TEORIJA IN PRAKSA UREJANJA PROSTORA

IGRA USTVA RJALNOSTI

THE CREATI VITY GAME

ŠT. 8/2020

NO. 8/2020

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THEORY AND PRACTICE OF SPATIAL PLANNING

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CREATIVITY GAME

THEORY AND PRACTICE OF SPATIAL PLANNING

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I.

UVODNIK

EDITORIAL

Alenka Fikfak

RAZISKOVANJE IN KREATIVNOST PISANJA V LETU 2020

Revija Igra ustvarjalnosti je v letu 2020 doživljala vse močnejše prelomnice in lahko njene aktivnosti kar primerjamo z epidemijo covida in premiki, ki so postopoma ustavljali družbeno življenje. Številka 7, letnica 2019 je bila obširna, z vsebinami različnih področij in je obetala aktivno nadaljevanje v leto 2020. Namen revije ni bil nikoli le pregled in objavljanje znanstvenih vsebin. Že njen naslov nakazuje množico dodanih vsebin in predstavitev, ki so vezane predvsem na urbanistične in ostale prostorske delavnice. Kljub temu, da se je zapiranje in postopno ustavljanje družbe v letu 2020 pričelo v mesecu marcu, pa je to ravno obdobje, ko se tovrstne aktivnosti v povezavi s prostorskimi študiji, največ odvijajo. Leto 2020 nam je v veliki meri odvzelo »kreativnost« ustvarjanja, ostali smo sami za računalniškimi zasloni, z navidezno virtualno družbo preko zoom-ov, teams-ov, webex-ov in še česa drugega. Kar je bilo v spomladanskih mesecih zaznati kot nemogoče, se je v jesenskih obrnilo v običajni delovni dan in spreminjanje celotnega koncepta bivanja. Človek je res prilagodljivo bitje, pa vendar, kam gremo?

In kaj smo v reviji ustvarjali v letu 2020, kljub stalnemu spraševanju kam gremo in kaj bomo, v že bližnji prihodnosti? Želje po predstavitev raziskovalnega dela v znanstvenih prispevkih so bile velike, najav s povzetki, z zelo raznolikimi vsebinami, več kot še za leto 2021. A pod pritiskom spreminjanja bivanja, smo se tudi raziskovalci spoprijemali z vsemi mogočimi težavami in tudi pisanje se je postopoma ustavljalo. Prav zato, se posebej zahvaljujem vsem avtorjem v tej številki, ki so s svojo energijo omogočili njen nastanek in še enkrat preprečili, da bi uredniški odbor, z vso prostovoljno energijo sedmih let, omagal. V septembru 2020 smo zasedba uredništva bili v vlogi so-organizatorjev in avtorjev vsebin znanstvene konference City street 4. Tudi konferenca se je prenesla na zoom platformo in tudi pri tem smo dokazali zdržljivost in inovativnost raziskoval-

cev v želji predaje znanja na mednarodnem nivoju. Mednarodnost se je prenesla na različne nivoje, v obliki, ki so nam vsem skupne, sogovornik je v vseh oblikah postal ekran. Revijo torej še vedno premeta od vse nove mednarodnosti do družbene pasivnosti, utrujenosti in odtujenosti. Pa vendar, v tej številki se boste srečali z urbano reciklažo, pregrevanjem uličnega prostora, naravnim prezračevanjem stavb, gradbenimi odpadki, in vlogo transporta. Vse skupaj pa povezuje kontekst grajenega, ki pa je tudi spremenljiv, tako kot so vse omenjene lokacije ali case studies v posameznih prispevkih.

V obdobju prve karantene, ki je bila na srečo v spomladnih mesecih, ko so sprehodi postali stalnica življenja, sem se kot opazovalec znanega prostora srečevala s podrobnostmi, ki so mi odpirala nova in nova vprašanja. Eno od teh nasprotij, ki verjamem da kažejo nepremišljenost družbe, je bilo opazovanje praznega avtocestnega prostora primorske avtoceste na odseku Vrhnika-Brezovica. In prav v tem obdobju o »veseli« novici, da je potrjena sprememba razširitve te omenje AC z dodanim tretjim pasom. Za koga pa? A se pisci teh novic niso niti vprašali kaj ej trenutno stanje in da mogoče to stanje lahko postane kar hitro stalnica? Ja, raziskovalci, pisci znanstveno objektivnih besedil, vaše delo postaja vse bolj pomembno in ima misijo opominjanja družbe in našega samo-uničenja. Pišimo in si predajmo znanstveno objektivne premisleke vsebin, pa tudi esejistično osebne vtise kaj se v našem in mednarodnem prostoru odvija. Pišite in tudi uživajte v branju zgodb iz leta 2020, ki na srečo le niso povezane z epidemijami in covidom, vsaj v tej reviji je temu namenjen samo uvodnik. Leto 2020, vsekakor drugačno!

izr. prof. dr. **Alenka Fikfak**
urednica revije IU

UVODNIK
EDITORIAL

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RESEARCH AND WRITTING

CREATIVITY 2020

The journal *Igra ustvarjalnosti* (Creativity Game) experienced all kinds of turning points in 2020 and its activities can be compared to the COVID epidemic and shifts that have gradually brought social life to a halt. Issue No. 7/2019 was extensive, consisting of content encompassing various fields, and promised to effectively continue into 2020. The journal's purpose has never been merely to review and publish scientific content. Its very title indicates a multitude of additional content and presentations, which are mainly related to urbanistic and other spatial workshops. The locking and phasing out of society began in March, which is precisely the period when activities in connection with spatial studies are usually most intense. 2020 has largely taken away our scope of creativity; we have been left alone behind computer screens, with virtual socialising on Zoom, Teams, Webex and others. Things that seemed impossible in the spring months proved to be part of a normal working day in autumn and so the whole concept of living started to change. Human beings are fairly flexible, but where are we going really?

What have we created in the journal, despite constantly asking ourselves where are we going and what are we going to do in the near future? There was a great desire to present research work in scientific papers, and announcements with summaries of very diverse content showed that there would be enough material, even for 2021 and beyond. However, under the pressure of changing living standards, researchers have been facing all kinds of problems, too, causing our writing to gradually stop. For the same reason, I would like to express my special thanks to all the authors featured in this issue who devoted their energy and enabled the journal to come out, thus preventing once again the editorial board, based on seven years of voluntary work, from giving up. In September 2020, members of the editorial board co-organised and participated as authors in the City Street4 scientific conference. The conference took place on the Zoom platform, where we have also demonstrated the persistence and innovation of researchers

desiring to share knowledge at an international level. Internationality has been transferred to different levels and in the form that we all share, while a screen has become our partner on the other side. The journal is thus still full of new internationality, social passivity, fatigue, and alienation. Yet this issue offers you topics such as urban recycling, overheating of streets, natural ventilation of buildings, construction waste, and the role of transport. They are connected by the context of the built environment, which is as diverse as all the locations or case studies mentioned in individual contributions.

During the first lockdown, which was fortunately in the spring months, when walks became a permanent feature of life, I was observing the space that was familiar to me and encountering details that raised new questions. One of the things, which I believe shows the recklessness of society, was to observe the empty Vrhnika - Brezovica section of the Primorska motorway while the "good" news broke about the expansion of the aforementioned motorway with a third lane. But who is that for? Have the writers of these news articles even asked themselves about the current situation, which may become permanent in quite a short time? Researchers and writers of scientifically objective texts, your work is truly growing in importance and it is your mission to remind society and to warn it of self-destruction. I encourage us to write and share scientifically objective reflections of content as well as essays with personal impressions of what is happening in our local and international environment. I hope that you will be inspired to write, and equally so, to enjoy reading stories from 2020, which are not, I'm pleased to say, related to epidemics and especially COVID-19. It is only the editorial that is dedicated to this topic, at least in this journal. 2020—definitely a different year!

Assoc. Prof. Dr **Alenka Fikfak**
Editor of the Journal

II.

ČLANKI

ARTICLES

Jernej Červek: TRAJNOSTNI PRISTOPI V URBANISTIČNEM NAČRTOVANJU: RECIKLAŽNI URBANIZEM

SUSTAINABILITY APPROACHES TO URBAN PLANNING: RE-CYCLING URBANISM

DOI:

<https://dx.doi.org/10.15292/IU-CG.2019.07.012-019> ■ UDK: 711.4: 502.131.1 ■ SUBMITTED: September 2020 / REVISED: October 2020 / PUBLISHED: November 2020

1.02 Pregledni znanstveni članek / Review Article

POVZETEK

Sodobna mesta po svetu se širijo predvsem pod pritiskom rasti prebivalstva, v Sloveniji pa stagnirajo predvsem pod vplivom suburbanizacije. Mesta se niso pravočasno odzvala na nove oblike bivanja, na podnebne razmere in na preveliko porabo energije ter so zato postala utesnjena, nezdrava in potratna. To sproža kritiko dosedanjih paradig razvoja in operativne neodzivnosti trajnostnih politik. Na podlagi pregledane literature o fenomenu trajnosti – urbanih politik, konceptov in oblik mest – prispevek ugotavlja, da se načrtovalski procesi v slovenskih mestih še vedno prednostno ukvarjajo z reševanjem nujnih investicij, celostno reševanje mesta na podlagi dolgoročnih vizij pa še vedno ostaja odprto vprašanje. Medtem pa sodobni globalni pristopi v urbanističnem načrtovanju mest na trajnostnih načelih težijo k intervencijam v obstoječi mestni prostor. Eden od takih pristopov je reciklaža mesta, ki poseže v mesto z namenom, da ga prilagodi sodobnim zahtevam na osnovi celostnega pristopa, ki vključuje zbiranje in analizo podatkov o obstoječem stanju in ugotovitve povezuje s prakso.

KLJUČNE BESEDE

kulturna dediščina, sledenje pogleda, raziskave, vizualna pozornost

ABSTRACT

While the growth of global urban centres is primarily attributable to population growth, Slovenian towns are stagnating due to suburbanization. The urban centres have failed to timely adapt to new forms of living, climate change and excessive energy consumption; in consequence they are becoming cramped, unhealthy and wasteful. This has led to criticisms of existing development paradigms and operative lack of responsiveness on the part of sustainable policies. Based on relevant literature on sustainability – urban policies, concepts, and urban forms –, the paper shows that town planning approaches in Slovenia still primarily deal with solving problems of necessary investments, leaving comprehensive urban solutions based on long-term visions on hold. Meanwhile, the global contemporary town planning approaches based on sustainability principles tend towards interventions into existing urban space. One such approach is urban recycling; a form of urban intervention aimed at adaption of the urban environments to contemporary needs on the basis of comprehensive approach which includes collecting and analysing data on the existing situation and integrates observations with practice.

KEY-WORDS

re-cycling, urbanism, sustainable cities, town planning, urban design

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1. SUSTAINABLE APPROACHES IN TOWN PLANNING

Global urban population is rapidly growing. More than half of the world population lives in urban areas while projections of population growth suggest that the proportion of world population living in urban areas will reach 60% by 2030 (United Nations, 2014). Meanwhile, in "Europe already 76% of the population lives in cities" (Ležnicki, Lewandowska, 2014: 91). "However, the situation in Slovenia is slightly different: unlike the states in which fast urbanization is underway, Slovenia is characterized by suburbanization and comparatively low proportion of urban dwelling population. Since the 1980s, the proportion of urban population has not exceeded 50%, while UN projections anticipate its increase to just 61% by 2050" (Ministrstvo za okolje in prostor, 2019).

Due to dynamic suburbanization, cities spread faster than they concentrate, and they primarily spread to raw agricultural and wooded areas. Uncontrolled city growth may adversely affect both environment and inhabitants (Buckley et al., 2008). Urbanization in Slovenian towns and cities is reflected mainly in construction on urban edges, concentrated construction of residential neighbourhoods, and industrial and shopping zones. According to Gantar (2016: 53), "the contemporary situation in Slovenian context might well be described as one in which the development of new spatial structures and forms, including 'aesthetic practices', is in some ways outpacing spatial planning, thus forcing the latter to retroactively adapt itself to new spatial realities, such as shopping centres on urban edges, various transformations of former industrial areas, residential changes brought about by the construction of highway networks – to enumerate just the most obvious and also the most important ones."

One response to uncontrolled urban growth is to be found in the increasingly common concept of sustainable development and the subsequent policies, concepts, and urban forms which increasingly influence contemporary lifestyle.

The present article discusses the concept of sustainable development and its influence on urban planning which has led to a number of urban policies, concepts, and different urban forms. It emphasizes research on one of the new approaches to urban planning, i.e. re-cycling urbanism. This is followed by a presentation of the Spanish and the Italian school, the concept of re-cycling urbanism, and the content of re-cycling urban design. The article concludes with an assessment of contemporary urban planning in Slovenia, primarily characterized by a relative lack of comprehensive approaches.

2. METHOD

The review of the primary and secondary literature was made to reveal the main aspects of sustainable development and town planning issues in relation to re-cycling urbanism. The review has focused on three main themes: 1) sustainable policies, 2) urban development concepts and urban forms and 3) new approaches in town planning with special attention to re-cyclical urbanism. We have systematically applied the quantitative method of textual analysis to the content of the literature by using the following criteria: frequency of selected words, presence/absence of key concepts, and collocation (trends towards interconnection of selected words and concepts). By doing so, we have identified the main requirements of re-cyclical urbanism that can be incorporated into classical urban development plans.

2.1. Concepts of sustainable development and urban design

Our starting premise is a need for modernizing urban design (town planning), with sustainable development and urban design interpreted as follows.

Sustainable development is a well-established concept used in all areas of human activities. The most commonly cited definition of sustainable development, according to Gro Harlem Brundtland, reads as follows: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (as cited in Medved, 2018). Another basic principle, underlined by the Brundtland Commission, requires that local and global development should be planned in such a way as to balance three basic components: a) environmental protection, b) economic growth, and c) social equality (Kos, 2004).

Due to perspectives of different scientific disciplines, various derivatives, guidelines, instructions, strategies, principles, etc. are to be found in literature. Thus Berdavs (2010) points out that "one notable characteristic of the concept of sustainable development is its ubiquity; it is not limited to certain areas of social life", and proceeds that "it is also a subject of intensive research, present in very different research areas of both natural and social sciences".

Urban design plan (urban plan, town plan) is the only planning act of the Slovenian national law with a comprehensive approach to cities (or other larger urban areas). As a planning act, it is a product of "a process of development and division of municipal (i.e. urban) structures which need to be complexly and comparatively interpreted, and above all comprehensively designed and formed: not merely in a technically sound but also in an aesthetically ambitious manner" (Košir, 1993). The goal of urban design is to plan and shape city development, its growth (both spread and concentration) and renovation, and to allocate its activities (plan for area uses), including its traffic and communal infrastructure. Pogačnik (1999) describes the urban plan (town plan, Ger. *Stadtplan*) as a "long-term vision of urban development of the city". Proceeding from such visions, urban design directs spatial development on a long-term basis, and is consequently realized in official planning acts. Therefore, urban design "cannot solve all urban planning problems", writes Šašek Divjak (1999), underlining the need for its sufficient adaptability and flexibility in order to allow for necessary changes. As pointed out by Dimitrovska Andrews and Nikšič (2005), the role of urban design is "primarily to direct development and regulation of the city as a whole, protect and develop the image of the city, direct organization of spatial activities and uses, direct regulation of particular characteristic parts of the city, and above all provide for a healthy environment and quality of living".

In their article on flexible urban planning, Vidmar and Koželj (2015: 46) present basic principles of contemporary urban design and planning. According to them, urban designers "have to develop their spatial idea in compliance with all the requirements given in the land use plan" and "other spatial planning documents, laws, standards, and norms. These quantitative requirements set out the boundary conditions that define solution space within which the urban designers need to establish high quality relationships between multitude of buildings to form a whole development".

3. SUSTAINABILITY AND URBAN PLANNING – URBAN POLICIES, CONCEPTS, AND FORMS

Sustainable urban policies

International sustainable urban policies are increasingly important in the top-down approach to urban planning. Political documents on international and national levels are constantly being supplemented and upgraded. For our present purposes, the relevant documents on the international level under the auspices of the Organization of United Nations directing urban development are the *2030 Agenda for Sustainable Development* (Agenda za trajnostni razvoj, 2015) – with Goal 11 stating “Make cities and human settlements inclusive, safe, resilient and sustainable” – and the *New Urban Agenda – Habitat III* (Nova urbana agenda, 2016) – emphasizing “a vision of cities for all” in order to “produce just, safe, healthy, accessible, affordable, resilient and sustainable cities and human settlements” on the global level. The relevant document on the European Union level is the *Urban Agenda for the EU – Pact of Amsterdam* (Urbana agenda EU, 2016).

Common goals of all these three policies are comprehensive approaches, public participation, urban renovation/city regeneration through adequate density planning, sustainable construction, housing policy with emphasis on quality affordable housing, renewable energies, open built and green spaces, accessible water, quality air, and waste management.

Concept of sustainable city

Political endeavours towards more sustainable development have also motivated town and spatial planners to develop new approaches and concepts of “sustainable cities” in urban planning. As stated by Hesse and Schmitz (1998: 435), “growth of welfare mass motorization created conditions for leaving the city with its cramped living conditions”. Consequentially, according to Hassan and Lee (2014: 1268), the “major concern is the unsustainable nature of cities and the problems resulting from urban sprawl. These issues have motivated planners, geographers and governments to seek appropriate solutions to the environmental, economic, and social problems through sustainable developments”. Building on principles and goals of sustainable development, several different concepts of a sustainable city have appeared, such as “green cities”; “digital cities”; “smart cities”; “resilient cities”; “eco-cities”; “low carbon cities”; and combinations thereof (de Jong et al., 2015). Williams (2010: 128) in his discourse on sustainable cities points out the existence of different “competing ‘visions’ of sustainable urbanism” and suggests a “multiplicity of socially-constructed potential futures” should be preferable to the “one model fits all” approach, which might provide a good starting point for future development. After all, all cities are different, and their sustainable development is further influenced by their location, broader urban area, available resources and policies, which is why it is important for each city to find its own workable sustainable concept.

Forms of sustainable cities

Recent scholarly discussion on the forms of sustainable cities primarily highlights the concept of the compact city, according to Williams’ influential review article (2010: 129) which states that within debates on the subject “the idea of ‘the compact city’ has been favoured, above other settlement patterns in policy for a number of decades”.

Hassan and Lee (2014: 1272) state that the term was developed by George Dantzig and Thomas L. Saaty in 1973, propagating “in the 1980s and 1990s as a backlash against postwar urban planning,

which impacted negatively on the economic, environmental, and sociocultural aspects of communities”.

According to Rogatka and Ramos Ribeiro (2015: 57), the main elements of a compact city are “mixed spatial use and high density of activities; diverse range of services; short distances; diminished pollution; car non-dependence; cycling encouragement; social interactions; high density of population; walking encouragement; accessibility; efficient public transport; well-organized urban infrastructure; energy efficiency”.

Despite the popularity of the compact city, criticisms include lack of green spaces since it is impossible for a city to provide both for higher building density and planning new spaces. As pointed out by Hassan and Lee (2014: 1273), citing Ståhle (2010), “scholars urge that the compact city does not guarantee the provision of sufficient green spaces within the city, and thus, it is considered the anti-theory of a green city”. They continue, quoting Oktay (2012), that, due to the disparity of cities “in density, form, structure, and location, the compact city theory may be suitable for some cities, but it may fail in other cities”.

The influence of goals, concepts, and forms of sustainable cities on urban development

As a result of political goals, concepts, and urban forms in town planning, the influence of the sustainability concept is reflected in the context of the city itself, seeking solutions for new forms of living, work, travel, and adapting to climate change.

The paradigm of sustainable development casts the spread of cities and settlements to raw agricultural and wooded areas in a distinctly negative light. Namely, the sustainability paradigm is based on sustainable development, which, transposed to urban planning, means that the needs for city growth must be contained within existing urban areas as internal development and intact nature preserved as unzoned areas.

Internal urban development and concentration can thus provide an answer to the basic orientation towards environmental protection and nature conservation. However, excessive concentration leads to cramped living conditions which do not provide a quality living environment, important for human society. Visvanathan (2017) writes that the “resilience of cities encompasses a broad range of issues including building efficient recovery systems (engineering and multi-equilibria resilience) in the cities or planning means of adaptation to the increasing environmental, economic or socio-cultural stresses (socio-ecological resilience)”, and continues that “the cities foster networked material land energy flow which evolve around the idea of resource efficiency and 3R” (i.e. Reduce – Reuse – Recycle).

New directions in urban planning and new approaches to urban design seek solutions inside the existing city space which can be recycled and qualitatively reused for new forms of quality living.

The sustainable paradigm suggests a mental leap in urban planning from classical to re-cyclical planning. The emphasis is no longer on classical planning as technical planning and dimensioning of objects, searching for available physical space or creating new space for construction of new objects. Instead, the new approach focuses on use and recycling of the existing city adapting to new social requirements. Consumption of space, goods, and energy is replaced by recycling, which can positively affect society.

The goal of this approach is to lower the consumption of both materials and energy through reuse of the existing urban space, al-

Figure 1: Venn diagram of classical urban design (CUD) and sustainable urban design (SUD) in comparison.

ready invested with materials and energy. The city is being recycled. This means that urban design is in a process of transition from its classical form based on technical planning, dimensioning of urban areas, designing activities and infrastructural integration, to a new approach based on:

- Participative society actively cooperating in the search for new solutions and ideas (including new forms of living, work, and travel);
- Circular economy recycling resources and materials, returning them into production cycles and reusing them;
- Eco-systemic solutions adapting to climate change. (Figure 1)

4. NEW APPROACHES IN URBAN PLANNING – “RE-CYCLICAL URBANISM”

The new direction in urban planning was initiated by the Spanish and Italian schools where the so-called re-cyclical urbanism was developed. Re-cyclical urbanism recycles the entire city, and not just through renovations of degraded and abandoned urban areas but also through interventions into quality built urban areas by adapting to principles of sustainability. Such approach also emphasizes the formative role of city architecture since a well-planned, high-quality and aesthetically pleasing city positively affects human well-being.

Beginnings of re-cyclical urbanism – the Spanish School

One of the progenitors of re-cyclical urbanism is the University of Alcalá near Madrid with its design studio Advanced Projects in Architecture and the City (*Proyectos Avanzados en Arquitectura y Ciudad*). The studio was founded as a response to contemporary global developmental trends and related imminent and drastic changes, writes Cervera Sardá (2011). She explains the role of the studio in researching existing “urban systems” with the aim of rebuilding or transforming them into “efficient urban cities”. The concept of the “Recycled City” was created in order to balance human, social and environmental parameters of these cities. She raises the question of whether a city can be recycled and answers that “the core concept of ‘Recycled City’ inherently carries the idea of intervention into the existing city, with the intention of adapting it to contemporary demands. To recycle a city means to build ‘towards the inside’ and to consider it as something that is ‘alive’”.

Within the scope of the studio, research was carried out into three different city areas, namely two in the centre of Madrid and one in the city suburbs. Thus a “broad and diverse basis of urban schemes” was created in order to “cover as many different situations as possible and to confront them from different aspects”.

The first case is the Salamanca neighbourhood, also known as Plan Castro, with a grid street plan and chess-like block layout, quality architecture with opulent facades, high population density (280 inhabitants per hectare), and important social activities. According to Cervera (2018), the area lacks “adjustments that were preventing its modernisation and adaptation to the needs of a balanced efficient habitability suited to the 21st century”.

Urban recycling of the “quality” city area suggests a revision of the block concept, namely interventions into existing spaces inside the block perimeter, turning such spaces into publicly accessible greeneries. In this way, the city would gain previously inaccessible new open green spaces. Another intervention was proposed into the block structure itself, where apartments “stretch between 200 and 500 m² and have several poorly lit by natural light rooms without ventilation”. As a solution, the concept of terraces was proposed in order to gain both vertical and horizontal connections and to allow light to enter the apartments.

New types of apartments offer habitable space for different sets of families, social and age groups, and thus provide an answer to the lack of social housing in Madrid.

The second case is the district of Tetuán-Valdeacederas, “an outskirts unplanned borough from the beginning of the 19th century”, as described by Cervera (2018). She adds that this “peripheral settlement has had from the very beginning an irregular morphology characteristic of unorganised or unplanned settlements”. According to her, an “altogether integral rehabilitation of this zone would allow for a better distribution of population density and would furnish the interior with green and open spaces. Additionally, an integral rehabilitation plan would enable the improvement of existing infrastructures and the option of implementing sustainable energy and mobility models”. However, local “government regulations have legal vacuums” which might prove to be an obstacle to suggested interventions. Nevertheless, the main problem is the guiding principle of private capital with unplanned rehabilitation which “continues to be irregular, disorganised, congested, lacking in concerns over the sunshine and natural light, with poor optimisation of land and low quality in architectonic and landscape terms”.

The last case is the nearby area of Alcalá de Henares, one of Madrid’s industrial zones and at the same time a commuter town. This city area was forced into recycling by the economic recession. Cervera (2018) describes its configuration “as an industrial framework isolated from the city by the railway tracks and newly developed residential areas. All of it is a mixture of the historical, the new and the productive”. Urban recycling suggests using urban

Classical urban design
distribution of activities and land use
economic public infrastructure network
social activities network
public space areas
green space areas
urban and architectural design
nature and cultural heritage conservation
involvement of the public

Figure 2: Content of classical urban design and recycling urban design in comparison.

voids to establish parks and areas adjacent to railways to construct high buildings which would serve as sound barriers. One of the objectives was “to promote the use of trains as one of the better urban alternatives for environmentally friendly and sustainable travel” and “to build a fully comprehensive bicycle lane scheme widely accessible to all with the aim to promote a healthier and more sustainable transport system”.

“The objective of the design exercise was primary to recover the citizen’s interest in the streets. The situation called for a meticulous analysis of various urban contexts and their specific needs”, concludes Cervera (2018) and adds that adequate “construction, the improvement of urban spaces, and the provision of appropriate infrastructures and services, can all be critical to the urban restructuring of an area”.

Origins of re-cyclical urbanism – the Italian School

The idea of a city “that can be recycled” has also been on the minds of architects and town planners from the University of Venice, as summarized in their report *Recycling City: Lifecycles, Embodied Energy, Inclusion*. Fabian et al. (2012) write that urban “recycling is not just reusing, but, if we follow the analogy with the organic world, it puts forward a new life cycle”, adding “that the city is a resource and that it can be recycled in parts or episodes or as a whole at the end of the different life cycles”.

Their approach to recycling buildings, infrastructure, and the entire city is based on three pillars of sustainability: energy, social, and economic pillars, while taking into account their lifecycles. Namely, according to the authors, allowing for “the energy required to create, to use and (should it be the case) to dispose of” a structure or structures, “very often recovering what already exists is a lot more energy efficient than demolishing and rebuilding”. At the same time, urban recycling provides a solution to the social aspect through integration of new needs of different social groups and social relationships.

In regard to urban recycling, this group of researchers is primarily concerned with a multitude of empty or underutilized industrial buildings as an outcome of the recent economic crisis, residential buildings which have become »empty nests« and are suddenly too big and too expensive for the remaining parents, and multi-apartment buildings in city centres which are decaying due to dispersed ownership.

Urban recycling is opening up new combinations of work and habitability/shared habitability of different social and age groups. Another possibility is recycling through public-private partnerships.

Recycling of buildings is closely connected to the infrastructure network where car use is to be gradually replaced by other forms of mobility, such as private (bicycle, walking) and public passenger traffic. Such transformations involve recycling of enormous areas, implying “the exploitation of the areas around the station, spaces of great accessibility where applying a scenario of the progressive reduction of the use of the private automobile would be plausible”, while “areas freed up by the automobile (garages, service stations, carparks) would become the fundamental support” of activities towards redesign of urban public spaces (Fabian et al., 2012).

Furthermore, recycling is not confined just to the city but also applied to its edge which is closely related to areas of production and agriculture. Fabian et al. (2012) suggest these deeply connected spaces could become “a field in which possible horizons of growth can be experimented within a scenario of food self-sufficiency”.

Micelli and Mangialardo (2017) explore the connection between urban recycling and potential reuse of existing real estate, primarily in connection with the construction industry. Their aim is “to point out the potential radical change of the construction industry in Italy” which can be achieved in two manners: “through demolition and reconstruction or retrofitting the existing real-estate stock”. According to the authors, recycling in this way is supported by the state of the market “because real-estate market values are not capable of supporting radical city transformations through demolition and reconstruction». Meanwhile, the available data indicate that a shift towards real estate reuse is already underway. As stated by Micelli and Mangialardo, “the construction industry confronts a new challenge: innovating reuse technology – with reduced costs and increased effectiveness – and finding new sources of value to support the investment choice”.

Re-cyclical urbanism implies adapting the existing urban stock to the new ways of habitability and life, increasingly dictated by sustainable development. The city is being recycled in accordance with the social principles of sustainability in order to make it more accessible for human beings, create

	Landscape	City	Infrastructures	Districts	Social innovation	Makers
RE-nown		Creative ecosystem	Branding upcycling	Cultural districts	Talents	
RE-ticular	Ecological network	Metropolitan archipelago		Hub spaces		
			Gateway city			
RE-think	Interpretation	Cloud governance		Living lab	City apps	
RE-silience	Landfill reuse	Urban metabolism	Urban acupuncture Retrofitting	Adaptive spaces	Social innovation centres	Urban farms
RE-sponsible		Crowdsourcing		Urban centres	Co-working / co-housing	Social streets
RE-mote		Opensource city	Smart grid	Self-sufficient block	Cyber-physical spaces	FabLab
RE-make	Drosscapes	Reversing city	Waterfront regen	Energy district	Sharing economy	Urban DIY/DIT

Table 1: Conceptual draft of Re-cyclical Urbanism (after Carta, 2016).

new open and green spaces, and recycle buildings that will be energy efficient and adapted to the new ways of living. Simultaneously, the approach is in line with the environmental aspect since green cities, energy efficient buildings, and changing travelling habits in favour of short-distance walking and cycling diminish harmful impacts on the environment.

5. NEW APPROACHES TO URBAN DESIGN

Urban design is the only planning act with a comprehensive approach to cities. It has to take into account the individuality of each city and take advantage of its competitiveness. "Using various strategies to achieve sustainable performance of the city, any city is able to adjust this purpose based on its own potential and capacity", claim Roychansyah and Felasari (2018: 2). Urban design is a long-term vision of the city which "should encourage the formation of the self-image of the city, revealing what the city means to its inhabitants and what their expectations regarding its future are" (Koželj, 2007). Urban design directs the city development which, while being realized in official planning acts, still remains adaptable for new purposes.

Classical model of urban design based on distribution of activities and land use, spatial planning for construction of buildings, and traffic and communal networks, open public and green spaces, and conservation of nature and cultural heritage can no longer cope with new demands (Figure 2). Apart from sustainability, there are also demands posed by new forms of living, work, and travel in the city.

Urban design is a tool for comprehensive design of a city: from new interventions to use of existing spaces and their interconnections while simultaneously providing for sustainability principles. The cases of both the Spanish and Italian Schools point towards large urban reserves which can be reused by applying the recycling approach. Classical structure of urban design can be transformed into recycling urban design by emphasizing the use of existing spaces and the three sustainable components:

- **Participative society:** urban inhabitants are participating in and contributing towards better quality urban living, work, and travel (such as self-sufficient building islands, co-working, co-housing, living streets, accessibility, urban agriculture, etc.);

- **Circular economy:** reusing urban space, buildings, and objects with lesser input and higher utilization (use of underutilized buildings such as big apartments and abandoned production spaces, green roofs, inaccessible courtyards, as well as energy and materials recycled for reuse);
- **Eco-systemic solutions:** adapting to climate change, creating new green areas (for better urban climate and cleaner air).

New approaches in technology and digitalization can be used to rapidly and reliably gather and process various city data which will serve as planning basis. Re-cyclical urban design is no longer two- but three-dimensional planning; it is a search for new spaces and new solutions which aim to provide answers to new demands (see the concept of re-cyclical urbanism as suggested by Carta, 2016, in Table 1).

New approaches to urban design based on re-cyclical urbanism do not merely attempt to change the material appearance of the city but are directed towards the vision of a city on a human scale.

6. SITUATION IN SLOVENIA

When it comes to residential construction, classical urban design in Slovenia lags behind global trends. The prevailing trend is still the construction of, on the one hand, single- and double-apartment houses with gardens, contributing to urban spread, and on the other, multi-apartment buildings with minimal proportion of green spaces, contributing to urban concentration. Another major factor in urban spread has been the construction of new shopping centres and production plants on urban edges, leaving behind empty city centres and brownfield sites of former factory complexes. Another contributing factor is to be found in the new road projects, such as the city bypasses, which have additionally increased traffic congestion.

Furthermore, the urban pressure of single- and double-apartment houses has infiltrated the countryside, turning smaller formerly agricultural settlements in the city vicinity into suburbs. Traditional villages with majority agricultural population have been transformed into commuter neighbourhoods, causing congestion of farms inside the villages and their consequent

relocation to outside areas All of these changes have created a process in which urban design is lagging behind in its search for new building locations outside the city while leaving unsolved problems which have arisen inside the city.

Urban population growth in Slovenia is stagnating, and cities are following the suit. In relation to physical, functional, environmental, and social criteria, there is a growing number of brownfield sites. Hot urban islands with worsening air quality are forming due to the lack of green spaces, further negatively affecting the quality of living.

Slovenian cities need a new approach to urban design with the emphasis on urban recycling. The guiding principle in this process should be the reuse of existing urban spaces with interventions in favour of quality habitability, work and travel, reduced energy consumption, and attaining eco-systemic solutions.

7. CONCLUSION

The reviewed literature suggests that cities have not responded in a timely fashion to new forms and demands of urban living, climate change and excessive consumption of energy. Therefore, interventions into the process of urban spatial planning/urban design itself are needed. There is an increasing emphasis on comprehensive approaches to city design for which a strong and long-term vision of the city is needed, a vision based on sustainable principles.

Re-cyclical urbanism or urban recycling can provide an alternative approach. Non- and underutilized urban spaces and buildings can be recycled in a sustainable manner for new forms of living, work, and travel. Cities are increasingly adapting to the needs of their inhabitants since those can be incorporated into urban design in an easier and faster manner with the help of new technologies and data processing. At the same time, cities are becoming high quality living spaces which are self-sufficient and can adequately respond to climate change through eco-systemic solutions.

Instead of the classical process of technical planning and dimensioning, urban design has become a recycling process. Re-cyclical design is not just recycling and reuse of a space; space itself is adapting to new urban living requirements. Cities are recycled in spatial, social, economic, and environmental aspects. Cities and city planning must be regarded as living entities since they are in the process of constant change and adaptation to new requirements.

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Kristijan Lavtižar: TEMELJI NARAVNEGA PREZRAČEVANJA STAVB

FUNDAMENTALS OF NATURAL VENTILATION IN BUILDINGS

DOI: <https://dx.doi.org/10.15292/IU-CG.2019.07.020-027> ■ UDK: 697.921.2 ■ SUBMITTED: October 2020 / REVISED: October 2020 / PUBLISHED: November 2020

1.02 Pregledni znanstveni članek / Review Article

POVZETEK

Pri razumevanju prostorskih vprašanj v povezavi z zdravjem je pomembno poglobljeno poznavanje dejavnikov okolja, kot je mikroklima. V zaprtih prostorih preživimo večji del dneva, zato imajo zlasti pogoji prezračevanja poseben pomen glede na njihov vpliv na naše počutje, zadovoljstvo, storilnost ali zdravje. Namen članka je prikazati pregled nad sodobnimi načini prezračevanja posameznih notranjih prostorov s poudarkom na naravnemu prezračevanju. Ključna vprašanja, ki so bila v ta namen izpostavljena, so: Kakšni sistemi so v uporabi danes, katera so njihove pomanjkljivosti in izzivi, s katerimi se srečujemo, kako so prezračevanje reševali v preteklosti ter kako je mogoče tradicionalna znanja uporabiti v sodobni arhitekturi? Zato, da bi lahko na to odgovorili, morajo biti jasne fizikalne zakonitosti. V prispevku so prikazani strnjene standardne načine in metode prezračevanja stavb po svetu in podani predlogi za njihovo uporabo pri načrtovanju kakovostnih in trajnostno zasnovanih odprtih in zaprtih prostorov (stavba, posamezni prostor, predprostor objekta). Zbrani so primeri uporabe naravnega prezračevanja in vzorci združevanja uveljavljenih principov zračenja, ob upoštevanju zakonitosti mikroklimatskih dejavnikov, s sodobnimi tehnologijami mehanskega prezračevanja in prepustnih fasadnih sistemov. Jedro prispevka se nanaša na vprašanje: Ali obstajajo možnosti za prezračevanje stavb, ki zagotavljajo ustrezno kakovost mikroklimе in sočasno ambientalno integracijo z naravnim okoljem?

