Requirements of the aesthetic and compositional zoning of the territory; ▪ Requirements of the development of a human - friendly environment, including those for people with disabilities; Output of the transit traffic; ▪ Significant improvements in communication and transport infrastructure; ▪ Improving the transport services in the city and the municipality by public road transport

The Municipal Development Plan (MDP, Obshtinski plan za razvitie) of the Municipality of Varna is the main strategic document that outlines the objectives and priorities for sustainable and integrated socio-economic development of the region. The Municipal development plan has been drafted for a 7-year cycle of action, 3 months up to its. The strategic framework of the MDP - Varna is based on the existing potential of the city. It considers the analysis of the present situation and the future prospects of development in all aspects of planning. MDP is a working document compiling the targets and the ways to achieve them, in compulsory accordance with the Regional Development Strategy and all urban plans that are in force. For MDP is essential to put forward a common framework and sequence of concrete actions for sustainable and integrated development at the local level. In its scope and content, the tasks and measures set out in the plan are not directly related to pedestrian issues but affect aspects and problems related to walkability. In two of its main priority areas (Table 4, PA2 and PA3), are provided measures to improve the elements of the transport system in terms of pedestrian spaces, urban design, public transport, and an accessible environment. The main goal of the Municipal Development Plan is to ensure the link between the regional and local strategic development contexts by virtually integrating bottom-up and top-down planning approaches. The implementation of the specific tasks in the plan contributes to the achievement of the goals set at the higher levels of strategic planning - district, regional, national and European.

Table 4 Priority Areas, defined by the Municipal Development Plan

Priority areas in the MDP of Varna for the 2014-2020 period			
Priority Area 1: "Economic Growth" 4 Priorities, 8 Strategic Objectives and 32 measures	**Priority area 2 :** "Improving the quality of life" -5 priorities, 11 specific objectives and 49 measures	**Priority area 3:** "Integrated development on the territory" -3 priorities, 16 specific objectives and 69 measures	**Priority area 4:** "Cooperation" - 3 priorities, 6 specific targets and 18 measures

The Integrated Plan for Urban Regeneration and Development of Varna (Integriran plan za gradsko vazstanovyavane i razvitie - IPGVR) is a medium-term strategic document that aims to identify key strategic assets, potentials, and resources for the development of the city. The plan is determined to create an integrated planning basis for the city to regenerate key development areas and parts of its territory tailored to the needs and wishes of the local community.

The implementation of IPGVR is structured in a system of strategic objectives and projects, forwarded to three main areas of impact indirectly affecting distinct elements of walkability (useful, safe, comfortable, interesting). The main purpose of the development of the city's territory in the document is to build an integrated system consisting of separate but interconnected functional and spatial components. The main priority of the project is the utilization of the available strategic advantages on the territory of the city. Fundamental objectives of the project are to solve or at least to alleviate the most serious problems of the different functional and spatial subsystems included in the urbanized territory.

Although not directly, but as a comprehensive strategic document, IPGVR is committed to promote sustainable urban mobility and integrated urban transport in the impact areas. In the schedule of the implementation of IPGVR, are developed specific measures and projects

concerning directly pedestrian areas and revitalization of particular urban zones and areas in the city.

According to the Bulgarian legislation, Master Urban Plans are part of long-term strategic spatial plans. The last one in force for the territory of Varna Municipality was developed in 2007 and approved in 2012. It was made according to and taking into account the existing at that time laws and regulations and the impact of the socio-economic and infrastructure factors, specific for the centrally planned economy of the territory. An integral part of the Master Urban Plan are the rules and regulation for its implementation, approved at the same time as the plan.

The Master Plan is the basis for the overall construction of the territory of Varna Municipality. The provisions of the plan determine the functional zoning and the predominant function of the territories, the type, and function of the technical infrastructure and the protection of the environment and the zones of the cultural and historical heritage. The Master Urban Plan is obligatory in the further elaboration of detailedurban development plans.

The strategic purpose of the Master Urban Plan of Varna is to serve as a managing tool in the local spatial planning policy, for creating an optimal spatial and functional structure for the development, construction, and complexity of the city. In its analytical part, the plan analyzes parameters such as Modal split of territory, degree of motorization, state of communication and transportation system, including the pedestrian spaces, as well as other indicators such as green system, public service structure, etc. Apart from the analysis of the existing situation, the Master Plan deals with the hypotheses for the development of the surveyed indicators in short and long term periods. The Master Plan specifies: The general structure of the territory of the municipality of Varna, with the relevant rules and regulations; Requirements of the aesthetic and compositional zoning of the territory; Requirements of the development of a human - friendly environment, including those for people with disabilities; Output of the transit traffic; Significant improvements in communication and transport infrastructure; Improving the transport services in the city and the municipality by the public road transport.

3.2. Focused strategies and regulation in Varna

In addition to the current legislation in Bulgaria and complex strategies at the local level (described in the previous section), in Varna Municipality are available two main documents with a focus on walkability and active mobility forms: Strategy for development of pedestrian traffic and active forms of mobility in Varna and General Plan for organization of the traffic in Varna for 2018.

In recent years (since 2016) the development of urban mobility as active forms of mobility in Varna is due to the implementation of several projects of European programs at municipal, regional and national levels.

For the first time, within the European project "CityWalk - Towards Energy Responsible Places: Establishing walkable cities in the Danube Region", Varna Municipality developed a strategic document focused entirely on the pedestrian traffic and forms of active mobility: "Strategy for development of pedestrian traffic and active forms of mobility in Varna". The strategy generally aims at creating a sustainable pedestrian system to ensure safe mobility of Varna residents and visitors in a clean and healthy environment. The main goal of the strategy is to create a sustainable urban environment that provides the conditions for easy, safe and convenient pedestrian traffic and active forms of mobility in line with the needs of a modern, adequate, environmentally friendly, healthy and active life for all members of

society. The general objectives of the strategy should be achieved by establishing the main directions of the policies of the Municipality of Varna and offering guidance for initial actions implementing these policies. The Vision of the Strategy is Varna to become a city that is safer, more welcoming and more convenient for pedestrians and cyclists. The development of pedestrian traffic and active forms of mobility should predominate in urban traffic scheme and mobility so that more than 50% of residents will choose in the future not to use their private car for their daily journeys and especially for pedestrian-friendly routes and destinations. Any citizen should be able to access any facility in the city center within less than 20 minutes without using private motor means of transport, to reach their job places anywhere in the city or any cultural facility, or premises for leisure, entertainment or shopping within 45 minutes. The strategy sets 6 strategic and specific tasks (Figure 1) towards the reach of its main goal.

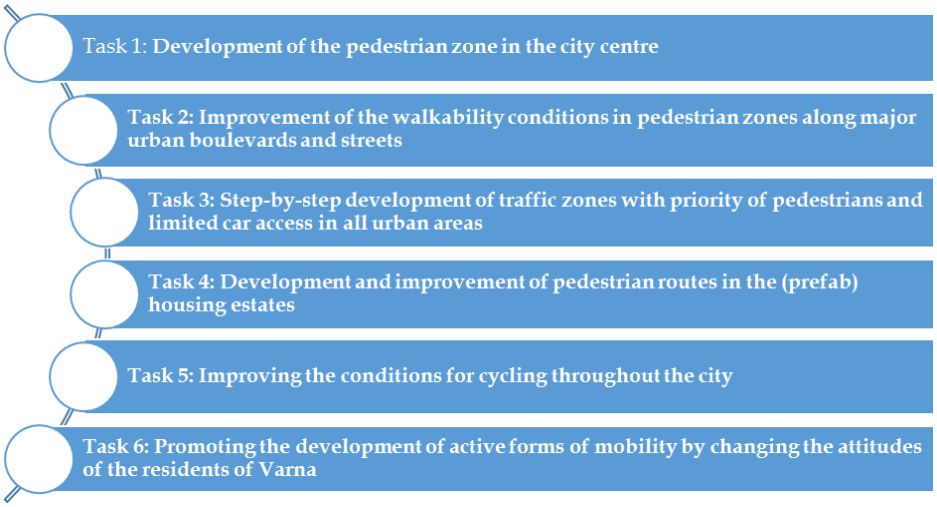


Fig. 1 Strategic and specific tasks, set by the "Strategy for development of pedestrian traffic and active forms of mobility in Varna"

According to the current legislation in Bulgaria and particularly according to Ordinance no. 1 of 17.01.2001 on the organization of road motorization, a General Plan for the Organization of the Movement of the Settlements is comprised of all communications-transport areas serving the traffic of road vehicles, vehicles of the regular public passenger transport, pedestrian and bicycle traffic and parking.

A master plan for the organization of traffic is made with a duration period of up to 5 years, based on established traffic regime schemes in the primary street network of the city. The plan for communication and transportation (adopted together with the MUP) is the basis for the development of the General Plan for Organization of the Traffic. In its scope and essence, the Plan develops primarily a traffic scheme for the various modes of motorized transport: cars, buses and freight cars. The pedestrian traffic and the other forms of active mobility (cycling) take part as the secondary and tertiary elements of the city's general traffic system. Based on the MUP, the General Plan develops further pedestrian and bicycle

movement schemes, such as hypotheses and vector strands, but there is no specificity about their implementation and realization.

At the local level, for the municipality of Varna, there are two ordinances focused on mobility: Ordinance for the Construction of a Publically Accessible Environment in the city of Varna (Adopted 05/02/2003) and Ordinance for Organizing the Movement on the Territory of Varna Municipality (adopted 31/ 01/2018).

The Ordinance for the Construction of a Publically Accessible Environment in Varna aims to define specific rules and regulations supplementing the terms and conditions for the construction of public spaces in the city of Varna in order to use the urban environment and the buildings of all population groups, including people with disabilities. In the framework of the survey, a review and comparison with the nationally applicable Ordinance № 4 of 01/07/2009 shows that there is a complete discrepancy between the two documents. The contradiction of the ordinances emerges from the fact that they were written in different years: the municipal one was adopted in 2003 and the national one - 2009. Although the local ordinance is still in force, it has not been updated since its adoption in 2003. According to the existing legal norms in Bulgaria at such cases, the higher-level regulation, namely the national one, is considered applicable.

In 2018, in connection with the implementation of a paid parking system for one of the central parts of Varna, an ordinance was adopted defining the rules, restrictions, and prohibitions related to the organization of the traffic and parking of road vehicles in the territory of the Municipality of Varna: Ordinance for Organizing the Movement of the Territory of Varna Municipality (31. 01.2018). The focus of the document is primarily on motorized vehicles, with forms of active mobility (pedestrians and cyclists) being dealt with within a single paragraph of several articles pertaining to their movement. The Ordinance aims to organize the way of traffic, whether pedestrian or automotive, without regulating norms or specific requirements in the construction of the communication transport system in the city.

4. Conclusions and Further Work

In the process of studying the national legislative framework, connected to the problems of planning and design of the communication - transport systems, the way of movement in urban territories and the rights of pedestrians and cyclists, the authors did not found other related strategic and normative documents than those already reviewed in the paper. The World and European practice in the countries where the active mobility has a high modal split is the pedestrian and bicycle traffic to be governed by additional rules and regulations, which so far is missing in Bulgaria's policy framework.

The authors recognize the insufficient political understanding of the need of specific rules and regulations on a local level, as an essential problem for the unsatisfactory index of walkability calculated for Varna with the Walkability Index Calculator, which was developed as part of the CityWalk project. Evaluated as "Poorly walkable" Varna has obviously managed to make only minor progress in establishing the key conditions of sustainable urban mobility, despite participating in many programs funded by the EU. Raynovska (2019) observes the substantial task of modeling space together with its functional purpose but contrary to that a lot of the infrastructural settings for good

walkability are still absent in the city of Varna. At research, conducted by the local governance, for the needs of the team working out the first stage of the "Strategy for development of pedestrian traffic and active forms of mobility in Varna", the respondents determined the level of walkability in the city as poor. The good news is that the level of walkability in the city can be significantly strengthened using various carefully designed infrastructural improvements. Good pedestrian infrastructure in itself, however, is not sufficient; raising the awareness of residents of the benefits of walking is also necessary.

The low level of public participation (citizens and NGOs) in the process and realization of the EU projects in Bulgaria and particularly in Varna, is mainly due to the unwillingness of the local government to organize and conduct beneficial, non - formal, mandatory public debates (Slaev et al, 2019). As a result of the insufficient presence of the problem for active mobility in the public space and the low level of awareness of the interested persons, there is also some apathy on the side of the citizens about the subject. If, on the other hand, the contributions of local residents have not been integrated into the planning and decision - making process, that would result in a lack of public support and, even if planners and government, nationally or/and locally, have proposed useful solutions, they are less likely to be implemented (Kovachev et al, 2018). All this reflects in the incomplete and often poor design and builds of the projects for renovation and construction of new elements of cities' transportation system (sidewalks and walkways, pedestrian zones, bicycle lanes, etc.). To reverse and change the situation described above, an integrated transport policy framework is required, in which active transportation becomes the priority for the urban development of Bulgarian cities and Varna in particular.

Although in the context of the current topic we focus on the pedestrian movements, for it represents the largest percentage of active forms of transport, pedestrians do not exhaust the problem on a global scale. It was found that the regulatory framework in Bulgaria and locally does not adequately consider (with small exceptions), the other forms of active mobility and their place in the road traffic (Nozharova, Nikolov, 2018). During the last few years and to date the Municipality of Varna is a partner in several European projects, including the "CityWalk" project, that are focused on the problems of sustainable urban mobility. It is expected that this will result in the establishment of several focused strategic documents and norms and also detailed plans on the local level, aimed at the problems of pedestrians and other means of active transportation.

In additional studies should be addressed the following problems:

- possibilities for improvement of the existing Bulgarian legislation, regarding active transportation;
- other forms of active transportation and their connection with pedestrian and bicycle transport.

Acknowledgment. *The paper is a part of the research done by the Varna Free University team within the project "CityWalk. Towards energy responsible places: Establishing walkable cities in the Danube Region". The project is co-financed by the Danube Transnational Programme of the European Union. The authors would like to thank for having the opportunity to work on that topic.*

REFERENCES

1. ARUP, "City of Perth, Walkability Study", Final Report, Report Ref 02, Perth, Australia, 15 June 2015
2. B. Nozharova; P. Nikolov, "The policy framework and the active mobility in Bulgaria", Proceedings, 2nd International Conference on Urban Planning – ICUP 2018, Nis, Serbia, 2018, pp. 53-60
3. A. Kovachev, A. Slaev, B. Nozharova, P. Nikolov, P. Petrov, "Can public participation contribute to sustainable mobility? The experience of Bulgarian cities", in 'Bolay, J.C., Maričić T., Zeković, S. (Eds.) (2018), A Support to Urban Development Process', 2018, pp.59-79, Belgrade: EPFL & IAUS., ISBN 978-2-8399-2394-1.
4. A. Slaev, A. Kovachev, B. Nozharova, P. Nikolov, P**.** Petrov, "Overcoming the failures of citizen participation: The relevance of the liberal approach in planning", (2019), *Planning Theory*. E-published ahead of print 21/05/2019, DOI: 10.1177/1473095219848472
5. P. Nourian, S. Rezvani, K. Valeckaite, S. Sariyildiz, "Modelling walking and cycling accessibility and mobility: The effect of network configuration and occupancy on spatial dynamics of active mobility' in 'Smart and Sustainable Built Environment", Vol. 7 Issue: 1, 2018, pp.101-116, Emerald Publishing Limited, 2046-6099, DOI 10.1108/SASBE-10-2017-0058.
6. P. Papaioannou, S. Basbas, C. Konstantinidou, I. Politis. 'A Policy Framework for the Facilitation of Pedestrians in Thessaloniki, Greece.", 23rd International Cooperation on Theories and Concepts in Traffic Safety (ICTC) workshop in co-operation with COST-358 Pedestrian Quality Needs (PQN) 11th International Walk21 Conference, "Getting Communities Back to their Feet – Promising approaches to support walking for a sustainable future". 23rd International Cooperation on Theories and Concepts in Traffic Safety (ICTC) workshop in co-operation with COST-358 Pedestrian Quality Needs (PQN). 2010, Hague, The Netherlands.
7. R. Raynovska, "Spatial development of reception areas in public buildings of culture and education". In: E-Journal VFU. issue 12/2019, ISSN 1313-7514, https://ejournal.vfu.bg/bg/architecture.html#.
8. ACTIVE TRAVEL. ACTIVE SCOTLAND. Our journey to a sustainable future. Cycling Scotland. Living Streets Scotland. Paths for All. Sustrans Scotland, 2012. https://www.pathsforall.org.uk/component/option,com_docman/Itemid,69/gid,784/task,doc_download/ [Accessed: 21st February 2019].
9. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Action Plan on Urban Mobility. Brussels, Commission of the European Communities, 2009. http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52009DC0490:EN:NOT. [Accessed: 01st March 2019].
10. Government of Canada/Public Health Agency of Canada. https://www.canada.ca/en/public-health/services/health-promotion/healthy-living/physical-activity/what-active-transportation.html [Accessed: 24th September 2018].
11. National Strategy for Regional Development of the republic of Bulgaria for the period 2012 – 2022. http://www.strategy.bg/StrategicDocuments/View.aspx?lang=bg-BG&Id=772 [Accessed: 11th March 2019].
12. National Strategy for improving the safety of movement on the roads of the republic of Bulgaria for the period 2011 – 2020. http://www.strategy.bg/StrategicDocuments/View.aspx?Id=714 [Accessed: 11th March 2019].
13. Ordinance No. RD-02-20-2 (from 20.12.2017) for planning and designing the communication-transport systems of the urbanized territories. http://dv.parliament.bg/DVWeb/showMaterialDV.jsp?idMat=121406 [Accessed: 11th March 2019]
14. Ordinance No. 4 (from 1.07.2009) for the design, execution and maintenance of buildings in accordance with the requirements for an accessible environment for the population, including for people with disabilities. https://www.mrrb.bg/bg/naredba-4-ot-2009-g-za-proektirane-izpulnenie-i-poddurjane-na-stroejite-v-suotvetstvie-s-iziskvaniyata-za-dostupna-sreda-za-naselenieto-vklyuchitelno-za-horata-s-uvrejdaniya-dv-br-54-ot-2009-g/ [Accessed: 11th March 2019]
15. Pedestrians and Cyclists, European Commission, Directorate General for Transport, September 2015. https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/ersosynthesis2015-pedestrianscyclists25_en.pdf [Accessed: 01st March 2019]
16. Road traffic act (from 01.09.1999) https://rta.government.bg/images/Image/n_uredba/zdvp.pdf [Accessed: 11th March 2019]
17. Strategy for the Development of the Transport System of the Republic of Bulgaria for the period until 2020. http://www.strategy.bg/StrategicDocuments/View.aspx?lang=bg-BG&Id=604 [Accessed: 11th March 2019].
18. Spatial Planning Act (from 31.03.2001) https://www.lex.bg/laws/ldoc/2135163904 [Accessed: 11th March 2019]
19. Municipal Development Plan (MDP) for the City of Varna for the 2014-2020 period, http://www.varna.bg/bg/articles/8643/%D0%9E%D0%B1%D1%89%D0%B8%D0%BD%D1%81%D0%BA%D0%B8_%D0%BF%D0%BB%D0%B0%D0%BD_%D0%B7%D0%B0_%D1%80%D0%B0%D0%B7%D0%B2%D0%B8%D1%8

2%D0%B8%D0%B5_%D0%BD%D0%B0_%D0%9E%D0%B1%D1%89%D0%B8%D0%BD%D0%B0_%D0%92%D0%B0%D1%80%D0%BD%D0%B0_%D0%B7%D0%B0_%D0%BF%D0%B5%D1%80%D0%B8%D0%BE%D0%B4%D0%B0_2014-2020_%D0%B3..html [Accessed: 10th March 2019]
20. Integrated Plan for Urban Regeneration and Development (Integriran plan za gradsko vazstanovyavane i razvitie - IPGVR) for the City of Varna for the 2013-2020 period, http://agup.varna.bg/ipvgr/ [Accessed: 10th March 2019]
21. Master Urban Plan (MUP) for the Municipality of Varna Including Rules and Regulations for its Implementation, http://agup.varna.bg/index.php/oup/grafichna-chast [Accessed: 10th March 2019]
22. General Plan for Organization of the Traffic in the City of Varna, http://agup.varna.bg/index.php/generalen-plan-za-organizatziya-na-dvizhenieto [Accessed: 10th March 2019]
23. Ordinance for the Construction of a Publically Accessible Environment in the city of Varna (5.02.2003), https://varna.obshtini.bg/p.php?i=3263861&b=0 [Accessed: 10th March 2019]
24. Ordinance for Organizing the Movement on the Territory of Varna Municipality (31. 01.2018), https://varna.obshtini.bg/p.php?i=3300108&b=0 [Accessed: 10th March 2019]
25. Transport Canberra. https://www.transport.act.gov.au/getting-around/active-travel [Accessed: 11th February 2019].
26. White Paper on transport: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. Brussels, European Commission, 2011. http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF. [Accessed: 12th March 2019].
27. Wikipedia. Active mobility, https://en.wikipedia.org/wiki/Active_mobility#cite_note-1 [Accessed: 12th March 2019].
28. Walkability Index Calculator, http://www.rri.hu/citywalk/calculator [Accessed: 14th March 2019].

