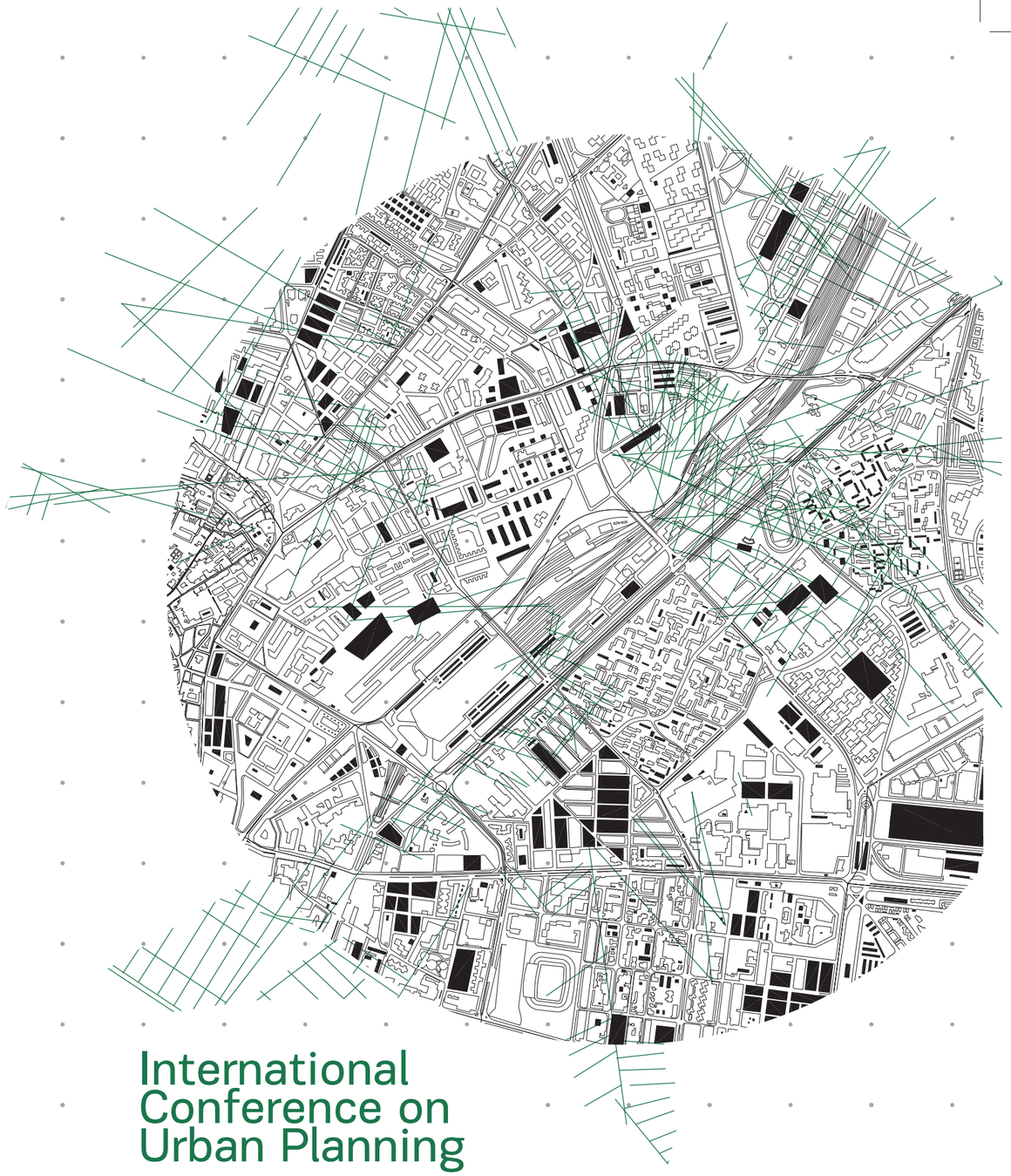
ICUP2025



International Conference on Urban Planning

ICUP2025

PROCEEDINGS

Serbia, Niš, April 10-11, 2025

urban planning cluster niš



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International Conference on Urban Planning
ISSN 2738-0548

5th International Conference on Urban Planning - **ICUP2025**

Publisher
Urban Planning Cluster Niš
For Publisher
Miljana Ignjatović

Editor
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Text formatting, prepress and cover
Anđela Stevčić
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Vojislav Nikolić, PhD

ISBN-978-86-907796-0-4
Circulation
50 copies
Printing
Overprint Niš

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

711.4(082)(0.034.2)

INTERNATIONAL Conference on Urban Planning (5 ; 2025 ; Niš)
Proceedings [Elektronski izvor] / [5th] International Conference on Urban Planning - ICUP2025, Niš, April 10-11, 2025. ; [organized by Urban Planning Cluster, Nis] ; [editor Mladen Šoškić]. - Niš : Urban Planning Cluster Niš, 2025 (Niš : Overprint Niš). - 1 USB fleš memorija ; 6 x 2 x 1 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovne strane dokumenta. - Tiraž 50. - Foreword / Mladen Šoškić. - Napomene i bibliografske reference uz tekst. - Bibliografija uz svaki rad.

ISBN 978-86-907796-0-4

a) Урбанистичко планирање -- Зборници

COBISS.SR-ID 169886729

5th International Conference on Urban Planning - **ICUP2025**

Organized by
Urban Planning Cluster, Nis



Co-organizers
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Faculty of Economics of the University of Niš
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FOREWORD

The Fifth International Conference on Urban Planning – ICUP2025 continues the tradition of bringing together experts, researchers, academics, and professionals. The conference is conceived as a platform for interdisciplinary dialogue, emphasizing the importance of integrated approaches to planning and shaping sustainable, inclusive, and human-centered urban environments.

Urban planning today transcends traditional disciplinary boundaries. It is increasingly connected with information technology, environmental science, geoinformatics, economics, sociology, public health, and political science. This interdisciplinary nature reflects the complexity of contemporary urban challenges and the need for collaborative approaches in addressing them.

ICUP2025 includes 61 peer-reviewed papers from authors representing 25 institutions across 12 countries: Serbia, North Macedonia, Bosnia and Herzegovina, Croatia, Bulgaria, Romania, Spain, Germany, the United States (Florida), Malaysia, Nigeria, and Mozambique. Contributions come from a broad spectrum of academic and professional fields, and include most major universities in Serbia—Niš, Belgrade, Novi Sad, and Novi Pazar. This wide geographic and institutional representation underlines the relevance and global reach of the conference.

The central theme, "People-Centered Urban Landscapes: Planning, Designing, and Building for Humanity," reflects the conference's dedication to promoting urban environments that not only fulfill functional needs, but also support social well-being, equity, and sustainability. The topics addressed in the papers span a range of issues, including nature-based solutions, climate change mitigation, heritage preservation, technological innovation, social inclusion, and regulatory frameworks.

The papers included in this Book of Proceedings provide valuable insights into both theoretical and practical aspects of contemporary urban planning. The contributions reflect current trends, challenges, and solutions, and are expected to serve as a basis for further academic research and professional development in the field.

Mladen Šoškić, PhD, Associate Professor,
Faculty of Civil Engineering, University of Belgrade
Chairman of the Scientific Program Committee


infrastructure









Lecture Summaries

This section presents a summary of five lectures delivered by leading international experts, each addressing a key subtopic of the conference. Through diverse disciplinary lenses and geographic contexts, the speakers explored innovative approaches to urban transformation, reflecting on how we monitor, design, manage, and reimagine our cities for a more inclusive and sustainable future.

CLAUDIA VAN DER LAAG-YAMU

Why Central Locations Matter for Urban Well-being
Conference Subtopic: 1. Monitoring, Evaluation and Urban Data
Professor van der Laag-Yamu's lecture focused on how the spatial structure of cities shapes urban life and social equity. By applying the Space Syntax methodology, she explored how spatial analysis tools help us understand movement, accessibility, and social connectivity. Her research highlights the value of central locations and how data-driven evaluations can inform urban design that fosters well-being. Her contribution offered a clear example of how monitoring and spatial data can guide more inclusive and evidence-based planning.

JOSE PINTO DUARTE

Computer-Aided Urban Planning and Design: From Formulation to Optimization
Conference Subtopic: 2. Trending in Architecture – Towards a Sustainable Future
Professor Duarte introduced a computational approach to urban design, showcasing how digital tools can derive rules from architectural precedents and apply them at multiple scales—from single buildings to entire urban areas. He also discussed the integration of 3D printing technologies in sustainable housing, emphasizing scalable, adaptable, and resource-efficient solutions. His work exemplifies how architecture and technology converge to support innovation and sustainability in the built environment.

WENDY GUAN ZHEN TAN

Beyond the Plan: Strategic Innovations in Managing Public Space
Conference Subtopic: 3. Planning and Management of Public Spaces
In her lecture, Wendy Tan addressed the crucial, often overlooked aspect of urban development: the long-term management of public space. Drawing on the Dutch context, she emphasized the need for strategic teams and governance structures that go beyond physical planning. She posed fundamental questions around values such as democracy, legitimacy, and adaptability, inviting participants to rethink the dynamics of shared urban environments. Her presentation directly engaged with the challenge of maintaining quality, resilience, and inclusivity in public space.

ALI A. ALRAOUF

The POST Condition and the Inevitability of Creativity: A Critical Tale of Three Buildings and One City
Conference Subtopic: 4. Education of Future Experts Creating for Humanity
Professor Alraouf explored the intersection of architectural meaning, heritage, and identity. Through case studies from Doha, he argued for an educational approach that encourages future architects to engage critically and creatively with history and context. His lecture championed a model of architectural education and practice that is responsive to cultural transformation and rooted in humanistic values—calling for design that is as thoughtful as it is innovative.

OGNEN MARINA

People Driven Urban Development – From Brain Drain to Brain Gain Cities
Conference Subtopic: 5. Youth as Drivers of Innovation for Cities of the Future
Ognen Marina tackled the pressing issue of youth emigration in smaller cities, using Bitola as a case study. He stressed the importance of designing cities that recognize and empower young people as catalysts for innovation and regeneration. His lecture advocated for participatory, people-driven planning that creates opportunities for young professionals—not only to stay, but to return and invest in their hometowns. His insights aligned strongly with the theme of youth-led transformation and urban renewal.















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Workshop QoL Summary

MEASURING QUALITY OF LIFE IN CITIES IN SERBIA AND IN THE BALKAN REGION

KEY WORKSHOP TAKEAWAYS

On 10 April 2025, the Quality of Life Initiative by UN-Habitat, together with the Ministry of Construction, Transport and Infrastructure of the Government of Serbia, organized a workshop on Measuring Quality of Life in Cities in Serbia and in the Balkan Region. The event took place on the margins of the 5th International Conference on Urban Planning (ICUP) by the Urban Planning Cluster. The objectives of the workshop were centered around the changing nature of quality of life in Serbia and the Balkan region and the ways to measure it, and corresponded to this year's theme of the ICUP – People-Centered Urban Landscapes: Planning, Designing, and Building for Humanity.

Session 1. Urban Development Dynamics in Serbia and the Balkan Region addressed key trends and challenges shaping urban development in Serbia, the Balkan region, and beyond (in the Marmara Region, Turkey). Participants representing the Agency for Spatial and Urban Planning of the Republic of Serbia, the World Bank, and the Local Academy in Turkey highlighted converging trends across these regions: depopulation, population aging, migration to larger cities, and gentrification; as well as the importance of preserving cultural identity, strengthening climate resilience through legislation, and increasing civic participation—especially among vulnerable groups—in planning policy and practice. Legalizing informal settlements and enhancing housing quality were also noted as priorities. A shift in focus from measuring supply and demand ("the quantity") to the quality of life in measurement was also flagged. Regarding the barriers to effective urban policy implementation, participants identified limited local capacities, lack of political coordination, an overabundance of externally driven projects, and the absence of reliable, disaggregated data and institutional capacity to act upon it.

The second session, Measuring Quality of Life Using the Global Index, enriched the discussion by providing insights into the global Quality of Life Initiative by UN-Habitat and its key value proposition – an innovative self-assessment tool, the Index, to measure quality of life – as well as lessons learned from piloting this Index in Niš. The session revealed that the Index was developed based on the city's Voluntary Local Review (VLR), allowing for deeper reflection on local development priorities and addressing data gaps while engaging multisectoral stakeholders through a local workshop. The workshop, in turn, provided locally

relevant insights beyond formal datasets, making the VLR results more reflective of the city's challenges and priorities. In summary, despite limited data availability, Niš leveraged VLR findings and involved knowledgeable local actors to contextualize the Index. This effort coincided with the establishment of the city's first monitoring system (also being the first of its kind in Serbia), which aims to enhance long-term policy evaluation and planning capacity.

The final session, Scaling Up the Quality of Life Initiative, explored the broader application of the Quality of Life Index in Serbia, the Balkan region, and beyond. Cities highlighted their motivation to join the Initiative – to gain access to better tools and data for understanding resident well-being, including perceptions of safety and belonging. Factors supporting the scale-up of the Initiative were also discussed. In particular, this requires strong institutional support, better organization of existing data, financial investment, and capacity-building, particularly in digital literacy. Alignment with the Sustainable Development Goals (SDGs) enhances relevance, while combining objective indicators with subjective well-being data ensures a more comprehensive picture. Multi-stakeholder partnerships and coordinated support from the UN system were emphasized as critical to fostering learning, replicability, and local ownership of the Initiative.

In summary, the workshop reaffirmed that people-centered, data-informed urban planning is essential for improving quality of life. The Quality of Life Initiative provides cities in Serbia and the Balkan region with practical tools to build more inclusive, sustainable, and responsive urban environments, grounded in both global frameworks and local realities, while ensuring progress towards meeting global goals.

The Quality of Life Initiative is sponsored by the Quality of Life Program

Workshop SDG Summary







With fewer than five years remaining to achieve the 2030 Agenda, the SDG Localization Workshop, organized in the framework of the 5th International Conference on Urban Planning (ICUP 2025) in Niš, Serbia, brought together national and local authorities, international organizations, and development partners to explore how local governments can move from planning and reporting to impactful implementation of the Sustainable Development Goals (SDGs).

The event emphasized that local governments are central to the realization of the SDGs, acting as the bridge between global aspirations and local realities. Through Voluntary Local Reviews (VLRs), cities and municipalities have demonstrated leadership in tracking progress and shaping their development pathways. However, discussions stressed that VLRs must evolve beyond diagnostic tools and become instruments for action, guiding investment, policymaking, and multi-stakeholder engagement.

Keynote presentations and interventions from UNRCO, UN-Habitat, UNEP, GIZ, Public Policies Secretariat, Ministry of Construction, Transport and Infrastructure, the Standing Conference of Towns and Municipalities, and the National Agency for Spatial and Urban Planning highlighted global approaches, regional progress, and actionable insights. UN-Habitat's presentation underscored the role of VLRs as part of a continuous cycle, where monitoring informs action and action feeds back into more refined strategies. It also emphasized the importance of multilevel governance, aligning local and national efforts to enhance coherence, collaboration, and SDG ownership. UNEP's intervention zoomed into the environmental dimension of the 2030 Agenda and provided useful insights into the analyzed gaps and challenges at the local level. It also provided recommendations for further action at local level to be supported by the UN and other development partners.

A central theme that emerged during the panel discussion was the need to build both human and financial capacities at the local level. While several Local Self-Governments (LSGs) in Serbia have already made progress in data monitoring, there is still a gap in aligning these efforts with the SDGs. Municipalities like Kruševac, Leskovac, and Novi Sad shared concrete examples of local initiatives and challenges in operationalizing their SDG commitments. VLRs represent the precious support for LSGs to improve evidence-based planning for Local

Development Plans and General Urban Plans, and to establish continuous monitoring at the local level in order to have better action-oriented planning proposals for implementation. In addition, it has been highlighted that it is essential to simplify and align local development planning processes with the localization of the 2030 Agenda. Rather than treating the SDGs localization as an additional task, the implementation and monitoring of SDGs should be integrated into existing legally mandated local development plans and reporting mechanisms.

Participants echoed the importance of inclusive stakeholder engagement, calling for stronger partnerships with civil society, academia, and the private sector. The workshop also touched on the need for innovative financing to scale up local SDG actions, ensuring that political will is matched with the resources needed for transformative change.

In conclusion, the session reinforced the message that localizing the SDGs is not an option—it is a necessity. Through integrated planning, stronger governance, and coordinated implementation, local governments can turn VLRs into tools for systemic, sustainable, and community-driven transformation. The workshop served as a vital step in strengthening Serbia's commitment to SDG localization and promoting a bottom-up approach to sustainable development.













Panel Summary

PANEL 1: URBAN GREEN SPACES: CHALLENGES, OPPORTUNITIES, AND SUSTAINABLE SOLUTIONS

Moderator:

- Ana Mitić-Radulović, Center for Experiments in Urban Studies (CEUS)

Panelists:

- Miljana Medarov Vujaklija, Head of the Monitoring Section, Planning Department of the City of Niš
- Jovana Antić, Department of Urban Inspection, Ministry of Construction, Transport, and Infrastructure
- Vesna Šabanović, Head of the Sector for Strategic Planning, Project Management, and Climate Change, Secretariat for Environmental Protection, City of Belgrade
- Michael Engel, Social and Climate-Responsive Urban Development Initiative, GIZ Serbia

The Adaptation Program to Changed Climate Conditions of the Republic of Serbia clearly states that temperatures in our cities will rise intensively, as Serbia is warming more and faster than the global average. While the observed increase in global average temperature is 1.1°C, Serbia has already warmed by 1.8°C compared to the pre-industrial period, and in summer by as much as 2.6°C, which poses a significant risk to safety and public health, especially in urban areas.

Expert studies show that our urban planning practices do not align with these scientific facts or population trends. In most cities in Serbia, construction areas are expanding while the number of residents is declining. This expansion and urban densification through intensive construction mainly result in more sealed surfaces, which further contribute to the urban heat island effect. In summer, temperatures above heated asphalt can be 10°C higher than above bare ground, and even 20°C higher than above grass, in the shade. Another issue is urban flooding, as there is no longer free land for water to drain after heavy rainfall.

In such planning approaches, green infrastructure is often viewed as a decorative element, neglecting the fact that natural elements in the city and biodiversity are becoming a critical and necessary primary infrastructure for adaptation to changing climate conditions.

Challenges, opportunities, and proposed solutions in the context of urban green space planning were discussed from various perspectives to better understand and address this complex, sensitive, and important issue.

Miljana Medarov Vujaklija, Head of the Monitoring Section from the Planning Department of Niš, highlighted some of the challenges facing the City of Niš amid the climate crisis. She pointed out that current plans propose proportionally fewer green spaces than before, and less than what is needed. However, she also suggested some tools that could aid urban planning, such as continuous monitoring of spatial changes, constructive collaboration with public utility companies, and innovative public policy solutions.

Jovana Antić from the Department of Urban Inspection of the Ministry of Construction, Transport, and Infrastructure shared an urban inspector's perspective on the situation on the ground in Niš, Leskovac, and Vranje, addressing challenges in monitoring the implementation of urban plans and

spatial changes. She also noted that local governments have responded well to urban inspection reports, leading to positive changes in permitting practices in certain municipalities.

Vesna Šabanović, Head of the Sector for Strategic Planning, Project Management, and Climate Change of the Secretariat of Environmental Protection of the City of Belgrade, presented the Green Infrastructure Strategy of the City of Belgrade, explaining the broad participatory process behind its creation and the plans for its implementation.

Michael Engel, representing the Social and Climate-Responsive Urban Development Initiative of GIZ Serbia, emphasized the importance of social inclusion, well-being, and an integrated approach to urban development.

The key conclusion is that a change in approach to land ownership and land use is necessary. Regulations should address public green spaces, but also greenery on private land and green areas within spaces designated for other purposes, to adequately assess and utilize the potential of green infrastructure.

Green infrastructure is not just a municipal service - it provides essential ecosystem services amid the climate crisis, biodiversity crisis, and environmental pollution crisis and should be valued accordingly.













Panel Summary

PANEL 2: IMPACT, OUTCOMES AND RESULTS OF THE PLANNING PROCESS

Moderator:

- Siniša Trkulja, Agency for Spatial and Urban Planning of the Republic of Serbia

Panelists:

- Agata Krause, Quality of life Initiative, UN Habitat
- Görsev Argin, Marmara Municipalities Union, Turkey
- Milena Dinić Branković, Faculty of Civil Engineering and Architecture, University of Niš
- Telman Maharramov, Localisation of SDGs, UN Habitat

Urban Planning should have an impact at the quality of life. Quality of life refers to the everyday activities and it has to be connected to the reality. Measuring quality of life through composite indicators of sustainable development goals is a pioneering work which balances between objective and subjective perception of living activities and defined goals and targets which have impact on them. The timeframe of the global Agenda 2030 is approaching and five years before 2030 preparations for the period after that year should be ongoing.

Voluntary Local Reviews are the tool which uses sustainable development indicators to monitor the level of attainment for 17 global goals. Niš is the first city in Serbia which made its Voluntary Local Review in 2024. On the other side, in the region of Marmara Sea four Voluntary Local Reviews have been made among the total number of six in Turkey. Voluntary Local Reviews have the role of raising awareness on sustainable development goals at local level and they link the best practices and sustainable development goals. They don't deal with sustainable development goals only from strategic, but also from tactic level. They should indicate positive and negative effects of activities, policies and plans at local level.

The Voluntary Local Review in Niš looks beyond its elaboration and its results should be further monitored, implemented and complemented with other topics, objectives and indicators. Additional insights on indicators is needed. It helps discovering new challenges which might be more important. It establishes monitoring of development at local level which is a necessity in Serbia.

Sixty-five per cent of Sustainable Development Goals relate to local mandates. Action oriented Voluntary Local Reviews look beyond the current timeframe of the Agenda 2030. Continuous monitoring at all levels should be established. More than 150 indicators for SDGs in Serbia are being monitored at national level currently and this is something that is constantly but slowly improving.

During the discussion the participants of the sessions were inspired and the following points came out:

Urban planners should identify the „DNA" of every city that is being planned. The DNA of Niš might be the Nišava river. It would be good to involve former mayors in planner's work. Evaluation phase in planning should help us to better identify what is coming next. Data collection is a common effort. When planning we should tend to be more simple and to look rather to golden middle solutions than to extremes. We should be aware of the moment and plan in real time, use the

recent and current work while it is not outdated. Our brain is like a planning machine which is linking past, present and future. We should look at problems and challenges from different perspectives. Ownership and partnership of projects and plans are very important. Youth and students do care for their future and for the follow up of the current work. GIS should be more used. In planning we should rather have the „yes mentality".











WORKS

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The contents of the papers presented in this publication are subject to review, but the authors are responsible for the originality and quality of their papers.

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ICUP2025
5th international conference on urban planning

PALILULA AT NIŠ: AN EXAMPLE OF OTTOMAN PUBLIC SPACE MANAGEMENT AND ITS POST-1878 REFLECTIONS

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ABSTRACT:

While the genesis of today's cities in Serbia is partially easy to follow through archaeological findings and historical narratives, smaller urban entities (districts) which have integrated and merged with those cities over time are much more difficult. The main reasons for this are: insufficient archaeological research in this direction, the fact that in the narrative smaller places are usually in the shadow of large urban centers, as well as a number of other reasons pointed out in this paper (spontaneity of settlement formation, socio-political circumstances, expansion of toponyms, etc.). Palilula in Niš is an example of an urban entity which evolved from a peripheral settlement to one of the largest municipalities in Niš in a short period of time, through Ottoman and Serbian eras. In order to better understand the development of this settlement to the format it has today, the paper analyzed the first phase of its evolution primary through the analysis of archival material of Ottoman provenience, creating a clear insight into the subsequent spatial development of the part of Niš where Palilula is located. In this way, Palilula in Niš serves as an example for a better understanding the development of urban areas in the territory of Serbia which after 1878 was known as Novi Krajevi [The New Territories].

Keywords: *Palilula, Niš; Ottoman Empire; Serbia; muhacirs; spatial planning*

1. INTRODUCTION

Until 1878, central Serbia was divided into two administrative-territorial and political entities. In the north was the Paşalık of Belgrade, i.e. Principality of Serbia (from 1830 on), and in the south the Paşalık of Niš. The differences between these two entities, apart from socio-political factors, were also influenced by the different cultures to which they were exposed – the northern part was exposed to European culture and over time spontaneously created its own dynamic of development, while the society of the Paşalık of Niš continued to function under an oriental regime just like the other parts of the Ottoman Empire.

The similarity of both parts of Serbia in this period, except when it comes to the politics and culture of living, was most obvious in the presence of numerous toponyms of Ottoman origin. Those toponyms might be classified in two groups, as those who are applied in both urban and rural areas – çifltik (ranch/farm/estate), kovanlık (beeyard), hisar (hill fort), mahalle/mala (district/quarter) etc. and those which refer exclusively to urban matrix of towns and cities developed by the Ottomans. The most numerous toponyms from this group are kale (fort, fortress) and kapı (city gates) like Stambol, Vidin, Beograd etc. which today may be met here and there as the city toponyms throughout Serbia.

The last group of toponyms also includes Palilula, of which there are at least five in Serbia (Belgrade, Kragujevac, Aleksinac, Svrljig district and Niš). Its etymology of Serbian origin[1] does not indicate the urban canon which the Ottomans practiced, hence making it quite a unique landmark name. Furthermore, among

1 'Paliula' in Serbian language is a proper noun meaning 'a place where lighting a smoking pipe (is allowed)'.

these Palilulas, the one at Niš stands out due to the circumstances in which it was created and the importance it had for the city towards which it gravitated.

2. THE URBAN CONTOUR OF OTTOMAN NIŠ IN 19TH CENTURY

By the 19th century, the urban contours of Ottoman Niš already got their permanent form. The skeleton of the city's infrastructure was laid at the beginning of the 18th century with the construction of the fortress of Niš on the right bank of the Nišava river, in the city's innermost center. This large military-administrative and residential complex stretched on roughly ~22 ha of land (Andrejević, 1996). Fortress was adjoined by two settlements on its western (Belgrade-mala) and the eastern side (Jagodin-mala). The fortress and these two settlements on the right bank of the Nišava formed the northern half of Niš, where the military capacities, the high city administration, the Muslim clergy (ulema) and the largest part of the buildings of Islamic profane and sacred architecture were concentrated. The north side of Niš was separated from the rest of the city by the river Nišava.

Judging by the preserved maps, the left (southern) half of Niš was twice as big as the northern half. It was made up of the bazaar (market) and suburban quarters located around it, some of which were ethnically and religiously homogeneous, and some of which were with heterogeneous populations. In contrast to the northern half, whose defense was made by the thick stone walls of the fortress, the defense of the southern half of Niš was made by strong and high wooden palisades, which surrounded this part of Niš in the east-west direction and closed it from the bank to the bank of Nišava. The main traffic connection between these two parts of Niš was the large city bridge on Nišava, which connected the city at the vicinity of southern gate of the Niš fortress (Stambol gate).

Life in the community that made up Niš also took place outside the security parameters described here. A network of Christian villages and çifltiks existed in the immediate and wider surroundings of the city, and peripheral non-Muslim settlements sprung up right next to the palisade of the southern half of Niš, forming community Serbian town (Srpska varoš). On this stretch, in the southeastern quadrant right outside the palisades, the most important toponym was the Church of St. Nicholas. The year of construction of this orthodox temple is not precisely known. It was rebuilt in 1722 by the bishop of Niš Joanikije (Midić, 2019). Most likely in the period after the end of the Great Turkish War (1683–1699), i.e. during the settlement of the new and the return of the dispersed native Christian population, two settlements/villages, Tapija and Prgovac, emerged in this part behind the palisade toward east (Ranđelović, 2022). Although the precise locations of both are not certain, the latter is known to have been a mixed settlement of Serbs, Jews and Roma and to have been located on the estate of the Muslim beys of the Nişli family in swampy Čair. The demographic changes of the southeastern quadrant behind the city palisades (where Palilula will be later formed), is not entirely clear after 1739. It is certain that the Church of St. Nicholas was converted into a mosque in 1739, which indicates that over time the Muslim element became present in this part of the immediate vicinity of Niš (at that time still not a part of the outskirts of the city). As this mosque/former church was abandoned by the middle of the 19th century, it is certain that even after the influx of Muslims in post-1739 period their presence in this part started to decline.

The consequences of two national anti-Ottoman uprisings of the Serbs (1804–1813, 1815–1817), a series of local Christian revolts in the Paşalık of Niš (1833–1841) and the Crimean War (1853–1856) caused major demographic changes in Niš during the first half of the 19th century. Naturally, all this reflected on the organization of the city and the way it functioned. Both Muslims and non-Muslims sought safety by settling in Niš and its outlying settlements, striving to be as close as possible to the communities to which they professedly belonged. The internal policy of the Ottoman Empire, which in the period 1839–1876 went through the process of Westernization (Tanzimat), is also linked to these external factors which reflected on Niš. One of the main principles of the Tanzimat – the equalization of the rights of all subjects, regardless of their religious and ethnic affiliation – influenced the humanization of relations in Ottoman society. The resulting emancipation of non-Muslims affected their greater economic visibility, and thus business connections with their Muslim counterparts from the classes of traders and other economic elites (Ranđelović, 2022). Thanks to this, there was a closer social and cultural mixing of the elites of both sides, which similarly descended to some extent on the lower social classes (Ranđelović, 2024). Still, in the urban positioning, it was clear that Muslims were dominant in the northern (safer) part of Niš, and Christians in the southern. However, the population did not settle so that the two sides were mutually isolated antipodes, but their neighborhoods closely touched each other, often forming mixed neighborhoods.

3. THE FORMATION OF PALILULA (1862–1864)

In the years immediately before the formation of Palilula, the city administration in Niš dealt with two major problems which were causally connected. After the end of the Crimean War (1853–1856), the European part of the Ottoman Empire (Rumelia) was flooded by thousands of Tatar and Circassian Muslim refugees (muhacirs) who sought salvation here after the Russians expelled them from the Crimea. The network of enclaves of these Crimean muhacirs was formed purposefully and strategically along the banks of the Danube, in the large cities of Rumelia and rural areas. The aim of such Ottoman plan was to provide manpower for preventing enemy to cross large Balkan rivers and block directions forseen as invading routes of Serbian army in the case of a war of the Principality of Serbia and the Ottoman Empire (Stojančević, 1983). In this regard, Tatar and Circassian villages sprung up on the Serbian-Ottoman border north of Niš, in the western parts of Paşalık of Niš, but also in the city of Niš and its surroundings (Mramor Hill). In Niš, one such settlement of the Circassians was founded in the early 1860s on the site of today's Clinical Center (Ranđelović, 2022). This problem of overpopulation in Niš, which was imported from outside, made it difficult for the local government to control the distribution of the population, and therefore the functioning of the city. The usurpations of state land by individuals and groups started to happen, as well as the formation of shanty towns and slums. All this, in addition to urban chaos, also caused unhealthy communal and sanitary conditions in the city.[2]

The problem which made this situation even more difficult was the arrival of another group of muhacirs to Niš. In Belgrade, after the Ottoman soldiers assaulted a Serbian boy at Čukur-česma, massive street clashes between the Muslim and Serbian townsfolk started to happen (1862). The conflict escalated when the Ottoman garrison from the Belgrade fortress bombarded the Serbian town (Srpska varoš) in Belgrade (Ćorović, 2004). In order to prevent this incident to turn into an open conflict between the Principality of Serbia and the Ottoman Empire, the Great Powers organized mediation conference in Kanlıca district at Constantinople, coming with a protocol which defined future relationship between the Principality of Serbia and the Ottoman Empire. According to the protocol, the Sublime Porte was obliged to demolish two of its strategically important fortresses in the Principality of Serbia (Užice and Soko), to keep its military garrisons only in Belgrade, Smederevo, Kladovo and Šabac, while the Muslim townfolk had to sell off their property and leave cities in the Principality of Serbia (Ranđelović at al., 2010). In mid-September 1862, the implementation of the Kanlıca protocol began, so the Muslims from the Principality of Serbia had to start moving out. In accordiance with that, most of the Turks from Belgrade decided to settle in in Niš (Đorđević, 1983).

Immigration of muhacirs from Belgrade to Niš was carried out from two directions and in several steps. One group went along the Danube to Vidin, and then came to Niš via Lom (November, 1862). The second group from Belgrade, due to the low water level of the Danube, had to reach Niš heading Via Militaris on foot.[3] By the end of November of the same year, there were 1,852 muhacirs from Belgrade (376 families), of which 350 expressed their desire to settle in Pirot.[4] Apart from this group of muhacirs who were sent from Niš to Pirot, the muhacirs who were fishermen were sent from Niš to the settlements on the Danube, due to the nature of their jobs and skills. The total number of Belgrade muhacirs who had to be taken care of in Niš was about 2,100 people (spring, 1863).[5]

Due to the increase of the Muslim population by almost 35% in a short period of time, the local authorities and the governor of Niš Midhat Pasha had to act quickly. As a temporary solution, the local Muslims were obliged to accept the Belgrade muhacirs in their homes, however, very soon a special committee was formed, which was in charge of permanently solving the existential problems of the muhacirs. The committee corresponded with the authorities in the neighboring Ottoman provinces, from where immediate help in money and supplies was required, reported to the central authorities in Constantinople about the dynamics of solving the refugee issue, and requested funds from the capital when certain problems could not be solved *in situ*.[6]

A part of the muhacirs managed to find their way to Niš while waiting to sell off their property in Belgrade. These were mostly artisans and merchants who managed to take some of their capital with them. However, most of the Turks from Belgrade were not so lucky, so already in April 1863, Midhat-paša initiated the project

2 BOA, I. MVL. 470/21289 (February 16th 1863)

3 BOA, A.MKT.MHM, 24540 (November 2nd 1862)

4 BOA, I. DH, 499/033937 (November 27th 1862)

5 BOA, A.MKT.MHM, 25937 (April 5th 1863)

6 BOA, I. DH, 502/34116 (December 23rd 1862); BOA, A.MKT.MHM, 25937 (April 5th 1863); BOA, I. DH. 502/34154 (February 7th 1863)

of building a settlement specificaly meant for them.[7] This project, for which approval was given by the Ottoman Supreme Council for Legal Affairs, was realized in the period January-May 1864. [8] The settlement for Belgrade muhacirs was built on state land that stretched west of the former Church of St. Nicholas/Fethiye mosque, and extended further west, in the direction of Kovanlık. Today's location corresponds to the stretch from 'Crvenkapa' kindergarten across Stanoje Bunuševac Street towards the Old Cemetery. What makes the construction of the settlement unique for the urban policy of the Ottoman authorities at that time is that the settlement was organized according to precisely established instructions given and approved by the Ottoman Supreme Council for Legal Affairs. The main street was 2m wide, and the distance (alleys) between the houses was 1.2m wide.[9] Two public fountains were built from the accompanying buildings and a guard post was erected. The muhacirs and local folk were allowed (even preferred) to open their shops freely in the new urban settlement, so that it would come to life. "Local folk" here means Muslims of Niš.

The main building towards which the entire new settlement gravitated was the Fethiye Mosque. As this Muslim temple died out by the middle of the 19th century, Midhat Pasha thoroughly adapted it in 1863 as it was meant to meet the spiritual needs of the settled Muslims (Ranđelović, 2022). For this reason, the settlement is often referred to as Fethiye Mosque Mahala in addition to the name Beograd-mala. However, the name which spontaneously became popular among the people was Palilula.

It is not entirely clear how and why the settlement was named this way, nor is it possible to give a definitive answer. Palilula was the name of one of the districts in Belgrade, which could indicate the origin of Muslim residents who settled here in Niš from Belgrade. According to Ćirić, Palilula in Belgrade was mostly inhabited by Serbs and other Christians (Ćirić, 1976). In that case, it is not clear why this colony of Belgrade Muslims did not take the name by one of the districst from their hometown where only Muslims lived, but the one where Serbs lived? On the other hand, Nikolić said about the origin of the Belgrade Palilula that it was founded by the Belgrade Vizier Maraşli Ali Pasha, in order to accommodate his numerous servants there (Politika, 1939). As it is known that due to his licentious way of life, Maraşli Ali Pasha was surrounded by an entire army of servants, certainly his people were made up of Christians as well as Muslims. In that case, Ćirić's theory that Belgrade's Palilula was a Christian settlement fails, showing that it was rather a district with religiously and ethnically heterogeneous population.

Another problem related to Palilula reffers to its name. It was allegedly created after Prince Miloš Obrenović's ban on smoking tobacco in Belgrade's suburbs due to frequent city fires. In this way, the restriction of smoking in public areas by the prince's order left the Belgrade settlement of Palilula as a free place for it, hence this is how it got its name. The question remains why before 1878 only a few cities of the Principality of Serbia had the districts named Palilula, but not all the cities of the Principality, expecially if Prince Miloš's authority extended over its entire territory? Beside that, Niš was not in Principality of Serbia before 1878, yet it had its own Palilula since 1864. From all these speculations, few things are certain; as urban categories there were no areas in Ottoman cities where smoking was prohibited (except religion places), so Palilulas were not result of the Ottoman communal practice; that since 1864 there has been a permanent settlement of Belgrade Muslims in Niš who transferred the toponym from their hometown; that until 1878, Niš continued to periodically suffer from city fires, which shows that no restrictions after 1864 had any effect on their reduction. Because of all this, it is perhaps most accurate to conclude that the origin of the name Palilula was lost in the spontaneity with which the common folk began to use it, as it is the case with any other toponym.

At the end of May 1864, Palilula had 144 houses in which 350 people lived. The houses were built with money provided from the Constantinople, private donations from the local population (where Christians were also obliged to collect funds) and collective donations that came from numerous cities throughout Rumelia. Christians participated in the construction of houses by forced labor (kulluk), and they were also obliged to provide the furniture and seeds which the muhacirs needed to start their lives and self sustainable households. Because it was built purposefully and quickly, Palilula was a unified settlement. It was organized in two rows of almost identical one-story houses with a square base, which did not have open private units, i.e. fenced yards (Ćirić, 1984). So that the entire complex does not look like it was systematically built, during the construction of the settlement, various fruit trees were planted here and there, making Palilula greener and giving it a final touch.

7 BOA, A.MKT.MHM, 25937 (April 5th 1863)
8 BOA, MVL, 977/34 (January 20th 1864); BOA, MVL, 992/28 (May 31st 1864)
9 BOA, MVL, 977/34 (January 20th 1864)

The position of the settlement was such that it allowed its expansion by 30-50%, if the needs required it.[10] However, while the position had this advantage, the location itself was bad. The reason for this was that the choice of location was a political and not an urban solution. The equalization of the rights of Muslims and non-Muslims during the Tanzimat caused in the Ottoman Empire a sudden political and economic emancipation of the latter, which caused a very dynamic local political scene in Niš. Thanks to this, the Christians in Niš managed to start the construction of the Great Cathedral (1856), and right next to this huge Christian temple, the Serbian school was also rebuilt (1863). Both institutions influenced the Serbian town in the southern part of Niš to become a cultural and religious center important for the political gathering of local Serbs. Considering political activity of Serbs as a threat to local Muslims and the functioning of the city, the local authorities decided to build a settlement just above Serbian town for the expelled (and therefore frustrated) Muslim refugees from Belgrade and in this way put pressure on Serbs and other Christians in Serbian town. What the local authorities have overlooked in this case are the characteristics of the terrain. Palilula above the Serbian town was located at the foot of the Seličevica hill. That is why it was always flooded when it rained heavily, protecting the Serbian town as a buffer zone from the floods from Seličevica (Ranđelović, 2022). Although in spite of this, Palilula was considered a healthier and better organized muhacir colony than the one in which the Crimean refugees lived, its unhealthy position as much as the unfavorable political conditions for Muslims after 1878 influenced its inhabitants to move out of here and leave Niš.

4. PALILULA AFTER 1878

The outcome of the Second Serbian-Ottoman War (1877–1878) was of great historical importance for the Balkans. With the victory of the Serbian army, the Paşalık of Niš ceased to exist, and its territory, which was liberated by the Serbian army, in the administration of the Principality of Serbia began to be called The New Territories. From January 1878 in Niš, as well as in other cities of The New Territories, major political and demographic changes took place. Regarding the latter, almost the entire Muslim population left Niš and headed for the parts of Rumelia still held by the Ottomans. For the wealthier Muslims, the refuge was Constantinople, Thessaloniki, Bitola or Seres, and for the rest of the Turks, it was mainly Skopje. Thus, Niš, which before the liberation in 1878 had about 13,000 inhabitants (mostly Christians), 4,274 local Muslims (1,075 families) had left by the end of 1879. The group of 401 Muslims who decided to stay in Niš was mostly concentrated in Beograd-mala near the Fortress of Niš (Ćirić, 1984).[11] Along with the departure of the Muslims, the displaced local Serbian population started to return to Niš as well as the Serbian newcomers from other parts of the Principality of Serbia.

Along with the population, in the years immediately after liberation Niš will also dramatically change its urban physiognomy. Abruptly, almost overnight, buildings of profane and sacred Islamic architecture will disappear, and in their place will be erected buildings with characteristics of European architectural trends. Narrow alleys, densely packed neighborhoods will disappear and, gradually, Niš will approach the other large cities of the Principality of Serbia in terms of appearance and way of functioning.

The Muslims of Palilula, among which at that time there were still living those who remembered the relocation from Belgrade in 1862–1863, could certainly be expected to react particularly sensitively to the changes in 1878. As the Church of St. Nicholas returned to its original state already in 1878 by the new Serbian authorities, i.e. to be the Orthodox Christain temple, it was a clear indication that the Muslim population on Palilula, which had previously used it as the Fethiye mosque, was also rapidly dispersing. If the circumstances of the war had not pushed the Muslims to leave Palilula by then, it was done by the passive pressure of the increasing number of Serbian settlers who came here. The key moment for this was the construction of the Belgrade-Niš railway (1884), i.e. commissioning of its branch Niš-Pirot (1887), which physically separated Palilula from Serbian town, i.e. other parts of Niš. Already by the end of the 19th century, even this obstacle will be neglected due to urbanization and an even greater influx of population, and then the complete integration of Palilula into the urban physiognomy of Niš will finally occur. In that period, the part of Palilula where the settlement of Belgrade muhacirs used to be will lose its importance, and the central part of Palilula will become the stretch which led to the north, from the Church of St. Nicholas to the crossing of railway to Pirot (Episkopska ulica – Palilulska rampa).

10 BOA, MVL, 992/28 (May 31st 1864)

11 About 3,500 Muslims should be added to this number. They were Ottoman military personnel and civilians who fled to Niš during the fightings with the Serbian army in other parts of the Paşalık of Niš. Those Muslims, together with the Muslims from Niš, formed a column of 8,000 people who set off for Rumelia.

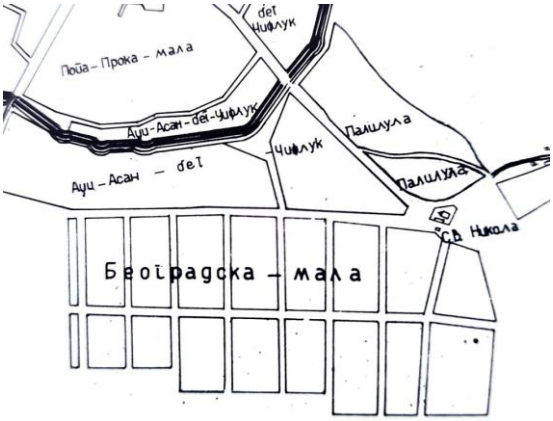


Figure 1: Belgrade Muhacir mahalle (Београдска-мала), the core of post 1878 Palilula District, (F. Vinter, 1878)

The expansion of this part of the city in the interwar period, and especially in the post-war socialist period, had an impact on the spread of the name Palilula on the peripheral settlements which adjoined Palilula. Thus, Palilula also included the settlements located west of it, in the direction of the Old Cemetery, which in the time of the Ottomans formed the Leskovac gate mala (Pirotska rampa). This is another interesting feature of Palilula in Niš, that, like Belgrade-mala near Fortress of Niš, belongs to a small group of so-called 'movable' toponyms (Ranđelović, 2024).

5. CONCLUSION

Palilula in Niš is currently the only documented example of planned civil construction from the Ottoman era in Serbia. The defined technical conditions, under which its construction was carried out, the stable inflow of financial resources, which were necessary for this, and the architect's obvious intention to make Palilula a long-term solution, are indicators that it was an undertaking which had elements of what we could consider a construction project in the modern sense.

As Niš had, by European model, a communal service for garbage removal and city lighting since 1868, future research on Palilula in Niš should provide an answer to the question of whether Palilula was also covered by these, for that time, modern amenities that could affect the quality of life of its dwellers. If the result of these future researches could prove that, then it will mean that Palilula in Niš was planned to be a prototype of a modern Ottoman settlement, not only carefully built but also arranged better that it was tought before.

AKNOWLEDEGMENT

The research was financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (contract no. 451-03-66/2024-03/200371).

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ICUP2025
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URBAN GROWTH, SHRINKAGE, AND REVITALISATION SHAPED BY THE DANUBE: THE CASE OF TOWNS IN THE LOWER DANUBE REGION IN SERBIA

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ABSTRACT

Being the most international river all over the world, the Danube has an immense influence on cities and towns on its shores. However, this influence is the strongest in the Danube sections where the other natural resources, such as a good inland connectivity or fertile plains and valleys in background, are more limited. This is the case for six towns located in the Lower Danube Region in Serbia – Veliko Gradište, Golubac, Donji Milanovac, Tekija, Kladovo, and Brza Palanka. They are mainly located in the Iron Gates, the longest gorge of the Danube. Narrow Danube Shores and isolating mountainous hinterland with limited resources have shaped the destiny of these towns inseparably connected to this powerful river. Their growth, shrinkage, and revitalisation have relied on the prospects of the Danube thereof. This symbiosis has also shaped the local economy, urban facilities and demographic trends of these towns, which has further reflected on their urban morphology. The aim of this paper is to present this unique urban growth and shrinkage these six Serbian towns shaped by the Danube of during pre-socialist period, i.e., in 19th and the first half of 20th century.

Keywords: *urban shrinkage; towns; the Danube; Serbian urbanisation; early modernity*

1. INTRODUCTION

Rivers have been the major drivers of urban development since the dawn of civilisation. In Europe, the riverside position has had a critical impact on many cities and towns both spatially and temporarily (Benevolo, 1993; van de Brandeler et al, 2019). The type of urban development shaped by river has often mirrored onto the formation and characteristics of urban morphology (Abshirini and Koch, 2016). This is clearly visible today in many European cities and towns, which prospects are interrelated with their rivers in myriad ways, respecting to ecological, economic, social, cultural, and physical/spatial aspects (EEA, 2016). In addition, living in European towns is more challenging comparing to the main cities (Lecomte and Dijkstra, 2023).

The Danube presents one of the longest and the economically most important rivers in Europe. In addition, it is the most international river all over the world; it passes through 10 countries in Central, Eastern and South-Eastern Europe, with many borderland sections (Kadar and Gede, 2021). Another unique feature of the Danube is that four national capitals – Vienna, Bratislava, Budapest and Belgrade – are located on its shores. Plus, the Romanian capital of Bucharest is only 60 km far away from the Danube. Apart of the capitals, numerous smaller cities and towns are situated along the Danube. The river has been even the more important driver of their development than for these five aforementioned major cities.

The aim of this paper is to present an extreme situation relating to the interconnection between the Danube and urban development on the example of six towns in the Lower Danube Region in Serbia: Veliko Gradište, Golubac, Donji Milanovac, Tekija, Kladovo, and Brza Palanka. This region is very specific, because its backbone is the longest gorge of the Danube, the 120-km-long Iron Gates (Antonić et al, 2019). Its position within the broader Danube Region makes it more physically isolated by mountains and more remote concerning inland connections and transportation (Antonić et al, 2019). To conclude, the Danube has played a significantly bigger role in the formation and development of these six towns than in the case of many other Danubian cities and towns, which have plains and valleys with a lot of other resources in their background.

This strong influence of the Danube can be noticed in these towns today. All of them are shrinking due to overlapped physical and political remoteness, as the Danube is also a border between Romania and Serbia in this section. Some of them, like Brza Palanka and Donji Milanovac, represent the negative extremes of this process in Serbia – these two towns have lost ½ of population in the last 30 years (Antonić, 2024). It had to be said that urban shrinkage is not an exception for Eastern Europe, where this process has been dominant during post-socialist period. Nevertheless, the current focus is still on deindustrialisation problems in bigger cities (Haase et al, 2016). Therefore, the other causes, such as the low connectivity and accessibility, have not been examined enough in the general research on urban shrinkage. This paper tends to present exactly this situation on the example of the six selected towns in the Lower Danube Region in Serbia and how the river shaped their rise and decline during early modern and capitalist period, from early 19th until middle 20th century. The final expectations of this paper are to explain the interdependence between river and town development through the characteristics of their urban morphology as guidelines for the future urban planning.

2. METHODOLOGY

This paper is tailored as a multi-case study on six selected cities – Veliko Gradište, Golubac, Donji Milanovac, Tekija, Kladovo. and Brza Palanka (Fig. 1). The multi-case study is chosen because small towns in Serbia are rarely examined independently last decades and up-to-date theoretical knowledge is scarce. Hence, there is a necessity to introduce a comparative analysis in this research, to enable obtaining high-quality scientific data, where multi-case study is more suitable than single-case one (Gustafsson, 2017). The comparative analysis is done by two parallel lines: (1) through the comparison of demographic statistical data and (2) through urban morphology. This dual comparative approach allows achieving the better understanding town development shaped by a big river (the Danube).



Figure 1: Location of six selected towns in the Lower Danube Region in Serbia (Author: B. Antonić)

3. ANALYSIS: LOWER DANUBE TOWNS WITHIN EARLY MODERN SERBIA

The development of modern cities and towns in the territory of the present-day Serbia began in 1815, after the establishment of the first autonomy of Serbs in the territory which the central part of Serbia today. It had to be noted that urban settlements in this territory existed during Ottoman times, from middle 15th till early 19th century. They had a hierarchy, too. The most important were 'cities' (just six of them), consisting of a fortress with Ottoman garrison and suburbia with ethnically mixed population. After them, just 'small towns' (Tur. *Palanka*) existed with a more military than economic role, to control Christian hinterlands (Kojić, 1970).

The prevalent military character of Ottoman 'palankas' was critical for their fast disappearance after the consolidation of Serbian autonomy during the Principality Period (1815-1882). Many of them simply lost their importance with the rise of the first capitalist economy in the middle of 19th century. This period is also marked with the establishment of a new form of urban settlements in Serbia – a market town (Serb. *Varošica*). This can

be emphasised as a local invention. The main feature of this new settlement was economical, based on retail and crafts for rural surroundings, while its size usually was behind; many market towns were smaller than nearby villages up to the World War II (Kojić, 1970). The development of market towns in 19th-century Serbia was cemented with the Law on settlements in 1866, which legally organised the position of cities and market towns and defined the procedures for their official proclamation (Kostić, 1928).

Three of six selected cities in the Lower Danube Region were proclaimed as market towns by this law by its initial enactment, whereas three others were added to the official list of the towns in the next two decades. However, it seems that their economic and demographic development was faster before these years (Table 1):

Table 1: The main figures for six selected cities: the Period 1815-1900

Town	*Year of town proclamation*	*Population censuses*				
		1834	*1868*	*1884*	*1900*	*1868-1900*
Veliko Gradište	*1866*	*1,330*	*2,519*	*2,769*	*2,996*	*+18.9%*
Golubac	*1881*	*-*	*926*	*1,296*	*1,527*	*+64.9%*
Donji Milanovac	*1866*	*705*	*1,207*	*1,211*	*1,454*	*+20.4%*
Tekija	*1885*	*-*	*982*	*1,158*	*1,336*	*+36.0%*
Kladovo	*1866*	*706*	*1,359*	*1,854*	*1,854*	*+36.4%*
Brza Palanka	*1885*	*-*	*616*	*1,013*	*1,051*	*+70.6%*

This trend could be clarified by explaining the role of the Danube for the 19th-century Serbia. Being the northern border of then Principality of Serbia (1815-1882) to more developed Habsburg Empire, the Danube was not just the main transportation corridor in pre-rail era, but also the main border crossing for international trade of the Principality (Savić, 1989). The urban evolution shaped by the Danube was still visible in the urban morphology of these towns, which clearly indicates their dependence on the Danube as a key driver of their formation and early development (Fig. 2). The majority of bigger urban settlements during the Principality Period were those ones on the Danube or close to it, indeed.



Figure 2: The Danube Riverfront in central Golubac, Serbia, today. The main square in the centre of the photo was next to the old port, which was located on the site of the present-day town park (left from the square on the photo) (Source: TO Golubac)

The Danube triggered the development of many small market towns in the Principality, too. B. Kojić (1970) differentiates three types of market towns in 19th-century Serbia. Planned towns were completely new, developed by a plan. Regulated towns were the former Ottoman settlements radically remodelled by regulating measures, especially in their newer, peripheral parts and along the main corridors. The third type – irregular towns – mainly preserved the oriental characteristics of an organic urban matrix despite the attempts of state to regulate them. This differentiation was done mainly by the urban morphology of Serbian market towns by several elements: (1) street system, (2) town shape, (3) the main square and/or street, (4) town blocks and land plots, and (5) key buildings, such as a church or town hall.

In accordance to this approach, the research is elaborated through the morphological maps of the matrix of the six selected towns in the late 19th century (Fig. 3). All of them show their strong dependency to the Danube. Their form clearly follows the natural morphology of the Danube Riverside, regardless od their regulated or irregular urban matrix. This is even evident is Donji Milanovac as a settlement fully developed by plan, where orthogonal street network is adjusted to the riverside. Then, their squares and main streets are usually connected to the riverfront (port/dock), but they are also a bit distanced from the river due to previously often floods in this pre-embankment era. In the case of Tekija, the main square even makes the part of town riverfront. In contrast to this, the position of main buildings, such as a town hall or church, is not related to the Danube, which can be also attributed to the already mentioned risks from floods.