KLJUČNE BESEDE

prezračevanje, sistemi klimatizacije, naravno prezračevanje, onesnaževala, smernice

ABSTRACT

When environmental factors, such as the microclimate, in-depth knowledge is important in understanding spatial issues related to health. We spend most of the day indoors, so ventilation conditions are especially important, given their impact on our well-being, satisfaction, productivity, and health. The purpose of this article is to present an overview of modern methods of ventilation of individual indoor spaces with special attention paid to natural ventilation. The key questions raised for this purpose are: What systems are in use today, what are their shortcomings and the challenges that we face, how had the problem of ventilation been addressed in the past, and how can traditional knowledge be applied in modern architecture? To be able to answer this, clear physical laws must be defined. The article presents the standard methods of ventilation of buildings around the world and gives suggestions for their use in the design of quality and sustainably designed open and closed spaces (buildings and their indoor spaces). Examples of the use of natural ventilation and samples of combining established ventilation principles, considering the legality of microclimatic factors, with modern technologies of mechanical ventilation and permeable facade systems are collected. The core of the article refers to the question: What are the possibilities for the ventilation of buildings that ensure the appropriate indoor air quality while simultaneously allowing for the ambient integration with the natural environment?

KEY-WORDS

ventilation, air conditioning systems, natural ventilation, pollutants, guidelines

UVODNIK
EDITORIAL
ČLANEK
ARTICLE

RAZPRAVA
DISCUSSION
RECENZIJA
REVIEW
PROJEKT
PROJECT
DELAVNICA
WORKSHOP
NATEČAJ
COMPETITION
PREDSTAVITEV
PRESENTATION
DIPLOMA
MASTER THESIS

1. UVOD

Čisti zrak je ena izmed najosnovnejših antropocentričnih potreb, ki jih moramo zagotoviti. Zaradi te potrebe je ustvarjanje ugodne mikroklimе v zaprtih prostorih in s tem zagotavljanje udobnega prostora za bivanje bistvena zahteva pri arhitekturnem načrtovanju, zaradi česar je prezračevanje elementarno v integralnemu postopku arhitekturnega načrtovanja in oblikovanja. Zaradi onesnaževanja ozračja se veliko pozornosti namenja zunanjim prostorom, kjer je koncentracija onesnaževal, zlasti ob virih onesnaževalcev, tudi najvišja, vendar povprečna oseba v urbanem okolju v notranjih prostorih preživi veliko večino časa, pri čemer večino svojega časa v zaprtih prostorih preživijo ravno najbolj dovzetne osebe za razvoj bolezni, in sicer starejši, majhni otroci ter bolniki (Fink, 2013; Franck et al., 2003; Stellman, 1998). Posledično ima zdravo bivalno okolje z ustreznim zračenjem tudi večji pomen za kakovost življenja, ki pa je izpostavljeno enakim onesnaževalcem kot zunanje okolje. Poleg onesnaževal je zelo pomembna koncentracija ogljikovega dioksida. Visoke koncentracije kisika pa med drugim pripomorejo k večji zbranosti, fizični sposobnosti, kakovostnemu spancu (Fisk, 1997; Staniforth et al., 1998). Ker ljudje nimamo posebnega čutila, ki bi bil občutljiv na ustrezno raven kisika ali drugih plinov brez vonja, jih ne moremo zaznati, ko jih je v prostoru preveč ali premalo, kadar ta meja ravnovesja ni že znatno prekoračena. Zaradi tega je pomembno, da posvečamo posebno pozornost avtonomnim sistemom prezračevanja stavb, ki neprestano zagotavljajo ustrezno kakovost zraka. Ustrezna kakovost zraka preprečuje tudi številne sindrome bolnih stavb (SBS), okužbe, ki se prenašajo z aerosolnimi patogeni in druge bolezni (Dovjak & Kukec, 2019; Smajlovic et al., 2019). Povezava med prezračevanjem, gibanjem zraka v stavbah in prenosom nalezljivih bolezni, kot so ošpice, tuberkuloza, norice, gripa, črne koze ali SARS-Co-V-2, je široko raziskana in dokazana (Li et al., 2007; Richardson et al., 2014). V preteklih letih se je gradnja stavb usmerila v trend pasivnih gradenj, predvsem zaradi energetske krize. Standardi zrakotesnosti so se postavljali pred potrebo prezračevanja stavb, zato v nekaterih prostorih stavb do izmenjave zraka ne prihaja, razen takrat, ko je urejen sistem naravnega, mehanskega ali hibridnega prezračevanja. Številne pasivne hiše brez ustreznega prezračevanja so pri slabšem koeficientu izmenjave zraka zato manj ustrezne, iz vidika kakovosti mikroklimе in kasnejše adaptacije pa zahtevne in drage (Hasselaar, 2008; Mlecnik et al., 2008; Aynsley, 2014).

Prezračevanje je vsakršna izmenjava zraka med notranjim in zunanjim okoljem, torej med zaprtimi notranjimi prostori in okolico stavbe. S prezračevanjem se vzpostavi tok dovajanega ali svežega zraka in tok odvajanega ali onesnaženega zraka. Gibanje zračnih mas v naravi ali v grajenem okolju povzročajo razlike v zračnem pritisku, premikajoče od višjega k nižjemu. Premikanje vetrov v naravi je posledica različnega segrevanja tal, ki povzroča vzgon, in različnih višin reliefa, zato višje lege na razgibanemu terenu prinašajo več vetrov (Recknagel et al., 2004). Podobno se gibajo tudi zračni tokovi v notranjih zaprtih prostorih. Izjema v zaprtih prostorih je mehansko prezračevanje, saj razliko v tlaku ustvarjajo tudi mehanske prezračevalne naprave. Nadzorovan dotok zraka imenujemo prezračevanje, medtem ko nenadzorovan prehod zraka imenujemo vdor ali infiltracija ter na drugi strani eksfiltracija, iztekanje zraka iz stavbe (Turner et al., 2012). Zaprte prostore stavb prezračujemo bodisi naravno, mehansko ali hibridno. Namen prezračevanja je zagotavljanje kontroliranih in stabilnih mikroklimatskih pogojev v notranjih prostorih skozi celotno življenjsko dobo stavbe, v vseh letnih časih in ne glede na število njenih uporabnikov (Emmerich et al., 2009).

2. METODE

Prispevek je pregledni članek, ki opisuje možnosti za prezračevanje stavb, v katerem se iščejo možnosti za zagotavljanje ustreznih in kakovostnih notranjih prostorov ob upoštevanju ambientalne integracije naravnega okolja in sodobnih potreb po nadzoru mikroklimatskih razmer. Pripravljene sheme so nastale na osnovi zbranih referenc, ki niso vključene v prispevek, in literature zadnjih nekaj letih. Posamezni primeri prezračevalnih sistemov bodisi v shemah bodisi v referenčnih primerih so izbrani zaradi jasnosti posameznih inženirskih rešitev ali zaradi njihove priljubljenosti in uveljavljenosti v sodobni arhitekturi. Zbrani primeri literature ustvarjajo pregled tradicionalnih tehnik in sodobnih tehnologij prezračevanja.

3. NAČINI PREZRAČEVANJA STAVB

Posplošeno lahko načine prezračevanja delimo na naravno prezračevanje, mehansko prezračevanje, pri katerem se klimatizacija doseže s klimatizacijsko napravo ter hibridno prezračevanje, pri katerem se hkrati uporablja naravno in mehansko prezračevanje. Mehansko prezračevanje delimo naprej na posamične (lokalne) in centralne sisteme, slednjemu lahko pravimo tudi kanalsko prezračevanje. Za mehansko, prisilno, strojno ali umetno prezračevanje se šteje vsakršno prezračevanje, kjer se uporabljajo strojni elementi pri načrtovanem prezračevanju stavb, bodisi za zamenjavo odtočnega zraka z zunanjim bodisi za klimatizacijo s klimatizacijsko napravo. Sistemi prisilnega prezračevanja so v večini primerov del večjih sistemov, ki skrbijo za uravnavanje temperature v prostorih in ustrezno filtracijo zraka (Peperko, 2009). Sestavljajo jih ventilatorji, filtri, regulatorji ogrevanja in hlajenja, naprave za vlaženje in razvlaževanje zraka, s katerimi lahko dosežajo želene parametre udobja v prostoru (Recknagel, 2004). Zadnji način prezračevanja je hibridni pristop, kjer se uporablja kombinacijo naravnega prezračevanja in mehanskih sistemov, ki vključujejo opremo za distribucijo zraka in hladilno opremo za hlajenje. Naravno prezračevanje se uporablja, kadarkoli je to izvedljivo ali zaželeno, da se poveča udobje, pri čemer se izogne potratni porabi energije in obratovalnim stroškom celoletne klimatske naprave (Center for the Built Environment [CBE], 2013).

3.1 Tradicionalne tehnike prezračevanja

Naravno prezračevanje z vetrnimi lovilci izvira iz dežel s sušnimi podnebji, kot so Severna Afrika ali ozemlje okrog Perzijskega zaliva, in je v nekaterih delih sveta v uporabi že tisočletja. Gre za tradicionalni arhitekturni element, ki se uporablja za pasivno prezračevanje in hlajenje notranjih prostorov. Vetrni stolpi ali lovilci vetra so lahko orientirana na eno, dve ali več smeri in s tem lovijo ter raznašajo različne smeri vetra glede na mikroklimatske pogoje. Tehnologija je bila v 20. stoletju počasi opuščena in zamenjana s sodobnimi sistemi centralnega prezračevanja in klimatizacije ter vnovič oživljena zaradi potreb po zmanjšanju stroškov prezračevanja (Attia in De Herde, 2009). Vetrni stolp (*arab. malqaf*) je egipčanska vernakularna arhitekturna naprava, ki ujame veter v stavbo in preusmeri navzdol v notranje prostore (Slika 1). Lovilniki vetra so zgrajeni v mnogih regijah Irana. V Bandar Abbasu in drugih pristaniščih ob Perzijskem zalivu, kot tudi v mestu Yazd (Slika 1), so običajno kvadratni stolpi, zgrajeni na strehah z odprtini na eni strani, usmerjenimi proti hladnim morskim vetrovom. Najpogostejša uporaba lovilcev vetra je za hlajenje in prezračevanje poletnih dnevnih prostorov in kletnih delov hiš. Zrak, ujet v odprtinah stolpa, se ohladi med spuščanjem in hladi uporabnike spodaj s konvekcijo in izhlapevanjem. Kadar je vetra malo ali ga ni, se zrak dviga proti stolpu, katerega

stene segreva sonce, tako da skozi poletne sobe vleče hladen vlažen zrak iz dvorišča in kletnih prostorov stavbe (Bahdori, 1978). V študiji učinkovitosti tradicionalnega prezračevanja z uporabo tehnike malqaf in njihove potencialne integracije za rabo v nizkih gradnjah so ugotovili pogojno zmožnost njihovih testnih modelov do izmenjave zraka do 5,6-krat/h (Attia in De Herde, 2009). Nekatere antične metode hlajenja so bile tako učinkovite, da je bilo mogoče z njimi doseči temperature blizu ledišča. Na puščavskem območju Perzije so uporabljali vkopane stožčaste strukture, imenovane Yakhchāl, v katerih so izkoriščali metodo hlajenja z izhlapevanjem vode. Uporabljale so se za hranjenje hrane, ledu in veljajo za prehodnico kasnejših ledenic, ki jih poznamo v Evropi.

Slika 1: Shema primera vetrnega stolpa BĀDGĪR na levi (I.) in MALQAF na desni (II.).

Med republikanskim in imperialnim obdobjem antičnega Rima je gradnjo stanovanjskih objektov zaznamoval *domus*. To je bila uveljavljena in standardizirana tipologija hiše, v kateri so prebivali svobodni in premožni ljudje (Frazer, 1998). Zanj je značilen centralno umeščen in odprt notranji atrij (lat. *atrium*), okrog katerega so bile razvrščene sobe (Slika 2). Sobe so bile ločene na spalnice (lat. *cubicla*), jedilnice, kuhinje, dnevne sobe in predverje (lat. *vestibulum*). Z izjemo predverja so se odpirale zgolj proti atriju in navzven imele zaprto steno. Atrij je bil odprt, redko opremljen in redko zaraščen, saj je zagotavljal svetlobo vsem prostorom. Na sredi atrija je bil praviloma plitek odtočni bazen (lat. *impluvium*), v katerem se je zbirala deževnica (McManus, 2007). Deževnica je pritekala z nagnjene strehe nad atrijem (lat. *compluvium*). Takšna introvertirana zasnova je izkoriščala notranje prezračevanje iz centralno umeščenega atrija, ki je poleg varnosti, zasebnosti in miru zagotavljal svež zrak, umaknjen od dima in umazanije, ki jo povezujemo s tedanjimi zunanjimi javnimi trgovskimi ulicami. Zbrana deževnica se je nato stekla v zbiralnik pod bazenom skozi filtracijske plasti različnih sedimentov, s katerimi so odstranjevali nečistoče. Bazen je imel dodatno funkcijo ohlajanja notranjega zraka z evaporacijo stoječe vode. Atrij je z njim nudil učinkovito pasivno hlajenje, s kroženjem svežega hladnega zraka skozi zaledne sobe. Na zunanosti so bila redka okna (lat. *fenestrae*), ki so bila sprva le manjše zidne niše, zaščitene z loputami (Smith, 1875). Zaprt zunanji obod stavbe je razviden iz tlorisa (Slika 2). Izraz atrij, ki ga uporabljamo še danes, se je kasneje uporabljal tudi za različne prostore v javnih in verskih zgradbah, večinoma pri opisovanju arkadnih dvorišč in večjih domačih prostorov z vrtovi.

V študiji, ki je analizirala občutljivost hitrosti menjave zraka v naravno prezračevanem atrijskem prostoru, osnovanem na rimskem *domusu*, so ugotovili, da ima pogoj smeri vetra in števila zračnikov, vključenih v model, velik vpliv na potencialno urno izmenjavo zraka (Horan & Finn, 2008). Na modelih je bilo ugotovljeno, da je veter enakomeren pri vpadnem kotu med 0° in 90°. Toda nelinearno razmerje je izkazal model z enojnim zračnikom pri enakem odklonu smeri vetra, kar je pokazalo odvisnost smeri vetra in števila odprtih glede na pozicijo stavbe.

Slika 2: Tloris rimske hiše v Pompejih. Na levi strani je viden atrij (lat. atrium) ter na desni vrt (lat. peristylum).

3.2 Naravno prezračevanje stavb

Pod pojmom naravno prezračevanje smatramo pasivno izmenjavo zraka skozi potencialne odprtine v prostoru, kjer se izkoriščajo naravne fizikalne lastnosti zraka pri različnih temperaturah v prostorih in zunanosti, brez uporabe mehanskih naprav. Odprtine so lahko projektirane za prezračevanje namensko ali nenamensko. Načrtovane prezračevalne odprtine so okna, prezračevalni kanali, prezračevalne lopute, zračnik ipd. Nenamenske odprtine običajno nastanejo ali se povečujejo s staranjem objekta. Nastanejo špranje med okvirji vrat, med roletnimi omaricami, povečajo se razlike v netesno vgrajenem stavbnem pohištvi in med okvirji oken. Izmenjavo zraka, ki nastane kot posledica naravnih lastnosti temperaturnih razlik in tako posledično tlačnih atmosferskih razlik ali gibanja zraka zaradi vetra, štejemo za naravno prezračevanje. Meritev in izračunov se pri takšnih izmenjavah zraka v praksi ne poslužuje, izvajajo se praviloma na podlagi spremembe koncentracij onesnaževal (Todorović, 2005). Takšno prezračevanje je posledica vdora oziroma infiltracije zraka, ki poteka nekontrolirano, je intenzivnejše ob večjih temperaturnih razlikah med notranjim in zunanjim zrakom in je odvisno od smeri vetra na zunanje stene stavbe. V zimskih in poletnih mesecih temperaturne razlike povzročijo različne gostote toplega in hladnega zraka, zaradi česar nastane v prostoru gibanje zraka, ki pomembno prispeva k prezračevanju, vendar samo po sebi ne zagotavlja ustrezne količine svežega čistega zraka (Etheridge, 2012). Druga oblika naravnega prezračevanja poteka na način odpiranja oken. Takšna pasivna oblika prezračevanja se ne odvija samodejno, vendar je lahko najbolj ekološka rešitev in ponekod smiselna izbira pri načrtovanju objektov. Pri uporabi naravnih prezračevalnih sistemov se srečujemo z izzivi, kot so ustrezna stopnja prezračevanja, razporeditev svežega zraka v prostorih, nadzorovanje vlage, zagotavljanje ustreznega pritiska v zgradbi in vstop onesnaženega zraka iz okolice brez možnosti filtracije ali čiščenja (Todorović, 2005).

3.2.1 Metode naravnega prezračevanja

Osnovni principi naravnega prezračevanja izhajajo iz treh načinov prehajanja zraka skozi stavbo. Prvi poteka preko prečnih vetrov s pomočjo vetra, drugi način je odvisen od dvigovanja vzgonskih tokov in tretji zahteva enostransko prezračevanje (Emmerich et al., 2001). Za prvi primer je potreben veter, ki teče po prerezu neprekinjeno skozi odprtine na fasadah, običajno gre za okna, na obeh straneh stavbe. V drugem primeru tlačne razlike povzročijo dovajanje hladnega zunanjega zraka in odvajanje toplega zraka v okolico skozi višje ležeče odprtine na strehi stavbe. Takšna odprtina je lahko dimnik ali notranji atrij. Zadnji princip je primer rešitve lokalnega prezračevanja, kjer se zagotavlja zračenje samostojnih prostorov. Zračni tok povzročijo tlačne razlike v mikroklimi, temperaturni gradient ali turbulenca. Vse naštetje sile so neizrazite in relativno spremenljive. Ne glede

na specifične posameznih principov prezračevanja so najbolj učinkoviti sistemi tisti, ki v kombinaciji izkoriščajo prednosti vseh naštetih načel.

Temeljne tipe fasade lahko ločimo na polne stene in stene s predori ali odprtinami. Polne stene imajo lahko toplotni izolacijski sloj na notranji ali na zunanji strani, pri čemer prva ne izkorišča možnosti zadrževanja toplote v sami steni. Fasade s predori so lahko popolnoma prazne, imajo enojno ali dvojno zasteklitev, druge imajo v celoti ločen dodatni sloj. V spodnjih prikazih (slika 3-5) so predstavljene osnovne zakonitosti in pojavnosti oblikovanja fasad ter njihovih odprtini, ki so bile izluščene na podlagi pregledanih referenčnih primerov. Prva skupina (a; I.-VII.) predstavlja poglobitvene značilnosti, po katerih lahko opredelimo fasadni ovoj (od leve proti desni): polna stena brez izolacije, zunanja izolacijska plast, notranja izolacijska plast, odprta stena s prebojem brez zasteklitve, enojna zasteklitev, dvojna zasteklitev, kombinirana zunanja zasteklitev. Na podlagi naštetih elementov in njihove kombinacije zunanjih sten, stropa in tal v prostoru se odločamo za uporabo prezračevalnih sistemov ali tehnik. Poleg ostalih elementov, kot so velikost prostora, sistem gretja in hlajenja, predviden način rabe, število in prisotnost uporabnikov, določajo potrebe po prezračevanju posameznih prostorov in stavbe kot celote.

Druga skupina (b; I.-VII.) s shematskimi prikazi prikazuje možne variacije prezračevanja in organizacije dovajanja čistega zunanjega zraka ter odvajanja umazanega zraka, kjer je izvzeto običajno prezračevanje z odpiranjem oken (od leve proti desni):

prezračevanje mimo zunanje fasadne zasteklitve, prezračevanje z nagibno odprtino, prezračevanje z adicijo zračnika in okenske odprtine, prezračevanje z adicijo zračnika in zunanje fasadne zasteklitve, dovajanje preko zračnika in odvajanje s prezračevalnim jaškom, dovajanje in odvajanje s prezračevalnimi jaški, prezračevanje z okensko rešetko. Predstavljene metode so največkrat uporabljene v prostorih pisarniške, komercialne, tehnične ali druge podobne uporabe. V uporabi so tudi v večnadstropnih objektih, kjer se v višjih nadstropjih pojavlja problem vetra. V načinu prezračevanja z mehanskimi sistemi omogočajo bolj kontrolirano prezračevanje z dovajanjem na predvidenih mestih ob konstantni hitrosti.

Tretja skupina (c; I.-VII.) prikazuje najpreprostejše načine naravnega prezračevanja, kjer se zanašamo na prosti pretok skozi odprtine, odprta ali priprta okna, rešetke ali preko jaškov (od leve proti desni): roletni sistem odpiranja zračnikov, sistem rešetk, odpiranje okna na navadni vzgib, odpiranje okna na vertikalni osi, odpiranje okna na stežaj, odpiranje okna na horizontalni osi, odpiranje okna na potisk. Našteti načini odpiranja omogočajo veliko mero prilagodljivosti in enostavnost pri zračanju, omogočajo tudi prilagodljivost pri dveh ali več okenskih odprtinah znotraj enega prostora in prilagajanje posamezniku, vendar zahtevajo večjo mero pozornosti in spremljanje pogojev mikroklimi v prostoru.

Učinkovitost prezračevanja skozi okna je primarno odvisna od vrste oken, izvedbe inštalacije in zračnega tlaka, na kar vpliva tudi prečno zračenje ali zračenje s prepikom. Najučinkovitejše

Slika 3: Sheme osnovnih elementov fasad (skupina a; I.-VII.).

Slika 4: Avtonomni in pol-avtonomni načini prezračevanja (skupina b; I.-VII.).

Slika 5: Načini prezračevanja z ročnim odpiranjem oken (skupina c; I.-VII).

je, kadar so prostori do največ 2,5-krat globoki, kot so visoki. Prečno prezračevanje zadostuje tudi za 5-krat globlje prostore (Knaack et al., 2014). Pri posameznih primerih načina prezračevanja z ročnim odpiranjem okna je kakovost prezračevanja odvisna ne le od oblike ali načina odpiranja okna, temveč tudi od smeri vetra na fasado stavbe. Najmanj učinkovito je, kadar se veter premika vzporedno z odprtinami, zaradi česar se zmanjša hitrost notranjega pretoka zraka (Sacht & Likiantchuki, 2017). Značilnosti, kot so vrsta oken, ali so fiksna ali mobilna, velikost preseka odprtine odprtega okna, ali so prisotni elementi, ki povzročajo ovire pri prostem prehodu zraka, vplivajo neposredno na pogoje naravnega prezračevanja (Sacht & Likiantchuki, 2017). Pri prezračevanju z odpiranjem oken ločimo kratkotrajno in dolgotrajno zračenje prostorov. Kot dolgotrajno zračenje s priprtimi okni štejemo odpiranje oken z zvrčanjem v polvertikalni položaj. Omenjeni način zahteva približno šestkrat več časa za celotno izmenjavo zraka v prostoru kot intenzivno, kratkotrajno zračenje. Raziskava učinkovitosti naravnega prezračevanja (Japelj, 1985) je pokazala, da se je v prostoru z odprtim oknom v polvertikalni položaj (na vzgib), zrak izmenjal v 30 do 60 minutah. Čas zračenja se je lahko skrajšal z odprtjem oken na stežaj, kjer se je zrak popolnoma izmenjal v 5 do 10 minutah. Intenziteta prezračevanja pa se je še dodatno povečala ob ustvarjanju prepiha z odprtjem vrat v prezračevanem prostoru, pri čemer se je zrak popolnoma izmenjal v 1 do 5 minutah pri popolnoma odprtem oknu in v 15 do 30 minutah s polvertikalnim odprtim oknom. (Japelj, 1985). Poleg načina odpiranja in vrste oken, velikosti odprtine, volumna prostora, imata pri merjenju učinkovitosti naravnega prezračevanja bistveno vlogo frekvenca in čas odpiranja vrat (Marr et al, 2012).

3.2.2 Prednosti in slabosti naravnega prezračevanja

Naravno prezračevanje lahko zadosti potrebam po prezračevanju brez energetske porabe in z njo povezanih izpustov toplogrednih plinov, v kolikor je bila energija na določenem območju pridobljena z uporabo fosilnih goriv. V britanski študiji energetske porabe mehanskega prezračevanja (Building Research Energy Conservation Support Unit [BRESCU], 2000) so ugotavljali prihranke na sestavnih delih in procesih tovrstnih sistemov. Naravno prezračevane stavbe so nadomestile energetske porabe za hlajenje od 14 kWh/m² do 41 kWh/m² letno, kar je nanese na 10% celotne energetske porabe. Meritve so bile izvedene v podnebjju, kjer zunanje temperature zraka poleti redko presegajo mejne vrednosti toplotnega udobja. V drugih državah, recimo v podnebjju z relativno visoko vlažnostjo, ni mogoče pričakovati podobnih energetskih prihrankov. Ne le za

hlajenje, pri mehanskih sistemih prezračevanja velik del energije potrošijo ventilatorji. 20 kWh/m² do 60 kWh/m² letno je v enaki študiji znašala energetska poraba za ta namen ali 15% celotne energetske porabe takrat, ko so bile klimatske in operativne razmere preizkusa primerne (Building Research Energy Conservation Support Unit [BRESCU], 2000).

HVAC (sistemi za gretje, prezračevanje in klimatizacijo) poleg stroškov energetske porabe zahtevajo vzdrževanje. Potrebno je redno čiščenje kanalskih sistemov za prenos zraka, difuzorja, servisiranje hladilnih naprav in vlačilcev zraka, čiščenje in menjava filtrov, čiščenje prenosnika toplote. Menjava glavnih filtrov se izvaja praviloma vsakih 6 mesecev, medtem ko je čiščenje prenosnika toplote po navedbah proizvajalcev priporočljivo vsake 2 leti (Federation of European Heating, Ventilation and Air Conditioning Associations [REHVA], 2020). Nepravilno vzdrževanje, v določenih primerih tudi vzdrževanje v skladu s priporočili upravljalca, prvič predstavlja dodatno obremenitev za ventilatorje in glasnejše delovanje zaradi posledičnega zračnega upora na kanalskem omrežju. Drugič, predstavlja nevarnost za zdravje uporabnikov prostorov bodisi zaradi neustreznih filtrov bodisi zaradi same distribucije patogenov skozi centralni prezračevalni sistem. Pomemben dejavnik pri raznosu aerosolov in patogenov v prostoru je vzorec pretoka zraka, ki je pri mehaničnih sistemih lahko nadzorovan, vendar pa neučinkovit pri nadzoru kapljičnega prenosa okužb (Qian in Zheng, 2018). Problematika vpliva na javno zdravje centralnih sistemov prezračevanja se je pokazala ob izbruhu virusa SARS-CoV-2. Evropska federacija za gretje, prezračevanje in hlajenje je zato izdala posebna priporočila za upravljanje tovrstnih sistemov za preprečevanje raznosa okužbe, ki vključujejo nadgradnjo obstoječih HVAC sistemov (Federation of European Heating, Ventilation and Air Conditioning Associations [REHVA], 2020). Skriti strošek mehanskih sistemov je poleg očitnega stroška njihove vgradnje tudi prostor, ki ga zasedajo v stavbi ali na zunanosti stavbe. V poslovnih stavbah je zniževanje stropov za potrebe prezračevalnih sistemov poleg električnih in drugih inštalacij uveljavljena praksa. Zavzet prostor je sicer lahko namenjen večjemu udobju, občutku velikosti prostora, večjemu odboju dnevne svetlobe po notranosti prostora in blaženju hitrega naraščanja onesnaževal v prostoru zaradi večjega volumna prostora (Emmerich et al., 2001). Kljub temu imajo tudi sistemi naravnega prezračevanja slabosti, saj denimo prav tako povzročajo energetske izgube, zlasti ob delih dneva in letnih časih, ko se pojavljajo večje temperaturne razlike med notranjimi prostori in zunanostjo (Feustel, 1985). V notranjih prostorih želimo doseči poleg optimalnega toplotnega udobja tudi ustrezno zvočno izolacijo ter neprekinjeno prezra-

čevanje, ki vseskozi zagotavlja dotok svežega zraka. Z naravnim prezračevanjem ne moremo prezračevati v celoti kontrolirano, kar pomeni, da je lahko v nekem trenutku v prostore dovedena preveč svežega zraka ali premalo. Preveč denimo takrat, ko se pojavijo velike temperaturne razlike med notranjem in zunanjim zrakom, kar povzroči nihanja ob dovajanju svežega zraka.

Gibanje zraka je nepredvidljivo zaradi vzgonskih sil in turbulence. To lahko privede do neželenih klimatskih razmer in pregrevanja, kar vodi v dodatne nepotrebne energetske izgube ali povzroča lokalno neudobje uporabnikom zaradi nepredvidenege prepiha, hladnih tokov ali nezadostnega hlajenja. Nekontrolirano prezračevanje prinese tudi vdor onesnaženega zraka, ki je lahko posledica prometnih onesnaževalcev, domačih kurišč, industrije ali gradbišč, kjer so emisije vezane na določeno časovno obdobje ter odvisne od makro- in mikroklimatskih razmer. Zrak je lahko onesnažen s troposferskim ozonom, prašnimi delci, dušikovimi oksidi in žveplovimi oksidi. Po drugi strani so v praksi mehanski prezračevalni sistemi pogosto urejeni tako, da nadzorujejo temperaturo in ne same kakovosti zraka, zato ne morejo zagotoviti ustreznega prezračevanja in nadzora kakovosti zraka (Leyten in Kurvers 2000). Nadzor mikroklimatskega udobja pri HVAC sistemih je vendar lahko zavajajoč, saj so ti izdelani tako, da vzdržujejo prezračevanje glede na uravnavanje določene temperature in ne nujno glede na kakovost zraka ali dejanske potrebe uporabnika. V takšnih primerih uporabnik sam odpre okno, v kolikor prostor to omogoča, in v trenutku spremeni pogoje mikroklimatskega udobja z neposredno izmenjavo zraka iz okolice. Naravno prezračevanje lahko tako smatramo kot bolj kontrolirano, saj omogoča takojšno ukrepanje, vendar je samokontrola kot subjektivna metoda tudi manj učinkovita. Raziskava vzorcev prezračevanja večstanovanjske stavbe je pokazala, da uporabniki sicer nadzorujejo prezračevanje v svojih stanovanjih z odpiranjem oken in vrat ter na ta način ohranjajo zadovoljivo kakovost zraka, toda z veliko izdatnejšim prezračevanjem, kot bi bilo potrebno (Muhsin et al., 2012).

Nenazadnje je pri naravnih prezračevalnih sistemih, zlasti v določenih podnebnih in krajih z obilo naravnega okolja, potrebna tudi zaščita z mrežo. V nasprotnem primeru tvegamo vdor neželenega mrčesa in drugih živali. Učinkovitost pretoka zraka je odvisna od zunanjih vremenskih razmer, saj so v določenih situacijah najugodnejši pogoji pri nizkih temperaturah in vetru, kar prinaša večje toplotne izgube (Etheridge, 2012). Prezračevanje vpliva še na vrednosti relativne vlage v prostoru, vnašanje alergenov, kot je cvetni prah, in na gibanje prahu. Pri mehanskih sistemih je ta vpliv zaradi filtrov in vlažilcev zraka še posebej poudarjen. Dodatna slabost mehanskih naprav je hrup, ki ga povzročajo ventilatorji (Balvers, J. 2012; Bujoreanu, C., & Benchea, 2016). Njihova intenziteta je odvisna od vrste sistema in mesta vgradnje, vendar se temu pri naravnem prezračevanju lahko popolnoma izognemo.

4. OPUŠČANJE PREZRAČEVALNIH SISTEMOV

Po koncu obdobja moderne in prenehanju gibanja CIAM se je v arhitekturi do neke mere zakoreninilo utilitarno načelo Le Corbusierja - »Hiša je stroj za bivanje« (Mumford, 2002). Navkljub nadaljnjemu razvoju stroke se je arhitektura z razvojem novih tehnologij gradnje in stavbnih instalacij, razvoja na področju strojništva in mikroklimatskega inženirstva, znova približala Corbusierjevi teoriji. Z nastopom novih arhitekturnih in oblikovalskih slogov v petdesetih letih prejšnjega stoletja so se številna prepričanja razhajala, vendar pa je prav razvoj klimatizacijskih in prezračevalnih sistemov, ki se je razvijal vzporedno in neodvisno od arhitekture, najbolj vplival na kakovost mikroklimatske notranjih

prostorov, ki jo je zagotavljala gradnja tedanjih stavb. Čedalje bolj se je stremelo k temu, da je bil mehanski prezračevalni sistem tisti, ki je morebitno pomanjkljivo načrtovano stavbo reševal in zagotavljal ustrezne razmere, na ta način pa deloval kot aparat za »umetno življenjsko podporo«. Ta aparat ob popolnem delovanju zagotavlja idealne, po možnosti posamezniku prilagojene pogoje temperature, vlage in čistega zraka, ki so neodvisne od mikroklimatskih razmer zunaj objekta.

Proti koncu prejšnjega stoletja se je ob boku okolju prijaznega in trajnostnega načrtovanja oblikovala teorija in smer, ki popolnega klimatskega udobja ni več postavljala za prvobiten cilj. Takšen pristop arhitekture je učila Sydneyjska šola arhitekture, ki se je razvila v tretjem četrtletju 19. stoletja. Zagovarjala je uporabo lokalnih, neobdelanih materialov ter avtohtonih vrst vegetacije. Za eno izmed ikon integracije z naravo, po filozofiji »Best architecture is no architecture« velja Lucasova hiša, ki je predstavljala navdih za generacijo arhitektov Sydneyjske šole. Glenn Murcutt je v svojih delih (hiša Ball, Magney, Marika, Frederics) združeval najrazličnejše principe, ki izvirajo iz te šole. Z lamelasto podolgovato obliko hiš je omogočil učinkovito križno prezračevanje. Dvignjene strešine, ki so prepuščale prosti pretok na obeh straneh, so skupaj z visokim stropom pomagale ustvarjati konvekcijo in kroženje zraka v prostorih. V hišah z atrijskim jedrom so bili ti načrtovani tako, da so preslikovali in ujeli zunanost in klimo po nazorih rimske atrijske hiše. Pred njih je umeščal zrcalne bazene, preko katerih je potoval veter in ohlajal pregrete prostore (Fromonot, 1995). Deževnico je shranjeval v neposredni bližini, včasih tudi pod samim objektom. Izpostavljenе fasade je pozorno zaščitil, medtem ko je odpiral manj ranljive stranice s perforiranimi fasadami ali drsnimi stenami in na ta način zračil objekt. Ustvarjal je v Avstraliji, v državi s puščavskim in savanskim, deloma tudi sredozemskim podnebjem, kar je omogočilo najlažjo implementacijo teorijo »nične« arhitekture.

Murcutt je ob uporabi polprepustnih elementov, opisanih v prejšnjem poglavju, projektiral hiše, ki so kot celota opravljale nalogo klimatske naprave. Z interakcijo s posameznimi elementi zastorov in drugih polprepustnih elementov je uporabnik na enostaven način priključil objekt svojim potrebam in ga uglaševal, tako kot glasbenik uglašuje svoj inštrument. Senčila na strehi hiše Done so se na način diafragme odpirala električno, žaluzije na fasadi hiše Marik so se obračala na oseh in omogočala najrazličnejše alteracije. Na primeru projekta Broken Hill je Murcutt mehaniziral sistem vetrnih past, kot to počnejo na bližnjem vzhodu z malqafi (Fromonot, 1995). Trdil je, da se mora arhitektura vrniti v sozvočje z naravo na način, da so uporabniki arhitekture del narave in del dogodkov, ki se v njej dogajajo, zato naj se del zunanjih elementov in kvalitet, kot so svetloba, zvoki, veter in vonj, preslikajo tudi v notranje prostore. Tadao Ando je eden najbolj znanih japonskih arhitektov. Podobno kot Murcutt poudarja povezavo med naravo in arhitekturo ter opozarja na humanistično plat in fizično izkušnjo klimatskega načrtovanja. Vrstna hiša Azuma je majhna dvonadstropna betonska hiša, dokončana leta 1976, ki prikazuje zamatke njegovega poznejšega dela. Gre za ozek betonski blok, sestavljen iz treh volumnov in stisnjen v vrsto v stanovanjski četrti. Na sredini se do pritličja odpirata atrij in dvorišče, ki sta odprta samo proti nebu – na tak način ustvarja kontrast med javnim značajem ulice in privatnim jedrom hiše, kar spominja na rimski atrium. Atrij je neločljiv del hiše, v katerem poteka celotna komunikacija. Vzpostavlja okno v tisti del narave, ki ga mesto dopušča in osredotoči čute na zaznavanje odprte narave, svetlobe, vremena in letnega časa. Kasneje zgrajena hiša Kidosaki posnema to doživljajsko izkušnjo z atrijem, ki je prav tako zamejen z visokimi vertikalami betonskih sten, ki proti vrhu oblikujejo okno proti odprtemu nebu.