POSTOJEĆI ZAKONSKI OKVIR PODRŠKE AKTIVNE MOBILNOSTI U BUGARSKOJ. STRATEGIJE I PROPISI U VARNI

Aktivna mobilnost, aktivno putovanje, aktivni transport i aktivni prevoz su sinonimi transporta ljudi koji koriste samo svoju fizičku aktivnost za potrebe kretanja. Najpoznatiji oblici aktivne pokretljivosti su hodanje i vožnja bicikla, iako su skejtbord, skuteri ili roleri također oblici aktivne pokretljivosti. Grad Varna je treći po veličini grad u Bugarskoj i najveći morski grad u zemlji. Na vrhuncu turističke sezoni, grad ima mnogo više uličnih problema nego obično. Čini se da je zagušenje svake godine sve veće i to utiče na aktivni transport. Kao rezultat dominanacije individualnih automobila u našem svakodnevnom životu, čini se da se zanemaruju aktivni oblici transporta. Da bi se ovaj trend promenio, potrebna je integrisana transportna politika sa pešacima u njenom fokusu. Jedna od veoma važnih komponenti za podršku aktivne mobilnosti je politički okvir. On treba da garantuje da svi oblici aktivne mobilnosti imaju svoje pravo da koriste ulice i da nisu zanemareni u procesu planiranja. Sadašnja studija ima za cilj da analizira postojeće relevantne nacionalne i lokalne (za grad Varnu) propise koji se odnose na pešačenje i biciklizam i da oceni stepen političke podrške kako bi se poštovala njihova prava i potrebe. Studija se bavi postojanjem relevantnih politika i načinom njihovog sprovođenja. Prikupljeni podaci o regulatornom okviru ocenjuju se metodom analize sadržaja.

Ključne reči: *aktivna mobilnost, prava pešaka i biciklista, politički okvir*

FACTA UNIVERSITATIS
Series: **Architecture and Civil Engineering** Vol. 17, N^{o} 2, 2019, pp. 173-187
https://doi.org/10.2298/FUACE190315010P

LAND USE AND BUILDING REGULATIONS: THE CASE OF SPATIAL PLANS FOR PROTECTED NATURAL AREAS (SERBIA)

UDC 658.23(497.11)

Marijana Pantić, Jelena Živanović Miljković, Saša Milijić

Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia

Abstract. *Land use and building regulation within protected natural areas in Serbia is specific in comparison to areas without this status. Since urban plans define the rules and conditions limited to urban settlements and locations of national priority (e.g. tourism resort in natural protected areas), other areas, including significant parts of protected natural areas, rely on spatial plans, which often contain elements of detailed urban planning (i.e. regulation and building rules). Preservation of ecologic and environmental functions is a priority in protected natural areas (particularly in zones of I and II level of protection), but they are also eligible for controlled development purposes in zone of III level of protection. Due to large distance from administrative centre and institutions responsible for building inspection, it is not rare case in Serbia that illegal building in protected areas makes them more exposed to illegal actions.*
Therefore, this paper focuses on the role of spatial plans in balancing between land use and building in protected natural areas on the one hand and nature protection on the other hand. In-depth analysis of chosen spatial plans, here is given a comprehensive review of building and land use postulates, regulations and different levels of protection applied in spatial planning. Starting from the Spatial Plan of the Republic of Serbia 2010-2020, analysis gives a major significance to four special purpose area spatial plans of different kind: Gornje Podunavlje Special Nature Reserve, Tisa River Multifunctional Ecological Corridor, Kopaonik National Park and Vlasina Landscape of Exceptional Features. Finally, there is shown diversity and systematisation of existing measures, and contribution to understanding of challenges and recommendations on future improvements of methodology in planning and implementation of plans in order to enhance balance between development and protection.

Key words: *spatial planning, protected natural areas, land use, building regulations, Serbia*

Received March 15, 2019 / Accepted June 3, 2019
Corresponding author: Marijana Pantić
Institute of Architecture and Urban & Spatial Planning of Serbia, Kralja Aleksandra Blvd. 73/II, 11000 Belgrade, Serbia
E-mail: marijanap33@yahoo.com

1. INTRODUCTION

The principal question confronting planning of protected natural areas is to determine an acceptable degree of human impacts (Eagles et al. 2002). Even though the primary role of protected areas is to protect and preserve the biodiversity, ecological and natural values and resources, the natural environment can provide added value if properly used for other purposes and activities because they become multifunctional (Sayer et al., 2003; Ranganathan, 2010; Bergandi et al., 2013). However, the balance between the development and protection is an ultimate challenge for societies aware of contemporary climate change issues and not so rare misuse of natural resources (Belokurov, 2010; HABIT CHANGE, 2013). Zoning, as established standards of an acceptable land use, helps to control the sprawl of undesirable impacts and represents the best way to reduce spatial conflicts in the land use. Tourism may be seen as a more favorable alternative to some other form of the land use in protected natural areas (Eagles et al., 2002), on the other hand, tourism will always have an environmental impact on protected areas (Danilović Hristić et al., 2018), because they are inherently sensitive. That is why it is vital for the impact to be assessed as precisely as possible before decision on intervention is made and implemented (Eagles et al., 2002).

Concerning the land management issues in Serbia, urban planning and urban plans are predominantly aimed at managing the land use in urban areas, while one of the initial and key tools for balancing between the development and protection outside of cities is spatial planning, particularly special purpose area spatial plans, which contain elements of urban (detailed) planning. Support to the nature protection by the spatial planning starts with the statement and elaboration of existing environmental problems. In general, but also regarding construction activities and building, the issue is the conflict between development and protection. In spite of planning and urban documents, defined land use and building regulations, attractive touristic and scenic locations are simply being overloaded by illegal construction (Pantić et al., 2018a). Therefore, the task of this paper is to show in which way protected natural areas in Serbia are integrated into the spatial planning, by answering the main research question: how spatial plans define the land use and building regulations in protected natural areas in order to limit development to an extent that is not harmful for the natural sustainability? Research sub-questions are: (1) what are the recognizable postulates related to the land use and building regulation in spatial plans? (2) what are particular land-use and building regulations applied in spatial plans? and (3) can spatial plans be sufficient in balancing between the land use and building in protected natural areas on the one hand and the nature protection on the other hand?

The following paragraphs will present a methodological approach, legal framework for nature protection and spatial planning in Serbia, results, discussion, conclusions and implications.

2. METHODOLOGY

This research is conducted using qualitative research methods, a document analysis and a case study analysis. The document analysis starts with the most general documents regulating spatial planning, land use, building and nature protection in Serbia: the Law on Nature Protection (2009), the Order on Protection Regimes (2012a), the Law on Planning

and Construction (2009), the Spatial Plan of the Republic of Serbia (2010) and four spatial purpose area spatial plans [hereinafter SPASPs], which were chosen as case studies.

The case study analysis involves a detailed review of the chosen SPASPs and a generalisation of results in the form of postulates and the land use and building regulations contained in the plans. There where it appeared relevant, differences based on different area types were commented. For the purpose of this research, SPASPs were chosen as case studies because this type of a planning document is the only document that can be purposely prepared for a protected natural area, by encompassing its entire territory and with the goal to regulate the sustainable development within it. As there is over 20 adopted SPASPs, it was helpful to limit the choice, which was done based on a set of the following criteria: (1) out of seven types of protected natural areas (as defined by the Law on Nature Protection), four of them are the foundation for ordering, preparing and adopting a SPASP; so each chosen case study covers one out of four types of protected areas; (2) each spatial plan represents a different geo-morphological area – mountains, lowlands, large water accumulation, river basin and/or Ramsar area, (3) spatial plans are representatives of a larger time-sequence from 2004 to 2016. Based on the criteria, the SPASPs that encompass the following protected natural areas were chosen for the analysis: the Vlasina Landscape of Exceptional Features (2004), the Kopaonik National Park (2009, 2016), the Gornje Podunavlje (Upper Danube Area) Special Nature Reserve (2012) and the Tisa River Multifunctional Ecological Corridor (2015) (Fig. 1). Therefore, the case studies are SPASPs prepared for listed protected natural areas.

Fig. 1 Case studies – SPASPs encompassing protected natural areas

3. LEGAL FRAMEWORK FOR NATURE PROTECTION AND SPATIAL PLANNING IN SERBIA

The basic legal acts that regulate nature protection in Serbia are the Law on Nature Protection (2009) and the Order on Protection Regimes (2012a), while the spatial planning is being primarily regulated by the Law on Planning and Construction (2009). In the sphere of spatial planning, national spatial plans could be also taken as legislative acts because they are being adopted and published in the same manner as any other law. After the adoption, the implementation of a spatial plan is legally binding for all institutions at national, regional and local levels. The Law on Nature Protection defines three types of protection: (1) protected areas, (2) protected species and (3) mobile protected nature documents. The last two types do not overlap with spatial planning because they are whether mobile – so they are not related to a specific location – or they represent individual natural elements (e.g. a specific three) that take insignificant amount of space to be subject of spatial planning.

In contrast to those types, protected areas comprise seven sub-types of protection, where four of them are the foundation for ordering, preparing and adoption of a SPASP. These are national parks, landscapes of exceptional features, nature parks and special nature reserves. Their common characteristics are interrelations between the nature and culture, where predominantly natural areas are still inhabited by sparse settlements and by people that preserve forms of traditional life-style. Those areas could vary in size from a couple of hectares to over 100,000 hectares. Another group of protected areas are natural monuments and protected habitats, which are usually rather smaller in terms of the territorial sprawl, therefore, usually included in spatial plans with/within other protected areas or ecological corridors. The last category is strict nature reserves that are not inhabited and have solely the nature protection role, for which they are not of particular interest in the spatial planning.

Among other tools, the Law on Nature Protection recognises spatial and urban plans, as well as planning and project documentation as tools for planning, ordering and use of protected areas. There is one more connection between the Law on Nature Protection and the Law on Planning and Construction: preparation of the strategic environmental assessment (additional, but inevitable document following a spatial plan preparation) and the study for accessibility evaluation (a document defined by the Law on Nature Protection as a part of the strategic environmental assessment). If the mentioned documents show that the environmental impact is too high and non-sustainable, measures defined by spatial plan cannot be implemented.

The Order on Protection Regimes defines three levels of protection within a protected area, which is also accepted in spatial planning and spatial plans, while the Law on Planning and Construction sets the principles and protection, order and development propositions. The planning legislative act also defines constructions in the natural environment that do not need a construction permit (e.g. hiking paths and infrastructure that follows the paths, etc.).

4. LAND USE AND BUILDING REGULATION IN PROTECTED NATURAL AREAS – AN ANALYSIS OF SPASPS

4.1. General Framework

Governing and development of nature assets in the way that they are preserved for the future generations appears to be the common effort of most of national documents, including SPASPs. Participation, as general postulate in any contemporary decision-making procedure is in the case of protected natural areas in Serbia specially oriented towards the inclusion of successors of elderly households in settlement reconstruction by special programs. This shows the effort to bring changes that would be as attractive as possible to future generations, thus sustaining living in sparsely populated areas. Another option to preserve continuation of investments (economic vitality) is involvement of private investments in traditionally publicly financed projects.

Analysed SPASPs insist on balancing between tourism development and development of alternative rural economies in river/water accumulation basins on the one hand side and natural values on the other, which is suggested to achieve by synchronization of capacities such as the number of beds for tourists in accordance with other capacities such as ski-lifts, ski-slopes, water supply and sewage infrastructure, nature revitalisation activities, etc. Therefore, no construction or building is allowed, as SPASPs define, before completion of infrastructure (primarily a sewage system).

The SPASPs show the intention to rather have a planned increase of population density than a sprawl of building land in order to prevent soil sealing and preserve natural habitats. Similarly, "urban recycling" actually means rather reuse of neglected buildings and brown-field land than occupying new spaces. By stressing relevance of settlement attractiveness through identity and tradition in architecture, SPASPs aim to stress the relevance of using local materials and traditional styles/forms of building. In addition, the plans bring forward values such as the implementation of planned actions in phases, efforts to put obligations on re-cultivation of locations disrupted by planning measures and raise awareness on the relevance of institutional/personal improvement within the system.

4.2. Zoning in SPASPs

Spatial plans usually cover a slightly broader area than the protected area itself, which allows the planners to put these extra zones in the function of an additional protection, but also proclaim them for zones with no additional limitations. Taking into account the zones defined in protected areas, analysed spatial plans concentrate the greatest amount of activities in the zone of III level of protection, they allow more restricted functions and use in the zone of the II level of protection – usually soft-impact activities and inevitable constructions of public interest, while the zone I of the protection is prohibited for any type of construction and activities basically limited to scientific research and hiking.

For example, in the case of SPASP for Vlasina Landscape of Exceptional Features, there are defined locations prohibited for tourism activities – the area upstream from the dam, places of water inlets into the accumulation, swamp areas and floating islands (Official Gazette, 2004). Another aspect in zoning is, for example, prohibition of building for private and personal use, but still with a possibility to build the tourism accommodation. Besides, construction of small water accumulations for local water supply of the mentioned

accommodation is allowed in the II level of protection zone, and in case of ski-centres, there is also an allowed construction of structures related to functioning of cable cars and ski-slopes. This indicates that ski centres represent a case in which the II zone of protection is the main area of activity and is the most intensively used.

Existing forest paths are usually being assigned for hiking and Nordic skiing, therefore, the impact of these activities is minimal after implementation of the plans, if occurring at all. In addition, some of the analysed spatial plans prepare different tourism development zones, which differ in type and extent of permitted tourism activities, as well as in type and extent of building (intensive/extensive, small/large extent, etc.).

When it comes to zoning according to the land use type, water land is aimed to water protection and protection from water, which is practically the rule that does not depend on the kind of area that is being the subject of the plan; hence, constructions and buildings on this type of land are predominantly in accordance with its functions, but soft-impact activities such as tourism, recreation and sports could also be allowed. Further on, the agricultural land is intended for agricultural production and other agricultural activities, which means that the type of allowed building is in function of it, in the same way the forest land is limited to constructions in function of forests, forestry and hunting.

4.3. Building Regulations

In an effort to protect natural resources, the spatial plans define building regulations for the building land outside of settlements, because settlements are expected to be covered by urban plans. A general tendency in analyzed plans is the enlargement of building land, but with efforts to decrease it in any location where it is possible, and with focused sprawl in contact zones between settlements or other built areas. The plans also highly recommend building land re-use and use of brownfield locations – so to say "land recycling".

Some examples of constructions have already been mentioned in previous paragraphs: cable-cars, ski-slopes, tourism resorts and electricity-supply infrastructure. In addition, SPASPs regulate locations and rules for tourism and development infrastructure such as parking lots, garages, bus stops, roads, ports, docks, moors, marinas, car-camps or development of inter-modal transport zones. However, regarding the topic of this paper, even more relevant is to mention examples of nature protection, starting with anti-erosion measures, wind-safety belts, sewage-systems, canals for atmospheric water, water-purification systems (waste-water management), re-cultivation planned and spontaneously organized landfills (solid-waste management). Precisely speaking, the rules can be listed as follows: (1) overall number of beds in tourism accommodation; (2) gross population density allowed (e.g. 46 stationary users per ha); (3) number of floors (sometimes prohibition of increase of floor numbers for already build buildings); (4) number of allowed buildings on one plot (usually one holiday house + accompanying construction – garage, storage place, etc.); (5) minimal distance from one building to another; (6) minimal width of a plot; (7) land occupancy index (usually low, about 10%); (8) floor area ration (also usually low, about 0.3); (9) roof slope; (10) position of a building on a plot – in reference to side borders of a plot, and regulation line towards road and towards e.g. river bank; (11) maximal gross area of main and accompanying building; (12) minimal area size of a plot; (13) allowance/ disapproval for balcony, porch or pergola construction; (14) height of bottom and top edge of a fence (in order to secure the free movement/migration of wild animals); (15) type of a

fence allowed (green, transparent, etc.) or prohibition of any type of fence; (16) types of allowed house designs – usually based on local tradition and local materials; (17) removal of certain type of buildings/activities (e.g. farms); (18) height of a fence.

In addition to detailed building regulations, spatial plans can also address more general rules such as the prohibition of constructing barriers in riverbeds in order to keep fish migratory habits, prohibition for building commercial buildings, waste disposal and landfills in the vicinity of rivers. On the other hand, greening of spaces between built areas is supported and their minimal mutual distance defined (100-300 m), path paving and paving in general are also put under regulation (e.g. not closer than 20 m from river bank) and pavement slope limited to 45% in order to ensure easy transit of wild animals. If a protected area is related to a larger river, spatial plans also defined desirable locations for beaches with mobile equipment, as well as they define conditions for changes in riverbeds (minimal depth, width, curve radius, etc.). For the places where infrastructural corridors intersect ecological corridors, spatial plans recommend preparation of a technical solution for provision of an unrestricted migration of animals, including solutions against the electrocution of birds (Official Gazette, 2015).

The SPASPs also call for a necessary preparation of urban plans and engineering projects before building. In another words, a potential constructor or resource exploiter must contact corresponding institutions for obtaining necessary permits based on the prepared documentation. If the intervention has a more considerable impact, investors are obliged to finance the preparation of an impact assessment on their own expense. Spatial plans also mark areas that need further elaboration in terms of urban and detailed urban planning. Often, given locations represent simply rough suggestions that get practical use only through the preparation of urban plans and projects that elaborate them into details. There is even an open possibility that one SPASP calls for a preparation of another spatial plan of the same kind within its territory, e.g. Spatial Plan for Donje Podunavlje Special Nature Reserve (Official Gazette, 2012b).

If a building was illegally built outside of the building land, SPASPs proclaim that their legalization is not permitted and its future is on local government to decide. If a building has obtained a building permit before the spatial plan defined new building locations, the owner should build waste-water and solid waste disposal systems and additionally thoroughly examine and harmonize with new set of regulations. In any other case of construction, SPASPs suggest the application of rules and regulations defined by spatial plans themselves.

Fiscal policy, decrease of local taxes and provision of bank loans for energy efficient building are some of the suggestions in analysed spatial plans that connect building regulation and nature protection, although indirectly. Therefore, the role of national and local governments is significant in provision of incentives, but, as analysed spatial plans additionally address, the governmental role is crucial in the sphere of prevention and inspection of illegal building activities – the problem that must be put under control.

5. RESULTS

The current version of the supreme national document in spatial planning – Spatial Plan of the Republic of Serbia (2010) – declares a clear goal regarding the nature and environmental protection: Serbia should obtain an increase of protected areas by 10% up

to 2020, or by almost 100% compared to the year 2008. On its way to meet the aspiration, the national spatial plan, in synergy with other plans analysed here, promote certain postulates. Some of the postulates are explicitly related to nature protection and building, while the value of others is in indirect benefits.

The postulates can be distinguished as:

- The most general – sustainability, participation and support to public-private partnership;
- Those that refer to balancing between development and nature protection – relativization of conflicts between nature protection and development, synchronization and infrastructure at the first place;
- Postulates that reflect nature protection in building and construction processes – density over sprawl, "urban recycling", identity and tradition; and
- Other postulates – "it is not too late" postulate, after exploitation comes re-cultivation postulate, and institutional/personal improvement postulate.

Realisation of plans in phases postulate is particularly relevant for the nature preservation because a successive realization of planned measures gives a possibility to realize potential mistakes during the process (change of the plan), but also because development of accommodation infrastructure can be timely followed by the construction of supra- and infra-structure. In the case an inadequate structure already existed in planned area before the plan itself was made, and it does not fit the newly set regulations, the SPASPs defines that any following reconstruction and intervention must adapt it to the new rules. Sometimes, some excessive measures must be conducted in a protected area or the excessive activity is practiced before the area went under the protection (e.g. exploitation of local mine pits), especially regarding the fact that using the local resources and materials for construction is encouraged. One of the postulates proclaimed in SPASPs in order to prevent the negative impact is approval of the activities but only with previously obtained permit by local authorities and with obligation of the beneficiary to re-cultivate the site. Last but not the least, there is a postulate that refers to a permanent improvement of institutional and personnel know-how, so that development in natural areas can be led independently and taken care of at the very local level. This postulate refers also to the inspection sector.

One of the basic actions by which the spatial planning protects the environment, as well as the public interest, is the land use zoning. Since protected areas already have their three zones distinguished by the level of protection, spatial planning integrates them into land use planning process and add to it another layer of zoning typical for the planning procedure – division on water-, forest-, agricultural- and building-land. The task for the spatial planning is to subtract locations and areas where these activities are prohibited, even though the prohibition does not come from the Law on Nature Protection. In this case, the role of the spatial plan is to secure areas of public interest such as water-source zones, protection belts, etc.

The spatial planning practice tries to minimize the impact by proclamation of the minimal removal of forest cover, obligatory recovery of terrain after interventions through grassing and afforestation with autochthonous species of trees. All three types of zones/land use – water, agricultural and forest land – allow construction of lineal infrastructure (e.g. electricity, gas and fuel transport). Economically speaking, the most valuable zone, therefore the most commonly misused and the most difficult to control, is zone of building land.

There are two major types of constructions and buildings that spatial planning deals with: buildings made for public interest and buildings made for private interest. In contrast to the most of the private building constructions, public interest buildings are not only in function of protected area use, but also in function of their protection. Besides regulation of public infrastructure, spatial plans regulate building rules for individual and collective dwelling (permanent or temporary) and complementary objects. Nevertheless, not all spatial plans give the same regulations, nor they regulate the same aspects, however, these are four major groups of urban parameters and land use regulations found in the analysed examples:

- Areal regulations
- Parcel regulations
- Main object regulations
- Complementary object regulations.

The first group of building regulations aims at control of overall number of stationary population and tourists in a nature protected area. Its main role is to give parameters of optimal population density, which would not endanger the priority of protected areas – nature protection. One of the examples is proclamation of gross population density allowance at 46 stationary users per ha.

The second group of regulations comes down at the level of a parcel, thus defining the minimal area size or width of a plot, land occupancy index (usually low, about 10%), ground-floor area ration (also low, about 0.3) and number of allowed buildings on one plot (usually one holiday house, plus one accompanying constructions such as garage, storage place, etc.). SPASPs also try to enforce control of position of a building on a plot by proclaiming the minimal distance of the main building in reference to side borders of the plot, regulation line between a plot and river bank or road, and minimal distance from one building to another. Last to be listed in this group is the regulation of building removal from a parcel due to improper activity the building might support (e.g. farms).