Although the initial genesis of all the towns into modern urban settlements has some common elements shaped by the Danube, every town has some unique features, linked with their grouping in three aforementioned types (Fig. 3):

1) PLANNED TOWNS: It is already mentioned that Donji Milanovac is the only such example. The town was developed in a strict orthogonal manner by the plan from 1832 (Kojić, 1970). The town centre is therefore distanced from the port area, to be safe from floods, which is a difference comparing with the other studied towns. Donji Milanovac is also specific as it was completely relocated during the formation of the Iron Gates Lake in the early 1970s (Orlović, 1994; Badescu et al, 2022);

2) REGULATED TOWNS: There are three towns in this group. However, two first towns – Veliko Gradište and Kladovo – were already urban settlements in the Ottoman times, which is preserved in the more spontaneous character of their older parts, close to the town ports on the Danube. The newer or southern parts of both towns from the late 19th century show more regulation and planning interventions. In both cases the main square and street represent key connections between these two parts;

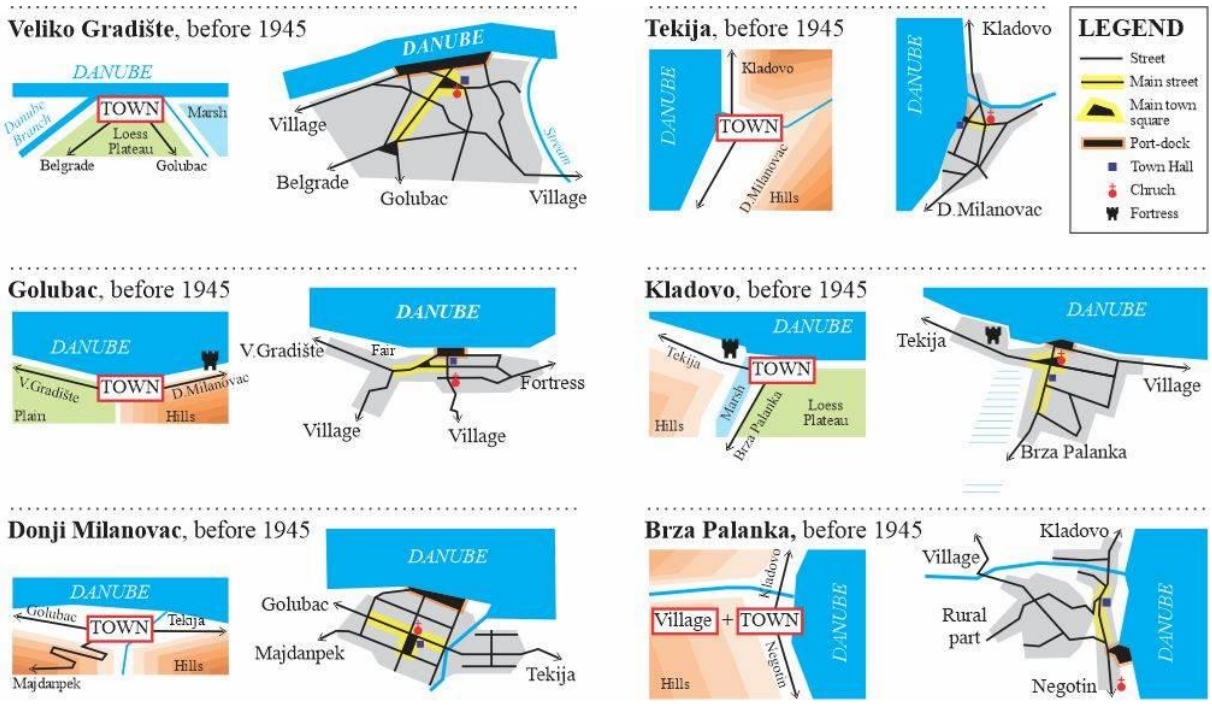


Figure 3: The formation and the main morphological features of six selected towns in the Lower Danube Region in Serbia (Author: B. Antonić, 2021)

Although Golubac also belongs to the type of regulated towns, this town is a bit different, because it was still a village in the first days of the Principality. Therefore, Golubac was more regulated after the town proclamation in 1881. The present-day matrix of the older part of Golubac is relatively regular, with adaptations to the natural environment (hills in background). As results, Golubac has a different morphology, where the main square and port area are close to each other (Fig. 2), while the main street goes parallel to the river;

3) IRREGULAR TOWNS are Tekija and Brza Palanka. Both of them are also the two smallest ones and the last settlements to be officially proclaimed as towns in the analysed group. In both cases, their urban morphology presents the elements of an unfinished regulation; irregular settlement form, the fuzzy network of streets and urban blocks and physically unfinished centre. Nevertheless, there are differences, too. While Tekija is developed as a compact urban-rural settlement, Brza Palanka was rather dispersed, with has two different strata: a lower, urban section ('town') along the Danube Road and next to port and an upper, rural section close to fertile areas in hinterlands.

The Table 1 already reveals the slowing down of the demographic growth of six selected towns after the proclamation of the Kingdom of Serbia in 1882. The probable cause is the rise of rail in Serbia as a dominant transport mode in the turn of 19th century. The main rail through the Kingdom was built through the Morava

Valley in its central part. Hence, rail corridor bypassed the Lower Danube Region and became a big competition to the previously important river transport. This was evident in the next population censuses in the first half of 20th century (Table 2). The slow increase or even decrease of population in the analysed towns indicates the elements of the pre-socialist urban shrinkage. The exemptions were Donji Milanovac, with the fast development of mining in mountains behind it, and Brza Palanka, where a big rural part mainly contributed to its demographic growth.

Table 2: The main figures for six selected cities: the Period 1815-1900

Town	*Population censuses*				
	1900	*1910*	*1931*	*1948*	*1900-1948*
Veliko Gradište	*2,996*	*3,242*	*2,982*	*2,783*	*-7.1%*
Golubac	*1,527*	*1,594*	*1,541*	*1,373*	*-10.1%*
Donji Milanovac	*1,454*	*1,634*	*2,160*	*2,274*	*+56.4%*
Tekija	*1,336*	*1,367*	*1,109*	*1,385*	*+3.7%*
Kladovo	*1,854*	*1,809*	*1,927*	*2,128*	*+14.8%*
Brza Palanka	*1,051*	*1,513*	*2,008*	*1,730*	*+64.6%*

Consequently, the urban form of six selected towns did not change significantly during the interwar period (1918-1941), which was visible by comparing the 19th-century data from the morphological maps with the first postwar topographic maps from the 1950s. The development trajectories of these towns were very different in socialist Yugoslavia (1945-1991), where their position in this specific section of the Danube has played a bigger role then their urban legacy from the pre-socialist times. However, the fragility of the position of these towns has been noticeable during the post-socialist transition (1992-), as all of them have witnessed a significant depopulation (Antonić, 2021).

4. CONCLUSION

Urban shrinkage and depopulation have become a 'hotspot' topic' for researchers of post-socialist urban development. However, the six studied towns in the Lower Danube Region in Serbia present a 'window' in the past episodes of urban growth and shrinkage, caused by their interdependence on the changes of their connectivity. In the case of this study, this is the importance of the Danube River as a transportation corridor in this part of Europe. In that way, these towns can be a model how present-day shrinking small cities and towns can be guided if the main cause of their shrinkage is not related to industry, but to connectivity and accessibility. In this sense, this paper can contribute to newly-developing research about non-global urbanism, cities and towns (Renn, 2014).

The main findings also show that the big rivers as waterways are very important for the overall state of small urban settlements on their shores. This is usually a neglected topic in the practice of urban planning, where this segment is usually less important that road and rail connection. Moreover, it seems that adequate planning responses on the problems of these towns can not be uniform, because this relation between a town and a river can have different spatial and functional repercussions. In this situation, the research of local features of urban morphology can be a very important support in customising local urban planning to be resistant and proactive for the future (re)development.

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ICUP2025
5th international conference on urban planning

COMMUNITY CREATIVITY BOOSTER METHOD

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ABSTRACT

In the context of a post-socialist society in transition, where support systems for local communities are not sufficiently developed, there are many weak points within the decision-making processes for development of certain open public space on local level. One of them is that participation of the youth in such processes is not established in any formal sense. Guided by this thought, the 'Community creativity booster method' was established through the collaboration of two research units of the University of Belgrade - Faculty of Architecture (hereinafter UB-AF). After that, we continued developing it through several subjects within regular classes of UB-AF, which opens up possibilities for its further improvement. This method could be used in various ways, and it can influence strengthening the sense of community and belonging to society as well as to stimulate regeneration and strengthening the capacity of institutions while establishing relations between the civil, public and private sectors of society through a cyclical participatory process. Its main goal is to stimulate and engage different generations and institutions to participate in the process of improvement, development or placemaking within the open public space which certain local community is using trough youth engagement. In the entire process, the academic institution should use an enabling leadership style in its role of process facilitator.

Keywords: *youth participation; inclusive approach; enabling leadership style; open public space; local community*.

1. INTRODUCTION

Open public spaces within neighborhoods play a vital role in fostering socialization. However, in post-socialist societies undergoing transition, such as Serbia and other Eastern European countries, participatory mechanisms in local governance require greater sophistication and development to ensure these spaces meet community needs. In these systems, the key users of such spaces such as children and youth are often excluded from decision-making processes regarding their improvement. As a result, their needs are neither prioritized nor adequately addressed. Typically, maintenance or renewal projects for open public spaces are determined through top-down approaches, constrained by limited funding. This frequently leads to the replication of design solutions that fail to reflect the actual, contemporary needs of end users. Additionally, these projects often overlook alignment with climate change policies and strategies, such as Nature-Based Solutions (hereinafter NBS) (European Commission, 2024; IUCN, 2024; Mitić-Radulović & Lalović, 2021). To address these

gaps, 'Community creativity booster method' emphasizes the inclusion of marginalized groups, particularly children and youth, while advocating for the co-creation of NBS at the community level.

As children and youth are usually not burdened by systems, rules, and procedures, they tend to be more creative than adults and often have a deeper emotional connection to nature. By actively including them in co-creation processes, their enthusiasm can inspire and engage their parents and guardians. Consequently, this encourages broader community involvement in the redesign and sustainable transformation of shared open public spaces. Co-creation led by children and youth, supported by their parents or guardians, challenges decision-makers and other stakeholders to consider fresh perspectives and innovative sustainable ideas such as NBS. This unconventional 'bottom-up' initiative forms a niche for innovation (Mitić-Radulović & Lalović, 2021) by creating a platform for dialogue and collaboration, where decision-makers are exposed to novel approaches and methodologies. The key innovation of this method lies in its ability to optimize the decision-making process by aligning it with the community's genuine needs. It also provides 'on the job' training and education for participants while fostering trust and collaboration among all stakeholders. The 'Community Creativity Booster Method' positions academic institutions, particularly those specializing in urban design, as enabling leaders (Lalović et al., 2019). Through the use of group communication techniques, these institutions build trust and enhance participants' capacities for co-creation, ensuring the process can be replicated within the community in the future.

2. THE GENERAL METHOD OVERVIEW

This method has been developed collaboratively by two research units within the UB-AF: 'Innovation Laboratory of Sustainable Development' and 'Participatory Urban Design and Participatory Public Art'. Given the constraints on creativity in public procurement, it seeks to drive changes in practice through innovative approaches. Based on previous experience, laboratories formed general description of the process which is illustrated in Figure 1. It demonstrates that this process can be applied in various contexts and for different types of open public space.

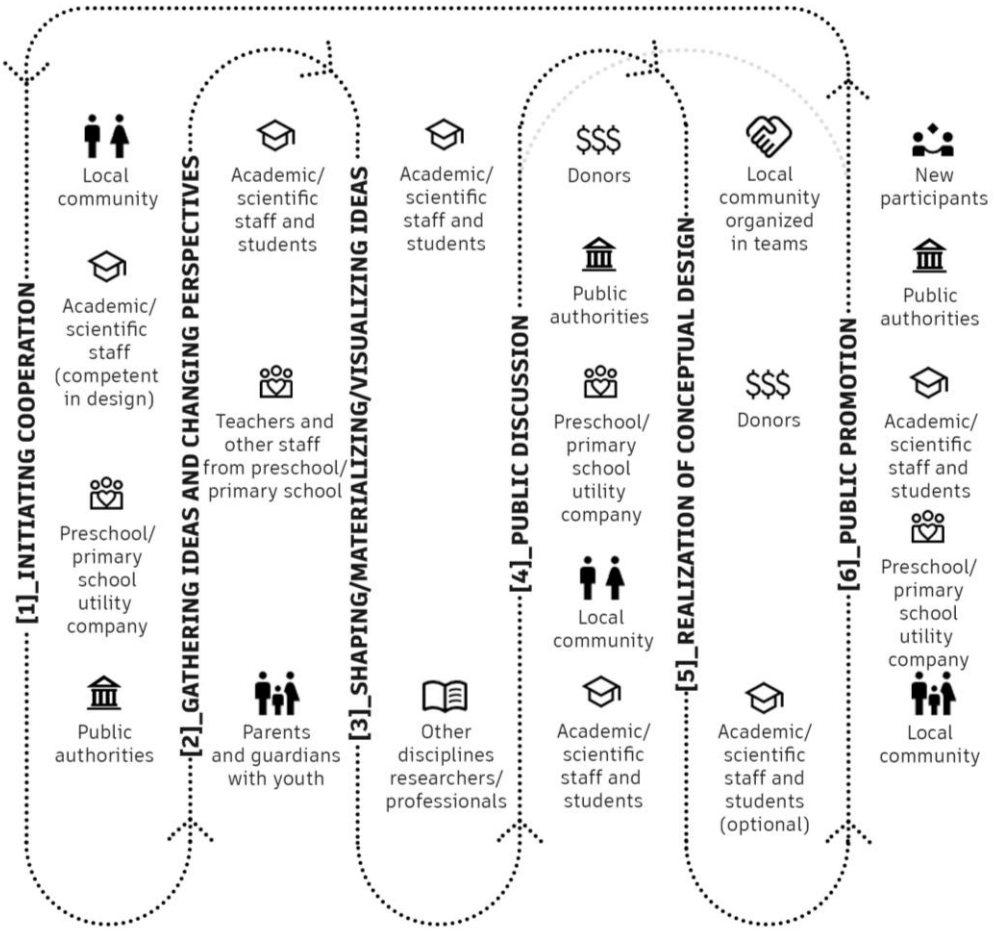


Figure 1: The scheme of Method Application Process

[1] The initial step involves representatives from academic or scientific institutions facilitating communication among various stakeholders. The academy plays a crucial role in supporting local communities by amplifying their voices, addressing the needs of marginalized groups, and fostering collaboration with key decision-makers such as public authorities and public preschool or primary school utility companies. The primary objective is to establish a shared understanding of the initiative's purpose and benefits, leading to a formal agreement and a well-defined framework for the process, including participants, timelines, roles, and responsibilities for each stakeholder.

[2] The second step represents gathering youth's ideas about space design while encouraging other stakeholders to shift their perspectives. This is achieved through a locally relevant workshop facilitated by academic staff and students. The creative group process for youth is stimulated using various techniques, including group communication, education, storytelling, and visioning, which naturally elicit a positive response. The primary objective is to produce tangible outcomes, such as narratives or drawings that depict an envisioned future where open public spaces meet all needs and exist in harmony with nature. Conversations with the youth, along with an analysis of their drawings and stories, reveal unique ways of thinking and experiencing space. Parents and teachers observe the process, gaining indirect education on these topics while being encouraged to adopt new perspectives. Their natural inclination to support children's ideas fosters their active engagement, allowing them to share their own needs and visions as well.

[3] The step of 'shaping, materializing, and visualizing ideas' involves transforming the collected ideas into conceptual open space designs enriched by students' creativity. These designs are crafted to resonate emotionally and philosophically with the youth involved. Under the guidance of teachers, associates, and experts from various disciplines, students develop conceptual proposals that closely align with the original ideas while being realistically adapted for practical implementation. This step not only teaches students how to translate abstract ideas into feasible designs, but also helps them learn to create clear, comprehensible presentations for non-expert audiences, especially children and youth, who should be able to recognize their contributions in the proposed designs. Furthermore, the conceptual designs include preliminary cost estimates and material specifications at a general level to demonstrate their feasibility and practicality.

[4] The broader local community should be encouraged to participate in public discussion with representatives from public preschool or primary school utility companies (particularly teachers), private investors, and public administrators. The primary aim of this step is to inspire potential donors or contributors to support the implementation of the conceptual designs. During the public events, such as exhibitions and discussions, the academic staff take on the role of facilitators. These events are initiated by children and youth, who are now supported by their parents, teachers, students, and professors, creating a united and compelling initiative. Throughout the process, private and public sector representatives are motivated to support the local initiative and apply the NBS, which opens for them other opportunities. The public discussion results offer possibilities for implementation and create partnerships between the public and private sectors.

[5] When potential donors or contributors are identified, the initiators of the process, typically the youth's parents and guardians, receive support to form teams responsible for managing and overseeing the implementation of individual conceptual designs. These teams collaborate with donors and are further supported by relevant institutions. The first task for each team is to identify a construction firm capable of adapting the designs to its technical and practical capacities. If the firm agrees, the team can seek the involvement of the student whose concept is being brought to life, with guidance provided by teachers throughout the process. This collaborative effort ultimately leads to the completion of the open space design.

[6] The public promotion of results and the launch of new initiatives serve as a meaningful moment of self-reflection for the community. This event provides an opportunity for the community to share experiences both internally and with others who aspire to achieve similar goals. It can be hosted by the local community, local administration, and/or the institution involved in the process. This step fosters mutual trust, promotes the establishment of best practices, and inspires the creation of new initiatives.

3. RESULTS AND CHALLENGES

This chapter outlines the prior experiences related to this method and provides an overview of its development process. The aforementioned laboratories have extensive experience with participatory processes (Zivkovic, Djukanovic & Radosavljevic, 2019; Živković & Lalović, 2018), including the creation of the first inclusive children's playground in Ćićevac, Serbia, through a similar approach. In addition, the teaching staff who founded and are part of these laboratories have gained invaluable experience over the past two

decades through their work in the international program ‘Public Art & Public Space’ (PaPs, 2024). This program is also an integral part of the regular curriculum at the UB-AF.

The general process of applying the ‘Community Creativity Booster Method’ was initially implemented between the spring and fall of 2022 in collaboration with the preschool institution ‘11. April’ (Јовановић, Лаловић & Ђукановић, 2023). This institution manages approximately 30 facilities in New Belgrade, and its funds are therefore limited. The motivation for applying this method arose from the local community’s need to find a way to secure funding for the small-scale renovation of the courtyard at one of these facilities - the public kindergarten ‘Lastavica’. Through the local community association ‘Blok 37’ the parents' council connected with the UB-AF, which assisted in organizing a workshop. Based on this workshop, students, mentored by faculty members, later developed conceptual design proposals.

During the three applied processes students have created 22 conceptual open space designs. These processes have functioned as an extracurricular activity. All designs had one representative visualization, brief technical description and preliminary estimation and calculation done by one parent from local community, who is also an architect. Some examples of those designs are shown in the Figure 2.



Figure 2: Students’ open space conceptual designs

Further development required that teams of parents find a construction firm. One team of parents has found such firm, but the ‘11. April’ sector responsible for equipping the kindergartens’ open public space insisted on the implementation of the regulations which do not include this type of interventions. With the inclusion of the

municipality of New Belgrade in the negotiations, an agreement was reached that the expert representatives of the parents should adjust the description of certain design solutions and to send it to the competent ministry for public procurement. After the involved parents did all that was required of them one and a half years ago, unfortunately the process was obviously stopped by the institutions for unknown reasons. According to available sources, kindergarten staff did not manage to realize any conceptual design solutions yet.

Generally, '11 April' was interested and supportive for further cooperation, but wider meeting with different stakeholders was not achieved. During the fall semester 2022/2023 attempt of UB-AF to organize meeting between various stakeholders with this topic failed. For example, high school 'Drvo Art' was significant stakeholder who could develop some of the students' ideas within their equipped workshops, and to establish cooperation between high school and faculty, but they have canceled their participation due to ongoing COVID pandemic and never wrote back again.

Also, during the fall semester 2023/24 school year, an opportunity has arose to make this process a topic for an elective course ‘Open city spaces’ on the third year of bachelor level on UB-AF. Representatives from the UB-AF had a meeting with representatives of the preschool institution ‘11. April’. Again, sector responsible for equipping the kindergartens’ open public space insisted on the implementation of the regulations which do not include this type of interventions. Beside that, unfortunately, the students were younger and not as enthusiastic as when it was an extracurricular activity. Two new kindergartens were involved, but only few students' projects were presentable.

During the fall semester of the 2024/25 school year, an ongoing process at UB-AF involves first-year master's students in the elective course ‘Urban Recreation’ who are developing conceptual solutions for the preschool institution ’Boško Buha’. However, this process currently excludes direct participation components. The primary goal is to first establish a stronger and more detailed collaboration among stakeholders, as previous attempts faced challenges due to misunderstandings.

4. CONCLUSION

For kindergartens under the preschool institution ‘11. April’ the process was set in motion thanks to the strong community bonds nurtured by the local community association ‘Blok 37’. Driven by their dedication to supporting their children, parents further strengthened their connections throughout this initiative. Even after 2.5 years, the children and parents of Blok 37 still recall the experience and eagerly wonder whether some of the proposed concepts will be realized. Through the parents’ council, the energy boost has spread to other kindergartens and communities. As a result, kindergartens outside the ‘11. April’ institution, such as ‘Boško Buha’, have reached out to UB-AF to initiate similar efforts, while more laboratories, including ‘Vital Places Lab’, are showing growing interest in the topic. There are several key guidelines for establishing similar processes in the future.

First and foremost, initiating this process requires basic community awareness and a willingness to cooperate. In the kindergarten cases mentioned, no formal cooperation between stakeholders currently exists, as the process has typically been established through informal, verbal agreements. One common obstacle is that many participants often expect UB-AF to develop the final project for implementation. However, the intended approach is for construction firms to refine and transform conceptual design solutions into final projects, leveraging their own expertise and capabilities. Given the complexity of this process, it should always be accompanied by official cooperation among all stakeholders to clearly define roles and responsibilities.

Parents should take the lead in developing strategies and mechanisms for implementing conceptual designs while also setting clear ethical guidelines for acceptable donations. A key concern is that gambling establishments are among the main potential donors, and allowing their involvement could send a highly controversial message to society. Despite the importance of these efforts, only a few parents have taken the initiative to form teams, actively seek suitable construction firms, and identify ethical donors.

Furthermore, nature-based solutions (NBS) offer minimal environmental impact while providing lasting economic and social benefits. These small-scale interventions require only modest, affordable investments from the community, yet they strengthen cooperation and mutual support among its members.

To achieve meaningful outcomes, academic institutions play a crucial, though not indispensable, role. An effective leadership strategy relies on external cognitive authority, such as academia, to guide and facilitate the community’s sustainable transformation efforts. This process broadens perspectives and fosters innovation among all participants. A key insight from past cases is that older students tend to show greater motivation in

exploring this topic, drawing from contemporary themes and theories in the field (RS, 2024; Stupar, 2017). As students engage with these initiatives and later transition into various stakeholder roles after graduation, the academy's direct involvement naturally diminishes over time.

This method also holds significant potential for building trust and fostering partnerships between the civil, public, and private sectors through collaboration, ultimately leading to tangible results. It encourages the exchange of best practices and broader community participation in such processes. To achieve this, institutional professional services should be more open to refining regulations, as existing policies do not adequately address the types of interventions that students have proposed for kindergarten cases.

The 'Community creativity booster method' encourages the integration of a bottom-up decision-making approach into local urban design practices. The involvement of children and youth serves as a catalyst for local community development and holds significant transformative potential, paving the way for a more inclusive, innovative, and cooperative model of local governance.

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PRINCIPLES AND BENEFITS OF DESIGNING GREEN STREETS: SUSTAINABLE APPROACHES TO URBAN DEVELOPMENT

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ABSTRACT

Global challenges such as rapid urbanization, climate change, the high percentage of impervious surfaces, and water pollution create an urgent need for sustainable urban solutions. In this context, the concept of green streets emerges as a key element in future city planning, aiming to enhance urban resilience and improve environmental quality. This paper explores the fundamental principles of designing green streets, emphasizing strategies that promote biodiversity, manage stormwater effectively, and improve urban aesthetics. Concrete recommendations for redesigning existing urban spaces are provided, taking into account the functional classification of streets and their respective roles within the urban ecosystem. Using the example of the transformation of a commercial street in Niš, the possibilities for applying these principles in a local context are presented, highlighting the practical implications of green street design. Finally, the paper analyzes the ecological, social, and economic benefits of implementing green streets, including improved air and water quality, increased property values, and enhanced public health. This paper highlights the importance of green streets in sustainable urban development strategies and calls for their integration into urban planning frameworks to create healthier, more livable cities.

Keywords: *urban planning; green street; street redesign, sustainable urban development, urban resilience, ecological benefits*

1. INTRODUCTION

With the growing population in urban areas and rapid urbanization, the need for preserving and enhancing green spaces has become urgent. Climate change exacerbates this issue, highlighting the importance of sustainable urban design in helping cities adapt to extreme weather events such as floods, droughts, and storms. Additionally, urban heat islands and rising temperatures further impact the quality of life. Rainwater runoff in cities poses complex problems, as impermeable surfaces prevent proper absorption, leading to soil erosion, flooding, and water pollution (Lovell, 2010). To address these challenges, more cities are adopting urban green planning principles, with the concept of green streets gaining attention. This topic is becoming increasingly relevant in urban planning and development. This paper aims to contribute to a better understanding and promotion of the approach that encourages the integration of the Green Streets concept into urban strategies as a key factor in transforming cities toward a more sustainable and resilient future.

This paper will first present the definition and typology of green streets, providing a clear understanding of their characteristics and significance. It will then examine the design of green streets based on different street hierarchies, highlighting the various approaches to their implementation. Following this, a case study of Branka Krsmanovića Street in Niš will be analyzed, with recommendations for its redesign and transformation into a green street. Finally, the conclusion will discuss the benefits and importance of green streets for sustainable urban development and the overall improvement of quality of life in cities.

Various methods were employed in this research to provide a comprehensive understanding of the concept of green streets. In the section examining the role and significance of green streets, a descriptive analysis was used to explore key aspects of green street design, focusing on their impact on sustainable urban development. Additionally, a comparative analysis was conducted to identify differences and similarities between various green street models and their implementation in different urban contexts. Furthermore, a case study method

was applied to analyze the specific example of Branka Krsmanovića Street in Niš, evaluating the potential for its transformation into a green street. This combination of methods allowed for a thorough exploration of the topic, offering insights into how green streets can contribute to stormwater management, enhance biodiversity, and improve overall urban resilience.

2. THE TERM AND TYPOLOGY OF GREEN STREETS

Green Streets represent an innovative approach to urban planning, designed to address the shortcomings of conventional streets characterized by a high percentage of impervious surfaces. Such streets lead to numerous consequences, including limited connectivity with stormwater management systems and a primary focus on cars, which reduces pedestrian safety and comfort (Im, 2019). Conventional streets are typically built according to standard regulations that prioritize motor vehicle traffic, whereas Green Streets offer greater flexibility in planning to meet local needs and promote a more sustainable lifestyle.

There are numerous definitions of Green Streets, which authors explain in different ways, focusing on the aspects they consider most significant. What they share in common is the description of Green Streets as a sustainable method for managing stormwater, often applied in public spaces, using environmentally friendly materials for this purpose. Below, several definitions provided by various agencies and organizations dedicated to environmental protection are presented to offer a comprehensive understanding of the Green Streets concept:

- Portland Environmental Services (2019) defines a Green Street as a street that uses vegetated facilities to manage stormwater runoff at its source is referred to as a green street. 'A green street is a sustainable stormwater strategy that meets regulatory compliance and resource protection goals by using a natural systems approach to manage stormwater, reduce flows, improve water quality, and enhance watershed health'.
- Environmental Protection Agency (2009) states that 'Green streets and alleys are created by integrating green infrastructure elements into their design to store, infiltrate, and evapotranspire stormwater. Permeable pavement, bioswales, planter boxes, and trees are among the elements that can be woven into street or alley design'.
- City of Philadelphia (2014) considers that 'Green streets present opportunities to manage stormwater while maintaining the primary function of the street for vehicles and pedestrians'. A green street acts as a local stormwater management system, capturing stormwater runoff, allowing it to soak into soil, filtering it and, at the same time, reducing the amount of stormwater that would otherwise make its way into Philadelphia's sewer collection system.
- Water Environment Research Foundation (2009) states that 'Green streets are an example of how individual stormwater BMPs are used as elements of a broader program aimed at mitigating a significant source of stormwater pollution'.

A Green Street can comprehensively be defined as a public space designed for all types of traffic, adapted to its context, and incorporating landscape elements, engineered stormwater drainage controls, and sustainability principles and practices. Its purpose is to enhance non-motorized transportation options (pedestrian and bicycle traffic), reduce the urban heat island effect, improve water and air quality, protect ecological resources, and provide numerous additional benefits. The Green Streets initiative can offer sustainable and regenerative solutions to the urban challenges we face today and will continue to face in the future.

The application of Green Street typologies contributes to improved planning, design, and management of urban spaces and facilitates the efficient exchange of knowledge and experiences among professionals from various fields. There are several typologies of Green Streets based on the position, form of greenery, and their functions. Each typology has its own characteristics, adapting to the specific requirements and needs of a given area. According to the position and form of greenery within the street's regulatory width, four types of Green Streets can be identified: 1) streets with linear, continuous greenery; 2) streets with linear, discontinuous greenery; 3) streets with pocket greenery; and 4) streets with a combination of the aforementioned greenery arrangements. These types can be observed in streets of different ranks and varying regulatory widths.

- Linear continuous greenery – single-sided, double-sided, or central
  Linear continuous greenery extends continuously along the entire length of the Green Street. It can be single-sided, located along one side of the street, or double-sided (Fig. 1a), where greenery runs

along both sides of the street. Alternatively, it can be centrally positioned (Fig. 1b), meaning the greenery is placed in the middle of the street, between the traffic lanes.



(a) (b)

Figure 1: (a) Double sided linear continuous greenery, and (b) Central linear continuous greenery
Source: Im, J., 2019.

- Linear discontinuous greenery (cellular) – single-sided or double-sided
  Linear discontinuous or cellular greenery appears as greenery with interruptions along the street segment. This typology can be single-sided, where the discontinuous greenery extends along one side of the street, or double-sided (Fig. 2), where the discontinuity is present along both sides. In this case, the greenery may alternate or appear simultaneously on different sides of the street.



Figure 2: Double sided linear discontinuous greenery
Source: Im, J., 2019.

- Pocket greenery – single-sided or double-sided
  Point-based greenery refers to the presence of green "spots" or smaller green areas along the street. These spots can be single-sided, located along one side of the street, or double-sided (Fig. 3a), when they are found on both sides.
- Combination
  The combination of typologies means that different positions and forms of greenery can be integrated within the same Green Street. For example, linear continuous greenery can be combined with point-based greenery, creating diverse and interesting spatial compositions (Fig. 3b).



(a) (b)

Figure 3: (a) Pocket greenery, and (b) Combination
Source: Im, J., 2019.

In addition to the aforementioned typologies, there are also types of Green Streets that arise from different urban situations, such as whether the greenery is located along the street segment, at an intersection, etc. (Fig. 4a and 4b).



(a) (b)

Figure 4: (a) The greenery along the street segment, and (b) The greenery at an intersection
Source: Im, J., 2019.

3. THE DESIGN OF GREEN STREETS WITHIN DIFFERENT HIERARCHIES

The concept of Green Streets, combined with Green Infrastructure (GI), represents a key innovation in urban planning, enabling the integration of green elements into every street, regardless of its hierarchy or

purpose. Whether it is a major arterial road passing through the city center or a residential street in a quieter neighborhood, this concept offers opportunities to enhance the living environment and improve the quality of life for all users.

The technical elements of Green Streets are a key component in the design of sustainable and environmentally friendly streets in urban environments. Various technical elements are implemented during the design process of Green Streets, with the following being of particular importance for this study: tree infiltration trenches, rain gardens, curb extensions, tree pits, bioswales, and permeable pavement. The National Association of City Transportation Officials (NACTO), a coalition of transportation departments in North American cities, has successfully described and illustrated the integration of various Green Infrastructure elements into streets, considering their hierarchy and function. Their guidelines and examples provide detailed and practical recommendations on how to optimize the use of space based on the street's classification. They have published two manuals, the first being the *Urban Street Stormwater Guide*, which demonstrates how cities can use their streets as a resource to enhance resilience and address climate change. This guide represents the first collaboration between city transportation departments, public works, and water management agencies. The second manual, titled *Global Street Design Guide*, sets global standards for designing streets and public spaces. It encompasses accessibility, safety, mobility for all users, environmental quality, economic benefits, public health, and the overall quality of life (National Association of City Transportation Officials).

In addition, elements of a Green Street can also be integrated into other transportation areas, such as parking lots, sidewalks, and bicycle lanes. The selection of technical elements to be integrated into a street depends on several key factors, with the primary consideration being the purpose or hierarchy of the street itself. Local climatic conditions also play a significant role, allowing for the selection of elements tailored to cooling needs, water management, biodiversity preservation, and other priorities. Other important factors include the availability of space, user needs, and technical feasibility. To achieve an optimal balance between functionality, sustainability, and aesthetics, these factors are often combined, resulting in the application of multiple technical elements within a single design. For the purposes of this research, the design of two streets is presented: one of a higher hierarchy—a city highway and one of a lower hierarchy—a residential street.

3.1. City highway

City highways are busy urban streets that form the backbone of cities, playing a crucial role in their functionality and identity. They are characterized by high activity levels, heavy vehicular traffic, and an increasing demand for spaces dedicated to pedestrian and bicycle movement. As cities continue to grow, the pressure on these streets to accommodate multiple uses and provide safe environments for all road users intensifies. While adapting these streets for effective stormwater management can be challenging, the implementation of Green Infrastructure offers the greatest benefits precisely on these roads.



(a) (b)

Figure 5: (a) The existing condition of a typical highway, and (b) Recommendations for redesign
Source: https://nacto.org/

Figure 5a illustrates the existing condition of a typical city highway, which is defined by high traffic volumes and unsafe vehicle maneuvers, leading to a dangerous environment for both pedestrians and cyclists. The streets are dominated by extensive areas of impervious surfaces, which contribute to surface runoff and exacerbate stormwater management issues. Despite having underutilized potential for incorporating tall greenery in central medians, which could aid in both stormwater management and improving air quality, these areas remain largely barren. Additionally, the lack of adequate horizontal signage, the absence of dedicated spaces

for cyclists, increased emissions of harmful gases, ecosystem fragmentation, and monotonous pedestrian pathways.

In Figure 5b, recommendations for redesigning the city highway are provided as follows: 1) Design the central area with tall greenery to facilitate efficient stormwater drainage; 2) Reduce the width of vehicle lanes to an optimal size that ensures smooth traffic flow. At every intersection, provide clearly marked pedestrian crossings to ensure safe passage for pedestrians; 3) Incorporate rain gardens with low vegetation at bus stops and parking areas along the street; 4) Wherever feasible, integrate bioswales with gentle slopes to manage stormwater effectively. These bioswales can also serve as physical barriers between sidewalks and roadways; 5) Use appropriate horizontal signage to clearly demarcate bicycle lanes. Additionally, install higher curbs to prevent unauthorized vehicle access to pedestrian zones. It is recommended to use porous or permeable concrete or asphalt to allow efficient stormwater drainage through their structure.

3.2. Residential street

Residential streets are the lowest-ranking streets, typically less busy and intended for local traffic within urban neighborhoods, predominantly surrounded by residential buildings. These streets often do not reach their full potential as public spaces, yet they are ideally suited for the implementation of Green Infrastructure (GI) elements due to their characteristics and function. The application of GI elements and their transformation into green streets can contribute to creating calmer streets that are safe for pedestrians and cyclists.



(a) (b)

Figure 6: (a) The existing condition of a typical highway, and (b) Recommendations for redesign
Source: https://nacto.org/

Figure 6a illustrates the existing condition of a typical residential street, characterized by a narrower regulatory width, designed for one-way vehicular movement with parking spaces provided along one or both sides of the street. The street lacks adequate horizontal signage, such as pedestrian crossings and other road markings. There is a low level of safety for road users, and the potential of existing greenery for efficient stormwater management remains underutilized. Rainwater is retained on the street and sidewalk surfaces.

In Figure 6b, recommendations for redesigning the residential street are provided as follows: 1) Use appropriate horizontal signage to clearly indicate pedestrian crossings, parking spaces within the regulatory width of the street, and markings for bicycle lanes, which can help calm motor vehicle traffic; 2) Place rain gardens and other technical elements in a way that clearly directs pedestrian movement safely; 3) Incorporate underground infiltration trenches along the sidewalks to channel stormwater; 4) Apply porous or permeable paving for all traffic surfaces.

4. BRANKA KRSMANOVIĆA STREET: REDESIGN RECOMMENDATIONS

Based on the previously conducted analysis of the potential of existing streets in the Medijana municipal area, it has been determined that Branka Krsmanovića Street falls into the category of streets that, within their regulatory width, contain linear greenery and have the potential to accommodate technical elements for managing stormwater runoff. The street has linear greenery on both sides of the roadway, in partially good condition, which currently serves only as a physical barrier between the sidewalk and the roadway but has the potential to incorporate green street technical elements. This greenery can be better integrated into the street's infrastructure, enhancing its role in urban ecology and improving the overall quality of the space for both pedestrians and residents. The improvements can be made as follows:

- Due to the gentle slope in the southeast-northwest direction, stormwater runoff would be addressed by designing the street with a slope of 1.5-2% in the northeast-southwest direction, incorporating new bioretention areas and existing stormwater management systems. The bioretention areas are designed in organic shapes to fit into the existing urban context. These areas would serve to collect and filter rainwater, reducing the risk of flooding while enhancing the ecological quality of the area. They extend from tree to tree, ensuring that the roots of existing trees are not damaged, which allows for the retention and enhancement of the existing green infrastructure.
- To reduce vehicle speed and improve pedestrian safety, it is planned to install speed bumps by raising part of the roadway to the level of the sidewalk. This will help create a safer environment for pedestrians and encourage drivers to slow down, particularly in areas where pedestrian movement is more frequent.
- The existing parking area would be reduced and lowered to the level of the roadway, using concrete grid pavers with greenery for its materialization. Access to residential building entrances would be provided through the existing parking spaces, minimizing disruptions to the established flow of traffic. Tree rows and medium and low greenery would be revitalized and enhanced, ensuring that the street maintains a green and inviting atmosphere for all users.
- To enrich and enhance the entire street space with various amenities and activities, spaces for passive recreation are planned within the regulatory width of the street, alongside the new bioretention areas. These spaces would offer opportunities for residents to relax, socialize, and engage with their environment, improving the street's quality of life and contributing to a more vibrant and sustainable urban area.

The proposed recommendations for redesign can be visualized and better understood through the attached street detail (Fig. 7).

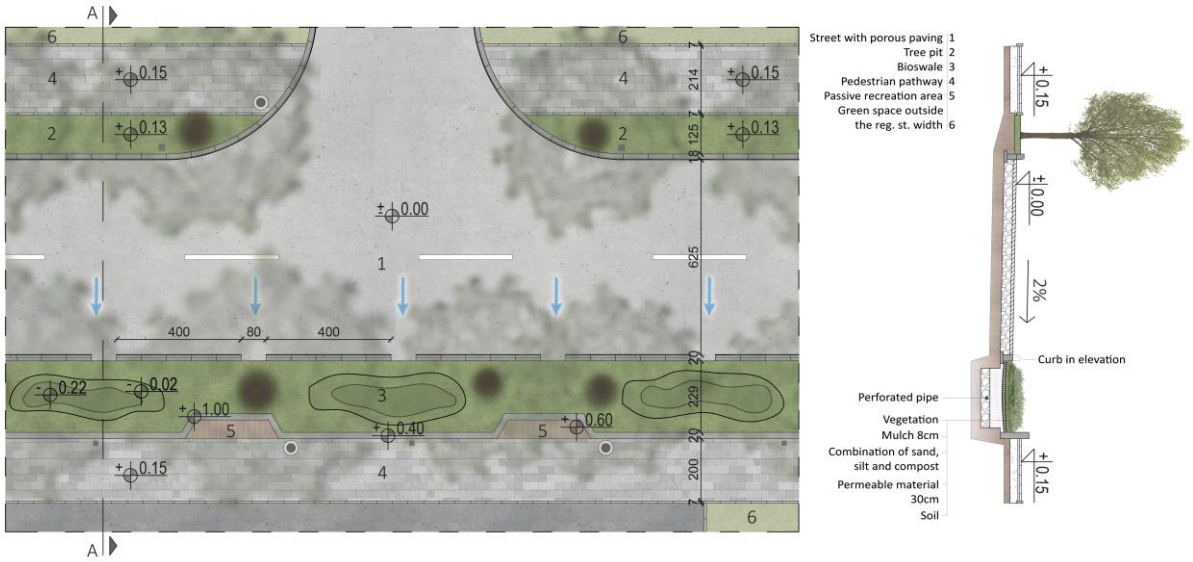


Figure 7: Detail of Branka Krsmanovića Street – urban redesign recommendations
Source: Author

5. BENEFITS AND LIMITATIONS IN THE APPLICATION OF THE GREEN STREETS CONCEPT - CONCLUDING CONSIDERATIONS

The concept of green streets in urban areas brings significant ecological, social, and economic benefits, such as reducing the urban heat island effect, improving the microclimate and environmental quality, promoting healthier lifestyles for residents, and creating more pleasant and functional urban spaces. Based on the analysis of reference literature and conducted research, a large number of benefits brought by the implementation of the green streets concept have been identified. The research determined that all these benefits can be grouped into five main categories, which cover different aspects: efficient stormwater management, environmental preservation and enhancement, social progress, transportation improvement, and economic efficiency. Given the increasing global challenges such as climate change and extreme weather conditions, efficient stormwater management stands out among all the potential benefits of green streets and has become one of the most relevant topics in sustainable urban planning. Although this category is particularly

emphasized, the other benefits of green streets are equally important, and many of them stem directly from this. For better insight and understanding of the various aspects of green street benefits, their presentation is provided in a tabular form (Fig. 8).

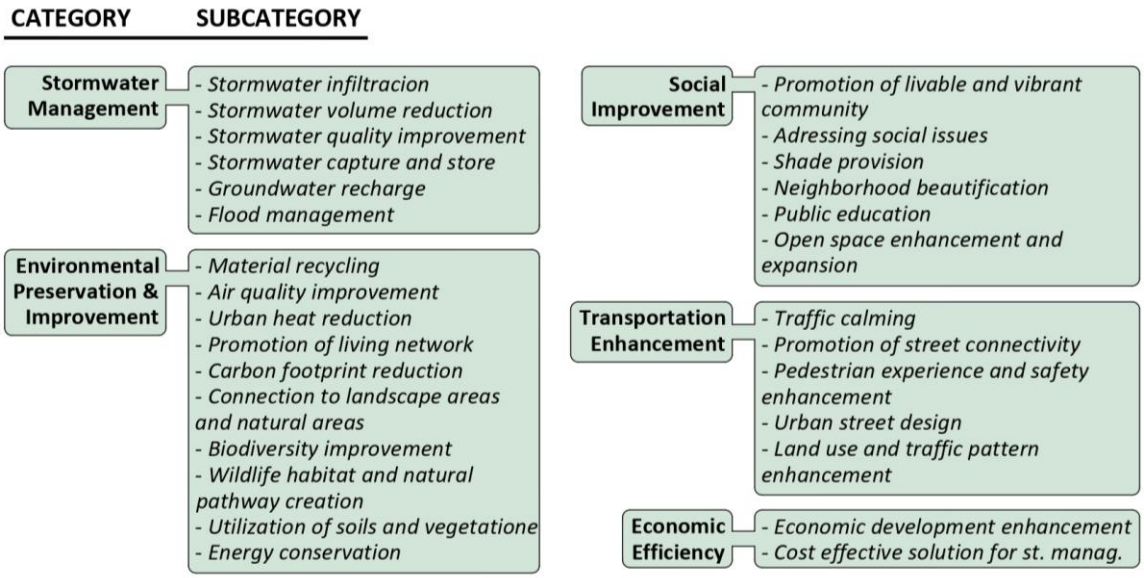


Figure 8: List of Green Streets benefits across various categories
Source: Author, based on previously research conducted

Although the implementation of green streets brings numerous benefits, it is important to also highlight certain limitations and drawbacks of this concept. Implementing green streets requires significant initial investments in infrastructure, plantings, and installation of maintenance systems, which can be challenging. Additionally, the regular maintenance of plants and green areas can be expensive and demanding. In terms of spatial limitations, it can be difficult to find sufficient space for the implementation of technical elements of green streets in urban areas, especially in densely populated regions and central city zones. Furthermore, certain weather factors, such as strong winds, droughts, or floods, can complicate the maintenance and long-term functionality of green streets. The realization of projects based on this approach often requires long-term planning, as well as the involvement and collaboration of various relevant stakeholders.

Despite all the challenges associated with implementation, green streets enrich the urban landscape, create healthier living spaces, and help mitigate the negative effects of climate change. Investing in them represents a strategic step toward building sustainable, resilient, and functional urban environments. In conclusion, the future of our cities lies in our ability to recognize the value of green solutions and integrate them into the core of urban planning. Only through collective effort and innovative approaches can we build cities that are prepared to face the challenges of today and provide their residents with a high quality of life.

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PLANNING FRAMEWORK FOR (RE)DEVELOPING PUBLIC OPEN SPACES IN RESIDENTIAL NEIGHBOURHOODS: CASE OF BELGRADE (SERBIA)

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ABSTRACT

In urban planning and design disciplines, public open spaces (POS) have been recognised as an important quality of life factor whose development should be supported by planning regulation and design guidance. Although in theory there is a general agreement on what good quality of POS is and how to achieve it, in practice, the treatment of POS in urban planning stands in the close relation to the specific development context. In that sense, the changes in social, political and economic system induce changes in how public open spaces are conceived and regulated through urban planning. This paper deals with post-socialist transition of Serbia and reviews standing planning framework for (re)developing public open spaces in residential neighbourhoods, taking Belgrade as a case. It explores POS treatment in the key strategic and planning documents in order to recognise potential cause-and-effect relationships between the current planning framework and the development characteristics of residential POS, by investigating: 1) POS treatment within the regulation related to the existing modernist large housing estates, and 2) POS treatment within the regulation related to new multi-family housing. Critical analyses of conceptualisation, planning standards and guidelines for POS reveals changes in planning approach in the new post-socialist urban development context, as well as diversified modes of POS treatment in relation their (un)recognised value, purpose and location in the city.

Keywords: *public open space; planning framework; residential neighbourhoods; multifamily housing; post-socialist development*

1. INTRODUCTION

Public open spaces (POS) are constitutive elements of urban structure and important quality of life factor in the city. By enabling socialisation, recreation, contact with nature, urban mobility, symbolic, ecological and many other functions, POS contribute to the overall experience of urban living. For all these reasons their development is recognised as important for urban quality and therefore supported by planning regulation and design guidance. It seems that in theory there is a general agreement on what good quality of POS is, so today POS planning at local level considers their quantity, accessibility and connectivity as well as different quality dimensions at both POS system and location level (Carmona et al. 2008; Živkovć et al. 2019).

But how these qualities are to be achieved in practice, depends on how POS is conceptualised and regulated through urban planning in a specific social, spatial and development context (Vasilevska et al.2020). In that sense, it can be assumed that the changes in social, political and economic system may affect the way public open spaces are conceived and regulated through urban planning, and that these changes may diminish the

quality of both existing and newly planned POS. This issue is of special importance for residential POS in multi-family housing areas and large housing estates (LHE) in post-socialist transition context. Existing research on post-socialist transformation of POS recognises the problems of their underuse, decay, reduction, privatisation etc. and relate them to urban planning approaches (Vasilevska et al.2014; Vasilevska et al.2020).

To contribute to this line of the research, this paper deals with POS treatment in urban planning in the context of post-socialist transition of Serbia. In order to reveal how new development context affects the POS planning at local level, the paper reviews standing planning framework for (re)developing public open spaces in residential neighbourhoods taking city of Belgrade as a case. After introducing theoretical framework, the paper explores POS treatment through content analysis of the key strategic and planning documents. It critically analyses the conceptualisation, planning standards and guidelines for: 1) POS treatment within the regulation related to the existing modernist large housing estates, and 2) POS treatment within the regulation related to new multi-family housing.

2. URBAN PLANNING AND PUBLIC OPEN SPACES DEVELOPMENT

Public open spaces are social spaces that are open and accessible to people. They are simultaneously part of both urban open space system and of public sphere, and as such they are planned and designed to fulfill different social and environmental functions (Živković et al. 2019). In general, they are expected to be „secure, accessible, inclusive, connected, easy to understand and maintain, relate to local context, and incorporate the highest quality design, landscaping, planting, street furniture and surfaces"(GLA, 2011:215). To meet a range of human needs, people need the variety of public open spaces in their local living areas. They need places to meet, to linger, transit or to rest, to have a contact with nature, to participate in variety of recreational activities (Carmona et al. 2008). Urban planning aims to address these needs, and provide for quality POS especially in residential areas. It does so by defining quantity and quality standards and regulations in a way that reflects local needs, values and development goals in specific social, economic and political context.

But, how planning framework shapes the development characteristics of residential POS is not a simple question. At one level, the way in which urban planning influence POS variety, accessibility, quality and quantity depends on planning system and how the topic of public, open or green spaces planning is integrated into it. Different planning systems relate differently POS planning with different spatial planning levels and sectors of development (GLA, 2012). Besides that, Maurani and Amit-Cohen (2007) recognise two main value bases for open space planning that shape the logic of its treatment in urban and spatial plans. These are: *provision* of recreation and other services to society and *conservation* of natural values. At another level, when it comes to POS in multifamily housing, two main lines of influence on residential POS development through development strategies and urban planning can be recognised. The first one is *direct*, when the strategy or plan directly addresses public, open or green spaces as a constitutive topic. In this case POS system or individual POS type is recognised, valued and regulated in order to achieve expected quality level (PLA, 2013). The other one is *indirect* and is related to how housing development is conceptualised and regulated, consequently influencing the characteristics of residential POS of specific housing type (GLA, 2011, 2012). In addition, other development areas, such as mobility and infrastructure, culture and heritage, environmental quality issues, also have indirect influence on how POS is regulated and delivered through urban plans. All these factors will be considered in the review on planning framework for developing POS in post-socialist Belgrade, in the next section.

3. PLANNING FRAMEWORK FOR (RE)DEVELOPING RESIDENTIAL PUBLIC OPEN SPACES IN POST-SOCIALIST BELGRADE

3.1. Post-socialist Belgrade

Belgrade is the capital and the largest city in Serbia (Census 2022), and has a status of a special administrative and territorial unit with its own local self-government. It is also the most densely populated territorial unit and urban area which accounts for 42,1% of Serbia's GDP (Census 2022). As the capital of former Yugoslavia, the city experienced rapid expansion in the second half of the 20th century. In order to provide homes to a large number of new inhabitants, the socialist government built the largest new settlement on Balkans - New Belgrade. Numerous large housing estates (from here on, LHEs), built in the form of super blocks with generously dimensioned greenery and public open spaces became the main physical and functional manifestation of the New Belgrade, but also other modernist LHE's built at the outskirts of the city.

At the beginning of the post-socialist era, during 1990s, Belgrade faced an economic decline and substantial social and structural changes such as de-industrialization and formation of brownfields, illegally built dwellings and commercial spaces, filling in, decline and privatization of POS, etc. But aftermath, in 2000s, the city attracted a large share of investments in banking, retail and office developments, and solidified its position of a financial and business centre in the Balkan region. The real estate market has become one of the strongest economic sectors in Serbia in recent years, with Belgrade experiencing intensive expansion. It is marked by development of the new multi-family housing types (mix-used complexes, gated communities, etc.) where investors are domestic and foreign private companies. Changed circumstances such as privatization, unregulated institutional and planning conditions, relaxed legal culture, etc. caused the changes in the treatment of POS in newly built housing areas. This was reflected in their disappearance (gated communities), reduction (compared to the standards of the previous period) and privatization of POS (PDPOS). At the same time, POS within numerous Belgrade's LHEs were exposed to transformation due to densification of the LHEs. How this was supported by changes in strategic and urban planning will be analysed in the next section.

3.2. POS in strategic and public policy documents

Strategic and public policy documents form the basis for urban planning approaches to specific issues. At national level The Strategy of Sustainable Urban Development of Serbia until 2030 considers the problem of POS and recognizes the need for strategic action both directly and indirectly. POS within inherited and new multi-family housing is treated within the framework of strategic direction and measures related to the arrangement of settlements and general POS improvements, as well as within the strategic directions for the environmental and cultural heritage and protection. The expressed strategic commitment can be understood as a key planning potential for the implementation and operationalization of activities related to POS.

At the city level, the umbrella strategic development document is the Development Strategy of the City of Belgrade until 2027 (Strategija razvoja Grada Beograda do 2027. godine), which is adopted as a public policy document in accordance with the Law on Planning System of the Republic of Serbia. Multi-family housing and residential POS are treated indirectly, through broader development priorities, goals and measures. Potential goals and measures which can be related to residential POS in multi-family housing are shown in Table 1.

Table 1: Potential measures related to POS within multi-family housing in the Development Strategy of the City of Belgrade until 2027

Development priority: Improvement of social cohesion, openness and equality		
Priority goal 3: City without barriers.		
Measure 3.1.	Removal of physical obstacles to movement	
Priority goal 4: A city for young people		
Measure 4.6.	Free time and youth mobility	Projects (selected overview) • Investment in pedestrian, sports and park infrastructure • Ensuring the multifunctional use of built spaces for the needs of young people (sports facilities, cultural facilities and open spaces for young people)
Development priority: Human-made traffic		
Priority goal 1: Sustainable urban mobility		
Measure 1.2.	Increasing the share of walking in daily movements and improving the pedestrian infrastructure	Projects (selected overview) • Realization of new and expansion of existing pedestrian zones, integrated streets and areas, super-blocks and spaces, the rearrangement of street furniture, traffic signals in pedestrian zones and integrated streets • Securing areas intended for pedestrians from parking vehicles and other contents that take up space and/or obstruct the movement of pedestrians
Measure 1.3.	Increasing the share of bicycle traffic in daily movements and improving bicycle infrastructure	
Measure 1.5.	Ensuring the availability and accessibility of the most important elements of the traffic infrastructure to all citizens	
Priority goal 2: Safety of traffic and public spaces		
Measure 2.3.	Increasing the security of public spaces	Project (selected overview): Formation of green corridors
Development priority: Planning and development of a sustainable city and urban infrastructure		
Priority goal 1: Adoption and implementation of urban development plans of the City		
Measure 1.1.	Urban planning for the development of residential areas	
Measure 1.5.	Urban planning for development of green areas and areas not intended for sports, culture and recreation	Projects (selected overview): • Installation of urban and children's furniture in the municipality of Obrenovac • Landscaping of the municipality of Obrenovac • Design, construction and arrangement of public green areas, parks and recreational and other public areas in the municipality of Obrenovac
Development priority: Sustainable growth and development of the urban environment		
Priority goal 1: Protection and improvement of air quality		
Measure 1.3.	Preservation of biodiversity, natural values and protected natural assets	Project (selected overview) • Improvement and protection of public green areas - increasing the quality of maintenance of public green areas – renovation damaged and degraded public green areas

3.3. POS in urban planning documents

The review of planning framework for (re)developing POS in residential neighbourhoods considers plans relevant for post-socialist urban transformation of Belgrade. It includes the following: 1) two general urban plans - Master Plan of Belgrade 2021 from 2003 (Generalni plan Beograda 2021) (from here on, MPB 2003) and Master Urban Plan of Belgrade from 2016 (Generalni urbanistički plan Beograda iz 2016 (from here on, MUPB 2016); and 2) two general zoning plans - General Regulation Plan for the Building Area of the Local Self-government Unit – the City of Belgrade (Units I-XIX) (Plan generalne regulacije građevinskog područja sedišta jedinice lokalne samouprave – grad Beograd, celine I – XIX (from here on, GRP-CB 2016) and Plan of General Regulation of Green Areas System of Belgrade from 2019 (Plan generalne regulacije sistema zelenih površina Beograda iz 2019) (from here on, GRP 2019). In order to enable revealing the relation between planning values and solutions, each of these plans is presented according to their development context, goals, concept and character of regulation it provides.

3.3.1. Master Plan of Belgrade 2021 (MPB 2003)

Context. In the first years of transition, marked by radical social, economic and political changes, urban planning takes on a completely new dimension. In such environment, MPB 2003 is being developed aiming to support on-going socio-economic changes.

Goals. MPB 2003 envisioned Belgrade as a cosmopolitan and European city, which maintains traditional elements that make its unique character. For housing development, the MPB 2003 suggests that maintenance of the existing LHEs will be of primary importance. On the other hand, the new economic system will produce new social differences, in which it will be necessary to meet the demand for the quality housing by more affluent population, while at the same time supporting the development of economically accessible housing.

Concept. Spatial organization should support transformation of the urban fabric with the appropriate construction on the new locations that should support the economy-driven development. A system of public greenery as a kind recreational resource and ecological infrastructure is proposed, as well as new housing construction in response to new needs of city dwellers. Urban development should open up possibilities for large scale urban projects, while at the same time respecting the needs of small investors to build in almost every urban location. Four main spatial-functional zones (central, middle, outer and marginal) with 57 urban areas with special character of Belgrade are defined in which different interventions can be expected during the implementation period(Fig. 1a).