5. ZAKLJUČEK

Optimizirana zasnova stavbe omogoča učinkovito navzkrižno prezračevanje in dobro izpostavljenost dnevni svetlobi. Za izgradnjo pasivne hiše z nično porabe energije je potreben tehten premislek o običajni rabi uveljavljenih naprav za prezračevanje, gretje, hlajenje in filtracijo. Tradicionalne tehnologije prezračevanja in njihova kombinacija z modernimi pametnimi tehnologijami nadzora mikroklima postavljajo temelje inovativnemu modelu hibridnega hladilnega sistema, ki zagotavlja boljše mikroklimatske pogoje ob zmanjšani porabi energije.

Pri vseh naštetih zahtevah in zakonitostih pri načrtovanju stavb in njihovih prezračevalnih sistemov se je potrebno vprašati, kakšni so cilji projektanta, stranke in uporabnika novogradnje, kako bo objekt v svoji življenjski dobi deloval in kako želimo, da se uporabniki prostorov v njih počutijo. V zadnjem poglavju je predstavljena miselnost, ki se odmika od zagotavljanja idealnih klimatskih pogojev v prostorih, hkrati pa dopušča določeno mero nihanja. Po Murcuttu in Tadau Andu obstaja koncept človeka in narave, ki tvori neločljivo povezavo, kar prihaja v konflikt z današnjim življenjskim slogom. Gre za temeljni odnos, ki je vtkan v človeško bit, in je rezultat človeškega razvoja v sobivanju z negostoljubnim, včasih celo nevarnim življenjskim okoljem. Variacije v prezračevanju, kar je ena izmed značilnosti in v določeni meri pomanjkljivosti naravnega prezračevanja, so lahko tudi pozitiven učinek. Te prihajajo iz naravnega okolja, četudi znotraj mesta, kjer so značilni naravni cikli, naj bo to glede temperature, svetlobe ali padavin. Povezanost izhaja iz sprememb v času dneva, meseca in leta, kar daje občutek ritmičnosti dnevu in mesecem. Zaznavanje tople naravne sončne svetlobe, ki pod ostrim kotom pada v poletnem času, ali hladen občutek vetra ob odprtem oknu sredi zimskega obdobja dajejo posebno specifično zaznavanje narave in s tem boljše povezanost z okolico. Zrak, voda in svetloba so temeljne predpozicije, ki spreminjajo svojo prisotnost glede na prostor. Učinek konstantnih mikroklimatskih pogojev v zaprtih prostorih je posledično tudi vprašanje človeške psihologije.

Posamezne karakteristike naštetih elementov je potrebno prikazati v celoti ter njihov značaj integrirati na način, da so še sprejemljive v zaprtih notranjih prostorih. Stavba je zapleten sistem inštalacij, saj mora odgovarjati na najrazličnejše pogoje okolje in klime, ki so težko določljivi. Mikroklimatske razmere lokacije pri načrtovanem objektu je zato potrebno karseda natančno opredeliti in na njih odgovoriti s pomočjo ustreznih arhitekturnih elementov, ki omogočajo vzdrževanje stavbe z minimalnim vložkom dodatnih sistemov. V nadaljnjem raziskovanju prezračevalnih sistemov, se je koristno posvetiti tistim elementom, ki zagotavljajo sprejemljivo okolje za uporabnike večino časa ob upoštevanju težje merljivih karakteristik arhitekture, kot so naravni cikli.

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Martina Zbašnik-Senegačnik, Ljudmila Koprivec: GRADBENI ODPADKI KOT SUROVINA V TRAJNOSTNEM GRAJENEM OKOLJU

CONSTRUCTION WASTE AS A RESOURCE IN A SUSTAINABLE BUILT ENVIRONMENT

DOI: <https://dx.doi.org/10.15292/IU-CG.2019.07.028-036> ■ UDK: 628.477.6 ■ SUBMITTED: October 2020 / REVISED: November 2020 / PUBLISHED: November 2020

1.02 Pregledni znanstveni članek / Review Article

POVZETEK

Grajeno okolje zahteva čedalje večje količine surovinskih virov, hkrati pa nosi pomemben del odgovornosti za nastajajoče odpadke. Do odpadkov prihaja v celotnem življenjskem ciklusu, čeprav se v začetnih fazah nastajanja gradiv deklarirajo kot industrijski odpadki, ob gradnji, obnovi in rušitvi objektov pa prihaja do gradbenih odpadkov. Gradbeni odpadki, ki so sicer med vsemi najbolj voluminozni, imajo velik potencial v krožnem gospodarstvu. Vračanje odsluženih gradiv in komponent med surovinske vire bo omogočilo zaprt krog življenjskega ciklusa gradiv, brez odpadkov, ki bi končali izven gradbenega sektorja.

Trajnostna načela gradnje vključujejo štiri osnovne strategije – izogibanje odpadkom, ponovno uporabo gradiv in komponent, njihovo nadaljnjo uporabo in recikliranje. Možnost obdelave gradbenih odpadkov in njihovega vračanja v proces gradnje je odvisna od vrste prevladujočih materialov, ki sestavljajo konstrukcijske elemente stavbe in ločljivosti/neločljivosti konstrukcijskih zvez. Arhitekt ima odgovorno nalogo pri zmanjševanju količin gradbenih odpadkov, saj zasnova stavbe postaja ključna pri obvladovanju gradbenih odpadkov. Konstrukcija s potencialom za smotno razgradnjo na koncu življenjske dobe stavbe vključuje več konceptov – izbor gradiv z nizkim potencialom obremenjevanja z gradbenimi odpadki, projektiranje razstavljivih kompozitnih gradiv in konstrukcij ter projektiranje enovitih konstrukcij. V prispevku so evidentirani odpadki, ki nastajajo zaradi grajenega okolja. Predstavljeni so koncepti arhitekturnih zasnov s potencialom zmanjšanja količin gradbenih odpadkov in njihovega vračanja med surovinske vire.

KLJUČNE BESEDE

gradbeni odpadki, krožno gradbeništvo, recikliranje, ponovna uporaba, urbano rudarjenje, digitalni potni list gradiv

ABSTRACT

The built environment requires ever-increasing amounts of raw material resources and at the same time bears the responsibility for the resulting waste. Waste is generated throughout the life cycle. In the initial phases it is referred to as industrial waste, while during construction, reconstruction, and demolition it is called construction waste. Construction waste is most voluminous but it also has a great potential in circular economy that aims at the closed loop cycle where already used construction materials and components are recovered as raw materials.

Sustainable building principles include four basic strategies, waste avoidance, construction materials and components re-use, continued use, and recycling. The possibility of construction waste treatment and its possible recovery in the building process depends on the type of prevailing materials that are contained in building elements as well as on detachability, separability and inseparability of structural joints and components. The architect plays a responsible role in decreasing the volume of construction waste as the conception of a building represents the key factor in sustainable construction waste management. Planning a construction with a good dismantling potential at the end of the building's life cycle includes a number of factors such as the choice of building materials with a low environmental impact, the design of detachable composite materials and structures as well as the design of mono material structures. This article focuses on waste resulting from the built environment and discusses architectural concepts with a potential of reducing the volume of construction waste and its potential recovery as a construction resource.

KEY-WORDS

construction waste, circular economy, recycling, reuse, urban mining, digital material passport

UVODNIK
EDITORIAL
ČLANEK
ARTICLE

RAZPRAVA
DISCUSSION
RECENZIJA
REVIEW
PROJEKT
PROJECT
DELAVNICA
WORKSHOP
NATEČAJ
COMPETITION
PREDSTAVITEV
PRESENTATION
DIPLOMA
MASTER THESIS

1. UVOD

Svet se sooča s čedalje večjim pomanjkanjem surovin, hkrati pa še nikoli v zgodovini ni nastajalo toliko odpadkov kot danes. Gradbeni sektor je velik porabnik naravnih surovinskih virov in je odgovoren za velik delež odpadkov.

Grajeno okolje sestavljajo gradiva, katerih življenjski cikel je sestavljen iz šestih faz – začne se z izplenjevanjem surovin v naravi, konča pa kot gradbeni odpadke na deponijah (Zbašnik-Senegačnik, 1996). Poleg gradbenih odpadkov, ki so voluminozno najbolj vidni, pa gradiva povzročajo tudi industrijske odpadke, ki nastajajo v ostalih fazah življenjskega ciklusa gradiv – pri proizvodnji gradiv in komponent, sredstev za lepljenje, površinsko obdelavo, pri izdelavi orodij za delo z gradivi, do odpadkov prihaja na gradbišču med gradnjo, odpadki nastajajo pri uporabi in vzdrževanju stavbe ... Odpadki, vezani na današnji način bivanja in življenja na planetu, počasi postajajo najpomembnejši problem človeštva in zahtevajo temeljit razmislek in korenite spremembe.

Novi Akcijski načrt EU za krožno gospodarstvo (SRIP, 2020) napoveduje celovito strategijo za trajnostno grajeno okolje, ki bo spodbujala načela krožnega gospodarstva v celotnem življenjskem ciklusu stavb z vključevanjem načel krožnosti za gradiva in komponente, ki sestavljajo stavbo. Po Kibertu (2008) je 50 % celotnih odpadkov, ki jih ustvari gradbena industrija po vsem svetu, posledica odstranitve odsluženih stavb, torej rušenja. Stavbe se namreč odstranijo ob koncu življenjske dobe, ko je možnost ponovne uporabe odsluženega materiala velikokrat nemogoča. Čeprav postaja recikliranje celotne stavbe priljubljeno, je koristnejša uporaba predelane gradbenega materiala neposredna ponovna uporaba. Ponovna uporaba materialov namreč zahteva minimalno rabo energije v primerjavi z energijo, potrebno za recikliranje materialov (Addis, 2006). Na tem temelji paradigma, da ima razstavljanje konstrukcije stavbe na posamezne elemente zaradi ekonomskih in okoljskih koristi prednost pred rušenjem (Coelho in de Brito, 2011). Gradbeni odpadki, ki ob tem nastanejo, so pripoznani kot surovina za krožno gradbeništvo, v katerem proizvodi po koncu življenjske poti začnejo nove življenjske cikle v enaki, izboljšani ali predelani obliki.

V prispevku so evidentirani odpadki, ki so posledica gradnje, uporabe in odstranjevanja grajenega okolja. Raziskan je potencial zmanjševanja odlaganja gradbenih odpadkov z njihovim vračanjem med surovinske vire in koncepti arhitekturne zasnove, ki to omogočajo.

2. FAZE ŽIVLJENJSKEGA CIKLUSA GRADIV IN NASTAJANJE ODPADKOV

Gradiva so vse okrog nas, saj tvorijo celotno grajeno okolje v katerem živimo, delamo, se šolamo, rekreiramo, zdravimo ... Njihov življenjski cikel se začne veliko pred vgradnjo v stavbo. Sestavlja ga šest faz, vsaka od njih se vrši na različnih lokacijah,

ki so med seboj oddaljene (Zbašnik-Senegačnik, 1996). Na koncu življenjskega ciklusa gradiva končajo kot gradbeni odpadke izven gradbenega sektorja, na deponijah, divji odlagališčih, redko v sežigalnicah, in predstavljajo družbeni in civilizacijski problem (slika 1).

Odpadki ne nastajajo samo ob novogradnji, obnovi ali rušenju, ko se deklarirajo kot gradbeni odpadki. Precejšen del odpadkov, povezanih s stavbami, se uvršča tudi med industrijske odpadke, čeprav nastajajo zaradi potreb po gradivih v gradbenem sektorju. Dejanski odpadki, ki jih povzročajo gradiva v celotnem življenjskem ciklusu, segajo v različne industrijske procese (Ur. l. EU, L370/46, 2014).

2.1 Faza pridobivanja surovin

Vpliv gradiv na okolje se začne z izplenjevanjem surovine iz naravnega okolja. Surovine za gradiva so največkrat neobnovljivi naravni viri (boksit, krom, kobalt, mangan, pa tudi zlato, srebro, svinec, cink, kositer, kamen, ilovica ...). Les in druga rastlinska in živalska gradiva sodijo med obnovljive surovinske vire. V fazi pridobivanja surovin prihaja do naslednjih vrst odpadkov:

- ob fizikalni in kemični predelavi kovinskih mineralnih surovin nastajajo jalovine, odpadki z nevarnimi snovmi, prah in prašni delci itd. (npr. rdeče blato iz proizvodnje glinice), nadalje gramoz, drobir, pesek, glina, mulj (lahko vsebuje tudi nevarne snovi);
- pri obdelavi in predelavi lesa in lesnih polizdelkov, npr. ivernih plošč, nastajajo odpadno lubje in pluta, žaganje, oblanci, odrezki, delci plošč, furnirjev; odpadna sredstva za lepljenje in zaščito lesa lahko vsebujejo nevarne snovi;
- do odpadkov prihaja v kemijskih procesih, v katerih nastajajo sredstva za premaze, barve, emalje, lepila, tesnila, sredstva za površinsko zaščito, npr. organska topila ali druge nevarne snovi, mulji barv in lakov, odpadki iz odstranjevanja barv in lakov, odpadna sredstva za odstranjevanje barv in lakov ...

2.2 Faza proizvodnje gradiv in polizdelkov

V industrijskih procesih v proizvodnji gradiv prihaja do povečanih koncentracij škodljivih vplivov na okolje (emisije, prah, vlakna, škodljive substance, hrup ...). Dodaten negativni vpliv nastane zaradi potreb po energiji zaradi dolgih transportnih poti, povezanih z globalno centralizacijo proizvodnje gradiv. Poleg tega v fazi proizvodnje nastajajo:

- odpadki iz elektrarn in drugih kurilnih naprav (ki zagotavljajo energijo za proizvodnjo) vsebujejo pepel in elektrofiltrski pepel, žlindro, trdne odpadke iz razžvepljevanja dimnih plinov, kotlovski prah ...);
- odpadki iz železarske in jeklarske industrije (žlindra in odpadki iz predelave žlindre, odpadki, ki vsebujejo nevarne snovi, mulji in filtrne pogače ...);

Slika 1: Linearni življenjski cikel gradiv.

- odpadki iz termične metalurgije aluminija, svinca, cinka, bakra, barvnih kovin (žlindre iz taljenja rud, prah in drugi delci, mulj in filtrne pogače, odpadki iz obdelave hladilne vode ...);
- odpadki iz livarn železa, barvnih kovin (žlindre, prah, odpadne uporabljene in neuporabljene livarske forme in jedra);
- odpadki iz proizvodnje stekla in steklarskih izdelkov (delci in prah, odpadni material iz steklenih vlaken, mulj iz poliranja in mletja stekla ...);
- odpadni produkti iz proizvodnje keramičnih izdelkov, opek, ploščic in gradbenih izdelkov (odpadne zmesi, delci in prah, mulj, odpadna keramika, opeka in ploščice po žganju, odpadki iz glaziranja, mulj iz čiščenja odpadne vode ...);
- odpadki iz proizvodnje cementa, apna in sadre;
- odpadki iz kemične obdelave in površinske obdelave ter površinske zaščite kovin in drugih materialov, npr. galvaniziranje, cinkanje, luženje, jedkanje, fosfatiranje ... (kisline, lug, mulji, tekočine za izpiranje ...);
- odpadki iz oblikovanja ter fizikalne in mehanske površinske obdelave kovin in plastik – npr. opilki in ostružki, prah in delci železa, mineralna in sintetična olja, odpadki iz peskanja ... (odpadna organska topila, hladilna sredstva in potisni plini ...).

2.3 Faza prodaje gradiv, polizdelkov in komponent

Prodaja gradiv se vrši v specializiranih prodajalnah z velikimi skladišči, v tej fazi nastaja:

- odpadna embalaža iz lesa, kovin, plastike, stekla, papirja, kartona in lepenke, kompozitna in mešana embalaža, embalaža iz nevarnih snovi.

2.4 Faza vgradnje

Pri vgradnji gradiva na mesto, kjer bo služilo svojemu namenu, nastaja:

- ostanki gradiv (kosi opeke, malte, mavčno-kartonskih plošč, keramičnih ploščic, parketa, cevi, toplotne izolacije ...)
- odpadna embalaža (papirna in kartonska, plastična, lesena, kovinska, sestavljena (kompozitna) embalaža, steklena, mešana).

Posebej problematični so mešani odpadki, ki nastajajo ob montaži gradiv na gradbišču, med katere spadajo uporabljene embalaže lepil, barv, tesnil ..., tudi zato, ker niso prazne oz. v celoti uporabljene in jih ni mogoče reciklirati. Na gradbiščih delavci pogosto ne ločujejo odpadkov, zato vsi ostanki gradiv, embalaže, tudi poškodovano in uničeno orodje itd., končajo na deponijah kot mešani komunalni odpadki.

Slika 2: Odpadna embalaža pri vgradnji gradiv – (A) možnost sortiranja in recikliranja, (B) zaradi umazanosti posod embalaže ni mogoče reciklirati.

A

2.5 Faza uporabe

Uporaba je najdaljša faza življenjskega ciklusa gradiva. Gradiva so vgrajena povsod, oblikujejo naše okolje v mestih, naseljih, v stanovanju, na delovnem mestu, v prostorih za rekreacijo, šport itd. V fazi uporabe nastajajo:

- odpadki zaradi vzdrževanja, prenove in obnove stavbe in komponent za njeno delovanje;
- odpadki zaradi proizvodnje energije za delovanje stavb (npr. pepel ...);

v času življenjske dobe stavbe se večkrat zamenja in odvzre na deponijo staro pohištvo in opremo, gospodinjske aparate, svetila, tekstilne obloge ...

2.6 Faza odstranitve

Na koncu življenjske dobe stavbe gradiva in komponente končajo kot:

- gradbeni odpadki in odpadki iz rušenja objektov (beton, opeka, ploščice, keramika, les, steklo in plastika, kovine in zlitine bitumenske mešanice, premogov katran in izdelki iz katrana);
- zemljine, kamenje in izkopani material;
- izolacijski materiali;
- gradbeni materiali, ki vsebujejo azbest;
- gradbeni materiali na osnovi sadre;
- gradbeni odpadki in ruševine;
- odpadki iz naprav za ravnanje z odpadki (sežigalnic), iz čistilnih naprav ...

Odstranjenih naprav, pohištva in druge opreme se v tej študiji ne obravnava, čeprav imajo kot odpadke prav tako veliko težo.

Dejstvo je torej, da je prav grajeno okolje in vse, kar je povezano z njim, razlog za nastajanje in kopičenje velikih količin odpadkov. V prispevku se osredotočamo na gradbene odpadke – to so odvečni ali poškodovani materiali, ki so posledica gradbenih dejavnosti pri novogradnjah, obnovah in rušenju stavb. Sestava gradbenih odpadkov je odvisna predvsem od prevladujočih gradbenih materialov, ki so na voljo za posamezne objekte. Tehnične smernice o razvrščanju odpadkov klasificirajo gradbene odpadke in odpadke iz rušenja objektov v osem kategorij (Ur. l. EU, C 124, 2018): (1) beton, opeka, ploščice in keramika; (2) les, steklo in plastika; (3) bitumenske mešanice, premogov katran in izdelki iz katrana; (4) kovine in zlitine; (5) zemljina, kamenje in izkopani material; (6) izolacijski materiali in gradbeni materiali, ki

B

A

vsebujejo azbest; (7) gradbeni material na osnovi sadre; (8) drugi gradbeni odpadki in ruševine. Ustrezno sortirani predstavljajo možnost za vračanje v gradbeni sektor.

3. ZMANJŠEVANJE KOLIČIN ODPADKOV

EU je prevzela vodilno vlogo v trajnostni prihodnosti s pobudo »Resource Efficient Europe« (COM, 2011), ki predvideva novo pot do ukrepov za učinkovito rabo virov. Do leta 2030 postavlja več mejnikov – 65 % recikliranje gospodinjstevskih odpadkov, 75 % recikliranje odpadne embalaže, zmanjšanje odlagališč gradbenih odpadkov na največ 10 % komunalnih odpadkov. V marcu 2020 je bil sprejet novi Akcijski načrt EU za krožno gospodarstvo (SRIP, 2020), ki predvideva premik paradigme linearnega modela gospodarstva »vzemi, izdelaj, uporabi in zavrzi« v bolj trajnostni krožni model »vzemi, izdelaj, uporabi, ponovno uporabi in recikliraj«. Prehod v krožno gospodarstvo je bistvenega pomena za izpolnitev programa za učinkovito rabo virov, vzpostavljenega v okviru strategije Evropa 2020 za pametno, trajnostno in vključujočo rast.

V krožnem gospodarstvu se čim dlje ohranja ekonomska in okoljska vrednost materialov – bodisi s podaljšanjem življenjske dobe izdelkov, ki so iz njih nastali, bodisi z zankanjem nazaj v sistem, da se ponovno uporabijo. Pojem odpadkov v krožnem gospodarstvu ne obstaja več, ker se proizvodi in materiali načeloma ponovno uporabljajo in krožijo v nedogled (Den Hollander, Bakker in Hultink, 2017). V krožnem gospodarstvu odpadki postanejo surovina in začnejo nove življenjske cikle v enaki, izboljšani ali predelani obliki.

Za ohranjanje naravnih surovinskih virov in v prid izogibanju gradbenim odpadkom sledimo štirim osnovnim strategijam, ki so v vrstnem redu navedene glede na stopnjo njihovega vpliva na zmanjševanje odpadkov (Hillebrandt et al. 2019):

- izogibanje odpadkom;
- ponovna uporaba;
- nadaljnja uporaba;
- recikliranje.

3.1 Izogibanje odpadkom

Najbolj čista in vzdržna rešitev je izogibanje odpadkom. To pomeni predvsem izbiro gradiv in tehnologij gradnje, ki po koncu življenjske dobe ne obremenjujejo okolja (npr. naravna gradiva, reciklirana gradiva ...). Vgrajeni sestavni elementi morajo biti čim bolj kakovostni in v fazi uporabe dobro vzdrževani, kar podaljša življenjsko dobo stavbe.

B

Slika 3: Ločevanje gradbenih odpadkov med rušenjem – (A) kovinski in leseni elementi in (B) mineralni odpadki (opeka, kamen, ometi)“.

3.2 Ponovna uporaba

Konstruktivske elemente se lahko ponovno uporabi tako, da ohranijo svoj primarni namen. Pri ponovni uporabi morajo gradbeni materiali zagotoviti določeno stopnjo kvalitete in dolgoročne trajnosti. Primer: visoko kvalitetne materiale kot so les, naravne kamnite plošče, stekleni fasadni paneli, klinker opeka in gramoz se po odstranitvi s stavbe lahko očisti in obnovi ter ponovno uporabi za enak namen na drugem mestu (Hillebrandt et al. 2019).

3.3 Nadaljnja uporaba

Če se že uporabljeno gradivo ali izdelek uporabi za drugačen namen kot je bila njegova primarna funkcija, ga lahko kategoriziramo kot izdelek za nadaljnjo uporabo. Primer nadaljnje uporabe je npr. odstranjena fasadna opeka, ki se lahko uporabi kot del novega tlakovanja (Hillebrandt et al. 2019).

Izvedeni projekti s ponovno in nadaljnjo uporabo izdelkov kažejo na nov doprinos k načrtovanju in oblikovanju trajnostne arhitekture, ki mora zadovoljiti vse bistvene zahteve gradnje, hkrati pa je v svoji uporabi in obliki lahko tudi inovativna in zabavna.

3.4 Recikliranje

Recikliranje je v krožnem gospodarstvu zelo pomembno, saj se po končani uporabi izdelek zopet uvrsti v proizvodni proces, namesto da bi ta končal kot odpadki. Če se snovi, ki se pridobi pri postopku razgradnje izdelka, ponovno uporabijo za nove izdelke z enako stopnjo kvalitete v zaprti zanki, jih lahko kategoriziramo kot reciklirane (Hillebrandt et al. 2019). Primer kvalitetnega recikliranja je npr. recikliranje odsluženega jeklenega nosilca in izdelava novega jeklenega nosilca z drugačno obliko profila. Če ima izdelek iz recikliranih surovin slabše lastnosti kot osnovni izdelek, govorimo o manjvrednostnem recikliranju (angl. downcycling, npr. sintetični materiali, ki pri procesu recikliranja izgubijo kvaliteto). Krožno gospodarstvo spodbuja t.i. večvrednostno recikliranje (angl. upcycling), pri katerem nastane izdelek višje kakovosti kot izhodiščni material.

Gradbena industrija predstavlja prednostni sektor pri izboljšanju recikliranja materialov z namenom učinkovitejše izrabe naravnih virov. Trenutno je najpogostejša uporaba gradbenih odpadkov in odpadkov iz rušenja v obliki recikliranega agregata za nasutje pod temeljno ploščo ali za utrjevanje cest in pešpoti, saj prinaša tako okoljske kot ekonomske učinke (Farina et al. 2020). Agregat je ena osnovnih sestavin v gradbeništvu, saj sestavlja 60 do 75 % volumna betona. Reciklirani agregat je (če je ob rušenju pravilno

izbran in predelan) enakovreden naravnemu agregatu, zanj veljajo isti predpisi kot za naravne agregate. V proizvodnji betona ima celo prednost pred naravnim agregatom, saj vsebnost cementa recikliranemu agregatu izboljša hidravlične lastnosti. Znižanje vsebnosti cementa na račun veziva iz recikliranega betona zato lahko zmanjša ogljični odtis betona tudi za 20 % (ZAG, 2014). Dodana vrednost je možnost uporabe recikliranega agregata v proizvodnji samozgoščevalnega betona, ki se je sposoben sam oblikovati, odzračiti (Manzi in Bignozzi, 2020) in samozdravilnega betona, ki ima endogeno sposobnost celjenja razpok, kar precej zmanjša stroške vzdrževanja stavbe (Garcia-González et al. 2020). Reciklirani agregat je lahko tudi sestavni del visoko-kvalitetnih betonov, ki imajo boljše mehanske lastnosti, lažjo obdelovalnost in boljšo obstojnost proti agresivnim kemikalijam v primerjavi s tradicionalnim betonom (Ettxeberria, 2020).

Velik delež gradiv v stavbah predstavljajo tudi kovine – zaradi globalne razširjenosti armiranega betona kot gradbenega materiala in naraščajočih količin žic in cevi se ocenjuje, da stavbe vsebujejo vsaj 50 % vseh kovin v uporabi (van Beers in Graedel, 2007). Kovine se, za razliko od ostalih gradiv, reciklirajo že nekaj časa. Klinglmair in Fellner (2010) ugotavljata, da že 30 % bakra, porabljenega v Evropi, in 50 % železa v ZDA izvira iz recikliranih virov. Ključni cilj v svetovni industriji je zato 100 odstotno recikliranje kovin. Ta pričakovanja zvišujejo visoka učinkovitost ločevanja kovin od drugih odpadkov in drugi ukrepi, kot npr. visoke komunalne tarife ali prepoved odlaganja kovin med reciklirane odpadke (Kucukvar, Egilmez in Tatar, 2016). Kovine imajo velike možnosti za recikliranje, saj lahko ohranijo in celo povečajo svojo vrednost pred drugimi gradivi. Reciklirane kovine lahko bistveno zmanjšajo rabo energije v proizvodnem procesu. Recikliranje aluminija zmanjšuje rabo energije za proizvodnjo za 95 %, recikliranje bakra pa za 85 % (Hillebrandt et al. 2019).

3.5 Urbano rudarjenje

Pojem »urbano rudarjenje« opisuje potencial naših mest kot vir surovin. V zadnjem stoletju je poraba materialov narasla vsakih deset let za faktor 10 – trenutno porabi človeštvo letno skoraj 60 Gt (Krausmann et al. 2009). To dramatično povečanje je pripeljalo do kopičenja 792 Gt materialov v stavbah in infrastrukturi (Krausmann et al. 2017). Zaloge materialov v našem grajenem okolju, ki so potencialno primerni za uporabo, je torej enormno, stavbe pa postajajo banke materialov oz. rudniki surovin. Uveljavlja se termin urbano rudarjenje, ki se nanaša na predelavo sestavnih delov in elementov vseh grajenih struktur, vključno s stavbami, infrastrukturo, industrijo, izdelki itd. (Baccini in Brunner, 2012). Količine gradiv v grajenem okolju so pogosto primerljive ali celo višje od naravnih zalog (Cossu in Williams, 2015). Zato je obnavljanje surovinskih virov iz antroposfere atraktivna alternativa izčrpanju naravnih virov, ki sicer povzroča visoke stroške pridobivanja in prevoza primarnih virov ali odvisnost od tistih, ki primarne vire nadzorujejo (Koutamanis, van Reijn in van Bueren, 2018). Urbano rudarjenje sledi načelom krožnega gospodarstva. Rudniki surovin v prihodnosti ne bodo v podzemlju, ampak v naših mestih (Hebel, Wisniewska in Heisel, 2014).

4. VLOGA PROJEKTANTOV PRI OBVLADOVANJU GRADBENIH ODPADKOV

Stavbe predstavljajo količinsko najpomembnejši vir gradbenih odpadkov. Do nedavnega je večina sestavnih delov stavb končala na odpadu med mešanimi odpadki, prepogosto tudi na divjih odlagališčih. Danes se razmere spreminjajo in prihaja do zavedanja, da je nekatera gradiva po odsluženju stavbe mogoče ustrezno razstaviti, obdelati, ponovno uporabiti, reciklirati.

Možnost obdelave gradbenih odpadkov in njihovega vračanja v proces gradnje je odvisna od:

- vrste prevladujočih materialov, ki sestavljajo konstrukcijo stavbe, in
- ločljivosti/neločljivosti konstrukcijskih zvez.

Ključna pri obvladovanju gradbenih odpadkov torej postaja zasnova stavbe. Konstrukcija s potencialom za smotno razgradnjo na koncu življenjske dobe stavbe vključuje več konceptov:

- izbor gradiv z nizkim potencialom obremenjevanja z gradbenimi odpadki,
- projektiranje razstavljivih kompozitnih gradiv in konstrukcij,
- projektiranje enovitih konstrukcij.

4.1 Izbor gradiv z nizkim potencialom obremenjevanja v fazi odstranitve stavbe

Odločanje o izboru materialov sodi poleg oblikovanja v samo bistvo arhitekturnega načrtovanja, saj gradiva materializirajo abstraktni arhitekturni koncept. Arhitekti morajo pri odločitvah zadovoljiti tako umetniško idejo kot tehnične zahteve. Pri izboru torej štejejo vizualne in uporabne vrednosti, pomembne so tudi ekonomske vrednosti (hierarhično zaporedje vrednotenja se lahko spreminja). Zahteve krožnega gradbeništva prinašajo še en kriterij pri izboru gradiv – zasnova mora omogočati vračanje odpadnih elementov med surovinske vire.

Trajnostna zasnova stavbe vključuje upoštevanje negativnih potencialov gradiv. Surovine za gradiva izhajajo iz narave, vendar je pot od surovine do končnega produkta različno dolga, v proizvodnih procesih pa prihaja do nastajanja različnih odpadkov. Tudi na koncu življenjskega ciklusa gradiva bolj ali manj obremenjujejo okolje. Gradiva lahko glede na nastanek razdelimo v tri skupine, ki se razlikujejo tudi po stopnji onesnaževanja na koncu življenjskega ciklusa – naravna gradiva, umetna mineralna gradiva in sintetična gradiva.

4.1.1 Naravna gradiva

Naravna gradiva se pridobijo iz naravnih surovin v elementarni obliki in se nadalje uporabijo brez dodatne obdelave, ki bi spremenila njihove lastnosti. S stališča odpada so neproblematična rastlinska naravna gradiva, torej les, pluta, slama, bambus, kokos, trstika Na koncu življenjskega ciklusa se razgradijo in povrnejo v naravo kot hranila. Ta gradiva so CO₂ nevtralna – na koncu življenjskega ciklusa se sprostijo toliko CO₂, kot so ga rastline iz okolja vzele v času rasti. Rastlinska naravna gradiva se obnovijo približno v času življenjske dobe stavbe ali prej. Ker so naravna gradiva (npr. les) teoretično neskončno dosegljiva, je njihova uporaba v gradnji zaželena. Naravna mineralna gradiva (npr. naravni kamen, ilovica) so nastala z naravnimi procesi in se na koncu življenjskega ciklusa razgradijo. Ne glede na njihov naravni izvor pa je zaradi njihovega dolgega obdobja nastanka dostopnost teh gradiv končna. Možnosti za recikliranje naravnih mineralnih gradiv so omejene, priporoča se njihovo ponovno uporabo. V tem primeru morajo zagotoviti določeno stopnjo kvalitete in dolgoročne trajnosti. Npr. obloga iz naravnega kamna večjih dimenzij se lahko odstrani brez poškodb, s tem pa se poveča možnost ponovne uporabe (Hillebrandt et al. 2019).

4.1.2 Umetna mineralna gradiva

Umetna mineralna gradiva izdelava človek s pomočjo visoke vgradne energije ter raznih kemičnih in fizikalnih postopkov. Surovine za ta gradiva so mineralnega izvora, nahajajo se v na-

ravi, vendar pa jih je potrebno za koristno uporabo še predelati. K umetnim mineralnim gradivom štejemo opeko (tudi keramiko in porcelan), kovine, steklo, mavec, apno, cement, beton, malto, anorganska toplotno-izolacijska gradiva.

Reciklabilnost umetnih mineralnih gradiv je omejena. Iz velikega dela mineralnih gradiv se izdelajo agregati, saj je povpraševanje po njih v gradbeništvu veliko. Približno 80 % mineralnih gradiv se manjvrednostno reciklira, preko 15 % mineralnih gradiv se uporablja kot polnila, preostalo se odlaga na odlagališča.

4.1.3 Sintetična gradiva

Sintetična gradiva so iz sintetičnih veziv in polnil ter dodatkov. Vezivo je praviloma polimer, izdelan iz fosilnih snovi (nafta, katran, zemeljski plin ...). V večini sintetičnih snovi je približno 10 – 20 % veziva. Polnila so zelo raznovrstna: praškasta (lesna in kamena moka, kreda, kuhinjska sol, zračni mehurčki ...), vlaknasta (steklasta in azbestna vlakna, azbest ...) ali v obliki listov (papir, tkanine, furnir ...). Dodatki so večinoma kemične snovi (olja, soli, mila ...), ki prinašajo večjo plastičnost, preprečujejo staranje, regulirajo čas strjevanja ali dajejo barvo (pigmenti, organske barve).

Sintetična gradiva nastopajo v mnogih oblikah, največ pa se pri gradnji uporabljajo umetne mase, umetna toplotno-izolacijska gradiva, umetna lepila, kiti, fugirne mase, tesnilne mase ..., kompozitna sintetična gradiva. Lastnosti, zaradi katerih so uporabna pri gradnji, se zelo hitro poslabšajo, sicer pa so lahko izjemno dolgoživa, biološko odporna, v naravi lahko obstanejo do 450 let (Umwelt Bundesamt, 2017). Pri zgorevanju odpadkov iz sintetičnih gradiv obstaja nevarnost toksičnih izpustov (Hillebrandt et al. 2019), kar predstavlja problem pri sežiganju v sežigalnicah. Reciklabilna je le skupina termoplastov (Hegger, Manfred, 2005). Plastike višje kvalitete se lahko reciklirajo večkrat tako, da izdelki dosegajo enako stopnjo kvalitete. Za uspešno recikliranje mora biti sintetično gradivo čisto, brez dodanih lepil ali drugih materialov. Za recikliranje velikega dela plastike se uporablja princip manjvrednostnega recikliranja, saj se njihove mehanske, kemične in toplotnoizolacijske lastnosti v procesu recikliranja večinoma slabšajo (Hillebrandt et al. 2019).