The third group of building regulations refers to main buildings. For the sake of landscape and nature quality maximisation, the plans regulate the number of floors (sometimes prohibition of increase of floor numbers for already built buildings), building capacity (overall number of beds in tourism accommodation), maximal gross area of main and accompanying building, roof slope degree, allowance/disapproval for a balcony, porch or pergola construction, or types of allowed house designs – usually based on the local tradition and local materials. Finally, the last group – complementary building regulations – refer to additional building and other elements of a parcel, which involves definition of maximal gross area of accompanying building, fence type allowance (green, transparent, etc.), prohibition of any type of fence, and specifying other details about fence (as overall height of a fence might be rather aesthetic matter, but regulation of height of the bottom and the top edge of a fence aims at securing free wild animal transit/migration).

In order to secure nature protection, SPASPs are not limited solely to listed regulations, but also define procedures that need to be followed on the way from an idea of potential intervention in space to its implementation. Building regulations defined by spatial plans also include illegal construction issues, and the general tactic is the removal of the buildings, but also the prohibition of their further enlargement if the building is located in the newly defined building land.

6. DISCUSSION

Most of the analysed plans indicate that there are unsolved issues on the land market and that the state land privatization out of control lead to, not only to illegal building, but also unplanned and spontaneous conversion of agricultural land into building land. These trends diminish identity and attractiveness values, but also have a negative impact on the biodiversity and pollution. The main pollution comes from the liquid and solid waste, because illegally built areas are not equipped with appropriate infrastructure (water-supply, sewage system and waste disposal solutions). The Kopaonik National Park is one of the notorious examples: its high landscape attractiveness is "punished"by the uncontrolled building actions to such an extent that this protected area is getting close to lose the features that put it on the protected area list in the first place (Official Gazette, 2009 and 2016)[1]. In spite of several decades of spatial and urban planning for this area and proclamation of balanced distribution of tourism accommodation capacities, only a few locations have been in the centre of interest for building (areas above 1.600 m), while many other locations, especially in lower elevation areas, have remained untouched. This is also the case in European mountains – the trend of shifting skiing related activities and infrastructure to higher altitudes due to the impacts of climate change and the shift of the lower snow line to higher altitudes (Marty, 2013).

Besides the illegal land conversion and building, which is the common problem detected by each analysed plan, the planning documents also detect issues that might be specific for certain types of protected areas. For example, a major problem in Vojvodina region is the shallow groundwater that is easily polluted by turning a well into cesspit, or slowing down a river flow due to embankment of riverbeds, which further leads to eutrophication of swamps (Official Gazette, 2012b; Official Gazette, 2015). This already indicates that not only an absence of implemented plans, but also of implemented projects can cause undesirable consequences. One of the examples is realisation of some plans for afforestation by allochthonous species that has led to the biodiversity loss, such as in case of the SPASP of the Tisa River Multifunctional Ecological Corridor (Official Gazette, 2015), giving open-hands in construction of small hydropower plants that turned to be almost absolutely out of control leading to the loss of forests, excessive erosion, loss of river biodiversity and in some cases even to loss of entire streams, change of meso-climate, etc. (Vujić, 2018). Another example of improper implementation of planning are ski-slopes, such as the case at Stara Planina (Ristić et al, 2009), or elsewhere because this sort of infrastructure requires interventions and even use of high mountain areas that are usually in the I or II zone of protection. Underground distribution of gas and fuel does not allowed growth of plans with deep roots, which put limits to sprawl of forests and agricultural activities (Official Gazette, 2015).

Spatial plans do not only register and list the existing problems, but apply several layers with the aim of relativizing conflicts between development and protection (Table 1). The most general level is defined by development postulates, such as sustainability, which might not be detailed but is a good direction for defining more specific measures. The following

[1] The Kopaonik National Park has continuality in spatial planning; therefore, in the paper are compared SPASPs for Kopaonik National Park adopted in 2009 and 2016. The comparison indicates that later plan is methodologically enhanced in terms of regulation, building and protection rules, following innovations brought by the Law on National Parks (Official Gazette, 2015).

level encompasses two types of spatial zoning. Primary zoning is practically literally related to protection zones delineated by proclamation of protected area, with the distinction that spatial plans encompass a broader area than the protection zones itself, which can be flexibly defined by a plan to additional protection or soft development. Another type of zoning that is specifically related to land use (water-, forest-, building-, and agricultural-land), could also have a protective function, especially if it is defined as the water land or forest land. Agricultural land can also improve the biodiversity richness of an area, but if a spatial plan does not regulate the use of fertilizers in agriculture, then negative environmental consequences could occur. The most detailed level, by which the spatial plans balance the development and protection, is the building regulations or building rules. At this point, spatial plans go to the level of defining parcel, main and complementary object parameters.

Table 1 Levels of land use and building regulations in spatial plans – protected natural areas in Serbia

I	POSTULATES			
II	ZONING			
	I	II	III	+
	Water land	Forest land	Building land	Agricultural land
III	BUILDING RULES			
	Areal regulations	Parcel regulations	Main object regulations	Complementary object regulations

7. Conclusions and Implications

The role of spatial planning in nature conservation appears to be relevant, particularly for territories that are not necessarily regulated by urban plans. The role of planners is recognizable, since they need a substantial knowledge on relationships between the use and human impacts to predict relationships at a variety of scales and over time (Eagles et al. 2002).

In practice, various land use regulation instruments are implemented, based on planning solutions and propositions, regarding the fact that plans are legally binding (Živanović Miljković, 2018). As presented, special purpose area spatial plans can set generally binding content for land use and building in protected natural areas, which is mandatory for everyone, irrespective of whether buildings were made for public or private use, or land is public or private (Pantić et al., 2018a). As it is presented through this paper, relations between planning, building, land use and nature protection have been recognized in a few areas of action – from planning and regulation of large infrastructural constructions of national importance (e.g. touristic resorts, supra- and infrastructure, etc.) to rather precise regulation of building and fence height or building materials. At the very precise level, spatial plans define building instructions in a manner usually expected for urban detailed planning, although they are being defined for areas outside of cities.

Recognition and statement of different environmental problems caused by the human activity is one of the efforts of spatial planners to raise awareness on diverse issues, if not broader, then within the professionals involved in development, decision-making and

governance. Parallel consideration of several zoning criteria and relativisation of conflicts between nature protection and development – level of protection regime and land use – represent the foundation in the planning process, which also shows that planning for naturally valuable areas is the main precondition in creation of special purpose area spatial plans. By following sustainability and other postulates based on the sustainability, planning practice puts effort in order to reach balance between the protection and development, so to keep values and identity of countryside and nature in Serbia. In spite of the efforts, there are the cases when interventions and investments in space bring only short-term benefits, but at the expense of long-term damages. It is not necessarily about unsuccessful planning, but about poor implementation and partiality in decision-making process (Milijić, 2015). However, lessons should be learned and future planning should emphasize potential negative consequences that interventions in fragile natural surrounding could cause and define instructions for the implementation phase as precisely as possible.

It is easier to understand identification of a great number of illegally built structures in the protected areas that have been put under the protection just recently. But, it is alarming to notice that each spatial plan analysed here states the same problem even though some of the areas have been under protection and regulated by spatial and urban plans for decades. As it was identified in other sources (Bryson, 1993; Pantić, 2014; Pantić et al., 2018b), the absence of implementation of spatial plans – their regulations and measures – is the problem, and not the absence of planning documents. Therefore, it is of a crucial relevance to point out the gap between planning and realization of plans – the field where is the most expected from the governance at the national and at the local level. Only after awareness on the problem is raised among professionals and local communities, responsible actions and support can be expected from citizens themselves. One of the most operational tools recommended by analysed documents is enforcement of the inspection sector. In summary, the role of spatial planning is decisive for development of protected natural areas in Serbia, but it is not the action where development ends. In contrary, an adoption of a spatial plan represents only an initial phase and foundation that further on must be completed and upbuilt by plans at a lower hierarchy level, responsible implementation, inspection and monitoring.

Spatial planning and SPASPs are based on about 20 recognizable postulates that are clearly addressed in the analysed spatial planning documents. The postulates are prevailingly directed towards the relation between the spatial planning and protected natural areas, by embracing a group of general postulates such as sustainability, postulates that accentuate the need for balancing between the development and nature protection, postulates that reflect the nature protection particularly in building and construction processes and finally the group of thematically scattered postulates. Based on the postulates, SPASPs define both general and very specific regulations that are aimed to control land use and building in protected nature areas. The general framework for the land use is given through zoning (protection zones and area types), while concrete building rules are set through very precise obligations regarding areal, parcel, main object and complementary object dimensions (height, width, mutual distances, etc.). With that level of thoroughness joined with continuous improvement of practice, SPASPs as tool for balancing between the land use and building and nature protection in protected natural areas would be sufficient only if the set measures and rules are not omitted or purposely

ignored in the phase of implementation. Therefore, in spite of the fact that protected natural areas in Serbia are integrated into spatial planning on several levels – from the most general to the very precise – its efficiency in limiting development to a harmless extent for natural sustainability depends also on other relevant instances such as awareness, responsibility and timely inspection.

Acknowledgement. *The paper is a part of the research done within the projects No. III 47014 and TR 36036, financed by the Republic of Serbia Ministry of Education, Science and Technological Development in the period 2011–2019.*

REFERENCES

1. Belokurov, A., Dudley, N., Krueger, L., Lopoukhine, N., MacKinnon, K., Sandwith, T., Sekhran, N., Stolton, S. "Natural Solutions: Protected Areas Helping People Cope with Climate Change". Imprint WWF International. 2010.
2. Bergandi, D., Blandin, P. "From the Protection of Nature to Sustainable Development: The Genesis of an Ethical and Political Oxymoron", Revue d'histoire des sciences, 2012/1 Vol. 65, Armand Colin, 2012. pp, 103-142.
3. Bryson, M. J., Bromiley, P. "Critical Factors Affecting the Planning and Implementation of Major Projects". Wiley Online Library. 1993. Retrieved from: doi.org/10.1002/smj.4250140502 (accessed in October 2018).
4. Danilović Hristić, N., Stefanović, N. and Petrić, J. "Opportunities for Development of Tourist Potentials in Protected Areas of the Water Storage Reservoirs, on the Example of Spatial Plans of the Special Purpose Areas in Serbia". Facta Universitatis Series: Architecture and Civil Engineering Vol. 16, No 3, 2018. pp. 489-500. Doi.org/10.2298/FUACE181019024D.
5. Eagles, P.F.J., McCool, S. F. and Haynes, C. D.A. "Sustainable Tourism in Protected Areas: Guidelines for Planning and Management". IUCN Gland, Switzerland and Cambridge, UK. 2002.
6. HABIT CHANGE "Management Handbook: A Guideline to Adapt Protected Area Management to Climate Change". Project implemented through the CENTRAL EUROPE Programme, co-financed by the ERDF. 2013.
7. Institute for Nature Conservation of Serbia (Zavod za zaštitu prirode Srbije) (2018), www.zzps.rs (accessed in September 2018).
8. Law on National Parks (Zakon o nacionalnim parkovima) (2015), Official Gazette of the Republic of Serbia No. 84/2015.
9. Law on Nature Protection (Zakon o zaštiti prirode) (2009/2016), Official Gazette of the Republic of Serbia No. 36/2009, last amended in 14/2016.
10. Law on Planning and Construction (Zakon o planiranju i izgradnji), Official Gazette of the Republic of Serbia No. 72/2009, 81/2009 - corr., 64/2010 – Constitutional Court decision, 24/2011, 121/2012, 42/2013 - Constitutional Court decision, 50/2013 - Constitutional Court decision, 98/2013 - Constitutional Court decision, 132/2014, 145/2014.
11. Marty, C. "Climate Change and Show Cover in the European Alps", in Ronaldo, A., Rixen, C. (eds.) Impacts of Skiing and Related Winter Recreational Activities on Mountain Environments, Bentham, 2013. pp. 30-44.
12. Milijić, S. "Sustainable Mountain Area Development in Serbia (Održivi razvoj planinskih područja Srbije)", Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade. 2015.
13. Order on Protection Regimes (Uredba o režimima zaštite) (2012a), Official Gazette No. 31/2012.
14. Pantić, M. "Sustainable Development Perspectives for Serbian Mountain Areas: Lessons from the European Concept", (Doctoral thesis). 2014. Retrieved from QUCOSA - Quality Content of Saxony, (urn:nbn:de:bsz:14-qucosa-144339), http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-144339.
15. Pantić, M., Milijić, S. and Živanović Miljković, J. "Spatial Planning as a Land-Use and Building Regulation Tool for Protected Natural Areas in Serbia". In P. Mitković (Ed.), ICUP2018 2nd International Conference on Urban Planning – Proceedings (331-338). Niš, Serbia: Faculty of Civil Engineering and Architecture, University of Nis, 2018a, pp. 331-338.

16. Pantić, M., Nenković-Riznić, M., and Milijić, S. "Participatory Approach for Innovation in Spatial Planning Process in the Context of Climate Change in Serbia". Presented at the poster session at the MedCLIVAR2018 Conference in Belgrade. 2018b.
17. Ranganathan, J. "Promoting Development, Protecting Environment". World Resources Institute web site. 2010. Retrieved from: www.wri.org/blog/2010/02/promoting-development-protectingenvironment (accessed in October 2018).
18. Ristić, R., Vasiljević, N., Radić, B. and Radivojević, S. "Degradation of Landscape in Serbia Ski Resorts – Aspects of Scale and Transfer of Impacts", Spatium International Review No 20, 2009. pp. 49-52.
19. Sayer, J., Elliot, C., Maginnis, S. "Protect, Manage and Restore. Conserving Forests in MultiFunctional Landscapes", in the Congress Proceedings: World Forestry Congress XII – Forests, Source of Life. Quebec, Canada. 2003. Retrieved from: www.fao.org/forestry/87724/en/ (October 2018).
20. Spatial Plan of the Republic of Serbia (Prostorni plan Republike Srbije) (2010), Ministry for Environment and Spatial Planning of Republic of Serbia, Official Gazette of the Republic of Serbia No. 88/2010.
21. Special Purpose Area Spatial Plan for Gornje Podunavlje Special Nature Reserve (Prostorni plan područja posebne namene specijalnog rezervata prirode 'Gornje Podunavlje') (2012b): Official Gazette of the Vojvodina Autonomous Region, No. 3/2012.
22. Special Purpose Area Spatial Plan for Kopaonik National Park (Prostorni plan područja posebne namene Nacionalnog parka Kopaonik) (2009), adopted by the Government of the Republic of Serbia, Official Gazette of the Republic of Serbia, No. 95/09.
23. Special Purpose Area Spatial Plan for Kopaonik National Park (Prostorni plan područja posebne namene Nacionalnog parka Kopaonik) (2016), adopted by the Government of the Republic of Serbia, Official Gazette of the Republic of Serbia, No. 89/2016.
24. Special Purpose Area Spatial Plan for the Tisa River Multifunctional Ecological Corridor (Prostorni plan područja posebne namene za Multifunkcionalni ekološki koridor Tise) (2015), Official Gazette of the Vojvodina Autonomous Region, No. 14/2015.
25. Special Purpose Area Spatial Plan for Area of Special Use Vlasina (Prostorni plan područja posebne namene 'Vlasina') (2004), adopted by the Government of the Republic of Serbia, Official Gazette of the Republic of Serbia No. 133/2004.
26. Vujić, P. "Ministarstvo: Zabraniti gradnju mini hidro-elektrana". 2018. Retrieved from: mondo.rs/a1137535/Info/Drustvo/Mini-hidro-elektrane-gradnja-Ministarstvo-ekologije-protivMHE.html (accessed October 2018).
27. Živanović Miljković, J. "Urban Land Use Regulation in Serbia: An Analysis of Its Effects on Property Rights", in: Jean-Claude Bolay, Tamara Maričić and Slavka Zeković (Eds.) A Support to Urban Development Process, EPFL and IAUS, 2018. pp. 129-147.

KORIŠĆENJE ZEMLJIŠTA I KONTROLA GRAĐENJA NA PRIMERU PROSTORNIH PLANOVA ZAŠTIĆENIH PRIRODNIH PODRUČJA U SRBIJI

Korišćenje zemljišta i kontrola građenja u okviru zaštićenih prirodnih područja u Srbiji nose specifičnosti u odnosu na područja koja ne nose ovaj status. S obzirom da su pravila i uslovi definisani urbanističkim planovima ograničeni na gradska naselja i lokacije od nacionalnog značaja (npr. turistički centar u zaštićenim područjima), ostala područja, uključujući veće delove zaštićenih prirodnih područja, oslanjaju se na prostorne planove, koji često sadrže i detaljnu razradu sa pravilima uređenja i građenja. Prioritet u zaštićenim prirodnim područjima je očuvanje ekoloških i drugih funkcija životne sredine (posebno u zonama zastite I i II stepena), ali su ona takođe namenjena i kontrolisanom razvoju u zoni zaštite III stepena. Zbog velike udaljenosti od centara uprave, neretko se dešava u Srbiji da ilegalna gradnja u zaštićenim područjima njih čini osetljivijim i više ugroženim posledicama nelegalnih postupaka.

Iz navedenih razloga, fokus ovog rada je na ulozi sprostornog planiranja u balansiranju između korišćenja zemljišta i gradnje s jedne strane, i zaštite prirode u zaštićenim prirodnim

dobrima s druge strane. Detaljno analizirajući odabrane prostorne planove, ovde je dat složeni pregled različitih pravila, postulata i nivoa zaštite primenjenih u prostornom planiranju. Polazeći od Prostornog plana Repbulike Srbije od 2010-2020. godine, ova analiza daje presudni značaj prostornim planovima područja posebne namene različitih karaktera: specijalnom rezervatu prirode Gornje Podunavlje, multifunkcionalnom ekološkom koridoru reke Tise, nacionalnom parku Kopaonik i predelu izuzetnih odlika Vlasina. Naposletku, ovde je prikazana raznolikost i sistematazacija postojećih mera, kao i dati doprinos razumevanju izazova i preporuke za buduće unapređenje metodologije u planiranju i implementaciji planova s ciljem unapređenja ravnoteže između razvoja i zaštite.

Ključne reči: *prostorno planiranje, zaštićena prirodna područja, korišćenje zemljišta, pravila građenja, Srbija*

FACTA UNIVERSITATIS
Series: **Architecture and Civil Engineering** Vol. 17, N^{o} 2, 2019, pp. 189-203
https://doi.org/10.2298/FUACE190316011C

GREEN INFRASTRUCTURE EVALUATION MODEL: CASE STUDY OF BELGRADE

UDC 711.4:502.12(497.11BEOGRAD)

Marija Cvetković, Ivan Simić, Vladimir Mihajlov

Department of Urban Planning University of Belgrade, Serbia

Abstract. *In this article, we consider possibilities to apply green infrastructure as an urban planning approach that provides polyvalent space for ecosystem services and human well-being and evaluates their impact on the city (re)generative space of biophilia. Two residential areas in Belgrade (block 45 in New Belgrade and Savamala neighborhood in the old city center) will be used as the focus of the research presented in this article. Even though they are characterized by different ecological, urban, morphological and social characteristics, they share direct contact with Sava River. Therefore, the adaptive potential of these spatial segments will be the subject of the analysis presented in this article, and the emphasis will be on applying and evaluating design within the integrated network of green infrastructure, and the study will determine what impact it has to planning and implementation of elements of green infrastructure.*

Key words: *Evaluation model, green infrastructure, environmental planning and design, the ecosystem approach, biophilia, Blocks 45, Savamala.*

1. INTRODUCTION

Unlike natural ecosystems, urban systems create large ecological footprint that reflects in degradation of natural habitats, as well as in the loss of biodiversity and ecosystem services (Alberti, 1999). The urban heat island effect and disturbance of the natural runoff of water impair the quality of life and desirable positive effects of open public and private spaces (Gill et al., 2007). The value base of planning paradigm was altered by the new discourses of ecology. The ecosystem approach to planning in the framework of integrated socio-ecological system implies attaining human well-being, in which integrated social elements can be viewed as distinct types of physical and biological components (Pickett and Cadenasso, 2004). This approach is based on the principles of multi-scalability, hierarchical structure of ecosystems, the relation elements-processes, connectivity and spatial continuity (Pickett and Cadenasso,

Received March 16, 2019 / Accepted July 31, 2019
Corresponding author: Marija Cvetković
Department of Urban Planning University of Belgrade - Faculty of Architecture, Kralja Aleksandra Blvd, 73/2, Belgrade 11000, Serbia
E-mail: marija.cvetkovic@arh.bg.ac.rs

2004; Ahern, 2007). Studies show that the ecosystem services are essential to the survival of wildlife on Earth, according to that they are also essential for people and their well-being (Ahern, 2007; Irvine et al., 2010). As part of discourse, the term green infrastructure (hereinafter GI) appears as a new-planning and design concept that supports a set of ecological and cultural functions, contributes to better health and well-being of people (Ahern, 2007; Irvine et al., 2010; Lafortezza et al., 2013; Zaręba 2014).