Regulation-rules of arrangement and construction. Plan recognises housing in the open block and provides regulation for existing urban blocks and new housing development. In existing housing areas it aims to support specific values of modernist LHE so it provides restrictive quantitative parameters for its further transformation and qualitative recommendations for its improvement. It enables transformation of the modernist LHE open blocks based on detailed plans in a way that takes into account its conceptual, cultural and natural values. When needed, the additional parking should be provided, while protecting existing valuable greenery. When allowed, new parcelation of LHE should provide parking and green areas with min. 12-15m2/inhabitant and 1m2/st (min 100-150m2) for children's playgrounds including minimal area and distance standards for each category. For in park-like areas, the new construction is forbidden. In some cases, development of existing LHE is linked to formation of new linear centres and defined in relation to the location and specific character of the urban area. For new housing development, the Plan expresses the need for diversification of housing types. Urban parameters and guidelines are defined for new housing development at urban block and building plot level. Specific development guidelines are provided for each of 57 units, and, for example, in New Belgrade, Plan suggests the continuity of modernist urban planning character. The need for new commercial space is recognised, while at the same time public spaces are defined as valuable urban resource. The necessity for protection of urban and architectural design concept is recommended, while the development along some main streets has been planned for new linear mixed-use centre.

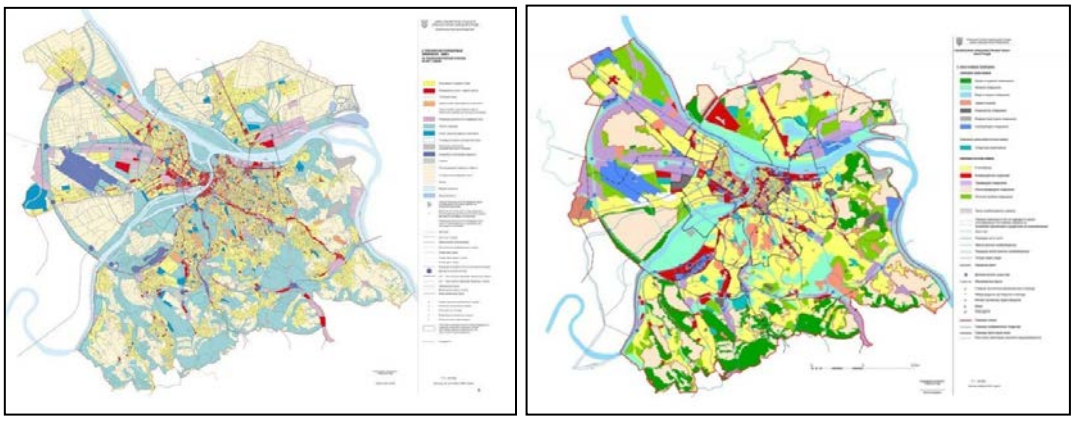
3.3.2. General urban plan: Master Urban Plan of Belgrade (MUPB 2016)

Context. MUPB 2016 was prepared in the circumstances of the substantial legislative changes. The concept of urban development and the strategic determinations of the MPB 2003 were retained in MPB 2016 and harmonized with the changed priorities of the City (Fig. 1.b).

Goals. Belgrade is envisioned as sustainable compact city, competitive in the south- Eastern Europe. To achieve this, creating and promoting city identity through natural and cultural heritage protection but also through integral development projects in key city locations (urban riverfronts) was proposed. Development objectives relevant for POS planning included: urban renewal and intensive use of existing urban structures, mixed-use of all urban areas, rational use and preservation of the un-built land, preservation and promotion of cultural heritage, protection of nature, landscape and ecologically sensitive areas. In relation to multifamily housing, POS design objectives refer to preservation and improvement of quality residential fabric, construction of new residential areas, preservation and planning of green and recreational areas, infrastructural equipment, etc.

Concept. Previously defined elements of the long-term urban development conception (MPB 2003) are retained in the new MUBP 2016, harmonised with the necessary economic, demographic and social changes. The territory within the MUBP 2016 is divided into 20 spatially functional units, largely based on the previous division of space into 57 units introduced by MPB 2003. These 20 units were used for further planning elaboration of sub-units within plans for the general regulation of the construction area

Regulation- rules of arrangement and construction MUPB (2016) regulates new buildings and improvement of the existing housing blocks depending on housing type and location on city territory. Multi-family housing typology consists of three main types: 1) lower (up to P+4+ PK/Ps); 2) higher (up to P+8+PK/Ps); and 3) high (more than P+8+PK/Ps) housing. Multi-family housing in open urban block in existing LHE is recognised as valuable concept to be protected and improved. the Plan suggests formation of linear mixed-use centres along the streets that border existing LHE and suggests that new plots should be built without endangering the free, park-like parts of the settlement. New construction should preserve the visual identity of the open block and provide for adequate fitting into the context through the rules of architectural design. MUBP 2016 directly provides basic standards for green areas in open urban block for both existing and new multi-family housing. It recognises the immportance of green areas for meeting the needs of the local population. These areas function as a local parks and consists of park-like area for quiet rest, children's playgrounds and playing fields, and should meet the standard of 15-16 m²/apartment. In existing blocks, the construction of new buildings is not allowed. But, although MUBP 2016 recognises open and green spaces of LHE as important asset, it does not treat them under category of POS. New multi-family housing is planned through different housing types on specified locations. General guidelines and norms are provided related to heritage preservation, public space protection and development, parking regulation, and building regulation that protects ambience values and arrangement of inner block open spaces. These guidelines are specified for each urban zone (central, middle, peripheral) while specific building rules and parameters should be defined in General regulation plans.



(a) (b)

Figure 1: (a) Master Plan of Belgrade 2021 (MPB 2003) and (b) Master Urban Plan of Belgrade (MUPB 2016)

3.3.3. General zoning plan: General Regulation Plan for the building area of the local self-government unit – the City of Belgrade (units I-XIX) (GRP-CB 2016)

Context. The conception of this plan represents continuity with the MPB 2016, which forms the planning basis for this plan.

Goals. As a general zoning plan, subordinated to general urban plan, GRP-CB 2016 has the same development goals as the MUPB 2016.

Concept. GRP-CB 2016 teritory include city municipalities divided into 19 specific units. Development recommendation is given for each of these units, while taking into account their specific character and structure. Within each unit specific character areas were recognised and treated accordingly through general and specific guidelines. Within this plan, LHE were recognised as specific development area in New Belgrade but also treated in other specific locations throughout Belgrade. The use of space is related to its publicity and divided into areas of public and other uses. Regulation of each of the 19 units is provided through defining: a) Planned use; b) Implementation plan, and c) Area for direct application (Fig 2a).

Regulation-rules of arrangement and construction. Improvement of existing and development of new multifamily housing is regulated under this plan following the housing typology and location in city territory. Ten different residential zones with the same construction rules are defined, including Multifamily housing zone in existing settlements – open block (C9), and Housing zone in new complexes (C 10). Rules for building housing zone in new complexes provide direct regulation for free and green areas according to the type of housing, while the minimum percentage of green areas in direct contact with the ground is 30%. Besides that, the new housing development that refers to either transformation of LHE or to new building locations, is also regulated by Building regulation and rules for mixed city centre zones. Regulation for free and green areas specifies that their percentage within the building complex is min. 65%, and on the construction plot it is min. 50%, while the minimum percentage in direct contact with the ground is 30%. It also states that within the green areas in the existing open residential blocks, the construction of above-ground or underground structures is not allowed. Exceptionally, the construction of infrastructure facilities and/or underground garages is allowed, on the surface of a maximum of 1% of the total green area (of the block). Regulation for parking places refer to specific norms and regulates location and construction of underground garages when they are planned within green areas.

3.3.4 General zoning plan: Plan of General Regulation of Green Areas System of Belgrade (GRP 2019)

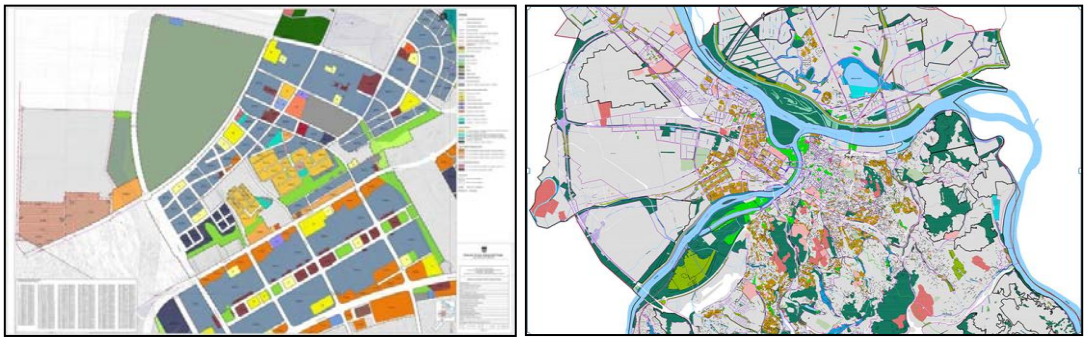
Context. Belgrade's determination to plan the city based on principles sustainability forms the main basis of the Plan. MUPB (2016) states that "Realization of the system of green areas implies a change in their status from subordinate to primary city infrastructure" and makes necessary to develop the city's "Green regulation" to establish rules for green areas system management and the Plan is the final phase of this project (Fig. 2b).

Goals. The Plan aims to create a holistic planning basis for preservation and improvement of existing forests and green areas and achieving their multi-functionality, for enhancing the typology of green areas, for preservation of valuable biotopes (habitats), for providing locations for the new forests and green areas, etc., in order to establish a unique system of green areas in Belgrade in line with European standards.

Concept. Belgrade's green areas system is based on the principles of connection, multi-functionality, accessibility, nature conservation and improvement of Belgrade's landscape character. The planning concept refers to: 1) preservation and 2) improvement of existing green areas; and 3) planning of new green areas. The elements of the system include both green areas within public purposes, and those within other purposes. The system is planned in six spatial-functional units, namely: 1) "core"; 2) "inner ring"; 3) "outer ring"; 4) "green connections", 5) continuously built urban fabric; and 6) discontinuous built-up area system of green areas

Regulation-rules of arrangement and construction. Rules of arrangement and construction are defined as general and specific. General rules refer to urban space protection measures for landscape and nature, cultural values and views, protection from disasters, erosion and floods and other. Specific norms for POS in LHE and new multi-family building are given, as well as General rules for public green areas and include: 1) rules for preservation, arrangement and reconstruction of existing and 2) rules for building new public green areas. POS and greenery within residential and mixed city centres is treated by General rules for green areas within other purposes. Residential green spaces are regulated following the typology provided by GRP-CB 2016 and specific rules are determined for multi-family housing in open block system. For example, for "Multi-family housing zone in existing organized settlements - open block (S9)" green areas are recognised as public good, and their planning, arrangement and maintenance as activities of general interest. The Plan defines their permitted use and regulates design and arrangement. Location, size, natural features, arrangement, equipment and the quality of maintenance are defined in line with the dominant function of each public green area. The minimum green spaces should be 20 m² per capita and for new green spaces in open urban blocks, guidelines foresee planting of woody trees to enable shade of 50% of the plot area, use of all age groups and greening of parking areas. For zone S10 - housing zone in new complexes spaces, min. of green spaces on building plot should be in accordance to the zone, with minimum % with direct contact to ground (30% in line with GRP and 35% for inner

ring).Rules of arrangement and construction for direct application relate to open residential block through the Rules for preservation, improvement and reconstruction of existing public green surfaces in open residential blocks. The relationship of GRP for green areas to the PGR of the construction area of Belgrade is defined and changes to GRP are specified and related specifically to public green areas. Other green areas are fully implemented according to the PGR of the construction area of Belgrade. In that sense, PGR of green areas system of Belgrade (2019) doesn't have obligatory status and is subordinated to GRP for the building area of the local self-government unit – the City of Belgrade.



(a) (b)

Figure 2: (a) General Regulation Plan for the building area of the local self-government unit – the City of Belgrade (units I-XIX)(2016) and (b) Plan of General Regulation of Green Areas System of Belgrade (2019)

4. DISCUSSION AND CONCLUSIONS

The post-socialist transition of Serbia was followed by changes in urban planning that reflects the withdrawal of the state and prioritization of private investments in urban development. Taking Belgrade as a case, our review of conceptualisation, planning standards and guidelines for residential POS development reveals both changes and continuities in planning approach as compared to previous period. The continuity is reflected in a fact that POS social and environmental values are recognised in all analysed documents. The changes refer to how these values are interpreted and operationalized in post-socialist urban planning documents.

In all analysed documents POS development is recognised as important quality of life factor and treated in both direct and indirect way. While Development strategy of Belgrade treats POS indirectly in relation to different social, environmental and economic priorities, all analysed urban plans provide also a direct POS planning recommendations, but their specificity vary between types of plans and spatial organisation they propose. In that way, residential POS is planned for both conservation of natural values and for recreation and other services. Recognised as Belgrade's modernist heritage, POS in urban open blocks is protected and regulated. But, although holistic and systemic view on open space planning is declared as important goal, its implementation was not consistently integrated into planning documents. It is developed in detail in GRP 2019, but since this plan is not of obligatory nature its planning solutions are not treated as priority.

Indirectly, in urban plans POS characteristics are shaped by the diversification of new housing types and through the guidelines to improve the existing ones. The new element in planning are diversified modes of POS treatment in relation their value, purpose and location in the city. Unfortunately, certain general planning directions in favour of new private investments affect POS in inherited and newly planned residential areas. In order to commercialize and intensify the use of urban space, quantity and quality norms for green and open space are adjusted to specific urban zone and building type, which in some cases leads to the reduction of POS quantity and reduces its potential for multifunctional use. As a consequence, in the peripheral transformation of inherited LHE as well as in some new multifamily housing, POS becomes scarce and monotonous.

We can conclude that although post-socialist strategic and urban planning in Belgrade enabled continuity in recognising residential POS development as important for life quality as well as a part of modernist heritage, it enabled certain reduction of POS quantity and quality and didn't manage to provide a coherent view and POS recommendations that are well integrated with other development sectors and between urban plans. In this way, residential POS destiny depends on the interpretation of unrelated guidines and (comercial) development priorities in lower level planning documents. Further research should focus on this problem, as well as on how some good planning solutions change during planning process in a way that does not prioritize public interest.

ACKNOWLEDGEMENTS

This research was supported by the Science Fund of the Republic of Serbia, GRANT No 7572, Project Reclaiming Public Open in Residential Areas: Shifting Planning Paradigms and Design Perspectives for a Resilient Urban Future - RePOS.

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ICUP2025
5th international conference on urban planning

PUBLIC BUILDINGS IN THE VILLAGES OF ALEKSINAC MUNICIPALITY-CONDITION ASSESSMENT AND POSSIBLE REUSE OF FORMER "CULTURAL CENTERS"

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ABSTRACT

During the last decade the local government of the Municipality of Aleksinac initiated the reconstruction of public buildings in the villages belonging to its territory. During this process most of the buildings, so-called "domovi kulture" ("cultural centers"), were recorded and revitalized. The manner in which this job was done is based on the local policy which does not necessarily have a sustainability plan. The recording of several of these facilities was conducted and rehabilitation plans designed were designed for all of them. This paper aims to show the number and condition of these buildings, as well as to analyse the way in which their restoration and new(old) purpose is defined during the reconstruction. Also, it will refer to the origin of these buildings and the circumstances under which they were built and how most of them were abandoned over time and left to decay. The potential of these buildings and their importance for the quality of life of local communities will also be discussed in this paper.

Keywords: *urban planning; revitalisation; cultural center; public buildings; reuse; redesign*

1. INTRODUCTION

The municipality of Aleksinac is situated in southeast Serbia, covering the area of 707 square kilometers, with 72 settlements, but only around 40.000 inhabitants (Serbian Republic Institute for Statistics, 2024).

During the last decade the local government has been working very intensively on reconstruction of public buildings and spaces in the rural areas of the Municipality. Beside the local administration, republic institutions recently also have had several different programs, formulated in various ways to encourage local communities to rebuild their own "cultural centers".

When it comes to culture, we can say that practically every settlement in the Municipality of Aleksinac has a building called "dom kulture" ("cultural center") or even officially registered in the cadastre as such, but usually they are not in use as cultural centers or not in use at all.

From official data of the Republic of Serbia statistics we learn that in the Municipality of Aleksinac in the year 2022, there was one cinema, one theatre and no museums at all. But if we search the web, we will find one museum in Aleksinac, that was established before 2022.

All together we realise that we have a huge potential in public buildings predefined as objects of culture, at least by their name, in almost every village, a lack of cultural institutions in general and most likely insufficient visibility of the existing ones. On the other hand, there are some initiatives that are moving in the positive direction, but we still wonder what their real purpose is and could they be sustainable investments.

2. HOW, WHEN AND WHY DID WE BUILD SO MANY "CULTURAL CENTERS" IN SERBIA?

In their essence cultural centers should be occupying an important place in the everyday life of the cities, municipalities and villages (Ristić, 2014). Their main function is to bring cultural events closer to people of all ages, regardless of education, origin and lifestyle preferences.

Therefore, first we need to deal with the name "dom kulture" ("cultural center") and literally it means "the home of culture". The idea behind the "home of culture" is humanist, "enlightening" and educational, but there is a big difference between those public buildings depending on the scale of the settlement they are placed in and the number of public they are attracting.

Some forms of the first "cultural centers", or better "premises of culture" appeared in Serbia in the second half of the XIX century, together with the European "wave of culture". Between the two world wars they will acquire much clearer forms, both architecturally and in terms of the cultural programme.

After the Second World War this will transform into a not so clear, but at the beginning a very strong mission of the great Yugoslav country. Although mostly utopian, Malraux's[1] concept of the specific national cultural form opposed the Soviet availability and necessity of consuming culture for all, but in Yugoslavia it resulted in the construction and formation of a large number of "cultural centers" that played a significant role in great cultural and economic transformation of the numerous, multinational and mostly peasant population. Sometimes it served simply as the source for elementary literacy and in other cases it produced avant-garde development of gifted individuals and culturally enlightened communities. Both extremes had an impact on the development of society in general.

In order to make things simpler and clearer, on this occasion, we will focus only on "cultural centers" in rural surroundings.

In March 1967, the Educational and cultural council of the Republican Assembly of the former Federal Republic of Serbia prepared and disseminated a document related to the problems of cultural life in the rural settlements and "cultural centers". The idea behind this activity was to collect information on the state of cultural centers re-formed or newly formed and developed between 1945 and 1967. This was supposed to be done with the help of a survey covering 177 municipalities. From the collected data we can learn many important pieces of information crucial to understanding of public life of the time and public buildings' role in it (Nikolić, M., Ivanišević, M., 1969).

For example, we can state the following facts about the rural "cultural centers":

- the "cultural" contents were very often mixed with the newly established "cooperative home" ("zadružni dom") in one building,
- beside churches and schools, these were the first public buildings in the rural areas, and
- they were usually given a central position in the village.

Most of the "cultural centers", and now it is clear why they are "so called", because they were not only "cultural", were built between 1945 and 1950 and very often their name was switched with the term "cooperative home". The idea was to build at least one "cultural center" for tree settlements.

The republican government developed designs for 8 types of those public buildings, because there were 8 types of villages defined at that time, according to their size (Nikolić, M., Ivanišević, M., 1969). Also, recommendations were given for construction that should follow the peculiarities of the vernacular architecture in the specific climate and geographical areas. On the other hand, we can see that the real possibilities of local communities played a crucial role, since all the construction work and construction materials were supposed to be obtained on the volunteer basis from the local people and local resources.

In general, "cultural centers" or "cooperative homes" were usually combining those two functions in one building. The program consisted of cooperative offices, stockrooms and stores, but also: libraries, reading rooms, cinema and theatre halls.

Between the years 1948 and 1968 the number of "cultural centers" in Serbia, by the official data, varies from 1068 to 2000, mostly because there was a confusion about the name and the function of these.

They had many problems in functioning, from the founding rights and ownership to the dispute about their role and purpose. Then again there was a continuous lack of equipment and staff and maybe most importantly lack of funds for their normal functioning.

1 Georges André Malraux (1901-1976) novelist, art theorist and French minister of cultural affairs.

Beside formal recommendations and attempts from both sides, government and locals, to make some kind of order in this area, not much was done, so the future of this ambitiously conceived idea was left to chance.

3. CONDITION ASSESSMENT AND RECONSTRUCTION PROJECT DESIGNS

From the statistical data in 1968 we cannot learn much about the "cultural centers" in the Municipality of Aleksinac, but we can say that it belongs to the best rated local governments, since it is placed in the group that has 61-90% of settlements with the existing "cultural center" (Nikolić, M., Ivanišević, M., 1969). So, we can tell that most of those public buildings were already constructed up until that year.

Beside the town of Aleksinac, there are 71 settlements belonging to its territory. From the year 2021 to the present 28 "cultural centers" were partially, or totally, a subject of some kind of reconstruction project[2]. They were budgeted at more than 800.000 euros[3].

Table 1: The list of "cultural centers" and their state before the reconstruction projects

Number	*Name of the settlement*	*Number of residents (in 2022)*	*Use of the building*	*Number of construction phases*	*Size of the building in total (m2)*	*In use*	*State*
1	*Aleksinački Rudnik*	*1014*	*"cultural center"*	*1*	*2360?*	*partially*	*neglected*
2	*Trnjane*	*1361*	*mixed*	*1*	*1000*	*partially*	*neglected*
3	*Bobovište*	*1074*	*mixed*	*1*	*600*	*no*	*neglected/ruin*
4	*Nozrina*	*743*	*mixed*	*2*	*632*	*no*	*neglected/ruin*
5	*Vrelo*	*355*	*mixed*	*1*	*608*	*no*	*neglected/ruin*
6	*Srezovac*	*238*	*miced*	*2*	*244*	*no*	*neglected/ruin*
7	*Prćilovica*	*2410*	*mixed*	*2*	*174*	*partially*	*neglected*

The author of this paper was involved in seven of these projects (Aleksinački Rudnik, Trnjane, Bobovište, Nozrina, Vrelo, Srezovac i Prčilovica), so this will be the main focus, showcasing the types, the design ideas and reconstruction process and the possible further steps in order to achieve sustainability and greater visibility for those potentially more valuable spaces and better used public buildings (Table 1 and Table 2).

Table 2: The list of "cultural centers" and their intended use after the reconstruction projects

Number	*Name of the settlement*	*The year of the project*	*Intended use of the building*	*Planned size of the building (m2)*	*Planned size of the new open space (m2)*	*State (in 2025)*
1	*Aleksinački Rudnik*	*2023*	*mixed*	*2360?*	*0*	*unchanged*
2	*Trnjane*	*2021*	*mixed*	*1000*		*reconstructed*
3	*Bobovište*	*2021*	*mixed*	*390*	*177*	*partially reconstructed*
4	*Nozrina*	*2021*	*mixed*	*419*	*213*	*unchanged*
5	*Vrelo*	*2021*	*mixed*	*290*	*318*	*unchanged*
6	*Srezovac*	*2023*	*miced*	*93*	*151*	*unchanged*
7	*Prćilovica*	*2023*	*mixed*	*174*	*110*	*reconstructed*

All reconstruction projects consist of the following parts: the existing state descriptions with technical and photo documentation, the newly designed state with the explanation of the proposed design, technical solutions and planned budget.

Project designs for cultural center reconstruction encompass a wide range of approaches, but generally we had to focus on the investors project tasks. Beside that the main guiding ideas were:

- Modernizing existing structures**:** This involved updating layouts for better accessibility and flow, integrating sustainable technologies, improving energy efficiency and general technical capabilities.

2 Villages included in the projects: Trnjane, Mozgovo, Glogovica, Donji Adrovac, Deligrad, Dašnica, Prćilovica, Tešica, Donji Ljubeš, Kulina, Bobovište, Moravac, Srezovac, Subotinac, Aleksinački Rudnik, Vukanja, Moravac, Aleksinački Bujmir, Korman, Ćićina, Grejač, Donja Peščanica, Gornje Suhotno, Draževac, Rutevac, Nozrina, Vrelo i Radevac. The used data origins from the official government tendering website (https://jnportal.ujn.gov.rs/).

3 The investor was the local government of the Municipality of Aleksinac. The used data origins from the official government tendering website (https://jnportal.ujn.gov.rs/).

- Preserving historical elements: Many "cultural centers" have significant historical value. Designs often strive to retain original features while blending them with contemporary additions. This was especially done in the cases where we had memorial plaques or some other historical assets.
- Creating flexible and multi-use spaces: Modern cultural centers often host diverse events. Reconstructions prioritize adaptable spaces that can accommodate exhibitions, performances, workshops, and community gatherings. This was especially important because not all spaces were given a final purpose by the Investor in advance.
- Open space arrangement: Some of the building parts were supposed to be demolished, but we used all the elements and material that could fit into new project designs, which include space for children, informal gathering, rest and recreation. Since the community was not officially directly involved in the projects we tried to build a successful design based on our previous experience. To meet their needs and desires in the best possible way, we were often incorporating, throughout the process, public input and feedback gathered during the field work.

In addition to the mandatory and required content the project designs have always considered sustainability and best solutions that would suit the local community and the Investor's priorities. Depending on the project task, different designs have been applied that can be innovative and economical at the same time.

3.1. Aleksinački Rudnik "cultural center"

Aleksinački Rudnik is physically connected to the town of Aleksinac on the north-west side. It is established as the residence of the local mine workers. The "cultural center" is in the central area together with other public buildings, like elementary school, post office, sports facilities and public park. The terrain is slightly sloped. Thanks to its location, next to the town, and to the importance and size of the mine belonging to it, this building looks more like those in cities. The owner is Municipality of Aleksinac and the total size of the built area of the "cultural center" is around 1800 m2 with variable number of storeys, so the total size is unknown since there is no available archival or other data.

The subject of the reconstruction project was only one part of the south-east wing of the building where the only functioning institution is located (the public library). On the same floor, the Municipality planned to relocate a part of the public health center, formally covering the Aleksinački Rudnik area, so this was the reason for a partial reconstruction. Beside the necessary works in the interior (155,36 m2), we also covered with this project design some exterior areas (95 m2), since this part was also neglected and positioned at the entrance of the exposed wing (Figure 1a and Figure 1b).



(a) (b)

Figure 1: (a) Aleksinački Rudnik "cultural center", south-east wing entrance, and (b) mural at the south-east wing dedicated to the tragically deceased miners

3.2. Bobovište "cultural center"

Bobovište is one of the largest villages in the Municipality, positioned in the plain, to the north-west of Aleksinac town. It is mainly agricultural, and its form is determined by the position of the main roads, so the houses are placed exclusively along them. The "cultural center" is also on the main road approach on the north-east side. Typically, it is right next to the elementary school, but in addition there is a World War II monument in the area and a memorial plaque from the same period placed on the building itself. The whole building was planned for reconstruction, but the west wing was supposed to be totally demolished due to its

poor condition. Its total size was around 600 m2, with elevated ground floor plus one storey not finished completely during the original construction (Figure 2a and Figure 2b). The owner is the Municipality of Aleksinac.

The planned activities were focused on the ground floor of the building, where once again a health center was supposed to be located. All the other enclosed spaces were not given a purpose by the Investor. Therefore, we proposed some contents. In the place of the west wing, we have organised multipurpose open public space.



(a) (b)

Figure 2: (a) Bobovište "cultural center", street facade, and (b) first floor appearance of the demolished west wing

3.3. Trnjane "cultural center"

Trnjane is also one of the largest villages in the area. It is positioned in the plain right next to the main roads, railway track and South Morava River, to the west of Aleksinac town. It is mainly agricultural. The "cultural center" is also located in the central area, by the main road, together with the elementary school. The owner is Municipality of Aleksinac and the total size of the "cultural center" is around 1000 m2, with ground floor plus one storey (Figure 3a and Figure 3b).

The subject of the reconstruction project was almost the whole building. On the same floor, the Municipality planned to relocate a part of the public health center, formally covering the Aleksinački Rudnik area, so this was the reason for a partial reconstruction. Beside the interior works we also included works on the exterior of the whole facility as well on the free space in front of the building. None of the building parts were intended for partial or total demolition.



(a) (b)

Figure 3: (a) Trnjane "cultural center", street facade, before reconstruction and (b) after reconstruction

3.4. Nozrina "cultural center"

Nozrina is a medium-sized rural settlement located to the south of Aleksinac. It is positioned in the plain right next to the main roads, railway track and South Morava River, the activities of the locals are based mainly on agriculture. The "cultural center" is also located in the central area, on the crossroads, but not by the main road, where other public buildings are placed (Figure 4a). The owner is Municipality of Aleksinac and the total size of the "cultural center" is around 632 m2, with ground floor only.

The subject of the reconstruction project was the whole building, but the north-west wing, which represents the older construction phase, was planned for total demolition due to its poor condition. In this case, because

of lack of free space this was done, and the open space was rearranged as a small park. The owner is the Municipality of Aleksinac.



(a) (b)

Figure 4: (a) Nozrina "cultural center", street facade, and (b) Vrelo "cultural center", street facade

3.5. Vrelo "cultural center"

Vrelo is a small village but in the hilly part of the Aleksinac Municipality, located to the south-east from the town. The "cultural center" is on the main road and on the crossroads. The owner is the Municipality of Aleksinac. There are no other public buidings in the vicinity. A World War II monument is placed on the same plot as well as one public drinking fountain. The total size of the building is 608 m2 (Figure 4b).

The whole building was planned for reconstruction, but the east wing was planned for total demolition due to its poor condition. There was no clear vision from the Investor of the new purpose. We decided to carry out partial demolition and to reuse one part of the wing as controlled open space for local community gatherings.

3.6. Srezovac "cultural center"

Srezovac is a small village, but it is physically connected with neighbouring settlements. Positioned in the plain, to the north-west of Aleksinac town it has good connection to the main roads. The "cultural center" is not on the main road, but on the crossroads. The owner is the Municipality of Aleksinac. The total size of the building is 244 m2 with ground floor only There are no other public buidings in the vicinity. A memorial plaque from World War II is placed on the building facade.

The whole building was planned for reconstruction, but the north-west wing, which represents the older construction phase, was planned for total demolition due to its poor condition. In this case, because of lack of free space this was done, and the open space was rearranged as a small park.

3.7. Prćilovica "cultural center"

Prćilovica is also one of the largest villages in the Municipality, positioned in the plain, to the south-west of Aleksinac, very close to the town center. The "cultural center" is located on the main road in the central part of the settlement. The owner is the Municipality of Aleksinac and the total size of the building is 174 m2 with ground floor only (Figure 5a and 5b). A memorial plaque from World War II is placed on the building facade. There are no other public buidings in the immediate vicinity.

Only part of the building was planned for reconstruction, but the important works are planned on the open space in front of the facility.



(a) (b)

Figure 5: (a) Prćilovica "cultural center", street façade before reconstruction, and (b) after reconstruction

4. DISCUSSION

The abandonment of "cultural centers" in villages due to depopulation presents both a challenge and an opportunity. While the loss of these once-vibrant hubs can be disheartening, their empty shells hold the potential for renewal. By embracing a mixed-use approach to their reuse, these buildings can be transformed into vital community assets that address a range of local needs.

Given the absence of other public buildings in these villages, repurposing former "cultural centers" becomes even more crucial. They can house essential services like libraries, healthcare clinics, or post offices, while also providing spaces for social interaction and cultural expression. This could include community kitchens, co-working spaces, workshops, or even small museums dedicated to local history.

The key to successful reuse lies in community engagement. By actively involving residents in the planning process, we can ensure that these revitalized spaces truly reflect their needs and aspirations. This participatory approach fosters a sense of ownership and empowers communities to shape their own futures. Ultimately, the adaptive reuse of former "cultural centers" offers a powerful tool for rural revitalization, transforming relics of the past into vibrant hubs for the future.

There are several good examples of reconstruction of "cultural centers" and other public buildings in the villages. One of them is additionally involving academic society, professionals in cultural heritage revitalisation, professors and students of architecture. Through the projects called "Stara, ne dam te" ("Old I want give up on you") and "Stara kao nova" ("Old as new"), this kind of campaign was realized in Pirot District by the Faculty of Architecture from the University of Belgrade with the help of many stakeholders and donors. In this way everybody wins, we get fresh ideas for the project, the local community is given a sense of importance and students get real-world experience (AFUB, 2020).

Another case study can be shortly presented in order to showcase a completely different aproach. The initiative is called "Gostuša conservation project". It was started by the Institute for cultural heritage preservation in Niš in 2011. and was supported by the Ministry of culture of the Republic of Serbia, to preserve the unique cultural, natural and spatial values of a village, again located in Pirot District. Further the project was developed by the Architect Aleksandar Radovic Foundation, an organisation belonging to the non-governmental sector. Some of the main activities were focused on reconstruction of public buildings, a local community center and a local church. The financing was obtained throughout grants supported by the European Union and Europa Nostra. Projects were realized on a voluntary basis including youth from all over the world attracted by the camps and summer schools organized there and awarded by the several most prestigious European awards in the field of cultural and natural heritage preservation (Vasić Petrović, E., 2019).

There are also numerous examples from the European Union programmes where the factors affecting the rehabilitation of the public buildings are carefully analysed and formulated through specific calls for funding, while at the same time they are aligned with the main official agendas in different areas (European Commission, 2022). Serbia is a part of the IPA (Instrument for pre-accession assistance) Funds Action Programme which sets out priorities for European Union financial assistance to support our country in the integration process (EU in Serbia, 2014).

5. CONCLUSIONS

In conclusion we can say that independently of any other initiatives or support programmes, it is crucial for the local governments to recognize that simply investing in the reconstruction of public buildings is not enough. Sustainable revitalization requires a commitment to giving these spaces a clear purpose, driven by the genuine needs and aspirations of the community. This means actively involving residents in the planning process, ensuring their voices are heard and their priorities are reflected in the final outcome.

Without this participatory approach, these projects risk becoming unsustainable, failing to engage the community and ultimately falling into disuse once again. Furthermore, we can clearly see that there could be a lot more than a local initiative, since there are so many active organisations, formal institutions and individuals dedicated to the common good and willing to share their time, knowledge and ideas to make it come true.

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SACRAD CULTURAL HERITAGE AS A DYNAMIC ELEMENT OF URBAN IDENTITY

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ABSTRACT

In the modern world, cities and regions are dynamic sites of change where the past and the future intersect in unique ways. These areas are not merely geographic entities; they are complex sociocultural and economic structures that continuously evolve under the influence of migration, urbanization, and technological advancement. In this context, sacred heritage plays a crucial role, but its preservation and integration into the urban environment pose challenges due to the evolving needs of communities. This research is founded on the belief that the dynamic preservation of sacred cultural heritage strengthens community identities and fosters sustainable urban environments. The primary goal of this study is to understand the complex interactions between sacred heritage and urban or regional contexts. Specifically, it aims to explore how sacred heritage serves as a vital component of the identity framework of cities and regions, as well as its role as a catalyst for urban and regional development, contributing to cultural heritage, the economy, and social connections. The anticipated results are expected to identify key factors and strategies for the successful preservation and integration of sacred heritage into contemporary urban contexts, thereby supporting sustainable development and enhancing cultural appreciation.

Keywords: *sacred heritage; identity; preservation; cultural heritage; sustainable development; urban landscape*

1.INTRODUCTION

Cultural heritage represents a valuable resource that shapes the identity of cities and urban areas around the world. In the contemporary context, we are faced with the challenges of urbanization, rapid development, and the need to preserve the authenticity and richness of cultural heritage. For this reason, the theme of this research reexamines the role of cultural heritage, with an emphasis on sacred cultural heritage, as an important factor in urban development, analyzing the challenges and opportunities that arise in the process of integrating sacred heritage into urban space. Cultural heritage is a deeply rooted part of the identity of every city and region, enriching and shaping their character throughout the centuries. 'Cultural heritage encompasses a wide range of material and immaterial creations, which, in its essence, is one of the foundations of national roots and identity, and only when accepted as a value in its own environment does it acquire a supranational dimension' (Golubović 2014, p. 363). The rapid development of cities, urbanization, and changes in social and economic structures lead to the reshaping of the urban fabric and often pose a threat to the preservation of authenticity and the integrity of heritage.

The subject of this research concerns the possibilities of integrating sacred cultural heritage into urban strategies and policies that take into account the rapidly growing and changing characteristics of cities. We will focus on a specific example – the Đurđevi Stupovi Monastery, one of the most important cultural assets of Serbia, located in an area that is rapidly urbanizing and susceptible to commercialization, particularly through the development of tourism. By analyzing this heritage through the lens of contemporary urban changes, the question arises of how the preservation of cultural heritage can be aligned with the needs of the modern community, taking into account people as the center of all urban strategies.

Starting from the hypothesis that sacred cultural heritage can be successfully integrated into urban planning and processes through a holistic approach, which not only preserves the historical significance of monuments but also contributes to the socio-economic sustainability of the community, the research will demonstrate that

the approach to the issue should be based on finding a balance between the needs and interests of all stakeholders, whether it concerns the local population, believers, the monastic community, or visitors. All activities and solutions should be directed toward a harmonious coexistence and the preservation of the monastery as a space of incomparable significance for both the community and the individual.

The purpose of this research is to analyze the challenges and opportunities of integrating heritage into modern urban development, using the Đurđevi Stupovi Monastery as a specific case study. The aim of the research is to develop recommendations for an urban planning approach that enables synergy between the preservation of cultural heritage and the dynamic needs of contemporary cities, with a particular emphasis on involving the local population and the monastic community in decision-making processes.

The methodology that has been applied in this research is based on the theoretical analysis of relevant approaches and concepts related to urban planning, cultural heritage preservation, and sustainability in urban environments. In addition, a specific case study of the Đurđevi Stupovi Monastery has been analyzed, focusing on its urbanization and tourism-driven commercialization, and examining ways in which these changes can be directed to preserve the balance between the needs of the city and the protection of valuable sacred heritage.

2. CONCEPTUAL FRAMEWORK

In this chapter, key authors and theories that have shaped contemporary practices of cultural heritage preservation in the context of its integration into dynamic urban flows will be presented. The focus will be on methods that emphasize a holistic approach, as well as the social and cultural factors that are essential for proper preservation today, with particular attention given to the preservation of sacred monuments.

One of the most important theorists in the field of cultural heritage preservation, Cesare Brandi, emphasized the necessity of incorporating the artistic, historical, and ethical aspects into the process of restoration. In his work Theory of Restoration, Brandi formulates the well-known aesthetic principle that restoration should not change the essential identity of the monument but should enable its continued existence and experience in the same context in which it was created, while preserving its visual and emotional value. Brandi underscores the importance of the monument's authenticity, meaning that restoration should not conceal the traces of time and the changes that have occurred, as they contribute to the historical and cultural character of the monument (Brandi 2007, p. 56). Additionally, Brandi introduces the concept of the aesthetic function, which refers to the monument as a living element of culture and daily life, not merely a museum exhibit. In the context of urbanization, this approach would imply that monuments should not be separated from the rest of the urban environment, but should hold a function and significance in the daily activities of the community.

Kevin Lynch, in his work The Image of the City (1960), explores the perception of urban space, particularly the role of elements such as landmarks in shaping the identity of a city. Lynch provided practical guidelines for designing urban spaces that are legible and intuitive for residents, which would contribute to a sense of belonging and identity in urban environments. He also emphasizes that ‘a frequent problem is the sensitive redesign of an already existing environment: discovering and preserving its strong images, resolving perceptual difficulties, and, above all, extracting the structure and identity hidden within the confusion’ (Lynch 1960, p. 115). His concept of paths, edges, nodes, landmarks, and districts offers a systematic framework for understanding how people construct and read space. The author highlights that the identity of a place is not only embedded in its physical characteristics but also in the way we perceive and emotionally connect to them. For sacred heritage, his insights are invaluable, as they illustrate how sacred monuments can serve as powerful landmarks that shape collective memory and urban structure.

ICOMOS (International Council on Monuments and Sites), as a global network for the protection of cultural heritage, plays a crucial role in setting global guidelines. The Venice Charter (1964), adopted by ICOMOS, is a document that defines the fundamental principles of monument preservation, with an emphasis on the importance of authenticity, integrity, and contextual meaning. The document is of great significance as it acknowledges that monuments, particularly in urban environments, are inextricably linked to the broader cultural landscape, and must be considered in the context of their geographic, social, and cultural positioning. This is particularly relevant for modern cities, where cultural heritage, construction, and modern urbanism must be integrated without compromising the core value of the historical monument. This is especially true for religious structures such as monasteries, which are often at the heart of communities but also face the challenges of urban modernization.

David Lowenthal is one of the most renowned authors in the field of heritage sociology, particularly known for his critical analysis of the phenomenon of heritage production. In his work The Heritage Crusade and the Spoils of History (1998), he points out how heritage becomes a market commodity and how commercialization and tourism are often in conflict with the principles of preservation. Lowenthal examines how monuments are frequently treated as cultural capital or attractions that serve to satisfy contemporary social and economic needs (Lowenthal 1998, pp. 97-102). While acknowledging the invaluable worth of heritage, he warns that excessive exploitation of heritage, particularly for tourism purposes, may lead to its cultural sterilization and the loss of deeper meaning.

Lowenthal observes the differences between history and heritage – while history is traditionally conceived as an abstract, objective analysis of past events, heritage carries a deeply personal and collective dimension. Heritage is often constructed to reflect social, political, or identity ambitions. In this sense, heritage becomes more than history; it is a mirror of contemporary values and societal desires. The author highlights how the selection of elements that become part of heritage is often motivated by the need to create continuity between past and present generations, while ignoring or neglecting parts of the past that may be uncomfortable or controversial. This reduces historical complexity and transforms heritage into an 'artistic product' in which the dimensions of the past are simplified and transformed into a commercial product aimed at satisfying the needs of the modern market. Lowenthal's work thus explores how history in contemporary societies is interpreted in a way that often does not correspond to actual history but serves ideological and economic purposes of the societies. He calls for a deeper reflection on the value of heritage and history, emphasizing that preserving heritage and understanding history requires more than mere tourism offerings or marketing strategies.

By combining these theoretical approaches, we can conclude that the preservation of cultural heritage in urban environments is most effective when it focuses on creating a balance between preserving tradition and integrating into contemporary urban dynamics. A holistic approach allows for viewing cultural heritage as a living and dynamic entity, connected with the community and everyday life, rather than merely as a static object in a museum. By incorporating social, cultural, and ecological factors into heritage management, it is possible to create sustainable urban policies that support cultural heritage as an integral part of the identity and development of the community.

3. CASE STUDY – ĐURĐEVI STUPOVI MONASTERY

3.1. Brief historical overview of the Đurđevi Stupovi Monastery

'The self-perception of Novi Pazar could be characterized by two key words: history and crossroads. History forms the essential foundation of the city's identity. Both in the selection of symbols and in the traits by which the city is known, cultural and historical monuments dominate, either as collective symbols or individually: the well-known mosques, churches, monasteries, as well as secular buildings.' (Spasić and Backović, 2017, p. 63).

Among the numerous cultural monuments of Novi Pazar, the Đurđevi Stupovi Monastery holds a special place as one of the most significant landmarks of Serbian medieval architecture and spirituality. Founded in the 12th century during the Nemanjić dynasty, the monastery represents a symbol of medieval Orthodox heritage, making a substantial contribution to the preservation of the cultural identity of this region, and further highlighting Novi Pazar as a crossroads of history and spirituality. The Đurđevi Stupovi Monastery is an integral part of the serial property 'Stari Ras and Sopoćani', which has been included on the UNESCO World Heritage List since 1979. This property encompasses key monuments of medieval Serbia, including the Sopoćani Monastery, the Church of the Holy Apostles Peter and Paul , and the archaeological site of the former town of Ras. As part of this unique ensemble, Đurđevi Stupovi bears witness to the cultural and spiritual heritage of Serbia, reflecting the significance of this region at the crossroads of Eastern and Western influences during the 12th to 14th centuries. The monastery consisted of several ecclesiastical buildings, with the Church of St. George being one of the most significant monuments within the complex, built in the Romanesque style, making it a key example of medieval architecture. Additionally, the monastery played an important cultural and spiritual role in the spread of Christianity and the development of education during the Middle Ages, and some sources associate it with the creation and preservation of ecclesiastical and literary works.

Over the centuries, the Đurđevi Stupovi Monastery was repeatedly devastated and destroyed, suffering numerous attacks, including the Ottoman occupation that lasted almost four centuries, as well as two major

fires that almost destroyed many parts of the complex. Each of these events left a deep mark on the monument, but despite this, the monastery managed to preserve its spiritual and historical value over time. However, until the 20th century, the Đurđevi Stupovi Monastery was almost completely forgotten and neglected. The restoration of this significant monument only began in the early 2000s, when experts and the local community recognized its invaluable importance for the cultural and spiritual heritage of the region. An important part of the restoration was the 'Let us renew ourselves, let us raise the Pillars' campaign, initiated in 2003.[1] Although the complex is not yet fully res tored, the return of the monastic community and the opening to visitors marked a symbolic moment for the restoration of its lost identity and a true revaluation of this sacred and historical heritage.

3.2. The significance for the city's identity

Sacred sites are an integral part of the city's profile, serving as landmarks in space and acting as central places for the faithful (Barišić 2011, p.59). The city is a living fabric of memory, spaces that we carry within ourselves, all around us – from the streets we love to those we avoid. Nostalgia when leaving, joy when returning, scents, sounds, colors – all these sensations shape our experience of the city and create its unique soul (Antešević, 2012, pp. 36). It is clear that cultural heritage is a vital element of contemporary society and the most important component of identity in modern times. Heritage is a collective property that speaks about the past of a people or territory, passed down from generation to generation, enabling us to understand our place in history and to better cope with the constant changes in society; it thus represents an important element of stability in a world that changes at an incredibly fast pace.

The Đurđevi Stupovi Monastery plays an exceptionally important role in the cultural and religious identity of Novi Pazar and the wider region. As one of the holiest places for the local Orthodox community, the monastery serves as a significant foundation for preserving historical and cultural continuity, and it is deeply rooted in the collective memory of the people of this area. Although contemporary society faces all the challenges of globalization and urbanization, the monastery remains a key symbol of resilience and a unifying factor for the community, whether it pertains to its religious, cultural, or economic significance. It is not just seen as a religious center, but as a place that symbolizes historical struggles and the survival of the people in the region, and also contributes to the recognition of the city's identity on the global cultural heritage map. For the residents of Novi Pazar, the Đurđevi Stupovi Monastery is not just a symbol of spirituality and the past, but also a testimony to their rootedness in a space where different cultures and histories intertwine. In it, they recognize the continuity of identity, the strength of unity, and a deep connection to their heritage that withstands the test of time and challenges.

While the monastery holds significant spiritual importance, the interaction between culture, history, and contemporary urban trends often creates tensions and challenges regarding the preservation of its identity within the modern urban context. Immovable cultural assets, such as traditional sacred sites, are not mere relics of the past but are custodians of identity and preconditions for the expression of freedom, without which everything loses its value and significance. They serve as evidence that there is no chasm between the past and the present, but rather a continuous link that enables the community to stay rooted in its traditions while navigating modern changes. The preservation of sacred sites must therefore be understood as a living process that recognizes the need to harmonize historical values with contemporary urban development.

'It is evident that if the kind of identity that, on one hand, has negatively conserved the life's changes while seriously preserving the continuity of the past, and, on the other hand, has positively affirmed the meaning of human existence and endurance, weakens within the individual and humanity, then all the more daring and dangerous are the actions and endeavors of humankind that move beyond the boundaries of the continuity that has been witnessed for centuries.' (Jerotić 2011, p.4).

1 The campaign titled 'Let us renew ourselves, let us raise the Pillars' aimed not only at the restoration of the monastery but also at raising awareness about the significance of this cultural heritage. This campaign mobilized a wide community, both local and broader, offering an opportunity for all interested individuals and organizations to contribute to the restoration of this important monument. The campaign had a significant impact on revitalizing both the material and spiritual values of the Đurđevi Stupovi Monastery, bringing it back into the cultural and tourist currents of contemporary society.

3.3. Identifying key challenges

3.3.1. Urbanization

The process of accelerated urbanization in Novi Pazar directly affects the preservation of the Đurđevi Stupovi Monastery. The geographical proximity of the monastery to the city's urban core creates a series of issues that threaten its integrity. Over the past three decades, the expansion of urban settlements has significantly impacted the natural landscape surrounding the monastery. With urbanization comes the continuous growth in the number of residential and commercial buildings, altering the appearance and character of the area. Along the route to the Đurđevi Stupovi Monastery, dozens of new weekend homes and villas have been built in recent years, significantly disrupting the landscape, obstructing the view of the monastery, and diminishing the overall image (figure 1).



Figure 1: View from the path towards the monastery (Photo by V.Ravić)

The main problems and challenges identified as a result of the urbanization process are as follows:

- **Illegal construction** often goes unchecked due to inadequate enforcement of the legislative and planning frameworks in Novi Pazar, posing a threat to the area surrounding the Đurđevi Stupovi Monastery. The uncontrolled building process can completely degrade the atmosphere of the site, create visual disturbances, and even pose physical risks to the monastery's structures. New constructions are awkwardly placed without consideration for the cultural significance of the location, and improper materials and construction practices are used, further destabilizing the surrounding environment.
- **The increased population density** in the immediate vicinity of the monastery creates conflicts with the very essence of the religious site. The ongoing urbanization is bringing settlements closer to the monastery, and people who move into these new areas are not always aware of the cultural heritage contained in these regions, nor do they show a willingness to preserve it. As a result, this growing population and the unplanned buildings may not only disrupt the integrity of the site but also decrease awareness of the importance of cultural heritage among new generations.
- **Infrastructure development and the strain on natural resources** are linked to urbanization, which often brings the need for infrastructure projects such as roads, sewage, parking lots, and other facilities. Traffic congestion created near the monastery negatively affects the quality of the space, air, and acoustic environment. Increased traffic at a site of spiritual and cultural importance not only impacts daily life but can also seriously damage the monument structures if protective measures are not adequately implemented.

3.3.2. Commercialization and tourism

While tourism in itself can be valuable for the preservation of cultural heritage, excessive commercialization and mass tourism lead to serious problems that threaten the authenticity of the Đurđevi Stupovi Monastery. These challenges have arisen due to the unregulated development in the surrounding area and inadequate regulations that allow for excessive commercial development near the monument itself.

- The incomplete and illegal hospitality offer near the monastery represents a serious problem, as there is no restaurant or hospitality facility managed by the monastery, which would be desirable for providing quality services to visitors and proper valorization of the site. Instead, several hospitality

establishments are not only out of alignment with the needs and spiritual character of the monastery, but they are also illegally constructed, disregarding legal norms. These facilities disrupt the ambiance and provide inadequate conditions for tourists, who are unable to experience the full spiritual and cultural value of the monastery.

- Excessive tourism, as the monastery becomes an increasingly popular destination, leads to a large number of visitors, especially during the summer months. Mass tourism, which causes crowds and the construction of new buildings, can negatively affect the authenticity of the space. Visitors, who come mostly because of the image of the monastery as a tourist destination, may contribute to commercialization prevailing over the spiritual and cultural character of the monastery.

3.3.3. Planning and legal regulations

Although there are specific laws and planning documents regulating the protection of cultural heritage, the application of these laws is often insufficiently effective, which contributes to the endangerment of monuments such as the Đurđevi Stupovi Monastery. In Serbia, Cultural Heritage Law (Zakon o kulturnim dobrima'Sl. glasnik RS', 76/2023) establishes the foundation for the protection of cultural properties and outlines procedures for their inclusion in the register of cultural heritage. However, the problem arises in the implementation of these laws on the ground. Unauthorized construction and disregard for planning documents most commonly occur in protected zones, which is the case in the area surrounding the monastery.

Planning and Construction Law (Zakon o planiranju i izgradnji, 'Sl. glasnik RS', 62/2023) mandates mandatory construction in accordance with permits and obligations for the protection of cultural heritage. However, frequent issues arise due to the lack of coherent and uniform implementation of building permits in culturally significant areas, as well as the high allowed construction density in protected zones, which endangers the integrity of the monument. Nature Protection Law (Zakon o zaštiti prirode, 'Sl. glasnik RS', 71/2021) , although focused on natural resources, also plays a key role in preserving cultural landscapes in the field of cultural and historical heritage protection. However, despite this legal framework, the application of the laws is not fully in line with expectations.

Spatial Plan for the Special Purpose Area of Stari Ras with Sopoćani (Prostorni plan područja posebne namene Stari Ras sa Sopoćanima, 'Sl. Glasnik RS', 47/2012) established to ensure sustainable development and protection of this region, does not provide adequate guarantees for preventing illegal construction. Although this plan defines three levels of protection: cultural property zone, protected surroundings, and landscape zone, the pressures from urban construction and illegal building continue to seriously endanger the area. Additionally, all efforts to stop unauthorized construction within the protection zone have thus far met with limited success, highlighting the gap between theoretical plans and the actual situation on the ground.

Although there is basic legislative regulation, more specific and effective solutions are needed, including stricter control of urbanization around the monastery and better implementation of existing cultural heritage protection laws.

4. GUIDELINES AND RECOMMENDATIONS

The Đurđevi Stupovi Monastery faces a range of challenges, including the effects of urbanization and illegal construction, commercialization and tourism, and inconsistencies in the implementation of planning and legal regulations. These guidelines and recommendations are aimed at preserving the authenticity of the monastery, its spiritual significance, and cultural value, while also preventing the endangerment of the surrounding area.

The urbanization process in the immediate vicinity of the monastery must be strictly controlled to preserve the historical and visual integrity of the area. The priority is to redefine the protective zones, with a particular focus on the third protection zone, where illegal construction is most prominent. The existing boundaries should be aligned with the actual state on the ground through detailed analyses and a revised Spatial Plan for Special Purpose Areas. Additionally, the enforcement of planning regulations must be more consistent to reduce the rate of illegal construction.

At the same time, additional measures must be implemented to prevent harmful infrastructural development. Urban planners and heritage conservation experts should establish building regulations that ensure the harmony of new structures with the spiritual and visual character of the area. These measures should include

controlling materials, dimensions, and architectural styles of new constructions to avoid incompatibility with the landscape surrounding the monastery.

Tourism is significant for the promotion and preservation of cultural monuments, but its intensity must be balanced with the preservation of the spiritual character of the monastery. The complexity of the issue arises from the conflict between local interests and the demands for global protection. Local communities often see heritage as a resource for tourism and economic development, while at the same time there is a need for global protection due to its universal value (Jenkins 2018, p.77). It is recommended to develop a sustainable tourism strategy that includes:

- **Developing a controlled hospitality offer:** Instead of leaving this to illegal initiatives, the monastery could establish its own facilities, such as a restaurant and souvenir shops, which would align with the spiritual character of the site and generate revenue for the preservation of the monument. These facilities should be located at a certain distance from the monastery itself to avoid disturbing the peace and daily life of the monastic community.
- **Limiting excessive tourism:** To avoid overcrowding and space degradation, it is essential to establish limits on the number of visitors during specific periods. Scheduling visits with advance appointments could help manage the flow of people more effectively.
- **Visitor education:** Installing informational boards, providing guides, and organizing educational programs about the historical and cultural significance of the monastery can raise visitors' awareness of its value. Guided tours with experts and local clergy, as well as educational activities for children, help foster a culture of heritage preservation. The use of digital tools like audio guides can also enhance the experience and increase interest in preserving the monastery among all age groups.

Enforcement of existing laws, such as the Cultural Heritage Law, needs to be more vigorous, while additional legal measures are required to address specific challenges, such as illegal construction and inadequate infrastructure. A *Detailed regulation plan* must also be created to define building rules in all protection zones precisely. Furthermore, inspection services should be better equipped, both technically and in terms of staffing, to respond quickly and efficiently to violations of regulations.