4.2 Projektiranje razstavljenih gradiv in konstrukcij

Stavbe so kompleksen projekt, produkt oblikovalcev, inženirjev in proizvajalcev materialov in komponent. Sestavljene so iz materialov in sestavnih konstrukcijskih elementov s svojimi detajli, ki definirajo konstrukcijo ter njene tehnične in oblikovne karakteristike. Zaradi njihove pomembnosti za družbo in izjemnega učinka na globalno izrabo surovinskih virov je pomemben vsak poskus upoštevanja trajnostnosti stavb oz. z njimi povezanih gradiv v celotnem življenjskem ciklusu – od pridobivanja surovin in proizvodnje materialov, do oblikovanja, vgradnje, uporabe/delovanja stavbe, obnove/vzdrževanja do odstranitve. Vsaki stavbi se enkrat izteče življenjska doba, takrat nastopi problem odsluženih gradbenih elementov oziroma odpada. Stavba mora biti sestavljena tako, da jo je mogoče po koncu življenjske dobe razstaviti, njene gradbene elemente pa sortirati, obdelati ter ponovno uporabiti ali reciklirati.

4.2.1 Razstavljivost kompozitnih gradiv

V zadnjih desetletjih se vedno znova pojavljajo nova kompozitna gradiva, ki jih sestavlja več snovi. Takih kompozitov po koncu življenjske dobe ni mogoče reciklirati, zato končajo na odpadu. V prihodnosti bo potrebno razviti tehnologijo, s katero bo mogoče osnovne sestavine kompozitnih gradiv zopet ločiti in jih ponovno uporabiti. Tako kompozitno gradivo, ki se

masovno uporablja, je npr. beton. Če bi ga bilo možno razstaviti na pesek in cement, bi bil rešen problem odpada. Problem pri obdelavi gradbenih odpadkov je tudi v premazih, površinskih obdelavah in lepilih, ki jih je običajno težko odstraniti in poslabšajo možnost recikliranja.

4.2.2 Razstavljivost konstrukcij

Razstavljivost konstrukcij na osnovna gradiva bi morala biti dosegljiva z več vidikov. Vsi sestavni deli stavbe nimajo enako dolge življenjske dobe, zato je za podaljševanje uporabnosti stavbe nujno predvideti možnost razstavljanja ključnih konstrukcijskih elementov in njihove zamenjave. V aktualni praksi tudi po koncu življenjske dobe stavbe vitalni konstrukcijski elementi prepogosto končajo med mešanimi odpadki, ker je sestavne elemente nemogoče ločiti in sortirati. S stališča ravnanja z gradbenimi odpadki morajo biti detajli oblikovani tako, da dopuščajo enostavno demontažo, ločevanje in sortiranje konstrukcijskih elementov ter njihovo ponovno uporabo in recikliranje. Razstavljivost stavb je del krožnega gradbeništva v strategiji krožnega gospodarstva.

4.3 Projektiranje enovitih konstrukcij

Pri enovitih konstrukcijah je uporabljena ena vrsta materiala, kar poenostavi (tudi poceni) demontažo in sortiranje. Tradicionalno in trajnostno gradivo les se vse bolj uveljavlja tudi v enovitih konstrukcijah. Poleg vse večje uporabe križno lepljenih lesenih elementov se je v zadnjih letih vidno povečala uporaba masivnega lesa (Nemčija, Avstrija, Švica). Enovite konstrukcije so butane ilovnate stene, lahko so sestavljene tudi iz prefabriciranih ilovnatih zidakov. Z ustrezno debelino ilovnatga gradiva se poleg nosilnosti dosega dobra zvočna, toplotna izolativnost sten z odlično akumulacijo toplote in uravnavanjem vlažnosti bivalnega prostora. Potencial za izvedbo enovitih konstrukcij je tudi porobeton (Hillebrandt et al. 2019).

4.4 Digitalni potni list materialov – orodje za načrtovanje

Arhitekt že v začetnih fazah načrtovanja vpliva na to, kakšno obremenitev za okolje bo stavba predstavljala po koncu življenjske dobe. Ocena negativnega potenciala gradiv mora biti narejena na začetku projektiranja, kar je ob pomanjkanju informacij na enem mestu težka naloga. Ključno inovacijo na tem področju predstavlja digitalni potni list materialov, s katerim se lahko oceni stopnjo reciklabilnosti stavbe ter soustvarja pomembne ekološke indikatorje stavb že v zgodnji fazi oblikovanja (Honica et al. 2019). Digitalni potni list materialov je nastal v okviru evropskega projekta BAMB (Bamb, 2020a). Za začetek je bilo izdelanih 300 potnih listov materialov in komponent, ki predstavljajo nadgradnjo dosedanjim tehničnim informacijam. Digitalni potni list materialov omogoča neizbrisljivo, varno, zaupno in zanesljivo bazo podatkov. Zbrane so informacije, ki so ključne pri izbiri materialov, izdelkov in komponent in so v pomoč projektantom in drugim deležnikom v procesu gradnje, rušitve ter nadaljnjih odločitvah o ponovni uporabi, predelavi ali recikliranju oz. uničenju v procesu pridobivanja energije (Marinič, 2020). Potni listi gradiv omogočajo krožne poslovne modele s tem, da definirajo gradiva in prikazujejo njihove krožne poti. Digitalni potni list omogoča dobaviteljem, izvajalcem, arhitektom, uporabnikom in prihodnjim uporabnikom pridobivanje informacij preko digitalnih platform, s tem pa pokažejo na možnost umestitve gradiv v kontinuirane zanke uporabe in ponovne uporabe. Trenutno je še veliko izdelkov, ki jih še ni mogoče vključiti v krožno uporabo. Zato platforma digitalnih potnih listov gradiv nudi tudi povratno informacijo, da bi lahko

vsi deležniki v procesu gradnje optimizirali izdelavo, izbor, uporabo gradiv, izdelkov in storitev, primernih za uporabo v krožnem gradbeništvu (Bamb, 2020b). Potni listi gradiv bi v bližnji prihodnosti morali delovati znotraj informacijskega modeliranja stavb (Building Information Modelling - BIM), nabor gradiv pa bi se moral dopolnjevati (Bamb, 2020a).

4.4 Nova paradigma načrtovanja – izzivi na arhitekto

Vsa zgodovina arhitekture je – poenostavljeno rečeno – zgodovina izumljanja gradiv, konstrukcij in prostorskih konceptov v funkciji zadovoljevanja človeških resničnih ali namišljenih potreb. Smo v prelomnem trenutku, ko arhitektura dobiva še eno pomembno funkcijo, ki bo vplivala na kakovost življenja prihodnjih generacij – v načrtovanje in izvedbo grajenega okolja bo morala vključevati načela trajnostnega razvoja. Težične odločitve arhitekta se danes od zgodovinskega vodila »**kako stavbo narediti**« prenaša na izziv prihodnosti »**kako stavbo odstraniti**«. Vodilo ob tem bi moralo biti predvsem »**kako stavbo na koncu življenjske dobe ustrezno razstaviti**«. Življenjski cikel gradiv, ki ga je do sedaj sestavljalo šest faz (pridobivanje surovin, proizvodnja gradiv in komponent, prodaja, vgradnja, uporaba in odstranitev), danes namreč pridobiva sedmo fazo (ponovna uporaba in/ali recikliranje), linearni proces življenjskega ciklusa (slika 1) pa se spreminja v krožnega (slika 4). Življenjski cikel gradiv bi moral biti v prihodnosti popolnoma zaprt – naš grajeni prostor bi moral torej delovati brez jemanja naravnih dobrin in odlaganja odpadkov. Arhitekt ima možnost izbire, s tem pa tudi poslanstvo – z arhitekturno in konstrukcijsko zasnovo omogočiti, da stavba po končani življenjski dobi ne bo končala kot odpadke, ampak kot surovinski vir.

Arhitekti lahko prispevamo k zmanjšanju nastajanja gradbenih odpadkov s ponovno uporabo proizvodov ali podaljšanjem njihove življenjske dobe, z izborom materialov, ki imajo potencial za recikliranje, pa tudi z inovativnimi predlogi in iskanjem novih rešitev v fazi načrtovanja ter, nenazadnje, z ozaveščanjem vseh deležnikov o prednostih in izzivih trajnostne gradnje s poudarkom na ustvarjanju zdravega okolja za uporabnike.

5. ZAKLJUČEK

Rast prebivalstva, cvetoče gospodarstvo in hitra urbanizacija so močno pospešili nastajanje trdnih odpadkov po vsem svetu. Pomemben dokument, ki vzpostavlja pravni red na tem področju, je Direktiva o odpadkih (2008/98/ES in 2018/851), ki se osredotoča predvsem na preprečevanje nastajanja odpadkov in vključuje strategije izogibanja nastajanja odpadkov in uporabo odpadkov v verigi surovin. Največji potencial te strategije se odraža prav pri gradbenih odpadkih, ki v Sloveniji količinsko

predstavljajo okrog 60 % vseh nastalih odpadkov (Mladenović in Mauko-Pranjić, 2020). Ta delež se še poveča z upoštevanjem industrijskih odpadkov, ki so vezani na gradiva, saj nastajajo pri pridobivanju surovin, proizvodnji gradiv in komponent, prodaji, torej še preden gradiva in komponente pridejo na gradbišče. Pred družbo je torej velik problem s številnimi izzivi.

V prispevku smo se osredotočili predvsem na gradbene odpadke, ki nastajajo ob novogradnjah, obnovah in rušitvah stavb. V vse te aktivnosti so neposredno ali posredno vključeni tudi arhitekti, ki s svojimi projektnimi odločitvami posežejo na področje obstoječih surovinskih virov, vplivajo pa tudi na možnost razgradnje stavbe, ko odslužena gradiva in komponente postanejo skupen družbeni problem. Ta trenutek je mogoče ugotoviti, da je država sprožila aktivnosti v zvezi s to problematiko in da se razvija iniciativa krožnega gospodarstva, ki ima največji potencial prav na področju gradbeništvu, s tem pa nastaja možnost za obvladovanje gradbenih odpadkov. Premalo se zaenkrat osveščenost odraža med projektanti, izvajalci in investitorji. Premik bi prinesla ustrezna izobraževanja o zasnovi trajnostne stavbe, ki ne vključuje samo njene energijske učinkovitosti, ampak tudi vpliv na okolje v fazi razgradnje po končani življenjski dobi.

Pomanjkljive podatke o možnostih ravnanja s posameznimi gradivi in elementi zapolnjuje digitalni potni list, ki bo dopolnil informacijski model gradnje. Tehnični podatki o lastnostih, sestavi, vzdrževanju ..., konstrukcijskih detajlih ..., bodo dopolnjeni z informacijami o možnostih ponovne uporabe, recikliranja ali končne razgradnje. S tem se bo projektantom olajšalo delo, povečala se bo učinkovitost urbanega rudarjenja, posledično pa zmanjšal pritisk na naravne surovinske vire.

Primeri dobre prakse nakazujejo, da je urbano rudarjenje nov izziv pri načrtovanju stavb, ki vključuje tako ponovno uporabo gradiv in gradbenih elementov kot tudi izbor recikliranih gradiv. Trg se že odziva na novo paradigmo. Spletni platforme kot so nizozemska Oogstkaart (2020), švicarska Salza (2020), nemški Restado (2020) so podjetja, ki omogočajo nakup ali prodajo že uporabljenih izdelkov (Hillebrandt et al. 2019).

Pri nas organizirane podpore projektantom s ponudbo že odsluženih gradiv, komponent in izdelkov v ponovno ali nadaljnjo uporabo, zaenkrat še ni. Zgleden primer urbanega rudarjenja pa je prizidek Osnovne šole Brezovica (2010, arh. Slavko Gabrovšek), ki je nastal na lokaciji odsluženega objekta. Pri rušenju so skrbno ločili uporabna gradiva in konstrukcijske elemente ter jih vgradili v novo stavbo. Ponovno so uporabili lesene lepljene nosilce in jih vgradili v steno zunanjega evakuacijskega stopnišča, 800 m² komaj 6 let stare kakovostne strešne kritine pa na nadstrešnice kolesarnice, strehe knjižnice in zunanjih učilnic. Opeko iz starega objekta so uporabili za predelne stene v novi stavbi. Ostanke keramičnih ploščic so nadaljnjo uporabo našli kot stenska dekoracija, zdrobljena stekla iz starih oken v transparentni predelni steni (slika 5), opečni drobir pa za nasutje ravne strehe. Ta primer dobre prakse še išče posnemovalce.

Več zgledov urbanega rudarjenja lahko najdemo v tujini. Na fasadi Verkehrshaus der Schweiz, Halle für Strassenverkehr v Luzernu (Annette Gigon / Mike Guyer Architekten, 2020) so uporabljeni stari prometni znaki, na večnadstropni stavbi v Seulu pa stara vrata (Choi Jeonghwa, 2020). Pri projektu Upcycle Studios v Kopenhagenu so veliko pozornost namenili principom ponovne uporabe, nadaljnje uporabe in recikliranja izdelkov. Arhitekti so za oblikovanje velikih steklenih površin na fasadi uporabili dvoslojna okna iz stavb, ki so bile renovirane. Masivni les, ki je bil kot odpadni material namenjen sežigu, so v stavbah uporabili kot talne in druge lesene obloge. V proces gradnje

Slika 4: Krožni proces življenjskega ciklusa gradiv je zaprt sistem iz sedmih faz.

A

Slika 5: Urbano rudarjenje pri gradnji prizidka Osnovne šole Brezovica (arh. Slavko Gabrovšek) – (A) stena stopnišča iz starih lesenih lepljenih nosilcev, (B) notranja stena iz odslužene opeke; (C) ostanki keramičnih ploščic sestavljajo dekorativno oblogo stopnišča, (D) stara kritina na nadstrešnicah kolesarnice.

B

C

D

so vključili recikliran agregat, pridobljen iz 1400 ton betonskih odpadkov kopenhagenske podzemne železnice (Lendager Group, 2018). V Kopenhagnu je v gradnji stanovanjski projekt The Resource Rows istih avtorjev, v katerega se vgrajujejo materiali iz zapuščenih hiš. Arhitekti ocenjujejo, da se bo s ponovno uporabo elementov iz zapuščenih hiš ter s postopki recikliranja CO₂ odtis novih stanovanj v fazi gradnje zmanjšal za 70 % (Lendager Group, 2019).

Pričujoči arhitekturni primeri že izvedene dobre prakse na področju ponovne in nadaljnje uporabe gradbenih odpadkov in visokokvalitetnega recikliranja gradiv niso zgolj eksperiment, ampak nadaljevanje trajnostnega načrtovanja arhitekture, ki pa zaradi že uporabljenih ali recikliranih izdelkov ne zmanjšuje arhitekturne vrednosti stavb, temveč jim dodaja novo vlogo in novo priložnost, da soustvarjajo grajeno okolje prihodnosti v skladu s ciljem krožnega gospodarstva – okolje brez odpadkov. Najbrž ni naključje, da ima prenovljena Europa Building v Bruslju, kjer je glavni sedež Evropskega sveta in Sveta EU, fasado iz 3750 restavriranih lesenih okenskih okvirov, zbranih med obnovo ali rušenjem stavb po vsej EU (Samyn and partners, 2017).

Zahvala: Članek je rezultat raziskovalnega dela v okviru raziskovalnega programa P5-0068, ki ga financira ARRS.

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Md. Nazmul Haque, Sharmin Siddika, Mizbah Ahmed Sresto: POVEZAVA MED MESTNIMI ZELENIMI ULICAMI IN TRAJNOSTNOSTJO: PRIMER OBMOČJA MESTA KHULNA (KCC), BANGLADEŠ

NEXUS BETWEEN URBAN GREEN STREETS AND THE SUSTAINABILITY: CASE ON KHULNA CITY CORPORATION (KCC) AREA, BANGLADESH

DOI: <https://dx.doi.org/10.15292/IU-CG.2019.07.037-052> ■ UDK: 711.4: 502.131.1(549.3Khulna) ■ SUBMITTED: October 2020 / REVISED: November 2020 / PUBLISHED: November 2020

1.02 Pregledni znanstveni članek / Review Article

POVZETEK

Hitra urbanizacija v Bangladešu je negativno vplivala na ekosistem in posledično na podnebje. Območje preučevanja v tem članku je mesto Khulna (KCC). Glavni cilj te študije je predlagati izvedljive modele zelenih ulic za zmanjšanje onesnaženosti okolja. Predlagani so zeleni pasovi, ki zmanjšujejo vpliv škodljivih plinov in hkrati ohranjajo ekološko ravnovesje, kar prispeva k izpolnitvi 11. cilja trajnostnega razvoja. Članek ima tri dele. V prvem delu sta predstavljeni raziskava rabe in pokrovnosti tal ter raziskava javnega mnenja, izvedeni glede na sedanje stanje. Nato je predstavljen predlog sistema zelenih ulic na različnih križiščih, avtocestah in v soseskah mesta Khulna, ki temelji na nekaj uspešnih primerih. Nazadnje je predstavljen konceptualni okvir za izpolnitev 11. cilja trajnostnega razvoja. Iz raziskave je razvidno, da se je v zadnjih 20 letih vegetacija zmanjšala za 5 %. Prikazano je tudi, da je skupna količina ogljikovega dioksida (CO₂), ki jo lahko sprejmejo velika drevesa po desetih letih, približno 32.000 kg na leto. Skupna količina CO₂, ki jo lahko porabi grmičevje, je 34.810 kg na leto. Glede na raziskavo o zadovoljstvu uporabnikov je več kot 90 % ljudi več zamisel o zelenih ulicah, več kot 60 % pa jih meni, da bo uporaba ulic po ozelenitvi bolj praktična. Uspešno sprejetje zelenih ulic bo pripomoglo k doseganju za življenje prijetnih in zdravih skupnosti, mestno območje pa bo z izpolnitvijo 11. cilja trajnostnega razvoja postalo trajnostno.

KLJUČNE BESEDE

zelenе ulice, križišče, cesta, trajnostnost, urbanizacija

ABSTRACT

Rapid Urbanization in Bangladesh has created a negative impact on the ecosystem and it's resulting a change in the climate. In this research, Khulna City Corporation (KCC) is chosen to be the study area. The main objective of this study is to propose feasible models of green streets to reduce environmental pollution. Then it proposes green belts to alleviate the effect of harmful gases while maintaining ecological balance to achieve Sustainable Development Goals (SDGs) 11th goal. The study is completed in three phases. Firstly, Land Use Land Cover (LULC) detection and public opinion survey was conducted considering the existing scenario. Secondly, green street system was proposed in different intersection points, highways and neighborhoods of Khulna city on the basis of some successful cases and finally a conceptual framework for achieving SDG's 11th goal is shown. This research shows that about 5% vegetation has decreased over the last 20 years. Also it shows the total amount of carbon-di-oxide (CO₂) that can be consumed by big trees after 10 years is approximately 32,340 kg per year. The total amount of CO₂ that can be consumed by shrubs is 34,810 kg per year. According to user satisfaction survey more than 90% people like the idea of green street and more than 60% people thinks that using the streets will be more convenient after its implementation. The successful adoption of green streets will help to achieve livable and healthy communities and also it will push the urban area towards sustainability by achieving SDG's 11th goal.

KEY-WORDS

green streets, intersection, road, sustainability, urbanization

1. INTRODUCTION

The intermittent change in world's climate is the result of haphazard development causing imbalance in our ecosystem. Impenetrable spaces of urban areas is considered to be a challenge for developing green infrastructure, specially the streets. Green infrastructure can be defined as an interrelated network of strategically planned green space that reserves the environment and natural ecosystem (Benedict and McMahon, 2002). Researchers have estimated that construction of green infrastructure is approximately 5 to 30 percent cheaper than traditional infrastructure (Kloss and Calarusse, 2006; Garrison and Hobbs, 2011). One of the essential element of green infrastructure is Green Street. A green street can be comprehended as a technique which includes vegetation and engineered system applied to a street and transforming it into pedestrian friendly, transit oriented, use of recycled materials, parking lane with permeable pavement and ability to manage storm water runoff (Abelt and McLafferty, 2017). It primarily moderates impermeable surface with additional trees and plants to increase permeability so that runoff water can be easily treated (Tilley and Slonecker, 2007-2008). Regardless of having multi-functional assistances and affordability the application of Green Street is not widely encouraged due to lack of proper guidance (Copeland, 2016).

With the increasing density of population and hasty development, permeable surfaces in cities are reducing (Sieber and Pons, 2015). Climate change is causing urban flooding, temperature rise and drought, which affects the city ecosystem (Demuzere, et al., 2014; Baruch, et al., 2018; Paul and Meyer, 2001). Not only flood and temperature rise caused by imperviousness exacerbates the adverse climate condition but also environmental pollution such as air and sound pollution causes degradation of the surrounding atmosphere. The major reason behind air pollution is use of fossil fuel in vehicles and emission of CO₂ by burning down of it. Noise is another ecological problem intensifies with the increase of vehicular movement and traffic congestion. Air pollution can be mitigated by adopting green streets instead of urban parks because it is difficult to find open space in dense city areas (Lazzari, et al., 2018). Noise can be reduced by creating wide vegetation belts or plantation of dense hedges and shrubs (Lacasta et al., 2018). Moreover, Green Street enriches the aesthetic aspect of any city (Sabbion, 2018).

Bangladesh has constructed a large road network consisting 85,000 kilometer of highways and paved roads (Alam, 2008). City streets are administrated by City Corporation or Municipality. Maximum safety, reliability, protecting air quality by reducing vehicular emission, noise limit, traffic operation, balancing infrastructure and vegetation ratio, road side beautification all these are vital in designing a city street system (Karim, 2019). But for a developing country such as Bangladesh, constructing eco-friendly streets face several challenges due to lack of coordination among agencies, lack of resources, lack of policy and strategy and lack of understanding about certain technologies in a fast changing ecosystem. The condition of streets can be improved by significantly upgrading the design of pavements and evolving towards sustainable green streets (Alam, 2008).

The street system of Khulna city is challenged by impulsive urban development which causes social, environmental and economic degradation. The road condition of Khulna City Corporation is not up to the mark (Haque, et al., 2019). Broken pavements, abrupt traffic movement, waterlogging, clogged drainage, emission of harmful gas, burning fossil fuel are the most common problems seen in the city streets. The existing street condition

adds to the detriment of environment, more specifically air and noise pollution (Afroze et al., 2010). The objective of this study is to propose models of green streets to reduce environmental pollution and establishing green belts to alleviate the effect of carbon-di-oxide while maintaining ecological balance to achieve SDGs 11th goal of Sustainable Cities and Communities.

Several researcher have tried to explain the concept of green street implementation in several countries and cities in their paper. (Christ, 2010) have tried to review the case study in Portland, Oregon. Portland is one the first countries to adopt green street as sustainable infrastructural development. They have implemented it vastly in low density residential areas and are now expanding it to higher density residential areas. The primary goal of adopting Green Street was to manage runoff from storm water, enrich communal livability and flourish local economy. Another successful case study is seen in Washington D.C. where Green Street is implemented in broader scale and in dense urban areas. (Manual, 2014) in his report titled 'City of Philadelphia Green Streets Design' reflected on case study in Philadelphia where city agencies have adopted pilot projects of green streets. The aim was to set up a series of regulation and standards which was applicable in implementing green streets city-wide to treat storm water runoff.

2. POLICY ADAPTATION AND IMPLEMENTATION OF GREEN STREETS

2.1 A case study in the city of Cleveland (Im, 2019)

The city of Cleveland has taken initiatives to become a more environment friendly community by encouraging people to go green. They are steadfast to become a more pedestrian friendly and cycling friendly community by reducing the carbon footprint. In 2011, Cleveland conceded Ordinance 798-11 that said that the city of Cleveland has taken initiative to create a complete green network by adopting green streets that will expand the social, economic and environmental condition of the city as well as the citizens. The benefits of adopting green streets are:

- Healthy and convenient communities
- Quality of air
- Safety improvement
- Access improvement
- Economic development

Planning Process: Cleveland Complete and Green Street Task Force with the help of Alta Planning and Design team had developed plans for implementing Green Streets for the city of Cleveland. It involved workshop of stakeholders at local, regional and national level. The workshop led to understanding the pressing need of adopting Green Street and provide a permanent solution in reducing environment degradation. Table 1 represents various section design of the road adopted by the Cleveland government.

2.2 A case study in the city of Seattle, state of Washington, U.S. (SDOT, 2017)

The planning for Green Street in the city of Seattle was first proposed in 1985. The original plan was prepared for Downtown Seattle but an additional mapping was also prepared for the neighborhood green streets in Northgate. The Seattle Comprehensive Plan (SCP) and Transportation Strategic Plan (TSP) were prepared and this document provides the guidelines and

Design of Walkways	Intersection Design	Design for Cyclists	Transit Design	Green infrastructure for the right-of-way
Accessibility to the users	Clear space	Shared roadways	Accessible through multiple modes	Street trees
Width of the sidewalks where two people can walk side-by-side.	Visibility	Shared roadways with marked pavement	Simplicity of function	Adjusted soil
A sense of safety and security	Legibility	Separated bikeways	Safety and security	Sheet flow diffusion
Landscaping for visual and psychological comfort	Accessibility	Cycle tracks	Sustainable development	Pavement modification and permeable pavers
Drainage system for storm water runoff	Lighting	Parking of bicycle	The incorporation of arts in transit	Porous asphalt and recycled roadway surface.

Table 1: Overview of different section of the roads. (Source: Im, 2019)

regulations for the development of neighborhood Green Street. There were 17 green streets adopted in Downtown Seattle. Some 41 neighborhood green streets were also recommended in different neighborhoods which are yet to be adopted formally and still is in planning phase. It also contains information about design, construction and maintenance of the street. Table 2 shows two types of streets proposed- i) green streets ii) neighborhood green streets.

Principles for the basic design of Green Streets

There are several principles applied while designing the green streets and neighborhood green streets-

- Emphasize on walkways and open space compared to typical streets.
- Planning and design considering existing landscape.
- Restriction on volume and speed of transportation modes.

3. METHODOLOGY

3.1 Description of the study area

Khulna, a coastal region, located in the southern part of Bangladesh. It is the third largest and second biggest port city of Bangladesh. It has a coordinate of 22°51'8" north latitude and 89°32'35" east longitude (Karim, et al., 2013). The total metropolitan area comprises of 4,389 square kilometers with a population of 2,318,527. Khulna city is surrounded by a total of 356.64 km of roads (Kabir, 2019). But there is no green street implementation or adaptation plan taken by the city. The roads that are most

vulnerable due to heavy traffic and affected by higher pollution requires implementation of green streets. For this different important roads of Khulna city such as BIDC road, Khulna-Jessore highway, Khulna-Shatkhira Road, Sher-E-Bangla road and Khan Jahan Ali Road were selected (Fig. 1).

Figure 1: Study area map. (Source: Author, 2020)

3.2 Methods of data collection

The required data are collected from primary and secondary sources to run the research. Satellite images such as Landsat-8 and Landsat-7 image were collected from US Geological Survey (USGS) website. First of all a complete reconnaissance survey

Purpose of adapting Green Streets	Purpose of adapting Neighborhood Green Streets
It enhanced pedestrian movement and created a sense of space in areas with medium to high density residential areas.	It gives more importance on local communities need for specific street type.
Created a lively environment for pedestrians in the right of way of street to attract pedestrian.	Improve the environment for pedestrian movement to attract pedestrians.
Strong and efficient connectivity between residential communities and surrounding area by enhancing streetscape for people who uses the service.	Preserved open space for residential neighborhoods.
Location	Location
Downtown Seattle.	Neighborhood outside Downtown Seattle.
Typical Adjacent Land Use	Typical Adjacent Land Use
Residential or mixed use.	Residential or mixed use including residential uses.
Implementation	Implementation
The planning and construction of green street was funded by the developers interested in exchange for extended floor area ratio, determined by Seattle's land use code.	Funded by the Local Improvement District (LID), Neighborhood matching funds and other transit agencies through private development.

Table 2: Purpose of adopting green streets and neighborhood green streets. (Source: SDOT, 2017)

was done for getting proper idea about the study area. For collecting primary data several field surveys were conducted based on a pre-determined questionnaire. For collecting the data in physical and acceptable manner field visit is done which is usually known as field survey. A total of 3 field trips were conducted for this survey. People living along the selected study area roads and people who uses the roads on a daily basis were surveyed for primary data collection. Simple random sampling technique was followed for the survey. Images of different neighborhood roads, highways and intersection points was taken from google map. Road width, length, median and walkway width were calculated with the help of google map. CO₂ absorption capability of a trees were calculated using relevant equation. The total amount of CO₂ absorbed are accumulated to estimate the percentage of CO₂ reduced by trees.

3.3 Spatiotemporal analysis

A spatiotemporal evaluation of land use and land cover (LULC) was performed (Fig. 2) in order to detect the pattern of land use change and specially for monitoring the changes in vegetation coverage (Khamchiangta and Dhakal, 2020).

Figure 2: Land cover classification workflow. (Source: Author, 2020)

3.4 Public opinion survey

For conducting field survey simple random sampling method was applied in within defined study area. In simple random sampling the samples are picked indefinitely. The total population of Khulna City Corporation is approximately 663,342. From this number, 300 individuals were selected as sample size in

simple random sampling method to provide public opinion who uses the consecutive streets or resides beside the streets.

3.5 Implementation of Green Streets

For implementing green streets, major intersection points of Khulna city was chosen for identifying the existing scenario. Secondly green street system was proposed in different intersection points, highways and neighborhoods of Khulna city by using Sketch up software. For this study BIDC road Khulna, Khulna-Jashore highway, Khan Jahan Ali road, Sher-E-Bangla road, Khulna-Shatkhirra road, Royal more intersection point was selected.

Little changes in the road can make it more convenient to plant trees. After several field survey, green street construction proposals was designed by the authors maintaining compatibility with the existing scenario. If the distance is considered 10 meters from one big tree to another and 2m distance from one shrub to another then the possible number of trees can be calculated along the selected roads. Mehogany, neem, rain tree, basak and akanda were selected for plantation because they are locally available, cheap, well-adapted to the warm and humid climate and can grow swiftly even in saline soil.

It is found that a ten years old big tree can consume about 22 kg CO₂ and shrubs can consume about 5.9 kg CO₂ every year where saplings will absorb significantly less than this (Pirates, 2016). According to this statement the total amount of CO₂ was also calculated which will be consumed after the implementation of green streets.

Finally conceptual framework was formed to relate how green streets help to achieve SDG's 11th goal. Also a user's satisfaction survey was also performed to identify people's opinion.

4. RESULTS

4.1 Land use land cover (LULC) detection and monitoring

According to the land use classification percentage in table 3 the coverage of vegetation was about 30.15% in the year 2000, 29.25% in 2010 and 25.25% in 2020. It is clear that about 4.9% of overall vegetation reduced during the last 20 years. As existing vacant land and water bodies are also decreasing and the amount of buildup area is increasing (Fig. 3) so it can be an alarming problem for urban area people and ecological system.

Figure 3: Land use land cover (LULC) for (a) year 2000, (b) year 2010, (c) year 2020. (Source: Author, 2020)

Table 3: Percentage of land use type over the years. (Source: Author, 2020)

Land Use Type	Year 2000	Year 2010	Year 2020
Water Body	18.35 %	15.85 %	13.65 %
Vegetation	30.15 %	29.65 %	25.25 %
Build Up Area	39.65 %	43.55 %	52.45 %
Vacant Land	11.85 %	10.95 %	8.65 %

Figure 4: Disease caused by air pollution. (Source: Field survey, 2020) **Figure 6: Level of satisfaction. (Source: Field survey, 2020)**

4.2 Survey results

Field survey report states that the current state of street system causes severe noise pollution. According to Fig. 4 almost 21% people stated that they face sleep disturbance due to noise pollution. As the streets have no planned vegetation along the roadway the buildings located near them endure major noise pollution. Not only sleep disturbance, 27% of the residents complained they suffer from heart disease and 13% residents have hearing impairment. 27.5% people are annoyed due to the constant honking of heavy vehicles and not following traffic rules. Even during the night time unregulated vehicular movement and heavy transportation mode causes inconvenience.

Figure 5: Disease caused by air pollution. (Source: Field survey, 2020)

The amount of CO₂ produced through vehicles that uses fossil fuel causes heavy air pollution. Moreover, not enough tree beside the road side makes the effect of CO₂ emission more acute. Trees absorb CO₂ and emits O₂. Due to lack of trees CO₂ is released into the environment and get mixed with the air. Fig. 5 states 31% of the residents of surveyed areas have breathing problem because of air pollution. 25.40% people suffer from various chronic diseases and 2% have lung cancer. Heart disease is another critical problem faced by almost 17% of the surveyed person.

People living in the respective areas are not satisfied with the present street condition. There are inconveniences such as polluted environment, abrupt movement of vehicles, no regulated traffic rules or modified vehicles, unsafe and insufficient walkways, no shade or trees. All these makes the present layout of roads unsuitable for use. To almost 70% of people (Fig. 6) who uses the roads in the study area have said that the road condition is barely convenient or inconvenient.

Figure 7: Problems caused by sound pollution. (Source: Field survey, 2020)

Almost 90% of people have agreed upon adopting green street policy (Fig. 7). They are willing to change the current condition of streets and walkways. Moreover convenient vehicles are also preferred.

4.3 Green Street implementation and model

BIDC Road, Khulna

The length of BIDC road is around 3.5 km (Fig. 8). It is located Khalishpur area. The road contains no median and only a few space is available in both sides of the road for planting trees and shrubs.

List of trees and shrubs	Distance from one plant to another	Amount of trees and shrubs
Tree: Mahogany (Swietenia mahagoni)	10m	200
Tree: Neem (Azadirachta indica)	10m	200
Tree: Rain tree (Samanea saman)	10m	200
Shrubs: Basak (Adhatoda vasica)	2m	1500
Shrubs: Akanda (Calotropis gigantea)	2m	1500

Table 4: List of trees and shrubs. (Source: Author, 2020)

Figure 8: (a) Existing BIDC road, (b) Proposed road (Cross Section), (c) Proposed road (Top view), (d) Road Information (Top view). (Source: Author, 2020)

From table 4 the total amount of CO₂ that can be consumed by big trees after 10 years is

$$= (\text{Amount of total big tree} \times 22) \text{ kg} \\ = (600 \times 22) \text{ which is } 13200 \text{ kg per year}$$

So, the total amount of CO₂ that can be consumed by shrubs is

$$= (\text{Amount of shrubs} \times 5.9) \\ = (3000 \times 5.9) \text{ which is } 17700 \text{ kg per year}$$

Khan Jahan Ali Road Section 1 and 2

About 1.06 km was chosen from the total section of Khan Jahan Ali road. From the existing condition of Fig. 9 and Fig. 10 it is clear that one of the section contains median and another one is continuous two way lane.

From Table 5 the total amount of CO₂ that can be consumed by big trees after 10 years is

$$= (\text{Amount of total big tree} \times 22) \text{ kg} \\ = (90 \times 22) \text{ which is } 1980 \text{ kg per year}$$

So, the total amount of CO₂ that can be consumed by shrubs is

$$= (\text{Amount of shrubs} \times 5.9) \\ = (300 \times 5.9) \text{ which is } 1770 \text{ kg per year}$$

Figure 9: (a) Existing Khan Jahan Ali road section-1, (b) Proposed road (Cross Section), (c) Proposed road (Top view), (d) Road Information (Top view). (Source: Author, 2020)

Figure 10: (a) Existing Khan Jahan Ali road section-2, (b) Proposed road (Cross Section), (c) Proposed road (Top view), (d) Road Information (Top view). (Source: Author, 2020)

List of trees and shrubs	Distance from one plant to another	Amount of trees and shrubs
Mahogany (Swietenia mahagoni)	10m	30
Neem (Azadirachta indica)	10m	30
Rain tree (Samanea saman)	10m	30
Basak (Adhatoda vasica)	2m	150
Akanda (Calotropis gigantea)	2m	150

Table 5: List of trees and shrubs. (Source: Author, 2020)

Khulna-Jashore Highway

Selected portion of Khulna-Jashore highway is about 2 km (Fig. 11).

From table 6 the total amount of CO₂ that can be consumed by big trees after 10 years is
 = (Amount of total big tree*22) kg
 = (360*22) which is 7920 kg per year

So, the total amount of CO₂ that can be consumed by shrubs is
 = (Amount of shrubs* 5.9)
 = (1200*5.9) which is 7080 kg per year

Khulna-Shatkhira Road

Selected portion of Khulna-shatkhira road is about 1.3 km (Fig. 12).