The main subject of this paper are the possibilities of applying the concept of GI in the area of urban structures of Belgrade and evaluating their impact on cities green infrastructure. The study will address the possibilities of implementation of its spatial elements at neighbourhood/district level and linking them with Belgrade's green core as its main component at a higher city level. Two urban areas of Belgrade were taken for case studies: Block 45 in New Belgrade and Savamala in the old town, as representatives of two different models of urban structure, both located right next to the Sava River, the main green-blue corridor of the city. The study will determine what consequences it has for planning and implementation of elements of GI. The paper will also explore the potential of the informal greening of urban areas as a result of spontaneous activities of citizens and associations at the local level. These links also acquire a different format depending on the model of urban structure. The article will explore the capacity and compatibility of informal greening so that it could be integrated with the planned network of GI and thus successfully completed, as well as explore the potential of the informal greening of urban areas as a result of spontaneous activities of citizens and associations at the local level.

Informal green areas can be the result of different individual or collective actions, both located on the private, as well as the common or public area. Also, they are diverse in terms of their spatial configuration and relation to the built and natural elements of surrounding, and thus to the components that constitute the green infrastructure. However, the physical level, which is linked to the neighbourhood-district or individual land/ building is common to all forms of informal greening. The basic assumption is that the forms of development of the urban areas establish mutually different relationships with the corresponding elements of GI, which primarily refers to those elements of GI at lower spatial levels of a neighborhood/ district. The impact of community greening on the quality of local GI will be identified by comparing the green areas exposed to two different types of cultivation and maintenance—non-institutional (community greening) and institutional (provided by the public company). The analysis should provide data which will show the different impact of both approaches. These spontaneously formed processes will be analyzed in order to examine the possibilities for inclusion in the strategy and action.

With its autonomous informal adaptation the green area generated by tenants, local community or association can be considered a significant component of GI as a part of future greening urban plan concept at local level. Informal greening spaces, like GI, have ecological and psychological significance and they are an important factor of human well-being because, like GI, they have ecological, physiological and psychological importance. Considering functionalist and traditional city models of urban structures, these informal activities of greening acquire distinct features that can be categorized by type, size, purpose and ownership of the site, type of greening, initiating actors, and the opportunity for integration into the GI system, accordingly giving the assessment model. Elements of informal greenery contribute to ecological, economic and role in human well-being (Irvine et al., 2010), and as such they are eligible to become a part of the formal, strategically planned

network of GI. The importance of informal greening activities is reflected in their potential to induce changes at higher spatial and management levels, which will be transferred to, and influence the formal strategies and plans concerning the GI. As stated in Kinzig et al. (2005) as people modifying and responding to biodiversity at local scales in public green spaces and private domestic gardens, decisions by local authorities can dictate city-wide patterns of built form and conversely green space coverage. Informal activities such as public participation in the greening of urban space is vital for the creation of public green spaces that address multiple issues of quality. Working at local scales and providing meaningful opportunities for involvement may not only facilitate acceptance of what necessarily may be radically different types of spaces but could generate solutions that are more extensive and economical than otherwise might be possible (Irvine and Kaplan, 2001). After the introductory part we will first establish a theoretical framework which defines the basic principles of the GI planning, its objectives, features spacious levels, as well as links to relevant elements of the urban fabric/structure. Then follows a description of the context of the GI planning in Belgrade, the existing researches and planning documents.

We will use three consecutive techniques for the purpose of the case research: Identification of the GI components based on patterns processed using patch-corridor-matrix model (Ahern, 2007); assessment of the problems and potentials of urban areas for application components of GI using Forman's model (Forman, 1995); identification of informal activities of greening and assessment of the potential of such space consisting of analysis, planning, site visits and documentation of the current situation. In the final part, we will compare and evaluate the findings from the case studies and draw conclusions regarding the differences arising from the specific urban areas. They will be formulated so that they can be useful as a guideline for the planning and implementation of GI at urban and local level.

2. Theoretical Framework for Planning and Design Green Infrastructure

The GI planning is based on scientific landscape planning principles including a multi-scaled perspective, recognition of pattern-process interactions, the fundamental importance of connectivity and specific guidelines for planning the spatial configuration of landscapes. It is therefore essential that the structural elements of GI are identified on the basis of patterns landscape. Benedict & McMahon (2002) define GI as an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations. Benedict and McMahon also contend that GI is the ecological framework needed for environmental, social and economic sustainability and that it differs from conventional approaches to open space planning because it looks at conservation values and actions in concert with land development, growth management and built infrastructure planning. Green infrastructure provides environmental services in urban areas, which is a prerequisite for ensuring biodiversity, social and territorial cohesion and sustainable development, and overall human well-being (Lafortezza et al., 2013; Zaręba, 2014). It is possible to establish a high level of accessibility, connectivity and attractiveness of its elements with the residential, work and recreation areas by implementing GI in the selected areas, thus offering the ecological framework necessary for environmental, social and economic sustainability. The multi-scaled includes evaluating and planning of spatial configuration of landscape patterns and ecological processes at multiple scales, and interaction of these patterns and processes (Zaręba, 2014). This analysis typically indicates

key points for physical linkages, where important connections exist, or where connections should be made. In urban environments the appropriate scales are: the metropolitan region or city, the districts or neighbourhoods, and individual sites (Ahern, 2007).

Considering the subject of this work that explores and evaluates the connection of GI and certain models of urban structure, we consider GI in terms of its structure and the elementary units it consists of. For this purpose, we rely on the definition provided by Ortega-Álvarez & MacGregor-Fors (2009) presenting GI in structural terms as components that work together to preserve a network of ecologically and socially supportive locations. Depending on the type of function or service supplied, these sites are elements of GI range in size and shape. In general, two main components of GI are the hubs and links (Benedict and Makmahon, 2002). Hubs can contain sub-elements such as nature reserves, parks and open spaces, forests and agricultural land. Links are connections that include green corridors and green belts that connect ecosystems, enabling the flow of ecological processes (Williamson, 2003). Although these elements are precisely defined spatial entities, in nature there are no sharp boundaries.

The method that we applied to two case studies consists of three phases: (A) identification of the components GI based on patterns of landscapes; (B) an assessment of resources of the studied urban areas (case studies) for application components of GI; (C) identification and assessment of potential informal green space.

Table 1 Urban landscape elements classified in the Patch-Corridor-Matrix Model sorted by levels; according to Ahern (2007) and Green Infrastructure Guidance (2009).

Scale and Element	Region/ City	District/ Neighborhood	Individual sites/ Buildings
Urban Patches/ Hubs spots	▪ Wetlands ▪ Regional parks ▪ River islands ▪ Park forests ▪ Forests	▪ Parks ▪ Community gardens ▪ Botanic gardens ▪ Cemeteries ▪ Sport fields ▪ Squares	▪ Vacant lots ▪ Individual gardens ▪ Green roofs ▪ Terraces
Urban Corridors/ Lines	▪ Rivers ▪ Canals ▪ Riverways	▪ Drainageways ▪ Roads ▪ Powerlines ▪ inner block lanes ▪ tree alleys	▪ Green roofs ▪ Individual trees ▪ Vertical gardens
Urban Matrix		▪ Residential Neighborhoods ▪ Industrial Districts ▪ Waste disposal Areas ▪ Commercial Areas ▪ Mixed use Districts	

(A) The two case studies in this work will refer to the patch-corridor-matrix model developed by Richard Forman (1995) for the purposes of describing and understanding the spatial configuration of landscapes and identifying its fundamental elements. This is a convenient and widely recognized model for structural categorization and mapping of landscape mosaics from and universally accepted in the field of applied landscape ecology (Forman, 1995; Ahern, 2007). According to this model, there are three fundamental landscape elements - spatial components that define landscape structure: patches, corridors, and the matrix. Patches provide multiple functions including wildlife habitat, aquifer recharge areas, or sources and sinks for species or nutrients (Ahern, 2007). Corridors are

linear landscape elements that can be defined on the basis of structure or function. Forman and Godron (1986) define corridors from the structural basis as "narrow strips of land which differ from the matrix on either side. Corridors are linear landscape elements that can be defined on the basis of structure or function and they serve many functions within the landscape including habitat for wildlife, pathways or conduits for the movement of plants, animals, nutrients, and wind, or as barriers to such movement (Ahern, 2007). The matrix is the dominant land cover type in terms of area, a degree of connectivity and continuity, and control that is exerted over the dynamics of the landscape (Forman, 1995; Forman and Godron, 1986). Table 1 provides urban landscape elements classified in the Patch-Corridor-Matrix Model sorted by levels (Ahern, 2007; GI Guidance, 2009). As spatial information base for identification of landscape elements, we use the map of the current situation of biotopes of Belgrade, which is a part of the "Green regulation of Belgrade" and belongs to the official planning documents at the level of a city.

(B) To evaluate the potential of urban fields (case studies), we will use Forman's landscape planning rules for the implementation of GI elements, which recognize the fundamental, so-called 'Indispensable' patterns and their interrelationships: (1) a few large patches of natural vegetation; (2) major steam or river corridor; (3) connectivity with corridors and stepping stones between large patches; (4) heterogeneous bits of nature across the urban matrix. (Figure 1). These indispensable patterns are equally relevant in urban environments as they are in landscapes that are less dominated by human development and built infrastructure. Forman argues that these patterns are fundamental, for without them specific ecological functions will not be supported (Forman, 1995).

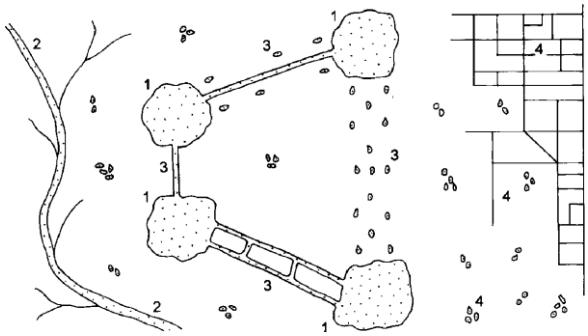


Fig. 1 Top-priority ecological 'indispensables' in planning a landscape (Forman, 1995).

(C) In the analysis, we will pay particular attention to the importance and role of informal activities that produce 'bits of nature' greening elements within the urban matrix. According to Forman's guidelines 'bits of nature' are one of four essential patterns in the planning of the urban landscape. Bits of nature within the urban matrix play a crucial role in ensuring a higher degree of connectivity of the entire urban landscape (Forman, 1995). These are a line or dot elements of GI at the local levels of neighbourhood/district and individual plots/structure (Table 1).

All three listed phases require identifying the issue and the potential for achieving Forman principles of landscape planning concerning the existence of all the essential elements, as well as a spatial configuration allowing the required connectivity. Previous studies (Djordjević, 2008; Popović, 2009; Radulović *et al.*, 2015) and measurements conducted on the territory of Belgrade revealed the negative effects of climate change on the ecological balance, as well as well-being of the community. Therefore, the adoption of climate adaptation and mitigation strategies became necessary (Cvejić, 2011). However, Marić *et al.* (2015) presented that there are no registered activities in the domain of investigation of the effects of green infrastructure in the context of climate change and its quantification in the Republic of Serbia. Current inaction has left numerous consequences on city biophilia - from environmental pollution, unsustainable use of natural resources, to the negative impact that further enhances the effect of climate change (Cvejić *et al.*, 2014). Serbian policies of spatial and urban planning do not consider the relation between the process of urbanization and the causes/effects of climate change correspondingly (Simić et al., 2017).

3. CASE STUDIES: BLOCK 45 AND SAVAMALA

Areas around the rivers Danube and Sava, with GI networks - islets, riverbank parks, foreland, lakes, ponds and wetlands that are located right next to them are called natural core areas of Belgrade (Belgrade green regulation 2003; City of Belgrade development strategy, 2011). The evaluation of selected units is based on several criteria defined in the Green Regulation of Belgrade: in the Green Regulation of Belgrade: the ratio of pervious surfaces, share of evapotranspirational surfaces, areas under treetops, vegetation structure of biotopes, multi-functionality, visual quality, as well as the condition of cultivation and maintenance. (Simić et al., 2017) All selected criteria provide a sufficient set for the evaluation of the condition and quality of GI before and after community greening. The banks and the riverside are recognized as important but underutilized areas of the city, and its specific location within the urban structure provides different possibilities of implementing the concept of GI. Therefore, the river Sava, as a green-blue corridor with urban areas that are directly related thereto, is taken as a testing ground for the analyses of the possibilities for the implementation of GI. Two Belgrade urban dwelling areas on the banks of Sava River-New Belgrade's Block 45 and Savamala were selected for the case study. What is common for these two urban areas is their position in relation to the green core of the city and the city's main green and blue corridors - Sava River with its coastline (Figure 2). Also, what they have in common are the identical standards that should be achieved in terms of adaptability to climate change and environmental quality. However, being related to two epochs of Belgrade's development that caused also their morphological differences, hence different problems in compatibility with functions of the city and its ecology (Sztumski, 2013). These morphological differences require problem based approaches to planning and designing of GI.

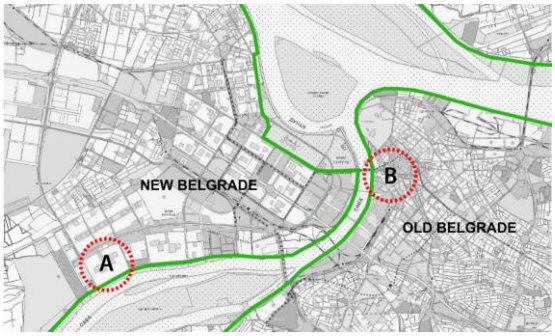


Fig. 2 Position of block 45 (A) and Savamala (B) in relation to green core of Belgrade and River Sava. (author: I. Simić)

The Belgrade Master Plan (2003) identifies this distinctive and extensive region of green and blue corridors as a "green core of Belgrade," which involves regions below the Danube and Sava river courses with GI elements corresponding to the region / city spatial level: river islands, coastal parks, forelands, lakes, ponds and marshes that are located right next to them. “Green core of Belgrade” makes the planning and conceptual basis for the planning of GI in the broader spatial levels such as region and city. For now, strategies and plans at the city and local level do not recognize sufficiently the principles of GI planning, such as multi-scalability, relations structures of the processes, connectivity and ecosystem services. The importance of GI is identified/recognized the most in terms of its role in adaptation and mitigation to climate change, in the form of action plans. The city of Belgrade in early 2015 adopted the Action Plan for Climate Change Adaptation in which as a measure of the highest priority was listed the planning and implementation of GI networks throughout the territory of the city, based on the concept defined in the Green Regulation of Belgrade (2003). In this way, spatial and urban planning at the level of town and municipality gradually turns to the preferred ecosystem approach to planning. However, in order to successfully implement GI at the local level, regulations and plans must contain information on the structural and functional properties that green spaces must have in order to integrate with components of GI at higher spatial levels, in the case of Belgrade with its “green core”.

3.1. Block 45

Block 45 is located in the municipality of New Belgrade, first among Belgrade municipalities across the surface of the intra-block greens (396.6 hectares). The block of 32,000 inhabitants occupies a strip of land on the left bank of the Sava River, implemented as a unique urban entity at the level of the extended local community. The block is divided into a southern and a northern part. There are 21 planned buildings in the southern half, lower levels from GF + 2 to GF + 4 in the form of semi-atrium houses opened and oriented towards the river. In the northern half, it was planned to construct 45 high-storey buildings (GF+7 to GF+15). Green areas are planned as a park and recreational area, as required by the principles of Le Corbusier town planning on which New Belgrade was conceived, complementing the built facilities that are ' immersed in the greenery'. Despite the large planned areas dedicated to greenery (norm of 22m² of green space per inhabitant is required), it remains insufficiently defined and with no clear differences in relation to other areas for public use. During the last decade, climate change and adaptation strategies promoted the importance of the issue of green space. The definition of public interest, i.e.

public land and area for new development, becomes the key to New Belgrade's urban planning, as well as the reconstruction and differentiation of green spaces in the elements that make up the GI network. The draft of a detailed regulation plan for blocks 45 and 70[1] in 2009 specified new values which include, inter alia, "the preservation and improvement of the achieved high standards of living and understanding the emerging needs of the population". Only within this set of priorities in urban and regulatory plans could be talking about the implementation of strategies and action plans which include the implementation of GI. In terms of the development of GI, the Action Plan for Climate Change Adaptation (2015) provides for the development of a network of green corridors along the promenade Lazara Kardenasa that connects residents of the city with the Sava river. Their role will be linked to the cooling air by evaporation, primarily through the avenue and small groups of trees. Setting permeable paving to reduce the outflow of atmospheric water, and the construction of canals and retention ponds along the dikes and banks increases the potential drainage system in flood prevention. At the level of structures, one of the possible interventions would be the introduction of green roofs and walls, while on the level of spatial units were highlighted: the use of local plant species (including edible plants), the preservation and improvement of urban forestation, as well as promoting the concept of ecological park. At the local community level activities would be aimed at spreading environmental ideas and lifestyle, relying on the already observed trend of urban gardening among the residents of blocks. Thus, their attention would not be focused exclusively on the private gardens, but also to stimulate the past practice of self-organization and self-initiated refining of free and green surfaces in the immediate environment of buildings.

We identified the basic elements of the area in the territory based on the patch-corridor-matrix model and the biotope map of Belgrade. (Figure 3a) on the basis of which we will identify the components of GI and their inter-relations using Forman's model. In the immediate surroundings of the block, on its west and east, there are five major patches (P1, P2, P6, P7 and P8) composed of potentially valuable biotopes extensively used and with rich structure (biotope map of Belgrade, 2007). According to their purpose, these are free public spaces covered with greenery (P1, P2, P8) or intra-block green areas (P6 and P7). Within the block, there are three patches small and medium-sized (P3, P4, P5) in potential also worthy biotopes with rich structure. Concerning the purpose, these patches are intra-block greenery. Corridors in the area of the block (C1, C2, C3 and C4) can be divided according to their importance into broader city (C1, C2), local (C3, C4) and intra-block. Within the block, there are three intra-block corridors (C3, C4, C5) whose purpose is pedestrian communication and connecting the block with the main green-blue corridor (C1).

Block 45 consists of two types of urban matrix: a matrix of 45 residential skyscrapers in the northern part of the block. (GF+7 to GF+15) which are arranged in a chessboard pattern. The areas between the skyscrapers are fragmented and designed for green areas, parking lot, children's playgrounds and vehicular and pedestrian communication; matrix of the southern part of the block, which consists of semi-atrium residential buildings oriented towards the river in north-south direction). In terms of the criteria of the presence of the river corridor, block 45 is in direct contact with the Sava banks, which is the part of the main green-blue urban corridor. The northern and the southern parts of the block differ in the built form, primarily in the type of residential buildings – the northern part consists of free-standing skyscrapers, whereas the southern part consists of semi-atrium buildings with a smaller number of floors.

[1] Block 70 is built with the similar urban structure as Block 45.

Two distinct urban matrixes caused the different greenery configuration: in the northern part it appears in the form of smaller park areas, with a narrow strip of greenery around the building or smaller residual areas around playgrounds and parking lots; in the southern part, green areas are less fragmented and consist of smaller park areas and greenery surrounded by a semi-atrium form of building. The apartments on the ground floor of these buildings own a narrow strip of green area, which is private property, while the remaining majority is the public green area mainly covered primarily by trees and bushes. Both urban matrixes of the block 45 have characteristic shapes bits of nature, which were created as a combination of the mentioned urban-morphological characteristics, as well as informal activities of greening initiated by dwellers. Given the importance of the bits of nature for the overall connectivity of the urban matrix, it is necessary to pay special attention to them. With informal activities, dwellers contribute to the impression that semi-atriums are a private or common space designed primarily for their needs. This informal greening transforms the semi-atrium area into very diverse and rich bits of nature (Figure 3c). Using Forman's criteria, the so called indispensable patterns of urban area, we are able to examine the potentials of the elements of the area to form a favourable spatial configuration of GI. The area in its immediate surrounding has several large patches of natural vegetation (Figure 3a, P1, P2, P7, P8) which, according to the structure of the biotope belong to 'complex, structurally rich fallow lands with mosaic arrangement of vegetation of different stages of succession' (biotope map of Belgrade, 2007). In the northern matrix of the block, informal greening is not as diverse as in the southern, primarily because of the high fragmentation of open areas due to dense and dispersed arrangement of skyscrapers and concrete areas, such as parking lots and playgrounds. The buildings and residual areas around parking lots and playgrounds reduce greenery to a narrow strip. However, dwellers' interest in individual greening is equally high, it is mainly expressed through the cultivation of flowers and low bushy vegetation such as hedges (Figure 3b).

For the planning and design of future GI, above recognized bits of nature transformed by informal activities are of great significance because it connects the levels of micro and macro, blocks with riverside areas and rivers, offering continuity of greenery. This is very significant for block inhabitants as it offers constant protection against elevated temperatures and sunlight, creating an integral space of rich biodiversity and connectivity of habitat for plant and animal species.

Fig. 3 Elements of GI (3a), bits of nature north urban matrix (3b), bits of nature south urban matrix (3c). (author: I. Simić)

3.2. Savamala

Savamala is the central urban area of Belgrade, covering an area of the two city municipalities- Savski Venac and Stari Grad. It is located on a slope along the left bank of the Sava. Savamala is bounded in the east by street Gavrilo Princip, and in the west its natural border is the river Sava. In the middle of 19th century Prince Miloš Obrenović set the direction of development of this part of town ordering traders to relocate their stores to Savamala, in future Abadžijska bazaar, as the new commercial zone and downtown area of Belgrade. People who lived and worked at that time of prosperity in Savamala were depended on the interaction with river since the goods for stores were supplied from ships to the docks of Sava river. The connection between residents of Savamala and river achieved its peak during the development of commercial zone and the construction of representative elite buildings in Karadjordjeva Street, but was interrupted by construction of the railway station and the railway in the early 20th century. During the 20th century, Savamala lost its significance and Karadjordjeva Street got traffic characteristics by becoming a transit zone. This leads to gradual degradation of its urban and environmental quality. Namely, the cutting of flux of people and greenery between the two lines - the Sava river and Karadjordjeva Street - proved to be a key issue in the development of Savamala. Although ideas on the relocation of the railway station and railway, as well as the relief of road traffic have existed since the Master Plan of Belgrade in 1972, they have not been achieved yet. However, construction of the station "Prokop" and relocation of the existing railway station would open the possibility to re-establish a vital relationship Savamala – riverbank. In recent years it became evident that there has been a resurgence of interest in this part of the city, since its degraded state is now perceived as a challenge for reactivation, especially in the civil sector, cultural and artistic circles.