The local community must be actively involved in the process of protecting the monastery. The formation of local monitoring committees ensures direct participation of citizens in preserving the site. These committees could serve as a bridge between the population, local authorities, and professional institutions. For landowners near the monastery who feel disadvantaged by the regulations, it is important to establish mechanisms for resolving disputes. Transparent procedures and special case review commissions would ensure a balance between the protection of the monastery and individual rights.

In addition to community involvement, the active engagement of the clergy is crucial for the preservation and promotion of the monastery. Currently, the clergy is not sufficiently included in the processes of planning and regulation related to the monastery's protection. Their participation in decision-making regarding the development and implementation of protection plans, as well as the creation of educational and digital tools for promotion, is essential. The clergy, as the custodian of the spiritual heritage, plays a vital role in maintaining the authenticity of the site and fostering a deeper connection with both the local community and the wider public. Engaging the clergy in these efforts will contribute to a more holistic approach to preservation, ensuring that the spiritual significance of the monastery is preserved alongside its cultural value.

5. CONCLUSION

The preservation of sacred heritage is more than just safeguarding buildings – it is about preserving the soul and identity of the community. A new relationship with sacred cultural heritage must be built to preserve it in its physical and layered identity complexity. Otherwise, heritage and people will lose their meaning and be diluted in degraded or distorted cultural spaces, losing their authentic spiritual guides (Vojvodić 2016, p.39). The issue of uncontrolled construction in the protected zones around the Đurđevi Stupovi Monastery presents a significant challenge for preserving this exceptional monument. A modern approach to heritage highlights that its value does not stem from pre-defined criteria attributed to things or events. Instead, it is shaped and maintained through everyday activities and connection to the place (Živković and Vasiljević 2013, pp.30-35). Unauthorized construction in protected zones can severely undermine the authenticity and integrity of the sacred monument and its surroundings, directly jeopardizing its historical and cultural value. The analysis of the problem points to the need for more effective legislation and stricter regulation enforcement to protect the

Đurđevi Stupovi from inappropriate interventions. Large-scale construction disrupts the quality of life in the community and damages future generations by causing space congestion and destroying green areas and the natural environment. It is crucial to establish clear protective measures and define plans that will properly regulate construction in sensitive areas around this monument.

'Intense work on the emancipation of human feelings and emotions lies ahead. Standards must be established in humans and humanity in relation to the environment. The entire social system must be involved in this, from politics and strategy to information, education, the management of the entire organization, and the individual' (Matović 2008, p.112).

We are witnesses to the fact that the decades behind us have been marked by passive observation of the relationship toward this issue, and natural and cultural treasures of immeasurable value have been marginalized to the extreme. Through this research, we have highlighted the pressing challenges facing the Đurđevi Stupovi Monastery, particularly those related to urbanization, commercialization, and tourism. Uncontrolled urban growth, driven by private interests, poses a significant threat to the site's visual and spiritual integrity. Commercial development in the area disrupts the peaceful atmosphere of the monastery, while the increasing flow of tourists brings both positive and negative consequences, particularly when tourism is not properly managed. Furthermore, the exclusion of the clergy and local community from the planning and decision-making processes has contributed to the weakening of efforts to protect the monastery. We emphasize the need for a more inclusive and coordinated approach, involving stakeholders from various sectors, including the clergy, local institutions, urban planners, and heritage experts. Strengthening legal frameworks and improving public awareness, alongside providing more comprehensive education about the monastery's cultural value, are essential steps for its long-term preservation. This research advocates for urgent action to balance development, tourism, and heritage protection to secure the future of Đurđevi Stupovi as an integral part of the urban identity.

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PUBLIC SPACES IN POST-INDUSTRIAL SITES – NAVIGATING BETWEEN VISIONS OF HERITAGE PROTECTION, URBAN MORPHOLOGY, SPATIAL PLANNING AND SPONTANEOUS REUSE ON THE EXAMPLE OF THE ELECTRONIC INDUSTRY SITE IN NIŠ, SERBIA

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ABSTRACT

The city of Niš in Serbia has a rich industrial history and tradition of production. Thus, a broad palette of industrial facilities can be found across the city. However, the once prosperous industrial production has faced collapse at the end of the 20th century due to numerous internal and external factors, which have led to the widespread abandonment of industrial sites. These spaces are often found within the urban network, with distinctive urban and architectural characteristics, significant cultural identity, and great potential for mindful repurposing and regeneration. Unfortunately, the current practice shows that these spaces are being reused partially and chaotically, often bypassing current spatial plans and disregarding the heritage qualities of the site. The aforementioned raises a question: Is the urban morphology of former industrial sites suitable for transformation into public spaces while keeping its distinctive cultural identity, and respecting the currents needs of use? This paper focuses on the former industrial giant of Southeastern Serbia – the Electronic Industry in Niš. By analysing the former site from various aspects, the purpose of this research is to find solutions for public space qualities in former industrial sites, balancing between the current practice of urban heritage regeneration principles, planned urban development, and ad hoc reuse.

Keywords: *industrial heritage site, urban morphology, public space, spatial planning, adaptive reuse*

1. INTRODUCTION

Industrial heritage is an integral part of the broader category of cultural heritage and represents the phenomenon of human labour within the history of technology (Kulenović, 2010). According to The International Committee for the Conservation of the Industrial Heritage (TICCIH), industrial heritage is defined as '… the remains of industrial culture which are of historical, technological, social, architectural or scientific value. Buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted and used, transport and all its infrastructure, as well as places used for social activities related to industry such as housing, religious worship or education.' (The Nizhny Tagil Charter for The Industrial Heritage, 2003). In socialist-oriented countries of the 20th century, like Serbia (then part of the Socialist Federal Republic of Yugoslavia), the working class was highly valued, and economic growth was secured through a model of rapid industrialization and a planned economy

(Rafailović, 2022). This led to the construction of large industrial sites throughout the country, many of which were located in central and peri-urban areas of major cities. However, the once-prosperous production sectors began to decline at the end of the 20th century as the process of deindustrialization swept across Europe (Stanojević and Keković, 2019). Many production sites were abandoned and now stand as ruins within the urban fabric, terminologically referred to as (industrial) brownfields. These brownfields share certain universal qualities common to post-industrial sites, such as their location within cities, extensive infrastructure, dimensional and structural characteristics that allow for flexible planning and reuse, and authentic architectural features that testify to technological advancements (Antić et al., 2023). Unfortunately, the pluralism of ideas and the institutions/people involved in the decision-making process regarding the future of post-industrial sites further obstructs their successful revitalization, as there is a complicated process of land ownership that is a consequence of the on-going transitional period which Serbia faces since the end of the 20th century.

This research focuses on the industrial site of the Electronic Industry in Niš (EI), a former production giant in Southeastern Serbia and one of the most renowned industrial sites in former Yugoslavia. Facing hardship at the end of the 20th century and undergoing widespread privatization as the newly independent countries of the former state transitioned from socialism to democracy at the end of the 20th century, this prominent industrial site began to be repurposed for various uses (Jevremović et al., 2016). Urban and spatial planning stakeholders, in cooperation with architects and heritage experts, have initiated efforts in planning the reuse of the site, envisioning it as a public space for business and work while preserving its distinctive industrial typology. However, the current in situ situation suggests that the site is being reused in a chaotic manner, with little regard for the industrial heritage qualities of the space. However, a question arises: are former industrial sites suitable for repurposing as public spaces, considering that they were originally designed to accommodate large technological equipment and facilitate the flow of machinery and labour, often with little attention paid to aesthetics or the humanity of the built environment? By conducting a case study of the EI site, this research aims to examine whether open spaces within former industrial sites can be successfully revitalized and repurposed into public spaces, taking into account their heritage qualities, existing urban morphology, and the current state and practice of reuse.

2. THEORETICAL BACKGROUND

Sites of industrial production are characterized by sharp boundaries that separate them from open and accessible city spaces (Antić et al., 2022). With the cessation of industrial production at the end of the 20th century, these spaces are no longer closed and restricted to the public. But does this automatically transform them into public spaces? Numerous examples of successfully revitalized post-industrial sites demonstrate their potential to be transformed into public spaces. Some of these sites have even gained recognition that reaches as far as the UNESCO World Heritage List, such as the Zeche Zollverein in Essen, Germany (Dorstewitz, 2013). However, former socialist countries in Europe have faced greater challenges in brownfield transformation, as the deindustrialization process brought severe socio-economic consequences (Hirt et al., 2017). Despite these difficulties, some post-industrial sites have been successfully integrated into the urban fabric (Figure 1). Notable examples include the Metelkova former military site in Ljubljana, Slovenia, which has been repurposed into an open-space cultural centre (Siegrist & Thörn, 2020). Similarly, the Rotermann Quarter in Tallinn, Estonia, has evolved into a dynamic urban hub, fostering economic development, social cohesion, and ecological sustainability by integrating business, commerce, and people-centred facilities (Kurg, 2009). A particularly significant example is the city of Rijeka, Croatia, where a participatory approach was implemented, engaging architecture students and local citizens in the development of solutions for abandoned coastal industrial heritage sites. These initiatives represent an important milestone in the adaptive reuse of vacant industrial facilities within central urban areas of post-socialist cities, demonstrating the potential for community-driven strategies in industrial heritage transformation.



Figure 1: Examples of repurposed post-industrial sites in post-socialist countries: Metelkova (Ljubljana, Slovenia); Rotermann Quarter (Tallinn, Estonia); Exportdrvo warehouse (Rijeka, Croatia); Elektrownia Powisle (Warsaw, Poland); Svilara Cultural Centre (Novi Sad, Serbia).

However, even though numerous examples exist all around the globe, it is necessary to determine which characteristics make a (post-industrial) city place suitable to be considered a public space. In the broadest sense, public spaces are understood as inclusive and accessible areas, including squares and streets, as well as green spaces such as parks and public gardens (Forczek-Brataniec and Jamioł, 2024). However, are mere physical attributes enough to label a space as public? Many urban planning and architectural scholars have explored this question.

For example, Gehl (2011) argues that outdoor activities are the essence of public spaces and categorizes them into three essential types: necessary activities: activities (where people are 'forced' to participate, such as education, work, and shopping), optional activities (activities people wish to do if time and place allow, such as walking, breathing in fresh air, and sunbathing), and social activities (activities that involve interaction with others, such as greetings, conversations, play, and active or passive contact with others in the space)

Gehl emphasizes that the need for social contact is at the core of public spaces. He suggests that planning decisions can influence patterns of activity, creating better or worse conditions for outdoor events and contributing to lively or lifeless cities (Gehl, 2011). When it comes to industrial heritage sites, several theories explore the qualities that make them suitable for public spaces. Song et al. (2024) identify three key challenges in transforming industrial heritage sites into public spaces, relying on the social network method: functional layout; spatial accessibility, and the richness of pathways.

Li and Lui (2014) highlight the importance of innovative strategies for urban planners working with post-industrial sites. They identify several critical aspects for reviving "frozen industrial landscapes," including: compensation function for the balance of nature; political-pedagogical functions; experience of nature and open space for town dwellers; preservation and transformation of (industrial) cultural landscapes; variety and beauty; ecology and aesthetics.

Matthew Carmona, Tim Heath, Taner Oc, and Steven Tiesdell (Carmona et al., 2003) synthesized the ideas of prominent urban design theorists such as Kevin Lynch and Jane Jacobs in their book Public Places – Urban Spaces: The Dimensions of Urban Design. They identified six key dimensions of urban design applicable to creating successful public spaces:

- the morphological dimension: land uses, building structures, plot and street patterns, permeability, automobility, façade dynamics, etc.
- the perceptual dimension: vision, hearing, smell, touch; cognitive, affective, interpretative, and evaluative perception; identity, meaning, and sense of place.
- the social dimension: psychological needs, affiliation, esteem, self-actualization, safety, etc.
- the visual dimension: naturalness, upkeep, historical significance, openness, order, rhythm, balance, harmony, unity, and detail.
- the functional dimension: comfort, relaxation, passive and active engagement, discovery, movement, privacy, climate, lighting, parking, and infrastructure.
- the temporal dimension: aesthetic value, functional diversity, resource continuity, cultural heritage memory, economic and commercial value, and place continuity.

Previous theoretical research highlights numerous factors critical for designing public spaces. The complexity increases when dealing with inherited spaces that already have a defined layout and physical structure, and even more so when these spaces possess heritage qualities that must be preserved. To conduct a thorough analysis, it is essential to integrate the theoretical frameworks of multiple authors. For this research, the following aspects will be considered: urban morphology and functionality, social engagement, cultural heritage preservation, ecological diversity, and durability and perceptivity.

3. CASE STUDY - THE ELECTRONIC INDUSTRY SITE IN NIŠ, SERBIA

3.1. Historical development & urban morphology

The Electronic Industry in Niš (EI) was established in 1948, in the aftermath of World War II, during the era of socialist industrial development that characterized communist Yugoslavia (Roksandić, 2017). It became one of the largest industrial sites in Southeastern Europe. In its early development phases, EI focused on producing radios and X-ray devices (Jevremović, 2022), and by 1973, it experienced rapid growth similar to global industries. Unfortunately, social and political changes in the country, coupled with the rise of warfare, political

turmoil, and a grey economy, began to hinder its progress. Additionally, the inability to keep pace with global technological standards, exacerbated by large-scale international sanctions, further contributed to the decline of EI's production capabilities. As the socialist state of Yugoslavia collapsed and dissolved, its former member states transitioned from socialism to democracy. This transition brought significant challenges to the industrial sector, including mass layoffs, bankruptcy, privatization, and liquidation (Šljukić, 2019). Furthermore, transition outcomes indicated complicated land ownership statuses and the need for investment in these spaces contributed to the widespread abandonment of production facilities.

The industrial site is located in the suburbs of Niš, approximately 4.5 kilometers east of the city centre, situated directly along the road axis connecting Niš to Sofia, Bulgaria (Figure 2). It spans a land area of 59.49 hectares and is classified as a large-scale production zone (Damjanović, 1980). The site has a rectangular shape and lies on predominantly flat terrain, bordered by a hilly belt to the south and a slope to the north. The main entrance is accessible via Car Konstantin Boulevard. The street grid within the site is rectangular, with standardized streets measuring 6 meters in width. The central street axis is flanked by sidewalks approximately 2 meters wide. This grid is further interconnected by concrete land plates and green spaces. A total of 119 buildings are registered within the site, primarily free-standing single-storey and multi-storey structures. Due to the site's phased development over several decades (1948–1980) (Milojković et al., 2017), there is no architectural unification. The buildings vary in size, materials, construction methods, and style (Stanojević et al., 2019).

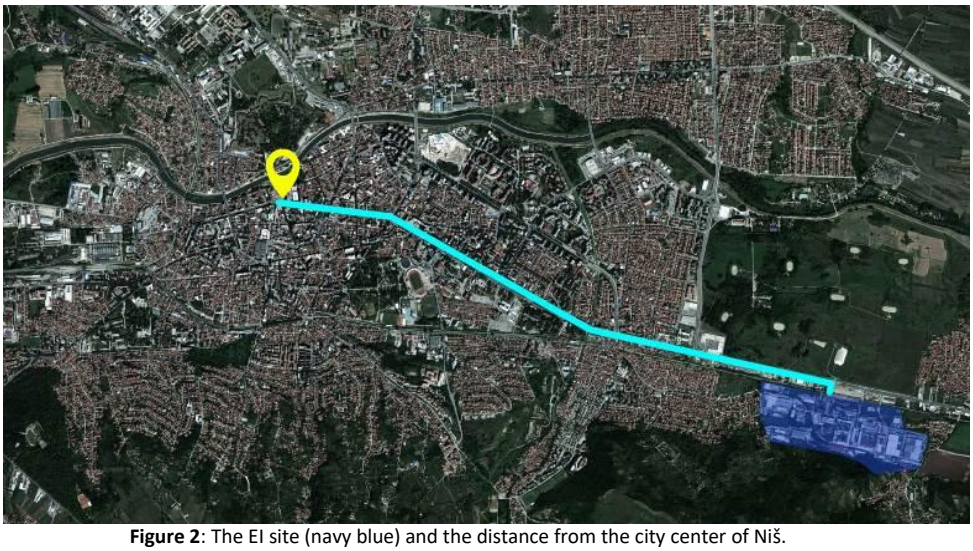


Figure 2: The EI site (navy blue) and the distance from the city center of Niš.

3.3. Current state & visions for future development

Like many post-industrial sites across former Yugoslavia, the EI site is currently being used in a partial and chaotic manner, with a mix of activities, predominantly business-related. It is not registered or legally protected as a spatial cultural or historical unit, nor under any other category for significant historical structures. In Serbia, a very small percentage of post-industrial sites are legally recognized and protected compared to other building typologies (Nikolić et al., 2024). However, some buildings within the EI site have been identified as valuable structures from the post-WWII mass industrialization period of Yugoslavia. These include several multi-storey production buildings, an administration building, and a storage facility (Figure 3), all located in the central area of the site. Out of the 119 buildings on-site, only five are recognized by the Institute for the Protection of Cultural Monuments of Niš (Stanojević et al., 2019). Unfortunately, the proper valorisation process has not yet taken place, meaning these recognized industrial heritage buildings still lack formal legal protection (General Regulation Plan Niš, 2015). Despite this, the EI site is informally regarded as a heritage landmark, especially among younger generations who were not born during the industrial sector's decline and are drawn to the raw "atmosphere of abandonment" (Hasse, 2012) associated with post-industrial sites. On the other hand, others view the EI site negatively, associating it with a troubled past of economic uncertainty, widespread unemployment, and industrial decline (Cizler, 2011). Currently, the EI site remains active and serves a variety of purposes. Domestic and international businesses utilize the large-scale buildings, while several educational institutions operate within the site. Additionally, alternative cultural initiatives and urban squatters have also made use of the space, further diversifying its functions.



Figure 3: Structures recognized as monuments of industrial heritage; Multi-storey production building and administration building.

The urban planning institutions of Niš have developed several urban plans to regulate activities at the EI site. According to the active General Urban Plan of Niš (2010–2025), the former EI site is classified within the city's potential business and work zones, emphasizing that the site's former production facilities are no longer operational and should be revitalized as brownfield investments (General Urban Plan Niš, 2008). The General Regulation Plan (PGR) for the Municipality of Palilula (where the EI site is located) was adopted in 2013, highlighting the need to draft a Detailed Regulation Plan (DRP) for the site (General Regulation Plan Niš, 2015). Subsequently, the Detailed Regulation Plan for the EI Complex was completed in 2014. This plan identified the site's potential as a future business and work zone, with opportunities for recreational facilities and green spaces. The site was divided into eight urban units (Figure 4) based on main traffic routes, spatial development, land use, functional relationships, and historical and environmental characteristics (Detailed Regulation Plan of the Electronic Industry Complex, 2014). The DRP outlines the future plans for each unit:

- Unit 1: no new construction is allowed; only refurbishment of deteriorating structures is planned
- Unit 2: no new construction is permitted; expansion of parking capacities and green spaces.
- Unit 3: new construction is planned.
- Unit 4: development of new infrastructure and pedestrian lanes is planned, with new construction allowed in the western and southern areas
- Unit 5: recognized as the central area of the EI site and labelled as an industrial heritage zone. No new construction is allowed; plans include expanding greenery and refurbishing historical buildings to preserve and showcase the site's industrial identity.
- Unit 6: new construction is allowed but on a smaller scale.
- Unit 7: new construction is planned to replace abandoned and decaying structures.
- Unit 8: designated for green spaces.



(a) (b)

Figure 4: (a) The partition of the EI site in 8 units, according to the PDR.; (b) The current state of the EI site. Diagonally hatched blue – industrial and work zones; Green – greenery; Purple – education; Parallel hatched blue – healthcare; Red – pedestrian and vehicle access; White – unbuilt areas; Purple lines – streets; Navy blue lines – industrial railways

According to the Plan, public spaces will constitute 35.55% of the entire site, or 21.15 hectares. These public spaces include streets, parking areas, educational and healthcare facilities, greenery, and communal services. The remaining 64.45% of the site, or 38.34 hectares, is designated for other uses, including industrial, work, and business zones. The division of these zones is shown in Figure 4. Currently, the land covered by buildings accounts for 25.26% of the total area.

4. DISCUSSION

To determine whether the EI site is suitable for repurposing as a public space, it is essential to analyse the site using defined parameters of urban design, as outlined in the Theoretical Background chapter. These parameters include urban morphology and functionality, social engagement, cultural heritage preservation, ecological diversity, and durability and perceptibility.

Urban Morphology and Functionality: There are several positive aspects when analysing the urban morphology of the EI site. For example, the functional layout is clear and well-organized, with buildings positioned along main infrastructural corridors. Linear pathways connect the site in an orderly fashion, and every point is easily accessible. Unfortunately, there is currently a lack of pedestrian lanes, though there is great potential for their future implementation. Spatial accessibility is a negative aspect, as the site is only accessible through one entrance, heavily relying on the busy Car Konstantin Boulevard. Alternative access points from other directions or additional access points along the boulevard would be preferable. An additional issue related to urban morphology is the presence of monotonous and deteriorating facades, which Gehl (2011) identifies as characteristic of monofunctional areas that are linked to (post)industrial sites. The prevalence of decaying and unembellished facades within the EI site negatively impacts the overall quality of its urban morphology.

Social Engagement: Drawing on the theoretical framework set by Gehl (2011) and his classification of outdoor activities, it is clear that there is an abundance of necessary activities within the EI site. Many of the buildings in use are workplaces, business hubs, or educational institutions, resulting in a high flow of people going to work or school. Unfortunately, the existing street pattern, primarily designed for the unhindered flow of industrial production, is not suitable for pedestrian recreational strolling. The peri-urban location of the EI site makes it less conducive to spontaneous gatherings, as it relies heavily on public transportation. As a result, optional activities are rare. Social activities are nearly non-existent, though seasonal cultural events take place during the summer months.

Cultural Heritage Preservation: The EI site stands as a testament to the era of mass industrialization in post-WWII Yugoslavia. It holds significant political, pedagogical, and educational value. Unfortunately, only a few buildings are legally protected as cultural heritage sites—specifically, just 4.2% of the entire built environment. Many buildings are in very poor physical condition. Those that are being reused by wealthy business corporations are in better physical condition. However, the lack of formal protection means there is no oversight by conservation authorities, and as a result, the heritage qualities of these buildings have been lost due to renovations. The site lacks stylistic unity, and the ad hoc reuse of buildings undermines its industrial heritage identity.

Ecological Diversity: The balance of nature within the site is satisfactory, with 15-25% of the area already covered in greenery. New green belts are planned, which may increase this percentage further. There is a variety of flora, with 28 different species of vegetation currently present on the site. However, soil remediation is needed due to the presence of industrial waste, a common characteristic of most brownfield sites.

Durability and Perceptivity: Like many industrial sites built in the aftermath of WWII and during the era of Yugoslav communism, the buildings on the EI site are constructed with durable materials such as steel and concrete. The fact that the site is still actively used, even after the cessation of production, and that spatial planning institutions have recognized its potential for future reuse confirms the durability of the site. Perceptivity, however, is a subject of debate. It goes beyond the mere valorisation of architectural and historical significance, entering the realms of sociology and psychology.

The discussion results suggest that there are both positive and negative aspects of utilizing the open spaces of the EI site. Urban morphology and functionality are certainly the most positive aspects, as the plot size and configuration, street network, linear functional organization, and large-scale open spaces provide the flexibility to implement various public functions. Ecological diversity and durability are also positive aspects, as there is potential for expanding green belts within the site, thus increasing the existing percentage of green areas. The use of durable materials in the site's construction also benefits overall economic investments. On the other hand, negative aspects include the lack of optional and social activities, which reduces social engagement among users, as well as the monotony of the existing building stock. Cultural heritage preservation is also a negative aspect, as the industrial identity of the site has already been altered. Nevertheless, with potential commitment from responsible institutions and individuals, it is possible to improve the general state of this authentic industrial area.

5. CONCLUSION

The reuse of post-industrial sites is a complex and challenging issue. The evaluation of results suggests that the balance between positive and negative aspects of transforming the EI site into a public space is approximately equal. Theoretically, key solutions can be drawn from the previous discussion. For instance, the results indicate the necessity of adapting the existing functional layout of the site, expanding pedestrian lanes to encourage the flow of people, and providing additional access points. These physical interventions are relatively straightforward to implement within planning frameworks. However, what about social interaction? One possible solution could be the introduction of culturally engaging activities. This is where theory and practice diverge. The open-market economic model, coupled with corporate greed and the pursuit of economic profit, often undermines such activities—especially since they are not clearly defined in the existing plans. The lack of formal protection creates a fertile ground for opportunists who buy and rent buildings on the site, altering them to suit their own needs without regard for heritage values. What about the local community's desires? The public's opinion on the new use of the EI site remains unknown. Is it a burden for the generations who lost their jobs when production declined, or a subcultural haven for young people? Furthermore, the question of priority arises. Is the preservation of industrial heritage a privilege and hallmark of developed societies? Do people question the authenticity of these spaces, or are they simply content with the fact that they are still in use after periods of uncertainty and instability? These questions require further exploration through experiments, surveys, and psychological and sociological research. This opens up opportunities for dialogue among architects, planners, conservationists, investors, and the local community. One thing is certain, however: repurposing and adapting post-industrial sites is a serious matter that demands extensive analysis and an interdisciplinary research methodology. This goes beyond the fields of architecture and urban planning, delving into various social sciences.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 and under the Agreement on the Implementation and Financing of Scientific Research Work of the SRO in 2025 - Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025.

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INTEGRATION OF INNOVATION AND URBAN DEVELOPMENT THROUGH SCIENCE AND TECHNOLOGY PARKS: THE CASE OF STP NIS

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ABSTRACT

The integration of innovation and urban development is essential in the formation of smart and sustainable cities. Science and technology parks, such as the Science and Technology Park Nis (STP Nis), play a pivotal role in facilitating this integration by serving as hubs for innovative ideas, where startups and tech companies develop advanced solutions for urban challenges. STP Nis provides a dynamic environment that fosters the development of environmentally conscious solutions, smart infrastructure, and digital technologies, all of which contribute to the transformation of urban landscapes. Through its support for technological entrepreneurship, STP Nis has become a platform for projects that aim to optimize urban resources, reduce environmental footprints, and improve the quality of life in cities. This paper explores the impact of innovations generated at STP Nis on urban development, with a focus on projects that address public resource management, smart transportation, and sustainable urban technologies. By examining successful initiatives from STP Nis, the paper highlights how these innovations can redefine urban spaces and promote a more sustainable approach to city planning. Ultimately, STP Nis demonstrate how science and technology parks can serve as catalysts for sustainable urban development, linking technological advancements with the evolving needs of modern urban environments.

Keywords: *urban development; science and technology park; innovation; sustainable cities; digital technologies*

1. INTRODUCTION

Urbanization is rapidly transforming the global landscape, with over half of the world's population now living in cities. This demographic change brings complex challenges, particularly in resource management, environmental sustainability, and the overall quality of urban life. To address these issues, the concept of smart cities has appeared as a transformative approach, using innovations and technology to create more efficient and sustainable urban environments. The concept of smart cities has emerged and it represents implementation of digital technologies, Internet of Things (IoT) devices, and data analytics in order to optimize city operations, upgrade public services, and improve the overall well-being of citizens. The success of the smart city service depends on the extent to which citizens' requests are met, participation citizens and their willingness to participate. By integrating smart city technologies, municipalities can overcome issues such as traffic jam, air pollution, energy consumption, and waste management more effectively. By enabling real-time monitoring, predictive analytics, and adaptive infrastructure management, these innovative technologies empower policymakers, city planners, and communities to make informed, data-driven decisions that balance economic growth with environmental sustainability. By examining Science and Technology Park Nis, its role and member companies, the paper highlights best practices in integrating digital solutions to address urban challenges the region of South and East Serbia. Furthermore, the discussion emphasizes the importance of stakeholder engagement, policy frameworks, and digital inclusivity in ensuring equitable access to smart city benefits. By fostering collaboration between public agencies, private sector partners, academia and community

stakeholders, Science and Technology Parks can leverage smart technologies to create inclusive, resilient urban ecosystems that prioritize sustainability and quality of life. As urban populations continue to grow, particularly in emerging regions like South and East Serbia, the need for smart, sustainable urban innovative solutions becomes ever more pressing. This paper seeks to contribute to the discourse by offering insights into how smart city concepts and innovation ecosystems can drive regional development and improve quality of life in a rapidly changing urban landscape. Within this context, the ,,Be Ready" project, implemented by Science and Technology Park Nis, plays a pivotal role in addressing some of the listed problems. Furthermore, companies like City and Me and Centre for Sustainable Energy Development (CORE), which are members of STP Nis, actively contribute to the development of digital and sustainable solutions aimed at improving urban living through innovative technologies. This paper studies the innovative potential of smart city technologies within the framework of STP Nis, an initiative designed to create an innovation-driven urban ecosystem in Nis and its surroundings in South and East Serbia.

2. DISCUSSION

The beginning of the new millennium in its initial years is characterized by processes of globalization that stimulate an increase in anthropogenic activities, which as a result requires a high level of architectural urbanization of space. Urbanization represents a complex set of challenges that significantly impact the social, economic, and environmental dynamics of cities. Among the most critical issues are urban sprawl, which leads to inefficient land use and increased strain on infrastructure; poverty and unemployment, which undermine social cohesion and economic stability; and housing affordability, leaving many urban residents without adequate living conditions. Additionally, cities often face insufficient investment to support growing populations, compounded by weak financial and governance capacities that hold up effective planning and project implementation. Rising inequality provokes urban challenges, creating disparities in access to essential services and opportunities, while urban crime and environmental degradation pose significant risks to both human well-being and ecological sustainability. Addressing these various challenges requires a holistic approach to urban development that integrates innovation and sustainability. Strategies must focus on optimizing urban functions and infrastructure to ensure that cities can meet the demands of growing populations while fostering economic growth and environmental resilience. This approach demands custom policies and solutions for each urban area, recognizing that a unified model is insufficient for addressing cities' diverse needs. Integrating innovation into urban development is essential, enabling the creation of smart and resilient urban environments. By employing forward-thinking policies and innovative technologies, cities can transform challenges into opportunities, ensuring a sustainable and prosperous future for their residents. Smart cities, also known as intelligent cities, offer transformative approaches to urban development, relying on advanced information and communication technologies to address modern urbanization challenges, foster sustainable growth, and improve the quality of life for citizens. While intelligent cities emphasize creating environments open to innovation, knowledge sharing, and global collaboration, often integrating technology with social and human capital, smart cities prioritize the efficient management of resources and adaptability. Intelligent cities encourage the flow of knowledge across sectors and foster collaborative efforts to address complex urban challenges. By embracing ICT, these cities promote connectivity, enabling efficient management of urban spaces. Smart cities, on the other hand, emphasize interconnected systems and networked infrastructure, allowing smooth communication and data sharing across sectors like transportation, energy, healthcare and governance. Both intelligent and smart cities rely on intelligent infrastructure to support socio-economic development, focusing on business-led urban growth, attracting investment, stimulating entrepreneurship, and creating job opportunities. Additionally, stable growth remains central to both models, ensuring technological advancements benefit all citizens. Human capital, creative industries, and social capital play a critical role in the success of both models by strengthening adaptability, fostering collaboration, and ensuring technological advancements are accessible to all. Environmental sustainability is another key aspect of smart cities, with a focus on reducing carbon emissions, optimizing energy use, and adopting green technologies. Smart cities use advanced ICT to improve residents' quality of life, optimize urban services, and drive economic growth. Smart cities can present challenges, such as the risk that technological benefits may concentrate in wealthier areas, leaving vulnerable populations behind. Policies must ensure equitable distribution of resources and opportunities, prioritizing inclusivity and ensuring all residents can access essential services like healthcare, education, and public transportation. Another challenge is the seamless integration of various technological systems across urban sectors, such as energy, transportation, healthcare, and governance. Overcoming technical barriers like system interaction, data management, and cybersecurity is

essential to fully unlock the potential of smart cities. Ensuring that all systems work efficiently and securely is key to realizing the benefits of these technologies. Environmental impact is an area where smart city technologies can make a significant difference. By optimizing resource use, reducing waste, and enhancing energy efficiency, smart cities lower their carbon footprint and become more sustainable. Technologies such as smart networks, energy-efficient buildings, and waste management systems contribute to cleaner urban environments, while also improving resilience to climate change and extreme weather events like floods and heatwaves. The benefits of integrating smart technologies into urban planning are numerous. For example, smart traffic management systems can reduce congestion, lower pollution, and enhance transportation efficiency. Similarly, smart meters and sensors help monitor water and energy consumption, resulting in cost savings for both residents and municipalities. Moreover, smart cities foster innovation by supporting startups, creative industries, and research initiatives, driving economic growth. The ability to monitor and respond to real-time data allows cities to remain adaptable and responsive to challenges like population growth, economic shifts, and environmental pressures. Smart solutions for environmental sustainability and climate change adaptation focus on integrating technology with innovative practices to reduce environmental impact and improve urban living conditions. These elements reduce environmental footprints and improve air quality, biodiversity, and the well-being of urban populations. Sustainable urban mobility is another vital component, with optimized public transit networks, electric vehicles, and intelligent traffic systems reducing emissions and improving efficiency. Incorporating circular economy principles—such as reducing waste and ensuring material reuse—further enhances sustainability. Smart waste management technologies help cities reduce landfill use and minimize the environmental impacts of waste disposal. By combining technology, sustainable practices, and social inclusivity, smart solutions ensure that urban development is both environmentally responsible and resilient to future challenges. Ultimately, integrating smart technologies with sustainability strategies enables cities to adapt to the long-term effects of climate change while improving the quality of life for their residents and contributing to global sustainability goals.

3. THE ROLE OF THE SCIENCE AND TECHNOLOGY PARKS IN URBAN TRANSFORMATION

Science and technology parks represent a powerful catalyst for urban development by integrating innovation and technological solutions into urban environments. Their role goes beyond providing infrastructure for innovative technology companies to operate, as they actively act as knowledge transfer centers, economic hubs and drivers of sustainable urban development. Examples from around the world, as well as from the Science and Technology Park Nis, illustrate how these institutions can transform urban spaces, fostering digital and ecological transformation. Acknowledging the infrastructure and support offered by these institutions, startups and companies develop technological innovations that are used to optimize the management of public resources, such as energy-efficient lighting systems, smart waste management and sustainable water supply systems. Projects that arise in parks can directly affect the improvement of urban mobility, the reduction of traffic congestion and air pollution, thereby significantly contributing to improving the quality of life in cities. In this sense, parks, including STP Nis, provide not only support in the form of easier access to financing and mentoring, but also opportunities for cross-sectoral cooperation, connecting the academic community, the private sector and public institutions in joint efforts to respond to urban challenges. Science and technology parks also contribute to the global connectivity of cities, promoting the export of innovative solutions and attracting foreign investment. This creates opportunities for the growth of local economies and encourages the development of urban environments in accordance with the principles of smart and sustainable cities. Through initiatives such as the development of digital city management platforms, smart energy grids and green technologies, STP Nis has established a model that connects technological progress with the needs of modern urban communities, serving as an inspiration for other cities in the region. At the same time, through its programs to support technological entrepreneurship, STP Nis enables local communities to actively participate in the development of innovative solutions, thereby strengthening social cohesion and economic resilience. Finally, science and technology parks, through their multidisciplinary nature and ability to integrate different actors, show how urban development can be shaped by innovation. STP Nis is an example that illustrates how it is possible to balance economic growth, technological progress, and sustainability, setting new standards in urban planning and development.

Science and Technology Park Nis recognizes challenges posed by urban development, particularly the growing issue of Urban Heat Islands (UHI), which significantly impact the environmental and social well-being of urban areas. As temperatures rise in densely built regions, increased by climate change, cities experience heightened heat stress, making them less resilient to extreme weather events. Recognizing the need for sustainable

solutions, STP Nis is implementing the "BE Ready" project, a transnational initiative aimed at enhancing urban resilience to climate change in the Danube region. This project, which involves 19 partners across 12 countries, focuses on reducing UHI effects through innovative, ecosystem-based solutions. The primary objective is to create climate adaptation strategies at the regional level by developing methods that reduce the ecological risks associated with urban heat islands. These methods include green, white, and blue acupuncture—small-scale, targeted interventions designed to address UHI effects effectively. Green acupuncture emphasizes the use of vegetation to cool urban areas, promoting biodiversity and improving air quality. White acupuncture, through reflective materials and innovative surface treatments, reduces heat absorption and prevents urban heat buildup. Blue acupuncture introduces water management solutions, such as ponds, canals, and green infrastructure, which naturally cool urban environments. These approaches are not only aimed at mitigating UHI but also enhancing the adaptability of cities to climate change, promoting more resilient urban spaces. STP Nis's leadership in the BE Ready project includes advancing methodologies for UHI risk assessment, developing data analysis tools, and modeling urban climate resilience. By providing cities with the necessary tools to assess and implement effective strategies, STP Nis is enabling long-term urban sustainability. Moreover, BE Ready emphasizes the importance of policy integration, knowledge sharing, and stakeholder collaboration, involving local authorities, communities, and businesses in building sustainable, climate-resilient cities. STP Niš supports over 70 technology companies and startups, with more than 700 employees engaged in developing smart and digital solutions. Member companies have attracted investments and have facilitated collaborations with municipal governments to implement smart infrastructure projects. Notable contributions include the development of traffic management systems, energy-efficient urban planning solutions, and green technology initiatives. In line with its mission to drive sustainable urban development, STP Nis has member companies like City&Me and CORE. City&Me, a digital platform that encourages eco-friendly behaviors and community engagement, aligns with STP Nis's goals by empowering citizens to participate in sustainable initiatives such as recycling, energy conservation, and environmental issue reporting. The platform's token-based rewards system motivates users to adopt eco-conscious behaviors, contributing to the development of a more connected and responsible community. Similarly, CORE, another member of STP Nis, plays an imporant role in advancing renewable energy solutions. By promoting clean energy sources like wind, solar, and geothermal, CORE supports STP Nis's green technology initiatives and contributes to reducing the region's dependence on fossil fuels. Through its involvement in energy transition projects, CORE also enhances regional energy security, a crucial component in ensuring long-term climate resilience. Despite its significant contributions, the implementation of smart technologies in urban environments faces several challenges. Regulatory barriers remain one of the most pressing concerns, as existing urban policies often do not keep pace with the rapid development of digital solutions. Bureaucratic delays and complex administrative procedures can hinder the deployment of smart technologies, slowing the transformation of urban areas. To overcome this, policymakers must work closely with technology developers and urban planners to create flexible regulatory frameworks that encourage innovation while ensuring compliance with urban planning principles. Financial constraints also present a considerable challenge. Many cities, particularly in developing regions, struggle with limited budgets for investing in smart infrastructure. Large-scale projects, such as sensor-based urban monitoring, smart grids, and automated traffic systems, require substantial financial resources. The role of science and technology parks in this context is crucial, as they can facilitate access to funding through venture capital, governmental grants, and international partnerships. By fostering financial collaborations between startups, municipal authorities, and private investors, parks like STP Niš can help bridge the financial gap necessary for large-scale smart city transformations. Public acceptance and adaptability are additional hurdles. While digital transformation offers numerous benefits, its success depends on how well the public embraces new technologies. Citizens may be hesitant to adopt smart city initiatives due to concerns about data privacy, usability, or resistance to changing traditional practices. Public awareness campaigns, education programs, and participatory governance models are essential for fostering trust and engagement in smart city innovations. STP Niš has actively contributed to this by organizing workshops, pilot projects, and community-based initiatives that encourage local participation in urban innovation. By addressing these issues through policy adjustments, increased public-private partnerships, and education programs, STP Niš aims to accelerate the adoption of urban innovations. By integrating green technologies, fostering collaboration, and involving renewable energy solutions, STP Nis is not only addressing immediate environmental challenges like UHI but is also shaping a more sustainable, climate-resilient future for the region. Through strategic initiatives and partnerships, STP Nis is creating the foundation for a more livable and adaptable urban landscape, setting an example for other cities across the Danube region and beyond.

4.CONCLUSION

Urbanization presents both significant challenges and great opportunities for the transformation of cities into more efficient, sustainable, and livable spaces. As cities around the world confront with issues such as traffic congestion, environmental degradation, and resource management, the concept of smart cities offers a transformative approach to urban development. By adopting advanced technology, data analytics, and innovative solutions, smart cities enable more effective management of urban infrastructure, improve service delivery, and enhance the overall quality of life for residents. Science and Technology Park Nis leads this transformation, particularly in the context of South and East Serbia, where urbanization is rapidly evolving. Through initiatives such as the "Be Ready" project, STP Nis is driving the adoption of climate-resilient solutions that address key urban challenges like Urban Heat Islands (UHI) and environmental sustainability. The involvement of companies like City&Me and CORE within STP Nis exemplifies the power of collaboration between public, private, and academic stakeholders in creating innovative, data-driven solutions for smart city development. By fostering partnerships, promoting sustainable technologies, and ensuring digital inclusivity, STP Nis is working on achieving more sustainable urban growth. This holistic approach not only tackles immediate environmental concerns but also lays the groundwork for long-term regional development that is inclusive, resilient, and adaptive to the changing climate. As the global urban landscape continues to evolve, the experiences and lessons learned from the STP Nis initiative offer valuable insights for other cities facing similar challenges, ultimately contributing to the creation of urban ecosystems that prioritize both technological innovation and the well-being of their residents.

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ICUP2025
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A REVIEW OF LEGISLATION AND PLANNING FRAMEWORK FOR (RE)DEVELOPING OF PUBLIC OPEN SPACES IN RESIDENTIAL NEIGHBORHOODS IN THE CITY OF BOR, SERBIA

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ABSTRACT

This paper aims to review the treatment of public open spaces (POS) within multi-family residential neighbourhoods in the City of Bor, Serbia, focusing on legal, strategic, and urban planning frameworks. In the socialist period, Bor experienced rapid development of the mining industry, which contributed to the increase in the number of inhabitants, and guided the direction of housing policy toward the construction of multi-family housing. Like other cities in Serbia, Bor experienced an economic decline since the 1990s, which affected radical changes in housing policy, degradation of multi-family neighbourhoods inherited from the socialist past as well as neglect and lack of maintenance of POS within them. This research highlights that the analysis of local strategies reveals that POS in multi-family housing in Bor are often treated indirectly, without specific measures for their improvement. Furthermore, urban planning documents primarily focus on housing construction while neglecting POS, which with legal frameworks failing to assign responsibility for POS upkeep, worsens them even more. The paper emphasizes the need for better integration of POS into urban development plans to enhance their functionality, safety, and attractiveness, to contribute to quality of life improvement. The results of this paper can serve to drive policy, legal, and practical interventions aimed at the (re)development of POS in multi-family residential neighbourhoods in Bor as well as other cities in Serbia.

Keywords: *public open spaces (POS); multi-family residential neighbourhoods; urban planning; (re)development; the City of Bor*

1. INTRODUCTION

Bor is a city located in eastern Serbia and the administrative center of the Bor District. It covers a territory of 856 km2 with a population of 41,290 (according to Census 2022) or 48 inhabitants per km2. About two-thirds of the city's population (28.822) lives in urban settlement. Bor has been a mining center since 1904, and until the 1950s, it was developed as a mining colony. After that, it came to a strong economic, population and spatial expansion of the city when numerous multi-family residential buildings were constructed. Since the 1990s, Bor has been faced a big economic decline, which has also affected population emigration and decline, as well as housing vacancy. However, a shift in the development of Bor's economy has recently been noticed, new companies are appearing, and average earnings are higher than national average.

Housing construction in Bor was mostly planned, organized and controlled. There are almost no zones of illegal housing construction in the urban area, except for a few smaller zones of spontaneously formed family housing. Under the influence of demographic growth and the limitations of the mountainous relief, multi-family housing was largely built, providing large areas of POS especially in multi-family housing built after the 1970s. Greenery still prevails in these neighborhoods and makes up 57% of the city's green areas (Master plan of the City of Bor). However, due to lack of maintenance and investment in POS, they are neglected and

devasted, without amenities and adequate urban equipment. In settlements closer to the central area, POS are additionally usurped by vehicle parking. Housing construction has been stagnant in Bor since the beginning of the 20th century, and urban densification has not occurred as in larger cities.

By analyzing laws, regulations and public policies related to POS treatment, as well as valid planning documents related to POS in selected MFHN of the city of Bor in the post-socialist period, the aim of the research is to investigate and determine:

1) Treatment of POS in the regulation in inherited multi-family residential neighbourhoods,
2) Treatment of POS in the regulation in new types of housing, considered at the level of the residential area (neighborhood),

in order to establish a cause-and-effect relationship between legal / urban planning principles and existing urban forms.

The research is based on analysis of strategic and urban planning documents, as well as regulations at the local level, with a particular focus on three representative multi-family housing neighborhoods: “2nd kilometer”, “5th local community” and “New city center” (RePOS, 2024).

2. PUBLIC OPEN SPACES IN STRATEGIC DOCUMENTS

Strategic documents for the City of Bor that are relevant for POS examination include Development Strategy of the City of Bor Urban Area, Housing strategy of Bor municipality 2015–2025 and Local waste management plan of the city of Bor for the period 2023–2031.

2.1. Development Strategy of the City of Bor Urban Area *(Official Gazette of the City of Bor, no. 9/2024)*

Development Strategy of the City of Bor Urban Area was developed with the aim of contributing to the sustainable development of the urban area in order to apply EU instruments of urban development and implement goals of Strategy of sustainable urban development of the Republic of Serbia until 2030. This strategy identifies the need for the establishment of green and open public spaces, the creation of a new identity of urban public spaces, as well as the construction of green infrastructure in all settlements.

POSs in multi-family housing are not addressed separately in this strategy, but more or less within the framework of broader development goals and measures for improving public spaces in general, protection of cultural heritage, climate change adaptation and encouraging citizen participation.

These goals include measures for arrangement, preservation, connection, revitalization and management of public spaces (Specific goal 1.1). There are also measures for the protection of architecture and urban heritage that are not protected cultural assets, which could incorporate some residential settlements built until 1990s (Specific goal 1.2).

POS are also indirectly addressed within the goal for sustainable mobility development especially through the measures for reducing the need for parking space and provision of pedestrian and bicycle paths (Specific goal 2.8).

Although not emphasized, potential treatment of POS could be included within the goals of adapting to climate change and measures for improving sustainable water management (Specific goal 2.4). Table 1 gives an overview of goals and measures relevant for public space development.

Although the need to improve POS is generally recognized in this Strategy and many measures directly or indirectly relate to them, within the proposed strategic projects none is related to POS in multi-family housing.

Table 1: Development goals and measures that directly or potentially relate to POS

Thematic goal 1.	*Strengthening of urban identity and renewal of the urban area by encouraging sustainable and integral development*
Specific goal 1.1	*Improving the quality of arrangement and accessibility of the urban area*
Measure 1.1.2	*Urban regeneration of settlements parts that have been destroyed by devastating processes, including the consequences of climate change (flooding, heat islands, etc.)*
Measure 1.1.3	*Arrangement, preservation and connection of public spaces (areas and facilities) in accordance with the concept of accessibility and respecting the accessibility of facilities of public services and services*
Measure 1.1.4	*Establishing measures to improve the management, maintenance and raising of the culture of living in*

	residential communities (multi-family buildings) and increasing the accessibility of multi-storey residential buildings (ramps, elevators)
Measure 1.1.6	*The creation of the polycentric city - the formation of new squares, urban pockets, public areas (parks) and the revitalization of existing areas*
Specific goal 1.2	*Encouraging the protection of cultural and architectural heritage*
Measure 1.2.2	*Restoration and protection of buildings and the whole of architectural and urban heritage that are not protected cultural assets (traditional types, vernacular architecture, industrial objects, architecture and urbanism before and after World War II, etc.)*
Thematic goal 2.	*Promoting the transition to clean and fair energy, green and blue investments, climate change adaptation and mitigation, risk prevention and management, and sustainable urban mobility*
Specific goal 2.4	*Adapting to climate change and disaster risk prevention, strengthening resilience to climate change, taking into account the ecosystem-based approach*
Measure 2.4.5	*Built or improved green infrastructure for adapting to climate change*
Specific goal 2.8	*Encouraging sustainable multimodal urban mobility*
Measure 2.8.1	*Encouraging the use of alternative forms of transportation - car share, electric scooters, bicycles, etc. in order to reduce the occupancy of public (parking) areas*
Measure 2.8.3	*Provision of infrastructure intended for pedestrians (pedestrian paths) and bicycle traffic*
Thematic goal 4.	*Improving social welfare*
Measure 4.8.2	*Construction of sports fields in urban and rural settlements*
Thematic goal 5.	*Improving the governance of urban/territorial development*
Specific goal 5.3	*Promoting participatory approaches and initiatives implemented jointly with the inclusion of local actors*
Measure 4.8.2	*Better participation and collaboration of citizens in shaping space*

Source: Development Strategy of the City of Bor Urban Area

2.2. Housing strategy of Bor municipality 2015–2025 *(Official Gazette of the City of Bor, No. 24/2015)*

Housing strategy of Bor municipality only considers the housing stock, its quality and housing conditions without its immediate surroundings. It does not consider POS in multi-family housing.

2.3. Local waste management plan of the city of Bor for the period 2023–2031 *(Official Gazette of the City of Bor, No. 15/2023)*

This plan relates to environmental aspects of POS by envisaging the formation of green islands for the placement of recyclable containers in the urban area of collective housing.

3. PUBLIC OPEN SPACES IN URBAN PLANNING DOCUMENTS

In the territory of the municipality of the city of Bor 27 plans are currently being implemented. Urban plans from the 90^{s} are actually changes and additions to those from the 1960s and 1970s, when it was the most intensive period of planning and construction. During the 1990s there was a review of existing solutions with smaller newspapers, but the 2000s were marked by stagnation in planning. In that decade, only two new urban plans were adopted, and that was as changes to existing ones, while many plans were invalidated. The economic crisis that hit the municipality of Bor and the loss of professional staff can be considered one of the causes of the reduction in planning activities.

3.1. Master Plan of the City of Bor from 1979-2000

During the seventies of the 20th century, due to the intensive growth of production in the Mining and Smelting Basin of Bor, there was a new need for housing units, and therefore for the creation of new planning documents. Based on the ambitious scenario of the economic, social and demographic development of Bor, the General Urban Plan of Bor 1979 was drawn up which foresees a significant expansion of the construction area, a radical reconstruction of the traffic and communal system and the construction of new settlements. Although the General Urban Plan of Bor 1979-2000 does not establish a system of green areas, the basic concept of spatial development is based on "intensive greening of all open spaces and special roads, as well as the formation of protective green belts at the interface between housing and ecologically aggressive production", i.e. as it was pointed out". According to the Law on Planning and Construction from 2009, the drafting of a new Master plan began.

3.2. Master plan of the City of Bor from 2015 *(Official Gazette of the City of Bor, No.20/2015 and 21/2015)*

Current Master plan for the city of Bor was adopted in 2015 for the period of 25 years (Figure 1). It provides the expansion of the city towards the south and southwest. In the plan, the following categories of construction land in the urban area of Bor are determined in accordance with the Law on Planning and Construction:

1. construction land with a public purpose, which includes traffic, hydrotechnical, energy and telecommunication infrastructure and facilities, communal facilities, urban greenery as well as other "public facilities and areas of general interest" determined by the Law on Expropriation, such as: educational facilities and areas, child protection, health, social care, culture, sports and recreation, etc.
2. surfaces for other purposes, which refers to all other construction objects and surfaces (housing, economy, services, etc.).

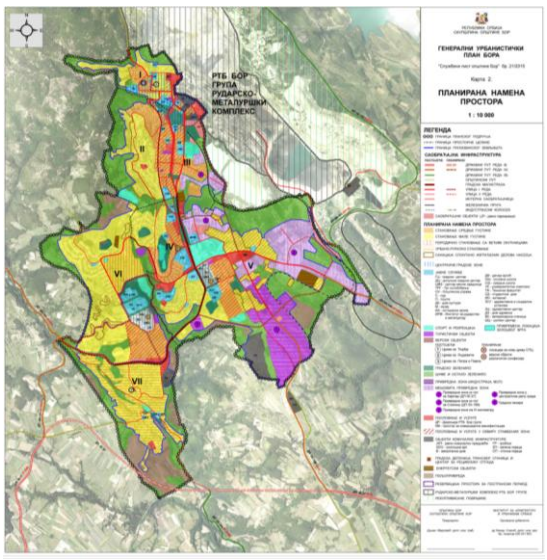


Figure 1: Master Plan of Bor 2015- Plan of land use
Source: Master plan of the City of Bor from 2015

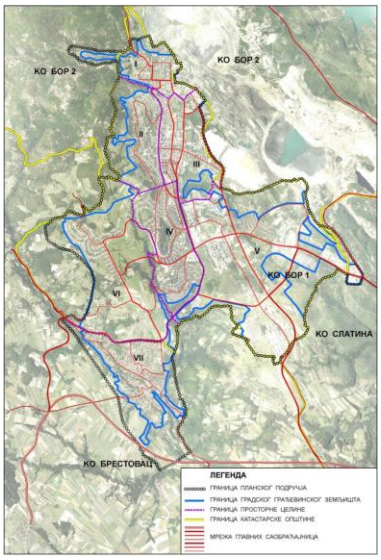


Figure 2. Planning area of the Master plan of the City of Bor
Source: Master plan of the City of Bor from 2015

Within the Master plan Bor is divided into 7 spatial units (Figure 2). Multi-family housing occupies around 128 ha, or 30% of the plan area. In zone III, only multi-family housing is present, and multi-family housing dominates in spatial unit I with 72% of the total use with predominantly housing and in spatial unit II (about 54%), while the smallest participation of this type of housing is in spatial units V and VI.

POS in multi-family residential neighbourhoods in Bor are not adequately recognized in planning documents, which is in line with their treatment in the Law on Planning and Construction (Official Gazette of the Republic of Serbia, no. 72/09 - 62/23). Namely, in the current Master Plan of the City of Bor from 2015 recognizes only public green areas and sport and recreation contents in multi-family housing, while other types of land that also serve as POS are not reviewed at all.

Within the goals and starting points of the Spatial development of Bor, only the renovation of recreational facilities and public green areas in multi-family residential neighbourhoods and zones is planned. This implies to the reconstruction of the field for small sports and children's playgrounds, while other types of POS are omitted and neglected, which indicates that POS still does not have an important position as it should have as significant indicators of quality of life. The General concept of spatial development envisages rehabilitation and reconstruction of the inherited housing fond in spatial unit III where analytic unit "2nd kilometer" is located, while POS are not subject of improvement. Furthermore, as part of the Planning solutions for tourism, sports and recreation, as well as for green areas, it is planned to improve existing and build new sports and recreational facilities at the level of local communities and multi-family residential neighbourhoods.

This primarily applies to fields for small sports as well as children's playgrounds that will be located in the surrounding green areas. The goal is to improve the quality of life of the local population through these facilities, by enabling easier access to recreational activities and green areas within residential areas. The

Master Plan states that the analytical units "5th local community" and "New city center" have the best housing conditions, with a high percentage of greenery. In accordance with that, for the analytical unit "5th local community" in the IV zone, no rehabilitation or reconstruction is foreseen, because the housing fund is of recent date. For the analytical unit "New city center" located in the V spatial unit, which was built in the last 20 years, except for planning the construction of sports and recreation grounds, other types of POS are not covered.

The intensification of measures for renovation, arrangement and care of greenery is given as a general guideline at the city level, without guidelines for specific multi-family housing. As part of the General conditions for the arrangement of green areas, the protection of green areas in multi-family housing is planned, with the enrichment of the existing fund of greenery with new species and, where possible, with accompanying contents. It is highlighted that the zone of quiet rest and walking with plateaus for quiet rest of adults represents the largest percentage of open areas. These areas provide recreational spaces and zones of active rest with play areas for older children and younger students, which implies the construction of sports fields that need to be located at a certain distance from residential buildings and isolated from them by green areas.