From table 7 the total amount of CO₂ that can be consumed by big trees after 10 years is
 = (Amount of total big tree* 22) kg

List of trees and shrubs	Distance from one plant to another	Amount of trees and shrubs
Mahogany (Swietenia mahagoni)	10m	120
Neem (Azadirachta indica)	10m	120
Rain tree (Samanea saman)	10m	120
Basak (Adhatoda vasica)	2m	600
Akanda (Calotropis gigantea)	2m	600

Table 6: List of trees and shrubs. (Source: Author, 2020)

= (240*22) which is 5280 kg per year

So, the total amount of CO₂ that can be consumed by shrubs is
 = (Amount of shrubs* 5.9)
 = (800*5.9) which is 4720 kg per year

List of trees and shrubs	Distance from one plant to another	Amount of trees and shrubs
Mahogany (Swietenia mahagoni)	10m	80
Neem (Azadirachta indica)	10m	80
Rain tree (Samanea saman)	10m	80
Basak (Adhatoda vasica)	2m	400
Akanda (Calotropis gigantea)	2m	400

Table 7: List of trees and shrubs. (Source: Author, 2020)

Figure 11: (a) Existing Khulna-Jashore highway road, (b) Proposed road (Cross Section), (c) Proposed road (Top view), (d) Road Information (Top view). (Source: Author, 2020)

Figure 12: (a) Existing Khulna-shatkhira road, (b) Proposed road (Cross Section), (c) Proposed road (Top view), (d) Road Information (Top view). (Source: Author, 2020)

Figure 13: (a) Existing Sher-E Bangla road, (b) Proposed road (Cross Section), (c) Proposed road (Top view), (d) Road Information (Top view). (Source: Author, 2020)

Sher-E-Bangla Road

About 1.05 km was chosen from the total section of Sher-e-Bangla road (Fig. 13).

List of trees and shrubs	Distance from one plant to another	Amount of trees and shrubs
Mahogany (Swietenia mahagoni)	10m	60
Neem (Azadirachta indica)	10m	60
Rain tree (Samanea saman)	10m	60
Basak (Adhatoda vasica)	2m	300
Akanda (Calotropis gigantea)	2m	300

Table 8: List of trees and shrubs. (Source: Author, 2020)

From table 8 the total amount of CO₂ that can be consumed by big trees after 10 years is
 = (Amount of total big tree* 22) kg
 = (180*22) which is 3960 kg per year

So, the total amount of CO₂ that can be consumed by shrubs is
 = (Amount of shrubs* 5.9)
 = (600*5.9) which is 3540 kg per year

Total amount of CO₂ Absorbed by Trees

The total amount of CO₂ that can be consumed by big trees after 10 years is 32,340 kg per year.

The total amount of CO₂ that can be consumed by shrubs is 34,810 kg per year.

4.4 Green Streets for Maintaining Ecological Balance

Without implementing green streets the pollution caused by unplanned roadway system and haphazard development results in serious environmental imbalance (Fig. 14). If there is not enough vegetation along the road system the emission of harmful gases from vehicles will add to carbon footprint. Trees work as a natural element to purify harmful gases from the air and also work as a barrier to absorb sound. A healthy environmental condition automatically leads to a sustainable development and resilient city. Thus, green streets are able to maintain ecological balance more effectively than typical street system.

Figure 15: Way forward to SDGs. (Source: Author, 2020)

4.5 Framework for Achieving SDG's 11th Goal

A sustainable city requires city's capability to resist any hazardous incident and rebuild its resilience. Green street is another solution to cope with the problems arise due to urbanization. It reduces sound pollution by absorbing noises through green belts. Such initiative enhances community livability. Green street proposes permeable roadway and pavements to control water logging and increases greeneries that enriches biodiversity. The overall road condition improves that has huge impact on the socio, economic and environmental condition of Khulna city.

5. CONCLUSION

To make a city grow and prosper, there is no alternative of swift and efficient road network and planned circulation of vehicular movement. The existing street condition of Khulna City Corporation are responsible for air pollution, sound pollution, waterlogging, traffic fatalities and traffic congestion. The selected roads of the study area more specifically BIDC road, Khulna Jashore highway, Sher-e-bangla road, Khulna-Shatkira road, Khan Jahan Ali highway have insufficient road service facilities. Most of the vehicles use fossil fuel and emit harmful gases. There is no automated monitoring system for roadway traffic regulation except installed traffic police at intersection points. The analysis shows vegetation and water bodies have reduced up to 5% and 3% from year 2000 to year 2020. By adopting green streets there will be green belts on both side of the roads will reduce air and sound pollution. Also adopting Green Street is a less expensive project to take on rather than traditional road construction with

Figure 14: Graphical representation showing the consequences of implementing Green Street in KCC. (Source: Author, 2020)

long term sustainable and ecological impact on social, economic as well as environmental aspect. This will help attain SDGs 11th goal of Sustainable Cities and Communities to turn Khulna City Corporation into a resilient city.

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Jaka Veber:

JAVNI PROMET KOT PROSTORSKI OZNAČEVALEC

PUBLIC TRANSPORTATION AS A SPATIAL MARKER

DOI: <https://dx.doi.org/10.15292/IU-CG.2019.07.046-053> ■ UDK: 6656.076.2:711.4 ■ SUBMITTED: September 2020 / REVISED: October 2020 / PUBLISHED: November 2020

1.02 Pregledni znanstveni članek / Review Article

POVZETEK

Besedilo obravnava potencialne koristi javnega potniškega prometa kot elementa v prostoru. Ta vidik se lahko nanaša na grajeno oz. stalno infrastrukturo; tiri, fizično ločeni avtobusni pasovi, postaje podzemne železnice itd. Gre za vizualno izstopajoče ali kako drugače izrazite, grajene prostorske elemente. Ti lahko potencialno pripomorejo k večji popularnosti javnega potniškega prometa, saj s svojo stalnostjo pri uporabnikih ustvarjajo vtis strateške zavezanosti k zagotavljanju kvalitetne storitve javnega prevoza, prav tako pa lahko predstavljajo pomemben del prostorske identitete nekega območja. Drugi fizični elementi oz. njihova oblikovna zasnova – napisi oz. znamenja, izgled vozil, javni prostori ob koridorju itd. – pa lahko pripomorejo k poudarjanju prednosti grajenih oz. stalnih elementov, ali pa se za doseg prejšnjih opisanih pozitivnih učinkov uporabljajo samostojno.

Uspešnost opisanih elementov pa je odvisna tudi od njihove prostorske porazdelitve, kar se v članku obravnava skozi zasnovo omrežja linij. Ta mora biti jasna in razumljiva, s čimer se uporabnikom olajša orientacija, prav tako pa takšna zasnova omogoča učinkovitejšo prezentacijo sistema skozi prostorske elemente. Uspešnost javnega potniškega prometa kot prostorskega označevalca je torej odvisna od njegove zastopanosti v prostoru skozi opisane prostorske elemente in od lokacijske razporeditve le teh.

KLJUČNE BESEDE

prostorska identiteta, mentalne karte, stalnost, fizična prisotnost, javni potniški promet

ABSTRACT

Potential benefits of public transportation as a spatial element are going to be examined. This can relate to permanent infrastructure such as rail tracks, physically separated bus lanes, subway stations etc. These are visually noticeable or otherwise significant built spatial elements and are relatively permanent, which might increase the popularity and use of a public transit service in an area by reassuring potential users of the authorities' strategic commitment to providing high quality transit as well as by becoming part of an area's identity. Other physical elements and their design – signage, vehicle appearance, public space redevelopment along corridors etc. – are important in this regard as well, and could either enhance the benefits of permanent infrastructure, or they could be used alone to attempt to achieve the same positive effects.

The degree to which these elements can be successful depends also on how they are distributed through space, which in this paper is linked to network or line structure. The network should be clear and easy to understand, enabling users to orient themselves, while also making it easier to apply physical elements which represent the system in space. Thus, the degree to which a public transportation service is represented in space through described elements and their spatial distribution, determines its strength as a spatial marker.

KEY-WORDS

spatial identity, mental maps, permanence, physical presence, public transportation

UVODNIK

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RECENZIJA

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PROJEKT

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DELAVNICA

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COMPETITION

PREDSTAVITEV

PRESENTATION

DIPLOMA

MASTER THESIS

1. INTRODUCTION

This text refers to public transportation (PT) mainly through its physical presence in space. It explores whether the presence of infrastructure and other physical elements related to PT could have a positive impact on the image of a PT service, as well as the surrounding areas, and thus possibly facilitate ridership, encourage urban (re)development and enhance spatial identity and readability.

Primarily, this paper refers to the presence of permanent infrastructure such as rail stations, light rail tracks, elevated or underground heavy rail tracks, busways etc. However, the design of these or other spatial elements tied to a transit service might be important as well, with potential examples being: signage, transit stop design, vehicle design, green corridor design, public space redevelopment etc. Furthermore, the positive effects of these elements could be enhanced through service quality, and based on how they are distributed in space, which I relate primarily to network structure. All this determines how well can a PT service mark the space and achieve the above described benefits, therefore becoming a successful spatial marker.

In an attempt to look beyond spatial factors such as urban density and land use policies, as variables determining the success of PT, what I wish to express in this text is the tangible value of PT serving not simply as an anonymous service, and of infrastructure not as just a technical tool, but of PT serving as a spatial feature that can contribute to a readable environment and enhance spatial identity – something well captured in the following quote by architect and poet Dolores Hayden: “Like the dwelling, which may be typical of the way millions were sheltered, something as basic as a railroad or streetcar system changes the quality of everyday life in the urban landscape, while marking the terrain” (Hayden, 1995, p. 22, found in: Douglas, 2010).

2. PHYSICAL PRESENCE AND PERMANENCE

Infrastructure, apart from serving its technical purpose, can also create benefits stemming from its physical presence alone. In this regard, it is important to understand the perception of permanence, mentioned in literature with regards to rail tracks and other fixed infrastructure. Dittmar and Poticha (2004) state that “developers and home buyers alike seem to be attracted to the permanence of rail transit”. Devney (2011) compares buses to rail services: “Bus routes can be changed more easily and are considered less permanent than rail systems”, while Parker et al. (2002) comment on the lack of permanence of bus routes: “Because the locations of bus routes are not fixed or permanent, this greatly increases the risk of investing in transit-supportive land use development”. It can therefore be speculated that different PT modes may have different levels of permanence, and thus accompanying benefits.

In this chapter, literature exploring the influence of PT infrastructure on surrounding property prices, development and the overall image of a city is going to be reviewed, in an attempt to see whether these factors may be dependent on perceived permanence. We will first look at research addressing benefits of rail infrastructure – as it is most commonly linked to permanence – and then move on to Bus Rapid Transit (BRT) systems. Next, we are going to move beyond permanent infrastructure and explore how PT can establish a physical presence in space through other elements and design decisions.

2.1 Rail – a benchmark spatial marker

A comparison between three PT systems – one light rail and two heavy rail – is provided by Lewis-Workman and Brod (1997), who explore non-use benefits of transit (i.e. regardless of whether or not a particular resident uses transit). Specifically, the authors focused on the effect transit has on property values. They found measurable property benefits of proximity to three stations (Forest Hills, 67th Avenue, and Rego Park) of the New York City MTA subway and to the Pleasant Hill Station of the San Francisco BART transit system, both of which are heavy-rail systems. Less prominent benefits were discovered for property values in the proximity to three stations of the Portland MAX light rail – the 148th Avenue, 162nd Avenue, and 172nd Avenue stations. We could see these results as hinting to the superiority of transit modes with more extensive infrastructure, i.e. with greater permanence (in this case, heavy rail as compared to light rail). Another possible explanation provided by the authors (ibid.) however, is the lower speed and capacity of light rail vehicles compared with heavy rail transit. Furthermore, the benefits that were evident in the Portland example were present only for properties located between 610 m and 1.6 km from stations. The authors (ibid.) explain this with heavy traffic of the major arterial road which Portland's light rail runs along. Traffic levels may conflict with the positive effects of the light rail line.

Similarly, Huang (1994) explores the effects of transportation infrastructure on nearby property values, stating that public programs can change the value of real property if they produce new private benefits or impose new private costs on landowners. Construction of a highway interchange, for example, can increase nearby land values by lowering the transportation costs associated with particular uses. If the availability of public utility connections decreases construction or operating costs or makes profitable, higher-density development possible, those effects will be reflected in higher property values (ibid.). According to the author, such capitalisation effects are predicted by theory; “Highways and fixed-rail systems directly affect the transportation costs associated with nearby sites, and classical location theory identifies such costs as the primary determinant of urban land value” (ibid.).

The two sources presented above suggest reasons for why infrastructure has an effect on surroundings – namely service quality (speed), noise levels, and a change in transportation costs. The next source, apart from such tangible benefits, also indicates a symbolic value of infrastructure.

Siemiatycki (2005) provides an account of PT infrastructure projects in Bilbao, Spain – particularly a Metro underground – serving as a catalyst for urban redevelopment while also carrying a symbolic meaning. The author describes a sense of community and local pride regarding the Metro;

The functionality and architectural splendour of the Metro symbolizes that the Basque people have the technical proficiency, institutional stability and long-term vision to carry out large scale public work projects. Furthermore, the Metro project is a concrete sign of modernity, and the active process of recovering from an economic recession that had crippled the local economy and shattered the city's social stability. (Siemiatycki, 2005)

Obviously, ambitious projects cannot be justified merely by symbolism however, as the main goal was to achieve tangible effects of urban redevelopment. To face the post 1970 manufacturing decline and overcome the natural barrier of the river

Nervion dividing the city along its length, the authorities relied on emblematic, large scale redevelopment projects, in order to reinvigorate the economic, political, cultural and environmental landscape. Improvements to the city's PT infrastructure played a central role in this strategy. Concrete effects in the form of improved public spaces and increased investment were envisioned, and "the Metro became a symbol of the new dynamism driving public intervention in the city and of Bilbao's evolving image" (Rodriguez & Martinez, 2003 in: Siemiatycki, 2005)). Evidently, the idea of a major infrastructure investment provided a basis for a wide reimagining of the city.

As noted by Siemiatycki (2005), it is the "coalescence of the tangible and the intangible that explains why capital intensive rail based transit solutions were selected over other modal alternatives such as an intensification of the existing bus network". He also further explains the mechanism of how ambitious projects benefit the urban economy; "such New Deal type policies represent a major subsidy to private industry, as the state coordinates massive pools of funds which drive private wealth creation. Through economic trickle down, this pool of resources gets redistributed throughout the broader economy" (ibid.). The strategy of relying on megaprojects appears to have been successful, as reference is again made to Rodriguez and Martinez (2003), according to which unemployment dropped from 27% in the mid-1990s, down to 16% in 2000. By 1999, over 55% of the city's gross output was derived from the tertiary sector, while the contribution of manufacturing has declined from 43% to 28% in the period between 1975 and 1996. In terms of ridership, Siemiatycki (2005) noted an increase in ridership since 1995 to 56 million passengers annually, referring to the Bizkaia Transport Consortium (2003). Since 2003, ridership has been increasing even further, to more than 91 million annual passengers in 2019, according to Metro Bilbao (2020).

The case of Bilbao demonstrates the potential of an ambitious transit project serving as a frame for urban redevelopment and rebranding of a city. It was chosen instead of a bus option and served as a driver of change and a major attractor for private investments. As can be assumed from the Bilbao example, the decision makers believed that an improved bus system would not have the potential to achieve the same effect as a new rail system. In the context of this paper, it shows how a fixed guided system with high permanence can serve as a framework for facilitating redevelopment.

2.2 Looking beyond rail

Currie (2006) identifies challenges and strengths of bus based transit systems for transit oriented development (TOD) and compares them to rail based systems. Bus systems are considered either as BRT – frequent, high-quality mass transit systems with much fixed infrastructure – or local/suburban bus – with low frequency services operating on-street with minimal fixed infrastructure. Rail services examined refer to urban commuter mass transit systems. Permanence of infrastructure is tied with magnitude and implications for development risks. This is related to observations by Parker et al. (2002) who state that "because of the magnitude of rail investments and the "newness" of the investments, rail development is more likely to have supportive public policies". The permanence of rail is also said to increase "the ability of developers and financiers to invest in transit supportive development near rail stations, as compared to bus stations and corridors" (ibid.). As Currie (2006) puts it: "Certainly, significant investment suggests significant commitment. Commitment and developer risks are linked".

Permanence of rail is questioned however, as the author (ibid.) refers to Niles and Nelson (1999), who give examples of Chicago bus routes that have existed for almost a century, while numerous tram systems have been removed in the 1930's and 1940's in North America. Still, in Ottawa, according to Bonsall (1997 in; Currie, 2006), "it was a busway that achieved densification of development around busway stations". Thus, although the Ottawa system is bus based, its busway and related facilities are a significant spatial element. Rathwell and Schijns (2002) note that the stations of the busway in Ottawa are substantial, distinct facilities, that enable stronger branding. They state that "bright red steel frames, curved glass, and concrete bases were far more substantial than bus passengers had been used to and signified that their comfort was being taken seriously for a change" (ibid.).

According to the same source (ibid.), in the first week after the opening of the South East Busway in Brisbane, Australia, the city owned transport operator, Brisbane Transport, recorded a 25.7 % increase in patronage on core busway services. After 6 months, the increase grew to 40 %. This again may indicate the potential of BRT permanent infrastructure (as well as permanent infrastructure in general) for increasing ridership.

However, as has already been implied previously, permanence and presence alone are not enough for infrastructure to produce benefits. If we exaggerate – an abandoned rail station, although relatively permanent, probably does not produce much benefit to development in surrounding areas, while its contribution to spatial image is probably low or even negative. Taking this into account – to requote Currie (2006): "significant investment suggests significant commitment" – it can then be claimed that the higher the perceived permanence, the better is the impression of PT quality, while at the same time, permanence itself may somehow force authorities to maintain a high quality PT. Service characteristics are an issue we will later be addressing more closely.

Next, we should seek a wider collection of physical elements that can be included into this supposed link between service quality and the physical manifestation of it. For this purpose, bus based systems – mostly BRT systems – are going to be examined more closely, as they do not necessarily require extensive infrastructure as rail based PT does, but can establish a presence in space through various other elements.

2.3 BRT – building identity through design

Bus Rapid Transit (BRT) systems provide an interesting midpoint between rail based PT and bus services. BRT often gets compared to light rail: "in many respects, BRT is rubber-tired light rail transit (LRT), but with greater operating flexibility and potentially lower capital and operating costs" (Levinson et al., 2002). According to Hess and Bitterman (2008), "BRT can later be useful as a means to phase in fixed transit infrastructure, such as light rail or heavy rail". Currie (2005) summarizes evidence from a range of studies and shows that BRT has generally similar performance to light rail in the perception of passengers. However, "where BRT vehicles (buses) operate totally on exclusive or protected rights-of-way, the level of service provided can be similar to that of full Metrorail rapid transit" (Levinson et al., 2002). BRT systems can cost significantly less to establish than rail based options, and, as shown by Currie (2005), are also generally more cost effective. BRT's feature various levels of infrastructure, from dedicated lanes marked only with different color or signage to physically separated right of ways. In the context of this paper, an analysis of BRT can be used to assess the benefits of fixed

infrastructure, and to explore how certain design principles can facilitate their benefits or compensate for the lack of permanent infrastructure altogether.

Stokenberga (2014) reviewed literature of BRT's influence on urban land development and property values, and among other factors addressed technical specifications. Permanence proved to be a central issue. The importance of significant physical running ways was recognised (suggesting permanence), while BRT flexibility was noted as a drawback. Station structures were also found to be influenced by the need to express permanence. To give a real world example, according to Hinebaugh (2009) the presence of identifiable station structures was cited as a key reason for speculative development when plans were unveiled for a BRT line along Cleveland's Euclid Avenue, as well as extensive streetscape renovations (here, we can see similarities with public space redevelopment in the Bilbao case described previously). Furthermore, Vincent and Jerram (2008) report that many developers agree on permanence of BRT to be an important factor for investment, with exclusive running ways and dedicated lanes as well as the size and quality of stations contributing to perceived permanence. Regarding permanence and land use strategies, Stokenberga (2014) concludes:

positive property development effects have been observed in cases where the BRT has been part of an integrated transit and land-use strategy and where significant investments have been made to create a sense of permanence of the system and to improve its environmental and aesthetic quality.

Still, supportive policies – most often this relates to land use policies – are crucial in providing benefits of transit. According to Miller and Buckley, (2000 in: Stokenberga, 2014), in Curitiba, the government instituted strong land-use controls and was thereby able to effectively guide growth to encourage development patterns along structural axes that reinforce and encourage use of the bus system. Also, Thole and Samus (2009), conclude that policies and the local climate are potentially more important than the physical permanence of a PT system. However, Levine (2006 in: Stokenberga, 2014), emphasizes the limited power of zoning and other regulations, and argues that, although requirements for dense development can accommodate market forces that are present, they cannot force a product the market is not willing to provide. It could thus be said, that the characteristics of a PT system itself may produce benefits which cannot be attributed solely to policies. These benefits could be tied to – among other characteristics – permanence, the impression of which should be encouraged when designing BRT.

Providing an expanded view of permanence regarding buses are Bitterman and Baldwin-Hess (2008), who arrange BRT identity components according to a continuum of physicality. On one end of the continuum are thus elements having a degree of permanence (namely; vehicles, stations, shelters, kiosks, street furniture, running ways and ITS displays), while the opposite end of the spectrum includes perceptual elements, or those with a lesser degree of permanence that change frequently (namely; website, timetable, logo/system name, colour palette, brochures, system maps, telephone information systems, wayfinding signage, system signage), in response to seasonal and route changes. The authors state that “users are typically more aware of changes to physical elements than to perceptual elements” (ibid.).

When talking about peoples' awareness of changes to physical elements, we should understand that this refers to a wide array of visible spatial elements. Apart from busways/running ways,

all the elements mentioned above can be used to design a PT service with a noticeable presence in space. Because BRT is a mode which finds itself on the border between the perceived permanence of rail and the perceived arbitrariness of on street buses, design decisions and technical characteristics can tilt the qualities of each individual BRT system closer towards one or the other. As we have already addressed the infrastructure aspects of BRT, we are now going to address design decisions in a broader sense in order to explore ways in which BRT can solidify its presence in space.

The task of improving BRT image is linked to either identity and branding in reviewed literature (see: Hess & Bitterman, 2008; Devney, 2011; Bitterman & Baldwin-Hess, 2008; Polzin & Baltes, 2002). It is often emphasized that BRT should be given a unique identity separate from other modes, particularly other bus based systems. “Bus routes that have a distinctive brand have a much higher awareness by the general public and are more legible for new users to understand than the rest of the bus network” (Devney, 2011). According to Hess and Bitterman (2008), mature BRT systems make use of a well-defined, simple colour palette that distinguishes BRT service from local bus service. Stokenberga (2014) – apart from dedicated or segregated right of way infrastructure and frequent operations – also emphasizes distinct branding and marketing as features through which BRT can be characterized as a high quality bus service.

Also, it is often implied that BRT's should try to emulate the characteristics of rail based PT. According to Devney (2011), branded bus services are important to increase the profile of bus services when commuter rail and light rail transit are well identified by tracks, stations and rolling stock. “Branding can be used to give buses a stronger identity. Bus service branding can be done with the vehicle livery, route design, service frequency, infrastructure, signage, information and promotion” (ibid.). According to Polzin and Baltes (2002), BRT options need to offer logical responses to traits of “physical presence and permanence” of rail investment. The authors (ibid.) note that customers, adjacent residents, businesses, and the general public traveling past a BRT alignment should be able to identify its physical presence, and mention features ranging from exclusive rights-of way, to signage, stations, electrification, which can establish the presence of BRT.

The approaches that have been described, although discerned from BRT literature, can be used to strengthen the identity of rail based PT as well. Branding can give BRT an identity which is separated from other modes, and convey information about a PT service to its users, in turn making it easier to use and understand. However, the extent to which the system can be made understandable probably depends also on the system itself, namely – on the network structure. As I will argue next, the network itself can have an effect on how successfully a PT service can be represented in space through physical presence and branding.

3. NETWORK LAYOUT – A FRAMEWORK FOR APPLYING PHYSICAL ELEMENTS

The evidence assembled by Currie (2005), mentioned earlier, sought to investigate the attractiveness of BRT compared to other transit modes from a passenger perspective. Insight is offered into how BRT systems could be improved in order to match rail based modes. Potential weaknesses of BRT compared to rail are said to be ride quality, vehicle design and lastly, general perceptions of system route and network knowledge. If we return

our focus to the perception of permanence, particularly the last point is relevant, and it is suggested that the scale of rail transit infrastructure, including stations and rights-of-way, is a significant factor in helping passengers understand how the system operates and also where transit stops are located. The author (ibid.) suggests; “The complexity of conventional bus-based systems, in terms of route structure and the large range of services offered, could be a weakness compared to rail. This needs to be addressed to achieve equivalent patronage levels to rail.”

The requirement for network simplicity which is implied above, signals the need to further explore network structure. Here, there is a possibility to link the perception of permanence, or designed spatial elements in general, with network structure. Regarding rail systems; because they require extensive built infrastructure with high permanence, this may signal a simple network layout to users, which can be easy to understand and useful for navigation. The same may be said for BRT depending on their technical characteristics and design.

This first leads us back to Currie (2006), who compares bus TOD (BTOD) and rail TOD (RTOD). Aspects other than permanence that have an effect on TOD are outlined. For example, the situation where the number of stations is potentially too great to concentrate development is called “scale dilution”. However, while concentrating development around a large number of bus stations can be difficult, compared to a small number of rail stations, a concentration of intense development around a few sites can have its own limitations as well. Luscher (1995 in: Currie, 2006) modelled the impacts of RTOD and BTOD projects in reducing auto use in San Francisco, and found that RTOD is more effective than a BTOD, but the number BTOD sites is so greater than the RTOD’s that overall, BTODs are more effective. BRT systems however, can have qualities similar to rail systems in this regard, as BRT stations can be very limited in number compared to on street bus. Currie (2006) nevertheless emphasizes that a large number of stations typical for bus systems can be “an opportunity for cities to obtain the higher benefits from TOD on a system wide basis and increase the community’s range of choice”.

Huang (1994), states that an effect of infrastructure on nearby land values is confirmed by nearly all of the reviewed studies, although the magnitude and extent of the effect varies. He gives three plausible theoretical explanations for such variation; cost and performance characteristics of the studied transportation systems, the time period in which each study has been made, and variations in supply. The last explanation refers to accessibility in other parts of the region: “if highly accessible sites within the relevant market are already plentiful, then new transportation facilities may have little or no effect on nearby land values” (ibid.). This last point is interesting as it hints towards limited supply or “rarity” having a measureable effect on the surroundings of infrastructure. As the author then explains, “in theory, consumers assess (1) the likelihood that benefits to a particular site will continue, increase, or decrease in the future; and (2) the comparative advantage of that site, *vis a vis* other locations in the future” (ibid.). We can link this to the difference between PT modes based on infrastructure – for example, rail based PT or even BRT can be considered both rarer and more permanent than compared to on street bus, thus implying long term benefits and greater accessibility compared to other sites, which can have a measurable effect on surrounding property values.

Frequency should be mentioned briefly. Dittmar and Poticha (2004), note that “after density, the most important questions about transit have to do with service frequency and speed”.

Frequency can make a service more practical and a more common site in space, resulting in people accepting it as part of the environment and as a frame based on which they orient themselves due to the practicality derived from frequency. Also, higher frequency can result in branded vehicles (with distinctive livery promoting PT) to become a more common sight in space, thus increasing its physical presence.

We can therefore recognise the importance of line structure and hierarchy, where limited supply can improve the readability of the system, as well as other service characteristics. As Douglas (2010) notes – discussing PT and local identity – “tourists regularly depend on mass transit... to get around cities and form mental maps of their layouts”. A clear and easy to understand line structure is therefore crucial in order for users to get an understanding of the system and implement it into their mental maps. Also, such a network layout can also entail easier marketing and identification through signage and colour. We could then say that spatial elements linked to PT – from rail tracks to stop signage and stations – are not only establishing or emulating a perception of permanence, or are merely an aesthetic element. They are also a materialisation of a simple and readable network structure and high quality service marked in space, according to which people can orientate themselves and rely on. The reverse relationship must be emphasized as well; a simple structure with frequent service can more easily tie itself onto permanent infrastructure and other spatial elements, and can then be more effective if it does so. Such a successful merger of these qualities results in PT acting as a successful spatial marker.

4. DISCUSSION

To outline the process of a PT system becoming a significant spatial marker; An understandable network layout can more easily be transferred into the physical reality of urban space through infrastructure or designed spatial elements. This in turn further strengthens the clarity of the system and makes it more noticeable, making it more possible to become part of peoples’ mental maps. This improves the identity of both the PT service and the surrounding environment, while also signifying a commitment of authorities for maintaining transit quality levels, thus incentivising surrounding development. Higher ridership is facilitated throughout the progression of this process.

This however, is only one (idealised) representation of the process. The described steps could also be put in a different order. Also, not necessarily all the steps of this process need to be taken. For example, simply updating the signage on a system in order to make the signs more noticeable and/or visually appealing, will improve the presence of the system and therefore make it a stronger spatial marker as before the update. Therefore, we can also say that there are different degrees to which PT can fill this role.

4.1 Public transportation as a spatial marker in Ljubljana

Finally, we should apply the information, gathered in this paper, to the analysis of PT in Slovenia. The usage of PT in Slovenia is among the lowest in the European Union. According to the data by the European Commission (2019), in 2017, only 13,5 % of passenger miles in the country were done by PT – the third lowest number among European Union members.

Noticeable is the lack of – particularly urban – PT in Slovenia for which it could be said can play the role of a strong spatial marker. The dominant form of urban PT in the country currently are city buses. However, from 1901 till 1958, a tram system used

Figure 1: Dedicated bus lane on Dunajska cesta, marked with yellow. Photo: J. Veber

to operate in the capital city, Ljubljana, while trolleybuses were in use there from 1957 till 1971 (see Brežina & Lokar, 2009). If we apply the knowledge from our review, both systems possessed a higher degree of permanence and physical presence than a bus system due to their technical characteristics of having rails and/or overhead wires as necessary infrastructure. Looking at the number of users through the years, we can see that, in Ljubljana, according to Koblar (2017), ridership on urban buses is in decline, as it has fallen from just under 43 million annual passengers in 2010, to under 38 million in 2015. Although we must be careful at making such connections, since traffic situation in Ljubljana followed trends tied to suburbanisation in Western Europe (see Šašek-Divjak, 2004), it is nonetheless interesting to note that the rise of buses, according to Bole (2004), coincided with the beginning of the end of PT (in Ljubljana) and the rise of personal vehicles.

The bus system of Ljubljana, operated by *Ljubljanski potniški promet* (LPP), possesses many traits which prevent it from becoming a significant spatial marker. First of all, there is very little physical separation from the remaining traffic, and thus perceived permanence. Dedicated lanes do exist on some sections, however they are not physically separated from automobile traffic (Figure 1). We can claim that only in the city centre do the bus lanes have a level of permanence or presence higher than in other parts of the city, due to them being an integral part of a public space redesign – that of the central “Slovenska Cesta” street (Figure 2). Furthermore, the exteriors of buses are often covered in wrap advertising (see: Granda, 2018), preventing a unified appearance of vehicles and blocking views from inside. This can create confusion for the strength and importance of the brand and image, when vehicle livery is less distinctive or noticeable. Finally, there is also the issue of network structure, addressed by Koblar (2017). The large number of bus routes running on the same sections, and a lack of hierarchy among them, create confusion among users and a poorer understanding of the system (for the map of routes, see LPP, 2020). All this could hinder the introduction and efficiency of branding, noticeable physical elements such as distinctive signing, and separation from other traffic. All of the above is decreasing the systems prospects of becoming a meaningful spatial marker.

Although plans for the re-introduction of tram/light rail in Ljubljana have been a popular idea and entertained in several traffic studies (see: Koželj, 2005), in recent times, the viability of such plans has been questioned (see: Bole, 2004; Koblar, 2017; Koželj, 2005). Due to its permanence, such a system would have advantages for establishing itself a spatial marker. However, permanence of guided PT modes, as we saw in the literature review, can be compensated for by other means.

Two recent bus based proposals for Ljubljana, which both introduce line hierarchy, could provide solid ground for strength-

Figure 2: Slovenska Cesta, with bus lane and patterned pedestrian surfaces. Photo: J. Veber

ening PT's role as a spatial marker. The first one is by RRA LUR (2010), proposing a system of 4 so called “Modern Fast Lines” (Slovene: *Sodobne Hitre Linije* – abbreviated as SHL) beside regular urban bus services. It is also implied that this system could form the basis for possible future upgrade to light rail. The other was developed by Koblar (2017; see also Koblar et al., 2018), who re-designed the urban bus network in Ljubljana, dividing it into 3 main lines, 2 circle lines, 6 secondary lines and 11 feeder lines.

If implemented, both these proposals could serve as a framework for applying spatial elements in order to improve their physical presence. Particularly the second proposal by Koblar (2017) is interesting, as it proposes just 3 main lines, making the system very easily understandable (potentially providing also benefits from limited supply described earlier), while also establishing differentiation among the remaining bus services, thus opening opportunities for further clarification of the network through design decisions or possible permanent infrastructure. For example, each of these line categories could be marketed differently (different logo, different vehicle colours etc.), while physical separation from other traffic could be encouraged on main lines. The author (ibid.) himself proposes an eventual upgrade of the system with the introduction of double articulated buses or trolleybuses on main lines, in case the increase in ridership would show the need for vehicles able to carry more passengers.

Both proposals provide an opportunity to begin the process of PT in Ljubljana gaining a distinct identity, by making it better represented in space. People could orient themselves according to it and accept it as part of the urban environment, whose identity would get improved as well. PT in Ljubljana could thus strengthen its role as a spatial marker. This does not necessarily mean an introduction of a new technology (light rail for example) however, as this text has examined how bus based systems can be successfully branded and their image improved through design of spatial elements.

5. CONCLUSION

In the text, I have attempted to outline ways in which PT marks the environment, particularly urban settings, and why this is beneficial. This is done primarily through the visible physical mark it has in space, but also through its spatial distribution. Furthermore, service quality also plays a role. Thus, a bond must exist between the physical characteristics of PT, its network organisation or hierarchy, and service quality. For example, high permanence with a confused line structure and infrequent service (as is the case with many main line trains services) performs poorly as a spatial marker. Similarly, a clear network structure which is not properly represented in space, cannot reach full potential.

What this paper attempted to argue for is that the appearance of PT simply matters. It is important that PT establishes a proper relationship with the environment, not just through supportive policies to facilitate TOD, but that PT itself must have a physical and aesthetic dimension, which may invite new users and encourage new development. This also extends to its spatial organisation, which should be clear enough for people to understand. It could also make it easier to apply spatial elements when we have a recognisable spatial organisation. This way, PT could more effectively form the backbone of people's cognitive maps, which Lynch (1960) claimed are often based on transportation networks.

ACKNOWLEDGEMENTS

I would like to thank anonymous reviewers of "Creativity Game – Theory and Practice of Spatial Planning" journal for their suggestions. Also, I wish to express special gratitude to Assoc. Prof. Dr. Alenka Fikfak for her support, technical assistance and discussion.

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Špela Verovšek:

VREDNOTENJE TRAJNOSTNE UČINKOVITOSTI SOSESK Z VIDIKA MOBILNOSTI IN POVEZLJIVOSTI NEIGHBOURHOOD SUSTAINABILITY ASSESSMENT — THE ASPECT OF MOBILITY AND CONNECTIVITY

UDK: 711.581: 502.131.1 ■ 1.03 Kratki znanstveni prispevek / Short Scientific Article ■ SUBMITTED: October 2020 / REVISED: October 2020 / PUBLISHED: November 2020

UVODNIK

EDITORIAL

ČLANEK

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RAZPRAVA

DISCUSSION

RECENZIJA

REVIEW

PROJEKT

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WORKSHOP

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COMPETITION

PREDSTAVITEV

PRESENTATION

DIPLOMA

MASTER THESIS

POVZETEK

Namen tega prispevka je vpogled v raziskavo tekočega nacionalnega projekta (financiran s strani Agencije za raziskovanje RS), ki naslavlja izzive podatkovno podprtega odločanja v trajnostnem urbanizmu ter razvoj novih metodologij za integracijo, optimizacijo in analizo prostorskih podatkov, ki so pomembni kot podpora odločanju pri trajnostni prenovi in optimizacijskih ukrepih v slovenskih soseskah in naseljih. Trenutno se posvečamo predvsem možnostim uporabe lokacijskih podatkov, ki jih zagotavljajo mobilne naprave in pripadajoča infrastruktura. Napredek na tem področju je omogočil hiter razvoj v industriji lokacijskih podatkov in raziskavam omogočili razumevanje uporabnikov in njihovega vedenja v realnem času na številnih področjih. Predvsem so tovrstni podatki uporabni na področju indikatorjev, povezanih z mobilnostjo in dostopnostjo, kot pomembnima faktorjema kakovosti bivanja v lokalnem okolju.