Savamala is classified in plans as continuously built urban fabric, which consists of the traditional city block as the elementary unit (Master Plan of Belgrade to 2021). Along Karadjordjeva street, it is homogeneous and consists of GF+4 to GF+6 storey buildings which form a continuous street front. In the zone along the riverbanks, the urban fabric is discontinuously constructed with a combination of low-rise city block and service and storage facilities. Regarding the planning treatment of green areas of Savamala at the local level, it is only partial. While it is recognized as an urban district, it extends over the territory of two municipalities. The part in the municipality of Savski venac is covered by Local environmental action plan (LEAP, 2010) which suggests "starting plans and projects related to the oldest urban part of Belgrade-Savamala" and launching "the current relocation plan of the railway station and repurpose of Sava amphitheatre." The plan is based on the projects "Belgrade green regulation" (2003) and "Mapping and evaluating biotopes of Belgrade" (2007), which established the concept of planning of green areas, which corresponds to the concept of GI, i.e. on biotope mapping, biodiversity and ecosystem functions which a network of greenery should take. LEAP defines the basic aims, among other things, the introduction of GIS (geographical information system) of green areas and "raising the modern forms of green areas such as 'pocket parks', roof and vertical greenery and others." (LEAP, 2007). The aims also include "open cooperation with citizens, private and non-governmental organizations and their participation in decision-making about the planning of green areas" as well as "organizing forums, exhibitions, advertising material on the importance of green areas for the quality of life in the city" (ibid).

Based on Belgrade's patch-corridor-matrix model and biotope map, we have recognized the basic elements of the area in the territory (Figure 4) on the basis of which we will define the components of GI and their inter-relations using the Forman's model. On the territory of

Savamala we recognized six major patches (P1, P2, P3, P4, P5, P6), of which P2, P5 and P6 belong to the park greenery, P1 to intra-block greenery, P3 to square and P4 to greenery along the road. The structure of their biotopes is diverse: green areas under trees and shrubs less than 50 percent (P2, P6), a complex structurally rich fallow land (P4), green areas under trees and shrubs more than 50 percent (P5) and micro-complex mosaically arranged biotopes with the participation of built surface less than 50 percent (P1).

In this densely built urban structure, streets have the corridor function and their green potential is reflected in the tree coverage percentage, water-absorbing areas and surface water drainage system. However, the current situation indicates almost entirely untapped potential in the first place in terms of rows of trees, although there is available space for them. The main street corridor is Karadjordjeva Street (C1) with a wider urban character. The connection between Karadjordjeva street and the Sava banks is achieved by a network of smaller street corridors (C2-C7): Hercegovačka, Braće Krsmanović, Mostarska, Zvornička and Železnička streets. It should be noted that the railroad blocks direct contact of river corridors with the riverbanks.

Savamala urban matrix is defined by a densely built closed block structure, a high percentage of asphalt and other waterproof surfaces, which implies fragmentation and low biotope diversity. Bits of nature are primarily limited to the block areas. However, there has been a recent trend of informal greening in the form of collective actions initiated by local organizations. Within Mikser festival "Blue-green dream" project is organized, which brings together the local community and professionals participating in the greening of public spaces, planting rows of trees, individual trees and placing of urban furniture for horticulture (Figures 4a, 4b). Public workshop on urban gardening “Zdravamala” (Figure 4d) was held within the "Spanish house" which is currently used as an informal public space (Zdravamala, 2014). The participatory workshop "My piece of Savamala" (2015), which addressed the new solution for free public space in Karadjordjeva Street, was held in the organization of "Mixer House" and "Urban Guerrilla". This action has implemented a method of participatory design by involving various actors - the local people, experts in the field of urban planning, architecture, ecology and engineering, as well as city and local authorities (Figure 4e).

Fig. 4 Elements of GI (4a), “Blue-green dream” (4b, 4c), “Zdravamala” (4d), “My piece of Savamala” (4e). (author: I. Simić)

4. CONCLUDING REMARKS

In the cases of two urban areas of Belgrade - Belgrade's Block 45 and the territory of Savamala, two urban areas of Belgrade located right next to the river bank and the Sava River and creating the main blue-green corridor at regional/city level - the possibility for green infrastructure has been explored, as a modern concept that combines ecological and social benefits in areas of high ecological diversity, and plans and projects in accordance with the principles of biophilic design. Although in a similar position in relation to the river, these areas represent entirely different models of urban structure - Block 45 is representative of the "functionalist" model of the city, it is characterized by a spacious, open and green space, but not sufficiently differentiated and maintained, while Savamala is a typical traditional urban structure of the old city centre, as the central city area of turbulent urban development. These implied different conditions for the development of green spaces: Green regulation of Belgrade treated area of the block 45 as an integral part of the internal ring of greenery and green core, while Savamala is treated as a part of a continuously built urban area with the lowest percentage of green space. Because of these contrasting conditions in terms of green spaces, planning of GI at the local level requires different approaches. Therefore, the research put emphasis on the study of spatial context, the specific problems of urban structure that challenges actions of GI implementation.

We have recognized informal greening activities, their spatial patterns, actors and objectives and potential role in the network of GI. We have recognized this type of greening as "bits of nature" referring to the model of Forman's "indispensable ecological patterns". We pointed out the importance of these elements for increasing the overall connectivity of the urban matrix in which they are located, and thus the overall connectivity of GI at the local level. Research showed that informal greening could take a very diverse spatial pattern, and it is different by the character of a private/public and individual/collective. As expected, two case studies have shown very different forms of informal greening, but it can be concluded that both play an equally significant role as bits of nature across the urban matrix, increasing the overall connectivity of urban matrix in relation to other elements of GI at the local level.

Block 45 is an urban structure with a high percentage of green and open spaces within the block, as well as the nature of similar patches in its immediate surroundings, giving the needed elements of GI a great potential for the development. Planned by the principles of Le Corbusier's modernist city, these areas are well connected with each other and achieve continuous connection with the Sava pier, as the main recreational area of New Belgrade and significant potential for development of green infrastructure network. The inhabitants of blocks are involved in gardening; they cultivate their private gardens, and they also organize themselves on their own initiative and try to enrich their free and green areas in the immediate environment of their facilities. Thereby, this biophilic need for stronger bonding with the immediate natural environment is spontaneously expressed. Building typology determines the type of urban matrix, as well as the type and level of informal greening. It features two types of urban matrix, south and north. The north matrix, with free-standing skyscraper type of housing, has less diverse biotopes and more fragmented structure of green spaces around and between buildings. Informal green spaces are the result of individual or joint activities of tenants in the green areas related to housing. Tenants are self-organized and they modify these areas by planting shrubs and flowers. The south matrix, with greenery in semi-atrium type of housing, brings intense

informal greening of spaces that includes individual gardening on private plots, as well as planting high vegetation in public green space. There is also an interesting phenomenon of "extension" of individual gardening to adjacent public space.

Savamala is a dense and intensively built urban area where parks are main patches, and streets are potential corridors of GI. During the last decade there is a re-affirmation of the region, based on local initiatives in the cultural and creative sectors. Savamala has become a center of cultural events which gradually runs the local population to accept trends of greener lifestyle, biophilia and active participation in the process of developing their living environment. The revival of actions and initiatives related to environmental revitalization and the introduction of a network of green spaces, which are in line with the urban structure of Savamala and its morphology. The questions of reconnecting with the Sava along the river banks is the key to establishing a continuous network of green infrastructure in the traditional core of Belgrade. Informal actions of greening spaces are substantially different in character than the one in block 45. The public spaces such as squares, urban pockets and surfaces along the roads have become the main available space for bits of nature. Unlike the block 45, the main initiators of informal activities in Savamala are locally based organizations. They are organizing inclusive projects and public participatory workshops involving experts, local residents and other stakeholders aiming to improve the public space environmental quality. In the urban matrix of Savamala, these public bits of nature are a key link in connecting all of the components of GI at the local level.

These processes, which started spontaneously and are primarily linked to the informal intervention level, should be engaged in designing and arranging planning strategies, which would raise recorded patterns to a higher spatial and organisational level. Given the need for immediate action to mitigate the impact of carbon-intensive life and enhance overall human well-being it can be concluded that the correct initiatives aimed at the local context show higher flexibility and productivity, and hence their potential, especially in the field of strengthening green infrastructure, must be exploited intensively and facilitated with corresponding actions at the city level.

Acknowledgement. *The article is realized as part of the project "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 within the framework of integrated and interdisciplinary research for the period 2011-2019.*

REFERENCES

1. AHERN, J. 2007, Green infrastructure for cities: The spatial dimension, in: Novotny, V. and Brown, P. (eds.) Cities of the Future Towards Integrated Sustainable Water and Landscape Management. IWA Publishing, London, p. 267-283.
2. Action Plan for Climate Change Adaptation for City of Belgrade, 2015, http://www.beograd.rs/download.php/documents/Akcioni%20plan%20adaptacije%20na%20klimatske%20promene-srp.pdf (28 Apr 2016).
3. Alberti, M. 1999, Urban Patterns and Environmental Performance: What Do We Know?, in: Journal of Planning Education and Research, no.19, p. 151-163.
4. Benedict, M., Mcmahon, E. 2002, Green infrastructure: Smart conservation for the 21st Century. The Conservation Fund and Sprawl Watch Clearinghouse, Arlington, VA.
5. Blue-green dream, 2014, http://www.slideshare.net/NALED/the-story-of-mikser (28th Apr 2016).

6. City of Belgrade development strategy (CBDS) 2011-2016 [Strategija razvoja grada Beograda 2011-2016], 2011, http://www.beograd.rs/download.php/documents/SRGBpredlog.pdf (28th Apr 2016).
7. Cvejić, J. 2010. Local ecological action plan (LEAP) of Savski Venac Municipality (Lokalni Ekološki Akcioni Plan Gradske Opštine Savski Venac). [online] http://www.savskivenac.rs/ekoppt/2010-4.pps (18 May 2016).
8. Cvejić, J., Tutundžić, A., Bobić, A., Radulović, S. 2011. "Zelena infrastruktura: Prilog istraživanju adaptacije gradova na klimatske promene". Ed: Đokić, V., Lazović, Z. (Ed.). Uticaj klimatskih promena na planiranje i projektovanje. Univerzitet u Beogradu, Arhitektonski fakultet.
9. Detailed urban plan of blocks 45 and 70 [Detaljni urbanistički plan bloka 45 i 70], 1966, in: RS Official Gazette, no. 09/11.
10. Forman, R., Godron, M. 1986. Landscape ecology; John Wiley & Sons: New York, NY, USA.
11. Forman, R. 1995, Land Mosaics: The Ecology of Landscapes and Regions, Cambridge University Press, London.
12. Gill, S. E., Handley, J. F., Ennos, A. R., Pauliet, S. 2007, Adapting Cities for Climate Change: The Role of Green Infrastructure, in: Built Environment, vol. 33, no 1, p. 115-133.
13. Green Regulation of Belgrade [Zelena regulativa Beograda], 2003, http://www.urbel.com/documents/zelena_regulativa_beograd.pdf (28th Apr 2016).
14. Green Infrastructure Guidance, 2009, http://publications.naturalengland.org.uk/publication/35033 (10th June 2016).
15. Irvine, K. N., Fuller, R. A., Devine-Wright, P., Tratalos, J., Payne, S. R., Warren, P. H., Lomas, K. J., Gaston, K. J. 2010, Ecological and Psychological Value of Urban Green Space, in: Dimensions of Sustainable City, Future City 2, eds. Jenks, M. and Jones C., Springer, London, p. 215-237.
16. Irvine, K. N., Fuller R. A., Devine-Wright P., Tratalos J., Payne S. R., Warren P. H., Lomas K. J., Gaston K. J., 2010. Ecological and Psychological Value of Urban Green Space. in: Dimensions of Sustainable City, Future City 2, Jenks, M., C. Jones (ed.).. Springer, London.
17. Kinzig, A., Warren, P., Martin, C., Hope, D., Katti, M. 2005, The effects of human socioeconomic status and cultural characteristics on urban patterns of biodiversity. Ecol. Soc.,pp. 10. [online] http://www.ecologyandsociety.org/vol10/iss1/art23/ (17 June 2016).
18. Lafortezza, R., Davies, C., Sanesi, G., Konijnendijk, C. 2013, Green Infrastructure as a tool to support spatial planning in European urban regions, in: iForest 6, p. 102-108, http://www.sisef.it/iforest/contens/?id'ifor0723-006, [2013-03-05]
19. Local ecological action plan (LEAP) of Savski venac municpality [Lokalni ekološki akcioni plan gradske opštine Savski venac], (2009). URL: http://www.savskivenac.rs/ekoppt/2010-4.pps (28th Apr 2016).
20. Mapping and evaluating biotopes of Belgrade [Kartiranje i vrednovanje biotopa Beograda], 2007, http://www.urbel.com/documents/info20-tema.pdf (28th Apr 2016).
21. Marić, I., Crnčević, T., Cvejić, J. 2015 Green infrastructure planning for cooling urban communities: Overview of the contemporary approaches with special reference to Serbian experiences, Spatium, 55-61.
22. Master Plan of Belgrade to 2021 [Urbanistički zavod Beograda, Generalni Plan Beograda 2021], http://www.urbel.com/cms_images/gup1.jpg, (17th Dec 2015).
23. My piece of Savamala - City Guerilla [Moje parče Savamale - Gradska gerila], http://festival.mikser.rs/en/project/my-piece-of-savamala/ (28th Apr 2016).
24. Ortega-Álvarez, R., Macgregor-Fors I. 2009. Living inthe big city: effects of urban land-use on bird communitystructure, diversity, and composition. Landscape and UrbanPlanning, 90: 189–195. (18) (PDF) Parasitism of Bat Flies (Nycteribiidae and Streblidae) on Bats in Urban Environments: Lower Prevalence, Infracommunities, and Specificity. [online] https://www.researchgate.net/publication/330881803_Parasitism_of_Bat_Flies_Nycteribiidae_and_Streblidae_on_Bats_in_Urban_Environments_Lower_Prevalence_Infracommunities_and_Specificity (Jul 30 2019).
25. Pickett, Steward. T. A., Cadenasso, M. L., And Grove, J. M. 2004, Resilient cities: meaning, models, and metaphor for integrating the ecological, socioeconomic, and planning realms, in: Landscape and Urban Planning, no. 69, p. 369–384.
26. Promena klime u Srbiji očekivani uticaji. [online] https://www.sepa.gov.rs/download/EnE09_T_%20Popovic_%20V_DJurdjevic%20i%20dr_Pr%20kl%20u%20Srbija%20i%20uticaji.pdf (Jul 30 2019).
27. Simić, I., Stupar, A., Djokić, V., 2017. Building the Green Infrastructure of Belgrade: The Importance of Community Greening. Sustainability, 9, 1183.
28. Sztumski, W. 2013, Towards the Sustainability of Urban Development, in: Problemy Ekorozwoju/Problems of Sustainable Development, vol.8, no. 2, p. 39-48.
29. Unep & UN Habitat, brochure. (2006) The Climate Change and the Role of Cities. UNEP.

30. Belgrade green regulation, http://www.urbel.com/default.aspx?ID=uzb_ZelenaReg3&LN=S (17th Dec 2015).
31. Williamson, K. S. 2003, Growing with green infrastructure. Heritage Conservancy, Doylestown, PA, USA, pp. 20. [online] http://164.156.7.76/ucmprd2/groups/public/documents/document/dcnr_002286.pdf (16th June 2016).
32. Zaręba, A. 2014, Multifunctional and Multiscale Aspects of Green Infrastructure in Contemporary Research, in: Problemy Ekorozwoju/ Problems of Sustainable Development, vol. 9, no. 121, p. 149-156.
33. Zdravamala, http://urbanincubator.org/portfolio_page/zdravamala/ (28th Apr 2016).Smith, J. J., 2010. Chapter title. Chapter 7 in Publication Name (Eds. A. A. Anderson, B. B. Bridgens and C. C. Conte). Wiley, Chichester. pp 139–164.

MODEL ZA EVALUACIJU ZELENE INFRASTRUKTURE NA PRIMERU BEOGRADA

U ovom radu razmatraju se mogućnosti primene zelene infrastrukture kao pristup urbanističkom planiranju koji obezbeđuje polivalentan prostor za ekosistem kao I za blagostanje ljudi. Takođe se ocenjuje njihov uticaj na gradski (re) generativni prostor biofilije. Kao fokus istraživanja su prikazana dva stambena naselja u Beogradu (Blok 45 na Novom Beogradu I Savamala u starom gradskom jezgru). Iako se odlikuju različitim ekološkim, urbanim, morfološkim I socijalnim karakteristikama, oni imaju direktan kontakt sa rekom Savom. Usled toga će adaptivni potencijal ovih prostornih segmenata biti predmet analize predstavljene u ovom radu, a naglasak je na primeni i oceni dizajna u okviru integrisane mreže zelene infrastrukture. Ovo istraživanje ima za cilj da odredi kakav je uticaj na planiranje I implementaciju elemenata zelene infrastrukture.

Ključne reči: *Model za evaluaciju, zelena infrastruktura, dizajn i planiranje životne sredine, ekosistemski pristup, biofilija, blok 45, Savamala.*

FACTA UNIVERSITATIS
Series: **Architecture and Civil Engineering** Vol. 17, N° 2, 2019, pp. 205-219
https://doi.org/10.2298/FUACE190327012Z

MULTIFUNCTIONAL PUBLIC OPEN SPACES FOR SUSTAINABLE CITIES: CONCEPT AND APPLICATION

UDC 711.4:502.131.1
711.61

Jelena Živković, Ksenija Lalović, Milica Milojević, Ana Nikezić

University of Belgrade – Faculty of Architecture, Belgrade, Serbia

Abstract. *The idea that multifunctional open spaces support sustainable urban development has been widely accepted in theory and intensively used in practice of urban planning and design. It is based on the assumption that multifunctional spaces bring a wider spectrum of environmental, social and economic benefits to urban areas. And yet, multifunctionality of space is still a vague and diffuse concept that needs further clarifications. Besides that, different academic disciplines understand and use this concept in different ways. This makes the application of the concept difficult to assess and manage in relation to different aspects of urban sustainability. Through the literature review, this paper analyses and compares how the concept of multifunctionality is used in various spatial disciplines (urban planning and design, landscape architecture) in order to better understand and relate its different dimensions, applications and expected benefits for sustainable development. Based on this, a new, relational and multidimensional conceptualisation of the multifunctionality of public open spaces is proposed for analysis and assessment of urban design solutions. It is further applied and discussed in relation to students projects from "Ecological urban design studio" from the University of Belgrade Faculty of Architecture, as visions for development of multifunctional public open spaces in modernist mass housing area of "Sava Blocks" in New Belgrade, Serbia.*

Key words: *multifunctionality, public open space, sustainable urban development, urban planning and design*

1. INTRODUCTION

Planning and designing multifunctional spaces is not a new idea, and great vibrant and vital urban spaces all over the world confirm its relevance and significance. Moreover, the concept of multifunctional space is nowadays widely promoted in the context of the sustainable spatial development, assuming that multifunctional spaces may bring a wider

Received March 27, 2019 / Accepted April 22, 2019
Corresponding author: Jelena Živković
University of Belgrade - Faculty of Architecture, Kralja Aleksandra Blvd, 73/2, Belgrade 11000, Serbia
E-mail: j_zivkovic@ptt.rs

spectrum of environmental, social and economic benefits to urban areas and thus contribute to urban sustainability.

Although the concept has been intensively used in spatial and strategic plans and projects at different scales, there is an on-going debate of what multifunctionality is, and how it can be best related to development [1] [2] [3] [4] [5] [6] [7]. These debates on urban and rural change, stress the problem of uncritical and weakly theorised use of the notion of 'multifunctionality', and recognise that the concept is still vague, diffused, and prone to different interpretations [8]. In addition, different academic disciplines understand and use the idea of multifunctionality in different ways, which makes its application difficult to assess and manage in relation to different aspects of sustainable urban development [9] [10].

At the same time, the idea of what urban functions are, changed as well. In the contemporary planning and design theory, the new integrated approaches to spatial development recognise new dimensions of functionality, and affirm the wider meaning of this term. For example, in elaborating her theory of integral urbanism, Nan Elin suggests new functionalities of an urban space that supports urban vitality. In this approach, functionality refers not only to classical urban functions - activities and use of space - but also ecological, emotional, symbolic and spiritual functions of space [11]. Moreover, in the field of landscape planning and architecture, the concepts of ecosystem services and green infrastructure are gaining much attention as a new way of perceiving the relation between nature and culture, attributing to Nature different values for spatial development [12].

In that context, this article aims to contribute to the debate on the meaning and use of concept of multifunctionality for sustainable spatial development, by specifically focusing on public open spaces in urban contexts. In a search for *how to conceptualise multifunctionality of public open spaces to best support urban sustainability*, it first provides a conceptual and theoretical analysis of the meaning and scope of the concept of multifunctionality of spaces in different spatial disciplines (urban planning and design, landscape planning and architecture). The aim of the analysis is to derive and determine various dimensions and different interpretations of the notion of *functionality* of spaces (that further influence how the concept is applied in practice), and to relate them to the concept and aspects of sustainable urban development.