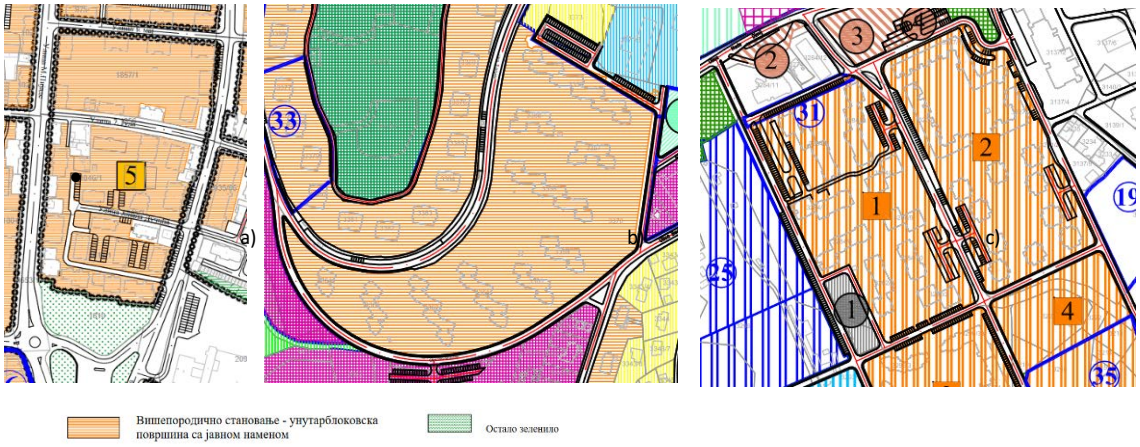
In the area of the Master Plan, there are no spatial possibilities for the formation of a bicycle network path. The Master plan provides a list of solutions for corridors of bicycle paths along the main roads that start analytical units “5th local community”, “2nd kilometer”' and “New city center”.

3.3. The General Regulation Plan for Urban Settlement of Bor from 2018 *(Official Gazette of Bor Municipality No. 1/2018 & 3/2018)*

Similar as in the Master plan of Bor, in according to the existing legal regulations, the following categories of construction land in the urban area of Bor are determined:

1. construction land with a public purpose
2. surfaces for other purposes

In the plan, it is stated that green areas are very common in Bor, especially in the blocks with multi-family housing, where they are treated as areas of "other uses". The plan introduces the term "intra-block spaces with a public purpose" (*unutar blokovski prostori javne namene*) within multi-family housing (Figure 3).



(a) (b) (c)

Figure 3: Plan of General Regulation of the City of Bor: a) multi-family housing in analytic unit ,, 2nd kilometer’’ b) multi-family housing in analytic unit ,,5th local community’’ ; c) multi-family housing in analytic unit ,,New city center’’ - intra-block spaces with a public purpose
Source: https://bor.rs/urbanizam-dok/urbanisticki-planovi/

The specific objectives of the Plan include the protection and improvement of green areas, protective greenery, the development of sports and recreation areas, and the special objectives of the renovation of the inherited housing stock (only buildings, without associated open spaces). Therefore, the improvement of other types of POS is not included in the general or special goals of the plan. As part of the objectives of the spatial development of tourism, recreation and sports in Bor, the renovation of recreational facilities in larger residential blocks and zones (small sports fields and children's playgrounds) is planned. The goals of protection and arrangement of urban greenery are:

- establishing a system of green areas in the city of Bor as a basis for conservation, management and development;
- preservation and improvement of existing areas under greenery by applying appropriate care measures;
- implementation of the system of green areas in terms of reducing potential negative impacts on the environment - industrial pollution, climate change, erosion and others;
- continuous formation and maintenance of the system of green areas, preservation and improvement of the territorial connection of all areas under green areas;
- arrangement of unorganized green areas within construction land as public green areas that are not intended for construction;
- realizing a networked system of green areas using linear connections between existing and planned green areas; and
- development of an information system about the system of green areas - cadastre of green areas.

In the blocks with medium-density multi-family housing in the II, IV and V spatial unit, within all analytical units are located, it is stated they are built according to appropriate planning documents, have a good layout of buildings with comfortable spaces and plenty of green areas. The plan states that landscaping of open spaces and the construction of playgrounds for children and adults are allowed. Furthermore, it is stated that the inter-block space has a public purpose with landscaped areas that include: city greenery, landscaping, pedestrian and car paths, parking space, children's playgrounds, etc. depending on the spatial possibilities of the block. Within the rules of arrangement and construction rules, the following conditions are given for open and green areas: ,,the minimum percentage of free areas in the block is 50%; a maximum of 30% of the surface can be under paths, plateaus, children's playgrounds and open fields; primarily adapt the space to rest, play and recreation and maintain and rejuvenate the existing vegetation''.

3.4. Plans of detailed regulation

Plans of detailed regulation in Bor for multi-family housing are not created in post-socialist planning documents.

4. PUBLIC OPEN SPACES IN LEGAL ACTS

Relevant legal acts for public open spaces examination in the city of Bor are Decision on municipal order in the city of Bor and Decision on general house rules in residential and residential-business buildings on the territory of the municipality of Bor.

4.1. Decision on municipal order in the city of Bor *(Official Gazette of the City of Bor, No. 18/2019)*

Decision on municipal order in the city of Bor distinguishes between “areas of public purpose” (*površine javne namene*) and “areas in public use” (*površine u javnom korišćenju*). In such way, in addition to the areas of public purpose, which are determined by the planning document for the arrangement or construction of public buildings or public areas, this decision recognizes areas in public use that are not designated by the planning document as areas of public purpose, and are accessible to a large number of citizens, which include, among others “built and arranged traffic and green areas within and between blocks of buildings, between buildings”. Areas that do not belong to the previous two are classified as other areas. A public utility company is responsible for the maintenance of areas of public purpose, while the maintenance of areas in public use is an obligation of the owners, that is, the users of those areas, if no other city regulation provides otherwise.

4.2. Decision on general house rules in residential and residential-business buildings on the territory of the municipality of Bor *(Official Gazette of the City of Bor, No. 28/2017)*

This act recognizes “land for regular use of the building” (*zemljište za redovnu upotrebu zgrade*), which serves all tenants. The manner of using and maintaining the land for regular use of the building is decided by the Assembly of the residential community, which is also responsible for its maintaining. This land can be used according to this decision for children play, carpet shaking, parking cars and other motor vehicles, as well as performing other common needs of the tenants.

5. DISCUSSION AND CONCLUSION

Existing local legal and planning framework does not set a clear foundation for the development of quality POS in multi-family housing in Bor, resulting in poor condition of POSs, which are characterized by low level of management, maintenance and arrangement. From the strategic aspect of development, there is a general tendency to improve the existing POS recognized from national to local strategies of urban development. On the one hand, it can be considered a key planning potential for POS development. However, in Development Strategy of the City of Bor Urban Area strategic goals and measures are quite broad set and POS in multi-family housing can be neglected in the process of the implementation, given that they are not included within the selected strategic projects and priority areas of intervention.

Valid urban planning documents do not sufficiently consider POS in multi-family residential neighbourhoods. They are treated as contents within green, sport and recreative spaces, while other types of POS are nor recognized. We can conclude that POS still do not have an important position in urban planning documents as it should have as significant indicators of quality of life.

In strategic and urban planning documents housing is often considered with a focus on the buildings themselves, without surrounding areas and associated POSs. Thus, for example, the renovation of the old housing stock is foreseen, but not the POS. The newer multi-family housing stock is considered favorable for living and the plans do not envisage its rehabilitation, which represents a limitation for the improvement of POS, which is necessary in some neighborhoods (5th local community).

Legal acts at the city level clearly determine the responsibilities for maintaining POSs in multi-family residential neighbourhoods, however, they are not still poorly maintained. One of the reasons for this lies in the unclear definition of “areas in public use” for which tenants and users of that space are responsible, given that the land is publicly owned. Legal acts also determine responsibility for maintaining the “land for regular use of the building”, but in inherited multi-family residential neighbourhoods from the socialist past, the building's cadastral plot is the same size as the building, so the question is whether this land was determined at all, since it was a weak practice in Serbia (Marković, 2022).

Potentials for design and improvement of the POS are adequate surfaces of the POS for arrangement in accordance with the current residents needs as well as generally high percentage of green areas (especially in analytic units “5th community” and “New City Center”). Limitations are multifaceted and include a lack of interest in POS in multi-family residential neighbourhoods regeneration at the local level, neglection in relevant planning documents, unclear responsibilities for management and maintenance, that manifested as long-lasting deterioration and gradual loss of their basic functionality (Bogdanović Protić et al., 2020), as well as lack of guidelines for improvement, which all result in a low level of equipment, poor image and low level of use. In order to create more functional, safer and more attractive spaces for all age categories of residents, it is necessary to include POS in multi-family residential neighbourhoodsin national documents and local urban plans, which could create a basis for their sustainable improvement in accordance with current urban approaches.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025. and by the Science Fund of the Republic of Serbia, #GRANT No 7572, Reclaiming Public Open in Residential Areas: Shifting Planning Paradigms and Design Perspectives for a Resilient Urban Future - RePOS.

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YOUTH-LED PLACEMAKING: METHODS AND APPROACHES TO TRANSFORMING PUBLIC SPACES IN SMALL BORDER TOWNS IN NORTH MACEDONIA

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ABSTRACT

Placemaking is a concept of designing, managing and developing public spaces, used as a tool for community-oriented urban planning. It focuses on enhancing public urban spaces such as sidewalks, streets, squares, parks and recreational areas. Also, the research field is expanding to include contributions from the private sector, non-profit organizations, foundations, and individuals, all of whom play essential roles in these processes.

This paper examines the city of Delchevo, located in the eastern part of the Republic of North Macedonia (RNM). With a population of 11,500, Delchevo has faced significant demographic, economic, and urban stagnation since the 1990s, leading to inadequate physical and functional structures in its public spaces—specifically the city square and city park. The lack of engaging content has diminished the ability of these spaces to meet the diverse needs of the community.

The aim of this paper is to establish a methodological framework for developing approaches to implement the placemaking concept. Considering the specific conditions of Delchevo, the methodology emphasizes collecting quantitative and qualitative data to gain insights into how younger residents—children, teenagers, and young adults—utilize public spaces and identify their needs. In preparing new spatial actions and approaches for revitalization, the perspectives of local residents, professionals, and local government are crucial to achieving a comprehensive and sustainable model for public space development.

Keywords: *methodology; placemaking; small town; sustainability; young residents*

1. INTRODUCTION – THE 'PLACEMAKING' CONCEPT

The concept of *placemaking* originated in the 1960s and 1970s, when urban planners, activists, and writers such as Jan Gehl, Jane Jacobs, and William H. Whyte introduced innovative ideas for designing cities that prioritize citizens rather than cars or public buildings. Their work emphasized the significance of dynamic urban environments and the role of public spaces in fostering vibrant cities.

While the term *placemaking* was initially adopted by urban planners, architects, landscape architects, and designers as early as the 1970s (Brambilla & Longo, 1977; Whyte, 1980), its popularity has grown significantly among the general population over the past two decades, particularly in cities where it has been implemented. It is primarily recognized as a tool for community-oriented planning, design, management, and development, with a specific focus on public urban spaces such as sidewalks, streets, boulevards, squares, parks, and recreational areas (Polstein, 2019; Peinhardt, 2018).

The international organization *Project for Public Spaces* (PPS) defines placemaking as a collaborative process that involves engaging communities in the creation and maintenance of public destinations at the heart of their neighborhoods. These spaces serve as hubs where people gather, shop, dine, socialize, and—most importantly—build the social and emotional connections that bind communities together (PPS, 2015). Jan Gehl argues that vibrancy in the public spaces guarantees social interaction and that it is essential to cultivate a diverse and multifaceted urban life. This includes the integration of recreational and social activities, pedestrian-friendly spaces, and opportunities for active participation in urban life (Gehl, 2010).

'Placemaking' is a concept of planning, designing, managing and developing public spaces. According to Wyckoff (Wyckoff, et al., 2015), there are 4 types: standard, tactical, creative and strategic. Each type varies in terms of spatial form, usage, functionality, and the social needs and capacities of local communities. A defining characteristic of placemaking is its universal applicability—it can be implemented in any location and city, regardless of the city's size or the spatial and physical characteristics of its public spaces.

Despite its growing recognition, the application of placemaking principles in small border towns, particularly in North Macedonia, remains limited. The city of Delchevo, has experienced demographic decline, economic stagnation, and insufficient investment in public spaces. The central square and city park, which should serve as focal points of community life, lack engaging content and fail to meet the diverse needs of the local population, especially young residents.

The primary goal of this research is to explore the potential of youth-led placemaking as a method for revitalizing public spaces in Delchevo. The study aims to identify the ways in which young people perceive and use public spaces in Delchevo; analyze their needs, expectations, and level of engagement in shaping urban environments and develop a methodological framework for incorporating youth participation in public space design and management. To address these goals, the paper investigates the following questions:

1) **How do young residents perceive and use public spaces in Delchevo?**
2) **What are the main shortcomings of the public spaces?**
3) **How can placemaking approaches improve their function and appeal?**

By addressing these questions, this research contributes to a broader understanding of placemaking in the context of small border towns and highlights the importance of youth engagement in urban development processes.

2. METODOLOGY

This research employs a qualitative and participatory approach to investigate the potential of youth-led placemaking in Delchevo. The study focuses on the city's public spaces, with a specific emphasis on its central square and city park, as they represent the primary areas for social interaction and community life.

The research incorporates the following methods: **Field observations**, **surveys** and **workshops**.

Fieldwork was conducted in the spring of 2024 as part of a broader research initiative. The author, in collaboration with local stakeholders, carried out the data collection and workshop facilitation. Participants were selected through an open call and local outreach efforts, ensuring a diverse representation of age groups and backgrounds.

The first workshop included 15 participants of varying ages and professions, while the second workshop engaged 25 young students under 14 years old. The selection aimed to capture different perspectives on public space use and improvement.

By combining these methods, the study provides a comprehensive understanding of how public spaces in Delchevo function and how placemaking can serve as a tool for their transformation.

3. OVERVIEW OF THE BORDER TOWNS IN THE EASTERN REGION OF RNM

The Republic of North Macedonia is located on the Balkan peninsula with total surface area of 25,436 km². It borders with two EU member states - Bulgaria and Greece and two EU candidate countries - Albania and Serbia. According to the Spatial Plan of the RNM and the State Statistics Office, there were 34 urban nodes (cities and towns) classified into four levels: state centres (1), macro-region centres (3), meso-region centres (9) and micro-region centres (21). The RNM has eight economic regions: Skopje, North-East, East, South-East, Vardar, Pelagon, Polog and South-West (fig.1):



Figure 1: Planning regions of RNM with Delchevo (red). (source: SSO,2023)



Figure 2: Satellite image of Delchevo, (source: Google earth)

The East Planning Region on the east side borders with the Republic of Bulgaria, and the communication with the neighbouring country is realized through the border crossing "Delchevo" in the municipality of Delchevo. According to the 2022 data, 174,314 inhabitants live in the Eastern region, while total population of the RNM counts 2,076,694 inhabitants (SSO, 2023). A total of 11 municipalities make up the East Planning Region: Berovo, Vinica, Delchevo (fig.2), Zrnovci, Karbinci, Kocani, Makedonska Kamenca, Pehchevo, Probistip, Cheshinovo - Obleshevo and Stip, of which 4 are classified as border cities: Makedonska Kamenica, Delchevo, Pehcevo and Berovo. These cities, with their spatial and demographic characteristics, belong to small cities, under 20,000 inhabitants. Regarding the border cities in the Eastern region, the smallest is the city of Pehcevo with a population of 3,237, and the most is the city of Delchevo with a population of 11,500 inhabitants.

The cities of Makedonska Kamenica, Delchevo, Pehcevo and Berovo are 20 km apart, and they functioned as a separate entity, without the elements that led them to joint functioning. Characteristic of these cities is that they are located in a region that is neglected and underdeveloped due to poor infrastructure.

Understanding the existing challenges faced by cities in this region is the first step toward implementing effective measures to address them. The public spaces of cities cannot be studied and analyzed separately and independently of the socio-sociological aspects, because the urban space is a complex medium that accurately reflects all changes in the values, rules, needs and expectations of society (Stupar, 2010). These cities belong to a region that is facing economic stagnation, is poorly connected to traffic and infrastructure, and the cities themselves have a small area and number of inhabitants. These factors affect the development and function of public spaces. According to Prof. Stupar, the form of a city and the identity of its spaces can be viewed as the outcomes of complex and dynamic processes that directly and indirectly impact the urban environment (Stupar, ibid.). Analysis of border towns in the eastern region reveals a primary issue: public spaces in these towns often possess inadequate physical and functional structures, with a low degree of social sustainability.

Demographic, economic, and spatial stagnation have contributed to the suboptimal condition of public urban spaces. These areas frequently lack the necessary features and functions to meet the diverse needs of their users. Instead, their accessibility is often reduced to utilitarian purposes, such as serving as city parking lots. Many of these spaces were designed during the era of the former socialist system and, despite undergoing a period of transition, their spatial and functional characteristics have remained largely unchanged. As a result, they fail to adequately represent civic life, thereby raising concerns about their social sustainability. A pertinent example is the town of Delchevo, where public spaces reflect these broader regional challenges, highlighting the need for targeted interventions to enhance their functionality and sustainability.

4. METHODOLOGICAL PROCEDURES FOR IMPLEMENTATION OF THE CONCEPT 'PLACEMAKING' IN DELCHEVO

The focus of this research is the city of Delchevo, with particular attention to the analysis and study of its public spaces, conducted through an urban workshop—the first public initiative on this topic in the city. Delchevo, as a small town in the eastern region of the Republic of North Macedonia (RNM), faces significant spatial and economic constraints, leaving little opportunity for large-scale capital investments in new public spaces or comprehensive transformations of existing ones. To address these limitations and revitalize the town's public spaces for optimal use by citizens of all age groups, the concept of *placemaking* has been applied.

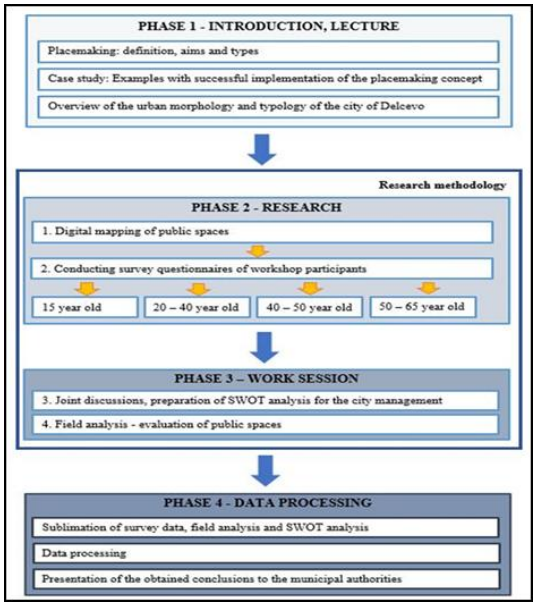
To support this effort, a program and project were developed in the spring of 2024 as part of the preparation of a doctoral dissertation and the collection of relevant data. This initiative included organizing two workshops—structured as informational and educational sessions—focused on public spaces and the roles of residents and local municipalities in their planning, maintenance, and transformation. The workshops provided participants with an in-depth introduction to the concept of *placemaking*, including analyses of the current state of public urban spaces and the development of proposals for new projects. Particular attention was given to improving the town square and park, aligning these projects with the identified needs and priorities of the local community.

The first workshop was held in the House of Culture in Delchevo, with a group of 15 participants, people of different ages and with different professions. The work program took place in 4 phases, (fig.3):

Phase 1: An expert lecture on the concept of *placemaking* was delivered, including presentations of national and international case studies that demonstrate successful implementation of the concept.
Phase 2: Survey questionnaires were distributed to participants to gather insights into their level of civic activism, involvement in decision-making processes related to public spaces, and the specific needs of citizens. The survey also explored participants' proposed approaches for addressing these needs through public space interventions.
Phase 3: Joint discussions were held to evaluate and analyse the current state of public spaces in the city, encouraging collaborative dialogue among participants
Phase 4: Following the workshop, all collected data were summarized and analysed. The resulting conclusions were compiled into a report to be presented to municipal authorities for further consideration and action.
The first workshop covered the following age groups: people from 15 to 20 years; people from 20 to 40 years; people from 40 to 50 years and people from 50 to 65 years.

According to the *Project for Public Spaces*, an effective placemaking process leverages the ideas, resources, and potential of the local community to create high-quality public spaces that promote the health, happiness, and well-being of citizens. As PPS states, *"The placemaking process starts at a young age and belongs to everyone"* (PPS, 2007). Consequently, in organizing such civic activities, it is essential to consider the perspectives of the youngest members of the community—children. Children contribute a sense of playfulness that fosters creativity and facilitates collaborative work. Their approach is often free from preconceived notions, and they tend to consider the needs of all groups within their community (Derr V, Chwala l, Mintzer M, 2018).

To ensure the inclusion of this vital demographic, a second workshop was organized a few weeks later at the *Vancho Prke* primary school in Delchevo. This workshop was designed for students aged 14 and under and engaged 25 participants. The students were divided into four groups, each tasked with proposing new features for the town square and/or the City Park. Additionally, they were asked to design a skate park and a playground tailored to their specific needs and desires. The workshop was conducted in three phases, (fig.4):



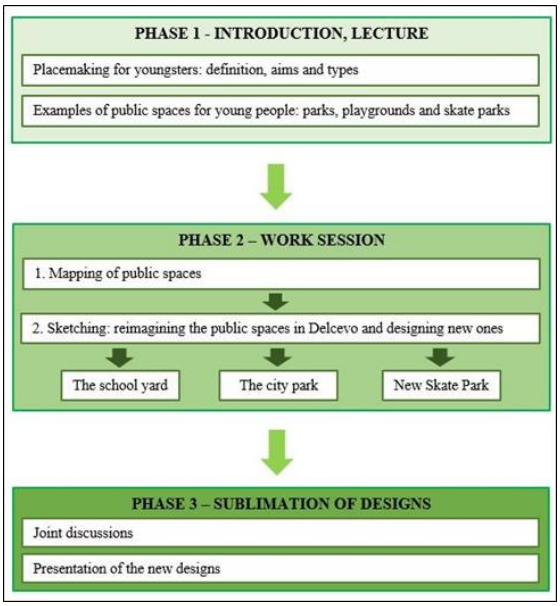


Figure 3: Stages of conducting a workshop with methodological procedures. **Figure 4**: Stages of conducting the children's workshop with methodological procedures, (source: author's)

Phase 1: A lecture titled *"Placemaking for Young People"* introduced students to the concept of placemaking, with an emphasis on its relevance to youth. The session included the presentation of international examples of public spaces designed specifically for young people.
Phase 2: A hands-on work session focused on mapping and identifying public spaces for development. The students were divided into three groups, each tasked with sketching proposals for new features in the city park, the schoolyard, and a skate park designed for teenagers (Fig.5a).
Phase 3: he final phase involved project presentations, during which each group shared their ideas, followed by a joint discussion to reflect on the proposals and gather additional input (Fig. 5b).



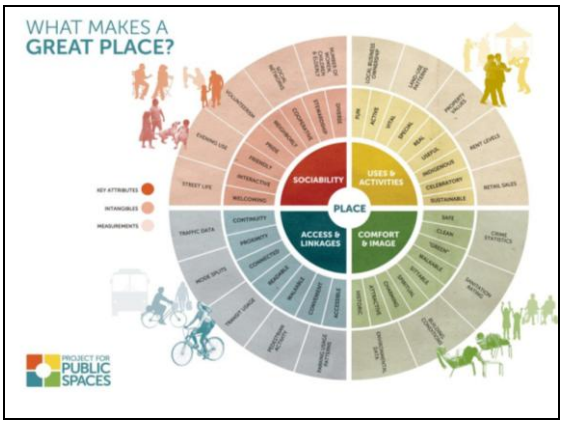


Figure 5: a) work groups with children; b) final project presentations (source: author's photo). **Figure 6**: The Place Diagram (source: PPS,2007)

Placemaking emphasizes collaboration and community engagement to design and transform spaces that align with the needs, aspirations, and values of their users. To gather relevant data, a survey questionnaire was developed and administered to the participants. The questions were carefully crafted to align with all the elements outlined in *The Place Diagram*, while also being adapted to the specific social and urban context of Delchevo. The questionnaire consisted of 12 questions, with 3 questions corresponding to each of the 4 key attributes and the 3 criteria defined in *The Place Diagram*. The results of the questionnaire were analyzed and presented graphically, providing valuable insights into the community's perceptions and priorities (fig.7):

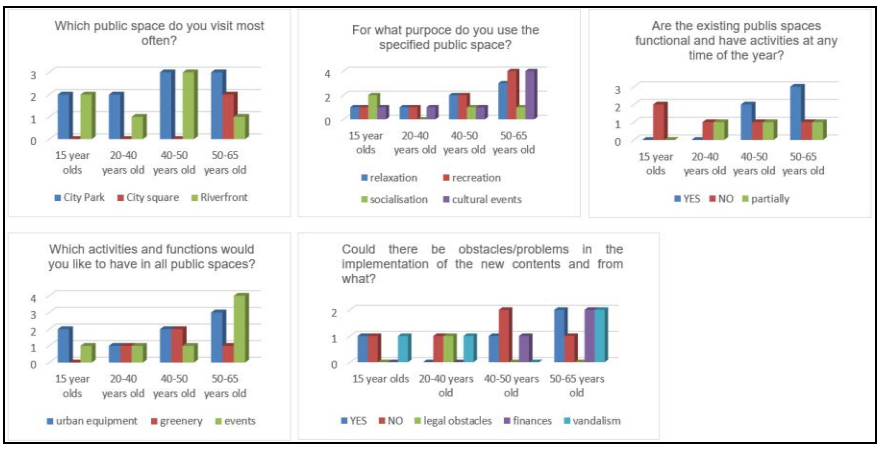


Figure 7: graphic results from the questionare

4.1. Field analysis – evaluation of the pubic spaces

The purpose of this activity was to document the characteristics and uses of specific public spaces through the method of observation. This approach allowed for a detailed spatial analysis and the collection of data on the activities of local inhabitants in the public spaces at a particular time. The evaluation of key elements of the public spaces was conducted using *The Place Diagram*, which provided a framework for analyzing the city square and city park. All key attributes, criteria, and aspects of these spaces were examined in detail. The evaluation was presented using graphic symbols and color codes, representing positive, negative, or neutral values for each criterion. The analysis focused on the town square and the park over a one-hour period, from

14:00 to 15:00. The observation of both spaces was conducted simultaneously, as the two public areas are physically connected (tab.1):

Table 1: evaluation of the city square and city park in Delchevo (source: author's)

Key elements of public space	Access and linkages							Comfort and image							Usage and activities								Sociability				
Criteria	Easily accessible	Sidewalk access	Access to various types of transport	Parking space provided	Ramps for disabled people	Proximity to services and activities	Signaling and information	Attractiveness of public space	Representativeness	Safety during use	Historical significance and age	Cleanliness and maintenance	Comfortable urban equipment	Digitalization of public space	Daily use	Period of use	Use of various age groups	Offering different activities	Active surrounding facilities	Unused spaces	Security and supervision	Temporary activities	Attracting people	User grouping	Interaction and socialization	Night use of space	Encourage positive feelings
City square	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Aft.	●	●	●	●	●	●	●	●	●	●	●
City Park	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Mor	●	●	●	●	●	●	●	●	●	●	●

4.2. SWOT analysis results

During the joint discussion at the workshop, a SWOT analysis was conducted to identify the strengths and weaknesses of the city administration, the opportunities presented by the Municipality of Delchevo in urban planning, tourism development, and cultural events, as well as potential threats to the implementation of new measures and concepts for revitalizing public spaces. The results of the analysis are presented in Table 2, (fig.8):

Table 2: SWOT analysis

Strengths	Weaknesses
- Easy availability of information - Youth activism and young active population - Formation of local groups for projects - Association and cooperation with neighboring municipalities from PHM and R. Bulgaria - Receiving grants and funds from abroad - Organization of public cultural events	- Poorly arranged public spaces - Lack of interest of the citizens in the decisions of the Municipality - Lack of information about the activities of the Municipality - Poor utilization of tourist and mountain potentials - There is no institutional responsibility and management
- There are possibilities for new arrangements of public spaces - Installation of new urban equipment - Conversion of abandoned buildings and spaces - The municipality offers opportunities for citizen involvement in decision making - Development of tourism	- Lack of financial resources in the Municipality - Climatic and natural disasters - Long-term maintenance of public spaces is problematic - Reduced biodiversity
Opportunities	**Threats**

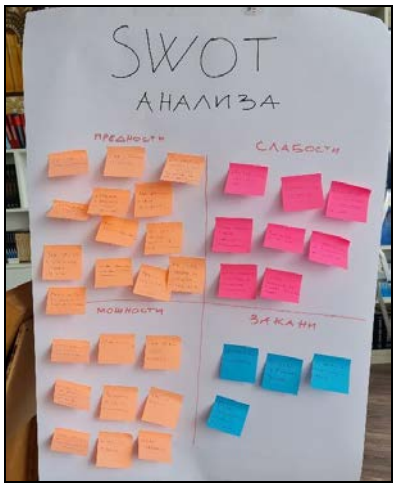


Figure 8: SWOT analysis during the workshops. (source: author's photo)

5. FINDINGS AND DISCUSSION

According to the research and analysis done during the workshop, a general conclusion was made that public spaces in the city of Delchevo, although they have a number of advantages, in terms of functions and elements, they are not fully used and do not have a large number of different contents that will make public spaces vital, active and attractive at all times. The condition of the **city square** requires new projects for its complete revitalization in terms of space, function and content. New recommendations for creating a place can be grouped into three groups:

1) Projects to improve the function of public space – developing the manifestation role of the square by introducing temporary and permanent cultural events in the fields of music, art and literature throughout the year, as well as a completely new urban design and the use of modern and interesting materials and elements.

2) Activities to implement new content in all seasons – implementing permanent and temporary activities that attract and activate people for mutual interaction, entertainment and games in order to achieve and improve socialization and interaction between people.

3) Introduction of planned actions to increase safety during the use of the square, as well as digitalization of the space – solutions for long-term security of the space by professional agencies, increased lighting and implementation of digital tools and elements, which would improve the use and positive experience of square visitors and tourists.

The **city park** in Delchevo requires new content and activities in order to increase attendance in both summer and winter. During the evaluation, the absence of sports and recreational content and elements was noted. Therefore, the new recommendations for creating the place focus on the following:

1) Projects to increase sports and recreational function – develop sports content and activities in the park and organize recreational events for all age groups throughout the year.

2) Activities to improve the representativeness and attractiveness of the park - improve the landscape appearance by revitalizing unused open spaces, install new, modern urban equipment, and introduce permanent and temporary activities that will attract and activate people for mutual interaction, fun, and play.

6. CONCLUSION

This study examined the role of youth-led placemaking in transforming public spaces in small border towns, focusing on Delchevo's city square and park. Through field observations, surveys, and participatory workshops, the research identified the main challenges of these spaces, assessed their current use, and explored possible interventions to enhance their functionality and appeal. The research aimed to understand how young people engage with public spaces in Delchevo and how placemaking strategies could improve their experience. The findings provide clear answers to the research questions:

1) **How do young people use and experience public spaces in Delchevo? -** The study revealed that young residents primarily use these spaces for passive activities (walking, meeting friends) rather than active engagement. The lack of engaging content, recreational facilities, and programmed events limits their appeal.
2) **What are the main shortcomings of these spaces? -** The central square and city park lack dynamic content, suffer from underutilization, and are not designed with youth needs in mind. Safety concerns, insufficient lighting, and a lack of interactive features further hinder their attractiveness.
3) **How can placemaking approaches improve their function and appeal? -** The workshops demonstrated that youth participation in urban design leads to creative, community-driven solutions.

The study also confirms that placemaking can be an effective tool for urban revitalization in small border towns. However, its success depends on long-term commitment from local authorities, citizens, and organizations. The findings suggest that:

- Community-driven urban interventions lead to more inclusive and functional spaces.
- Small-scale, low-cost improvements (such as pop-up events / installations) can significantly enhance public spaces.
- Collaborative urban planning that includes youth perspectives fosters a sense of ownership and civic engagement.

Given the success of this initial initiative, future efforts should focus on: Expanding the placemaking workshops to include a wider range of stakeholders; Implementing pilot projects based on the proposed interventions; and conducting longitudinal studies to measure the impact of these initiatives on public space use. By integrating youth-led placemaking into urban planning, Delchevo and similar towns can create more vibrant, sustainable, and inclusive public spaces that reflect the needs of their communities.

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ICUP2025
5th international conference on urban planning

TRANSFORMING ABANDONED RAILWAYS: CASE STUDIES FOR CREATION OF CYCLING AND WALKING CONNECTIVITY.

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ABSTRACT

The transformation of disused railway corridors into cycling and walking paths represents a significant shift towards sustainable urban mobility. These new functions create possibilities for bringing back and boosting local tourism and recreation on a new level. And they have their great potential also to be used as gradient-free, low-intersection and direct connections for everyday traffic. Because of their relatively flat terrain profile rail trails are perfect to be used and easy to follow whether one is walking or cycling. Reimagining abandoned railways is a unique opportunity to enhance connectivity, promote sustainable transportation and revitalize areas that have previously enjoyed the benefits of rail transport. By examining case studies from various places around the world this research explores contemporary approaches to adapting and reconstructing railways for active transportation, focusing on the benefits, challenges, and innovative solutions involved in these projects. The study aims to identify key factors that contribute to the success of these initiatives, including effective funding strategies, community engagement, and environmental considerations. The findings highlight the potential of repurposing abandoned railways to create sustainable, accessible, and enjoyable transportation and recreational infrastructure, contributing to healthier and more liveable urban environments. By identifying common themes and best practices, the research aims to provide valuable insights for policymakers, planners, and communities considering similar initiatives. In the end, this study advocates for the continued investment in and development of cycling and walking infrastructure as a means to foster more liveable, resilient, and sustainable urban environments.

Keywords: *transformation; abandoned railways; cycling and walking connectivity; case studies; sustainable development; healthier and liveable urban environments*

1. INTRODUCTION

The transformation of disused railway corridors into cycling and walking paths represents a significant shift towards sustainable urban mobility. Across urban, suburban, industrial, and rural landscapes, unused rail corridors that once served small settlements and industries are being reborn as “Greenways.” These trails preserve cultural heritage while enhancing connectivity, promoting healthier lifestyles, and stimulating economic growth. In urban and peri-urban areas, they help reduce traffic congestion and introduce green spaces into concrete settings (Sauter & Huettenmoser, 2008). Industrial railways—remnants of past

manufacturing—can be reimagined as cultural and recreational trails (Jones, 2017), while rural corridors reconnect small settlements, fostering regional cohesion (Taylor & Trent, 2019).

A notable example is the Rails-to-Trails Conservancy in the United States, which since 1986 has converted over 24,000 miles of rail corridors into multi-use trails. These pathways link urban with suburban and rural areas, offering safe, accessible routes for non-motorized travel. They have spurred economic development by attracting tourists and supporting local businesses, particularly in small towns once bypassed by modern infrastructure (Lindsey et al., 2006). In Europe, the Greenways movement exemplifies how international collaboration can enhance connectivity across varied landscapes. The European Greenways Association promotes sustainable travel routes along disused railways, encouraging eco-friendly tourism and local enterprise in both bustling cities and remote villages. Projects like Spain's Ojos Negros Greenway reinvigorate small settlements by drawing visitors to scenic landscapes and cultural heritage sites.

By encouraging cycling and walking, these projects reduce reliance on motor vehicles, cut greenhouse gas emissions, and improve air quality. Preserved as greenways, these corridors support biodiversity by maintaining continuous habitats for wildlife—a crucial advantage in fragmented peri-urban and rural areas (Benedict & McMahon, 2006). In urban settings, repurposed railways provide essential green spaces that enhance physical and mental well-being (Bedimo-Rung, Mowen & Cohen, 2005). For smaller communities, these trails improve access to services and reinforce local identity (Duggan, 2020). Their inclusive design accommodates people of all ages and abilities, fostering social cohesion and community interaction. Trails like these attract tourists, which in turn supports hospitality, retail, and service industries. In rural areas, the influx of visitors offers alternative income sources for communities affected by the decline of traditional industries (Racca & Dhanju, 2006). Properties near well-maintained trails often see increased value, reflecting the desirability of accessible green spaces (Campbell & Monroe, 2004).

Despite of the many benefits, challenges remain. Securing funding, resolving legal issues over land ownership, and addressing community concerns require careful planning and collaboration (Flink, 1993). Successful projects typically depend on partnerships between government agencies, non-profit organizations, and local stakeholders, with early and continuous community engagement essential to meet local needs and secure lasting public support (Moore & Ross, 1998).

The current paper explores the topic by reviewing international case studies of urban and rural trails. The examples include New York's High Line, Boston's Mary Ellen Welch Greenway, Melbourne's Outer Circle Rail Trail, and Paris's Promenade Plantée as well as some long-distance rural trails, such as Australia's Great Victorian Rail Trail, the USA's Katy Trail State Park, Germany's Hessen Railway Cycle Route, and Spain's Ojos Negros Greenway. Each of the projects demonstrates innovative reuse of obsolete railway infrastructure by transforming it into a linear park or green space, sharing the common goal of converting abandoned industrial corridors into active public spaces.

2. THE VALUE OF ABANDONED RAILWAYS

The potential of abandoned railways for tourism and local development is undeniable. Ristić (2024) highlights their ability to enhance rural landscapes and support sustainable growth. One of the most effective transformations is converting these corridors into non-motorized networks, improving accessibility, encouraging leisure activities, and promoting healthier lifestyles (Han-li et al., 2022). Many of these railway corridors traverse landscapes rich in historical and industrial significance. Their conversion into tourism assets allows for the preservation of local heritage. Curated trails incorporating interpretative panels, digital guides, and community-led tours provide immersive experiences, turning a simple walk or ride into an interactive dialogue between past and present. Thompson (2015) emphasizes that integrating history into recreational spaces strengthens both local identity and visitor engagement, transforming railways into living museums that narrate regional evolution.

Beyond cultural value, these projects also advance active transportation. By converting rail corridors into walking and cycling trails, cities and towns can promote sustainable travel, reduce congestion, and lower greenhouse gas emissions (Pucher & Buehler, 2010). Rail trails support public health initiatives by encouraging physical activity while simultaneously reinforcing environmental sustainability. Economically, repurposing abandoned railways yields substantial benefits. Research by Roberts et al. (2019) indicates that rail trail development boosts local economies by attracting tourism and generating business opportunities such as cafes, equipment rental shops, and boutique stores. In rural areas, where economic diversification is often challenging, these projects create new revenue streams and support local entrepreneurship. Enhanced

connectivity and increased visitor traffic contribute to long-term community resilience. Zhang and Li (2017) highlight how these spaces can bridge fragmented ecosystems, provide urban wildlife habitats, and mitigate the urban heat island effect. The integration of native vegetation into rail trails fosters environmental restoration while encouraging public interaction with nature, aligning with global sustainability objectives.

On a broader scale, the adaptive reuse of abandoned railways aligns with modern urban planning principles. Pojani and Stead (2015) assert that such projects contribute to resilient cities, supporting mixed-use development and minimizing ecological disruption. Instead of demolishing existing structures, repurposing them reduces waste and maintains cultural continuity, embodying the principle of "adaptive sustainability." These transformations create dynamic spaces that evolve with community needs, ensuring long-term relevance and functionality. The social benefits of rail trail projects extend far beyond transportation or tourism. Converting disused rail lines into public spaces fosters inclusivity, providing accessible environments for all age groups. Research by Martinez and Johnson (2018) underscores the role of such communal areas in strengthening social cohesion. These trails serve as informal gathering spaces, hosting cultural events, public art, and recreational activities that reinvigorate areas once defined by industrial decline.

In the long term, revitalizing abandoned railways represents a commitment to sustainable urban regeneration. As urbanization accelerates and natural landscapes face mounting pressures, reclaiming obsolete infrastructure symbolizes resilience and innovation. Cervero (1998) argued that transforming disused industrial corridors can trigger urban renewal, catalyzing economic and social revitalization. Abandoned railways are not remnants of obsolescence but foundations for future sustainability, connectivity, and community pride.

3. THE MULTIFACETED BENEFITS OF TRANSFORMING DISUSED RAILWAY LINES INTO RAIL TRAILS

Transforming abandoned railway lines into rail trails presents a compelling opportunity for sustainable urban and rural development. By repurposing these corridors, communities benefit from the economic growth, the improved public health and environmental quality, and the strengthen social cohesion.

Regarding the benefits for the economy the conversion of disused rail lines into trails creates a wide range of employment opportunities. The construction phase—including landscaping, rehabilitation, and ongoing maintenance—employs skilled labour, thereby injecting vital capital into local economies (Roberts et al., 2019). This approach is especially beneficial for regions facing economic hardship, where such projects serve as catalysts for revitalization (Martinez & Johnson, 2018). Cafés, restaurants, and retail outlets along these routes gain from increased foot traffic and higher cycling patronage. High-profile examples, such as New York City's High Line, illustrate that repurposing obsolete infrastructure can transform a corridor into an attraction that spurs real estate development and broad economic growth (Kay et al., 2015). Rising property values in adjacent areas further reinforce the economic advantages of these projects (Cunningham & de la Cruz, 2019).

Rail trails promote active transportation by providing safe and accessible pathways for walking and cycling. This shift encourages physical activity, which can reduce rates of obesity, cardiovascular diseases, and other chronic conditions associated with a sedentary lifestyle—factors that help lower public healthcare costs (Browne & Green, 2018). As healthier lifestyles flourish, communities not only see direct improvements in quality of life but also experience enhanced overall productivity, creating a self-reinforcing cycle of well-being.

From an environmental perspective, rail trails offer a sustainable alternative to building new transport corridors. Repurposing existing right-of-ways minimizes the need for additional land clearing and disrupts fewer natural habitats compared to large-scale infrastructure projects (Lee & Chang, 2014). In many cases, remediation of contaminated lands along former rail lines converts derelict spaces into thriving green corridors. These corridors help preserve local flora and fauna, improve air quality, and reduce the carbon footprint by promoting non-motorized transit (Pucher & Buehler, 2010). Thus, rail trails function as dual assets: they serve both recreational and environmental restoration purposes.

The social advantages of rail trails extend beyond physical health improvements. These accessible public spaces foster community engagement, offering venues for gatherings such as farmers' markets, cultural events, and neighbourhood festivals. Such interactions strengthen local identity and social bonds, contributing to heightened community pride (Martinez & Johnson, 2018). Additionally, the flat, even terrain common to rail trails makes them inclusive for people of all ages and abilities—including older adults and individuals with disabilities—ensuring equitable access to recreational opportunities. By connecting diverse neighbourhoods and reducing social isolation, rail trails enhance overall public safety and well-being.

4. CASE STUDIES OF SUCCESSFUL TRANSFORMATIONS

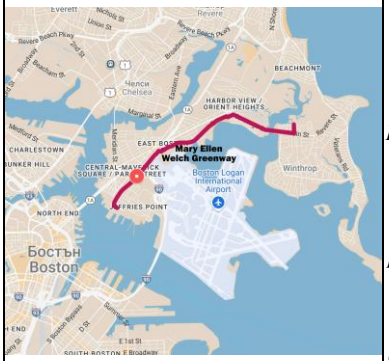
In this section several case studies are presented showing how abandoned railways have been successfully transformed into cycling and walking paths. For each case study the process, challenges, and outcomes of the transformation are illustrated. The presented case studies showcase how old railway corridors can be revitalized to serve modern communities while preserving the historical significance of the infrastructure. The selected case studies collectively show a diverse range of approaches—from metropolitan urban parks to long-distance rural trails—each tailored to local contexts and needs. Although all of them contribute to the enhancement of the environment, they achieve different specific effects. While studying and analysing the case study projects the authors have used six key criteria for comparison (Table 1), which allow for the evaluation of the significance, impact, and unique characteristics of each project. The detailed explanation of these criteria allows us to evaluate the projects from multiple perspectives—historical, technical, socio-economic, and environmental.

Table 1: Criteria for comparison

Criteria	*Meaning*
Historical context and original purpose	*Examines the initial function of the infrastructure: What was its original use? Why and how was it abandoned?*
Transformation process	*Focuses on how the infrastructure has been adapted for a new use*
Urban and infrastructural integration	*Evaluates how the transformed spaces are incorporated (adapted) into the existing urban environment.*
Social value and public impact	*Assesses the projects based on their ability to improve the quality of life (social impact).*
Economic impact	*Measures the effect on the local economy in both the short and long term*
Environmental benefits and sustainability	*Sustainable transportation and pollution reduction; preservation and restoration of the natural environment.*

The case studies are divided into two groups based on their range of approaches: one for metropolitan urban parks/urban trails (Table 2) and one for long-distance rural trails (Table 3).

Table 2: Selected case studies of successfully transformed abandoned railways in urban environment

Case Study	*Location*	*Description&Transformation*	*Impact*
The High Line, New York City, USA, 2.32 km		*Originally constructed in the 1930s to elevate freight rail traffic above the city's busy streets, the line fell into disuse by the 1980s. The High Line is an elevated linear park built on a 2.32-km stretch of an abandoned railway track on Manhattan's West Side. Recognizing its potential as a unique public space, community activists and city planners championed its transformation, culminating in the park's opening in phases starting in 2009. The High Line is one of New York City's most celebrated examples of adaptive reuse, transforming an obsolete piece of infrastructure into a vibrant urban park.*	*The transformation of the High Line has had a profound impact on its surroundings, such as Chelsea Neighbourhood. The High Line stretches along Manhattan's West Side, offering lush landscaping, public art installations, and striking views of the cityscape. Beyond its aesthetic appeal, the High Line has catalysed local economic revitalization, inspiring similar projects worldwide and redefining how cities can repurpose obsolete infrastructure into dynamic community assets.*
The Mary Ellen Welch Greenway (formerly the East Boston Greenway), Boston, USA, 5.3 km		*The Mary Ellen Welch Greenway is a multi-use trail and green space in East Boston, Massachusetts. The trail was developed along an old Boston & Albany Railroad freight corridor. It extends about 5.3 km, running from Piers Park near the waterfront to the Belle Isle Marsh Reservation, Boston's largest salt marsh. The Greenway serves as a key connection for pedestrians and cyclists. It connects multiple parks, which offers playgrounds, gardens, and community gathering areas. It provides direct access to Boston's Rapid Transit Blue Line, linking East Boston with downtown Boston, and integrates with cities' bicycle network.*	*The Mary Ellen Welch Greenway is an excellent example of how abandoned rail corridors can be repurposed into thriving green infrastructure that benefits both the environment and the community. The Greenway supports walking and cycling, offering a safe, car-free alternative for commuters and recreational users. The project revitalized neglected industrial land, transforming it into a vibrant public space. It enhances accessibility and mobility for East Boston residents, linking them to key destinations.*

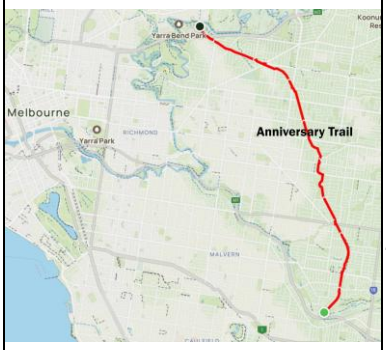
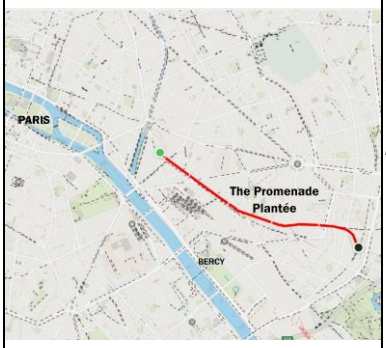
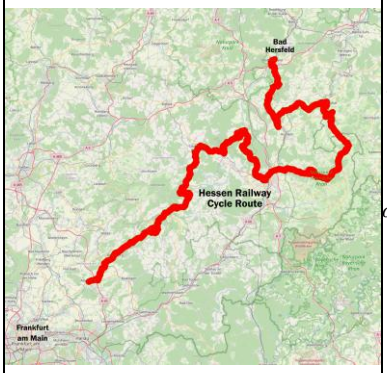
Outer Circle Rail Trail (Anniversary Trail), Melbourne, Australia, 16 km		*The Anniversary Trail is a prime example of adaptive reuse in Melbourne. It transforms a 16 km section of the 1891 Outer Circle Railway—originally built to link expanding suburbs—into a vibrant linear park. Rehabilitation began in 1991, and by the mid-2000s, the rail trail had been revitalized for multi-use recreational activities (including pathways, parks, playgrounds, and tennis courts) that integrate seamlessly into the city's green transportation network. Moreover, it now stands as both a community hub and a catalyst for local pride.*	*The transformation of the Outer Circle Rail Trail has delivered notable social, economic, and environmental gains. It revived a long-neglected corridor, spurring local economic activity by attracting visitors and benefiting small businesses. The trail promotes active transport, fostering healthier lifestyles, reducing reliance on cars, and enriching urban green space. By preserving a key piece of Melbourne's transport history, it reinforces local heritage and inspires similar adaptive reuse projects.*
The Promenade Plantée/ The Coulée verte René-Dumont, Paris, France, 4.7 km		*The Promenade plantée is a pioneering elevated park in Paris' 12th arrondissement that transforms a disused railway viaduct into a verdant urban corridor. Originally part of the historic Vincennes line and abandoned in the mid-20th century, it was revitalized in the early 1990s into a lush 4.7 km linear park stretching from the Bastille to Bois de Vincennes. The project preserves original railway elements while integrating modern design with extensive landscaping, offering a peaceful urban escape that celebrates the city's rich transport heritage and inspires innovative adaptive reuse.*	*Since its inauguration, the Promenade plantée has transformed Paris's urban fabric and enriched local communities. This linear park rejuvenates neighborhoods through boosted economic activity, urban renewal, and enhanced public interaction. As a pioneering adaptive reuse project, it repurposes historic infrastructure into vibrant, multifunctional settings, inspiring global initiatives such as New York City's High Line. Its exemplary design fosters strong community bonds, promotes active lifestyles, and sets a global benchmark for urban regeneration.*

Table 3: Selected case studies of successfully transformed abandoned railways for long distance rural trails

Case Study	*Location*	*Description&Transformation*	*Impact*
The Great Victorian Rail Trail, Victoria, Australia, 134 km		*The Great Victorian Rail Trail is one of Victoria's longest and most celebrated trails, spanning about 134 km. Developed from a disused railway corridor that once connected rural communities and supported regional industry, it now offers a scenic and accessible path for cyclists, walkers, and equestrians across varied landscapes—from open farmlands to native bushland pockets. Collaborative efforts preserved historic relics such as station platforms, bridges, and vintage signage, while modern upgrades and facilities like bike rentals and picnic spots maintain its rich railway heritage.*	*Since its conversion, the Great Victorian Rail Trail has generated significant social, economic, and environmental benefits. The trail attracts regional and international tourists, boosting local economies as visitors explore small towns along its route. It encourages active transportation by reducing car reliance and promoting healthier lifestyles. Environmental remediation has ensured the trail honors Victoria's rich rail heritage while supporting sustainable land use and biodiversity.*

Katy Trail State Park, Missouri, USA, 386 km		*Katy Trail State Park in Missouri stands as the longest rail trail in the US, extending about 386 km along the former Missouri-Kansas-Texas Railroad corridor. Once a vital freight and passenger route, the corridor was repurposed through an adaptive reuse project led by state and local agencies in collaboration with community stakeholders. Today, the rehabilitated trail honors Missouri's rail heritage while offering cyclists, walkers, and outdoor enthusiasts a safe, scenic, mostly flat route through farmlands, woodlands, and along the Missouri River.*	*The Katy Trail delivers notable economic, social, and health benefits. Attracting thousands of visitors each year, it boosts local tourism and supports businesses along its route. By encouraging active transportation, the trail promotes healthier lifestyles and reduces car dependence, while its preserved historic elements strengthen community identity. As a flagship project, it has spurred similar rail trail conversions nationwide, showcasing the transformative power of repurposing obsolete corridors into sustainable recreational assets.*
Hessen Railway Cycle Route Hessen, Germany, 240 km		*The Hessen Railway Cycle Route transforms a disused railway corridor into a dedicated cycling path through Germany's "Land of Extinct Volcanoes." Spanning roughly 240 km and divided into three segments to suit different cycling styles, the project emerged from a collaboration among local governments, regional planners, and community groups. The route offers a unique blend of natural beauty, local charm, and rich historical heritage—playing host to varied flora and fauna while promoting eco-tourism, sustainable recreation, and active community engagement. Its highlight is the impressive 1,172-meter-long Milseburg Tunnel.*	*Celebrated as a key recreational asset, the Hessen Railway Cycle Route boosts local economies by supporting cafes, rentals, and accommodations in small towns along its path. Its accessible, scenic, and culturally rich experience attracts cycling enthusiasts from across Europe, promoting sustainable tourism. By repurposing historic infrastructure, the route highlights regional uniqueness, supports car-free travel, encourages physical activity, reduces carbon emissions, and serves as a model for adaptive reuse projects worldwide.*
Ojos Negros Greenway, Teruel, Castellón and Valencia provinces, Spain, 183 km		*This itinerary between Teruel and the Valencian coast is Spain's longest "Vía verde," stretching 183 km. It repurposes a former mining railway from Ojos Negros to Sagunto that once served the Sierra Menera mining company. The trail splits into two sections—one in Aragon, centered in Teruel, and the other in Valencia, beginning along the Palancia River valley. Descending from the Barracas plateau at Sierra de Javalambre to Mediterranean orchards, it connects with the Xurra Greenway, offering a direct route to Valencia. Its success reflects the strong cooperation between the Valencian and Aragon governments.*	*The transformation of the Ojos Negros Greenway has yielded significant benefits. Attracting cyclists, walkers, and nature lovers both locally and worldwide, the trail boosts local economies along its route. It has spurred new business in hospitality, bike rentals, tours, and retail, fueling regional growth. By connecting rural areas with the bustling Valencian coast, the project enhances connectivity and drives economic uplift in regions once dependent on the old rail network.*

The presented tables clearly illustrate how different projects are tailored to their local contexts: metropolitan urban parks prioritize urban regeneration, public art, and community connectivity, while long-distance rural trails emphasize extended recreational opportunities, tourism, and the revitalization of regional areas. The selected examples demonstrate that abandoned infrastructure should not be regarded as a passive element, but rather as a valuable resource that can be transformed into sustainable, socially significant, and economically viable urban spaces.

5. CONCLUSION

Transforming abandoned railways into cycling and walking trails is a powerful, multidimensional strategy that revitalizes communities and connects regions. These projects serve as valuable tourism assets by showcasing rich historical narratives and natural beauty, while promoting sustainable urban transportation through safe, accessible non-motorized routes. In doing so, they catalyse economic and environmental revitalization by spurring community engagement, driving innovation, and bolstering ecological resilience. For

municipalities and planners facing modern urban challenges, converting obsolete rail corridors into vibrant public spaces offers a promising path to harmonize history, nature, and community well-being.

Realizing the full potential of rail trail projects requires comprehensive planning and proactive community involvement. Critical steps include conducting thorough environmental impact assessments, selecting optimal routes, and integrating sustainable design features—such as eco-friendly materials and energy-efficient lighting—to ensure long-term success. Early stakeholder engagement is essential to aligning projects with local needs and securing lasting commitment through continuous maintenance and adaptive management practices.