KLJUČNE BESEDE

trajnostno vrednotenje, soseska, mobilnost, povezljivost

ABSTRACT

The aim of this contribution is to reveal an insight into the ongoing national research project (funded by Slovene Research Agency), examining the data-driven support for sustainable and quality urban renewal on the neighbourhood level. Special concern is dedicated to the assessment methodologies and integration of data in the instruments used for assessment purposes. In our previous research projects, we encountered numerous obstacles related to data accessibility, data resolution and data integration accompanied by a critical lack of metrics for addressing less quantifiable aspects of urban quality, sustainability and well-being in neighbourhoods. Our current concern is focused to the indicators of mobility and connectivity as metrics important for quality and liveability of neighbourhoods.

KEY-WORDS

sustainability assessment, neighbourhood, mobility, connectivity

1. INTRODUCTION

This article provides a brief insight into recent research conducted by the Faculty of Architecture (University of Ljubljana), in liaison with the Faculty of Computer and Information Science and the Faculty of Arts (Department of Psychology), dealing with the data-driven support for sustainable and quality urban renewal on the neighbourhood level, along with the integration of data into instruments used for assessment purposes. In our previous research projects, we encountered numerous obstacles related to data accessibility, data resolution and data integration accompanied by a critical lack of metrics for addressing less quantifiable aspects of urban quality, sustainability and well-being in neighbourhoods.

Our present research efforts aim to reveal the potential of the location-based data provided by mobile devices and associated infrastructures. The latter have enabled the location-data industry and research to understand how audiences move and behave in real time. While such data are widely recognised as a beneficial source of information in various fields and solid advances have been made in both analytics and modelling, little progress has been seen in exploiting that potential as regards sustainability assessment tools.

Two main reasons make targeting the objectives of this research important: (i) to offer urban decision-makers a supporting instrument able to inform and substantiate spatial interventions in the renovation process of different neighbourhoods through a consistent and standardised framework of key indicators/criteria; (ii) to give spatial users and residents a clear insight into the state of the neighbourhood, its sustainability and quality, while also encouraging them to increase their commitment to improvements (through various ways like changing non-sustainable habits, their own monitoring, their own contribution of data etc.)

2. BACKGROUND

The question of the quality and sustainability optimisation of today's neighbourhoods has proven to be particularly relevant in combination with data-driven decision-making (Bibri, 2019) and related methodologies. Rerecord-keeping and monitoring the progress of neighbourhoods with respect to various aspects of sustainable development as well as the short- and long-term comparability of successful revitalisations is an emerging need.

In order to contextualise the sustainability and sustainable development of the built environment, many assessment tools have been developed in past decades. This has occurred at different spatial scales, from the single building scale to the neighbourhood and city scale so as to facilitate decision-making and improve the sustainable performance and organisation of various spatial entities (Zheng et al., 2017). Neighbourhood sustainability assessment (NSA) tools are instruments that evaluate the sustainability performance of a given mesoscale entity such as a neighbourhood or district against a set of criteria and corresponding indicators (Sharifi and Murayama, 2015). The composed indicators help to disaggregate the complex phenomena and impact chains in built environments and offer a practical framework for detecting situations and understanding the relationship with more abstract criteria and goals like environmental compatibility, economic efficiency and quality of dwelling. Compact sustainability assessment procedures were initially developed for impact assessment at the level of individual buildings and gradually developed to the neighbourhood or district

scale. The last decade has witnessed the release of several urban sustainability certification standards, especially ones focused on the spatial mesoscale. More than a few reviews (e.g. Sharifi & Murayama, 2015; Reith & Orova, 2015; Kaur & Garg 2019) note the most widely recognised systems, such as LEED ND (Leadership in Energy and Environment Design – Neighbourhood Development; United States), BREEAM Communities (Building Research Establishment's Environmental Assessment Method – Communities; UK), DGNB District (German Sustainable Building Council for District; Germany) CASBEE UD (Comprehensive Assessment System for Building Environment Efficiency – Urban Development; Japan), HOE2R (HQE High Quality Environmental and Economy in Regeneration standard, European Union), SCR (Sustainable Community Rating, Australia) etc. Most of these tools are similarly structured: the instruments follow a system of multidimensional criteria and indicators, wrapping up the scores by hierarchically arranging the goals to facilitate evaluation, monitoring and benchmarking. The indicators are commonly clustered according to an initial three-silo approach – gathered around economic, social and environmental dimensions/pillars on the highest hierarchical level, which impairs one's ability to understand the interdependence of these three domains and related impacts (Cohen, 2017). Similarly, four-part or five-part (daisy) concepts are introduced in some cases, comprising additional dimensions of technical/operational and institutional. In the next hierarchical step, NSA tools typically follow categories, often denoted as themes¹, which further label the concerns of sustainability and liveability². Each theme is further divided into sets of criteria, indicators and sub-indicators. NSA frameworks are often strongly linked to their original regional contexts and thus not necessarily transferable to other environments (Sharifi and Murayama, 2015). In order to open up their use and make them more universal, some tools provide two types of indicators: prerequisite/mandatory indicators and optional indicators. In addition, mandatory indicators can have different reference values (benchmarks) and the weighting scheme can be dissimilar in order to keep the evaluation relative to the regional context and to be able to distinguish between different cultural or local backgrounds. However, to make assessments reliable, comparable over time or transferable as regards the location the biggest challenge is to clearly identify the generic and specific indicators to be used and embedded in the frameworks or to define interchangeable indicators or suitable weights. The literature provides little by way of solid answers to these issues, instead pointing out specific scopes and indicators that seem to be more important than others in certain thematic areas.

Another crucial problem that is often identified is data availability. One can establish and propose a perfectly suitable indicator system for the assessment, but that is of little use if data are not accessible or available for certain scales, localities or time frames to perform the analyses. In reviews of assessment tools and their operability (e.g. Zheng, 2017; Boyle et al., 2018; Chao et al. 2020),

¹ A review (Verovšek et al., 2016) reveals the most frequently associated categories: natural resources and energy (also environmental resources, ecological concern, environmental efficiency etc.), built environment and organisation (also denoted as land use, urban pattern and building typology etc.), transport and mobility (also denoted as connectivity, mobility and accessibility, transportation and infrastructure etc.), identity and cultural heritage (historical continuity, sense of attachment), health and safety (safety of open spaces), quality of public spaces (also denoted as the liveability of urban places), economic value and marketing (denoted also as economic viability), community engagement (social cohesion and participation, social networking and interaction) and similar.

² As a concept, liveability is not an independent variable; to some extent, it depends on the 'triple-bottom' sustainability model. As such, liveability is a specific, nuanced and qualitative component of the broader concept of sustainability (Szibbo, 2016).

the lack of data for quantitative evaluation was most commonly fixed by performing qualitative assessments based on a surveying methodology³ or trained expert estimation. Another solution often used is simple interpolations where a wider area (or time lap) is relied on to proxy for performance against an indicator or more indicators. Both can critically decrease the geospatial resolution and eloquence of the data, resulting in an assessment of weak informative strength.

Paradoxically, on one hand we are facing an increasing amount of captured and gathered urban spatial data from various sources while, on the other, we encounter significant data scarcity, especially of small-scale, micro-urban and fine-grained records that allow us to theoretically define and track the NSA tool parameters. For this reason, we aim to further develop or modify the existing NSA indicators so that they reflect information relevant to specific aspects of sustainability and quality of dwelling, while also constituting solid pillars for data acquisition and analysis.

3. SUSTAINABLE MOBILITY INDICATORS

Due to the wide thematic coverage of assessment frameworks and accompanying extensive range of possibly important indicators, databases and data types, our work programme is set as a series of testbeds in initially separate theoretical and applied assemblies. This workflow allows us to study in detail selected data assemblies and actual IT-supported solutions. Our current interest concerns traffic and mobility indicators as a very important component of sustainability assessments. The second reason for delving into this thematic scope is the well-articulated prospect of data support in this thematic field, also feasible on the level of neighbourhood scales.

The addition of mobility as a concern in the context of sustainability assessment tools gave rise to a new discursive practice devised by academic research, government agencies, and transportation agencies and institutions. The World Business Council for Sustainable Development (WBCSD) formulates the process of developing urban sustainable mobility as follows: "The ultimate goal is to accelerate and extend access to safe, reliable and comfortable mobility for all whilst having, zero traffic accidents, low environmental impacts, affordability, and reduced demands on energy and time/..." (WBCSD, 2018).

The Directorate for the Mobility and Transport of the European Commission in liaison with the WBCSD has developed a comprehensive set of practical and reliable indicators (SUMI⁴) that support cities in performing a standardised evaluation of their mobility system, practices and travel patterns, which has to some extent also proven to be a good starting point for neighbourhood sustainability assessments. The indicator set specifically adapted for European cities (SMP2.0 Sustainable Mobility Indicators) comprises the following core indicators: affordability of public transport for the poorest group indicator, accessibility of public transport for mobility-impaired groups indicator, air pollutant emissions indicator, noise hindrance indicator, road deaths indicator, access to mobility services indicator, greenhouse gas emissions indicator, congestion and delays indicator, energy efficiency indicator, opportunity for active mobility

indicator, multimodal integration indicator, satisfaction with public transport indicator, traffic safety modes. These are further followed by 'non-core indicators': quality of public spaces indicator, urban functional diversity indicator, commuting travel time indicator, mobility space usage indicator, and security indicator (reported perception of crime-related security in the city transport system (including freight and public transport, public domain, bike lanes and roads for car traffic and other facilities like car or bike parking). Other tools for assessing sustainable mobility that have been developed cover similar thematic scopes (Gillis, et al. 2015) by which decision-makers can better understand the sustainability values, or the lack thereof, and further monitor or compare them with regard to the geolocation or time cross-sections.

Unfortunately, many indicators mentioned above or identified in other sources (e.g. Daniels et al., 2018) are not well suited to neighbourhood-like or even city-like scales. While promoting quantitative metrics with well-quantifiable and compact data use, the great majority⁵ of indicators is still forced to rely on the less efficient surveying methodology, indirect use (Verovsek et al., 2016) or imply an adaptation of the simple spatial or time-based linear interpolation methods, which considerably decreases the eloquence of the data. On top of extensive data requirements, such metrics are costly to obtain. For example, audits and surveys require a massive deployment of resources, and are only standardised at a country level (Kraemer et al., 2019), hindering the correct quantification of mobility indicators on a local scale.

For this reason, our effort was to delve into the opportunities given by location data. Location data is a term associated with geographical information about a specific mobile device's position related to a time identifier (Ewen, 2019). Location data can be aggregated and analysed to provide significant scale insights into behaviour and movement. One such opportunity is represented by the use of 'Floating Car Data' – records resulting from timestamped geo-localisation and speed data directly collected by moving vehicles and their users⁶, as a basis for estimating various parameters like actual vehicle travel times on selected routes. Such data are provided, for example, by services such as Google Maps, Waze, and similar, usually after paying a fee. Compared to classic data queries, as Kraemer (2019) puts it, such data sources – being constructed from mobility information alone – are significantly less expensive to compile (involving only computer-processing cycles) and are available in real time.

4. THE USE AND DEVELOPMENT OF TRAVEL TIME RELIABILITY INDICATORS

As regards our objectives to primarily address sustainable mobility with respect to quality of dwelling and liveability, we decided to consider measures of travel time reliability on road motorised trips. The importance of travel time reliability in traffic management, monitoring, benchmarking and network design has received considerable attention in the past decade (Fangfang Zheng, 2017). It refers to indicators assessing

³ Conducting a city-wide household travel survey requires extensive resources. Therefore, even developed cities and countries perform travel surveys only every 5 or 10 years. As a result, travel survey approaches usually lack instantaneity and continuity (Yin et al., 2020).

⁴ SUMI is a service contract for the European Commission's Directorate-General for Mobility and Transport providing technical support related to sustainable urban mobility indicators (MOVE/B4/2017-358). The project helps urban areas using the "SMP2.0 Sustainable Mobility Indicators" developed by the World Business Council for Sustainable Development (WBCSD).

⁵ The study conducted by Bongardt et al. (2011) proved by comparing and analysing 16 sustainable mobility assessment tools that more than 70% of revised indicators struggle with a significant or large lack of available solid data on the global level. The most serious challenge, they claim, relates to the efforts for collecting and processing data in terms of the less efficient surveying methodology.

⁶ Records rarely directly relate to cars/vehicles (e.g. GPS-equipped cars), but to the mobile devices of the car users – adopting the cellular network data, every switched-on mobile phone works as a traffic sensor and is thereby an anonymous source of information.

consistency or dependability in travel times, as measured day to day or across different times of the day (Federal Highway Administration, 2006) and essentially applied to any travel mode. Vandervalk et al. (2014) define it as the variability in travel times that occurs for a specific trip or route over the course of time and the number of times (trips) that either 'fail' or 'succeed' according to a predetermined performance standard or schedule. While being a highly valued characteristic among travellers and commuters, travel time reliability affects their participation in activities and plays a decisive role in perceptions of choice and well-being. Although the value of travel time has for many decades been considered the main factor in travellers' perceptions and hence drivers' route choice decisions, researchers have more recently postulated that these travel time models may have been leaving out reliability and certainty considerations (Chepuri et al. 2019) of importance for time management (individual trip planning) and modern travel patterns. In fact, Lyman et al. (2008) state the consistency of travel times along a given corridor may be of much more important than the actual travel times.

By considering on-road travel time reliability, we look at the question of the predictability of planned or executed trips associated with the neighbourhood/s under consideration. These metrics are important for providing a realistic assessment of how consistent and predictable the traffic situations are on certain routes – in our case, routes related to selected neighbourhoods and targeted destinations within the city. While travel times along a certain route on a working day often vary by the departure time during the day (differences in morning and afternoon peak hours), most travel time variability indicators seek rather than capture changes and deviations from the 'normal' or 'expected' at a certain time of the day. In relation to these targets, different kinds of solid measures have in recent years been proposed and applied to assess traffic performances and reliability (Chepuri et al., 2019) such as standard deviation, planning time index, buffer index, frequency of congestion, coefficient of variation, skew and width of travel time distribution, and others.

In order to observe and reflect on such reliability indicators in terms of NSA assessments, we established a testbed based on three neighbourhoods in the city of Ljubljana (Fužine, Savsko naselje, Soseska Zeleni Gaj) and six independent routes. Each neighbourhood was set as a route origin for two travel trips – one heading to the destination point in the city centre and one heading to the commercial service/shopping centre on the outskirts of the city.

The anonymous mobility patterns, more specifically the on-road travel times, were aggregated by Google's Directions API⁷ combined with the Real-time weather API, to capture the travel times for selected routes during 3-week periods. Although much attention was paid to the selection of data-capturing periods, to ensure representative situations on roads we faced certain unexpected impacts of Covid-19 regulations. The sample of days included in the examination period will be extended during the next few months after the regulation ceases to avoid declinations in data sets caused by the traffic situations thus imposed.

According to the data captured, we first proceed with descrip-

⁷ Google's Directions API provides anonymous trip times crowdsourced by users who have opted-in to Location History (Bassolas et al., 2020). More information about the aggregation procedures and data capturing can be found at <https://policies.google.com/technologies/location-data#how-find>

tive analysis of the traffic flows to estimate the components required (such as free-flow curves, the impact of weather conditions, day of the week etc.), which further allow for normalised values or other indicators of interest (e.g. buffer index) to be calculated. Current partial results revealed that travel times reliability fluctuates significantly both temporally (intra and inter days) and spatially (among the routes with regard to the origins in the neighbourhoods and among routes with respect to the destination). Traveling on certain routes in certain intervals would make one experience relatively high levels of time loss and uncertainty due to the increased travel time variability. By conducting additional analyses, we will further strive to find or modify the most narrative/descriptive indicators for NSA assessment purposes – in relation to location-data availability and prospects – to allow us to best classify the neighbourhoods, while also establishing a connection between mobility-related parameters on one hand and key quality/sustainability indicators on the other.

5. CONCLUSION

Given the ongoing debate on the optimal structure of NSA tools, their thematic coverage and indicators assortment in the assessment scheme, perhaps the most important question recurring in our research is: are the metrics proposed a true reflection of the issues and challenges that concern neighbourhoods and associated communities and people. The endorsed relevance of the particular observed variable/indicator is therefore an important step in ranking it among others in the NSA framework, thereby increasing the assessment instrument/tool's efficiency, feasibility and slickness.

Recognition of the different conceptual perspective in relation to the data requirements and opportunities compared to existing procedures obviously sheds light on the potential held by mobile location data. This has come about both from the user perspective in the manifestation of how the variability of travel time is experienced and from the perspective of urban planning/renewal and management in the expression of how the variability of travel times impacts the environment, local economies and travel patterns.

POVZETEK

Raziskovalni projekt predlaga razvoj novih metodologij za integracijo, optimizacijo in analizo prostorskih podatkov, ki so pomembni kot podpora odločanju pri trajnostni prenovi in optimizacijskih ukrepih v slovenskih soseskah in naseljih. Predlagani projekt gradi na izsledkih in delu predhodnega raziskovalnega dela, v katerem smo zasnovali sistem vrednotenja trajnostne učinkovitosti sosesk na osnovi modularnega sistema kazalcev in kriterijev ter povezane metode interpretacije vrednosti. Namen naših sedanjih raziskovalnih prizadevanj je razkriti potencial lokacijskih podatkov, ki jih zagotavljajo mobilne naprave in pripadajoča infrastruktura. Napredek na tem področju je omogočil hiter razvoj v industriji lokacijskih podatkov in raziskavam omogočili razumevanje uporabnikov in njihovega vedenja v realnem času na številnih področjih. Medtem ko se eksploatacija tovrstnih podatkov razmeroma hitro razvija in predstavlja enega najbolj koristnih virov v smislu analitike, ponovne rabe podatkov in modeliranja, pa se na področju ocenjevanja trajnosti sosesk ta potencial še ni udeležil. V pričujoči raziskavi se zato selektivno osredotočamo na parametre trajnosti/kakovosti, ki jih lahko merimo in spremljamo s pomočjo omenjenih podatkovnih setov. Pri tem vzdržujemo kontinuiteto zasledovanja poglobljenega cilja, to je, izboljšanje pogojev za podatkovno-podprto odločanje pri ukrepih in intervencijah ob prenovi sosesk.

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PROJEKT PROJECT

Sistem integracije prostorskih podatkov za vrednotenje trajnostne učinkovitosti slovenskih sosesk in naselij
Data integration framework for the assessments of the sustainable efficiency in Slovene neighbourhoods and settlements

ŠT. PROJEKTA PROJECT NO.
 J5-1798

LOKACIJA LOCATION
 Slovenija Slovenia

LETO IZVEDBE
 2019/2022

TIP PROJEKTA TYPE OF PROJECT
 raziskovalni projekt *research project*
 nacionalni *national*
 temeljni *basic*

DELOVNA SKUPINA WORKING GROUP

prof. dr. Tadeja Zupančič (UL FA)
 znan. sod. dr. Špela Verovšek (UL FA)
 doc. dr. Matevž Juvančič (UL FA)
 doc. dr. Simon Petrovčič (UL FA)
 izr. prof. dr. Miha Moškon (UL FRI)
 izr. prof. dr. Iztok Lebar Bajec (UL FRI)
 asist. dr. Miha Janež (UL FRI)
 asist. Žiga Pušnik (UL FRI)
 prof. dr. Matija Svetina (UL FF)

VODILNI PARTNER PROJECT LEADER
 Univerza v Ljubljani, Fakulteta za arhitekturo
 prof. dr. Tadeja Zupančič

Univerza v Ljubljani
 Fakulteta za arhitekturo

PROJEKTNI PARTNERJI PROJECT PARTNERS

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PROJEKT FINANCIRAN S STRANI PROJECT CO-FUNDED BY
 Javna agencija za raziskovalno dejavnost Republike Slovenije (ARRS)

JAVNA AGENCIJA ZA RAZISKOVALNO DEJAVNOST
 REPUBLIKE SLOVENIJE

INTERNET STRAN WEB PAGE
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GRADIVO PRIPRAVILA MATERIALS PREPARED BY
 znan. sod. dr. Špela Verovšek

Špela Verovšek:

A-PLACE: KREPITEV VEZI MED PROSTORI IN LJUDMI S KREATIVNIMI PRAKSAMI

A-PLACE: LINKING PLACES THROUGH NETWORKED ARTISTIC PRACTICES

UDK: 711:7 ■ 1.03 Kratki znanstveni prispevek / Short Scientific Article ■ SUBMITTED: September 2020 / REVISED: October 2020 / PUBLISHED: November 2020

UVODNIK

EDITORIAL

ČLANEK

ARTICLE

RAZPRAVA

DISCUSSION

RECENZIJA

REVIEW

PROJEKT

PROJECT

DELAVNICA

WORKSHOP

NATEČAJ

COMPETITION

PREDSTAVITEV

PRESENTATION

DIPLOMA

MASTER THESIS

POVZETEK

Projekt A-Place se osredotoča na krepitev vezi med ljudmi in prostori v šestih evropskih mestih (Barceloni, Bologni, Bruslju, Lizboni, Ljubljani in Nikoziji) s pomočjo sodobnih metod kreativnega usvajanja prostora. V vsakem mestu na izbranih lokacijah umetniki, arhitekti in drugi predstavniki kreativnih praks skupaj z lokalnimi skupnostmi izvajajo najrazličnejše aktivnosti za spodbujanje aktivne udeležbe lokalnih skupnosti. A-Place tako predstavlja platformo za ustvarjanje in razpravo o pripadnosti, identiteti, ki jo gojijo skupine iz različnih okolij in kultur v odnosu do svojega družbenega in fizičnega okolja. Z uporabo umetniških in kulturnih praks, ki se ukvarjajo s prostorom, želi A-Place nagovoriti različne deležnike (prebivalce, umetnike, arhitekte, študente in oblikovalce politik), da razmišljajo o pomenu in vrednosti ustvarjanja prostora.

KLJUČNE BESEDE

prostor, ustvarjanje prostora, kreativne prakse, identiteta prostora

ABSTRACT

Place plays a key role in the construction process of the identity of individuals and communities. A place is the result of the interaction between people, spaces and activities. In our global and multicultural societies, placemaking encompasses multiple spaces, actors, perceptions and media. However, the multiple meanings embedded in places are not always perceived by all members of a community, beyond those individuals or groups who create ties with them. Artistic practices can act as catalysts to unveil the multiple meanings underlying places, to make them perceivable to others; links which can give rise to a new sense of place beyond disciplinary and cultural limits. Through networked artistic practices, A-Place is dedicated to strengthening the bonds between people and places in six European cities (Barcelona, Bologna, Brussels, Lisbon, Ljubljana, and Nicosia). In each city, local partners carry out various creative placemaking activities with artists, architects, urban designers and local communities and encourage the active participation in building a better, more inclusive, and supportive community.

KEY-WORDS

place, placemaking, creative practices, place identity.

1. UVOD

Prostor igra ključno vlogo pri gradnji identitete posameznikov in skupnosti. Je rezultat interakcije med ljudmi, dejavnostmi in same prostorske stvarnosti v nekem časovnem preseku ali obdobju. V večkulturnih družbah ustvarjanje prostora vključuje več akterjev, zaznav in medijev (Foner et al., 2017). Vendar vseh pomenov, ki so vezani na določen prostor, ne zaznajo vedno vsi člani skupnosti oziroma so njihove zaznave in interpretacije različne. Zato nemalokrat prihaja do nerazumevanja, konfliktov ali celo nestrpnosti v prostorih, ki sicer nosijo visok potencial medgeneracijske in družbeno raznolike rabe, pestrost uporabnikov in njihove interakcije. Pri tem lahko umetniške prakse uspešno delujejo kot katalizatorji oziroma vmesni člen med prostori in uporabniki; pomagajo razkriti različne pomene prostorov, ki jih lahko hkrati zaznava več socialnih skupin in jim pomaga s prostorom ustvariti vezi, ki presegajo kulturne in fizične meje. Raznolikost praks, vključno s kreativnim ustvarjanjem prostora, taktičnim urbanizmom, pop-up urbanizmom ali kolektivnimi umetniškimi ukrepi, sovпада v potrebi po negovanju povezav med ljudmi in prostori, v katerih prebivajo, da bi poiskali načine za krepitev občutka pripadnosti in odgovornosti do prostorov bivanja najširšem smislu (Madrazo et al., 2020). Projekt A-Place se osredotoča na krepitev vezi med ljudmi in prostori v šestih evropskih mestih (Barceloni, Bologni, Bruslju, Lizboni, Ljubljani in Nikoziji). V vsakem mestu na izbrani lokaciji umetniki, arhitekti in drugi predstavniki kreativnih praks skupaj z lokalnimi skupnostmi izvajajo najrazličnejše aktivnosti ustvarjanja prostora in spodbujanja aktivne udeležbe raznolikih akterjev (lokalnih umetnikov, sosedskih skupnosti in nevladnih organizacij) pri gradnji bolj vključujočih skupnosti.

2. POJEM KREATIVNEGA USTVARJANJA PROSTORA

Ideja prostora, njegov pomen in njegova vloga v družbi so bistvene sestavine, na katerih sloni koncept kreativnega ustvarjanja prostora, h kateremu želi prispevati projekt A-Place. V nadaljevanju so povzeta nekatera temeljna načela, misli in etimologija, na katerih svoje aktivnosti gradi projektna skupina oziroma so pomembne za razvoj ideje ustvarjanja prostora. Povzeta načela so del nekaterih diseminacijskih materialov projektna skupine (Madrazo, et al., 2020; A-Place: Planning of local activities 2019-2020; A-Place: Quality Assessment Plan, 2020).

Ideja prostora (*place*) določa obstoj vezi med ljudmi in njihovim okoljem bivanja in delovanja. Sime (1986) meni, da izraz »prostor«, v primerjavi z »ne-prostorom« (*space* ali *non-place*) izraža močno čustveno povezavo, začasno ali dolgotrajno, med osebo in določeno fizično lokacijo. »Občutek pripadnosti« je tako neločljivo povezan z ljudmi, saj ustvarjajo vezi s kraji, v katerih prebivajo, s čimer to postanejo kraji njihovega bivanja. Kot trdi Relph (1976), so kraji »središča pomena - osredotočajo se na namen in namero« – na pomene in funkcije, ki niso enake za vse kulturne skupine (Madrazo et al., 2020). Termin »ustvarjanje prostora« (angl. *placemaking*) je prvotno začela uporabljati iniciativa *Project for Public Spaces* (New York). Opredeljuje ga kot »splošno zamisel in praktični pristop k izboljšanju soseske, mesta ali regije, ki navdihuje ljudi, da kolektivno ponovno osmišljajo javne prostore v osrčju vsake skupnosti« (Project for Public Spaces, 2007). Ustvarjanje prostora, ki poteka z aktivnim sodelovanjem in preko t.i. opolnomočenja članov skupnosti, v veliki meri pripomore k razkrivanju potenciala, skritega v družbeno-kulturnem preseku časa in prostora. Kot tako je del participativnega procesa, katerega cilj redefinicija in vnovično spoznavanje javnih prostorov, ob hkratnem spodbujanju identitete in prostora, družbenih ter kulturnih vrednot (A-Place:

Planning of local activities 2019-2020; 2020). Ustvarjanje prostora vključuje širok razpon dejavnosti, od kratkoročnih in zgolj začasnih posegov do dolgoročnih kooperativnih projektov, ki vključujejo različne strokovnjake, lokalne iniciative in odločevalce (Madrazo et al., 2020).

Kreativno ustvarjanje prostora je nastalo kot nadgradnja prvotnega koncepta, v okviru programa ameriške državne ustanove za umetnost *National Endowment for the Arts*, s ciljem vključevanja umetnosti/oblikovanja v načrtovanje skupnosti ter za krepitev lokalnih gospodarskih dejavnosti prek umetnosti in kulturnih obrti (Landesman, 2013). Cilj je javnim, zasebnim in neprofitnim sektorjem pomagati razvijati strategije za oblikovanje fizičnega in družbenega značaja soseske, mesta ali regije skozi kulturne dejavnosti (Markusen in Gadwa, 2019). Pri tem je izrazita raznolikost (angl. *superdiversity*) novi pogoj stalno naraščajočega, raznolikega in razdrobljenega vzorca, ki ga prepoznavamo v naših mestih (A-Place: Quality Assessment Plan, 2020). Najvidnejši izziv je razvejanost interesov v družbi, ki povzroča medkulturne konflikte, to pa otežuje najti skupno osnovo, na kateri bi urbanistično načrtovanje lahko gradilo (Meissner in Vertovec, 2014). Po drugi strani izrazita raznolikost ustvarja posebne, nove vzorce bivanja, ki jih lahko nagovarjamo.

Kreativno ustvarjanje prostora in urbanistično načrtovanje sta, kot menita Walker in Marsh (2018), prepletena in povezana do te mere, da eno omogoča ali zagotavlja drugo. Walker tako trdi, da se ustvarjanje prostora zares odvija šele, ko ljudje prostore uporabljajo za rekreacijo, druženje in zadrževanje, in ko oblikovalci v njih ustvarjajo na načine, ki dejansko naslavlajo prostorsko-družbene probleme. V tem smislu lahko koncept prostorske prakse razširimo tako, da vključuje družbene in politične okvire, ki vodijo v razmišljanje o ustvarjanju prostora, kot o raznoliki obliki produkcije družbenega znanja preko kreativnih praks in oblikovanja.

3. PRISTOP IN IZZIVI

Eden temeljnih ciljev projekta A-Place je krepitev vezi med ljudmi in prostori prek praks kreativnega ustvarjanja prostora. Pristop dela je aktivnostno in akcijsko naravnani in poteka v načrtovanih letnih ciklih dejavnosti, ki se izvajajo v posameznih partnerskih mestih. V obdobju prvega projektnega cikla posamezne partnerske institucije izvajajo aktivnosti v okviru šestih tematsko obarvanih sklopov, ki so podrobneje predstavljeni na strani projekta (Aplace, 2020):

A Weaved Place v barcelonskem urbanem območju L'Hospitalet (Barcelona) je prostor dejavnosti, ki nagovarja družbene skupine z različnim poreklom, in poudarjene razlike med soseskami, ki so povzročile družbeno in fizično razdrobljenost v tej občini, ki je sicer del metropolitanskega območja Barcelone. **A Calm Place** v bruselskem urbanem območju Schaerbeeku je skupek dejavnosti, ki se osredotoča na možnosti, izmenjave med študenti in prebivalci v njihovi izrazito raznoliki soseski, ter ustvarjalni potencial močno prisotne študentske skupnosti. **A Hidden Place** v Ljubljani predstavlja aktivnosti, ki se osredotočajo na revitalizacijo praznega zemljišča v soseski Bežigradski dvor. Gre za problem t.i. »ne-prostora« (angl. *non-place*) brez kolektivnega spomina ali rabe. Aktivnosti ustvarjanja prostora se izvajajo skupaj s Trajno, nevladno organizacijo, ki se posveča spodbujanju izobraževanja in osveščanja javnosti v okviru ekološkega in trajnostnega oblikovanja. **A Sound Place** v Lizboni je prostorski koncept za participativno ustvarjanje kulturne zvočne krajine v okolici predela Martim Moniz – enega najbolj večkulturnih sosesčin v Lizboni – z zbiranjem zvočnih zaznav prebivalcev in obiskovalcev, ki služijo kot osnova za zvočne predstave na

drugih urbanih lokacijah, tudi v drugih partnerskih mestih. **A Visionary Place** v Bologni je prostor dejavnosti, ki vključuje posamezne delavnice, predavanja in manjše dogodke – vse kot del festivala Urbane vizije, programsko usmerjene k razpravi o življenjskih pogojih migrantov, beguncev in razseljenih skupnosti. **A Confined Place** je koncept, ki je nastal kot odgovor na okoliščine pogojene z omejevanjem družabnega življenja na prostem zaradi pandemije (Covid-19). Gre za program dejavnosti, ki je odprt za tiste, ki želijo izražati in deliti izkušnje o življenju v obdobju zaprtosti skozi digitalna omrežja, ob uporabi različnih tehnik – besedil, pripovedovanja zgodb, slik in fotografij, avdio-vizualnih del in predstav.

Opisani pristopi so del kreativnega ustvarjanja, ki se odvija v sodelovanju partnerskih organizacij z lokalnimi skupnostmi in akterji. Poglavitni namen ukrepov, ki se načrtujejo v različnih mestih in kontekstih, je ustvariti mrežo multidisciplinarnih praks, ki pomagajo presegati idejo o prostoru kot zgolj fizični danosti, pač pa ga osmišljati širše, kot katalizator idej, kolektivnih spominov in številnih pomenov, ki jih nosi – tako za prebivalce kot obiskovalce. Eden glavnih izzivov v okviru projekta pri tem ostaja vrednotenje učinka izvedenih aktivnosti. Ocena družbeno-fizičnega procesa preoblikovanja ni niti enostavna niti lahka. Vrednotenje mora po eni strani težiti h generični zasnovi, ki omogoča medsebojno primerjavo, po drugi stani pa mora omogočati specifično obravnavo akcij ustvarjanja prostora, pri čemer se upošteva dani geo-prostorski in časovni okvir. To pomeni tudi upoštevanje pričakovanj različnih vpletenih akterjev (npr. umetnikov, načrtovalcev, prebivalcev) ter njihovih skupnih ciljev in vrednot. Ocena vpliva ustvarjanja prostora je tako neločljivo povezana s samimi dejavnostmi in lokalnim kontekstom ustvarjanja prostora. Metodologija ocene učinka, ki smo jo zasnovali za projekt A-Place, bo združevala družbeno-etnografske, fenomenološke in estetsko teoretične okvire za kritični argument, kako ustvarjanje prostora krepi sodelovanje v družbi in vključenost ter pomaga izboljšati odnose med skupinami v skupnosti.

4. ZAKLJUČEK

Pristopi, ki spodbujajo vključevanje ljudi in graditev občutka pripadnosti v določenem prostoru so danes številni in pogosto obravnavani tako v akademskem, strokovnem kot ekonomskem smislu. Obsegajo prakse kreativnega ustvarjanja prostora, taktičnega urbanizma, pop-up koncepta do klasičnih participativnih praks z vključevanjem različnih akterjev v proces načrtovanja (Madrazo et al., 2020).

V štiriletnem obdobju trajanja projekta A-place je predvidena izvedba vrste ustvarjalnih intervencij, razstav in (video) umetniških del v sodelujočih partnerskih mestih. Pri tem bo velik del pozornosti usmerjen v preučevanje vloge in ovrednotenje teh umetniških praks, kot katalizatorjev povezovanja skupnosti v izbranih prostorih, obenem pa tudi k učinkovitemu prenosu danih praks in ustvarjenega znanja med partnerskimi organizacijami in širše. Proces ustvarjanja prostora, kot smo ga zasnovali, bo torej istočasno v različnih mestih vključeval več zainteresiranih strani, ki bodo postopoma ustvarile mrežo različnih javnosti – različnih strokovnih, kulturnih, umetniških in lokalnih praks, ki splošni teoretični okvir znanj razširjajo s posameznimi specifičnimi primeri in izkušnjami.