Based on the findings, in the second part of the paper, we argue for relational and multidimensional approach to multifunctionality of space, and develop a new analytical framework for reading and evaluating multifunctionality of public open spaces in relation to ecological, socio-cultural and economic aspects of sustainable urban development. In the last section we showcase its application in the context of modernist mass housing area, through visionary students' projects from "Ecological urban design studio" from University of Belgrade Faculty of Architecture.

2. UNDERSTANDING THE CONCEPT OF MULTIFUNCTIONALITY IN SPATIAL DISCIPLINES

2.1. What is (multi)functionality?

Functionality refers to the *ability* to perform a task or a function. The meaning of functionality is relative and depends on which medium is considered as the carrier of an ability to perform the task/function - space, object, or activity (or even process) and for what purpose. In that sense, multifunctionality is a *feature* of space, artifact or activity

that means having or fulfilling several functions and achieving multiple outputs, purposes or goals at the same time. Multifunctionality can be also understood as a *value* that contributes to the simultaneous solution of multiple problems or the achievement of multiple benefits. But it is not a value per se; it becomes a value only when related to the specific purpose and goals [10].

2.2. Multifunctionality in spatial analysis: multifunctionality in SPACE and TIME

Conceptualized as a characteristic of space, multifunctionality refers to "the possibility of having more than one activity or function in the same SPACE and / or at the same TIME" [1]. In that sense, it is seen as a *characteristic* of the space that enables a synchronic or diachronic realization of various economic, social and environmental benefits.

Multifunctionality of space is a relative concept that depends on the spatial coverage that is the subject of the analysis (SCALE), or the spatial situation in which multifunctionality is considered. For example, in the size of the whole city it is always possible to identify multifunctionality, but it can be a set of fragments of mono-functional areas [5]. In addition, whether a site has one or more purposes or activities, also depends on its capacity to host activities with specific space requirements [1].

In relation to spatial development, the analysis of multifunctionality is possible on two grounds: on the *supply side* and on the *demand side* [9]. Multifunctionality viewed from the side of the offer, can be seen as a characteristic/feature of space or object (resources) that enables the realisation of the activities that achieve desired effects, as intentionally or consequently realised. Observed from the demand side, multifunctionality can be viewed as a social goal/value. Such a perspective starts from the social expectations in relation to a certain activity (use) and is related to the achievement of desired qualities of the particular territory [13].

The concept of multifunctionality of space and its relation to socio-spatial development is an important topic not only in urban planning and design, but also in other spatial disciplines such as landscape planning and architecture, forestry, agriculture. However, different scientific disciplines have different understandings and interpretations of this concept that we will further consider in more detail.

2.3. Multifunctionality in urban planning and design: multifunctional USE of space

The notion of multifunctionality came into focus of urban planning and design theory and practice due to the problems of spatial fragmentation, social segregation and traffic congestion, perceived as indicators of the decline in the ecological, social and economic quality of modern cities. The Functional-segregation doctrine of modern urbanism has been accused to be a key cause of the aforementioned problems [14].

As opposed to that, the concepts of mixed use of space and multifunctional land use were offered as a way to achieve better land utilization and greater vitality of the city. These concepts may be applied at different spatial scales and to both buildings and open spaces [5].While mixed use of space is related to enabling residential, commercial, cultural, institutional, or entertainment activities to take place in a certain area, multifunctional land use is understood as a combination of different socio-economic functions in the same area, where the focus is on achieving social and economic benefits from the USE OF SPACE [6]. Several different planning and design approaches to mixed land use were developed, such as "new urbanism",

"smart growth", "compact city", etc. They differ in the purpose of multiplying functions in space, and in spatial scale they applied, but in all these approaches use of urban land stands at the core [15]. Based on literature review [1] [2] [3] [4] [5] [6] [7] the following types of multifunctional land use can be identified in relation to space and time:

- Mixed use of the land – different functions are interconnected in a certain area;
- Multiple use of the land – different functions exist within the site, not necessarily integrated;
- Multifunctional use – includes both horizontal and vertical combining of functions in order to achieve synergies;
- Multifunctional use over time – space can have different functions at different moments.

In urban planning and design, multifunctionality of urban open spaces refers to use of both civic (built) and green spaces. Different types of urban open spaces (parks, gardens, edges, playgrounds, squares, pedestrian zones, wildlife habitats) can have a variety of functions and be used for different activities: recreation, play, movement, education, wildlife habitat setting, landscaping, agriculture, community development [16]. The application of the concept has historically been linked to central locations, but has over time, extended to other parts of the city. Unfortunately, until recently, functionality of land per se (ex. ecological value of undeveloped areas) was not taken fully into account when evaluating qualities of urban areas. Besides that, multiplication and increase of use of some urban green open spaces, caused their degradation and undermined their ecological sustainability.

2.4. Multifunctionality in landscape architecture and planning: landscape and ecosystem SERVICES

Within the disciplines of landscape planning and architecture, the concept of multifunctionality of space is based on the understanding of ecological relationships and processes in landscape. The landscape is understood as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" [17], and *landscape functions-services* are the benefits it brings to human well-being and to society [18]. Goods and services that different types of landscapes provide include: production of food and timber, water purification and climate regulation, biodiversity, aesthetics values and opportunities for recreation [19]. The provision of these services is based upon the performance of ecological structures, processes and functions [6].

In that sense, multifunctionality relates to the phenomenon that the landscape can provide multiple tangible and intangible goods and services that meet social needs or respond to social or economic requirements [7]. From this perspective, urban open spaces are perceived as parts of urban landscape, and their functionality is perceived as landscape functions based on natural and cultural ecosystem services. Landscapes themselves have various dimensions of quality that can be linked to various options of socio-spatial development. But, in practice, due to traditionally favouring nature over culture in landscape disciplines, the existing conservative attitude towards natural elements in urban areas neglects social and economic issues of development. There are still tendencies to maximise quantity of green spaces in urban areas without considering its economic sustainability, and to underestimate (or even perceive as negative) the value of built open spaces for urban life and development.

This restricts the full use of the concept of multifunctionality of landscapes and open spaces for sustainable urban development.

Fig. 1 Potsdamer platz, Berlin – multifunctional use and ecosystem services (A. Kujučev)

2.5. Meanings and dimensions of multifunctionality of space

The analysis reveals that conceptualisation of multifunctionality of space is possible on several grounds. It can be understood from spatial and temporal, as well as from the use and service perspective. At the same time, multifunctionality has been differently understood and interpreted in different spatial disciplines. Each of these perspectives stresses one aspect of relation to urban development. Seen individually and disciplinary, they do not fully use the potential of urban spaces for sustainable urban development.

The possibility to understand multifunctionality as a feature of space, but also as a value that contributes to the simultaneous solution of multiple problems or the achievement of multiple benefits, forms the basis for linking multifunctionality and sustainable development. Based on this, multifunctionality can be understood as a tool for urban ecological, social and economic sustainability, as well as a normative concept that evaluates the quality of sustainable development policies.

This is especially important for planning and designing public open spaces, as urban spaces that are generally open and accessible to a variety of people, whose sustainability depends on how they are perceived and valued by people. Therefore, based on results of our literature review and analysis, in the next section we will focus on the relation between public open spaces and sustainable urban development, and draft a basic conceptualisation of multifunctionality of public open spaces for better achievement and harmonisation of different aspects of sustainability.

3. Conceptualising Multifunctionality of Public Open Spaces for Development of Sustainable Cities

3.1. Concept of sustainable development in urban planning and design

The concept of sustainable development is value-based, resource and goal-oriented concept that tends to *balance and integrate* environmental issues and socio-economic development in order to equitably meet developmental and environmental needs of present and future generations, improve quality of life standards for everyone, and better protect and manage ecosystems. Anthropocentric and focused on the human well-being, this approach involves taking care of the overall living and non-living environment, understanding that

people depend on healthy ecosystems as much as they depend on other people. In that sense, sustainability is a requirement for long-term social, cultural, economic and environmental health and vitality [20].

In urban planning and design, this approach represents a breakthrough in relation to the traditional movements of environmental protection, which were focused primarily on the protection and conservation of nature. It assumes that destructive behaviours can be transformed towards a more productive and healthier environment and "represents a process of social transformation in which all vital functions of the community are maintained indefinitely and without jeopardizing the basis on which they are based" [21]. Understood in this way, the key to sustainable urban development is *harmonisation* of ecological, socio-cultural and economic values and goals.

3.2. Why are urban open spaces important for sustainable development?

Urban open spaces are all physically un-built spaces within the city's territory [22]. They are integral parts of the urban structure and through their own values contribute to the quality of life in cities. Open spaces can be planned and designed to perform various urban functions: movement and traffic, recreation, gathering, water management ..., but also "non-urban activities", such as agricultural production, forestry and nature conservation. Their purpose is related to their position in the city structure and to urban activities in surrounding areas [23]. The function of urban open spaces is conditioned by their materiality and physical structure. In this sense, they differ in relation to the presence and character of natural features in space. They exist in a wide range of forms of built (civic) and green open spaces. Taking into account the complexity of urban needs, all the categories of open spaces are equally important for the quality of life in the city [20].

Public open spaces (POS) are social spaces that are open and accessible to people. They are simultaneously a part of the urban open space system and a part of the public sphere. Besides their aesthetic and functional qualities, POS have various social functions and contribute to the urban identity. They operate as the arenas for social interaction and places for cultural exchange [24]. These places are also "containers of collective memory and desire... and places for geographic and social imagination to extend new relationships and sets of possibility" [25]. If well planned and designed, they may serve as an integrative element in urban structure, and contribute to urban sustainability based on their ecological, socio-cultural and economic functions and values [26]:

- THE ECOLOGICAL VALUE of an urban open space is based on its bio-physical characteristics that support natural systems and biodiversity. All components of the urban green infrastructure have ecological value per se, but built open spaces can contribute to ecological sustainability of urban areas too. If located, planned and designed based on ecological principles, they can enhance environmental quality of urban space by effecting urban climate, water and air quality.
- THE SOCIO-CULTURAL VALUE of an urban open space is many-fold. First, they can function as community meeting places for different levels of social interaction and engagement, thus contributing to social sustainability of the area. At the same time they can function as places where strangers encounter and mix up in pleasurable or contesting events, expressing the “right” to the city, contributing to sustainable urban development by nurturing the democratic culture. Public open spaces also have a cultural dimension, since through

symbolic representation and everyday practices they contribute to the formation of local cultures and identities.

- THE ECONOMIC VALUE of an urban open space is based on the capacity to function as a resource for various economic sectors: agriculture, forestry, leisure and tourism…In addition, high quality and convivial public open spaces make cities and urban areas attractive for tourists and new inhabitants, by providing a positive image of a place that is desirable for living and visiting.

Besides contributing to urban sustainability by bringing new values to urban areas, public spaces can also be perceived as indicators of urban sustainability. Negative phenomena in the urban areas, such as ecological degradation, economic weakening of the area, neglect, under-use and devastation of space, are manifestation of unsustainable life patterns and urban development policies.

3.3. Multifunctionality of public open spaces for sustainable urban development: developing an analytical model

In order to fully use the potential of the concept of multifunctionality to support sustainable development, we propose a matrix as an analytical model that relates different dimensions of multifunctionality of public open spaces to the ecological, socio-cultural and economic aspects of sustainability. In this framework multifunctionality of public open space is understood as a feature, characteristics that become value only when related to a certain set of development goals in a specific context. At the same time, multifunctionality of a public open space is perceived as multidimensional in order to better relate to various aspects of sustainable development (ecological, socio-cultural, economics) and thus contribute to their harmonisation. Dimensions of multifunctionality are defined in relation to: space, time, use and services provided by land:

- SPACE dimension refers to how different functions are distributed in space horizontally and vertically, as well as in relation to the scale (location, area,…). Mixed, multiple and multifunctional use may be considered.
- TIME dimension refers to how different functions are distributed in time – synchronic and diachronic multifunctionality is possible. "Diachrony" refers to the disposition(s) of functions across time. "Synchrony" refers to the disposition of different functions at one specific moment in time.
- USE dimension refers to provision of possibilities for people and other living beings to use the space in different ways - based on urban design to enable activities and/or through organisation of special events.
- SERVICE dimension refers to the capacity of land (natural or built) to provide tangible and intangible goods, services and amenities to people and nature

In the new analytical model - different dimensions of multifunctionality are related to different aspects of sustainability in order to reveal possible positive and negative impacts of multifunctional design solutions, as presented in Table 1.

Table 1 Public open space multifunctionality in relation to aspects of sustainability

		ASPECTS OF SUSTAINABILITY		
		Ecological	**Socio-cultural**	**Economic**
DIMENSIONS OF MULTIFUNCTIONALITY	**Space**	Increase and intensification of activities in space may diminish its ecological value. At the same time ecological value of space can be protected by revealing it to users through various activities.	Diversification and increase of activities in space attracts more people and supports sociability. Level of sociability depends on how activities are distributed -as dispersed or concentrated - and how are they linked and combined.	Diversification and increase of activities in space enhances attractiveness for different user groups and supports local economies, investments and rents in surrounding areas. Harmonisation between size, level of equipment and financing is necessary.
	Time	Increase and intensification of activities in time (synchronic and diachronic) may diminish its ecological value. Natural, vulnerable spaces may be especially endangered. Control of intensity of multifunctional use is a paramount.	Increase and diversification of activities in time attracts more people and supports sociability. Synchronicity enables concentration of people, and diachronic increase and diversification supports continuity of socialisation in space for different user groups.	Synchronic and diachronic increase and diversification of activities in time enhances attractiveness for different user groups and supports local economies, investments and rents in surrounding areas.
	Use	Increase and diversification of different uses of space, but also type and character of activities that are provided or enabled, are important for the increase or reduction of ecological values of the area.	Increase and diversification of different uses of space attracts more people and increase the chances for people to meet and interact. Level of sociability depends on type of activities, and how are they linked and combined.	The diversification of uses, attracts more people, enhance the attractiveness of space and supports local economies, investments and rents in surrounding areas.
	Service	Increase and multiplication of land functions and services for urban life, help revealing different values of Nature and confirm the need to protect natural features in urban environment.	Increase of environmental comfort and aesthetics through land and ecosystem services increases use and sociability of space, and helps construction of positive identity of the area.	Increase of environmental comfort and aesthetics through land and ecosystem services, increases economic value of urban area by enhancing its attractiveness to live, visit and invest.

4. Analysing Contribution of Multifunctional Public Open Spaces to Sustainable Development of Modernist Mass Housing

The new model for analyzing the contribution and effects of multifunctional public open spaces on sustainable development is applied to visionary students' urban design projects. The aim is to determine a) how different design solutions of multifunctional public spaces may contribute to the sustainable development of public promenade in modernist mass housing area, and to b) help identify possible shortcomings in order to reveal issues that need harmonization of sustainability goals. Examples were selected to showcase different approaches to multifunctionality of public open spaces, while addressing the same problem of underuse of the green public promenade. All cases are based on the water as natural element in urban space and theme that leads urban design visions.

4.1. Context and purpose of developing multifunctional public open spaces

"Sava Blocks" in New Belgrade, Serbia is a modernist mass housing area that comprises several super blocks (45, 44, 70). They are inter-connected by two parallel green promenades: centrally located "Lazaro Kardenasa Promenade" and "Sava river Promenade". These promenades form a part of well developed public open space system of super-blocks. They are characterised by high quantity of green public open spaces, but also with the problem of their underuse and neglect, especially in the Lazaro Kardenasa promenade case. Therefore, the purpose was to investigate possibilities for developing multifunctional public open spaces, as places where nature and culture connect, overlap and permeate, in order to contribute to sustainable development of "Sava Blocks".

4.2. Case 1 – "Water leads to water"

The project explores the relationship of the Block 45 with water, based on the fact that the block is located on the Sava riverfront and that this feature defines the block's identity. Moreover, the groundwater levels in the block are high and it is often threatened by flooding.

Fig. 2 Case 1 - "Water leads to water"- Milica Pavić

Key questions that are addressed in the project were: 1) what does water mean to different users, and 2) how to use water in urban design so that it contribute to the adaptation of cities to climate change? It was presumed that through the development of multifunctional public spaces as adaptation measures to climate change (at area, system and local level), it is possible to create an environmentally sustainable system of spaces, which simultaneously protect Block 45 of floods and control drainage, and are attractive, symbolic, useful and comfortable spaces for a variety of users (Figure 2, Table 2).

Table 2 Assessing sustainability of multifunctional public open space – case 1

		ASPECTS OF SUSTAINABILITY		
		Ecological	**Socio-cultural**	**Economic**
DIMENSIONS OF MULTIFUNCTIONALITY	**Space**	Nature is used as mentor in design at all spatial levels, and thus needs of nature and people are harmonised. Forms and activities that water as element in design brings, reveals values of nature and contribute to its appreciation and protection	Different functions of water are dispersed space, increase use by different user groups, support interaction and create positive identity .	Increase in number of activities, at system, area and location level, enhances attractiveness of space for people and may contribute to investments and rent. *Critical issue:* need for harmonisation between size, level of equipment and financing
	Time	Multifunctionality in time refers to changes in use of water basins in relation to seasons or flooding levels. Intensity of different uses is well planned in relation to location and size of natural elements in area, thus protecting their ecological value.	Seasonal and flood-related changes of water-plazas contribute to variety of uses and to identity. Increase and diversification of use of space at synchronic or diachronic levels, contribute to sociability of area *Critical issue:* level of sociability depends on season.	Increase of number of different activities that may simultaneously take place increase attractiveness and economic value of space. *Critical issue:* maintenance.
	Use	Introduction of water features, that support water related activities, increase use of space and enhance ecological value by providing contact with nature.	Increase of possible uses of space by different user groups contribute to greater sociability of area. Water based design brings positive local identity.	Increase of use enhance attractiveness and supports investments and rent increase in area.
	Service	Introduction of ecosystem - water services is the leading idea of the project and helps revealing different values of Nature.	Introduction of natural features - water and its services (retention, microclimate regulation…) into design, brings positive identity and attracts people.	Natural services are provided in space that may decrease the costs of flooding. Good balance of natural and special management areas is achieved.

4.3. Case 2 – "Vital space – water path"

The goal of the project was to activate the promenade Lazaro Kardenasa to become a vital and vibrant place. The spatial concept is based on the idea to develop the promenade as a complex system by designing multifunctional spaces for different purposes, related both to culture and nature.

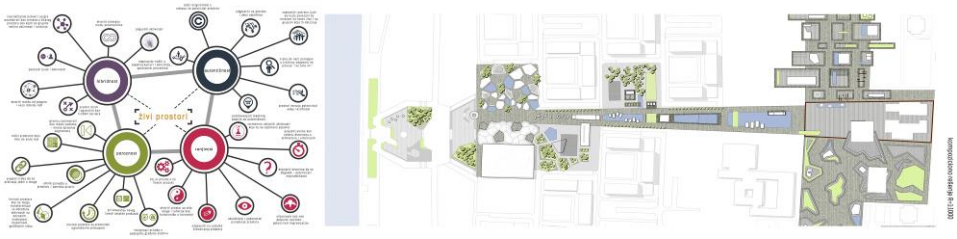


Fig. 3 Case 2 - "Vital space- water path"- Tamara Radić and Bogdan Popović

Focal social and economic activity points are located on the central position in the promenade, providing different necessary and thematic uses of space. They are combined with natural areas in order to support biodiversity and contact with nature. By their interconnection, public open spaces and buildings are defined as community meeting places. These natural and cultural sites located on the promenade are supported with a variety of activities provided in surrounding areas (Figure 3, Table 3).

Table 3 Assessing sustainability of multifunctional public open space – case 2

		ASPECTS OF SUSTAINABILITY		
		Ecological	**Socio-cultural**	**Economic**
DIMENSIONS OF MULTIFUNCTIONALITY	**Space**	Natural features of space were recognised as value to protect and support by revealing its importance to people through planning of different activities on various locations.	Increase and diversification of activities through well connected and authentically designed space, contribute to creation of positive identity and increase the use by different user groups. Both concentration and dispersion spatial strategies are applied.	Increase in number of activities at system, area and location level, enhances attractiveness of space for people and contribute to investments and rent. Harmonisation between size, level of equipment and financing is achieved through balancing private and public management.
	Time	Intensity of different uses in time is well planned in relation to type, location and size of natural elements in area, thus protecting their ecological value.	Increase and diversification of activities attracts different people and supports sociability in the area. Social vitality of space through time is supported by different forms of management and creation of spaces that differ in size, level of equipment and character.	Provision of variety of different types of spaces and increase of number of different activities that may simultaneously take place, increase attractiveness and economic value of space. *Critical issue:* maintenance of high quality spaces through time.
	Use	Introduction of water features supports both use of space and contributes to overall ecological value by providing contact with nature.	Increase of possible uses of space by different user groups was a main goal of the project in order to contribute to greater sociability of area. High level of sociability is achieved through provision of different types of activities and their connections.	The increase and diversification activities in space, attracts more people, enhance the attractiveness of area and supports local economies.
	Service	Although mostly built-up , this open space improves ecological value of area through integration of water retention and purification measures. *Critical issue:* increase in built-up surfaces lowers porosity and size of natural self-sustained areas.	Increase of activities, environmental comfort and aesthetics that attracts and connects people is achieved through water-spaces that provide variety of services (retention, regulation of microclimate).	Commercial, as well as natural services are provided in space that increase its economic value. New water-bodies provide environmental comfort and aesthetics and enhance attractiveness of area to live, visit and invest.