Our exploration of diverse case studies—encompassing both urban and long-distance rural settings—highlights the multifaceted benefits of adaptive reuse. In metropolitan environments, projects like New York's High Line, Boston's Mary Ellen Welch Greenway, Melbourne's Outer Circle Rail Trail (Anniversary Trail), and Paris's Promenade Plantée not only provide recreational spaces but also act as catalysts for community engagement and urban renewal. They blend historical context with contemporary design, creating green corridors that boost public health and encourage sustainable mobility. Meanwhile, long-distance trails such as Australia's Great Victorian Rail Trail, the USA's Katy Trail State Park, Germany's Hessen Railway Cycle Route, and Spain's Ojos Negros Greenway effectively bridge expansive landscapes and connect rural communities. These trails contribute significantly to regional tourism, stimulate local economies, offer scenic and safe alternatives to vehicular travel, and help reduce carbon emissions while celebrating natural and cultural heritage.

Collectively, these case studies demonstrate that adaptive reuse is far more than the creation of recreational pathways—it is a transformative process that revitalizes communities, preserves historical identity, and advances environmental sustainability. The success of these projects underscores how collaborative planning, innovative funding, and a firm commitment to heritage preservation can turn neglected corridors into thriving, multifunctional assets. As urban and rural areas continue to pursue sustainable development strategies, these examples provide replicable models for balancing progress with the preservation of our historical and natural landscapes.

By reimagining abandoned railways as dynamic arteries of active travel and connectivity, we honour their legacy while forging a more sustainable, interconnected future. These trails not only enhance local tourism and recreational opportunities but also offer efficient, low-intersection corridors for daily travel—truly demonstrating the transformative power of sustainable infrastructure repurposing.

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PERCEPTIONS OF SAFETY: IMPACTS ON URBAN LIVING AND WELL-BEING

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ABSTRACT

The quality of the urban environment plays a crucial role in determining the health and wellbeing of its residents, influencing not only their enjoyment of city life but also their willingness to raise families in such areas. Public spaces are integral to fostering community interaction and enhancing perceptions of safety, which significantly affect overall health. Yet, the relationship between environmental features—such as broken sidewalks, crime rates, and visible disorder—and safety perceptions remains poorly understood, particularly among individuals with disabilities who may feel more vulnerable. People often choose their routes based on perceived safety, favouring well-lit paths and lively storefronts while avoiding areas that appear unsafe.

This research serves as a documentation of strategies aimed at making streets safer, enhancing community liveability, and fostering a perception of safety. Using the university area in Tampa, Florida, as a case study, it explores various safety perceptions held by residents and leverages these insights to develop more effective solutions for the community. Utilizing a three-pronged methodology, the study combines empirical data from service requests, a systematic analysis of the built environment, and resident feedback from surveys. Preliminary results reveal a strong correlation between crime data and resident perceptions, highlighting the need for targeted safety interventions. By comprehensively examining the factors influencing neighbourhood safety and the role of public spaces in shaping perceptions, this study provides evidence-based recommendations for improving safety protocols that are both cost-effective and easy to implement. Ultimately, it aims to enhance the quality of life through the creation of safer community spaces.

Keywords: *safe streets; safety; urban planning; place making; neighbourhood safety*

1. DESIGNING SAFETY: THE ROLE OF BUILT ENVIRONMENT

Secure communities are those where the infrastructure and housing are designed to prevent crime, fostering safety and peace of mind for residents. A safe urban environment significantly enhances quality of life, promoting social cohesion, economic development, and attracting investment[1]. Conversely, poor urban security leads to fear, social isolation, and economic decline. The United Nations' Sustainable Development Goal 11 highlights urban security as key to improving inclusiveness, safety, resilience, and sustainability in communities[2].

Urban security faces threats like crime and violence, insecurity of tenure, forced evictions, and disasters. Both real and perceived crime affect health and well-being. Communities with high crime levels experience poorer health outcomes, and unsafe neighborhoods contribute to social isolation, which in turn leads to health issues like obesity and hypertension. The design of the built environment plays a crucial role in enhancing safety. Thoughtful urban planning, including architectural design, green spaces, and controlled access, can create a sense of security. Scholars like Jane Jacobs, Oscar Newman, and others have emphasized the connection between the built environment and urban safety. Jacobs highlights the importance of public surveillance and active streets in creating secure neighborhoods, while Newman argues that territoriality, natural surveillance,

1 This is referenced from the article "The Quality of Life: Research of Urban Security Aspects. The article also studies similar ideas presented in this research.

2 The United Nations Members in 2015 adopted the 2030 agenda, provides a blueprint for peace and prosperity for people and the planet, now and in the future. There are 17 sustainable goals, and goal 11 highlights security.

property maintenance, and access control contribute to safety. The "Broken Windows" theory by Wilson underscores the importance of addressing small signs of disorder, as they can lead to more serious crimes. This theory influenced policing and urban design policies (McKee, 2018).

CPTED (Crime Prevention Through Environmental Design) strategies, introduced by Clarence Ray Jeffery and expanded by Newman, focus on creating environments that discourage criminal behavior through design elements like natural surveillance, territoriality, and restricted access (Pellington, 2022). Research consistently supports the idea that careful urban design can significantly enhance both community safety and well-being.

2. SECURITY RATING INDEX (SRI)

The security of an area can be assessed through three main categories: Detailed Urban Elements, Supportive Aspects, and Measurable Elements.

Detailed Urban Elements include factors like building entrances, space delineation, and street activity. Studies show that entrances facing the street are associated with lower crime rates due to better visibility (Shu, 2000). Clearly defining public, semipublic, and private spaces fosters a sense of order and safety. CCTV systems are also effective in deterring crime, as demonstrated in *Safer Places: The Planning System and Crime Prevention* (Office of the Deputy Prime Minister, 2004). Additionally, active streets, where people engage in activities like walking and socializing, contribute to natural surveillance, which helps reduce crime (Shach-Pinsly, 2018).

Supportive Aspects focus on factors like maintenance, property ownership, and the criminal justice system. Well-maintained spaces with proper lighting and cleanliness improve perceptions of safety. Private properties, with better security measures, tend to feel safer compared to city-owned spaces. Moreover, an effective criminal justice system is essential for maintaining security and trust within a community.

Measurable Elements include factors such as mixed-use areas, streetlight density, and the number of intersections. These elements are assessed using an index that considers the proximity of buildings, streetlights, and intersections. Data is analyzed using GIS software to create maps that help identify areas with strong security features.

Overall, a comprehensive assessment of urban security requires considering both tangible elements and more abstract aspects that influence safety within a community.

Theme	Most Secured 1		2		3		4		5	
Mixed Usage	Most (5)		4		3		2		Least (1)	
Street Lights	Many (5)		4		3		2		Less (1)	
Building Proximity	0 < X < 5m	5 < X < 10m	10 < X < 15m	15m < X < 20m	20 < X < 25m	25< X < 30m	30m < X < 35	35 < X < 40m	40 < X < 45m	45 < X < 50m
Distance Between Junctions	0 < X < 5m	5 < X < 10m	10 < X < 15m	15m < X < 20m	20 < X < 25m	25 < X < 30m	30m < X < 35	35 < X < 40m	40 < X < 45m	45 < X < 50m
Number of Intersections	Many (7)		6	5	4		3	2	Less (1)	

Figure 1: Security Rating Index (SRI)

2.1. Case Studies

2.1.1. Tel Aviv, Isreal

The Security Sensitivity Index model, implemented in Tel Aviv, Israel, is designed to assess urban vulnerability and improve security by analyzing various urban features. This model uses pertinent and reliable data as the foundation for its analysis, with input from municipal officials, which enhances its accuracy and effectiveness. One of the primary challenges the model addresses is the high frequency of crime in the southern areas of the city, which are generally in poorer conditions. By analyzing the security sensitivity of different city areas, the model helps pinpoint vulnerable zones and suggests areas where security improvements are needed to reduce crime. A key component of the model involves evaluating the city's urban features through several categories:

1. **Building Height**: Structures in Tel Aviv are categorized based on the number of floors. The building height scale ranges from 1 (for buildings with 1-4 stories) to 5 (for buildings with over 50 stories). This

scale helps rank buildings based on their height, providing insights into urban planning, zoning, and emergency response planning.

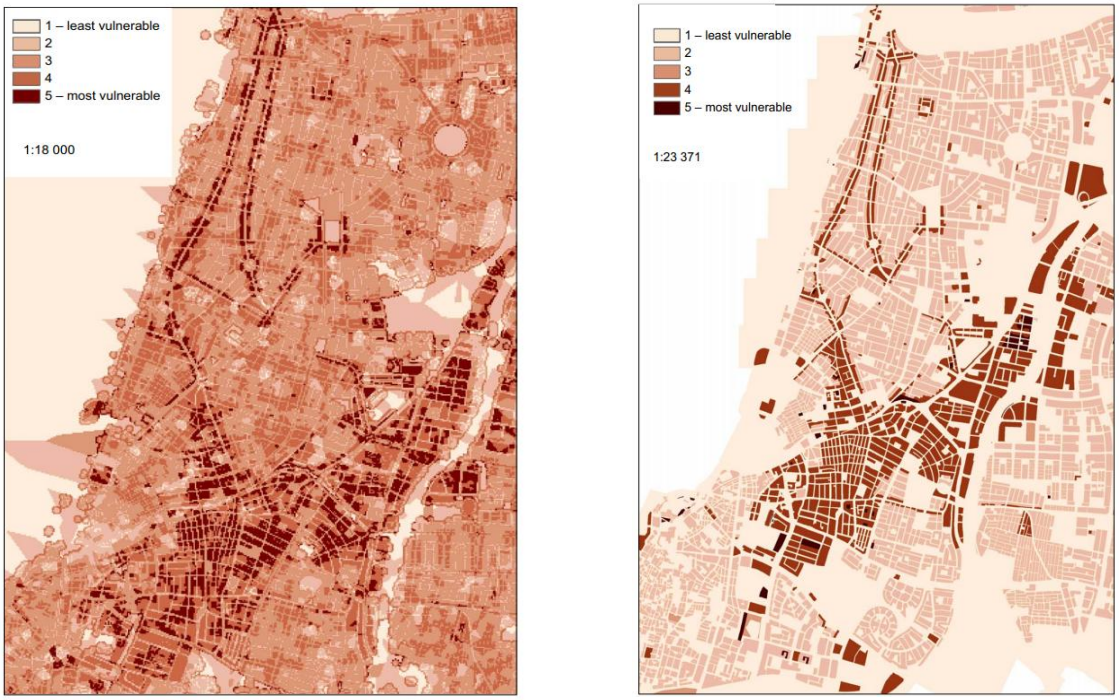
2. **Density of the Built Environment**: This scale assesses how close buildings are to each other, which could influence security vulnerabilities. Buildings within 10 meters of each other are rated 1, those between 10-20 meters are rated 2, and those between 20-30 meters are rated 3. This helps us understand how the density of buildings might impact security.
3. **Distance from Junctions**: The proximity of intersections to different areas in Tel Aviv is assessed using Euclidean distance. Each cell in a raster map is linked to nearby intersections, which provides insights into traffic flow, urban development, and emergency response planning.
4. **Usage Analysis**: This analysis categorizes land uses across Tel Aviv, assigning numerical values to different types of land use based on their function. Residential areas are given a value of 1, sports venues a 2, and commercial or mixed-use areas a 5.

The Security Sensitivity Index aggregates these ranked urban features into a single raster image, creating a comprehensive map of the city's security vulnerabilities. The result is a visual representation of areas that are more prone to security risks, which can assist policymakers and urban planners in targeting interventions effectively. This index is adaptable, allowing it to evolve with new data and insights, ensuring it remains relevant and useful. While the Security Sensitivity Index is a valuable tool for urban security planning, obtaining the required data can be challenging, and it may not always be complete. Nonetheless, the model has significant potential for other cities facing similar security challenges, as its adaptability makes it a flexible tool for enhancing urban resilience and sustainability. The Security Sensitivity Index aims to promote safer, secure cities by identifying vulnerable areas and suggesting ways to mitigate potential risks.



(a) (b) (c)

Figure 2: (a)- Analysis of Building **Height (**b)- Building Proximity **Map (**c)- Distance from Junctions



(a) (b)

Figure 3: (a)- Usage Analysis Map (b)- Overall Ranked Indices

3. FRAMEWORK

This research aims to assess the level of urban security in a specific geographic area by using both qualitative and quantitative measures. The Security Rating Index (SRI) will be employed for quantitative analysis, while qualitative indicators will be derived from a literature review. The study intends to explore how the built environment influences security perception, evaluate current security conditions, and investigate the relationship between qualitative and quantitative factors in assessing neighborhood security.

The research objectives include:

1. Collecting primary and secondary data on key security parameters.
2. Using the Security Rating Index to identify vulnerable hotspots in the region, and visually represent the area's security levels.
3. Proposing strategies to improve security in the study area.

The research problem focuses on the University Area, which faces challenges such as abandoned spaces filled with waste, harmful emissions from nearby businesses, and socio-economic issues like poverty and high crime rates. According to the U.S. Census data (2010-2014), 75% of residents are from minority backgrounds, and the area struggles with issues such as poor transportation, inadequate housing, and a lack of basic needs. The 2022 Neighborhood Transformation Strategy report highlighted these challenges.

Given the high crime rates in the area, the research will examine the relationship between neighborhood safety and the physical environment. It aims to propose strategies for addressing these safety concerns and improving the overall quality of life. Additionally, the research will review the efforts of the University Area Community Development Corporation (UACDC) to ensure their current and planned projects align with the area's security needs.

The research methodology outlines the steps and tools used to achieve the study's objectives. It began with reviewing similar studies and defining the scope of the study, which led to establishing the main aim and objectives. Visual assessments and resident surveys were conducted to gather insights, with the results analysed and graphically represented to explore interconnections between parameters. Strategies were then recommended based on the findings. Key tools such as ArcGIS for mapping, PowerPoint for timeline management, and Excel for analysis were crucial throughout the process.



Figure 4: Research Methodology

4. STUDY AREA: UNIVERSITY AREA, TAMPA

The University Area is delineated by Fowler Avenue to the south, Bruce B Downs Blvd on the eastern side, Bearss Avenue to the north, and I-275 on its western perimeter, as specified by the University Area CDC.

The University Area Community (UAC) is an underserved residential and commercial region in unincorporated Hillsborough County, covering 864 acres. Approximately 58% of residents live below the federal poverty line, with 80% from minority backgrounds. Around 85% of public-school students rely on free or reduced-price meals, and 89% of the population resides in rental homes. Once called "suitcase city" due to its high rental occupancy, the UAC is considered one of Florida's most economically disadvantaged areas. Despite its challenges, the community is located near key institutions such as the University of South Florida and Advent Health, all within a 5-mile radius.

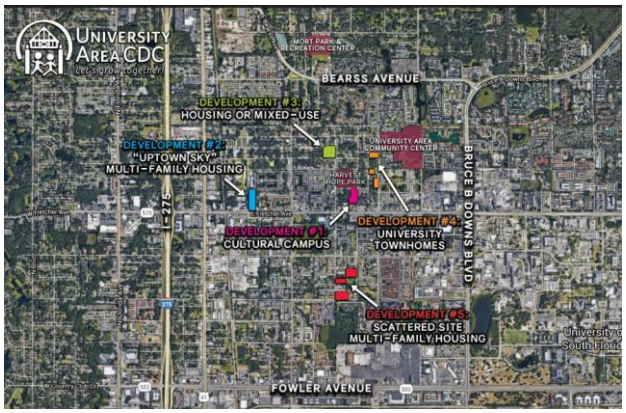


Figure 5: University Area Community Limits

4.1. Demographic Profile

The University Area consists of 8 census tracts. According to the 2020 Decennial Census, the University Area's population stands at 29,317 based on Census Tracts data. The median household income averages $28,670. Data from the 2021 ACS indicates that 12% of the population possesses a bachelor's degree or higher. Employment across the census tracts exceeds 50% for all but one tract, which registers an employment rate of 40%

Table 1: Demographic Data

Census Tracts	Population	Median Income	Education	Employment	Housing
108.17	4,747	24,957	10.90%	54.10%	1,842
108.08	3,433	33,086	15.80%	67.80%	1,722
108.21	3,151	23,220	8.90%	56%	1,213
108.22	2,265	31,079	5.50%	59.40%	1,142
108.15	2,163	23,309	14.50%	56.70%	936
108.05	5,852	26,201	5.80%	56.90%	2,208
108.14	3,420	38,259	25.90%	40.10%	1,816
108.16	4,286	29,255	10.60%	54.10%	1,906

Based on the 2020 Decennial Census Data, the University Area predominantly consists of Hispanic or Latino individuals, accounting for 45%, followed by the Black or African American community at 33%, with the White population coming next.

Table 2: Ethnicity Data

Census Tracts	Hispanic or Latino	White Alone	Black or African American	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some Other Race alone
108.17	2,910	813	847	5	46	1	17
108.08	1,168	724	1,261	9	127	3	27
108.21	1,639	353	1,025	5	5	4	31
108.22	971	571	600	2	41	1	8
108.15	1,077	175	789	6	18	6	33
108.05	2,945	623	2,035	7	59	3	28
108.14	559	1,361	741	1	537	12	6
108.16	1,492	630	1,926	13	56	1	29
Total	12,761	5,250	9,224	48	889	31	179

Based on the 2020 Decennial Census Data, the University Area predominantly consists of Hispanic or Latino individuals, accounting for 45%, followed by the Black or African American community at 33%, with the White population coming next.

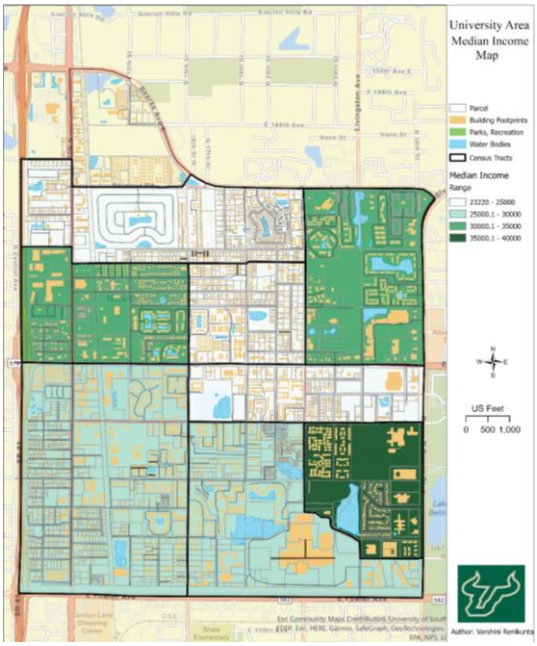


Figure 6: Median Income Map of University Area

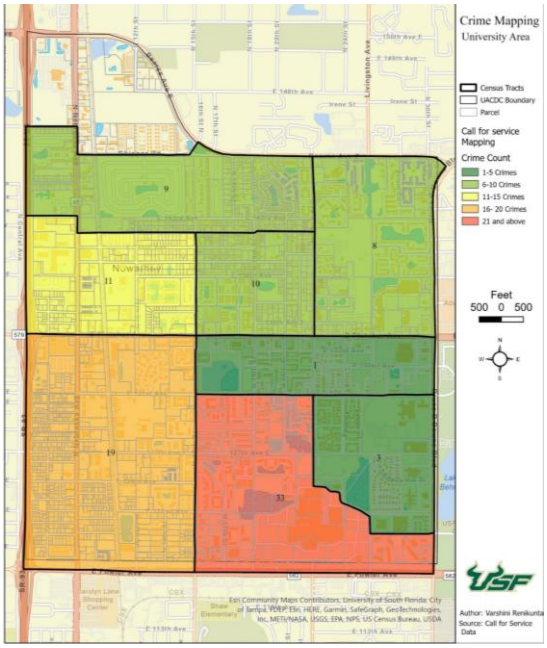


Figure 7: Crime Statistics of University Area

5. CRIME STATISTICS IN UNIVERSITY AREA

The crime map was created using data from Hillsborough County's Call for Service website, focusing on crime rates from April to June. The analysis, conducted on a census tract basis, reveals a higher concentration of crime in the southwestern tracts of the University area compared to the northeastern tracts. The crime categories include mischief, theft, violence, and complaints related to homelessness, law violations, and roadside nuisances. The data was downloaded in Excel, geocoded using ArcGIS, and spatially linked to census tracts to determine crime counts within each area.

6. QUALITATIVE ANALYSIS

6.1.1. Windshield Survey

This windshield survey was conducted on August 15th, 16th, and 20th, 2023, with the objective of visually assessing the built environment in the research area, pinpointing potential areas of vulnerability.The pavements are in moderate condition, with sidewalks present on one side of the road. Multiple instances of garbage dumping were noted on the streets. This locality is in proximity to both the code enforcement office and the sheriff's office.

6.1.2. Stakeholder Survey

During a quarterly meeting with the safety coalition at UACDC, Jossie highlighted the ongoing efforts of the University Area CDC to improve the community, noting successes in addressing homelessness and regular community events. She emphasized the CDC's commitment to continual improvement.

A ride along with Code Enforcement Officer Laura revealed challenges in the area, distinguishing between the northern part, which struggles with trash and debris, and the southern part, with higher crime rates. Laura noted the area’s deterioration between 2007-2010 but praised the collaborative efforts to revitalize it, pointing to specific areas like North 15th Street and Bearss, which had histories of violent crimes. The Community Resource Deputy Officer from the Sheriff's Office reported that the University area has consistently had higher crime rates than other Tampa neighborhoods. Officers patrol frequently and work with the community to prevent incidents. These insights from UACDC, Code Enforcement, and the Sheriff's Office reveal a community facing significant challenges but actively working toward improvement through collaborative efforts among local organizations, law enforcement, and residents.

6.1.3. Primary Survey

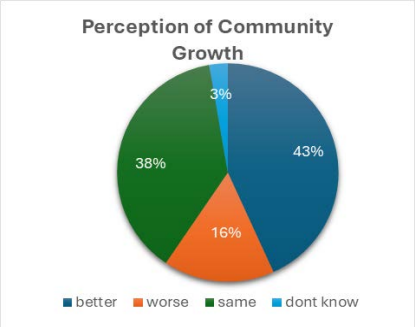


Figure 8: Perception of Community Growth

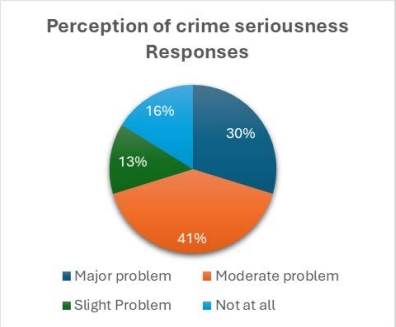


Figure 9: Perception of Crime Seriousness

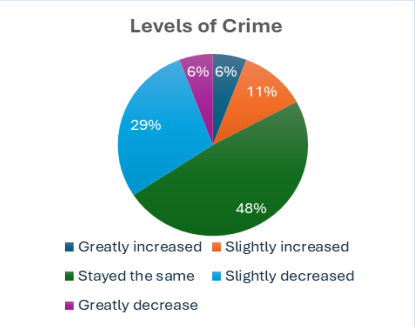


Figure 10: Levels of Crime

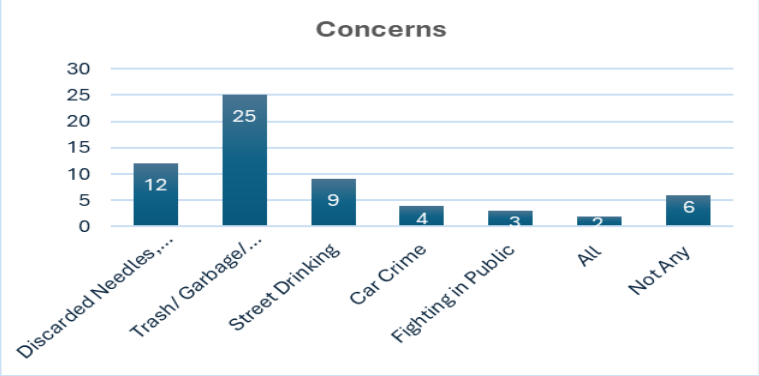


Figure 11: Concerns in the area

7. QUANTITATIVE ANALYSIS (SECURITY RATING INDEX)

The Security Rating Index used in this study was adapted from the version implemented in Tel Aviv, with modifications to better suit the local context of the neighbourhood. One key adjustment was replacing the 'Number of Junctions' parameter with 'Street Conditions,' as the latter more accurately reflects the area's infrastructure and its impact on security. Additionally, the measurement criteria for the parameters were recalibrated to align with Florida's standards and regulations, ensuring the index is contextually relevant and compliant with local frameworks. These changes enable a more precise and applicable security assessment for the area.

Theme	Scores	Vulnerability					Data Sources	Mapping Technique
		1	2	3	4	5		
Land Use	Usage	Residential	Community Center, Education	Office spaces, recreation	Commercial, Industrial, Mixed Uses, Shopping	Large Vacant lots, Parking	Hillsborough County Existing Land Use	Symbolizing Land Uses as per Vulnerability
Ligthing	Street lights	Abundant	Many	Moderate	Few	Very Few	Street light data from TECO	Spatial Joining Street light points to the Parcel layer. Summeraize all the Parcels with Street light in a distance of 50ft in all directions
Building Typology	Height	1 and/or 2	3 and/or4	4 and/or 5	6 and 7	8 and above	Hillsborough County Propert Appraiser Data	Caluclating the number of stories
	Density (DU/Acr)	High				Less	Hillsborough County Propert Appraiser Data	Calculating Number of Buildings per Acre of a Parecl
	Building Proximity	<5m	5-10m	10-15m	15-20m	20 and above	Hillsborough County Propert Appraiser Data	Calculate distance between units
Intersections	Number of Intersections	Abundant	Many	Moderate	Few	Very Few	Hillsborough County Intersections Data	Spatial Joining the Intersections Point layer with the Parcel and summerizing the Intersection with in a distance of 350ft radius
Streets	Sidewalk/ Crosswalk	Yes				No	Hillsborough County Sidewalk Data	Sidewalk Connectivity and Conditions
	Pavement Width/Condition	0				100	Hillsborough County Pavement Data	Streets typology, Pavement Current Condition (PCI)

Figure 12: Security Rating Index (Modified to University Area Context)

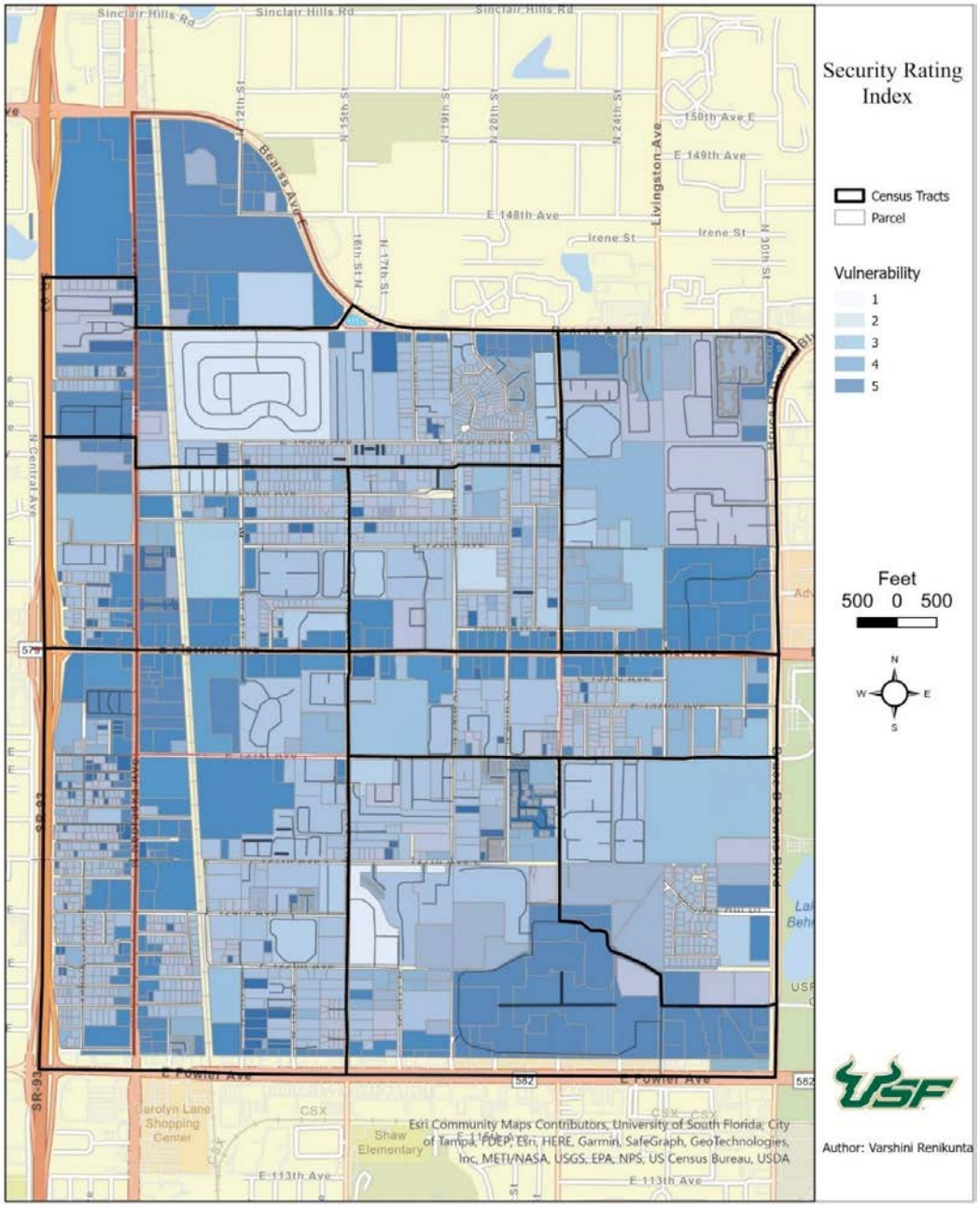


Figure 13: Security Rating Index of University Area

This map uses varying shades of blue to represent different levels of vulnerability within the built environment. Lighter blue areas indicate lower vulnerability and greater stability, while darker blue areas signify higher vulnerability and potential safety concerns. The map integrates all parameters from the Security Rating Index, with transparent layers that accurately reflect the impact of each parameter. This approach provides a clear and comprehensive visualization of the area's security landscape.

8. RECOMMENDATIONS

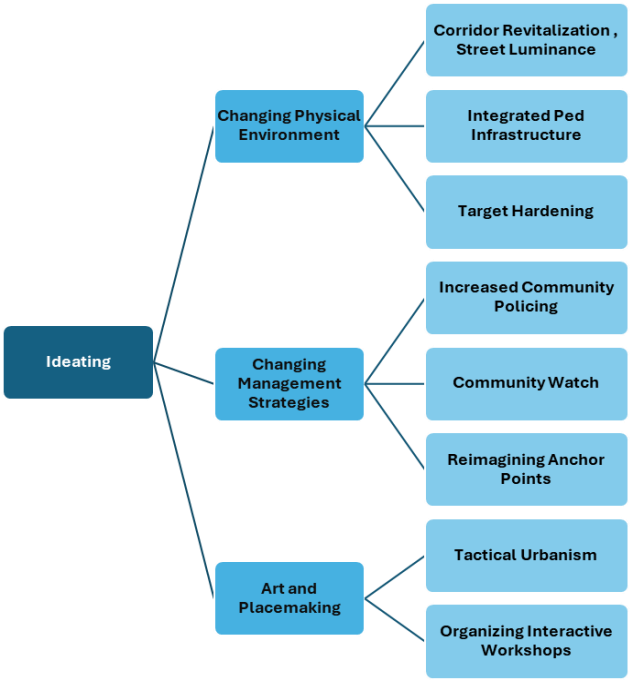


Figure 14: Recommendation Strategy

1. Changing Physical Environment:
   Revitalizing corridors, improving street lighting, and integrating bike and pedestrian facilities can transform spaces, making them safer and more welcoming. By enhancing visibility and accessibility, these interventions reduce opportunities for crime and foster a sense of community. Additionally, implementing target hardening techniques, such as securing vacant properties or fortifying vulnerable areas, can deter criminal activity, creating a more resilient and safer environment.

2. Changing Management Strategies:
   Increased policing and active community watch programs create a stronger, more visible presence that can deter criminal behavior. Reimagining anchor points, such as parks or public spaces, allows for better management and control, promoting positive activity and reducing the likelihood of criminal activity. These strategies strengthen the connection between law enforcement and the community, fostering a sense of security and ownership.

3. Art and Placemaking:
   Tactical urbanism, including temporary installations and creative interventions, can instantly transform a space, making it feel more engaging and safer. Organizing interactive workshops encourages local involvement, empowering residents to take ownership of their environment and actively contribute to its safety. Art and placemaking create vibrant, dynamic spaces that deter crime by enhancing social cohesion and promoting positive interactions among community members.

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ICUP2025
5th international conference on urban planning

TECHNICAL ASSISTANCE IN INTEGRATING CULTURAL HERITAGE INTO THE PLANNING OF SEVILLE'S CITY-PORT DISTRICT

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ABSTRACT

The Port Authority of Seville is in the final stages of approving its master plan for the city's first city-port district. After decades of restricted access, the opening of the historic Tablada docks will allow the public to engage with spaces that date back to the 1920s, a period of significant urban growth in Seville, opening post-colonial trade with the Americas and rapid technological progress. The docks are a repository of rich material, intangible and natural heritage, inserted in a wider regional landscape, which is largely unknown to the city. The Andalusian Institute for Historic Heritage (IAPH), a public business agency with competences in research, was brought in to work closely with the design office Citythinking in support of the planning process. In line with its mission, the IAPH conducted extensive multidisciplinary research to assess the heritage values of the docks and identify key heritage resources. This research allowed us to provide specific planning criteria and strategic guidelines aimed at preserving, protecting, and enhancing the area's cultural heritage. This paper offers an overview of the process, detailing the unique case of the Tablada docks, the application of heritage value theory during the research, heritage characterisation and proposal stages, and the means used to communicate and integrate advanced heritage concepts during the planning and project development process.

Keywords: *Town planning; urban renewal; industrial heritage; urban landscape; public-private collaboration; heritage values.*

1. A REPORT ON HERITAGE VALUES TO INFORM DEVELOPMENT PLANNING

In July of 2020, the Seville-based design office Eddea, Arquitectura y Urbanismo, SLP was commissioned by the Seville Port Authority (APS) the writing of a masterplan for creating a city-port district in the old Tablada docks.

Seville has historically been a port city, built on the furthest inland navigable point of the Guadalquivir River, where maritime and land routes meet. As such, the city and the port's developments have gone hand in hand, most notably as a result of holding the monopoly of American commerce between the 16th and the 18th centuries. The cultural significance of port infrastructure in the city cannot be understated, albeit the needs and operation of maritime freight during the last decades have caused the two spaces to become increasingly detached in terms of access, visibility and presence in the public imaginary.

The dock of Tablada represents a turning point in that history. It was built during the early 20th century, in the context of the city's - failed - urban and international expansion plans. Tied to the celebration of a grand Iberian-American Trade Fair, it meant an update of port infrastructure in response to new requirements in trans-Atlantic freight (figure 1). Both initiatives showcase Seville's intention to recover its commercial position

between America and Spain after the swift and traumatic loss of the Spanish colonial status in the 19th century. There were clear spatial, formal and conceptual connections between the developments of the city and the port, but at the same time the growing scale, mechanisation and complexity of dock operation required it to be further away and detached from the city's everydayness. The docks were a key territorial feature in Seville, serving as the city's second urban crossing over the Guadalquivir River and reconfiguring a vital connection to its hinterland.



Figure 1: Opening of the Alfonso XIII channel in 1926, main feature of the port's expansion. Source: Aviación militar, grupo de reconocimiento de Getafe.

Now obsolete for container and ro-ro freight, the Tablada docks have remained underutilised and closed off to the public for decades. In the meantime, urban growth has given it a more central and integrated position within the city, and shaped it as an area of opportunity laden with cultural values, but much unknown to the citizens.

On previous instances, the port authority had decommissioned the historic quays and handed them over to the city, but in more recent developments a model was adopted whereby some port uses would coexist with commercial and tertiary activities in spaces that were now to be open to the public. This is a large area spanning 2,2 km in length along the river and approximately 200 m across. By sharing this space with the city, the APS aimed both to renew and to leverage this rapport, for which special attention needed to be given to the heritage values during the planning process.

2. A METHODOLOGICAL APPROACH TO CULTURAL HERITAGE APPLIED TO AN INDUSTRIAL SITE

It is in this context that the Andalusian Institute for Historic Heritage (IAPH) was commissioned a report on the heritage values of the Tablada docks in July 2021 (IAPH 2022). Acting as contractor for the design offices Eddea and Citythinking SL, it would provide the City-Port District Technical Office (OTDUP) a background analysis on the most important heritage features. This document was to contain a heritage characterisation based on historical, architectural, functional, social and symbolic analyses, as well as a study of its relations with the urban landscape. It was also to include a strategy for heritagisation resulting in a set of specific intervention criteria for this particular instance of urban, industrial and port heritage. The report was not meant to curtail development but, in the understanding that heritage intervention is part of transformative processes, to guarantee that development and design decisions were made that preserved and enhanced the cultural values of the site.

For this reason, the IAPH has made a special effort to systematise the identification in an integrated manner with the project and strategic planning processes. The contract took thus shape of a one year long Technical Assistance process, starting in July 2021, which run parallel to the design stages, and therefore needed interim deliverables and periodical contact with the planning technicians.

3. INTER-DISCPLINARY METHODS AND TEAM

Jokilehto (2016, 17) opens the door to considering heritage valuation useful, beyond the prioritisation of assets, as a process in itself useful for guiding knowledge, intervention and enhancement. It is under this

premise that the IAPH proceeded to base its technical assistance, first and foremost, on a methodical analysis of the heritage values on the site.

The systematisation of value analysis focused on identifying the heritage resources that convey them. The dock, as an element of articulation on a territorial scale, was broken down into different sets of objects, both serial and singular, and into the main spatial, temporal and systemic relationships between them. The identification of these elementary parts was made possible by combining the historical and social studies, the architectural, urban and landscape analyses, and the environmental characterisation (table 1).

Table 1: Technical team involved in the writing

Coordination - IAPH		
José Luis Gómez Villa (Head of Intervention Centre)		
Drafting - IAPH		
Beatriz Castellano Bravo (Head of Projects Department) *Miguel Torres García (PhD Researcher – Projects Department)* *María Soledad González Arques (Technician – Projects Department)* *José Manuel Díaz Iglesias (Researcher - Landscape Laboratory)*		
Collaborators		
IAPH *Landscape perception analysis; industrial heritage; visualisation.*	***University of Seville*** *Background report on architectural keys and integration in the urban context. Overseeing.*	***Bioritmo (consultants)*** *Background report on natural and environmental values*
Silvia Fernández Cacho (Head of Landscape Laboratory) *Patricia Wanderley Ferreira Lopes (PhD Researcher- Documentation Centre)* *Theodoros Mavroeidis (Architect - Stagiaire)*	*José Ramón Moreno Pérez* *Félix de la Iglesia Salgado* *Marta García de Casasola Gómez (PhD Researchers - School of Architecture)*	*Beatriz González Sancho (Biologist)*

In order to relate these different strings of research, a conceptual and methodological framework was tailored according to the specificities of the case. A historical process of value accretion was assumed to have taken place, which could be scrutinised along the following:

- A landscape analysis defined its characteristics, values and singularities through the study of the natural environment, the historical construction of the territory through historical processes and socio-economic activities and, finally, through the perceptions that the citizens of Seville have of the area of study.
- An analysis as an urban-port system was conducted based on a diachronic analysis of the historical process of configuration of the docks, from two different points of view: as a functional-compositional system and in terms of the port-city relations. In the same way, the port-city interactions were analysed, with the understanding that the DUP constitutes an opportunity to reactivate the original relations, as well as to enhance the current potential of the whole.
- In order to assign heritage values the study takes as a reference the classifications proposed in the National Plan for Industrial Heritage (Ministerio de Educación, Cultura y Deporte 2011) and the Nizhny Tagil Charter on Industrial Heritage (TICCIH 2003), extending from its consideration as landscape and urban heritage.

After breaking down the area into elements, sets and relationships it was possible to assign attributes and group them into values; such an analytical approach could be easily communicated to the other teams that contributed to the general development strategy, be it in the fields of urban design and architecture, commercial viability, or regarding the port activities that to a certain extent will remain in the area.

Finally, and also in order to be better integrated into the decision-making processes, the value assessment was followed with an intervention strategy strictly on the heritage level. In this sense, the document lays out lines of action around the general objectives of enhancing the port's heritage; it identifies opportunities to strengthen territorial and urban connectivity, as well as to improve environmental quality. In the same way, it identifies areas of opportunity for the urban re-contextualisation of the docks, for ecological connectivity and for the better interpretation of its territorial context and landscape.

4. RESULTS: IDENTIFYING AND SPATIALISING HERITAGE VALUES

4.1. Values, attributes, resources

As synthesis, this multidisciplinary study produced a set of distinct *heritage resources* that are demonstrative of the *cultural values* of the Tablada docks insofar as they exhibit them in the form of *heritage attributes*. This analytical arrangement provides an advanced tool for assets identification and the communication of the results, and allows spatializing easily the values and other variables in maps and geographic information systems, which was articulated both in terms of its historical phases and by identifying sectors and hierarchical spatial ensembles (table 2).

4.2. Value breakdown

Values consist of cumulative layers of perceptions, associated with attributes, which are the different qualities that characterise the cultural asset in its historical, social, technological-scientific, functional, aesthetic and ecological dimensions. There is a rich literature on the general categories to which heritage values can be assigned (cf. Mason 2002; e.g. Choay 2007; Riegl 2007; Jokilehto 2016) and it is with reference to these different sets, with special attention to those of the Nizhny Tagil Charter (TICCIH 2003), that a specific one was devised for the study at hand:

- Historical value, as testimony of specific historical periods.
- Social-symbolic value, as part and record of the lives of ordinary men and women, as the testimony to their socio-cultural context and as memory of a working and local culture.
- Technological-scientific value, as a response to the development and evolution of engineering and techniques in industry and construction.
- Spatial-functional value, as a response to the organisational logics of urban and port activities, in terms of relations either between individuals or between individuals and merchandise.
- Aesthetic or architectural value, as quality of the formal, material and language of the architecture, design or planning or of other significant movable heritage assets.
- Ecological, bioclimatic and environmental comfort values of the built and perceived territory.

The rigour in this assignment of values depends on the application of a methodology based on the knowledge of the assets' different cultural facets. In the most recent formulations, values are conceived to be formulated from a perspective of the contemporary conditions and aspirations of society. Still, values are dependent on processes of accumulation through history and the continued practice of spaces and environments over time. Finally, the formulation of values is to be projected into the future, and help drive the process that the area will follow in subsequent stages. Therefore, it must address the potential that the assets hold to give continuity to their cultural features, to be reformulated, or to acquire new ones that guarantee the sustainability and durability of its essential characteristics over time.

4.3 Heritage resource identification

Heritage *resources* are those elements that are particularly representative of these heritage *values* and *attributes*. In order to assign these to concrete heritage resources and map them, and along the historical logics of the area's shaping and growth, a zoning (figure 2) was developed according to 4 levels of analysis:

- Level 0 - The CPD in its urban and landscape setting, containing the main interpretative keys to the historic urban landscape in its sector.
- Level 1 – Sectors - The most basic level analysis relates to the organisational approach and overall design of the port area of the DUP. This is a scheme which has remained essentially in place since it was proposed in the first drafts for the operations area of the Tablada docks. It is organised in bands parallel to the canal, which organise the flow of goods between the canal and the urban-territorial system.
- Level 2 – Sub-sectors - This second level elaborates on the first level, based on the historical process of development of port facilities and activity in the DUP, which has generated differential characteristics.
- Level 3 – Ensembles - The third level of zoning defines a series of sets of elements that share resources and heritage attributes of the highest order (figures 2, 3). As standardisation and the systemic dimension of space proved to be one of the main factors to be considered in this industrial and port

heritage assessment, the values of the ensembles, rather than those of discreet elements, play a preponderant role in its preservation and enhancement.

- Level 4 - Differentiated elements – It nevertheless became important to establish nuances and hierarchies within the ensembles, in order to give intervention criteria. These are structures and spaces that partake on the ensembles and their heritage attributes to varying extents.

Table 2. Heritage values: spatial distribution

HERITAGE VALUES					*LOCATION*		
Social	*Technological-scientific*	*Spatial-functional*	*Aesthetic-architectural*	*Environmental*	*Heritage ensembles*	*Subsectors*	*Sectors*
x	x	x	x		*Wharf*	*Tablada dock*	*Tablada dock*
x		x				*Tablada dock extension*	
x	x	x	x		*Transit zone*	*Tablada dock*	
		x				*Tablada dock extension*	
x	x	x	x	x	*Main avenue and street grid*	*Tablada dock*	
x	x	x		x		*Tablada dock extension*	
x	x	x	x		*Complementary zone*	*Tablada dock*	
x	x	x	x			*Tablada dock extension*	
x					** Without ensemble characteristics*	*Tablada dock*	
				x		*North transition area*	*Transition area*
	x			x		*South transition area*	
				x	*Contact areas with water surface*	*North transition area*	
	x	x				*South transition area*	
	x	x		x		*Concession area*	*Concession area*
x					*concession area*		
x	x	x			*Rail road*	**All*	**All*

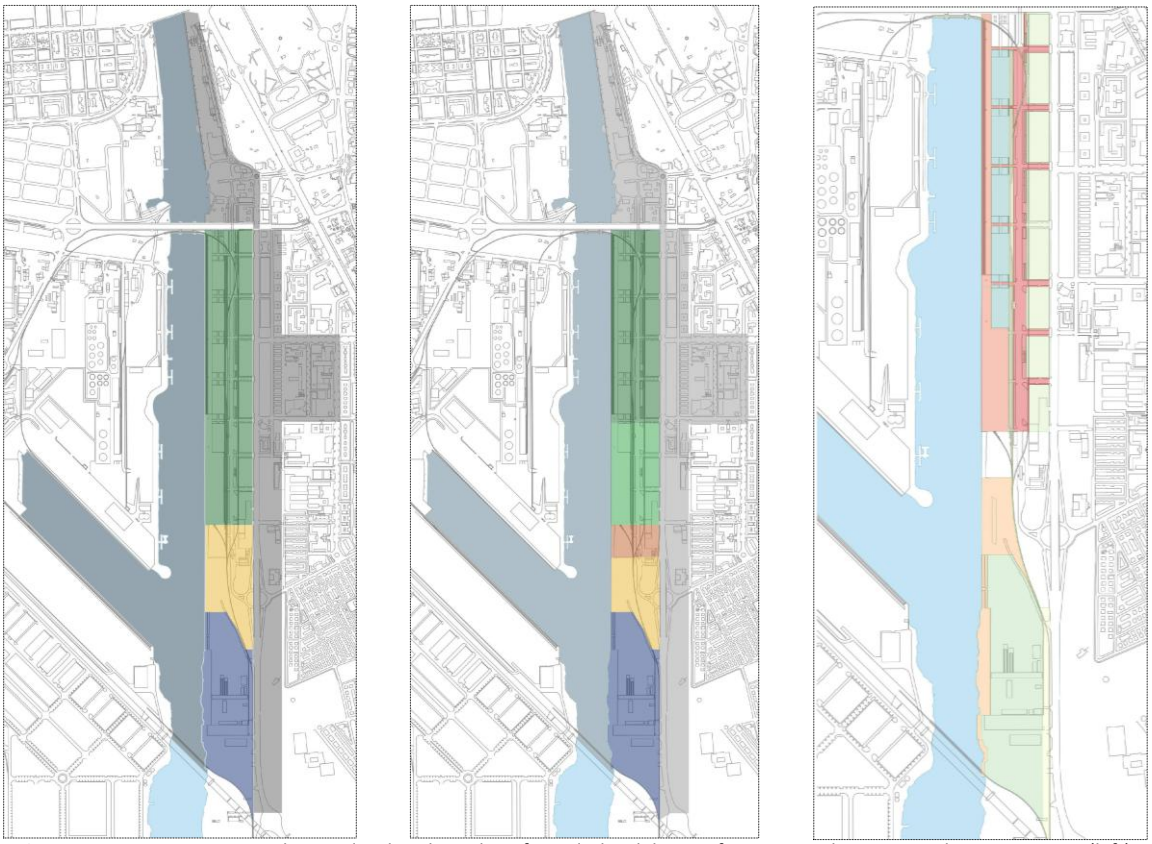


Figure 2: Mapping resources: showing levels 1 through 3 of a multi-level division for assigning heritage attributes to sectors (left), sub-sectors (centre) and ensembles (right).



Figure 3: Heritage ensemble standard fiche, containing graphical and textual descriptions of heritage values, attributes and resources. It also contained information on elements and areas which somehow deviated from the ensemble's character.

5. CONCLUSIONS: A STRATEGY FOR ENHANCING HERITAGE VALUE

The resulting report included a set of far-reaching recommendations (table 3) that resulted from the consensus and transdisciplinary reflection of the work team, which generally aimed at enhancing the value of this part of the port and of the urban landscape of Seville. It took the shape of a strategic approach to preserve the landscape characteristics and heritage values of the area, guaranteeing suitable conditions for its legibility and cultural interpretation, and with the ultimate aim of making this urban heritage known, recognised and appropriated by the citizens.

Table 3: Strategic guidelines proposal

GENERAL OBJECTIVES	*SPECIFIC OBJECTIVES*	*LINES OF ACTION*
O1. To enhance the memory of the Urban Port District	*SO 1.1 Ensure the readability and cultural interpretation of the industrial-port site.* *SO 1.2 Ensure the transmission of the site's social history and associated material records* *SO 1.3 Increase collective awareness of the site's heritage value and promote public and private action for its conservation.*	*LA 1.1 Recording, documentation, and inventory of historical processes in port spaces.*
		LA 1.2 Rehabilitation, reuse, and recovery of architectures, open spaces, and infrastructures.
		LA 1.3 Presentation and interpretation of heritage resources (natural and cultural) and attributed meanings.
		LA 1.4 Reuse and reinterpretation of port artifacts
O2. To enhance territorial connectivity and urban permeability	*SO 2.1 Recover and publicize the historical spatial relationships between port and city.* *SO 2.2 Project these connections into the future to contribute to new urban standards.* *SO 2.3 Ensure the functionality and long-term sustainability of the port-city relationships.*	*LA 2.1 Recovery and improvements in historical urban-port connections.*
		LA 2.2 Establishment of new territorial and ecological connections.
		LA 2.3 Promotion of diversity and urban integration of uses.

O3. To integrate into the urban landscape and improve environmental quality	*SO 3.1 Contribute to improving environmental quality, sustainability, and urban ecosystems* *SO 3.2 Contribute to the city's comfort and accessibility.* *SO 3.3 Optimize the contribution of heritage assets to urban quality.*	*LA 3.1 Highlighting natural and environmental resources.*
		LA 3.2 Recovery, enabling, and improvement of urban spaces.
		LA 3.3 Rehabilitation and recovery of architectures and infrastructures.

ACKNOWLEDGEMENTS

This study was funded by the company Citythinking SL by means a commercial contract.

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THE IMPACT OF ACCESS ROADS ON THE CITYSCAPE: THE CASE OF THE CITY OF PIROT

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ABSTRACT

This paper focuses on the significance of approach roads in urban design, with a particular emphasis on the case of Pirot, especially the approach near Gradić, which represents a key point in the city's history. The study defines the problem and analyses current traffic flows to propose solutions that would improve traffic infrastructure while preserving the existing urban fabric. Given that radical demolition is unfeasible, the proposed solutions aim to support the city's sustainability, preserve its identity, and minimize negative impacts on the urban composition.

The study references the example of Ljubljana, which successfully transformed the Ljubljanica River—a former waste disposal channel—into the city's lifeline by respecting its riverside environment. This revitalization project demonstrates how changes in the approach to urban space can create new city dynamics, enhancing its identity and quality of life.

Additionally, the paper highlights the critical role of approach composition in shaping the first impression of a city, influencing the perception of both visitors and residents, as well as the long-term identity of the urban space. It presents available research on the Fortress and urban planning in Pirot, with a special emphasis on integrating historical heritage into contemporary urban development. Furthermore, it analyses opportunities for sustainable planning that respects the historical and cultural significance of Pirot.

Keywords: *urban planning; approach road; urban identity; heritage; Pirot*

1. INTRODUCTION

Architecture and urban development are inseparably linked, as they together shape the spaces where the social, economic, and cultural life of a community unfolds. While architecture, through individual buildings and their immediate surroundings, defines the physical identity and visual experience of a city, urban planning ensures the coherence of these elements by regulating traffic flows, spatial distribution of functions, and integration with the natural environment. This synergy is crucial for achieving sustainable development, where infrastructure not only meets technical requirements but also preserves cultural heritage and enhances the quality of life for citizens.

A city's image (or sense of place), including its distinctive identity and overall ambiance, plays a pivotal role in forming the visual impression of both visitors and residents. The entrance to a city, as a critical contact point between rural and urban spaces, is the most significant element in shaping the first impression of a city's ambiance and identity.

Urban planning and traffic infrastructure are deeply interconnected, jointly influencing the growth and functionality of cities. The planning of approach roads, which serve as essential links between cities and regional transportation networks, is crucial for spatial development, economic activity, and the overall quality of urban life. The role of approach roads is particularly significant in smaller cities like Pirot, where traffic infrastructure directly impacts local industry, tourism, daily commuting, and the use and preservation of cultural heritage.

In the broader context of spatial planning, research emphasizes the need for designing approach roads based on traffic efficiency, environmental sustainability, and socio-cultural inclusivity. Scholars such as Pompe (2020), Caliscan (2010), and Sutro Rhees (1996) underline the importance of preserving and promoting local cultural heritage through urban design, particularly in areas that serve as primary entry points into a city. Comparisons with urban renewal projects in cities characterized by successful entryway compositions provide valuable insights into how changes to the layout of approach roads can improve connectivity and enhance the city's visual experience.

This paper examines the case of Pirot, where the planned improvement of the main approach road offers an opportunity to reconsider the city's traffic framework and its initial visual impression. Through an analysis of traffic patterns, urban implications, and potential community impacts, the study aims to contribute to the growing body of literature on sustainable and contextually informed infrastructure planning. The findings will serve as a basis for recommendations on optimizing the approach road while preserving the unique urban and cultural identity of Pirot.

The methodological approach of this study is based on three key phases. In the first phase, previous studies and research highlighting the issue of urban deformation at the *Gradić* (the historic fortified section of Pirot, Small Town) approach were analysed, providing a foundation for understanding the historical and traffic context. The second phase included an analysis of the sequence of the *Gradić* approach, observing spatial, visual, and traffic characteristics in their interrelations. Finally, in the third phase, a synthesis of the obtained insights, along with comparisons to relevant examples, offers a comprehensive understanding of the issue and proposes a sustainable solution that respects the identity of Pirot while enhancing the urban composition of the approach from the northwest side.

2. PIROT

Pirot, a city located in southeastern Serbia, has a distinctive urban development shaped over centuries by various cultural, historical, and geographical factors. The city boasts a rich historical heritage, with traces of urban life dating back to the Roman period. *Via Militaris* played a crucial role in the establishment and growth of Pirot as a regional trade and transport hub. Its influence has been enduring throughout history and continues to shape the city's urban identity and transportation infrastructure. The *Imperial Road* was a major Roman military and trade route that connected *Singidunum* (present-day Belgrade) to *Constantinople* (modern-day Istanbul). This road passed through Pirot, having a significant impact on the city's historical, economic, and urban development. Due to its location on *Via Militaris*, Pirot became an important stop for rest and supply for travellers, soldiers, and merchants. This contributed to the development of the settlement as a commercial and traffic centre in antiquity and the Middle Ages. Over the centuries, the traffic and trade along *Via Militaris* brought economic benefits to Pirot. Merchants brought goods, influencing the exchange of products and cultural ideas, shaping the local economy and society. The tradition of craftsmanship, particularly the production of *Pirot* carpets, is deeply rooted in the trade contacts enabled by this route. The initial structure of the settlement in Pirot developed along the main road, which influenced the formation of a linear urban matrix. Later constructions and expansions of the city maintained this primary alignment. This road also determined the location of key infrastructural objects, including bridges and the fortress that monitored the traffic. The *Pirot Fortress* was built near *Via Militaris* to protect trade routes and control traffic. Its construction and historical significance are directly linked to the strategic position of this route. Through interactions with various cultures using *Via Militaris*, Pirot developed a diverse cultural identity, reflected in its architecture, traditions, and customs.