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ŠT. PROJEKTA *PROJECT NO.*

607457-CREA-1-2019-1-ES-CULT-COOP2

LOKACIJA *LOCATION*Španija, Belgija, Ciper, Italija, Portugalska, Slovenija
Spain, Belgium, Cyprus, Italy, Portugal, Slovenia

LETO IZVEDBE

2019/2023

TIP PROJEKTA *TYPE OF PROJECT*

Project programa Kreativna Evropa

*Project under the Creative Europe programme*DELOVNA SKUPINA *WORKING GROUP*UL FA: Tadeja Zupančič, Špela Verovšek, Matevž Juvančič;
*Other institutions' members: Leandro Madrazo, Veronika Antoniou, Maria Irene Aparicio, Luisa Bravo, Maša Cvetko, Simone Garagnani, Mario Hernández, Alenka Korenjak, Burak Pak, Petra Pferdmenges, Chrysi Rapanta, Julie Reveillon, Rosaura Romero, Adrià S. Llorens, Teresa Tourvas, Ruben Verdú, Angel Martín Cojo, Marina Kyriakou, Giulia Gualtieri, Zala Velkavrh, Patrícia Pereira*VODILNI PARTNER *PROJECT LEADER*Šola za arhitekturo La Salle Barcelona
School of Architecture La Salle Barcelona

laSalle

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PROJEKT SOFINANCIRAN S STRANI *PROJECT CO-FUNDED BY*

Program Kreativna Evropa, EU

Creative Europe Programme EU

Co-funded by the
Creative Europe Programme
of the European UnionINTERNET STRAN *WEB PAGE*<http://www.a-place.eu/>GRADIVO ZBRALA IN PRIPRAVILA *MATERIALS PREPARED BY*

znan. sod. dr. Špela Verovšek

Gregor Čok, Gašper Mrak: PROSTORSKA RAZPOREDITEV POSLOVNIH SUBJEKTOV V SLOVENIJI

SPATIAL DISTRIBUTION OF BUSINESS ENTITIES IN SLOVENIA

UDK: 711.552(497.4):72.054 ■ 1.03 Kratki znanstveni prispevek / Short Scientific Article ■ SUBMITTED: October 2020 / REVISED: October 2020 / PUBLISHED: November 2020

POVZETEK

V prispevku so predstavljeni rezultati raziskave, ki je usmerjena v preučevanje poslovnih subjektov v fizičnem prostoru. Raziskava obsega ugotavljanje njihove lokacije, lege glede na namen-sko rabo prostora, morfološko enoto, sektor in tip poslovne dejavnosti. Z uporabo primerjalne raziskovalne metode in javno dostopnih podatkovnih baz smo izvedli medsebojna križanja in ugotavljali posamezne karakteristike. Ugotovil smo njihovo obsežno pojavnost na območjih stanovanj in razpršene poselitve, ter relativno majhen delež na območjih poslovnih con. Večina subjektov, zlasti s področja terciarnih dejavnosti, je umeščenih v stanovanjskih stavbah. To opozarja na velik obseg dela na domu, ki je posledica različnih zgodovinskih in upravnih dejavnikov. Delo na domu sproža tako pozitivne kot negativne učinke na prostor, gospodarstvo in družbo. V tem okviru je pomembno poznati njegove strukturne karakteristike in izoblikovati učinkovitejše instrumente za regulacijo. Preučevanje tega pojava je v obdobju epidemije Covid-19 dobilo nov pomen, zlasti na področju poznavanja njegovih socioloških in psiholoških učinkov.

KLJUČNE BESEDE

poslovni subjekti, namenska raba prostora, sektorji, delo na domu, regulacija

ABSTRACT

This paper presents the results of a research aimed at studying business entities in physical space. The research includes determination of their location, its relation to intended land use, morphological unit, sector and type of business activity. Using a comparative research method and publicly available databases, we conducted cross-examinations and determined individual characteristics. We found their extensive occurrence in the residential and dispersed settlement areas, and a relatively small share in the business zone areas. Most entities, especially in tertiary activities, are located in residential buildings. This is pointed out by relatively high level of work at home due to various historical and administrative factors. Working at home triggers both positive and negative impacts on the environment, economy and society. In this context, it is important to know its structural characteristics and design in order to implement more effective regulatory instruments. The study of this phenomenon has acquired new importance during the Covid-19 epidemic, especially in the field of knowledge of its sociological and psychological effects.

KEY-WORDS

business entities, land use, sectors, work at home, regulation

1. UVOD

V Sloveniji se soočamo z zelo razpršeno strukturo lokacij, na katerih se izvajajo različne poslovne dejavnosti. Kljub formalno pravnim določbam prostorskih aktov in usklajeni zasnovi namenske rabe prostora, ki opredeljuje območja monokulturne industrije, gospodarskih con, območij centralnih dejavnosti in drugih ustreznih namenskih zemljišč, je pri evidenci dejanskega stanja v prostoru evidenten izrazit odklon od regulacijskih planskih usmeritev.

Slovenija je, podobno kot ostale postsocialistične države (Andrusz et al., 2011), v obdobju tranzicije doživela tudi lastniško in strukturno preoblikovanje gospodarskega sektorja (Lorber, 1999). V prvih letih samostojnosti se je v novih tržnih pogojih konsolidiral t.i. podjetniški sektor, ki je nadomeščal zaposlitveno praznino nastalo ob razpadu SFRJ (Vadnjal, 1996). Z razmahom številnih podjetniških pobud so se v tem obdobju na celotnem državnem teritoriju pojavljale potrebe po ustreznih poslovnih objektih in zemljiščih. Poslovanje se je izvajalo na lokacijah nekdanjih industrijskih in obrtnih con, ustanavljati so se začele nove cone (Filipič, 2000), velik del te iniciative pa se je materializiral tudi v obliki dela na domu (Kos, 1990, 1993; Čok, 2004). Ta prostorsko organizacijski pojav je danes zelo obsežen in v družbenem ter prostorskem smislu povzroča tako pozitivne kot negativne učinke.

Z novodobno epidemijo Covid-19, ki v prvi vrsti predstavlja omejene pogoje dela, bivanja in ostalih procesov urbanega okolja se je ponovno pojavil tudi interes po preučevanju dela na domu in še posebej dela od doma (OECD, 2020; UN, 2020). Njegova prostorske, socialne, ekonomske in psihološke razsežnosti postajajo predmet številnih aktualnih ekspertiz (Shareena & Shahid, 2020; Adams-Prassl et al., 2020). V Sloveniji je bil pojav dela na domu do sedaj relativno skromno preučevan in analiziran (Čok & Furman Oman, 2019). Glede na njegovo splošno družbeno ustaljenost ali celo zaželenost, ter glede na njegov obseg je to preučevanje posebej pomembno, saj izsledki lahko pripomorejo k njegovi večji učinkovitosti. Pri tem so pomembni zlasti obstoječi ali novi regulacijski instrumenti in njihova uporaba. Delo na domu ob ustreznih obravnavi in s pomočjo sodobnih telekomunikacijskih tehnologij, lahko predstavlja resno alternativo konvencionalnim oblikam dela v kolektivnih delovnih organizacijah (Felstead & Henseke, 2017; Holliss, 2015). Ob tem

pa ostajajo še vedno aktualni številni psihološki in sociološki izzivi dela v socialni izolaciji oziroma v okviru ožje družinske skupnosti, ki so jih raziskovalci preučevali že pred desetletji (Toffler, 1980; Beck et al., 1992). V tem smislu je pomembno tudi danes razumeti teritorialni, urbanistični in arhitekturni kontekst tega pojava, ki ga aktualna epidemija še dodatno vzpodbuja in razširja praktično na celotno populacijo.

2. O RAZISKAVI

Raziskava je usmerjena v preučevanje lokacije, oblike, obsega, programa in drugih prostorskih karakteristik poslovnih subjektov in temelju statističnih podatkih uradnih evidenc (AJPES, 2019) in na obstoječih prostorskih (GNRP, 2019) in podatkov iz katastra nepremičnin in o rabi stavb iz registra nepremičnin (REN, 2019). Namenjena je ugotavljanju tistih elementov, ki so lahko predmet planiranja in načrtovanja. Izvaja se v okviru raziskovalnega programa Geoinformacijska infrastruktura in trajnostni prostorski razvoj Slovenije (P2-0227).

3. METODOLOGIJA IN REZULTATI

Raziskava poteka v dveh fazah. V prvi fazi smo izvedli povezljivost različnih podatkovnih baz (evidenca poslovnih subjektov, generalizirana namenska raba zemljišč, kataster stavb, register nepremičnin ipd.) in s pomočjo primerjalne raziskovane metode ugotavljali stanje glede: a) obsega poslovnih subjektov po sektorski opredelitvi in teritorialni razporeditvi, b) njihove lege v namenski rabi zemljišč in c) umestitve v določeni stavbni tipologiji. V drugi fazi izvajamo analizo poslovnih subjektov v različnih morfoloških strukturah.

Ugotovili smo, da so poslovni subjekti iz vidika prostorske razporeditve relativno razpršeni po celotnem teritoriju RS, evidentna pa je njihova zgostitev v osrednjeslovenski regiji. Njihovo skupno število znaša 275.030 (leto 2019). Glede na sektor dejavnosti jih skoraj tri četrtine (70,2 %) sodi med terciarne dejavnosti, sledijo kvartarne (18,4 %), sekundarne (10,4 %) in primarne (1,1 %) dejavnosti.

Analiza lege glede na namensko rabo prostora ponazarja presenetljivo velik delež njihove lociranosti na stanovanjskih območjih in območjih razpršene poselitve (skupaj 52,5%), dobra tretjina (31,5%) pa jih je lociranih na območjih centralnih

Legenda:

- Sedeži poslovnih subjektov
- Podrobnejša namenska raba**
- Stanovanjska območja
- Centralne dejavnosti
- Posebna območja
- Proizvodne dejavnosti
- Prometne površine
- Gozdna zemljišča
- Kmetijska zemljišča
- Površinske vode
- Ostala območja

0 0,375 0,75 1,5 km

Vir: AJPES, 2019; GURS, 2019; MOP, 2019

Slika 1: Prostorska razporeditev poslovnih subjektov na različnih namenskih rabah prostora; primer naselij Vrhnika in Žalec.

dejavnosti. Glede na organizacijo poslovanja v stavbnem tipu jih večina posluje v stanovanjskih stavbah (64,7%), ostale (35,3 %) pa v ne stanovanjskih stavbah (izvajanje in/ali registracija poslovanja). Analiza njihove lege na območjih poslovnih con ponazarja relativno majhen delež vseh poslovnih subjektov, saj jih je na teh območjih umeščenih zgolj 6,5%.

Vse navedeno ponazarja zelo velik obseg dela na domu, seveda pretežno v skupini terciarnih (storitvenih) dejavnosti. V določenem deležu pa se tudi na območjih stanovanj in razpršene poselitve pojavljajo dejavnosti sekundarnega sektorja kot so večja proizvodna obrt, skladiščenje ipd. dejavnosti, ki povzročajo evidentne vplive na zdravje in okolje.

Analiza njihovega pojava v različnih morfoloških strukturah ponazarja določene strukturne zakonitosti (večji spekter dejavnosti se izvaja na območjih enostanovanjskih stavb oziroma ohlapnejše pozidave, manjši spekter pa na območjih večstanovanjskih stavb oziroma strnjene pozidave). Ta faza raziskave še ni zaključena, vendar je iz vmesnih rezultatov že evidentna ohlapnost regulacijskega instrumentarija, ki dopušča organizacijo poslovanja praktično kjerkoli v prostoru (slika 1). Tako obsežna struktura v urbanem, zlasti bivalnem okolju, dodatno bremeni prometna omrežja, povzroča dodaten hrup, emisije in s svojo tehnološko oblikovno pojavnostjo sproža tudi določen neželen vizualni vpliv. Delni rezultati te analize so ustrezno izhodišče za potencialno nadaljnjo analizo v smeri preučevanje psihološkega in sociološkega vidika dela na domu. V navedeni analizi pa niso upoštevani še dodatne oblike prostorsko nezahtevnega »dela od doma«, izrazitega v času epidemije, saj tega pojava z izjemo izvajanja anket, praktično ni mogoče zajeti v prostorske evidence in posledično analitično preučevati.

4. ZAKLJUČEK

Navedeno opozarja na veliko lokacijsko in oblikovno pestrost prostorskih rešitev dela na domu, ki je posledica različnih dejavnikov. Med njih zagotovo sodijo: a) relativno velika zemljišča nekdanje tipične enodružinske gradnje iz 60., 70. in 80. let minulega stoletja, ter še vedno prisotna mentalna in upravna zapuščina tega obdobja (Sendi, 2017), b) splošno družbeno sprejet in prostorsko ustaljen koncept dela na domu iz obdobja po osamosvojitvi in c) relativno ohlapne regulacijske določbe veljavnih prostorskih aktov, ki temu pojavu posvečajo relativno malo pozornosti (Čok & Furman Oman, 2019). Po drugi strani pa aktualne ankete in statistične analize drugih avtorjev (Jakovljevič et al., 2020; Žibert et al., 2020) s področja preučevanje družbene situacije v času epidemije Covid-19 ugotavljajo, da smo se v Sloveniji na področju dela (tudi študija) dela na domu (to obliko je izvajalo cca. 50% prebivalstva) relativno hitro in učinkovito samoorganizirali. To dokazuje, da je obstoječa prostorska in organizacijska situacija, ki jo naslavlja naša raziskava, kljub določenim strokovnim pomislekom, v določenih parametrih očitno učinkovita (vključno s tipologijo stavb). Zagotovo pa je nadaljnje preučevanje in razvijanje ukrepov za njeno še večjo prostorsko in okoljsko sprejemljivost zagotovo smiselno in potrebno.

Zahvala

Avtorji prispevka se zahvaljujejo Javni agenciji za raziskovalno dejavnost Republike Slovenije za delno sofinanciranje študije iz državnega proračuna v okviru raziskovalnega programa Geoinformacijska infrastruktura in trajnostni prostorski razvoj Slovenije (P2-0227).

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III.

PREDSTAVITEV

PRESENTATION

MESTNA ULICA⁴

CITY STREET⁴ (CS4)

TIP PREDSTAVITVE *TYPE OF PRESENTATION*
mednarodna znanstvena konferenca

ADVISORY BOARD

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ORGANIZATOR *ORGANISATION*

University of Ljubljana, Faculty of Architecture and Urban Planning
Institute of the Republic of Slovenia in Collaboration with Notre
Dame University-Louaize, Ramez G. Chagoury Faculty of Architec-
ture, Art and Design and Aesop Thematic Group Public Spaces and
Urban Cultures

DATUM IN KRAJ IZVEDBE *DATE AND LOCATION OF THE EVENT*

Urbanistični inštitut RS, dne 23.-24.9.2020, Arnes Digital Platform

GRADIVO PRIPRAVILA *MATERIALS PREPARED BY*
doc. dr. Matej Nikšič, izr. prof. dr. Alenka Fikfak

POVEZAVE *LINKS*

<https://www.ndu.edu.lb/city-street-4/home>
<https://cs4.uirs.si/>
https://cs4.uirs.si/portals/cs4/posters/cs4_program_brochure.pdf
https://cs4.uirs.si/portals/cs4/posters/cs4_roundtable1_poster.pdf
https://cs4.uirs.si/portals/cs4/posters/cs4_roundtable2_poster.pdf
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FIKFAK, Alenka (urednik), NIKŠIČ, Matej (urednik), MADY, Christine
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Streets for 2030: proposing streets for integrated, and universal mobility
: [book of proceedings : Ljubljana, 23.-24. September 2020]. Ljubljana:
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961-6390-58-3. https://cs4.uirs.si/portals/cs4/posters/CS4_2020_BOP.pdf.
[COBISS.SI-ID 32867843]

UVODNIK
EDITORIAL
ČLANEK
ARTICLE
RAZPRAVA
DISCUSSION
RECENZIJA
REVIEW
PROJEKT
PROJECT
DELAVNICA
WORKSHOP
NATEČAJ
COMPETITION

PREDSTAVITEV
PRESENTATION
DIPLOMA
MASTER THESIS

KEY-SPEAKERS

- Bernard Khoury, neodvisni projektant, Beirut: Toxic Grounds
- Luka Skansi, Politehnika v Milanu: Fiume Fantastika. Monuments of a City of Five Capitals
- Darko Radović, Univerza Keio, Tokyo: When we think about streets, we are always thinking about something else
- Davisi Boontharm, Univerza Meiji, Tokyo: Capturing the Captivating Streets
- Luka Mladenovič, Urbanistični inštitut RS: Public transport and our cities

2 ROUND TABLES WITH AESOP

- Sreda, 23. september ob 15:30 - Public Spaces - Knowledge Transition Between Research, Policy and Practice
- četrtek, 24. september ob 15:30 - Moving Around our Cities in the Times of Epidemics – the Changed Demand for Public Spaces

10 THEMATIC SECTIONS

- T1: Integrated and Universal Mobility: Whose Streets?
- T2: Dense, Diverse and Designed Urban Development
- T3: Mitigating Traffic Congestion with Urban Development
- T4: Travel time and Efficiency of Transport Systems
- T5: Public-Transport-Oriented Cities for All
- T6: Borders in Street Life: Dividing or Protecting?
- T7: Green Mobility in a Way to Climate Resilient Streets
- T8: Pedestrian Friendly Cities to Support Climate Change
- T9: Perspectives on Sustainable Mobility: Culture of Everyday Activism
- T10: Street Lighting – Supporting Sustainable Urban Development

ABOUT THE EVENT

City Street 4 was the fourth conference in a series of the conferences City Street. It was co-organised by the Faculty of Architecture of the University of Ljubljana (FA) and the Urban Planning Institute of the Republic of Slovenia (UIRS) in collaboration with Notre Dame University-Louaize, Ramez G. Chagoury Faculty of Architecture, Art and Design (NDU).

The conference was initially planned to take place in Ljubljana between 23rd and 26th of September 2020. Besides the morning Plenary sessions with Keynote speeches, the afternoon Parallel sessions and Roundtables, a series of accompanying events was also planned – the on-site exhibitions, mobile workshops and a week-end study tour with discussions.

Due to the pandemics of covid-19 the Organisational board had to consider few options – to cancel the conference, to postpone it into the (unknown) post-pandemic future or to adjust the conference programme and organise it as an on-line event. The later variant was unanimously approved by all participating organizing institutions.

The programme of the on-line City Street 4 Ljubljana 2020 conference took place on 23rd and 24th of September 2020 and is presented into some more details here below.

The conference was opened by the representative of the hosting and co-organising institutions: the the Dean Dr. Matej Blenkuš and Dr. Alenka Fikfak from FA, the Director Dr. Igor Bizjak and Dr. Matej Nikšič from UIRS and Dr. Christine Mady from NDU.

The first keynote speech was by a Lebanese architect Bernard Khoury titled Toxic Grounds. As a practitioner he was drawn to problematic territories. On the example of Beirut he illustrated how in the environments of the absence of the consensual political projects where the future is hard to be predicted, the city neighbourhoods are shaped by the individualistic gestures that do not compose a harmonious whole. He pointed out that one needs to be extremely alert in such conditions, while the architecture has to be a political act – in the conditions where the state does not provide the public spaces and facilities even the corporate towers or shopping malls can hold a political charge.

The second keynote speech was by Dr. Luka Skansi who is an

Foto: M. Nikšič, UIRS, 2020

associate professor at Politecnico di Milano. On the case of Croatian port city Rijeka he presented a development of a city from a small and geopolitically insignificant town into one of the largest ports of the Mediterranean despite the contested and divided conditions during its growth. Rijeka's character and soul stays distinctive due to its embeddedness into various political entities during its politically turbulent past. The material and immaterial legacy is reflected in its dialects, cuisine, infrastructure, urbanism, architecture and monuments. Through the analyses of the monumental public sculptures Dr. Skansi explored the memorialization practices of different political entities and its reflections in the public open space of the city.

Dr. Darko Radović, a professor of architecture and urban design at Keio University, Tokyo, and a co-founder of co+re platform, opened the Day 2 with his keynote speech. He elaborated on the notion that when we think about the cities, we are always thinking about something else. He used the notion to point out that the streets encapsulate many of the leading aspects what the urban is all about. He claimed that as such streets are indicators of healthy (or not) urbanity. On the examples of Tokyo he then presented different cases of subjectivity of lived space. Based on his personal experience (himself coming from the s.c. Western culture) he pointed out some the conflicting perspectives that arise when ones realises that some basic concepts and words as such as public space and the right to the city are non-existing in Japanese culture.

Dr. Davisi Boontharm, professor of architecture and urban design at meiji University, Tokyo, also pointed out that the street is an intricate subject at the core of urbanity. Her interest of streets is placed within the context of her own cultural background of East and Southeast Asia. She interpreted them as places that are in a constant flux. She presented the capacity of some unconventional methods such as artistic drawing that are helpful in capturing and interpreting the character and meaning of streets. Through the case studies of Bangkok, Singapore and Tokyo and different projects related to street-space in these cities she illustrated the capacity of artistic capturing of street situations in depicting the personal attachment to a particular street as a

living space.

The keynote speeches section was complete by the talk by Dr. Luka Mladenović, a researcher and project manager at the Urban Planning Institute of the Republic of Slovenia. He addressed one of the cornerstones of sustainable urban mobility – the public transport. He put light on the complexity of the contemporary system of public transportation in cities that is not limited to public trams and buses anymore but combines a wide range of other new modes, shared or even private, to set up a comprehensive system – such as shared bikes, scooters, skateboards, rollers, shared rides etc. Dr. Mladenović pointed out the close relation and interdependence between the public transportation planning and the urban environments design.

The core part of the conference were the presentations within ten parallel tracks. Forty-eight presenters presented, they came mainly from Europe and the Mediterranean area. Their contributions addressed both theoretical and practical aspects of the contemporary provision of street space from different inter- and trans-disciplinary perspectives. The following themes were addressed: Integrated and Universal Mobility: Whose Streets?; Dense, Diverse and Designed Urban Development; Mitigating Traffic Congestion with Urban Development; Travel time and Efficiency of Transport Systems; Public-Transport-Oriented Cities for All; Borders in Street Life: Dividing or Protecting?; Green Mobility in a Way to Climate Resilient Streets; Pedestrian Friendly Cities to Support Climate Change; Perspectives on Sustainable Mobility: Culture of Everyday Activism; Street Lighting – Supporting Sustainable Urban Development. All the presentations were recorded and can be found at the conference web page <https://cs4.uirs.si/>, where the Book of proceedings is available too in a downloadable pdf format free of charge.

Two roundtables were organised within the programme of the conference in cooperation with AESOP Thematic group Public spaces and urban cultures. First roundtable titled Public Spaces – Knowledge Transition Between Research, Policy and Practice was moderated by Dr. Matej Nikšič (Urban Planning Institute of the Republic of Slovenia) and Ljubljana and Dr. Ceren Sezer

(RWTH Aachen University, Aachen). The participants were Dr. Patricia Aelbrecht (Geography and Planning School, Cardiff University), Cecilia Andersson (UN Habitat, Global Public Space Programme), Dr. Enzhe Dusaeva (Tamga Institute of urban studies, Kazan), M.Sc. Zeynep Gunay (ISOCARP Board, Director of Young Planning Professionals Programme), Alenka Korenjak (prostoRož, Ljubljana, Slovenia) and Tadej Žaucer (Ministry of infrastructure of the Republic of Slovenia, Sustainable Mobility and Transport Policy Division). In a lively discussion they exchanged the points of view on the challenges and opportunities of knowledge transition between public space research, policy and practice. They agreed that the complexity of urban environments requires transdisciplinary methods to analyse and conceptualise public spaces to be able to engage knowledge, approaches and theories of public spaces from various perspectives to inform and influence policy-making and practice in different contexts.

Second roundtable titled Moving Around our Cities in the Times of Epidemics – the Changed Demand for Public Spaces was moderated by Dr. Alenka Fikfa (Faculty of Architecture, University of Ljubljana) and Christine Mady (Notre Dame University-Louaize, Beirut). The participating discussants were Jose Chong (UN Habitat, United Nations Human Settlements Programme), Marko Peterlin (Institute for Spatial Policies, Ljubljana, Slovenia), Janez Černe (Deputy Mayor of The City Municipality of Kranj, Slovenia) and Stefano Ragazzo (AMAT - Agency of the Mobility, Environment and Territory of Milan Municipality, Italy). The contributors to the roundtable addressed the very timely issue of the Covid-19 pandemic crisis and how it has affected mobility, social practices and other forms of life that are part of public spaces. Among others they were discussing the mid- and long-term consequences of the fact that the public transport usage has decreased during the pandemics, while some other forms of mobility such as walking and cycling gained the popularity. They concluded that the public spaces must stay the places of the social exchanges and democratic practices even when the epidemiologic measures demand the changed behavioural patterns and practices.

Unlike the on-site exhibitions, mobile workshops and a week-end study tour with discussions that had to be cancelled due to the pandemic measures, some accompanying activities were fully organised online. Photo and Essay competition attracted all together.

The international writing contest for primary and secondary school students »My Street in the City of the Future« has concluded.

28 contributions were submitted, most of them in the category for younger students. Most essays were written in Slovenian and three in English. Despite a given limit on the number of characters, we accepted all texts for evaluation regardless of their length. Some of you, in addition to your contribution, also provided drawings to enrich your thinking about the street and your living space. For this reason, we have decided to publish all essays online.

After carefully reviewing and reading all the essays submitted, the expert jury decided to add another category to the two predefined ones (age 10-13, age 14-16, age 17-18) in order to award more original texts written by children/adolescents than originally foreseen. The essays were judged on predefined criteria and the jury selected the winners unanimously. The jury awarded most of the points to the content and conclusions of each essay. The essays were judged on originality, imagination,

foresight, boldness, character, persuasiveness, and maturity of independent thought in relation to the age of the primary or secondary school students.

In relation to the theme of City Street 4 conference, the post-conference publishing is in process at Urbani izziv / Urban Challenge Journal and Igra ustvarjalnosti / Creativity Game Journal. The publications of scholarly work is foreseen for mid 2021.

Last but not least - we would like to thank all the contributors who invested their time, efforts and resources into the successful implementation of the City Street 4 conference! And instead of a farewell – see you in Lisbon in 2022 for the fifth edition of the conference – City Street 5! Follow <https://www.ndu.edu.lb/city-street-4/home> for the up to date information.

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UVODNIK

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IV.
DELAVNICE
WORKSHOPS

KLIS 2020: VERTIKALNOST | THE KLIS CASE 2020: VERTICALITY | POVEZANOST | DRUŽBA CONNECTIVITY | LIVES

TIP DELAVNICE TYPE OF WORKSHOP
urbanistično-arhitekturna delavnica

MENTORJI MENTORS

izr. prof. dr. Alenka Fikfak, dr. Matej Nikšič, prof. dr. Tadej Glažar,
asist. Janez P. Grom, asist. Kristijan Lavtižar, Aleš Švigelj, Jan Barič,
Marko Lazič

ŠTUDENTJE STUDENTS

University of Split: Niko Borković, Zdravka Đajić, Nora Desković,
Iva Grbavac, Bruno Janković, Ana Ljubić, Ivana Satara
Meiji University I-AUD, Tokyo: Misa Aoki, Hiroya Himeno, Yuji
Hirota, Mai Iiyama, Shohei Kosugi, Suguru Sasaki, Ryuji Tomiya
Keio University, co+labo, Tokyo: Amami Iwata, Jumpei Kawamoto,
Yuki Mori, Shinichi Nishibori, Yurino Oguri, Reiya Sasaki,
Hiroki Shigemura
University of Ljubljana, Faculty of Architecture: Maša Blažič,
Dylan Gubbels, Tadej Gregorič, Urška Jernej, Blaž Parežnik, Lovro
Pintar, Vladimir Tripković
Politecnico di Milano: Daniele Bertuzzi, Paolo Del Duca, Mona
Gaber, Islam Rihan, Nur Yemisci, Ivana Gligorovska
Univ. des las Americas Quito: Santiago Aguire, Ariana Urgiles,
Emilia Romero, Arturo Cevallos, Andres Vergara
University of Canberra, Australia: Viktoria Holmik

ORGANIZATORJI ORGANISED BY

prof. Neno Kezić, University of Split, Croatia, prof. dr. Davisi
Boontharm, co+re, Meiji University, I-AUD, Japan, prof. dr. Darko
Radović, co+re, Keio University, co+labo, Japan

DRUGE INSTITUCIJE OTHER INSTITUTIONS

HAMBURG, Department of Urban Planning, HafenCity University;
LJUBLJANA, Department of Urban Planning, Faculty of
Architecture, University of Ljubljana; MALMÖ, Department of
Urban Studies, Malmö University; MILAN, Dipartimento di Architettura
e Studi Urbani, Politecnico di Milano; PARIS, Paris School
of Planning, Université Paris Est Créteil

SODELUJOČI PARTICIPANTS

University of Ljubljana, Faculty of Architecture, Chair of Urbanism
Department of System Design Engineering, Keio University,
Tokyo, Japan
Keio University, Tokyo
Meiji University I-AUD, Tokyo
Politecnico di Milano
Heritage Department, Imotski, Croatia
Faculty of Engineering, Architecture and Geodesy, University of
Split
School of Architecture and Design, KMUTT, Bangkok, Thailand
Gehl, Copenhagen, Denmark
University of Canberra, Australia
Manchester Metropolitan University, UK

DRUGI SODELUJOČI OTHER PARTICIPANTS

prof. Ana Medina, prof. Akira Mita, prof. dr. Darko Radović, prof.
dr. Davisi Boontharm, prof. Gabriele Masera, prof. Neno Kezić,
prof. Bratislav Gaković, prof. Chanyaporn Bstieler, prof. David
Sim, prof. Milica Muminović, prof. Rafael Balboa, Ray Lucas, Sidh
Sinthusingha.

DATUM IN KRAJ RAZSTAVE DATE OF THE EXHIBITION
20.9.2020, Split

GRADIVO PRIPRAVIL MATERIALS PREPARED BY
asist. Kristijan Lavtižar

Slika 1: »The Mark« je naziv projekta, ki so mu ga nadel avtorji na lokaciji Markezine Grede v Splitu. Projekt predstavlja vertikalno povezavo med mestom in pečino ter združuje številne programe turistične ponudbe. Avtorji: Dylan Gubbels, Emilia Romero, Mona Gaber, Nora Deskovic, Yuji Hirota, Yuki Mori, Niko Borkovic.

VSEBINA

Delavnico Klis 2020 je organizirala Občina Klis ob sodelovanju z organizacijskimi partnerji univerze Keio, Meiji in Split. V času pandemije so se odločili za delavnico preko spleta, katere cilj je bil ustvariti izobraževalne in raziskovalne koristi, ter prispevek k razvoju vizij za boljšo prihodnost krajev na izbranih lokacijah okoli mesta Split. Namen delavnice je bil tudi v utrjevanju načina sodelovanja na razdalji, ustvarjanje mednarodnih izkušenj, koristne praske in povezovanju vseh udeležencev, s poudarjanjem pomena interdisciplinarnosti. Fakulteta za arhitekturo Univerze v Ljubljani je sodelovala na delavnici kot partnerska institucija, katere člani so sodelovali kot študenti, tutorji, kritiki ali predavatelji.

Lokacija delavnice Klis 2020 se je osredotoča na mesto Klis, del hrvaškega somestja Split-Solin-Klis. Organizacijska skupina je prepoznala dve strateški lokaciji, ki sta bili odskočišče za razvoj vizij arhitekturno-urbanistične delavnice.

Markezina Greda je skalnata pečina nad mestom Split, ki se nahaja na severozahodnem delu območja Klisa (z arheološkimi ostanki od 5-7. stoletja n. št.). Postala je priljubljen izziv za izkušene plezalce, ki jo odlikujejo pogledi na okoliške kraje, Klis, Solin, Split, Jadransko morje in številne otoke. Prvotni cilj mesta Markezina Greda je bil okrepiti trenutne dejavnosti, hkrati pa s strateškim, nevpadljivim, minimalnim oblikovanjem ohraniti svoje dragocene okoljske specifičnosti. Druga lokacija te delavnice je Kamnolom Klis Kosa, ki leži na pobočjih jugovzhodnega hriba in se dviga na 350 m nadmorske višine. Zaradi invazivnega rudarjenja, ki je vplivalo na geološke razmere izvira reke Jadro, je bilo nekazno, da bo kamnolom verjetno kmalu prenehal obratovati. To je odprlo nešteto priložnosti za načrtovanje in oblikovanje prostorskih vizij za razvoj in sanacija tega degradiranega območja.

Topografsko zahtevna območja kamnoloma Klisa in Markezine Grede so predstavljale poligon za zahtevno interdisciplinarno usklajevanje prostorskega načrtovanja, urbanizma, arhitekturnega oblikovanja in inženiringa. Tema delavnice je bila iskanje prave identitete kraja, prilagajanje lokalnemu podnebjju, zagotavljanje povezanosti na zahtevnem terenu, ugotavljanje vertikalnosti kot prevladujoče morfološke značilnosti kraja, opredelitev potrebne infrastrukture, povečanje socialnih, prostorskih in tehničnih zmogljivosti tega kraja ob uravnoteženju z ranljivostjo tamkajšnjega okolja.

Slika 2: »Oasis« je projekt ene izmed skupin študentov, ki temelji na konceptu oaze dveh celic, ki ponujata mikroklimatsko zavetje za ljudi in vegetacijo na območju kamnoloma Klis Kosa. Avtorji: Iva Grbavac, Urška Jernej, Mai Iiyama, Islam Riham, Arturo Cevallos, Shinichi Nishibori, Ryuji Tomiya.

Študentje so svoje rešitve predstavili na spletnem sestanku, po srečanju pa so bili izdelani plakati za razstavo na Občini Klis.

ABSTRACT

The Klis 2020 workshop was organized by the Municipality of Klis in cooperation with the organizational partners of Keio University, Meiji in Split. During the pandemic of 2020, they decided on an online workshop aimed at creating educational and research benefits, and contributing to the visions for a better future of the places in the selected locations around the cities of Split. The purpose of the workshop was to consolidate ways of cooperation at a distance, to create international experiences for students, useful practices and to connect all participants, emphasizing the importance of interdisciplinarity. The Faculty of Architecture of the University of Ljubljana participated in the workshops as a partner institution, whose members participated as students, mentors, critics or lecturers.

»A HIDDEN PLACE« – ŠTUDENTSKA DELAVNICA USTVARJANJA PROSTORA NA BEŽIGRAJSKEM GRADBIŠČU »A HIDDEN PLACE« – A STUDENT WORKSHOP ON PLACEMAKING AT THE BEŽIGRAD CONSTRUCTION PIT

Ljubljana, Slovenija

2019/2020

TIP DELAVNICE *TYPE OF WORKSHOP*
urbanistično-arhitekturna delavnica

MENTORJI *MENTORS*
prof. dr. Tadeja Zupančič, doc. dr. Matevž Juvančič,
znan. sod. dr. Špela Verovšek
Prostoroz: Alenka Korenjak, Maša Cvetko, Zala Velkavrh

ŠTUDENTJE *STUDENTS*
Marieke Van Dorpe, Axel Schimpf, Barbora Výborová, Fadi
Suidan, Anna Kotlabová, Nina Alexandra Karelina, Julia Cordero
Pedrero, Daniela Leccese, Lucie Žadrapova, Zuzana Šutvajova,
Julia Sepúlveda Antón, Paula Mora de Urquiza, Natalia Caparrós
Pérez, Oriol Gracia, Natalia Caparrós, Lara Jana Gabrije, Ilvana
Gligorovska, Daniel Hernandez, Urša Katin Koželj, Xavier Llerena,
Eider Oruezabala, Nives Otaševič, Maja Perpar, Lea Elena Vidmar,
Klemen Žibert

ORGANIZATORJI *ORGANISED BY*
Fakulteta za Arhitekturo, Univerza v Ljubljani

DRUGI SODELUJOČI *OTHER PARTICIPANTS*
Trajna: Gaja Mežnaric Osole, Andrej Koruza, Primož Turnšek

NAROČNIK *CLIENT*
Delavnica je bil izvedena v okviru evropskega programa Crea-
tive Europe, v okviru projekta A-PLACE

DATUM IN KRAJ RAZSTAVE *DATE OF THE EXHIBITION*
PROSTOR V OBLAKU; virtualna razstava Fakultete za Arhitekturo
2019/2020

GRADIVO PRIPRAVILA *MATERIALS PREPARED BY*
znan. sod. dr. Špela Verovšek

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Co-funded by the
Creative Europe Programme
of the European Union

Slika 1: Simbolična intervencija za Bežigradom: »Skriti prostor« (photo: Pia Klančar).

Slika 2: Plakat – vabilo na delavnico. (grafika: Matevž Juvančič).

Slika 3: Vizualizacija – prvi vtisi; Bežigrad (students group B: Llerena, Otašević, Vidmar, Žibert, Van Dorpe).

Slika 4: Vizualizacija – »Skriti prostor se razkrije«.

Slika 4: Gostujoče predavanje v okviru delavnice (predavanje: Maša Cvetko).

VSEBINA

The student workshop was organised in the frames of the A-PLACE project (Linking Places Through Networked Artistic Practices), co-funded by the European program Creative Europe. Thematically it has focused on the revitalization of an empty plot in the Bežigradski Dvor district in Ljubljana, a place hidden behind a construction fence, overgrown with greenery, without a collective memory or use. In a 3-month process of the workshop, mentors from the Faculty of Architecture and ProstoRož led students through an exploration of the site and its socio-cultural context, discovering the ties to its past and present-day stories, and revealing its potentials for the future use. The placemaking proposals and interventions were carried out together with Trajna, a non-governmental organisation dedicated to promote nature based solutions, community economies, creative research, workshops and eco-infrastructure design. After a series of lectures, debates, site visits and analyses, intensive masterclasses and interviews with the potential users and stakeholders, students proposed temporal or semi-temporal interventions and/or on-site events to attract interest of the public. Five final holistic interventions and accompanying events were proposed by five student groups: A Growing Place, A Connective Place, A Converging Place, A Colourful Place, A Growing Space. These were first steps towards inhabiting this hidden place, making it more inclusive and attractive for the different social and interest groups.