4.4. Case 3 – "Promenade as a river flow"

In order to overcome problems of under-use and neglect of the "Lazaro Kardenasa promenade, "learning from nature" was selected to be the guiding principle of the project. Water was perceived as a mentor that guides development. The starting point for the project was the analysis of main users groups of the promenade (children, old people, recreationalists and people with dogs), their needs and the dynamic of their movement in public spaces. Development of a multifunctional promenade was conceptualised as a system of river-flows that connect and orchestrate flows of different user groups. A variety of ambiences was developed on different segments of this "flows", with a purpose to help people interact among themselves and with nature. The presence of water was integrated in this system in different forms and with different purposes: as a moderator of climate and place for water management; as a symbol and a spiritual and emotional connector with Nature; or as a place to relax or play. Basic commercial activities that support the public life and needs were also proposed in nodal locations (Figure 3, Table 3).

Fig. 4 Case 3 - "Promenade as a river flow"- Tamara Bošković

Table 4 Assessing sustainability of multifunctional public open space – case 3

		ASPECTS OF SUSTAINABILITY		
		Ecological	**Socio-cultural**	**Economic**
DIMENSIONS OF MULTIFUNCTIONALITY	**Space**	Ecological value of space is revealed and protected by connecting natural elements to various activities on the promenade. The idea of promenade as a river-flow connects different spatial scales.	Diversification and increase of activities on promenade attract more people and supports sociability. Both dispersion and concentration spatial strategies are implemented. *Critical issue:* organisation of events	Spatial interventions and increase of enhance attractiveness for different user groups and supports local economies, investments and rents in surrounding areas. *Critical issue:* management
	Time	Increase and intensification of activities on the promenade are related to built-up spaces and can't diminish ecological value.	Increase and diversification of activities in time, that support sociability of place are enabled in both synchronic (nodes and centres) and diachronic form (different user groups).	Synchronic and diachronic increase and diversification of social and economic activities in time enhances attractiveness for different user groups and supports local economies.
	Use	Increase and diversification of different uses of space, is harmonised with the natural characteristics and qualities of specific locations on promenade and thus contribute to ecological value.	Diversification of activities and possible uses of space is related to needs of different user groups. It attracts more people, and through overlapping of "flow-paths" increases the chances for people to meet and interact.	The diversification of uses, attracts more people and enhance the attractiveness of space. As such it supports local economies, investments and rents in surrounding areas.. *Critical issue:* management
	Service	Land functions and services are provided through development of water basins and flows, and help reveal different values of Nature to people	Increase of environmental comfort and aesthetics is provided and contribute to increases use and sociability of space, and construction of positive identity of the area.	Integrated natural elements (green and blue spaces) enhance environmental comfort and aesthetics and contribute to attractiveness of area to live, visit and invest.

4.5. Discussion

Presented design projects had different primary purposes and that was reflected in the design at both area and detailed levels, as well as in their expected performance. Anyway they all provided systemic view and manage to contribute to all aspects of urban sustainability.

The new analytical model *enabled broad understanding* of the conditions for sustainability of each project, by revealing space, time, service and use dimensions of multifunctionality. It also *enabled critical review* of different design approaches by *simultaneously* relating different dimensions of their functionality to various aspects of sustainable development. As such it helped identifying benefits but also shortcomings and critical issues of implementation of certain urban design solutions from ecological, social or economic aspects. The opportunity to simultaneously analyse the effects of design solutions on different aspects of sustainability is important for their harmonization in order to achieve sustainable cities. Based on this, it is possible to conclude that a new approach can help evaluation of design alternatives, but can also serve as a platform for discussion on alternative futures between different stakeholders in

the planning process, by revealing potential environmental, socio-cultural and economic benefits as well as critical issues of their application.

5. CONCLUSIONS

Our analysis revealed that multifunctionality is a complex concept that can be understood and applied based on its *spatial, temporal, use and service* dimensions. It is an important concept for sustainable urban development that has being differently understood and interpreted in different spatial disciplines, which makes its application difficult to assess and manage in relation to different aspects of sustainable urban development.

In order to better balance ecological, socio-cultural and economic development goals and, at the same time, enable creative and context specific approach to design of urban space, the concept of multifunctionality needs to be integrated into the planning and design of public open spaces in a *relational and multidimensional way*. This means that multifunctionality should be understood as a feature that becomes value only when related to certain set of development goals in specific context. At the same time, multifunctionality of public open space should be perceived as multidimensional in order to better relate to various aspects of sustainable development (ecological, socio-cultural, economic) and to contribute to their balance.

A new analytical framework, based on these principles and outlined in this paper, confirmed to be adequate for reading, analysing and assessing the contribution of multifunctional public open spaces to sustainable urban development, and applicable in different situations. Its application was showcased in the context of modernist mass housing, and it should be further tested in other urban development situations. Anyway, we suppose that this new approach has a significant potential for application in the planning and design practice. It can be used for evaluation of urban design alternatives in a rational or collaborative planning process, but also as a basis for the future public open space planning and design projects that aim to *balance* cultural and natural values in urban space. We hope, that understood in this way, planning and design of multifunctional public open spaces can more fully contribute to the quality of life in cities and be a factor of urban sustainability and resilience.

Acknowledgement. *The paper is a part of the research done within the Project TP 36035: "Spatial, Environmental, Energy and Social Aspects of Developing Settlements and Climate Change - Mutual Impacts" financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.*

REFERENCES

1. M. Batty, E. Besussi, K. Maat and J. Hars, "Representing multifunctional cities: density and diversity in space and time", Built Environment, 30(4), pp. 324–337, 2004. https://doi.org/10.2148/benv.30.4.324.57156
2. H. Haccou, et al, MILU Guide: practitioners handbook for multifunctional intensive land use, MILU net - The Habiforum Fondation, Gouda, 2007.
3. E., Hoppenbrouwer and E. Louw, "Mixed-use development: theory and practice in Amsterdam's eastern docklands", European Planning Studies 7 (13) pp. 967-983, 2005. https://doi.org/10.1080/09654310500242048
4. I. B. Kajtazi, Measuring Multifunctionality of Urban Area, Thesis. International Institute for Geo-Information Science, Enschede, The Netherlands, 2007.

5. S. Majoor, “New Norms for Multiple Intensive Land Use", 39th Iso CaRO Congress, 2003. www.isocarp.net/Data/case_studies/306.pdf [Accessed: 2nd July 2012].
6. R. Verkeer, H. De Groot and E.T. Verhoff, “Urban multifunctional land use: theoretical and empirical insights on economies of scale, scope and diversity”, Built Environment 30 (4), pp. 289–307, 2004. https://doi.org/10.2148/benv.30.4.289.57157
7. H. Wiggering, et al., “Indicators for multifunctional land use: Linking socio-economic requirements with landscape potentials”, Ecological Indicators (6) pp. 238–249, 2006.
8. G.A. Wilson, Multifunctional Agriculture: A Transition Theory Perspective, CABI international, Cambridge, MA, 2007.
9. OECD, Multifunctionality: a framework for policy analysis, AGR/CA (98) 9, OECD publications, Paris, 1998.
10. OECD, Multifunctionality: towards an analytical approach, OECD publications, Paris, 2001.
11. N., Elin, Integral Urbanism, Routledge, NY, 2006.
12. R. Fish, A. Church and M. Winter, “Conceptualising cultural ecosystem services: A novel framework for research and critical engagement”, Ecosystem Services 21, pp.208-217, 2016.
13. G. Huylenbroeck et al., “Multifunctionality of Agriculture: A review of Definitions, Evidence and Instruments”, Living Reviews in Landscape Research (1),p.3. 2007. http://dx.doi.org/10.12942/lrlr-2007-3
14. J. Jacobs, The Death and Life of Great American Cities. Vantage, New York. 1961.
15. J. Živković, K. Lalović, and D. Milovanović-Rodić, Multifunkcionalnost otvorenih prostora u kontekstu prilagođavanja gradova klimatskim promenama (Multifunctionality of Open Spaces in Adapting Cities to Climate Change), In: M. Bajić-Brković (Ed.), Klimatske promene, nacionalne politike i lokalni razvoj (Climate changes, national policies and local development) pp. 125-155. Faculty of Architecture University of Belgrade, Belgrade, 2016.
16. S. Waters and M. Smith, “The Planning and management of urban open spaces in Scotland”, Scottish Natural Heritage Review (SNH) No 130, 2002.
17. Council of Europe (2000) European Landscape Convention
18. L. Willemen, Mapping and Moddeling Multifunctional Landscapes, Thesis, Wageningen University, Wageningen, The Nederlands, 2010.
19. R. Hine, J. Peacock and J. Pretty, Green spaces: Measuring the benefits, drawing on case studies from the East of England. Report for the National Trust. University of Essex, 2008.
20. J. Živković, Uticaj ekoloških zahteva na oblikovanje otvorenih rekreativnih prostora u gradu (The Impact of Ecological Demands on Design of Open Recreational Spaces in Urban Environment), MSC Thesis, University of Belgrade Faculty of Architecture, Belgrade, 2000.
21. M. Bajić Brković, Ogledi o planiranju i održivom razvoju grada (Essays on planning and sustainable development), Faculty of Architecture University of Belgrade (internal edition),, Belgrade, 2000.
22. Ž. Vesnić Neđeral, Rekreativna funkcija otvorenih prostora u gradu (Recreational function of urban open spaces), Faculty of Architecture University of Belgrade, Belgrade, 1990.
23. J. Živković and N. Vasiljević, “Predeo i održivi prostorni razvoj Srbije” (Landscape and Sustainable Spatial Developlent of Serbia). In: M. Bajić-Brković (Ed.), Kreativne strategije za održivi razvoj gradova u Srbiji (Creative strategies for sustainable urban development in Serbia) (pp. 123-157). Univresity of Belgrade Faculty of Architecture, Belgrade, 2010.
24. Z. Đukanović and J. Živković, Public Art & Public Space program: learning, but doing! ANNALES-Anali za istrske in mediteranske studije-Series historia et sociologia. Vol. 25/1, pp. 49-65. 2015. http://zdjp.si/annales-series-historia-et-sociologia-25-2015-1/
25. J. Corner, “Terra Fluxus”, in: Waldheim Ch. (ed.) The Landscape Urbanism Reader, (pp.21-33), NY: Princeton Architectural Press, 2006.
26. R Kaufmann-Hayoy, T. Hammer and D. Raemy, “Institutional Steering and Collective Action for Sustainable landscape Development - The Case of the Vineyard Landscape at the Lake of Biel”, 2007. http: //www.ikaoe.unibe.ch/forschung/nie-bielersee/index.html [Accessed: 2nd July 2012].

MULTIFUNKCIONALNI JAVNI OTVORENI PROSTORI ZA ODRŽIVE GRADOVE: KONCEPT I PRIMENA

Ideja da je mutlifunkcionalnost otvorenih prostora važna za urbanu održivost se sve vise naglašava u teoriji i sve češće primenjuje u praksi urbanog planiranja i dizajna. Pretpostavlja se da multifunkcionalni prostori mogu da pruže širi spektar ekoloških, društvenih i ekonomskih koristi. Međutim, sam concept multifunkcionalnosti nije dovoljno teoretski elaboriran. Dodatno, različite akademske discipline konceptualizuju i koriste ovaj concept na različite načine. Usled toga je otežana procena kako multifunkcionalni otvoreni prostori stvarno doprinose održivom urbanom razvoju i kako ih razvijati sa tim ciljem. Ovim radom se, na osnovu pregleda literature, analiziraju i porede načini konceptualizacije i primene koncepta multifunkcionalnosti prostora u različitim displinama prostornog razvoja (urbanističko planiranje i dizajn, pejzažno planiranje i arhitektura) kako bi se razumele i uspostavile veze između različitih dimenzija multifunkcionalnosti i očekivanih koristiod primene koncepta za održivi urbani razvoj. Na tim osnovama se definiše nova relacijska i multidimenzionalna konceptualizacija (multi)funkcionalnosti javnih otvorenih prostora kao analitički okvir za vrednovanje doprinosa projekata urbanog dizajna održivom razvoju. Primena novog analitičkog okvira se demonstrira i diskutuje na primeru studentskih projekata sa studija "Ekološki urbani dizajn" sa Univerziteta u Beogradu- Arhitektonskog fakultet, kao vizija razvoja multifunkcionalnih javnih otvorenih prostora modernističkog kompleksa "Savskih blokova" u Novom Beogradu u Srbiji.

Ključne reči: *multifunkcionalnost, javni otvoreni proctori, održivi urbani razvoj, urbano planiranje i dizajn*

FACTA UNIVERSITATIS
Series: **Architecture and Civil Engineering** Vol. 17, N^{o} 2, 2019, pp. 221-233
https://doi.org/10.2298/FUACE190329013B

CRITERIA AND ASPECTS OF QUALITY OF OPEN SPACES IN HIGH-RISE HOUSING NEIGHBOURHOODS IN THE PROCESS OF URBAN REVITALIZATION

UDC 728.2:625.712.43
711.168

Ivana Bogdanović Protić, Petar Mitković, Milica Ljubenović

University of Niš, Faculty of Civil Engineering and Architecture, Niš, Serbia

Abstract. *The correlation between the quality of open spaces and quality of life in high-rise housing neighborhoods in contemporary urban-architectural and social frameworks has been confirmed by a series of multidisciplinary researches. Modern research indicates that in the process of revitalization, it is necessary to look at various aspects of the quality of open spaces in order to provide a more efficient degree of improvement. Creating adequate spatial conditions for the different types of activities of the daily spare time of tenants and the exercise of physical activity in the direction of improving psycho-physical health, achieving spatial-ambient values, as well as for encouraging good neighborly relations, communion, territoriality and sense of belonging, which are all determinants of the quality of life, can be managed by providing a certain level of quality open spaces. Bearing in mind that there are no unique criteria for the quality of open spaces in high - rise residential neighborhoods, the aim of this paper is to indicate the desirable characteristics of these spaces in accordance with the contemporary principles of urban design and practice in the process of their revitalization. Therefore, residential neighborhood Poptahof has been selected as a research platform that represents the good practice example of the revitalization of open spaces in line with identified criteria and quality aspects. These criteria can serve as a basis for further research of the modes of urban revitalization of open spaces, with the aim of improving the quality of life.*

Key words: *open spaces, high-rise housing neighborhood, urban revitalization, criteria and aspects of quality, quality of life*

Received March 29, 2019 / Accepted May 15, 2019
Corresponding author: Ivana Bogdanović Protić
University of Niš, Faculty of Civil Engineering and Architecture, Aleksandra Medvedeva 14, 18000 Niš, Serbia
E-mail: ivanab76@yahoo.com

1. INTRODUCTION

The evolution of the development of urban open spaces in high - rise residential neighborhoods shows a series of transformations in accordance with the urban and architectural practice and social priorities. Creating a pleasant residential environment that can meet the changing demands and wishes of tenants in a long-term perspective, which ensures adequate hygiene conditions and comfort, is one of the greatest challenges of urban practice and at the same time a complex and socially important task. This particularly refers to housing in high - rise residential neighborhoods, which in some areas often have negative attributes. Namely, one of the main problems of high - rise residential neighborhoods is devastation of open spaces, which is reflected through inflexibility, unattractiveness and low level of order, which contributes to deterioration of basic living values and quality of life [4]. With modest design, as well as maintenance and management problems and lack of adequate standards and legal regulations, open spaces lose functional, social and aesthetic dimensions. Furthermore, their long-standing neglect leads to a disruption of their primary function – being a comprehensive component of quality of life. All this indicates the need for their revitalization. In this context, the aim of this paper is to identify the desirable criteria for the quality of open spaces that can be used both for the evaluation of their current state and for determining the directions of transformation in the process of urban revitalization. In this paper the standard methodology of scientific research is applied, using several methods. Determining the criteria of quality of urban open spaces in high - rise residential neighborhoods for their evaluation was performed by review and analysis of the literature on theory and practice of planning and design of urban open spaces. After that, the systematization method is used for identification of the aspects of the quality of urban open spaces, in accordance with the aim of this paper and the contemporary principles of urban design and practice in the process of their revitalization. Therefore, residential neighborhood Poptahof has been selected as a research platform that represents the good practice example of revitalization of open spaces in line with identified criteria and quality aspects. These criteria can serve as a basis for further exploration of the modalities of promotion of open spaces, with the aim of improving the quality of life.

2. QUALITY CRITERIA OF URBAN OPEN SPACES

Modern approaches to the regulation of urban open spaces in foreign practice tend to have a synergistic treatment of their problems. Partial approaches have led to a narrow view of open spaces, the absence of a system of values, their inadequate role and importance for the quality of life of tenants of a high rise residential neighborhood. This points to the need to review the meaning of the quality of open spaces and redefine the criteria and aspects of quality in the revitalization process. In spite of numerous theories of the corresponding open spaces that we encounter in literature, the unique criteria for the quality of open spaces are neither harmonized nor defined by a single value framework [7]. In the early 1980s, Bentley et al. [3] formulated a new approach to urban design, known as the responsive environment. This approach has emphasized the need for more democratic environments and maximizing the level of choice of content and activities available to users. In addition to the above-mentioned attributes, open spaces should be harmonized with the principles of public-private delineation, be human-made,

and surface treatment and urban equipment should be adequately applied, in accordance with the purpose of space [8] [1] [2] [10] [11]. In determining the criteria of the quality of urban open spaces in this paper, it starts from the fact that the open spaces are places where residents like to spend their leisure time, which they perceive as entertaining, safe, inviting and attractive, where they are satisfied and they are proud of. The development of good neighborly relations and joint activities of tenants in open areas is particularly encouraged, which is an important indicator of the quality of life [6].

Starting from the multiple significance of open spaces for the quality of life and the identified quality criteria defined by the review of multidisciplinary literature, those who are relevant for directing the regeneration of open spaces are systematized: functional-spatial, ecological, psycho-social, visual-aesthetic and technological-organizational (see Fig.1) [6].

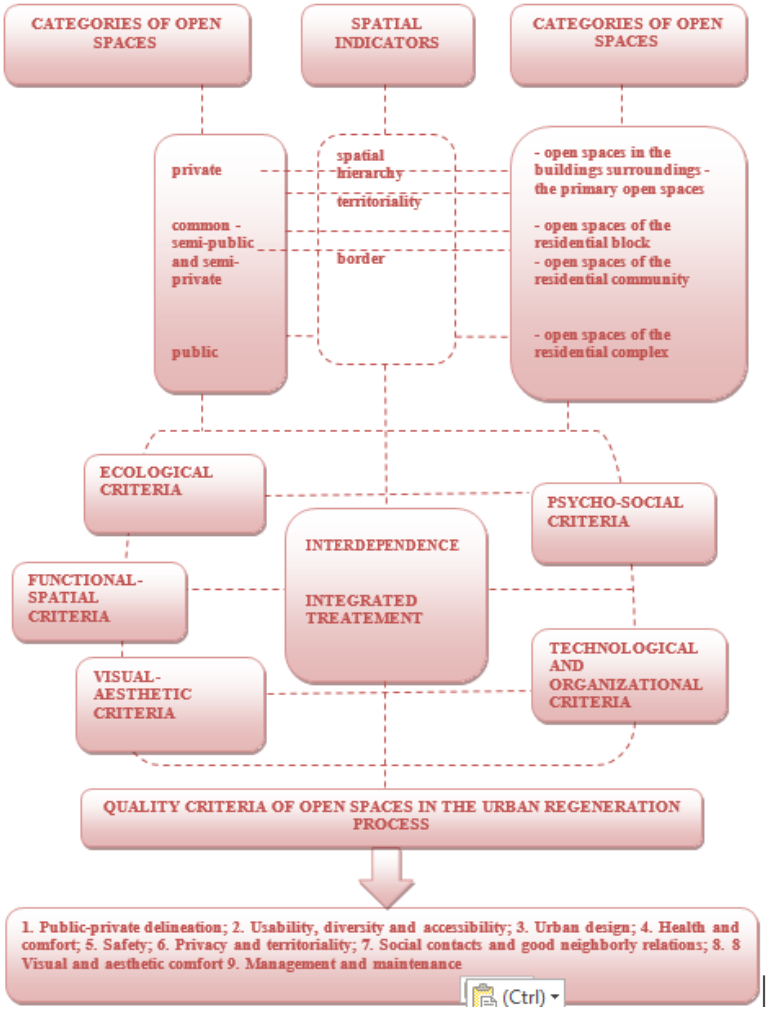


Fig. 1 Integration of spatial indicators and criteria for open space quality in high-rise housing neighborhoods. Source: Author

It should be emphasized that various researchers cite a wide range of experience, functional, social and environmental aspects of open spaces. This leads to the conclusion that all these aspects must be treated synthetically when assessing the state of open space, and for the purpose of determining the types of problems and levels of deprivation present. In this respect, the aspects of the quality of open spaces have been established, from which the principles for critical analysis of the state of open spaces in neighborhoods with high rise housing are derived. Bearing in mind the complexity of the problem of the quality of open spaces, it can be concluded that the established quality criteria cannot be final or complete, that is, it is possible and desirable to supplement them and align them with the social, economic, architectural and urban trends and changes in the needs of the tenants. In the context of all this, 9 key aspects of the quality of open spaces have been identified:

- public-private delineation
- usability, diversity and accessibility
- urban design
- health and comfort
- security
- privacy and territoriality
- social contacts and good neighborly relations
- visual-aesthetic benefit
- maintenance [2] [6] [8] [7] (see Fig.1).

They arise from the adopted characteristics of successful open spaces and the principles for achieving successful open spaces, as well as from the defined general criteria for the quality of open spaces. Thanks to the multiple significance of the quality of open spaces, as a determinant of quality of life, the interpretation of established quality criteria at all spatial levels in high - rise residential neighborhoods is of particular importance (see Fig.1). All this in the direction of a comprehensive study of the quality of open spaces in high - rise residential neighborhoods, directing the direction of regeneration.