Urban development in Pirot during the Ottoman period was characterised by narrow, winding streets and neighbourhoods (quarters) with adobe houses and courtyards. During this period, the *Pirot Fortress* was one of the dominant urban landmarks. The modernisation of the city began at the end of the 19th and early 20th centuries when rectilinear urban planning concepts with wide streets were introduced. Industrialisation, particularly the development of the textile industry, influenced the formation of new residential and industrial zones. Today, Pirot is situated on an important international route, Corridor 10, which connects Serbia with Bulgaria and Greece. One of the key challenges for Pirot is the inefficient approach infrastructure, leading to the idea of constructing a new main approach road aimed at reducing traffic congestion, showcasing cultural heritage, and improving safety. Given that Pirot is known for its traditional craftsmanship, particularly *Pirot* carpets, which are part of the city's cultural identity, preserving old craft neighbourhoods and integrating cultural heritage into modern urban plans represents a challenge for the city's further development.

Currently, Pirot can be approached from the northwest (towards Niš) and southeast (towards Sofia). The motorway (E-80, A-4) has two exits corresponding to the upper (Pirot West) and lower (Pirot East) zones of the broader Pirot area. From the western exit to the entrance of Pirot, a new intercity road leads, partially following the path of the older main road from Niš to Sofia. It spans 4.3 km to the city entrance. On the southern side, the approach road to the city fully follows the older route, spanning 3.2 km. The southern approach extends into the main street, which forms the city's main traffic spine, oriented along the northwest-southeast axis of the terrain. From the northern side, access to the city is possible from two directions: one near the *Tigar Tyres* factory on the right bank of the Nišava River, and the other on the opposite bank, near *Gradić* (or the *Pirot Fortress*). The latter approach is particularly noteworthy as it is linked to a cultural landmark of significant importance, with the *Pirot* fortress being listed in the Central Register of Cultural Monuments of Serbia by the Institute for the Protection of Cultural Monuments of Niš in 1968, following scientific studies of the site that began in 1953 when the fortress was declared a cultural monument. The main road from Niš to Sofia, which passes by Pirot, enters a tunnel on the northern side of the *Sarlah* hill, and in this area, it exits towards an overpass that crosses the road leading to the city hospital and further to Babušnica. Although the fortress is clearly visible from the overpass, making good use of the cultural conditions of the topographic area, the continuation of the approach (near *Gradić*) presents several unresolved issues in the architectural and urbanistic composition of the city's approach. This does not mean that the other approaches (near the *Tigar* factory, west, or near Poljska Ržana, east) are in a better position. On the contrary, their environmental value is much lower and deserves special investigation. In comparison to the dominant *Gradić*, these two approaches lack environmental and architectural value. Along these sections, buildings of various purposes are randomly placed on both sides of the streets, without understanding, assessing, or planning the approach composition in accordance with the organised urban structures. The purpose of this study is to address the issue of the approach to the city near the *Gradić* fortress and propose a solution, as well as to highlight the need for further research, including on other approaches to Pirot.

3. TURRES

The Pirot Fortress is a stone-built military fortification located on the right bank of the Bistrica River, on a secluded rock at the Sarlah hill. It consists of three connected sections: the Upper, Middle, and Lower Town. The Upper Town was constructed during the last decades of the 14th century, in the time of Prince Lazar, while the Middle Town was built during the reign of Despot Stefan Lazarević. The Lower Town had three gates: *Niš Gate, Stambol Gate*, and *Knjaževac Gate*, and the necessary defence was reinforced with a stone water channel. Archaeological excavations and conservation and restoration works were carried out between 1970 and 1986 (Cultural Monuments, 2025). According to Elena Vasić Petrović, the Pirot Fortress and its surroundings contain cultural layers ranging from prehistory to the modern era (Vasić Petrović, 2020). This author provided a detailed overview of all interventions, and after highlighting the neglect and degradation of this cultural monument, plans for its restoration and revitalisation were proposed (Vasić Petrović, 2006), including projects for the reconstruction of the Lower Town's walls, which date from the 18th and 19th centuries (Vasić Petrović, 2015), as well as the presentation of the Pirot Fortress through modern technologies (Vasić Petrović, 2020). Although archaeological sites on the Sarlah hill near Gradić were known in the early 1990s, the traffic loop was built next to the remains of an early Christian Basilica and parts of fortifications from the Byzantine period (Vasić Petrović, 2010). Additionally, works on Corridor 10 destroyed discovered remains from various historical periods (Vasić Petrović, 2020) in order to implement the planned motorway route, which represents another example of destructive policies towards the protection and presentation of cultural heritage in this region. Finally, the conservation and restoration work in 2018 "unjustifiably deviated from the plans, resulting in the devastation of some authentic parts of the fortress and incorrect interpretation of the remaining architecture" (ibid).

As an additional issue with the inadequate treatment of this site, the fortification is incorrectly presented as *Momčilov Grad*, based on speculation that it was built by *Duke Momčilo*, who appears in folk songs and legends. Recent archaeological research has proven that the fortress was built in the second half of the 14th century, and it can be stated with certainty that Duke Momčilo was not its builder (Pirot Fortress, 2025). Scientifically established names refer to the Towers or the Fortress (Nikolić, 1981), since Pirot was marked on the 2nd-century Roman geographical map as *Kula motrilja* or *Mutattio turres* (Vasić Petrović, 2010). Later, the name Kula (in Latin *Turres*) became *Pirgos* through Hellenisation, and there are also views that Pirot was named after the Greek word *pir* (fire), because fires were burning in the Barje settlement due to the ignited marsh gas, but the Greek word *pirotes* also denoted fever, which was present in the swampy area due to malaria (Panajotović, 1982). It is only in the second half of the 14th century that Pirot is first mentioned under its present name, and shortly thereafter, it became an important strategic point in Prince Lazar's state, who, unlike Duke Momčilo, was a historical figure. During the reign of the Ottoman Empire, the name *Kule* changed to *Kale*, and in Turkish sources, it is also

mentioned as *Sehir koyi*, meaning Village – City (Vasić Petrović, 2020). After the liberation from the Turks in 1877, the fortress was used as a military facility (Manić, 2016) until 1952, when it was handed over to the Pirot municipality for management. The Pirot Fortress or Pirot Town (which developed from this settlement) is often referred to as *Gradić* because of its size and the local name that highlights its compact structure compared to larger fortresses and fortified cities. This name has roots in folk tradition and the way the locals have historically perceived this fortified complex.

In addition to the aforementioned literature concerning architecture and development within broader themes of medieval history in Serbian cities (Deroko, 1950; Kalić, 1979), the Pirot Fortress has also been the subject of archaeological (Petrović, 1954; Pejić, 1996, 2015, 2020), historical (Panajotović, 1982; Lilić, 1994; Lazarević, 2014, 2024; Stamenović, 2024), and cultural studies (Zebić, 2020) and scientific-expert research.

4. URBAN DEVELOPMENT OF THE CITY OF PIROT

As far as the author of this paper is aware, the urban development of the city of Pirot has only been briefly explored in the literature. Only two papers were published prior to the major traffic interventions (Ćirić, 1969, 1973), while more recent works (Stanimirović et al., 2015, 2016, 2020, 2022, 2023) analyse more recent urban and architectural concepts. It is worth noting that the General Regulation Plan "Pirot - Centre" from 2022 is available on the website of the Public Enterprise for Planning and Development of Construction Land in Pirot (until 2016, this public enterprise was named the Directorate for Construction of the Municipality of Pirot). However, this plan does not include the *Gradić* area (PDR, 2025).

The Detailed Regulation Plan concerning the fortress is the "Kale" DRP from 2009, which was prepared by the Public Urban Planning Enterprise (JUP) and was available via the Directorate's website. At the time of writing this paper, the web link to this plan no longer exists. From this, it can be concluded that researching the urban development of Pirot is highly challenging due to the lack of accessible documentation of realised plans. The only written and drawn traces of earlier development can be found in the works of Dr Jovan Ćirić (Petković, 2011), highlighting the significance of this researcher within the topic.

According to Ćirić (Ćirić, 1969, 1973), the urban structure of Pirot was historically developed in harmony with the spatial milieu of Pirot, characterised by interwoven natural and cultural elements. He pointed out that the city's urban planning up until 1955 was well-oriented and that the degree of urban distortion (the ratio between actual and urbanistically justified conditions) significantly increased during the sixth decade of the 20th century (from 10% to 25%) and showed a tendency for further increase. He thus warned that future interventions would become increasingly difficult and costly unless this negative trend was halted.

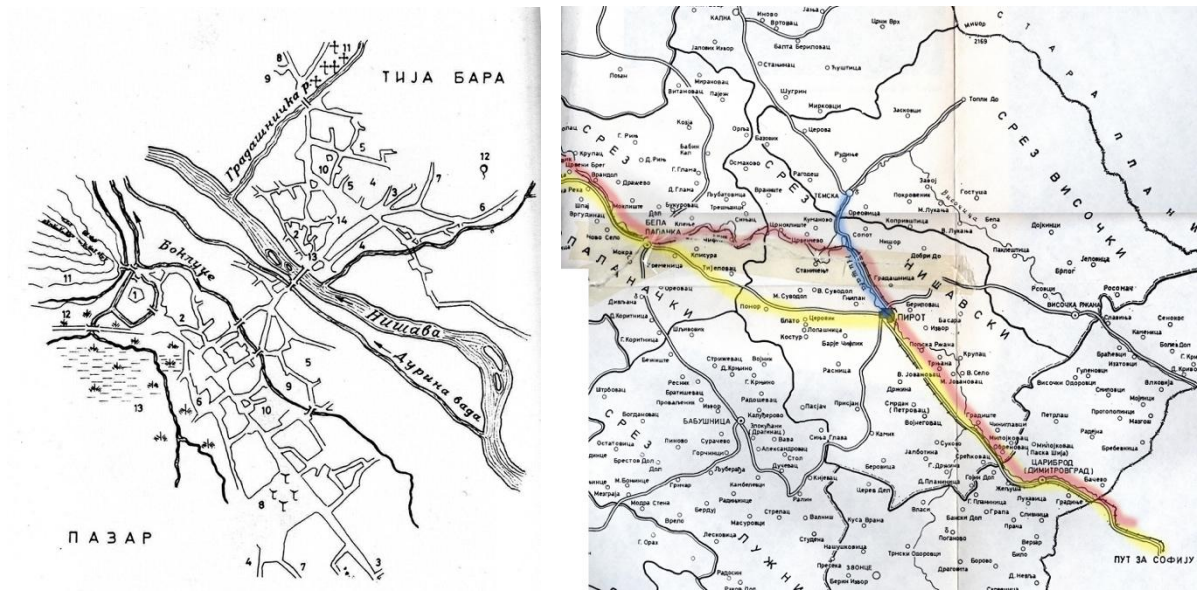


Figure 1: a) Map of Pirot from 1878, b) Map of the District from 1878 (Nikolić, 1981)

Ćirić was, in fact, a pioneer in highlighting the essential features of Pirot's natural and cultural environment, which are crucial for the proper organisation of urban composition. He also analysed the traffic flows of the city to ensure functional and optimal urban development of Pirot. His idea that traffic arrangements significantly determine the overall composition of the city is supported, as is his argument that, in addition to the technical

and construction aspects, the functional and aesthetic significance of the traffic network must also be considered.

As an illustration of erroneous partial urbanisation, lacking urban macro-studies and broader programme analyses, Ćirić cites the example of halting the initiated longitudinal development of the city due to the construction of a residential building within an urban area whose design and position were defined by an award-winning competition project by the Slovenian architect Marko Mušič (the high-rise building and the "Češalj" housing estate).

In his urban development plans for the city, Ćirić proposed establishing an additional longitudinal axis parallel to the main street, which would run to the right of *Gradić* (facing Niš). In his view, the existing access to the city, positioned to the left of *Gradić*, was defined by Mitad Pasha, who, in the mid-19th century, altered the direction of the main urban artery (northwest-southeast). Ćirić concluded that the unfavourable hydrological conditions (frequent flooding) in the area around *Gradić* were the reason why, during Ottoman rule, the route of the Niš road adhered to the foothills of Hill *Sarlah*. Crossing the bridge (of Roman origin) over the Bistrica River, one would enter the Fortress and Pirot through the Niš Gate. However, Ćirić did not fully reconstruct this significant approach to the city.

On the old map from 1878 (Figure 1), it is evident that the old road to Niš actually followed the route of the Constantinople Road and was positioned to the left of the fortress (Nikolić, 1981). The road to Bela Palanka passed through the village of Ponor, indicating that the Ottomans followed the reliable Roman route rather than altering its original direction. A second road, to the right of the fortress, crossed the Bistrica River and led to the village of Temska and further to Knjaževac. The railway took an entirely different route: from Sofia, through Caribrod, via Pirot, parallel to the road to Temska, along the Nišava River valley, past the villages of Staničenje and Čiflik, to Bela Palanka. Hence, the northern passage is called the *Knjaževac Gate* (Figure 2). Ćirić depicted these approaches to the city from the north and northwest through his description of the 1888 plan ("Regulation Plan of the Town of Pirot", Najhut. T.), which is not featured in literature and was already lost by the time of Ćirić's proposals (Ćirić, 1973).

The Niš road, which followed the former *Constantinople Road* route (via Ponor and later Ploče on Mount Suva Planina), was deemed unsafe during winter. In the 1960s, a proposal was made to construct a road to Bela Palanka via the village of Staničenje, along the railway line. Likely in 1972, a tunnel was opened through Hill Sarlah, which remains in use today for traffic between Niš and Sofia. In the 21st century, Ćirić's idea of routing the Niš road beside Gradić's ambient and monumental stronghold, alongside Hill Sarlah, was permanently abandoned (Stanimirović et al., 2020, 2022), as reflected in the 2009 detailed regulation plan.

To preserve and enhance Pirot's urban structure, Ćirić advocated a construction ban in areas critical to properly shaping the city's image, directly related to the Gradić environment. His vision was to highlight the fortress's setting and the scenic value of the striking morphological mass of Hill Sarlah, making them more visible from the city and the access road. Ćirić also paid significant attention to the threat posed by the development of the industrial zone, proposing the establishment of a protective buffer zone of tall and other greenery to mitigate air pollution near residential areas.

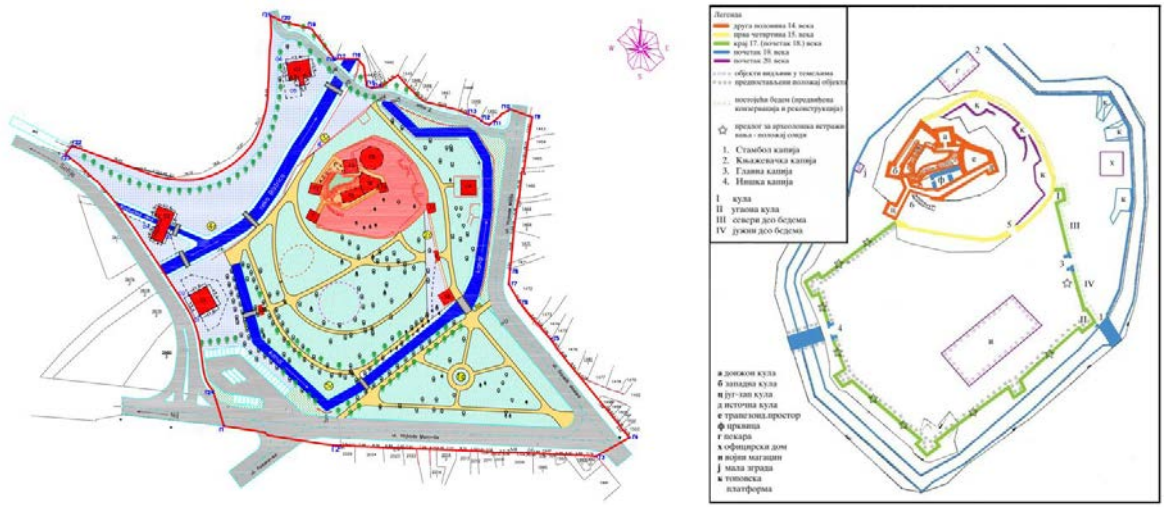


Figure 2: a) Land Use (PDR "Kale," 2009, resp. urban planner: Andreja Mančić) b) Pirot Fortress (Vasić Petrović, 2005)

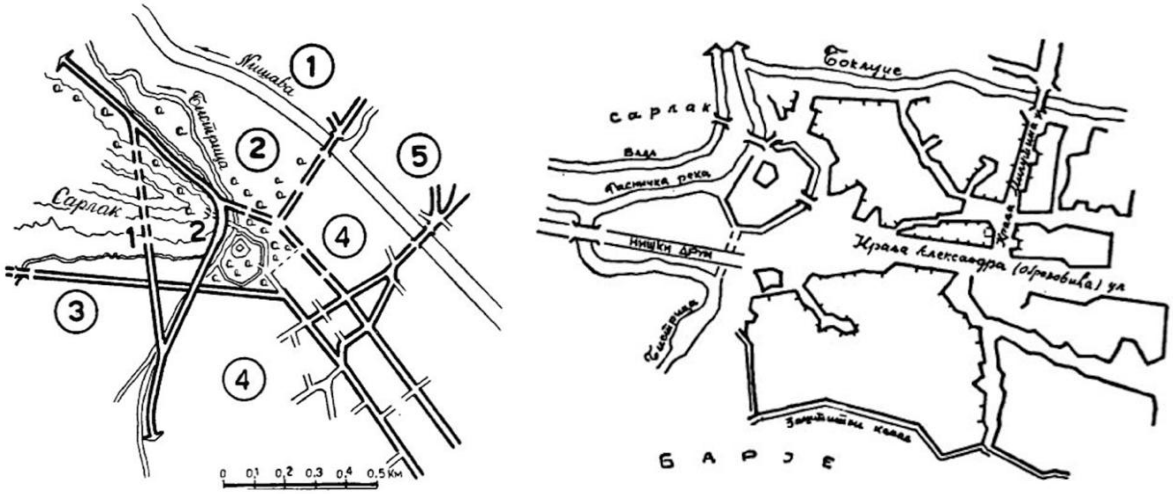


Figure 3: a) Sketch of Pirot's Development (Ćirić, 1969, p. 26) b) Appearance of Pirot in the Gradić Area at the End of the 19th Century (Ćirić, 1973, p. 166)

In Figure 3.a, the number 2 within a circle marks the recreational and protective zone of Hill *Sarlah*, the Bistrica River, and the Nišava River, while number 1 corresponds to the industrial zone, 3 to the residential development zone, 4 to the city core on the left (*Pazar*), and 5 to the city core on the right (*Tijabara*) of the Nišava River. Plain numbers illustrate plans for tunnel construction (1) and the relocation of the road to Niš to the left side of *Gradić* (2).

Despite advocating against the tunnel variant of the Nišava main road passing through Mount Sarlah, Ćirić proposed cutting into Sarlah's edge to create a gentle and visually clear curve for the mentioned road. This cutting of part of the elevation would likely lead to new archaeological discoveries, as an ancient settlement was located on the northern slopes of this hill, near the Bistrica River. His proposal to ban construction in the green buffer zone along the Nišava River, both upstream and downstream, was undoubtedly justified.

Unfortunately, the city has witnessed haphazard construction of residential, commercial, and industrial buildings, which not only halted the proper development of Pirot but also deprived the *Gradić* area of the opportunity to become part of a planned and successful architectural-urban composition. Ćirić's fear that Pirot would irreversibly enter a phase of unsalvageable urban development has materialized, leaving only minor interventions around *Gradić* feasible.

These include the removal of tall vegetation, which, by the end of the 20th century, significantly obscured the silhouette of the fortress. An intervention in the 21st century, during the fortress's revitalization, notably highlighted the form of Pirot's town. However, the same intervention introduced unnecessary elements into the architectural composition, which should ideally support the strategy of preserving and presenting built heritage. Examples include colourful light fixtures used to clumsily emphasize the city's "decorations" during holidays, which certainly do not align with the creative restoration concepts envisioned for *Gradić*.

5. APPROACH TO THE FORTRESS: URBAN AND TRAFFIC CONCEPTS

The most significant immovable cultural heritage in Pirot is the *Hristić Family House*, built in 1848, classified as a cultural monument of exceptional importance. According to the registry of immovable cultural properties managed by the Republic Institute for the Protection of Cultural Monuments (the Institute for the Protection of Cultural Monuments Niš has territorial jurisdiction, while the Republic Institute operates under the Ministry of Culture and Information of the Republic of Serbia), the *Pirot Fortress* (14th century) and the *Milorad Panajotović House* (*Bela Mačka*, 1848) are monuments of great importance. In addition, the cultural monuments include: *Gymnasium* (1897, architect: Milorad Ruvidić); *District Office Building* (1910, architect: Aleksandar Janković); *Karlo Skacel Pharmacy* (1912); *Municipal Court Building* (1910, architect: Jovan Ilkić); *Stojan Božilović Beli House* (19th century); *Church of the Nativity of Christ* (1834); *Monument to the Liberators in Tijabara* (1877). Additionally, the *Artisan and commercial shops in Tijabara* are protected as a spatial cultural-historical entity (Vlatković, 2012; Immovable Cultural Properties, 2025). The broader area surrounding the Pirot Fortress plays a dominant role in the city's approach routes and, together with *Hill Sarlah*, significantly contributes to forming the ambience of entering the city. It is essential to highlight that alongside this cultural asset, the Nišava River quay plays a pivotal role in shaping the city's image. Other objects under the protection of the Republic of Serbia

hold secondary importance. The wider image of Pirot is shaped by its surroundings, where natural beauty intertwines with the architectural forms of medieval Orthodox temples, embedded in protected monastic environments.

The approach to the fortress must be analysed through multiple layers. Addressing the urban planning for Pirot's entrance should integrate a sequential understanding of the environment, modern traffic demands, and the preservation of archaeological layers. Such a holistic concept enhances cultural heritage protection, strengthens the city's identity, and ensures lasting value for urban space through a harmonious symbiosis of past and future. The approach to the city of Pirot is not merely a spatial and traffic connection but a dynamic space where historical layers intersect with contemporary urban needs. The visual and functional experience of the approach should be seen as a *sequence of images* that convey the city's identity to travellers through landscape, traffic, and cultural elements. The sequential experience of movement can be divided into several key scenes:

1. *First Scene – Periphery*. The approach to the city begins with landscapes featuring expansive agricultural fields, river valleys, and mountainous backdrops. This area exudes a sense of natural openness but is vulnerable to visual disruption caused by unregulated construction and the presence of industrial structures.
2. *Transitional Zone – Suburbanisation*. Changes in traffic types and the density of structures gradually introduce the traveller to a more complex space, blending functional and residential elements. This segment underscores the importance of managing visual and spatial-functional conflicts to ensure continuity and a clear perception of identity.
3. *City Entrance*. This final sequence should emphasise Pirot's urban identity. The use of prominent architectural elements such as the *Gradić* (Pirot Fortress), green areas, or specific traffic solutions can shape a distinct mental image of the city. The absence of a marked or thematically developed entrance could lead to a loss of spatial orientation and emotional connection to the city.

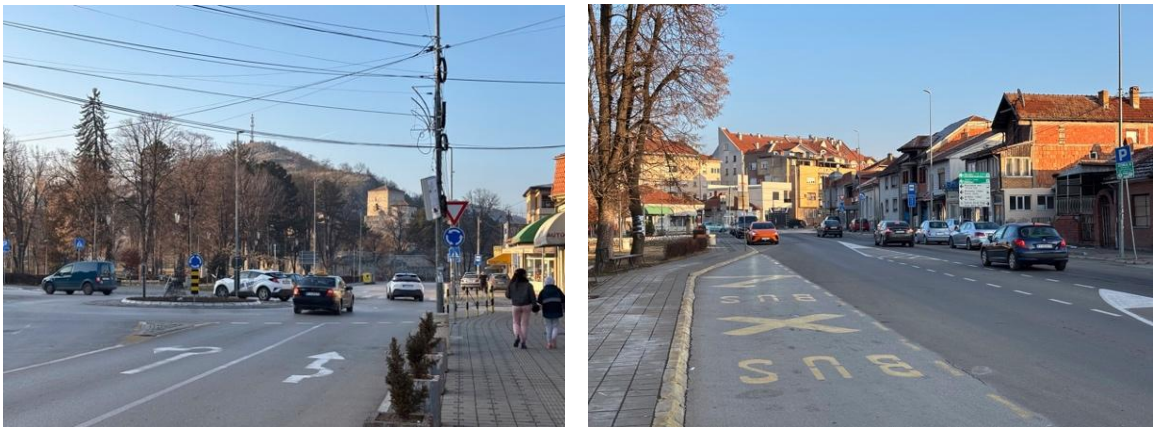


Figure 4: a) View towards the Gradić and Hill Sarlah, b) Approach to the City (author's documentation)

The first sequence corresponds to movement along the river, where the presence of industrial facilities significantly diminishes the ambient value of the approach. Not only is the orientation towards the city unclear, but industrial buildings are placed too close to the road, occupying what should have been a green buffer zone. This spatial arrangement highlights the prioritisation of industry as the "most important" city sector, directly influencing the routing of the motorway and access road. Consequently, to facilitate factory access while neglecting the opportunity to enhance communication towards Niš, the visual quality of the approach was sacrificed.

In the transitional zone, the roundabout located just beyond the tunnel reveals serious shortcomings – unclear and unsafe separation from the bypass, insufficiently precise signage, and, most critically, a destructive approach to historical layers. During past construction works, significant archaeological layers were uncovered in this zone, testifying to continuous settlement from the ancient period to the present day. These layers not only possess cultural and historical value but also require special attention in urban planning. The entrance area must be redesigned to avoid endangering already discovered remains, allow for future archaeological investigations, and create a harmonious relationship between contemporary traffic solutions and preserved historical layers.



Figure 5: View towards the Gradić (Drone footage: Aleksandar Ćirić, Pirot je moj grad, 2025)

In the final sequence, the importance of the *Gradić* and its broader surroundings has been diminished by unplanned construction, which fails to follow any strategic approach to the city and creates an unpleasant visual "noise" at the approach. The entry sequence should, in fact, combine functional requirements with the symbolic and visual values of archaeological heritage. The use of specific urban design elements, such as open spaces or interpretation centres, could enhance the visibility and accessibility of archaeological remains. This would provide a rich cultural experience for residents and visitors alike while adapting the traffic infrastructure without compromising the historical identity.

Interpretation centres are spaces or facilities designed to educate and inform visitors about significant natural, cultural, or historical sites. Their purpose is to deepen the understanding of the value of a specific location by explaining its context, significance, and unique features. A key characteristic of these centres is that they not only serve as venues for displaying information but also act as dynamic hubs for interaction and interpretation, encouraging visitors to reflect on and experience the space.



Figure 6: View towards the planned bus station (*Drone footage: Darko Ilić, Pirot, 2025*)

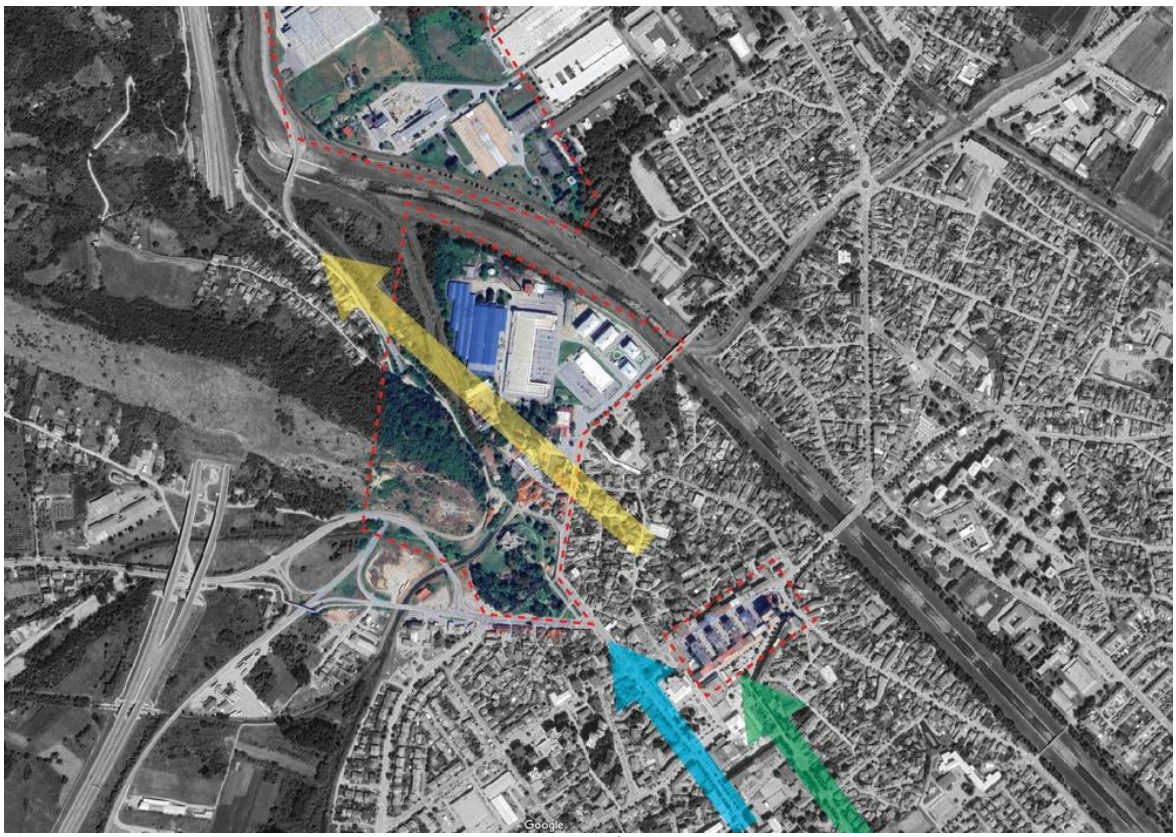


Figure 7: The sketch of interventions that nullified Ćirić's plan (author's documentation)

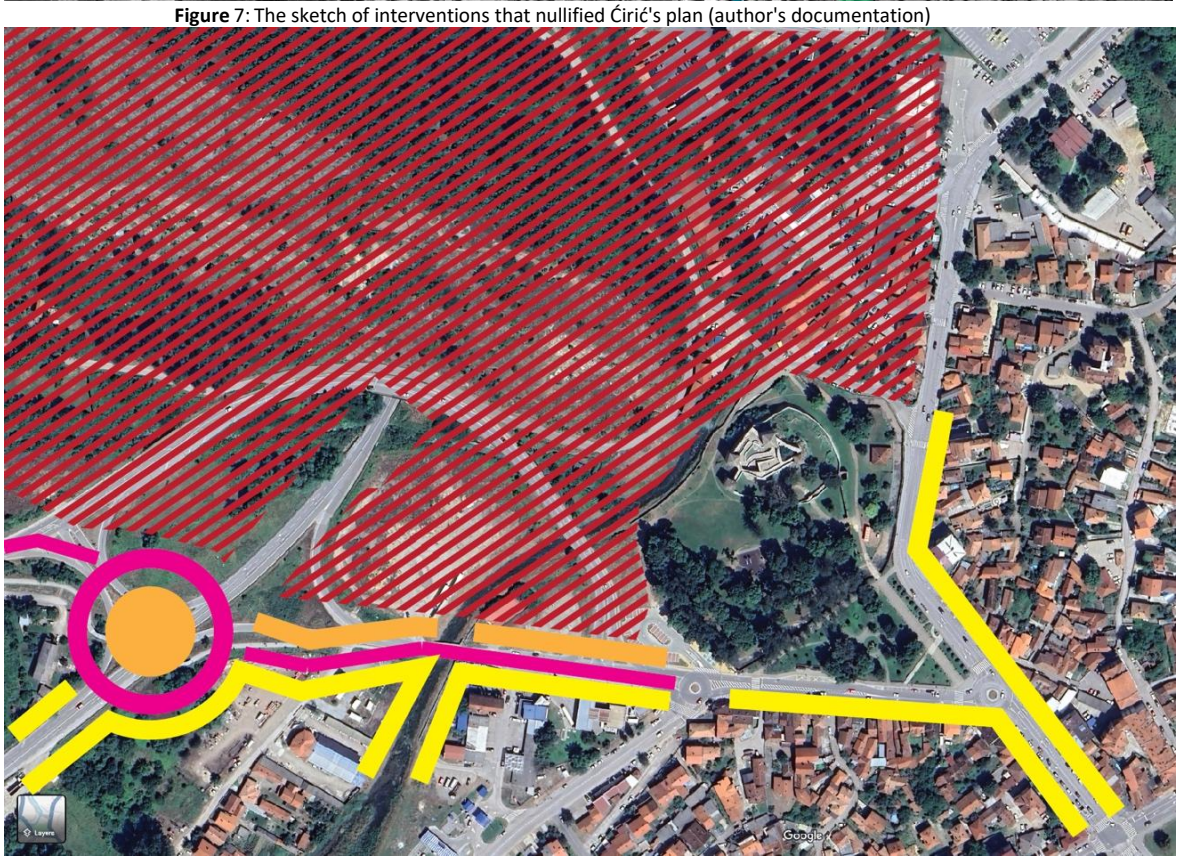


Figure 8: Solution sketch: red hatching – archaeological park; yellow – greenery; magenta – new road

It can be concluded that approach roads play a crucial role in defining a city's traffic and urban identity. Their function lies not only in ensuring safe and smooth traffic flow but also in harmoniously connecting with the preservation of cultural heritage, thereby creating a unique visual and spatial experience when entering the city. In the case of Pirot, the analysis shows that the approach in the area of Gradić fails to meet the criteria for a

successful visual composition, given the lack of an organised approach landscape structure. Additionally, this state threatens the future development of archaeological research, conservation, presentation, and revitalisation of cultural and historical remains.

The key urban development problem in Pirot lies in the inadequate integration of transport infrastructure with the city's cultural, historical, and natural context. Instead of being carefully designed to highlight the values of the urban and architectural heritage, the current situation reflects a lack of visual hierarchy and harmonious spatial planning. This results in a degraded environment and jeopardises archaeological layers, further complicating possibilities for revitalisation and enhancement of the approach, negatively impacting the overall image of the city and its tourist potential.

Additionally, uncoordinated construction around traffic nodes and industrial facilities hinders the creation of a coherent urban identity and visual continuity from the periphery to the centre. The issue is further compounded by the planned location of a new bus station near the fortress, which could lead to several negative consequences:

1. Degradation of the cultural-historical environment – Placing a massive infrastructure such as a bus station in close proximity to the fortress could disrupt the visual identity of this important cultural monument. Instead of highlighting the fortress as a dominant landmark, it could be overshadowed or visually obscured by an infrastructure object not harmoniously integrated into its historical context.
2. Disruption of archaeological research and conservation – The construction of the station could threaten further exploration and conservation of archaeological layers around the fortress. Potential damage to cultural heritage diminishes opportunities for the presentation and educational-tourism development of the area.
3. Traffic congestion and reduced safety – The location of the bus station in this zone could create additional traffic flows, increasing the risk of congestion in an already complex approach road structure. The poorly defined junction and existing problem of insufficient signage would be further exacerbated.
4. Missed opportunity for a high-quality urban ensemble – Instead of a coherent blend of traffic solutions, natural landscapes, and cultural-historical heritage, such development could result in a fragmented space lacking a clear urban identity, missing the opportunity to create an attractive urban ambiance and a representative city entrance.

Thus, the combination of a poorly planned approach road and the inappropriate positioning of the bus station underscores the need for strategic planning that integratively addresses the traffic, urban, and cultural-historical aspects of Pirot's development. The analysis identifies key points in the increase of *urban deformity*, such as the construction of housing that interrupted the street following the city's backbone (the former Fifth Congress Street), which could have alleviated traffic and improved the approach ambiance near the fortress; the construction of the tunnel and the junction with an overpass above the road leading to the hospital and over archaeological remains and unplanned construction around *Gradić* and in the green buffer zone. In such a complex situation, inserting a new approach into the existing urban fabric is impossible. Proposals to address this issue, based on this research, include:

1. Creating a study for the protection of Gradić's surroundings and Pirot's old urban architecture, extending from the fortress to the Gymnasium. A good example is the pioneering effort by the Institute for the Protection of Cultural Monuments in Niš and the Faculty of Civil Engineering and Architecture, University of Niš, in directing construction within the protected old town of Vlasotince through mandatory plans with guidelines for preservation, conservation, and improvement of architectural heritage (Cvetković et al., 2024). Given the difficulty of removing already constructed buildings, even those without project documentation, it is crucial to ensure future construction adheres to this study.
2. Establishing a roundabout at the bypass road junction towards Niš (via the tunnel) and the road leading to the hospital.
3. Announcing a public competition for an urban-architectural solution for the "Archaeological Park Turres" spatial cultural and historical ensemble, from the fortress, through the remains of the early Christian basilica, to the conclusion of the ancient settlement on Hill Sarlah.
4. Cancelling the construction of the bus station in the vicinity of Gradić.

5. Forming high greenery to screen the noise of unplanned construction around the fortress and in the river buffer zone towards the industrial complex.
6. Developing a comprehensive monograph on Gradić.
7. Presenting all plans related to Pirot's urban development comprehensively.

6. THE PLACE OF URBAN REGENERATION IN PIROT

Comparisons with urban regeneration projects in cities such as Ljubljana provide valuable insights into how changes in the alignment of approach roads can contribute to a more successful city composition. Ljubljana serves as an example of successfully integrating traffic solutions that have improved access to the city centre through the transformation of major approach roads into wider pedestrian zones and transport hubs prioritising public transport and bicycle lanes. This approach has reduced traffic congestion, improved air quality, and promoted the use of sustainable modes of transport. Ljubljana is undoubtedly a prime example of urban transformation within the context of sustainable urban planning, demonstrating how the repurposing or modification of certain parts of a city can contribute to better functionality, preservation of urban identity, and a reduction in the negative impact of traffic on the environment. Polajnar Horvat (2024) examined the restorative effects of such changes in Ljubljana, focusing on the ability of public spaces to contribute to users' psychological recovery. This concept comes from environmental psychology and relates to the impact of both natural and urban environments on human wellbeing. Spaces with more greenery (such as Tivoli Park) can be perceived as more restorative compared to urban spaces like city squares, suggesting that areas with natural elements significantly support psychological renewal and improve the emotional state of citizens. Gojčić (2019) analysed sustainable urban mobility strategies in Ljubljana, focusing on the integration of various transport modes and their impact on urban development. Based on this study, an action plan was developed aimed at improving the quality of life through the reduction of private car use and the promotion of sustainable transport forms. The planning and construction of bicycle lanes, as well as the installation of secure e-bike parking, resulted from collaboration with spatial planners and other relevant stakeholders, with the goal of creating a sustainable, efficient, and environmentally friendly urban mobility system in Ljubljana. Over the past decade, the city has made significant positive changes by integrating the regeneration of cultural heritage with the modernization of open spaces in the city centre, contributing to its transformation into a modern capital. This example can serve as a model for other post-socialist cities striving for sustainable urban development through careful planning and management (Svirčić Gotovac et al., 2019).

Given that Pirot is known for its natural beauty, improving access to Gradić with elements of green spaces and public areas could contribute to enhancing the quality of life and health for its population. The use of plants, trees, and smaller parks could reduce stress and improve the quality of public spaces. Inspired by Ljubljana's action plan, we could propose the enhancement of cycling and pedestrian infrastructure in Pirot, particularly around the access to Gradić and in green zones.

Between the two World Wars, the area along the Ljubljanica River was transformed into one of the city's most recognisable urban features. Plečnik had a vision to integrate the river into the daily life of the city, making it a central element of Ljubljana's urban identity. His concept of the Ljubljanica as the city's core demonstrated how a river can be integrated into urban life, not only functionally but also aesthetically (Potenza, 2020). Plečnik's transformation of the Ljubljanica River is often cited as a successful urban project revitalising neglected parts of the city. This is a great example of how architectural vision can change not only the appearance but also the function and significance of a space for the community. The Ljubljanica once served as a waste disposal canal, and its banks were often neglected. Plečnik succeeded in turning this space into the most beautiful and vibrant part of the city, now one of Ljubljana's main symbols. The project began with cleaning the river and regulating its course, resolving flooding issues and reducing pollution. Through carefully designed bridges, promenades, and pavilions, he managed to connect the river with the urban fabric. The former waste canal was transformed into a multifunctional space. His projects, such as the Triple Bridge and the Ljubljana Market, not only added aesthetic value to the space but also made it suitable for daily use—from commerce to recreation. The Ljubljanica became a place for social events and cultural activities. In this way, the river area became the city's lifeblood. Plečnik's transformation of the Ljubljanica River is frequently cited as a prime example of a successful urban project revitalising neglected areas of a city. His work is so significant that, in 2021, Plečnik's Ljubljana was added to UNESCO's World Heritage List. As demonstrated by the transformation of the Ljubljanica River, the development of the area around Gradić should not only address traffic needs but also contribute to the city's aesthetic value.

Incorporating elements of traditional architecture or properly adapting existing buildings can strengthen the connection to local identity and provide functional public spaces for the community.

The themes of city entrances and shaping urban identity are also useful for a deeper understanding of the city's character. Sutro Rhees (1996) discussed the importance of gateways as key elements in creating civic identity and enhancing urban spaces. She argues that approaches, whether in the form of bridges, roundabouts, parks, or architectural structures, represent symbolic and functional “gates” that define the experience of a city. Gateways are not merely passageways—they shape the first impression of a city, create its image, and function as bridges between the past, present, and future. The study emphasises the importance of integrating design, functionality, and local context to ensure that gateways fulfil their potential in shaping civic identity. Caliscan (2010) defines urban gateways as transitional points marking the entrance to a city or part of a city. Traditionally, they have been considered primarily symbolic structures that mark the beginning of a new urban realm. Although gateways often serve as the “entrance” to a city, their role in directing traffic, shaping urban identity, and improving infrastructure can be far more significant. The analysis highlights that urban gateways are not merely thresholds or physical barriers, but essential elements in creating civic identity and emotional connections with the city. As cities develop, gateways become increasingly important in shaping the perception and image of the city. The concept of urban gateways must be reinterpreted to reflect their more complex roles in modern cities. Urban gateways are not just passageways, but also key symbols that shape the city experience. In the case of Pirot, the approach to Gradić could become such a "gateway," which not only improves traffic connectivity but also reflects the city's identity, highlighting its cultural heritage and distinctiveness.

Pompe (2020) explored how urban design influences the perception of a city and its branding strategy. He analysed key urban elements that shape the city's image and how these elements contribute to creating a positive city identity. The conclusion of the research is that the perception of a city shapes its reputation and recognisability, and how qualitative urban elements (such as public spaces, streets, buildings, and bridges) can contribute to creating a positive image. Pompe connects urban design with the process of city branding, noting how specific architectural and urban elements can become recognisable symbols of the city and key factors in promoting tourism, business, and culture. Particular emphasis is placed on the importance of qualitative elements such as sustainability, aesthetics, functionality, and connection with the city’s tradition and culture. These factors not only improve daily life but also influence the emotional connection between citizens, visitors, and the city. Additionally, quality urbanism has long-term benefits, not only for aesthetic experiences but also for the city's economy, as it attracts investments, tourists, and talented people. Pompe’s view that designing urban spaces is not only a matter of functionality but also creating an emotional and cultural connection with the city is supported. Qualitative urban elements can significantly contribute to building a recognisable city brand, thereby enhancing its competitiveness, attractiveness, and social development.

The design of urban spaces influences the character of a city, and the development of the approach to *Gradić* as a well-designed traffic hub, with elements of modern urban design, can improve the city's perception and position it as an attractive destination for visitors and investors. This approach could become a visual "gateway," providing positive first impressions of Pirot. The gateway not only enhances traffic connectivity but also highlights the city's cultural heritage. Further development of the approach to *Gradić* could be part of a broader plan to improve the area in the Nišava Valley. The implementation of sustainable transport solutions and the revitalization of certain urban zones could contribute not only to better regional connectivity but also to the protection of natural resources, the improvement of the quality of life, and the stimulation of economic activity. As was done in Ljubljana, it is essential to design the integration with the natural environment, preserving both the cultural heritage and the identity of Pirot.

7. CONCLUSION

By analysing the significance of the approach road to *Gradić* and its urban context, this paper highlights the crucial role this space plays in preserving the identity and development of Pirot. Approach roads are not merely a technical aspect of urbanism but also an element of urban design that shapes the first impression of a city, its historical heritage, and future functionality. The proposed solutions in this paper are based on preserving the existing fabric, adapting traffic flows, and improving the quality of the space, while considering all aspects of sustainable development. Pirot, as a city with a rich history and significant cultural heritage, requires thoughtful planning that will preserve its identity while enabling modernization and functional integration with the wider urban area.

This paper builds on previous research that pointed out the potential for urban deformation due to inadequate solutions to the approach road issue at *Gradić*. Although these problems were previously identified, they were not resolved in time. Therefore, this paper once again aims to emphasize the importance of the issue, with the goal of raising awareness about the importance of planning and preventive action. As shown by the example of Ljubljana, where the revitalization of the Ljubljanica river brought a new dynamic and improved the quality of life, Pirot has the potential to redefine its urban concept through careful planning and respect for natural and historical resources. This paper emphasizes the need for the integration of research and a multidisciplinary approach in urban planning, illustrating how urban design can become a bridge between history and the modern needs of the community. At the same time, this research documents how deficiencies in macro planning and the vision of creating the city image have reflected on the multilayered development of Pirot.



Figure 6: A view of the Nišava River with Sarlah in the background (Drone shot: Aleksa Cakić; Ledo, 2025).

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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HOUSING QUALITY INDICATORS: DEFINING STANDARDS OF SUSTAINABLE LIVING

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ABSTRACT

Housing quality indicators represent essential criteria for evaluating the living conditions within residential spaces, extending beyond physical characteristics to encompass broader social and environmental concerns. These indicators play a crucial role in shaping sustainable communities by influencing public health and safety, and social equity. The assessment of housing quality involves key aspects such as functional integrity, environmental and social sustainability, and spatial adequacy, all of which contribute to sustainability and socio-economic development. In the context of Serbia, where significant deprivations and disparities in housing conditions are evident, the necessity for a standardized evaluation tool becomes increasingly urgent. The primary objective of this research was to develop a comprehensive framework of housing quality indicators that could not only assess existing conditions in Serbia but also drive meaningful improvements in the housing sector. This tool is intended to have a tangible impact on the housing market by informing policy decisions, encouraging better construction practices, and ultimately enhancing the quality of life for residents across various socio-economic groups. By focusing on sustainability and equity, this framework seeks to address the enduring challenges within Serbia's housing market, thereby facilitating the development of more inclusive and healthier living environments.

Keywords: *housing quality indicators; sustainability; comparative analysis; gated communities; housing segregation; socio-economic inequalities*

1. INTRODUCTION

Housing policy and urban planning are fundamental factors in shaping the quality of life in contemporary cities (Mouratidis, 2021). Housing quality is a dynamic and multidimensional concept that continuously adapts to shifting social, economic, and environmental factors. Assessing housing quality enables construction stakeholders, policymakers, and research institutions to systematically analyze the conditions of both existing and newly constructed housing. This process facilitates the identification of deficiencies and the development of evidence-based recommendations for improvement in living conditions (Sinha et al., 2017). To enhance housing quality and increase buyer awareness, it is essential to establish housing quality indicators for assessing the market supply. These indicators ensure transparency in evaluating structural integrity, materials, functionality, and energy performance, thereby promoting responsible construction practices, supporting sustainable urban development, and improving access to quality housing. The assessment of housing quality

through specific indicators is a crucial prerequisite for improving housing conditions, with criteria that are, to some extent, universal but also adapted to particular socio-political contexts (Brkanic, 2017). Given that housing quality is context-dependent and subject to change, no universal standards or normative frameworks can fully encompass this issue. It is a relative category that varies across countries and among specific social groups within a single country. Therefore, inadequate housing conditions should not be regarded solely as an architectural challenge but also as an economic and political concern (Lawrence, 1995).

Several tools have been developed to measure, assess, and improve the quality of residential building projects, such as the Housing Quality Indicators (HQI). However, only a limited number of studies have examined housing quality indicators in lower- and upper-middle-income countries (Wimalasena et al., 2022). In Serbia, the housing sector has undergone significant transformations from the post-war period to the present, transitioning from state-controlled and systematically planned development to the dominance of market mechanisms and private investors. While previous housing models prioritized the provision of residential units for a broad population, contemporary trends present new challenges, including increasing social and economic segregation. A particularly notable phenomenon in this context is the emergence of so-called 'gated communities', which raises critical questions about social justice and equity in urban development (Wu et al., 2020). This study examines the evolution of housing construction in Serbia, highlighting the implications of market-driven housing policies and their impact on spatial organization, social cohesion, and the accessibility of quality housing for a wider population. The primary objective of this research is to implement the HQI tool, which would not only assess the current housing conditions in Serbia but also contribute to meaningful advancements in the housing sector. In addition, the study explores the evolution of housing trends by comparing past and present housing models, with particular attention to changes in apartment size, layout, and communal spaces. The prioritization of investor interests, coupled with the market-driven approach to urban and housing sector planning, has fostered the development of gated community model. The rise of gated communities is explored, with an analysis of their implications for urban development and social equity. Furthermore, the research investigates the consequences of urban planning decisions, particularly regarding economic and social inequalities that may have emerged. Finally, the research aims to provide evidence-based policy recommendations aimed at improving housing policies and urban planning strategies. These recommendations seek to align national housing standards with sustainable development trends and international best practices. Overall, this study strives to enhance the understanding of housing quality in Serbia and propose measures that promote more inclusive, transparent, and sustainable housing development.

2. MATERIALS AND METHODS

This study employs the Housing Quality Indicators (HQI) tool to assess the state of housing in Serbia, examining key aspects of its quality. The methodological approach comprises several interconnected components: the analytical (contextual) framework, data collection methods, and data analysis methods. The first component, the analytical framework, investigates the evolution of housing development in Serbia, with a particular focus on the transition from state-controlled housing to market-driven models. This transition is analyzed through changes in spatial organization and access to quality housing. Special attention is given to how these transformations affect different social groups and their ability to secure adequate housing. The contextual analysis provides a historical review of housing development in Serbia, examining the consequences of market-driven policies, including the emergence of spatial segregation, the decline in housing quality, and the rise of luxury housing models such as gated communities. Through this analysis, the study seeks to offer a deeper understanding of the socio-economic and urban planning transformations that have shaped the current state of the housing sector in Serbia. The second component, data collection methods, involves the implementation of the HQI tool, which encompasses ten key indicators, including location, unit size, spatial layout, noise and light conditions, accessibility for people with disabilities, energy efficiency, and other factors contributing to housing quality. The selection of indicators was based on a combination of international standards for housing quality and the specific context of Serbia's housing sector. Additionally, a comparative analysis has been conducted to examine the dominant housing stock in Serbia in relation to contemporary community housing models, providing insights into ongoing challenges and emerging housing solutions in the housing sector. The third component, data analysis methods, focuses on evaluating housing quality using the HQI tool, which facilitates the assessment of various dimensions of residential conditions. The study also identifies key deficiencies in national housing policies and urban planning models, aiming to pinpoint the factors that impact housing quality. Based on the findings, policy recommendations are formulated to align housing standards in Serbia with contemporary global trends in sustainable development. By adopting a qualitative and comparative analytical approach, this study aims to identify key challenges within the housing

sector and propose policy recommendations for its improvement. Through this methodological framework, the research contributes to a deeper understanding of housing issues in Serbia and offers strategies for their resolution in alignment with contemporary international standards.

3. THE HOUSING QUALITY INDICATORS (HQI)

The Housing Quality Indicators (HQI) is a comprehensive tool developed in the United Kingdom to assess the quality of residential building projects, extending beyond mere cost considerations. Introduced by the UK's Housing Corporation, the HQI system aims to facilitate the evaluation of housing schemes by focusing on various aspects of quality, thereby promoting higher standards in housing development. Key features of the HQI system include its comprehensive evaluation, which allows housing projects to be assessed based on quality rather than simply cost. The form includes a series of questions regarding the location of the residential building within the settlement, site conditions, the housing unit itself, and the external quality of the surrounding environment. These questions are categorized according to the ten defined indicators:

(1) Location;

(2) Site - visual impact, layout and landscaping;

(3) Site – open space;

(4) Site - routes and movement;

(5) Unit – size; (6) Unit – layout;

(7) Unit - noise, light and services;

(8) Unit – accessibility;

(9) Unit - energy, green and sustainability issues;

(10) Performance in use (Harrison, 1999).

Additionally, the online accessibility of the HQI system, initially designed as an online tool, ensures ease of use for all stakeholders involved in housing development and assessment. In terms of application and impact, the HQI system has been instrumental in measuring, assessing, and improving the quality of housing schemes funded by the Homes and Communities Agency in the UK. By prioritizing quality metrics, the HQI system encourages developers to focus on aspects that enhance the living experience, ultimately leading to better-designed and more sustainable housing projects. The analysis of HQI profiles was conducted using the example of residential construction in Serbia, where a comparative analysis identifies the characteristics of the dominant housing stock and the contemporary housing development model. The ultimate goal is to highlight the shortcomings of the national housing policy and urban planning model in terms of economic, social, and environmental sustainability, based on which recommendations are formulated to align standards with global development trends.

4. CONTEXTUAL BACKGROUND

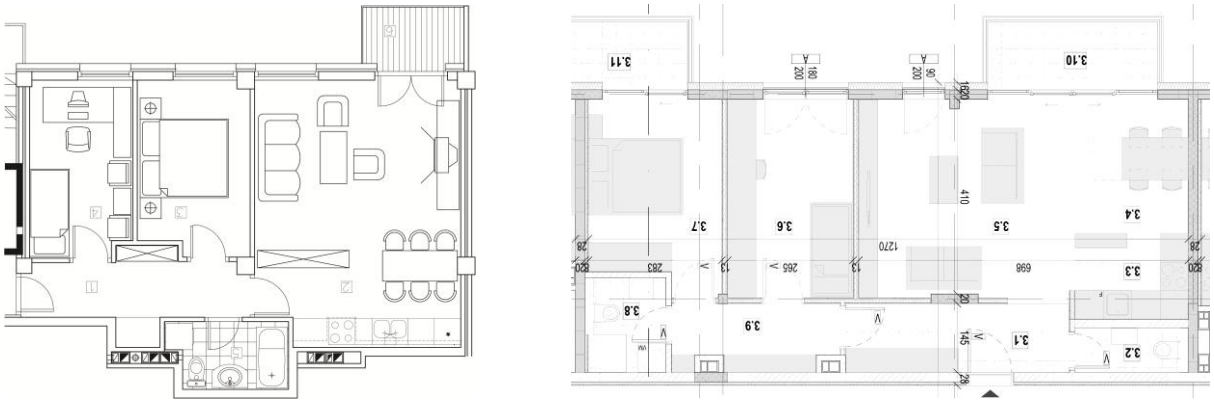
After World War II and the political changes in former Yugoslavia, migration from rural to urban areas increased. In addition to widespread poverty, a major challenge was the severe housing shortage, exacerbated by inadequate infrastructure. Post-war housing construction in Serbia was characterized by systematic planning, the development of large residential districts, and state oversight, supported by defined norms, financial resources, and skilled engineers. These buildings, constructed in the late modern architectural style, featured well-organized functional layouts (Milasinovic-Maric, 2012). Prefabricated construction systems were widely used, with standardized apartments designed according to strict norms and guidelines. The optimal size of residential units was determined based on the number of rooms, while the minimum area of individual rooms was precisely specified. Beyond basic residential functions, auxiliary spaces such as storerooms and terraces were included. Additionally, residential blocks were required to have parking spaces, playgrounds, green areas, and communal spaces for social interaction. Residential buildings also incorporated facilities such as laundromats, storage rooms, and rooftop terraces, all of which contributed to enhancing the overall quality of life for residents.