ABSTRACT

Semestrna delavnica AHiddenPlace na Fakulteti za arhitekturo Univerze v Ljubljani je potekala v sklopu projekta A-Place. Študenti so skozi proces raziskovanja prostora, spoznavanja s potrebami potencialnih uporabnikov in poglobljenega opazovanja naravnih danosti gradbene jame pri Bežigradskih dvorih razvili idejne projekte, ki na prostoru mirujočega gradbišča ustvarjajo prostor sobivanja med človekom in naravo, na katerem bo začasno deloval tudi kolektiv Trajna.

VELIKI DOGODEK V MESTU ZA VSAKOGAR?

A (MEGA) EVENT CITY FOR EVERYONE?

OLIMPIJSKE IGRE V PARIZU 2024

THE PARIS 2024 OLYMPICS

TIP DELAVNICE *TYPE OF WORKSHOP*

Mednarodna urbanistično delavnica

MENTORJI *MENTORS*

doc. dr. Matevž Juvančič, dr. Špela Verovšek, asist. Janez P. Grom,
asist. Kristijan Lavtižar

ŠTUDENTJE *STUDENTS*

Fakulteta za arhitekturo, Univerza v Ljubljani:
Sanja Djurdjević, Luka Jereb, Nik Žagar, Miha Šetina, Nuša Jerič,
Marjan Gracar, Lara Zalokar

ORGANIZATORJI *ORGANISED BY*

Paris School of Planning, Université Paris Est Créteil, Pariz

SODELUJOČI *PARTICIPANTS*

HAMBURG, Department of Urban Planning, HafenCity University;
LJUBLJANA, Department of Urban Planning, Faculty of Architecture,
University of Ljubljana; MALMÖ, Department of Urban Studies,
Malmö University; MILAN, Dipartimento di Architettura e Studi
Urbani, Politecnico di Milano; PARIS, Paris School of Planning,
Université Paris Est Créteil

DATUM IN KRAJ RAZSTAVE *DATE OF THE EXHIBITION*

10th - 14th, February 2020

GRADIVO PRIPRAVIL *MATERIALS PREPARED BY*

asist. Janez P. Grom

UVODNIK

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VSEBINA

Vsakoletno medinstitucionalno sodelovanje v okviru International Week je bilo v študijskem letu 2019/2020 izpeljano v organizaciji Pariške partnerice - Paris School of Planning. Partnerske institucije MALMO/MILANO/HAMBURG/LJUBLJANA/PARIS so poskrbele za udeležbo široke palete tutorjev, kritikov in predavateljev ter velikega števila študentov iz različnih področij.

Mesto Pariz in velika pariška metropola bosta gostili olimpijske igre v letu 2024. V organizacijo dogodka vključene občine to predstavljajo kot resnično priložnost v smislu gospodarskega in urbanega razvoja. Pojem in kvalitetno vrednotenje ter osmišljanje zapuščine je glavni element v pripravah na igre, ki jih zdaj MOK pozorno preučuje. Izkušnje iz preteklih dogodkov, iz drugih držav kažejo, da se stroški servisiranja projekta in kasneje vzdrževanja infrastrukture običajno povečujejo in koristi za lokalne skupnosti zanemarijo. Mesto Hamburg je prošnjo za leto 2024 zavrnilo leta 2014, ker so ji meščani nasprotovali zaradi visokih stroškov in pričakovanega dviga lokalne davčne stopnje. V velikem Parizu nekatere lokalne aktivistične skupine izpodbijajo uresničitvi programov urbanega razvoja, ki so povezani z igrami, in trdijo, da bo na koncu lokalno prebivalstvo nosilo stroške in nadloge del, onesnaževanje in celo izselitev, vendar novi objekti in stanovanja ne bodo imeli koristi. V projektih za organizacijo se olimpijske vasi, vodni in medijski center ter drugi objekti se nahajajo v severovzhodnem Parizu (okrožje Seine-Saint-Denis), industrijskem in delavskem območju, ki je bilo v zadnjih 20 letih podvrženo velikim načrtom prenove. letih.

Novo zgrajena območja zagotavljajo vrhunske pisarniške prostore in stanovanja, čeprav ima okrožje Seine-Saint-Denis še vedno eno najvišjih stopenj revščine v državi. Poleg tega so osrednja območja Pariza (ki bodo gostila tudi več olimpijskih objektov) pod stresom množičnega turizma, ki se spreminja zaradi boljšega sprejemanja obiskovalcev, včasih pa zanemarija svoje prebivalce. Kdo bo imel dostop do teh novih objektov in stanovanjskih površin? Naraščajoči življenjski stroški so del prebivalstva pregnali iz notranjih predelov Pariza. Ali bodo olimpijske igre pospešile to dinamiko? Glede na regionalni kontekst Pariza in naraščajoče razlike se lahko vprašamo, za koga so organizirane olimpijske igre? Komu bodo koristili? In kakšne vrste urbanih središč se bodo pojavile iz novih objektov?

To so bili vidiki, ki jih je obravnaval IW 2020. Delavnica je v uvodnem delu bila organizirana s serijo predavanj, s katerimi so bile predstavljene aktualne razprave o načrtovanju urbanega razvoja in družbene zapuščine prejšnjih (mega) dogodkov v Franciji, Nemčiji, Italiji in na Švedskem. Ta predavanja so omogočila vpogled v skupne izzive, s katerimi se srečujejo evropska mesta med mega-dogodki in po njih v različnih obsegi in v različnih nacionalnih okvirih. Po ogledu olimpijskih projektov na štirih glavnih lokacijah (olimpijska vas, Stade de France in območje vodnih središč, skupine Eifflovega stolpa in športno območje na Porte de la Chapelle) so skupine študentov na eni od štirih lokacij (s terenskim delom, zbiranjem podatkov itd.) izvedle podrobna analitična dela in opredelile ločene projekte, s katerimi so poskusili odgovoriti na izpostavljeno problematiko.

PART 2 - A PROJECT FOR THE PEOPLE?

Slika 1 in 2: Predlog načrtovanega posega (skupina 2). Konceptualna zasnova razvoj ideje na eni od predvidenih lokacij.

PART 2 - A PROJECT FOR THE PEOPLE?

Slika 3 : Prostorski prikaz opremljanja ambien-tov s slikami lokalnih prebivalcev (skupina 3).

ABSTRACT

The goal of the international week 2020 workshop was to discover fresh ideas on how to better adjust the organization of the games in Paris in 2024 so that the locals are being listened to and taken into consideration. As previous editions of the Games proved the projects have always been unsustainable and has cause dmajor damagas to locality. The students that took part of this edition of the IW tackled with these issues and presented their proposals in fron of a public audience.

LOKACIJE DELAVNIC

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PREDSTAVITEV
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MASTER THESIS

① Ljubljana, Slovenija

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V.

DIPLOME

MASTERTHESIS

Tjaša Kogovšek: IDEJNA ZASNOVA REURBANIZACIJE MESTNEGA JEDRA KOPER: Urbana regeneracija na območju Belvederja

REURBANIZATION DESIGN OF THE
KOPER CITY CENTER: urban regeneration
in the Belvedere area

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PRESENTATION
DIPLOMA
MASTER THESIS

AVTOR *AUTHOR*

Tjaša Kogovšek

TIP ZAKLJUČNEGA DELA *TYPE OF THESIS*

magistrska naloga

MENTOR *MENTOR*

izr. prof. dr. Alenka Fikfak, udia

somentor: doc. dr. Boštjan Bugarič, udia

LETO *YEAR*

2020

INŠTITUCIJA *INSTITUTION*

Univerza v Ljubljani, Fakulteta za arhitekturo

GRADIVO PRIPRAVILA *MATERIALS PREPARED BY*

Tjaša Kogovšek

COBISS Slovene Co-operative Online Bibliographic System and Services

KOGOVŠEK, Tjaša. Idejna zasnova reurbanizacije mestnega jedra Koper: urbana regeneracija na območju Belvederja. Magistrsko delo, Ljubljana, Fakulteta za arhitekturo, 2020. [COBISS.SI-ID 3880836]

Slika 1: Vizualizacija ambienta prenovljenega severnega mestnega obrobja Belveder.

VSEBINA

Mesta lahko predstavljajo prostor za vsakogar, samo če imajo vsi tudi priložnost soustvarjati. Vključevanje mnenja stroke, tj. arhitektov, urbanistov, mnenja mestnih akterjev in mnenja prebivalcev v zgodnje faze načrtovanja mest ni preprosto, ampak nujno potrebno, če želimo zadovoljiti potrebe njegovih uporabnikov. Idejna zasnova reurbanizacije mestnega jedra Koper temelji na upoštevanju javnih in strokovnih mnenj, pridobljenih v Kopru leta 2019 na dogodkih participativnega urbanizma. Magistrska naloga predstavlja del načrtovalskega procesa, skupnega reševanja prostorske, vsebinske in demografske problematike ter skupnega bodočega oblikovanja mestnega jedra Koper.

Zavoljo preprečitve nadaljnjega uničevanja historične vrednosti naselbinske dediščine, do 20. stoletja na otoku ležečega mestnega jedra Koper, je njegova reurbanizacija načrtovana postopoma, od strateške zasnove na nivoju mestnega jedra do izbranega urbanega detajla območja Belveder, katerega regene-

racija, lahko bistveno pozitivno vpliva na življenje prebivalcev celotnega mestnega jedra.

Koncept strateške zasnove temelji na vzpostavitvi ponovne prepoznavnosti otoške oblike mestnega jedra, ki je poudarjena z obrobim zaščitnim pasom zelenih površin, kar pa delno reši tudi prostorske konflikte mestnega obrobja in nudi zvočno zaščito. Mesto, s preobrazbo nekaterih mestnih ulic v peš cone in novo načrtovanimi zelenimi površinami, ponovno zadira in zmanjša splošno termalno pregrevanje.

Slika 3: Prikaz nivojev obravnave reurbanizacije mestnega jedra Koper.

Slika 2: Participativni dogodek v Kopru, 29.5.2019 in delni rezultat javnomnenjske raziskave.

... območje strateške zasnove - mestno jedro Koper
— območje situacije - lokacija Belveder
— območje detajla - Muzejski trg z ulico Belveder

Slika 4: Strateška zasnova mestnega jedra Koper.

Začasna raba parkirišč na zapuščenih predelih ob mestnem obrobju in nova, trenutno v gradnji, parkirna hiša na severnem mestnem obrobju, omogočajo odstranitev nepotrebnega tranzitnega prometa skozi mestno jedro. Izbor lokacije Mestne občine Koper, garaže pod Muzejskim trgom sicer ni najprimernejša, saj obstaja nevarnost ustvaritve prevelikega prometnega vozlišča na obalnem predelu. Vseeno pa njen avtomobilski dostop s spodnjega obalnega nivoja in dostop pešcev neposredno v zgornji nivo mestnega jedra, dopušča zaprtje ulice Belveder, kjer promet trenutno uničuje pogled na morje. Zeleni Belveder predstavlja prenovljeno zeleno in z javnim programom napolnjeno mestno ulico, ki povezuje severne mestne trge z 12 metrov nižjo obalo.

Mestno jedro obkroža cesta z umirjenim prometom, skupna avtomobilom, kolesarjem in pešcem, kjer nove prečne povezave omogočajo hitrejši dostop pešcev med obalo in ulico Belveder. Ulica se v celoti ozeleni in skupaj s prenovljenimi severnimi mestnimi trgi ustvarja mestno zeleno oazo, polno inovativnega

urbanega pohištva, pametno tlakovana za dostopnost vseh in opremljena z talnim taktilnim vodilnim sistemom. Vsi trgi se v obliki razgledališča podaljšajo do roba ulice Belveder in ustvarjajo nove možne točke zadrževanja ljudi z neprekinjenim pogledom na odprto morje. Muzejski trg ima zaradi svoje trenutne degradacije največjo svobodo oblikovanja, in zaradi lokacije postane glavna severna vhodna točka v mesto. Njegova idejna zasnova je prilagojena načrtom garažne hiše, vključeno z njenimi tremi izhodi, ki se pokrijejo z zelenimi pergolami. Razdeljen je na zeleni del s parkom, otroškim igriščem in večjimi drevesi ter urbani del z večnamensko ploščadjo, urbani vrtovi in družbenim objektom, ki skupaj s sosednjimi objekti tvorijo organsko urbano silhueto in varno mestno ulico. Glavna osrednja pot vodi do pokrajinskega Muzeja, table ob njej pa ga tematsko

Slika 6: Programska shema.

Slika 5: Konceptni tloris in prerez urbanega detalja.

Slika 7: Urbana oprema.

dopolnjujejo. Vodni motiv ob sredini poti prezentira bivšo vodno cisterno, historično najdbo, žal odstranjeno zaradi gradnje garažne hiše. Ostale historične najdbe so prezentirane v tlaku.

Magistrska naloga je bila javnosti v Kopru, decembra 2019 predstavljena na otvoritvi razstave Imaginarno ki vključuje 32 diplomskih in magistrskih del na temo koprskе arhitekture in urbanizma in predstavlja le del mozaika v morju urbanih idej, že, ali v bodoče ustvarjenih z namenom skupnega preoblikovanja in ustvarjanja trajnostnejšega in odpornejšega mesta.

ABSTRACT

The historic city center of Koper has been, due to its urban and program transformations during the last few years, losing its recognizable design of a medieval island town. The city is becoming demographically empty and is exposed to physical and social degradation, and is in an urgent need of a new urban plan. The purpose of the master's thesis is to prepare the conceptual design of Koper's re-urbanization by focusing on the northern periphery of the city, the Belveder area, with the emphasis on complying with the opinion of Koper's inhabitants as well as architects, urban planners and other experts in this field of work.

Ana Mestnik: SONARAVNI UKREPI V NAČRTOVANJU RABE PROSTORA ZA ZMANJŠANJE EROZIJSKE NEVARNOSTI NA POPLAVNIH OBMOČJIH SUSTAINABLE MEASURES IN LAND USE PLANNING TO REDUCE THE EROSION HAZARD ON FLOODPLAIN AREAS

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MASTER THESIS

AVTOR AUTHOR

Ana Mestnik

TIP ZAKLJUČNEGA DELA TYPE OF THESIS

magistrska naloga

MENTOR MENTOR

prof. dr. Franc Steinman, univ. dipl. inž. grad.;
doc. dr. Gašper Rak, univ. dipl. inž. vod. in kom. inž.

LETO YEAR

2020

INŠTITUCIJA INSTITUTION

Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo

GRADIVO PRIPRAVILA MATERIALS PREPARED BY

Ana Mestnik, mag. prost. načrt.

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MESTNIK, Ana. Sonaravni ukrepi v načrtovanju rabe prostora za zmanjšanje erozijske nevarnosti na poplavnih območjih. Magistrsko delo, Ljubljana, Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo: 65 f. [COBISS.SI-ID 28604675]

Slika 1: Visokovodni dogodek v Šoštanju novembra 2012 (Vir: GIS, 2019).

VSEBINA

Prostor se zaradi družbenih in gospodarskih potreb uporabnika ter naravnih procesov ves čas spreminja. Med naravne procese sodijo tudi visokovodni dogodki s spremljajočo erozijo, ki predstavljajo grožnjo človeku ter dejavnostim v prostoru in posledično predstavljajo omejitev rabe prostora. Ker razpolaganje z vodnim in obvodnim prostorom, ki je lahko hkrati tudi poplavno ogroženo, opredeljuje niz omejitev in določil, ki umerjajo njegov razvoj, se izkaže potreba po poznavanju podatkov o vodnih zemljiščih. V okviru magistrskega dela smo podali primerjavo treh evidenc, in sicer gre za podatke zemljiškega katastra, podatke evidence dejanske rabe ter podatke vodnih zemljišč po ZV-1 (slika 2). Zaradi vsebinskih in metodoloških razlik evidenc lahko

skenemo, da parcelno stanje pogosto ne odraža dejanskega poteka vodotokov, saj je voda dinamičen element okolja, ki ga ne moremo zamejiti s parcelnimi mejami. Zato so, vse dokler ne upoštevamo lastniškega statusa, primernejši podatki, ki odražajo dejansko stanje.

Ker se vsi posegi v prostor na obvodnih zemljiščih odražajo na vodah samih, se ustreznost posegov v obvodni prostor izkaže zlasti v času visokovodnih dogodkov, saj neprimerna raba prostora poveča njegovo ranljivost. Ob visokovodnih dogodkih se pri toku vode preko poplavnih območij pojavljajo strižne napetosti. V primeru, da vrednosti strižnih napetosti presegajo mejne strižne odpornosti, pride do odnašanja in poškodb na zemljiščih. Na mejno strižno vrednost in erozijo pomembno vpliva raba tal, saj je od pokrovnosti prostora odvisna hidra-vli-

Slika 2: Prikaz neskladja med tremi evidencami vodnih zemljišč na območju Šoštanj.

Legenda

vodno zemljišče (ZV-1)	rastlinjaki
pozidana zemljišča	trajni travniki
njive in vrtovi	drevesa in grmičevje; gozd
kmetijsko zemljišče v zaraščanju; neobdelano kmetijsko zemljišče	voda
ekstenzivni sadovnjaki	zemljiški kataster

0 100 200 m

Slika 3: Vizualizacija obvodnega prostora (Vir: Mestnik, 2020).

na hrapavost. V magistrski nalogi so na podlagi evidentiranih prekoračenih vrednosti mejnih strižnih odpor-nosti prikazane vzročno-posledične zveze med rabo prostora in visokovodnimi procesi. Ključno je, da se pri načrtovanju in določitvi različnih rab prostora izbere take rabe prostora, ki povečujejo odpornost poplavno ogroženega območja. Spremembe rabe prostora vplivajo na obseg in prostorsko razporeditev območij, ki so v času visokovodnih dogodkov poplavljeni in podvrženi eroziji. Ustrezno rabo na poplavno in erozijsko ogroženem območju uvrščamo med sonaravne ukrepe. Odločitev o izbiri sonaravnih ukrepov izhaja iz upoštevanja ideologije trajnostnega razvoja prostora, ki jo podpira ZUreP-2, saj poleg hidravlične izpolnjujejo tudi ekološko funkcijo.

Izhajali smo iz primarnega cilja magistrskega dela, da lahko s sonaravnimi ukrepi zmanjšamo škodo na poplavno ogroženem območju. Nujnost ukrepov, predstavljenih v treh scenarijih, temelji na poplavni in erozijski nevarnosti obravnavanega območja med Šoštanjem, Metlečami in Pohrastnikom, kjer se nizajo različne rabe tal. V obstoječi rabi prevladujejo njivske površine in trajni travniki (slika 4), ki ne zagotavljajo zadostne odpornosti podlage, da bi ta pripomogla k zaviranju erozije (slika 5).

Planiranje rabe obvodnega prostora mora biti premišljeno in skladno z veljavnimi predpisi. V magistrskem delu smo na podlagi razvojnih scenarijev predvideli celovito ureditev obvodnega prostora, ki je dopolnjena s sonaravnimi ukrepi, ki ne bremenijo okolja, izboljšujejo zadrževalno sposobnost območja ter soustvarjajo sistem zelenih površin. Razvoj obvodnega prostora pripomore k njegovemu oživljanju. Urejene zelene površine pomembno vplivajo na kakovostnejše bivanje (slika 3), zato je na območju Šoštanja, ki sta ga močno zaznamovali industrija in energetika, razvoj zelenega sistema izrednega pomena, saj predstavlja protiutež industriji in zagotavlja kvalitetnejše bivalno okolje.

Pokazali smo, kako lahko s smotrnim načrtovanjem rabe prostora in upoštevanjem veljavne zakonodaje blažimo posledice visokovodnih dogodkov, ki so stohastični. Ker vključevanje sonaravnih ukrepov v prostorsko načrtovanje omogoča optimalno ravnoesje med socialno-ekonomskimi funkcijami prostora, ki podpirajo njegov razvoj, in varovanjem okolja, lahko trdimo, da so ti sodobnost urejanja voda in obvodnega prostora.

ABSTRACT

Spatial planning is one of the non-structural flood protection measures. Land use together with water flow properties influences the shear stresses that occur when water flows through floodplain areas during the high water events. Erosion occurs when the value of the shear stresses exceed limits of the shear resistance. The key is to choose uses, which are more resistant to water erosion. The selection and change of land use are classified as sustainable measures because, in addition to the hydraulic function, they also include an environmental function. Consideration of the environmental aspect in the process of spatial planning follows the objectives of sustainable spatial development.

Slika 4: Dejanska raba na območju razredov poplavne nevarnosti.

Slika 5: Prikaz erozijskih nevarnost na obravnavanem območju.

Klemen Beličič: PREDLOG REGIONALNE ZASNOVE PROSTORSKEGA RAZVOJA TURIZMA NA PRIMERU BELE KRAJINE

PROPOSAL FOR A REGIONAL SPATIAL DEVELOPMENT CONCEPT FOR TOURISM IN THE CASE OF BELA KRAJINA

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DIPLOMA

MASTER THESIS

AVTOR *AUTHOR*

Klemen Beličič

TIP ZAKLJUČNEGA DELA *TYPE OF THESIS*

magistrska naloga

MENTOR *MENTOR*

doc. dr. Alma Zavodnik Lamovšek

doc. dr. Gregor Čok

LETO *YEAR*

2020

INŠTITUCIJA *INSTITUTION*

Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo

GRADIVO PRIPRAVIL *MATERIALS PREPARED BY*

Klemen Beličič, mag. prost. načrt.

COBISS Slovene Co-operative Online Bibliographic System and Services

BELIČIČ, Klemen. Predlog regionalne zasnove prostorskega razvoja turizma na primeru Bele krajine. Magistrsko delo, Ljubljana, Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo: 148 f.

VSEBINA

Turizem predstavlja pomembno gospodarsko dejavnost in je pomemben dejavnik regionalnega razvoja.

Ob opazni rasti turizma v Sloveniji in obravnavani regiji Beli krajini (grafikon 1) lahko trajnostni prostorski razvoj turizma dosežemo le z usklajenim načrtovanjem dejavnosti v prostoru. Strategija razvoja turizma v destinaciji Bela krajina je že bila izdelana v letu 2017, vendar ne obsega prostorske komponente razvoja turizma. Obstoječ dokument smo upoštevali, dodali številne druge analize ter izdelali lasten predlog prostorskega razvoja turizma na primeru Bele krajine.

Grafikon 1: Gibanje števila prenočitev turistov v Beli krajini za obdobje med leti 2008 in 2017 (SURSTAT, 2017).

V delu smo proučili normativna izhodišča, ki so obsegala pregled prostorske zakonodaje, strateških dokumentov (iz področja turizma in prostora na različnih ravneh) ter prostorskih načrtov. Izvedli smo prostorsko analizo regije, ki je obsegala analizo lokacije, naravnih značilnosti (podnebje, geologija, površje, rastlinstvo, prst, živali, vode in območje varovanja narave), družbenih značilnosti (poselitve, prebivalstva, gospodarstva, zgodovine, kulturne dediščine) in gospodarske javne infrastrukture.

Slika 1: Členitev Bele krajine iz vidika turističnega razvoja.

V analizi turizma smo proučili turistični obisk, znamenitosti, turistične produkte, organiziranost turizma v regiji, izzive in probleme, usmeritve za razvoj, turistične poti, športno in kongresno infrastrukturo ter prireditve. Izvedli smo polstrukturirane intervjuje s šestimi belokranjskimi turističnimi ponudniki in tremi institucijami, ki delujejo na področju turizma. Izdelali smo členitev prostora Bele krajine na enote, ki smo jih poimenovali doživetja (slika 1). Doživetje predstavlja sklop aktivnosti, ki jih turist lahko doživi ob obisku destinacije.

Na podlagi zbranih podatkov, mnenj in analiz smo izvedli SWOT analizo ter opredelili štiri strateške cilje:

Slika 2: Variantni koncepti prostorskega razvoja turizma Bele krajine.

Slika 3: Zasnova prostorskega razvoja turizma v Beli krajini.

S prostorsko in funkcionalno povezanostjo se obiskovalcem Bele krajine omogoči, da doživijo **štiri sklope doživetij** – kulturna doživetja, doživetja v naravi, kulinarčna in vinska doživetja ter doživetja na in ob Kolpi.

Bela krajina se razvije v **butično destinacijo primerno za individualne goste** z večjo kupno močjo. Razvoj v smeri butičnosti se opre na notranje potenciale regije, ki jih predstavljajo dobro ohranjena narava, naravni viri in bogata kulturna dediščina.

Prepreči se razvoj masovnega turizma ob reki Kolpi ter razvija turizem enakomerno in razpršeno po celotnem območju Bele krajine. Kljub razpršenemu razvoju Črnomelj, Metlika in Semič predstavljajo središča turističnega razvoja z večjim številom prenočitvenih kapacitet, turističnih in drugih storitev.

Prepreči se sezonskost turizma v destinaciji ter z raznoliko turistično ponudbo privabi goste tudi v hladnejši polovici leta.

Kot podlago za razvoj smo določili sintezni koncept, ki udejanja prednosti treh možnih scenarijev razvoja (slika 2). Os razvoja predstavlja pas ob reki in reka Kolpa z vso turistično ponudbo. Poleg tega se razvijajo tri večja središča, ki z večjim številom prenočitvenih kapacitet in dostopnostjo predstavljajo izhodišče za odkrivanje Bele krajine. Razvija se več manjših naselij in posameznih lokacij turističnih zanimivosti razporejenih po celotnem območju regije. S tem se prepreči prevelik pritisk turizma na območje ob reki Kolpi, izkoristi se infrastrukturno opremljenost in kulturni potencial Črnomlja, Metlike in Semiča ter omogoči razvoj turistične dejavnosti tudi na preostalih manj razvitih in slabše poseljenih območjih. Pri udejanjanju koncepta igra pomembno vlogo dobra povezanost med kraji in turističnimi ponudniki ter skupen nastop na trgu in promocija destinacije kot celote. Končni rezultat magistrske naloge je karta zasnove prostorskega razvoja v Beli krajini (slika 3) in 19 ukrepov

(preglednica 1). Zasnova določa pet vrst središč, obstoječo in predvideno točkovno in linijsko (turistično) infrastrukturo ter območja posebnega razvoja.

Rezultat magistrskega dela je predlog izdelave dela regionalnega prostorskega načrta na področju turizma, ki ga bodo v prihodnosti glede na veljavno zakonodajo morale izdelati slovenske regije.

ABSTRACT

The tourism development strategy of Bela krajina was already made in 2017, but does not include the spatial component of tourism development, which we included in our proposal of the regional concept of tourism development for region. In the master thesis, we analyzed spatial and other strategic documents. We carried out a spatial analysis and the analysis of tourism. Based on the previously mentioned analysis, we defined four strategic goals, a synthesis concept and finally created a map of the concept of spatial development in Bela krajina and 19 measures. The master thesis represents the concept of preparing a part of the regional spatial plan, which will have to be done by Slovenian regions in the future according to the legislation.

Preglednica 1: Ukrepi

Strateški cilj	Ukrep
CILJ 1: S prostorsko in funkcionalno povezano stjo se obiskovalcem Bele krajine omogoči, da doživijo štiri sklope doživetij – kulturna doživetja, doživetja v naravi, kulinarična in vinska doživetja ter doživetja na in ob Kolpi.	<ul style="list-style-type: none"> ■ UKREP 1: Raznoliko ponudbo različnih turističnih ponudnikov se povezuje in združuje v turistične pakete. ■ UKREP 2: Vzdržuje se obstoječe kolesarske poti in se jih enotno označi. ■ UKREP 3: Vzpostavi se nove kolesarske poti na odseku Črnomelj – Stranska vas ter kolesarske poti Črnomelj – Vinica po progi nekdanje nerealizirane železniške proge Črnomelj – Vrbovsko. ■ UKREP 4: Vzpostavi se mreže električnih koles po celotni Beli krajini. ■ UKREP 5: Vzpostavi se linijo avtobusnega prevoza, ki povezuje tri večja središča in središča za doživetja na in ob reki Kolpi. ■ UKREP 6: V središčih vinskih doživetij se uredi zidanice za namen prenočevanja turistov. Prouči se možnost vzpostavitve razpršenega hotela v zidanicah. ■ UKREP 7: V Rodinah, Stražnjem vrhu in Mavrlenu se za namene turizma ponudi gostom vinsko doživetje bodisi na turističnih kmetijah, vinotočih ali v vinskih kletih.
CILJ 2: Bela krajina se razvije v butično destinacijo primerno za individualne goste z večjo kupno močjo. Razvoj v smeri butičnosti se opre na notranje potenciale regije, ki jih predstavljajo dobro ohranjena narava, naravni viri in bogata kulturna dediščina.	<ul style="list-style-type: none"> ■ UKREP 8: Obnovi se grad Gradac in vanj umesti prestižni hotel ali drugo obliko nastanitve. V okolici gradu se uredi tudi manjše golf igrišče. ■ UKREP 9: Obnovi in revitalizira se stara mestna središča Metlike in Črnomlja. Revitalizacija vključuje tudi umestitev novih storitev in gastronomske ponudbe za zahtevnejše goste. ■ UKREP 10: V Grdunih in Starem trgu se vzpostavi vstopni točki za obisk KP Kolpa. V Starem trgu se uredi manjše informacijsko središče. V Grdunih se uredi glavno informacijsko središče in umesti upravo parka.
CILJ 3: Prepreči se razvoj masovnega turizma ob reki Kolpi ter razvija turizem enakomerno in razpršeno po celotnem območju Bele krajine. Kljub razpršenemu razvoju Črnomelj, Metlika in Semič predstavljajo središča turističnega razvoja z večjim številom prenočitvenih kapacitet, turističnih in drugih storitev.	<ul style="list-style-type: none"> ■ UKREP 11: Izvaja se nadzor nad turističnim obiskom ter preprečevanje pretiranega obiska določenih lokacij ob Kolpi v poletnih mesecih. V ta namen se izdela študija nosilnih zmogljivosti s poudarkom na območju reke Kolpe. V študiji se opredelijo ukrepi za omejevanje obiska. ■ UKREP 12: Sprejme se že izdelan plovni režim za reko Kolpo. ■ UKREP 13: Uredi se hotel v obstoječem objektu v Črnomlju. ■ UKREP 14: Uredi se kanalizacijsko omrežje in čiščenje odpadne vode na čistilnih napravah, prednostno v naseljih Učakovci, Preloka, Marindol in Dobljče.
CILJ 4: Prepreči se sezonskost turizma v destinaciji ter z raznoliko turistično ponudbo privabi goste tudi v hladnejši polovici leta.	<ul style="list-style-type: none"> ■ UKREP 15: Na smučišču Gače se uredi proge za gorsko kolesarjenje in vzpostavi center za servis in izposajo koles. ■ UKREP 15: Izgradi se vsaj eden od predvidenih termalnih kompleksov, bodisi v Božakovem ali v Šipku pri Dragatušu.
Drugi ukrepi	<ul style="list-style-type: none"> ■ UKREP 16: Omogočijo se lažje dostopni in bolj pogosti poleti za turistične namene z letali na letališču Prilozje. ■ UKREP 17: Za namene turizma se uredi kočevske vasi Komarna vas, Brezovica, Grčice in Planina. ■ UKREP 18: Uredi se vstopna in izstopna mesta za čolne na rekah Lahinji, Dobljčici in Krupi ter vzpostavi storitev za izposajo v naseljih v bližini omejenih vodotokov. ■ UKREP 19: Uredi se kopališče na reki Lahinji v Črnomlju.

VI.

SEZNAM AVTORJEV

LIST OF CONTRIBUTORS

LIST OF CONTRIBUTORS

UVODNIK EDITORIAL

Assoc. Prof. Dr. **Alenka Fikfak**
University of Ljubljana, Faculty of Architecture,
Zoisova 12, 1000 Ljubljana, Slovenia
e-mail: alenka.fikfak@fa.uni-lj.si
phone: +386 (1) 2000 775

Prevod: Nuša Klinc

Špela Verovšek

University of Ljubljana, Faculty of Architecture, Slovenia
Zoisova cesta 12, SI - 1000 Ljubljana
e-mail: spela.verovsek@fa.uni-lj.si

Gregor Čok,

University of Ljubljana, Faculty of Civil and geodetic Engineering,
Slovenia
Jamova 2, SI-1000 Ljubljana
e-mail: gregor.cok@fgg.uni-lj.si

ČLANKI ARTICLES

Jernej Červek

Ulica Angelse Hlebce 1D, 4000 Kranj, Slovenia
e-mail: jernej.cervek@gmail.com

Kristijan Lavtižar

University of Ljubljana, Faculty of Architecture, Slovenia
Zoisova 12, 1000 Ljubljana, Slovenia
e-mail: kristijan.lavtizar@fa.uni-lj.si

Martina Zbašnik-Senegačnik

Faculty of Architecture, University of Ljubljana, Slovenia
Zoisova 12, 1000 Ljubljana, Slovenia
e-mail: martina.zbasnik@fa.uni-lj.si

Ljudmila Koprivec

Faculty of Architecture, University of Ljubljana, Slovenia
Zoisova 12, 1000 Ljubljana, Slovenia
e-mail: ljudmila.koprivec@fa.uni-lj.si
phone: +386 1 2000 746

Md. Nazmul Haque

Department Of Urban And Regional Planning, Khulna University
Of Engineering & Technology, Khulna, Bangladesh
Room-208, Urp Building, Kuet, Khulna-9203
e-mail: nhaque13@urp.kuet.ac.bd
phone: +8801681934283

Sharmin Siddika

Undergraduate Student, Department Of Urban And Regional
Planning, Khulna University Of Engineering & Technology,
Khulna, Bangladesh
E-mail: ananya9601@gmail.com

Mizbah Ahmed Sresto

Undergraduate Student, Department Of Urban And Regional
Planning, Khulna University Of Engineering & Technology,
Khulna, Bangladesh
e-mail: mizbahahmed05@gmail.com

Jaka Veber

University of Ljubljana, Faculty of Architecture, Slovenia
Zoisova 12, 1000 Ljubljana, Slovenia
e-mail: veber.jaka@gmail.com

Gašper Mrak

University of Ljubljana, Faculty of Civil and geodetic Engineering,
Slovenia
Jamova 2, SI-1000 Ljubljana
e-mail: gasper.mrak@fgg.uni-lj.si

Znanstvena revija, št. 8 / leto 2020
Univerza v Ljubljani
Fakulteta za arhitekturo in
Fakulteta za gradbeništvo in geodezijo
Ljubljana, 2020

Scientific journal, No 8 / Year 2020
University of Ljubljana
Faculty of Architecture and
Faculty of Civil and Geodetic Engineering
Ljubljana, 2020

Naslov revije: Title of the Journal:

IGRA USTVARJALNOSTI THE CREATIVITY GAME
teorija in praksa urejanja prostora Theory and Practice of Spatial Planning

Urednici: Alenka Fikfak, Alma Zavodnik Lamovšek Editors: Alenka Fikfak, Alma Zavodnik Lamovšek

Oblikovanje in naslovnica: Gašper Mrak Design and Title page: Gašper Mrak
Lektoriranje: Mojca Vilfan Slovene text proofread by: Mojca Vilfan
Prevod: Mojca Vilfan Translation: Mojca Vilfan
Klasifikacija: (UDK) Renata Stella Čop, (DOI) Teja Koler Povh Classification: (UDK) Renata Stella Čop, (DOI) Teja Koler Povh

Založila: Univerza v Ljubljani, Published by: University of Ljubljana,
Fakulteta za arhitekturo in Faculty of Architecture and
Fakulteta za gradbeništvo in geodezijo Faculty of Civil and Geodetic Engineering

Spletna stran revije: Journal's Web Page:
<https://www.iu-cg.org/> <https://www.iu-cg.org/en/>

Spletna stran številke Current Issue Link
<https://www.iu-cg.org/stevilka.php?vol=8&lang=si> <https://www.iu-cg.org/stevilka.php?vol=8&lang=en>

DOI ISSN
<https://dx.doi.org/10.15292/IU-CG.2020.08> ISSN 2350-3637

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Univerza v Ljubljani
Fakulteta *za arhitekturo*

Univerza v Ljubljani
Fakulteta *za gradbeništvo in geodezijo*

Revijo je sofinancirala
Javna agencija za
raziskovalno dejavnost RS.

The journal is financially
supported by the Slovenian
Research Agency