3.0 Aspects of Quality of Urban Open Spaces

3.1. Public-private delineation

In the function of creating a suitable environment for active housing and stimulating social relationships and joint activities, it is important to get acquainted with the hierarchy of open spaces in high - rise residential neighborhoods based on the rules of access and the regime of space use, i.e. public-private delineation [13]. The hierarchy of open spaces is also in the function of urban design and is considered essential for achieving privacy and territoriality in residential neighborhoods. The basic typology of open spaces based on the rules of access and the regime of the use of space implies three types of open spaces: 1. private, 2. common and 3.public [12]. In addition, common spaces can be semi-private and semi-public spaces [14]. All types of open spaces have their relevance for the tenant's life and preferably all are represented (see Fig. 2). Spatial borders provide a degree of privacy, enabling people to exercise control over their own activities and activities of other [9].

a) b) c)

Fig. 2 Typology of open spaces according to public-private delineation a) private b) common c) public Sources: a) www.pt.rwth-aachen.d [Accessed: 21st March 2016]. b) Knoll, T., Moser, K., 2009. Evaluierung von Freiflächen im geförderten Wohnbau, Knoll, Planung & Beratung Ziviltechniker GmbH, Wien c) www.ura.gov.sg [Accessed: 15th November 2017].

3.2. Usability, diversity and accessibility

The usability of open spaces is a prerequisite for the realization of spare time activities and various occupancy activities, and in this sense open spaces can be perceived as positive or negative [6]. Key principles related to this aspect of quality are: availability, multi functionality, good urban design, maintenance of open spaces and compliance with the needs of tenants, easy accessibility from residential buildings, comprehensibility, layout of hiking trails, public-private delineation, offer of different types of activities and contents for different age categories of tenants (see Fig. 3).

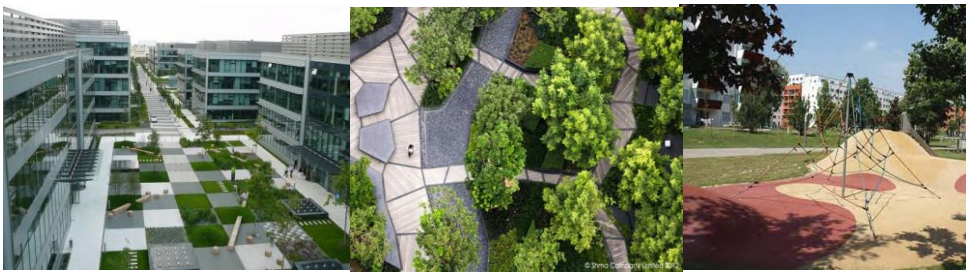
a) b) c)

Fig. 3 a), b), c) Usability, diversity and accessibility – examples. Source: Knoll, T., Moser, K., 2009. Evaluierung von Freiflächen im geförderten Wohnbau, Knoll, Planung & Beratung Ziviltechniker GmbH, Wien

3.3. Urban design

The usability of open spaces depends largely on the urban design (see Fig. 4). Several studies indicate that the key principles of a good urban design are: urban equipment, landscaping, materialization, variability and flexibility [6]. In contrast to previous ideas that the

urban equipment should be fixed, today most experts advocate a more liberal concept of urban equipment tailored to specific purposes. It should be flexible and multifaceted - adaptable to various joint activities of tenants. A particular attention should be paid to communication spaces, where different space and centre sites intertwine, so urban equipment should also be designed for the context of daily activities, but also specific, and occasional.



a) b) c)

Fig. 4 Examples of good urban design a) various seating areas b) paving c) playground. Sources: a) www.pinterest.com [Accessed: 14th February 2018]. b) www.designrulz.com [Accessed: 15th January 2018]. c) Lička et al. (2012)

3.4. Health and comfort

Health and comfort support the provision of favourable microclimate and are primarily related to ecological criteria for the quality of open spaces, but also for others. A favourable microclimate depends on the presence of vegetation (see Fig. 5), landscape orientation, topography, types of paving and the presence of water surfaces. Its effects can be seen through: visual advantage, air, thermal and acoustic comfort of tenants, which is manifested by the effect on the senses, and through the experience of open spaces, pleasant or unpleasant. It can be achieved by the proper orientation of open spaces and adequate urban design, by placing spatial elements that provide shelter from sun, wind and impurities as well as planned greening [6].

a) b) c)

Fig. 5 a), b), c) Favourable microclimate achieved by virtue of vegetation. Sources: a), b) Kirsten, R., Zwoch, F., 1998. Landschaftsarchitekten - Landscape Architecture In Germany, Nelte, Wiesbaden c) Http://Urbanplanet.Info/Urbanism/Revealing-Ecological-Potential-Open-Spaces-Urban-Fabrics [Accessed: 14th February 2018]

3.5. Safety

Safety is considered a key factor when tenants are choosing to use a certain open space. This includes both physical and social dimensions. The basic measures, whose application can provide safety are: adequate lighting of open spaces; comprehensiveness, ability to control and clear boundaries of space; differentiation of pedestrian and motor traffic; prevention of antisocial behavior; good urban design; regular maintenance; absence of parking in open and green spaces (see Fig. 6). Security implies adequate space availability, such as an appropriate location of activity schedules (such as barriers and signs) in order to prevent incidents or injuries, while social security refers to the absence of vandalism [11].

a) b) c)

Fig. 6 Safe open spaces a) adequate lighting b), c) possibility of observation from residential buildings. Sources: a) www. uli.org [Accessed: 1st June 2016] b), c) Lička et al (2012)

3.6 Privacy and territoriality

Privacy and territoriality are very important aspects of the quality of open spaces and are closely related. They can be realized by application od these principles: public-private delineation; personalization / creativity of tenants (see Fig. 7); spatial possibilities for intimacy, peace, harmony, silence, protection against noise; adequate space; protection against unwanted eyes; a sense of security, security; schedule of activities, conflicts. Territoriality is a delimitation of open spaces, which allows individuals or groups to use space and defines it [11]. This implies a psychological identification with the city, which is symbolized by the attitudes, possessiveness and distribution of urban equipment.

a) b) c)

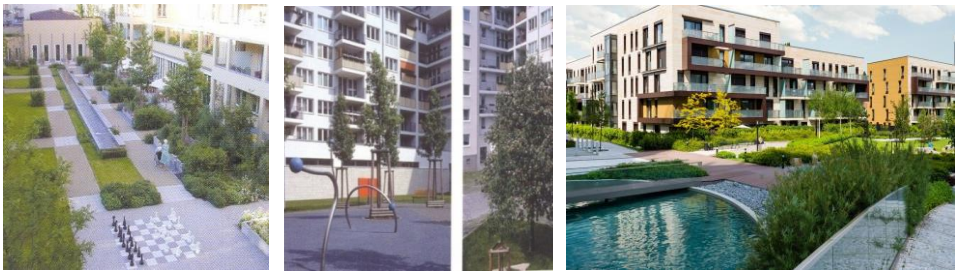
Fig. 7 a), b), c) Examples of personalization on open spaces. Source: L. Lička et al (2012)

3.7. Social contacts and good neighborly relations

A man as a social being has the need to establish contacts with other people, and socialization is of particular importance in high - rise residential neighbourhoods. The quality of the residential environment, that is, the spatial and design potential of open spaces, plays a decisive role in promoting good neighbourly relations. It is achieved by applying a quality urban design, by building space for sitting and gathering, adequate distribution and types of urban equipment. It includes: equipment for gathering, meeting, joint activities, social games; communicating with neighbours; frequency of use of an open space; user structure - different age categories of tenants; participation of tenants in the arrangement and maintenance of open spaces [6]. That is why the significant multifaceted character of these spaces is also important for the purpose of integrated treatment of the interests of different actors (tenants) in the context of social interactions as an important parameter of the quality of life of tenants of high - rise residential neighbourhoods.

3.8. Visual and aesthetic comfort

The visual and aesthetic experience of the space is conditioned by the individual perceptions and demands of particular users. However, in general, achieving this aspect of the quality of open spaces is possible by applying the following principles: good urban design, spatial and ambient integrity, the attractiveness of space, diversity, the presence of elements of nature, the suitability of a human measure (see Fig. 8).



a) b) c)

Fig. 8 a), b), c) Examples of open spaces that encourage good neighborly relations and which are visually and aesthetically pleasant. Sources: a), b) Nelte, H. M., 2003. Landschaftsarchitekten III. Neue Entwürfe ausgewählter Landschaftsarchitekten aus ganz Deutschland, Wiesbaden, c) http://www.urbanforestry.info/landscaping/parks-and-open-spaces/ [Accessed:August 24th 2018].

It can be said that the aesthetic dimension of open spaces is a key component that attracts tenants to stay in this area, that is, which favours the creation of inviting spaces. Represented colours, styles and spatial shapes can affect the emotions and behaviour of tenants, either in a positive or negative way, they can act incentive, cause user benefits, or act monotonously and reflectively [11]. Therefore, the esthetic dimension of open spaces must be meticulously accessed in the urban design.

3.9. Management and maintenance

Regular maintenance manifests itself to the degree of usable value of open spaces. The appearance and hygiene of open spaces affect the satisfaction of the tenants in this area, and therefore the length of their stay. On the other hand, in unsustainable, abandoned and dirty open spaces, the frequency and length of tenant's residence is low, and such areas are repulsive to tenants. Long-term neglect of open spaces leads to an increasing devastation and constant disturbance of the quality of life of tenants. The share of tenants in joint activities in open spaces and in their improvement and upkeep contributes to the improvement of the feeling of pride of tenants and the responsibility for the housing environment. Tenants' participation also allows them to make choices for alternative urban design and affirmation of space quality such as security, readability, identity, which will enhance their sense of belonging and control [5].

4. REVITALIZATION OF OPEN SPACES IN POPTAHOF

Residential neighbourhood Poptahof in Delft is a model of good practice of revitalizing open spaces where the applied quality criteria were identified in the initial part of this paper in a systematic and integrated manner through the implementation of the Master Plan for the restructuring of Poptahof in order to improve the quality of life. Poptahof is a social housing area built during the 1960s outside the historic centre of Delft on 18.6 hectares, and in the neighbourhood there are about 2800 inhabitants representing a large number of different nationalities [16]. The key problem in Poptahof was the degradation of open spaces, low level of orderliness and anonymity, impaired safety, lack of sense of community and low level of quality of life. During 2000, the City of Delft and Woonbron Housing Corporation created the Master Plan for the Restructuring of Poptahof with the aim of making Poptahof a pleasant location for living, working and passing time [15]. Master plan was re-formulated in 2003, a collaborative research carried out by a team of experts and tenants of the complex, whereby data were collected through: field observation, mini-interviews of tenants at the location and interviewing passers-by. The goals of the plan were: improvement of monotonous housing spaces, reorganization and construction of new open spaces, as a part of the integrated reconstruction of the neighbourhood (see Fig. 9).

The key point of this project's success was the formation of a public-private partnership in order to promote Poptahof jointly. The basic starting point for the revitalization of the neighbourhood was that well-organized and functional open spaces were a prerequisite for the realization of the long-term improvement process of the neighbourhood. Identified criteria for the quality of open spaces, as defined in the first part of this paper, can be noticed in the reorganization of Poptapark, as well as in the revitalization of the housing platform. Poptapark is centrally located in a place where there was previously a river with tall flora on its banks, and it is designed for all categories of tenants. It was found that the park provides a great potential for improving the quality of the entire Poptahof and creating a recognizable housing neighbourhood. The park is reorganized as a place for physical activities, gatherings, relaxation and community manifestations (see Fig. 9).

a) b)

Fig. 9 a) Master plan for the revitalization b) Poptapark. Source: https://www.urbangreenbluegrids.com/projects/poptahof-delft-the-netherlands/ [Accessed: August 21th 2018].

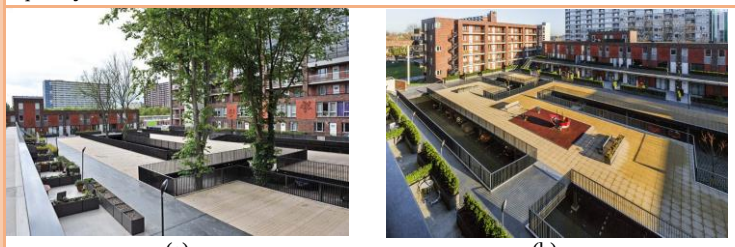
The following activities are planned in the park for various activities:

- playground, lawns, green hills (used for sunbathing, sledding, festival and other events);
- a bicycle path and walk that passes through the park and connects it to the main street and the shopping area;
- the place where the occupants deal with collective gardening.

The path for cyclists and pedestrians passing through the park contributes to the greater flow of people and facilitates interaction, observation of passers-by, and it is realized through integrated routes, directions and activities of different categories of people. A great effort was made to familiarize users with the rules of behaviour in the park for the purpose of safety and the prevention of antisocial behaviour, by placing signs and employing the park manager. The park is friendly to family gatherings - to stimulate joint activities of children and parents. It is especially important to realize a healthy and resilient water system. A part of the water system was designed to be visible. A water playground was built, the design for which was based on the winning idea from a children's competition (see Table 1).

Unlike Poptapark, the housing platform is not a public space. Although it has open access, this space can best be described as semi-public and located within the housing block. The terraced terraces of buildings surround this area and represent private spaces. The platform is also visible from the balcony and windows of the apartments on the higher floors, while the stairs are connected to the central park. Variability in design was applied at different spatial-functional level- creating various gathering and relaxing areas, then housing yards for gathering and meeting inside residential blocks, as well as informal semi-private meeting rooms.

Table 1 Review of of quality criteria implemented in Poptahof

Quality criteria	Implementation of Master Plan
1. public-private delineation 2. usability, diversity and accessibility 3. urban design 4. health and comfort 5 security 6. privacy and territoriality 7. social contacts and good neighborly relations 8. visual-aesthetic benefit 9. maintenance	 (a) (b) (c) (a) (b) play areas for children, a higher level of security (c) revitalized sports ground-quality criterion 2,3,8
	 (a) (b) (a)(b) semi-public housing platform: the gardens of the apartments on the ground surround the platform-quality criterion 1,2,3,6
	 (a) (b) (c) (a) (b) tenants participation (c) participation of children-quality criterion 6,7
	 collective gardening-quality criterion 4,6,7,9

Figures source: W. Tiessens, W., M. Dol, B. Peeters, et al., The image project new tools for neighbourhood regeneration, Regenerating neighborhoods by improving their image – an INTERREG IIIB Project. Table source: Author

5. CONCLUSION

In the current conditions, we are facing a trend of marginalization and degradation of the quality of open spaces in high-rise housing neighborhoods, which necessitates their revitalization and harmonization with the modern needs of the users. In this paper an integrated set of criteria for the quality of open spaces is presented, which can be used in the process of urban revitalization in order to improve the tenants quality of life in high-rise housing neighborhoods. By unifying different requirements that these spaces should fulfil in the quality of life function, criteria and aspects of quality that are relevant for revitalization of open spaces are systematized. A particular challenge is to harmonize the mutual relations of the varied and changing needs of tenants with established criteria for the quality of urban open spaces, as an instrument for determining the conditions that open spaces should fulfil in order to represent the desired destination of tenants in their spare time. The implementation of the Master plan for the revitalization of open spaces in Poptahof, demonstrates that the application of various measures towards the achievement of an integrated set of quality criteria contributed to modernization and creation of a positive perception of the entire residential neighborhood, so as to attracting additional investments of various interest groups and for the purpose of investing in mixed and multifunctional contents within the neighborhood.

The criteria and aspects of quality set forth in this paper cannot be final or complete, but can be adopted in the process of urban revitalization. Much more detailed research is needed to elaborate how to apply the proposed criteria, both within the analysis of the existing state of open space, in the function of identifying the types of problems, as well as in the process of determining the necessary measures and activities in the process of urban revitalization in order to achieve a higher level of quality.

Acknowledgement. *The paper is a part of the research done within the project of the Ministry of Science and Technology of Serbia "Optimization of Architectural and Urban Planning and Design in the Function of Sustainable Development of Serbia", (36042), project Manager prof. dr Nadja Kurtović-Folić*

REFERENCES

1. Y. Ashihara, Exrerior Design in Architecture, Van Nostrand Reinhold Company, New York, 1970.
2. De-mao Bai, ‘’Residential Area Planning and Environment Design’’, China Building lndustry Press, Beijing, 1993.
3. L. Bentley, A. Alcock, A., P. Murrain, S. McGlynn, G. Smith, G., ‘’Responsive Environments: A Manual for Designers’’, Architectural Press, London, 1985.
4. I. Bogdanović Protić, Urbana regeneracija višespratnog stanovanja, Zadužbina Andrejević, Beograd, 2009.
5. I. Bogdanović Protić, ‘’Tenants' participation as a tool for urban regeneration of multi-family housing’’, Proceedings of the International Conference ‘’Indis 2012: Planning, design, construction and renewal in the civil engineering’’, Novi Sad, pp. 757-763, 2012.
6. I. Bogdanović Protić, Definisanje modela revitalizacije slobodnih prostora kompleksa sa višespratnim stanovanjem u funkciji unapređenja kvaliteta života, doktorska disertacija, Građevinsko-arhitektonski fakultet Univerziteta u Nišu, 2016.
7. B. A. Coorey, Shaleeni, Design of open spaces in high density zones: case study of public housing estates in Hong Kong, Phd Thesis, University of Hong Kong, 2012.
8. R. Curran, Architecture and urban Experience, Van Nostrand Reinhold, New York, 1983.

9. S. H.Dendy, Resident Involvement in the Landscape Architectural Redesign of Public Housing: Creating Opportunities for a Sense of Ownership, Control, and Efficacy through a Participatory Design Process, Master Thesis, Virginia Polytechnic Institute and State University, Blacksburg, 1998.
10. J. Gehl, Life Between Buildings: Using Public Space, Van Nostrand Reinhold, New York, 1987.
11. Y. Li, Space Between Buildings in Beijing's New Housing, Master Thesis, School of Architecture, McGill University, Montreal, 1999.
12. L. Lička, C. Dlabaja, D. Grimm-Pretner et al., FreiWERT, Untersuchung der Qualität und Wertigkeit von Freiräumen von innerstädtischen Neubauprojekten und Darstellung innovativer Lösungen, Berichte aus Energie- und Umweltforschung, Wien, 2012.
13. E. E. Lozano, Community Design and the Culture of Cities: The Crossroads and the Wall, Cambridge University Press, New York, 1990.
14. G. Ruland, Freiraumqualität im Geschosswohnungsbau, Stadtent Wicklung, Wien, 2002.
15. W. Tiessens, W., M. Dol, B. Peeters, et al., The image project new tools for neighbourhood regeneration, Regenerating neighbourhoods by improving their image – an INTERREG IIIB Project (dostupno na http:/urban.nl/sites/urban/files/IMAGE_new_tools_for_neighbourhood_regeneration.pdf)
16. https://www.urbangreenbluegrids.com/projects/poptahof-delft-the-netherlands/

IDENTIFIKACIJA KRITERIJUMA KVALITETA OTVORENIH PROSTORA U STAMBENIM NASELJIMA SA VIŠEPORODIČNIM STANOVANJEM U PROCESU URBANE REVITALIZACIJE

Korelacija između kvaliteta slobodnih prostora i kvaliteta života u stambenim naseljima sa višeporodičnim stanovanjem u savremenim urbanističko-arhitektonskim i socijalnim okvirima potvrđena je nizom multidisciplinarnih istraživanja. Savremena istraživanja ukazuju da je u procesu revitalizacije potrebno sagledati različite aspekte kvaliteta otvorenih prostora kako bi ostvario što efikasniji stepen unapređenja. Stvaranje odgovarajućih prostornih uslova za različite vrste aktivnosti dnevnog slobodnog vremena stanara i vršenje fizičke aktivnosti u pravcu unapređenja psiho-fizičkog zdravlja, postizanja prostorno-ambijentalnih vrijednosti, kao i za podsticanje dobrosusjedskih odnosa, zajedništva, teritorijalnosti i osećaj pripadnosti, koji su sve determinante kvaliteta života, mogu se postići obezbeđivanjem određenog nivoa kvalitetnih otvorenih prostora. Imajući u vidu da ne postoje jedinstveni kriterijumi kvaliteta otvorenih prostora u stambenim naseljima sa višeporodičnim stanovanjem, cilj ovog rada je da ukaže na poželjne karakteristike ovih prostora u skladu sa savremenim principima urbanog dizajna i prakse u procesu njihove revitalizacije. Stoga je Poptahof stambeno naselje odabrano kao istraživačka platforma koja predstavlja primer dobre prakse unapređenja otvorenih prostora u skladu s utvrđenim kriterijima i aspektima kvaliteta. Ovi kriterijumi mogu poslužiti kao osnova za dalja istraživanja modaliteta urbane revitalizacije otvorenih prostora, sa ciljem poboljšanja kvaliteta života stanara stambenih naselja sa višeporodičnim stanovanjem.

Ključne reči: *otvoreni prostori, stambena naselja sa višeporodičnim stanovanjem, urbana revitalizacija, kriterijumi kvaliteta*

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

71/72+62

FACTA Universitatis. Series, Architecture and Civil Enginering / editor-in-chief Dragoslav Stojić. - Vol. 1, No 1 (1994)- . - Niš : University of Niš, 1994- (Niš : Unigraf-X-copy). - 24 cm

Tri puta godišnje. - Tekst na engl. jeziku. -
Drugo izdanje na drugom medijumu:
Facta Universitatis. Series: Architecture and Civil Engineering (Online) = 2406-0860
ISSN 0354-4605 = Facta Universitatis. Series: Architecture and Civil Engineering
COBISS.SR-ID 98807559

FACTA UNIVERSITATIS

Series
Architecture and Civil Engineering

Vol. 17, N° 2, 2019

Contents