However, following the 1990s, the state gradually withdrew from the housing sector, allowing market mechanisms to take precedence in shaping urban planning policies and implementing residential projects.

Since the dissolution of Yugoslavia, and in contrast to the previously established spatial development and planning policies that prioritized the public interest, the state became a facilitator for the privatization of housing and urban space. As a result, public land was sold to private investors, leading to a significant reduction in the construction of public housing. Simultaneously, the regulation of public spaces and open green areas became increasingly poorly managed. The rising demand for housing in urban areas, coupled with the decline in the purchasing power of the population, led to considerable compromises in housing quality. Urban planning, once focused on systematic construction, gradually adapted to the interests of investors, with construction occurring on sites that were formerly occupied by individual buildings, particularly in attractive central urban areas. In this context, design priorities increasingly focused on market demands, often at the expense of basic professional standards. Communal spaces in buildings were no longer planned, as these areas could not be sold, while existing communal spaces in older buildings were often repurposed into additional residential units. One of the primary strategies for optimizing construction costs and improving market competitiveness was reducing apartment sizes. Premises with a clearly defined purpose and areas reduced to a minimum were a result of a construction policy where quantity prevailed over quality (Zivkovic et al., 2024). Former single rooms were redefined as double rooms, storage and auxiliary spaces were eliminated, and terraces were either significantly reduced or completely omitted (Figure 1, a). The overall functionality of apartments suffered due to this size reduction, intended to make them more affordable for buyers. The lack of open spaces around buildings led to parking issues, a shortage of green areas, and inadequate spaces for recreation and social interaction.

Current trends in residential construction reflect broader shifts in the housing sector, encompassing changes in architectural design, spatial organization and market-driven housing policies. Among these developments, gated communities represent a specific residential model that has emerged as a direct result of urban transformation and socio-economic stratification. Unlike the more general trends in residential construction, which impact various types of housing, gated communities are exclusive, privatized enclaves that highlight the increasing polarization of urban housing markets. These communities emerged in Serbia in the early 2000s, where their rise is linked to the privatization of urban space, the departure from state-controlled housing models, and widening income disparities. Gated communities prioritize security, exclusivity, and controlled access, which contrasts sharply with previous public housing policies aimed at providing equitable solutions for the general population. A gated community, in essence, is a residential area with restricted access, typically enclosed by physical barriers. These developments often offer private amenities like green spaces, recreational facilities, and underground parking, and they provide a heightened level of security, privacy, and exclusivity compared to standard residential complexes. The ground floors of these buildings are often designated for commercial spaces, such as shops, restaurants, and service-oriented businesses, while architectural designs emphasize sophisticated materials. The contemporary concept of luxury housing emphasizes locations in close proximity to key urban landmarks and social hubs, with strong transportation connectivity to other parts of the city. The difference at the unit level is primarily noticeable in the size of the rooms and the accompanying amenities (Figure 1, b). Larger apartments are designed with additional spaces, such as storage rooms, walk-in closets, and en-suite bathrooms integrated within the ‘master bedroom’ concept. Rooftops often feature green spaces. Access to these complexes is controlled to ensure both security and privacy.

In the context of Serbia’s evolving housing market, gated communities symbolize a new form of socio-spatial segregation. Gated communities often occupy prime urban land, displacing open spaces or repurposing areas that were previously intended for communal use. As public land once designated for collective housing is increasingly transferred to private investors, the availability of affordable housing diminishes, exacerbating the housing crisis. Housing qualities that were once considered standard or a common way of living are now increasingly perceived as a luxury. While this approach may enhance the quality of living for certain segments of the population, it simultaneously highlights growing socio-economic inequalities, as the prices of these properties often exceed the financial capacities of the average person.



(a) (b)

Figure 1: A typical post-transitional apartment (a) and an apartment in a gated community (b) (taken from the authors' private archive)

5. ASSESSMENT OF HOUSING QUALITY USING HQI TOOL

Table 1 presents the results of a comparative analysis of housing quality in dominant residential construction and the emerging trend of gated communities in Serbia, evaluated using the HQI framework. Based on the results obtained in each category, general conclusions are drawn to provide guidelines for redefining housing policy to address the challenges posed by this type of urban development.

Table 1: Comparative analysis of HQI profiles: dominant housing stock and current trends in residential construction in Serbia

Analysis of HQI		*Comparative analysis: Dominant Housing Stock and Gated Communities*
1	***Location*** *Amenities* *– how close are they?* *Liabilities* *– how close are they?* *Noise sources – how close are they?*	*In dominant urban development, the prioritization of investor interests often leads to a reduction in communal and public spaces, thus limiting access to key amenities such as stores, schools, and parks. This shift towards maximizing profitability results in inadequate infrastructure, particularly in central urban zones, where higher density and noise from traffic and construction are prevalent. Additionally, the decrease in green spaces reduces the availability of natural noise barriers, contributing to an overall less favorable living environment. In contrast, gated communities integrate amenities such as parks, restaurants, and commercial facilities within the complex, ensuring convenient access for residents. These communities are strategically located in well-connected urban areas with easy access to transportation networks. While noise from surrounding environments may still affect gated communities, controlled access and architectural solutions—such as green roofs and enhanced sound insulation—offer higher protection from external noise sources, creating a more peaceful and secure living environment.*
2	***Site - layout and landscaping areas*** *Layout – relationship of buildings to each other* *Landscaping – excluding private open space*	*Market-driven urban planning has led to increased construction density, particularly in central urban areas, where buildings replace former individual units. This densification often results in reduced distances between buildings, limiting access to natural light, ventilation, and shared outdoor spaces. The reduction of public and communal spaces, driven by investor interests, contrasts sharply with past urban planning practices that prioritized parks and open spaces as integral components of city life. The lack of properly regulated public green spaces further diminishes opportunities for recreation and social interaction, negatively impacting the overall environmental quality. In contrast, gated communities are designed to prioritize privacy, security, and functionality. The layout typically maximizes space between buildings, incorporating internal courtyards, landscaped green areas, and controlled access points. These communities often feature underground parking to preserve open space and enhance the living environment. Moreover, shared green spaces, parks, and recreational areas within gated communities are professionally maintained and exclusively accessible to residents, ensuring a higher standard of quality and distinguishing these areas from public spaces in the wider urban context.*
3	***Site - open space*** *Site security* *Shared areas in flats* *Children's play* *Private and shared open space* *Characteristics of garden/private/shared open space* *Car parking*	*In dominant urban development, there is a clear lack of planned public spaces, which contributes to a heightened sense of insecurity. Dense construction prioritizes maximizing space for sale, often at the expense of communal areas, leading to smaller balconies replacing larger terraces, rare private gardens, and poorly maintained communal spaces. The absence of open spaces limits opportunities for children's play, and the reduction of such spaces exacerbates parking issues, further diminishing the quality of the living environment. Conversely, gated communities are designed with an emphasis on security and exclusivity. These developments offer controlled access, surveillance systems, and on-site security, significantly enhancing safety. Shared spaces are thoughtfully integrated, with amenities such as reception areas, private lounges, conference rooms, and recreational facilities, which are not commonly found in standard residential buildings. Children's playgrounds are strategically incorporated into these communities, alongside landscaped parks, urban furniture, private gardens, and green spaces. Underground parking is a common feature, optimizing space and ensuring convenience and security for residents.*

4	*Site - routes and movement* *Routes and movement* *Access to the unit*	*In dominant construction, developments are frequently located in central urban areas with limited space, resulting in congestion and inefficient movement. The lack of adequate traffic and spatial planning exacerbates this issue, and the reduction of shared spaces further hinders access to residential units and interior areas. These factors contribute to disorganized circulation and diminished functionality. In contrast, luxury complexes are deliberately situated in well-connected urban zones with robust transportation infrastructure. These developments prioritize efficient access control, utilizing security personnel, card-based entry systems, and private elevators. The design establishes a clear hierarchy of entrances, differentiating resident access from commercial spaces on the ground floor, thus improving flow and ensuring better organization.*
5	***Unit – size*** *Unit type by area* *Units by living spaces*	*Conventional urban housing prioritizes profit maximization, leading to the construction of smaller, simplified residential units with fewer rooms and functional spaces. These designs often limit storage, omit balconies, and focus on standardized layouts to meet market demands, sacrificing overall living standards for affordability and sales potential. In contrast, luxury housing developments cater to wealthier demographics, where the definition of 'luxury' extends beyond location to include high-end amenities, privacy, and design sophistication. These units feature additional living spaces such as walk-in closets, storage rooms, and multiple bathrooms, emphasizing spatial efficiency and comfort over sheer size. While market-driven developments aim to maximize profit through smaller, simplified units, luxury developments focus on optimizing the use of space for enhanced living quality.*
6	***Unit - layout most units*** *Total number of units being assessed and scored* *Additional features*	*Dominant housing developments often prioritize increasing unit density by eliminating common spaces and repurposing shared areas into additional residential units. This approach leads to higher population density and a decrease in spatial comfort, exacerbated by the reduced availability of green spaces and recreational areas. The lack of open spaces around buildings further contributes to parking problems and limits opportunities for social interaction and physical activity. In contrast, luxury housing projects focus on maintaining spatial quality, with larger apartments and thoughtfully designed layouts that emphasize exclusivity and privacy. These developments typically feature fewer units per complex, incorporating amenities such as underground garages, landscaped parks, and controlled access. Luxury apartments are often designed with large windows to optimize natural light, providing a more comfortable and exclusive living environment compared to the denser, more utilitarian designs of market-driven developments.*
7	***Unit - noise, light and services*** *Noise reduction characteristics* *Quality of light, aspects and prospects* *Standard of service provision* *Additional features – services* *Adaptability*	*In dominant residential developments, maximizing density often leads to thinner walls and poor sound insulation, exacerbating noise pollution both internally and externally. The reduced availability of open spaces and green areas results in closer building placement, further increasing noise and limiting access to natural light, particularly for lower floors. Smaller apartment sizes and rigid layouts restrict flexibility and optimal daylight orientation. In contrast, gated communities are specifically designed to minimize noise pollution, offering a quieter living environment. Strategic building placement, often with green buffers, helps mitigate external noise. Additionally, gated communities prioritize safety and adaptability through controlled access, private security, and adjustable environmental features. The more spacious and flexible layouts in these complexes allow for greater reconfiguration of living spaces, enhancing overall living quality compared to the more constrained, high-density urban developments.*
8	***Unit – accessibility*** *Accessibility within the unit*	*Market-driven apartment designs prioritize smaller floor areas to maximize profitability, leading to spatial constraints that may limit accessibility for individuals with special needs. The reduction of shared spaces and the lack of surrounding open areas further hinder access to public and semi-private spaces. In contrast, luxury apartments tend to offer more spacious and flexible layouts, incorporating wide hallways and design solutions that enhance movement and accessibility, particularly for the elderly or those with reduced mobility. However, these luxury units are often tailored to a specific demographic and are not always standardized according to universal design principles, which can limit their suitability for a broader range of users.*
9	***Unit - energy and sustainability*** *Code for sustainable homes* *Ecohomes* *Rehabilitation*	*Dominant construction practices typically prioritize profit, often at the expense of ecological considerations. The reduction in apartment sizes and terraces compromises natural light and ventilation, undermining energy efficiency and sustainability. There is a lack of widespread implementation of ecological standards such as the Code for Sustainable Homes or Ecohomes. In contrast, luxury complexes increasingly adopt sustainable practices, though these strategies are not universally applied and are often contingent upon their economic feasibility for investors. Rather than rehabilitating older buildings, investors frequently opt for demolition and new constructions, contributing to the loss of architectural heritage and increased construction waste. This approach highlights a significant disparity in sustainability practices between standard market-driven developments and more exclusive, luxury projects.*
10	*Performance in use* *Overall HQI score*	*Dominant housing construction in urban areas has been shaped by market principles, leading to a decline in housing quality for the average citizen, while luxury complexes cater to a narrower social group. Although new trends offer certain advantages, they are financially accessible only to a small segment of the population, leading to the complete neglect of the broader picture of urban development. The absence of regulations and systemic support measures for sustainable construction, energy efficiency, and apartment functionality has resulted in socio-economic inequalities, reduced living comfort, and urban space degradation. This model of housing development raises concerns about long-term sustainability and necessitates a new urban planning strategy that integrates accessibility, functionality, and ecological standards into the housing development process.*

6. DISCUSSION

The emergence of gated communities is driven by multiple factors, most notably the privatization and commodification of urban space, facilitated by the dominance of market-driven logic, which in this case offers an attractive living environment in exclusive locations. While such residential complexes are presented as the ideal model for contemporary urban living, their proliferation underscores deepening spatial and social inequalities, necessitating greater public scrutiny. Within these exclusive enclaves, privileged individuals gain access to security and high-quality complementary amenities that are otherwise absent from the broader urban environment. While these select residents enjoy the benefits of an 'ideal city', the broader implications for overall urban development are often overlooked. Gated communities typically accommodate economically and socially homogeneous groups belonging to the upper socioeconomic strata. As such, they can be understood as a mechanism of segregation, wherein the wealthiest segments of society realize their ideal vision of urban living. However, the effects of these exclusive housing models extend beyond their immediate beneficiaries, disproportionately impacting more vulnerable and less privileged populations, who constitute the majority of society. The promotion of such developments leads to the privatization and overconsumption of spatial resources, thereby limiting many citizens' access to adequate living conditions. This growing divide highlights the urgent need for critical engagement with urban planning policies to ensure more equitable and sustainable housing solutions.

Socio-economic differences are a key driver of housing segregation (Musterd & Van Ham, 2020). As a form of housing segregation, gated communities serve as a catalyst for deepening socio-economic and spatial inequalities. The widening income gap, combined with a real estate market that remains the primary means of acquiring housing and a lack of state-provided affordable alternatives, forces households into vastly different living conditions based on their financial capacity. This results in a fragmented urban landscape, where housing quality, infrastructure, and access to essential services vary significantly across different city zones. Households with limited financial means are often compelled to settle in peripheral areas, where they face inadequate infrastructure, a lack of public transportation, and restricted access to educational and healthcare institutions. The absence of state intervention in providing essential services further exacerbates their marginalization. In contrast, wealthier individuals can afford high-end apartments in well-planned environments that offer green spaces, kindergartens, playgrounds, and recreational facilities. By purchasing their homes in these exclusive developments, they are not only acquiring a place to live but also securing access to communal and social infrastructure that should, in principle, be a public good provided by the state.

Consequently, spatial segregation manifests as privileged social groups cluster within economically and socially homogeneous environments, while less advantaged segments of the population encounter significant barriers to securing adequate housing. This form of housing segregation, in turn, reinforces economic inequality by restricting social mobility among lower-income populations, as disparities in access to essential amenities play a crucial role in determining their potential for improving their socio-economic status. In this context, the spatial isolation of the wealthy within gated communities, alongside the forced segregation of marginalized and impoverished groups, contributes to an increasingly fragmented and polarized society, ultimately diminishing social cohesion. Within gated communities, the concept of public space is effectively abolished, thereby reducing opportunities for social interaction. This exclusion is not solely enforced through physical barriers but also through deliberate architectural design, distancing, and the promotion of a self-contained lifestyle. A further consequence of this phenomenon is the depoliticization of social life and a decline in civic engagement. The imposed lifestyle within gated communities fosters a diminished inclination among residents to engage in broader political discourse, particularly on matters concerning the public good. As those living in these communities have their needs met through privately developed infrastructure, they become less motivated to advocate for public infrastructure that serves the collective interest of society as a whole.

7. REGULATION AND IMPLEMENTATION OF HOUSING QUALITY STANDARDS

In the context of the analyzed residential construction, the obtained housing quality results can serve as guidelines for redefining the priorities and objectives of the national sustainable development strategy, as well as for establishing instruments to align it with global development trends. The Housing Quality Assessment Tool highlights key deficiencies and discrepancies in urban development, which should serve as a stimulating and supportive framework for improving planning and construction policies through regulatory measures. To ensure housing quality and enhance buyer awareness, a standardized certification model for assessing the quality of residential units should be introduced. A certificate of overall housing quality should provide potential buyers with fundamental information about a dwelling, enabling them to make more informed

purchasing decisions (Todorovic, 2016). Without such information, buyers are at a high risk of acquiring substandard housing at an inflated price. These documents should include comprehensive data on structural attributes, applied materials, functional aspects, and energy performance, thereby allowing for a more objective and transparent evaluation of real estate in relation to its market value. The implementation of such standards would foster a more responsible approach to architectural design and construction processes, promote the long-term sustainability of urban development, and improve access to quality housing across broader social groups.

The assessment results could further be applied to evaluate residential units in the process of determining purchase prices and rental rates for housing in social, state, and private ownership at the national level (Zivkovic, 2017). The obtained HQI profile data, expressed through a point-based system, could be integrated into the 'elements of utility value per dwelling' category within the 'List for Determining Building and Housing Quality', as outlined in the current 'Instruction on the Method of Determining Rent' (Government of the Republic of Serbia, 1992), adopted at the national level. Additionally, HQI-based scoring could also be implemented within the 'List for Determining Special Benefits of Buildings and Housing Units' in accordance with the 'Guidelines for Determining the Purchase Price of Housing' (Government of the Republic of Serbia, 1997), also adopted at the national level.

8. CONCLUSIONS

The HQI tool offers a potential solution for evaluating housing quality, setting standards, and ensuring that housing development aligns with sustainable practices, ultimately contributing to a more inclusive, transparent, and equitable housing market. The results of this study underscore the need for comprehensive changes in both urban planning and national housing policies to provide adequate housing for all citizens, while mitigating the negative consequences of market-driven trends that exacerbate social stratification. The construction industry in Serbia has entered a crisis, with low-quality apartments being sold at high prices. The trend of reducing floor area, using cheaper materials, and maximizing profit reflects the dominant housing model, which is the result of various factors, including the privatization and commodification of space—driven by the dominance of market logic—and the state's withdrawal from the provision of public services. As a result, individuals must adapt to market conditions that are often misaligned with their financial capacities. Standards that were once accessible to all citizens and the working class in former Yugoslavia are now marketed as luxury, increasingly unattainable for the average citizen. While 'gated communities' are presented as the ideal model for urban living, their expansion signals growing spatial and social inequality, which undoubtedly requires greater public attention. Privileged individuals gain security and access to high-quality amenities that are absent from existing urban areas. Enjoying the privilege of living in an 'ideal city' has broader implications, often overlooked, for overall urban development. Gated communities typically house highly privileged social groups, forming economically and socially homogeneous communities. They can thus be understood as a form of segregation of the wealthy, who create their own ideal of urban living. However, the consequences of such strategies extend beyond these communities, affecting less privileged and more vulnerable populations, who represent a much larger portion of society. By promoting such housing models, spatial resources are privatized and consumed, leaving many citizens without adequate options for securing proper living conditions. Gated communities not only reinforce existing social stratification but also establish a new system of spatial differentiation within cities. The stark contrasts between neighborhoods will persist unless the fundamental principles of urban design and housing policies are radically reformed. Standardizing and evaluating housing quality are essential for improving regulatory frameworks and urban development planning. The introduction of certification systems and the Housing Quality Indicator assessment would enable more transparent real estate evaluations, enhance buyer awareness, and encourage the adoption of sustainable construction practices. Furthermore, these assessment results could be used to regulate rental and purchase prices of residential units, contributing to a more equitable and efficient housing market at the national level.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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ICUP2025
5th international conference on urban planning

METHODOLOGICAL FRAMEWORK FOR ANALYSING THE TRANSFORMATION OF THE INSTITUTIONAL STRUCTURE OF URBAN PLANNING: THE CASE OF SAVA QUAY IN NEW BELGRADE FROM 2000 TO 2023

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ABSTRACT

The methodological framework for analysing the transformation of the institutional structure is focused on creating a database of formal urban planning documents for the area of Sava Quay in New Belgrade from 2000 to 2023. This database enables the identification, chronological review, and monitoring of specific research aspects. The applied methodological procedure includes the creation of: (a) a chronological review of all formal urban planning documents, (b) a database of documents for analysis, (c) content analysis of these documents, and (d) a chronological review of specific research aspects related to the institutions involved in the planning process, as well as changes in land ownership status and construction capacities in order to track changes in (i) planed land use, (ii) institutional participation, and (iii) decision-making mechanisms used in the urban planning process. The created database of planning documents, combined with the use of longitudinal comparative analysis, has enabled the identification of changes in the mechanisms of land use, the mechanisms of participation of various institutions in the urban planning process, and the mechanisms of decision-making in urban development. The presented methodological framework provided a basis for a critical analysis of the transformation of the institutional structure of urban planning within the given time frame and offered substantiated research findings.

Keywords: *methodological framework; database creation; institutional structure transformation; post-socialist transition; Belgrade*

1. INTRODUCTION

This paper examines the methodological framework for analysing the transformation of the institutional structure of urban planning during the post-socialist transition, with a focus on the Sava Quay in New Belgrade between 2000 and 2023. The aim of the research is to understand the impact of structural changes in the socio-economic and political systems on the institutional mechanisms that shape urban planning and decision-making regarding urban development. The emphasis is placed on analysing changes in the roles and positions of institutions involved in the planning process, as well as on decision-making mechanisms. The methodological approach is based on in-depth qualitative research, following the theories of Marshall & Rossman (2006) and Rossman & Rallis (2012), which enable a detailed examination of these aspects.

Qualitative research in urban planning, which recognizes cities as social constructs shaped by actions, practices, and historical contexts (Harvey, 1973; Lefebvre, 1974), enables an understanding of the dynamics of power, interests, and practices that shape urban development. Also, such research allows for the analysis of how

changes in the social and economic structure of a city influence decision-making regarding land use and construction (Massey, 2005). A key element of the qualitative approach is its focus on institutions as main actors in the decision-making process, examining how institutional changes are reflected in urban policies and decisions (Savini, 2020). Studying institutional dynamics helps to understand how power is regulated and how urban and social problems are addressed. Basically, qualitative research allows for an in-depth exploration of the social processes underlying these changes. Qualitative studies that focus on society most often use the case study method.

2. CASE STUDY

The Sava Quay area in New Belgrade, encompassing blocks 44, 45, 70, and 70a, was selected as the case study (Maruna et al., 2023). The choice of this case study is based on several aspects. This area intersects institutional jurisdictions at all levels of governance (national, city, and municipal), allowing for the observation and understanding of their complex interdependencies. The development of this area is a matter of interest and action for a highly active local community, whose engagement deeply involves urban planning and focuses on a wide range of socially significant issues, such as the protection of public interest, environmental protection, and ecology. The New Belgrade blocks also offer insight into the relationship between urban planning and the open residential block in contemporary urban development, particularly concerning land ownership status and the preservation of modernist heritage. This area is characterized by dynamic planning activity, which serves as a prerequisite for well-founded arguments and relevant research findings.

The complex research question and the study's aim necessitated the creation of a methodological procedure centered on longitudinal comparative analysis. This research approach is used to study changes over time by comparing different subjects, groups, locations, or social phenomena. The key characteristics of longitudinal comparative analysis are: tracking changes over time, comparing different units, and analysing cause-and-effect relationships (Scott, 2014). Longitudinal comparative analysis is a suitable methodological tool as it allows for tracking phenomena of scientific interest over a defined period and conducting comparative reviews and analyses, forming the basis for generating research results.

The research is based on formal urban planning documents concerning the New Belgrade blocks on the Sava Quay, specifically urban plans adopted for the territory of the Sava Quay and New Belgrade blocks 44, 45, 70, and 70a over the past 20 years. The main data sources are publicly available databases of planning documents from the following institutions:

- Urban Planning Institute of Belgrade PE: Data related to urban and spatial plans and other formal urban planning documents currently or previously in force (www.urbel.com; https://mape.urbel.com/urbelmape/maps/126003/01-granice-urbanisti-kih- planova-beograd#),
- City of Belgrade: Data concerning planning documents in the preparation phase (EPI) (https://www.beograd.rs/cir/gradski-oglasi-konkursi-i-tenderi/910-oglasi/),
- Official Gazette of the City of Belgrade: Data on spatial plans (RSPAA), urban plans (GUP, GRP, DRP), and other formal urban planning documents currently or previously in force (https://sllistbeograd.rs/).

The analysis included textual and graphical parts of planning documents as well as their supporting documentation basis:

- Adopted urban plans covering the studied territory that are or were in force within the research timeframe,
- Urban plans in the preparation phase (EPI), with publicly available interim solutions.

As units of analysis, the following were mainly observed:

- Institutions mentioned in the plans and the documents underpinning their operations,
- Changes in land use, particularly regarding land ownership status (private/public),
- Changes in planned construction capacities based on urban planning parameters,
- New institutions and other actors introduced into spatial management through land-use changes.

The research steps were conducted as follows:

1) Creation of a chronological overview of all formal urban planning documents,
2) Development of a database of formal urban planning documents for analysis,
3) Content analysis of formal urban planning documents selected for analysis,
4) Creation of a chronological overview of specific aspects relevant to the research in the timeframe from 2000 to the present.

3. RESEARCH STEPS

3.1. Step 1: Creation of a Chronological Overview of All Formal Urban Planning Documents

The chronological overview includes mapping all formal urban planning documents for the area within the research timeframe. All formal urban planning documents (in force, previously in force, or in the process of being drafted) and the years of their adoption were mapped:

- Detailed Regulation Plans (DRP/DUP): Includes infrastructure plans, plan modifications to these planning documents, and Decision on Plan Preparation (15 documents),
- General Regulation Plans (GRP): Includes plan modifications (6 documents),
- General Urban Plans (GUP): Includes plan modifications (6 documents),
- Regional Spatial Plan for the Administrative Area (RSPAA): Includes plan modifications (2 documents),
- Other documents adopted on the basis of other laws that define the planning of the area, that is, the legal basis of which is not the Law on Planning and Construction (7 documents).

In the preliminary chronological overview, a total of 36 formal urban planning documents were mapped, providing an insight into the overall planning activity in the area during the research period.

3.2. Step 2: Development of a Database of Formal Urban Planning Documents for Analysis

A review of systematically collected data revealed that, due to various aspects of the research, not all documents are mutually comparable. In this step, it was necessary to exclude certain formal urban planning documents from further analysis based on defined criteria:

- Documents that are not urban plans - spatial plans (RSPAA), which are created using a specific methodology characterized by generality in planning solutions and a strategic approach to urban development,
- Documents that do not cover the research area, plans whose solutions do not pertain to the analyzed territory (e.g., PM GRP 2021, PM GUP 2005, etc.),
- Documents with no significant impact on planned land uses and urban planning parameters, or their changes over time (e.g. DRP/DUP for infrastructure corridors.),
- Documents that are not comparable in content with urban plans (Decisions on Plan Preparation),
- Documents not adopted under the Planning and Construction Law (e.g. Plan for locating floating structures).

This way, a database of urban plans for further analysis was created, comprising 7 urban plans and 2 plan modifications to urban plans, for a total of 9 planning documents (Figure 1) (Maruna et al., 2023):

- Belgrade General Urban Plan 2021 from 2003 and its Plan modifications from 2009 (2003 GUP; 2009 PM GUP),
- Belgrade General Urban Plan from 2016 (2016 GUP),
- General Regulation Plan for the Construction Area of the Local Self-Government Center – City of Belgrade, Units I-IXI from 2016 and its Plan modifications from 2022 (2016 GRP; 2022 PM GRP),
- General Regulation Plan for Belgrade's Green Spaces System from 2019 (2019 GRP SGA),
- Detailed Regulation Plan for Block 44, New Belgrade Municipality (EPI Study) from 2017 (2017 DRP44),
- Detailed Regulation Plan for Block 70a, New Belgrade Municipality (EPI Study) from 2017 (2017 DRP70a), and

- Detailed Regulation Plan for the Construction of a Pedestrian-Cyclist Connection Between Omladinskih Brigada Street and Ada Ciganlija, New Belgrade and Čukarica Municipalities, from 2023 (2023 DRP Bridge).

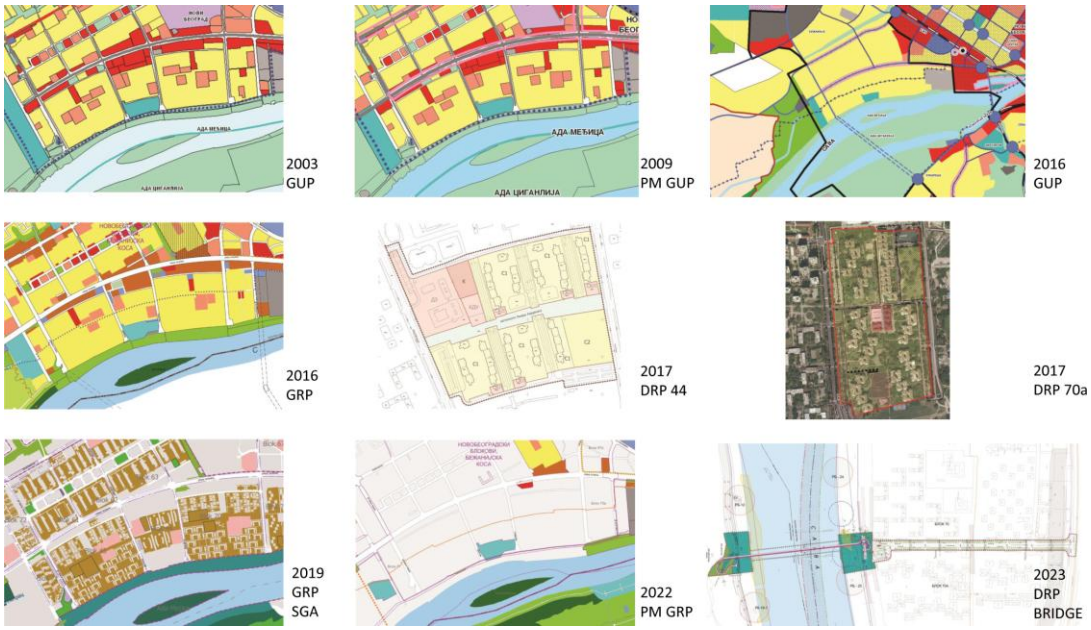


Figure 1: Overview of the urban planning documents database for analysis

3.3. Step 3: Analysis of the Content of Mapped Formal Urban Planning Documents

In the next step, the content of the mapped formal urban planning documents, specifically the urban plans for analysis, was examined. Due to changes in procedures and varying methodological approaches in plan development, as well as differences in data availability, plans adopted before and after 2016 were analyzed in distinct ways. A detailed analysis of plans adopted after 2016 was carried out according to the following aspects:

- Planned land use, focused on the land status as public or residential and commercial land uses, as well as urban planning parameters for residential and commercial land uses,
- Changes in planned land use and urban planning parameters for residential and commercial land uses in comparison with higher-level plans,
- Institutions that are expected to formally participate in the planning process, both in the drafting and in the process of adopting planning documents (institutions that only made observations during the stages of public insight were not considered),
- Position of involvement of institutions within the planning procedure.

For the plans adopted before 2016, aspects related to land status and land use, and urban planning parameters for residential and commercial land uses (points 1 and 2) were analyzed in order to track changes in land use and building capacity throughout the entire research period. The institutional analysis of these plans was not included.

Data regarding the ownership status of land in terms of planned land use and building capacity were extracted from the textual parts of the plan and graphical annexes that define the planned land use (e.g., Planned land use, Division into zones with the same building rules, Areas for public service buildings and complexes, etc.). Information on the institutions that formally participated in the preparation of the planning document and decisions about urban development was taken from the documentation basis (Decision on Plan Preparation, cooperation with public authorities, EPI Report, Strategic Environmental Impact Assessment Report, Public Insight Report, and the Justification from Secretariat for Urban Planning and Construction), and, if necessary, from the textual part of the plan.

3.4. Step 4: Creation of a Chronological Overview of Specific Aspects Relevant to the Research

The creation of the chronological overview database of specific aspects took place in two directions. The first direction involved mapping the analyzed urban planning documents from 2000 to the present, while the second focused on collecting data from the analyzed urban planning documents regarding (a) the ownership status of the land and (b) the institutions that formally participated in the preparation and decision-making process regarding urban development.

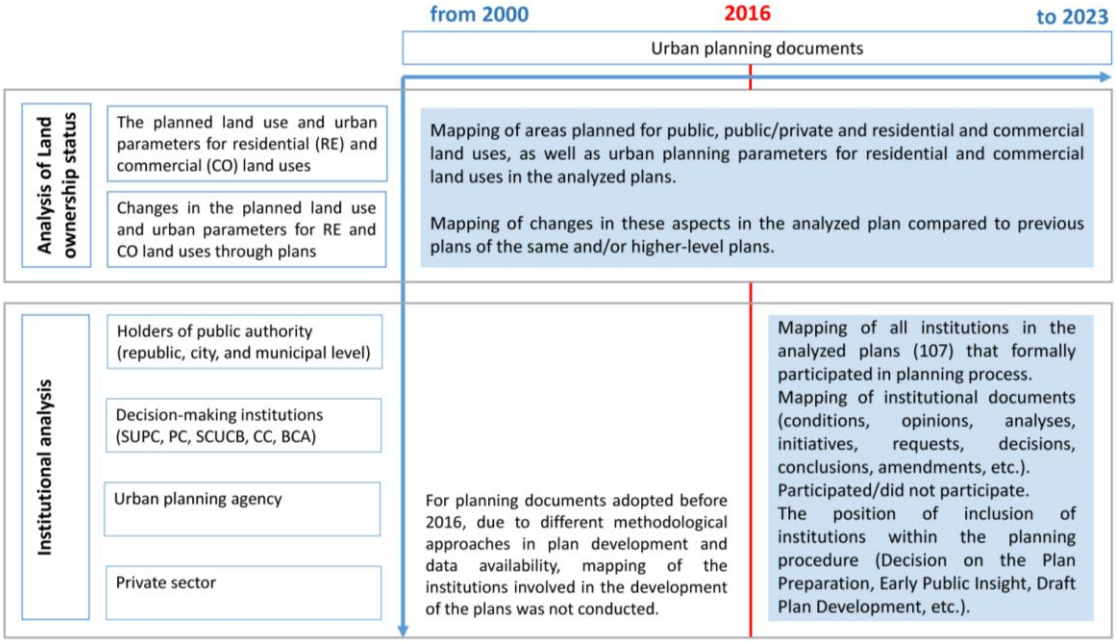


Figure 2: The methodological procedure for creating a database of the chronological overview of specific aspects of the analyzed urban planning documents and their development process

In the analysis of land ownership status, the planned land uses and urban planning parameters for residential and commercial land uses, as well as their changes over time through planning documents, were mapped. Specifically, the mapping included public land use, public/private land use, and residential and commercial land uses, along with the urban planning parameters for residential and commercial land uses. Changes in these parameters were then mapped in the analyzed plan compared to plans of the same and/or higher-level rank. This part of the analysis was carried out for all urban planning documents from 2000 to the present.

The institutional analysis includes the mapping of institutions that formally participated in the preparation and decision-making regarding urban development from 2016 to the present. The formal planning procedure in Serbia recognizes various positions and roles for public institutions in decision-making at different levels of governance. The basic groups include: (1) decision-makers, consisting of the plan creators (Secretariat for Urban Planning and Construction (SUPC)) and plan development monitors (Service of Chief urbanist of the City of Belgrade (SCUCB)), as well as the authorities responsible for expert oversight (Planning Commission (PC) and plan adoption authorities (City Council (CC), Belgrade City Assembly (BCA)), (2) holders of public authority, and (3) plan document developers (Trkulja, 2021). The structure of holders of public authority includes public utility companies at the local and national levels, city and republic institutes, city municipalities, and ministries of the Republic of Serbia. The developer of all the analyzed urban plans is the Urban Planning Institute of Belgrade PE. The private sector is mapped as the entity responsible for providing expert assessments on which urban development decisions are based. A total of 107 institutions were mapped, of which 95 are holders of public authority. The documents from these institutions that form the basis of their participation in the planning process were mapped (e.g., conditions, opinions, analyses, expert evaluations, initiatives, requests, notices, amendments, conclusions, etc.). It was mapped whether institutions responded to the invitation to participate in the creation of planning solutions, as well as their positions in the planning procedure (Decision on Plan Preparation (DPP), Strategic Environmental Impact Assessment (SEIA), Early Public Insight (EPI), Draft Plan Development (DPD), Public Insight (PI), Plan Adoption (PA)). The applied methodological procedure is shown in Figure 2.

This methodological procedure created a database that contains a chronological overview of the specific aspects of the analyzed urban planning documents and the processes of their preparation. It allowed insight into (a) the chronological review of changes in the planned land uses and urban planning parameters in urban plans compared to previous and higher-level plans, and (b) an overview of changes in the institutional structure and mechanisms used in the urban planning processes through comparative reviews:

- Activities of the authorities responsible for the preparation and monitoring of planning documents (SUPC, SCUCB),
- Activities of authorities responsible for expert oversight (PC) and adoption of planning documents (CC, BCA),
- Activities of holders of public authority (public utility companies (PUC), institutes, directorates, secretariats, municipalities, ministries of the RS).

4. RESULTS OF THE ANALYSIS

Changes in Land Use Mechanisms (Maruna et al., 2023):

- Transformation of land status from public to residential and commercial land uses as a condition for privatization,
- Increase in building capacity for residential and commercial use via mechanisms that enhance urban planning parameters change in the calculation area from block to building plot, and changes in typology,
- Imprecise definition of land status in open residential blocks as a result of the specific physical structure of New Belgrade blocks. In planning solutions, free and green areas in the open residential block are defined as residential areas, leaving room for interpretation as potentially available land for new construction,
- Relativization of planning solutions in planning documents is a mechanism whereby it is defined that the solutions are indicative and can be changed with the consent of relevant institutions without the need for formal amendments to the planning base (2016 GRP and 2019 GRP SGA).

Changes in Mechanisms of Institutional Participation in Urban Planning Processes (Maruna et al., 2023):

- Increased participation of higher levels of government in urban planning processes at the local level. A noticeable trend is the growing involvement of national institutions in decisions regarding urban development at the local level, while at the same time, there is a trend of decreasing participation of institutions from the group of holders of public authority in the planning process. This indicates a trend toward the centralization of decision-making regarding urban development. The direct influence of the highest levels of government is carried out through mechanisms for submitting initiatives and amendments.
- Increased participation of private enterprises in creating expert reports, as opposed to the traditional practice of engaging state scientific-research organizations. Private enterprises are entrusted with creating expert reports that justify the transformation of land ownership status from public to other uses, and once verified by relevant institutions, these reports become the basis for defining planning solutions. Furthermore, since 2016, no urban planning document has involved the academic sector, which is closely related to the absence of studies as arguments for planning solutions.
- Increased participation of institutions from the decision-makers group (SUPC, PC, SCUCB, CC, BCA). This mechanism is reflected in the multiple, conflicting roles of institutions within the decision-makers group in the planning process.

Changes in Decision-Making Mechanisms in Urban Development (Maruna et al., 2023):

- Transformation of planning solutions after public insight in the planning adoption procedure (amendment mechanism, correction of technical errors). The analysis of trends shows that key decisions about urban development are made within institutions in the decision-makers group at the city level. Their substantive participation occurs at the end of the planning process, after the public

insight is concluded and the public insight report is prepared and adopted, by engaging in amendment procedures. Although the amendment mechanism is a well-known legal solution, its use has proven to be a highly powerful tool for fundamentally changing planning solutions, as it allows decisions to be made without the participation of other institutions and stakeholders in the planning process, simply by the majority vote of the city assembly. The correction of technical errors follows a similar path.

5. CONCLUDING CONSIDERATIONS

In summary, the results of the research obtained through this methodological approach demonstrate that during the two decades of post-socialist transition, urban planning has been transformed in the following directions (Maruna et al., 2023):

- As a key instrument for the redistribution of spatial resources in favor of private capital interests – through the transformation of land ownership status during the urban planning process,
- Centralization of decision-making – vertically, through the expanded influence of higher levels of government, and horizontally, through the concentration of power within the decision-makers group at the city level,
- Development of decision-making mechanisms at the end of the planning process and within a narrow circle of city government institutions through the use of the amendment institute.

The presented methodological approach created a database of urban plans for selected New Belgrade blocks on the Sava Quay, which allowed for a well-grounded conclusion that the transformation of the institutional structure of urban planning during the post-socialist transition is characterized by frequent and significant changes in legal solutions, introducing new decision-making mechanisms into the planning procedure and opening space for the influence of particular interests on planning outcomes (Maruna et al., 2023). Planning and decision-making processes remain insufficiently transparent and continue to take place within a narrow circle of city administration institutions, with an increased influence of higher levels of government. Ambiguously defined and overlapping competences and responsibilities of institutions contribute to the weakening of their role and participation in the planning process. The transformation of the institutional structure of urban planning in Serbia does not align with the concept of good governance, but rather with the values of the neoliberal development concept, promoting deregulation, entrepreneurship, and competition. The criteria for decision-making about urban development are turned towards the profitability of investments in urban space, with much less emphasis on improving the quality of life for citizens.

ACKNOWLEDGEMENTS

The research was conducted with the support of the Science Fund of the Republic of Serbia, project no. 744648, Empowering Participation in Culture and Architecture: Activating Public Resources for and with Local Community - EPICA.

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ANALYSIS OF URBAN INFRASTRUCTURE AND WALKABILITY CHALLENGES FOR MOTHERS WITH STROLLERS IN NOVI PAZAR: RECOMMENDATIONS FOR SUSTAINABLE URBAN DEVELOPMENT AND THE IMPROVEMENT OF PEDESTRIAN MOBILITY

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ABSTRACT

Sustainable cities promote non-motorized mobility by creating environments conducive to pedestrian activities, which significantly contribute to public health, social well-being, and environmental sustainability. The primary factors influencing the walkability of urban areas include convenience, safety, comfort, and the overall attractiveness of the environment. This study examines the urban conditions in Novi Pazar, with a particular focus on the mobility challenges faced by mothers with strollers. It highlights the inadequacies of existing infrastructure, such as street congestion, sidewalk dimensions, and the integration of traffic systems for cyclists. Despite ongoing urban changes, these developments fail to meet contemporary demands for pedestrian mobility. This paper underscores the urgent need to enhance bicycle and pedestrian infrastructure to improve mobility and elevate the quality of life in urban settings.

Keywords: *sustainable cities; pedestrian activities; public health; urban changes*

1. INTRODUCTION

Sustainable cities promote non-motorized movement, creating environments conducive to walking and pedestrian activities. Mobility is considered important as increased walking benefits society in terms of public health, social well-being, and environmental sustainability.[123] One influential factor in the attractiveness of the

1 Carmona M (2019) Place value: place quality and its impact on health, social, economic and environmentaloutcomes. *Journal of Urban Design* 24(1): 1–48.
2 Gehl J (2010) *Cities for People*. Washington, DC: Island Press
3 Forsyth A (2015) What is a walkable place? The walkability debate in urban design. *Urban DesignInternational* 20(4): 274–292

environment is walkability, which has led to a growing interest in developing quantitative models of walkability to inform policy interventions and improve understanding of urban dynamics.

Previous studies have identified four key needs that must be met for walking to occur: convenience, safety, comfort, and attractiveness.[4][5] Jan Gehl defined the key influential elements for pedestrian movement as vibrancy, high-quality façades, and low-rise buildings.[6] The combination of these characteristics has been proven to promote walking activity. However, to motivate people to walk, it is essential to create pedestrian-friendly environments that support walking through quality sidewalks and destinations, as well as spaces perceived as safe, convenient, and empowering for physical activity.

The goal of this research is to identify and analyze the factors that present challenges to the mobility of mothers with strollers in the urban context of Novi Pazar. Specifically, the study examines the adequacy of urban infrastructure, focusing on pedestrian pathways and the quality of public spaces in facilitating the movement of this specific group of pedestrians. The research seeks to highlight issues that hinder mobility for mothers with strollers, aiming to inform policy development and contribute to the creation of more inclusive and accessible urban spaces.

The methodology employed in this study combines field analysis, route evaluations, and a review of urban planning documents. Observations were made on-site to assess the conditions of pedestrian pathways, while photographic documentation captured real-time obstacles and challenges faced by mothers with strollers. Additionally, the study involved a comparative analysis between the observed conditions and established design guidelines for pedestrian infrastructure. By identifying discrepancies between current urban practices and optimal design standards, this research aims to provide actionable recommendations for enhancing pedestrian mobility in Novi Pazar.

In the past decade, the city of Novi Pazar has seen a surge in high-rise construction, altering its visual identity. The urban matrix of the city is changing to meet evolving needs but is not keeping pace with current transformations. This has resulted in recurring issues in traffic management, including inadequately dimensioned streets, congestion in the city center, stationary traffic, unregulated bicycle and pedestrian pathways, and poorly defined sidewalks.

This research focuses on analyzing urban conditions for the mobility of mothers with strollers in Novi Pazar, specifically the adaptability of streets to meet the needs of these users. Although urban streets have evolved as an important indicator of citizens' quality of life, the issue in Novi Pazar is worsening. Pedestrian experiences are negative, and preferences for walking and the time spent walking are dictated by necessity. The research aims to highlight the problems causing mobility challenges for this specific group of pedestrians, with the goal of prompt action and finding adequate solutions for integration.

Land use patterns, street profiles, and sidewalks do not correspond to the population size of Novi Pazar. This clear deficit represents a fundamental reason for decades of stagnation in addressing these issues. Effective problem-solving policies must include improving cycling and pedestrian infrastructure, enhancing road safety, and creating more opportunities for physical activity in public open spaces and parks, as well as in indoor environments such as workplaces and community spaces.

2. PEDESTRIAN AREAS

Pedestrians are the most common, slowest, and least protected participants in traffic. Their individual behavior requires special protection, particularly in urban environments where their movement paths intersect with those of other traffic participants.[7] Pedestrian areas in Novi Pazar largely fail to meet the minimum spatial requirements necessary for human movement. The inability of two individuals to pass each other on sidewalks is a frequent occurrence, indicating that the dimensions do not conform to established standards. When planning pedestrian pathways, it is essential to consider specific groups, such as individuals with functional

4 Nakamura K (2020) Experimental analysis of walkability evaluation using virtual reality application. *Environmentand Planning B: Urban Analytics and City Science* 48(8): 2481–2496.

5 Talavera-Garcia R, Soria-Lara JA (2015) Q-PLOS, developing an alternative walking index. A method based onurban design quality. *Cities* 45: 7–17.

6 Silvennoinen, H.; Kuliga, S.; Herthogs, P.; Recchia, D.R.; Tunçer, B. Effects of Gehl's urban design guidelines onwalkability:A virtual reality experiment in Singaporean public housing estates. Environ. Plan. B Urban Anal. City Sci. 2022, 49, 2409–24

7 "Manual for Road Design in the Republic of Serbia," Republic of Serbia, Belgrade, 2012.

impairments. This entails designing according to the principles of universal design—creating environments accessible to all users. The measures required for designing pedestrian pathways that accommodate individuals with functional impairments are illustrated in Figure 1.

When comparing dimensions from the previous figure, the requirements for pedestrian pathways for the user group "mothers with strollers" are identical to those for individuals using wheelchairs. According to design guidelines, the minimum pathway width is 120 cm, while the optimal width is 180 cm. Usable pedestrian

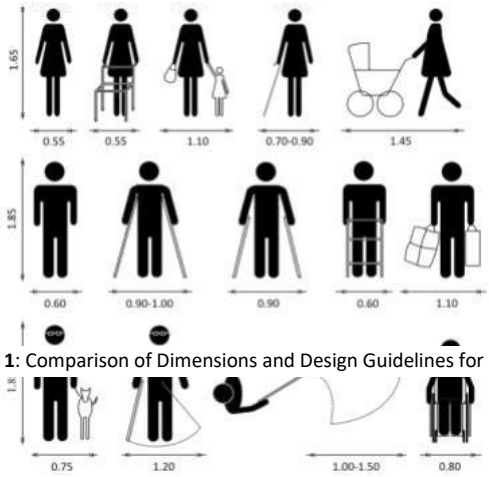


Figure 1: Comparison of Dimensions and Design Guidelines for Pedestrian Pathways

pathways are those with a longitudinal slope of less than 5%, equivalent to a gradient of 1:20. Pathways with steeper slopes are considered ramps. For wheelchair users, a gradient of up to 3% does not pose a challenge, while slopes of 4-5% over longer distances require horizontal rest areas of 150 cm in length every 30-50 meters. Pathways with steeper slopes are planned only in exceptional cases due to the terrain's topography. The cross slope should not exceed 2%.

To ensure durability, better accessibility, and greater safety, the surface of pedestrian pathways should be hard, even, and well-drained. The surface must not be slippery under either dry or wet conditions, and joints should be smooth. Edges should be designed so that visually impaired individuals can detect them, which can be achieved by using different materials or curbstones. Pedestrian pathways should be free of obstacles and height discrepancies, such as uneven manhole covers. Grates for drainage should be installed perpendicular to the direction of movement.When obstacles cannot be avoided, freestanding barriers in the environment should be marked with highly visible colors. Drainage channels can also serve as guiding lines for the visually impaired. Similarly, pedestrian pathways should be well and evenly lit to prevent glare. Thoughtfully placed lighting fixtures can also serve as orientation guides.

Traffic differentiation plays a crucial role in pedestrian pathway planning. Pedestrian traffic should be separated from motorized traffic by green spaces or bicycle lanes. Additionally, pedestrian and bicycle traffic should be separated by a height difference of 3 cm. Parking on pedestrian areas is strictly allowed only when a free surface of at least 120 cm in width remains available next to the parked vehicle. From the groups defined in the paper[8] arise 193 specific parameters that influence the quality of thepedestrian environment. Based on them, it is possible to create a model for evaluatingthe pedestrian environment because, in this way, a number of aspects that directly affectquality are covered.

8 Dragovic, D.; Krklješ, M.;Slavkovic, B.; Aleksic, J.; Radakovic,A.; Zecirovic, L.; Alcan, M.;Hasanbegovic, E. A LiteratureReview of Parameter-Based Modelsfor Walkability Evaluation. Appl. Sci.2023, 13, 4408.

3. AREA ANALYSIS

The urban planning process includes a segment dedicated to the preservation of a city's spatial resources, as well as the protection and development of public spaces. Due to the inability to rely on profit-driven investor-led construction to ensure equal access to urban services for all, this responsibility falls on the public sector. Systematic planning for public purposes must develop alongside investor-driven construction to achieve spatial balance, ensuring the city as a whole provides equal opportunities for various population groups. The urban development of Novi Pazar contradicts the contemporary approach to sustainable planning, which aims to protect the environment, reduce pollution, and decrease vehicular traffic while increasing the availability and quality of pedestrian-friendly spaces. The current pressing issue in the city is stationary traffic, which has taken priority, while the challenges faced by this particular group of pedestrians are largely ignored—highlighting a neglectful attitude toward non-motorized populations. In the city's central core, all public institutions are located within a maximum distance of 500 meters, which theoretically does not present a demanding route for pedestrians. However, along these routes, several recurring issues arise. Over the past decade, social media has played a crucial role in highlighting these problems, serving as a platform for citizens to share their opinions on the quality of pedestrian spaces and their improvement to better meet user expectations. Photographs capturing everyday life provide the most accurate depiction of the current state.

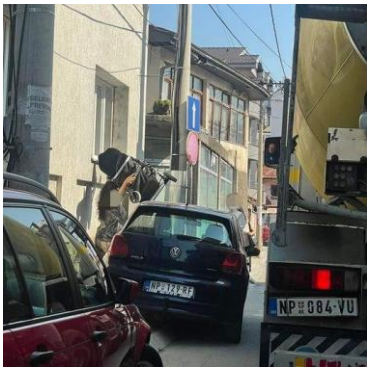




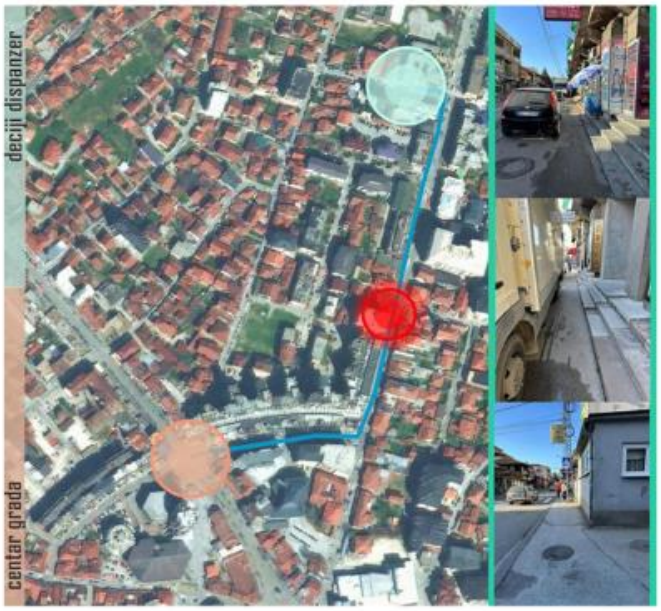
Figure 2, Figure 3: Illustrations of the condition of sidewalks in Novi Pazar from the perspective of a mother with a stroller.

3.1. Route Analysis

Although public spaces are defined by planning documentation, their formation is influenced by urban and architectural elaboration. Urban design involves the detailed development of urban parameters and rules established by regulatory plans. The selected streets for analysis connect the city center with institutions that mothers with children are most likely to visit.

3.1.1. City Center – Children's Health Center

The Children's Health Center is located at Stana Bačanin Street No. 1. The shortest distance from the city center is 650 meters via Stevana Nemanje Street, and according to Google Maps, the route takes approximately 9 minutes to walk



Factor	Rating (1-5)	Comments
Sidewalk width	2	Minimum width is only 0.80 m, which is insufficient for comfortable walking.
Obstacles on sidewalk	2	Presence of fixed barriers (kiosks, streetlight poles) and mobile barriers (parked cars).
Surface quality	4	Asphalt surface, generally stable but potential for irregularities.
Pedestrian safety	2	Lack of sidewalks on some streets and obstacles reduce pedestrian safety.
Accessibility	3	Narrow sidewalks and obstacles may hinder accessibility, but asphalt provides a smooth surface.
Green space	2	Tree lines cover only 1/3 of the route, indicating limited greenery.
Traffic and congestion	3	Presence of on-street parking may contribute to congestion.

Stevana Nemanje Street represents one of the busiest thoroughfares in the city, distinguished by its generously proportioned and comfortable sidewalks. During the urban transition of the 1970s, when traditional low-rise neighborhoods (mahalas) were replaced with modern urban blocks, low-rise structures were demolished, and multi-story buildings were constructed with regulated setbacks from the roadway. Despite these improvements, a persistent issue along this route is the obstruction caused by vehicles parked on the sidewalks, which significantly hinders the free flow of pedestrian traffic. The street's high concentration of hospitality establishments contributes to the substantial and continuous presence of people. The practice of parking on sidewalks, often accompanied by extended durations, has become a routine and widely accepted occurrence.

3.1.2. City Center – Health Center

The Health Center is located on General Živković Street. The shortest distance from the city center is 1,000 meters, following Višegradska Street and General Živković Street. According to Google Maps, completing this route requires approximately 15 minutes.

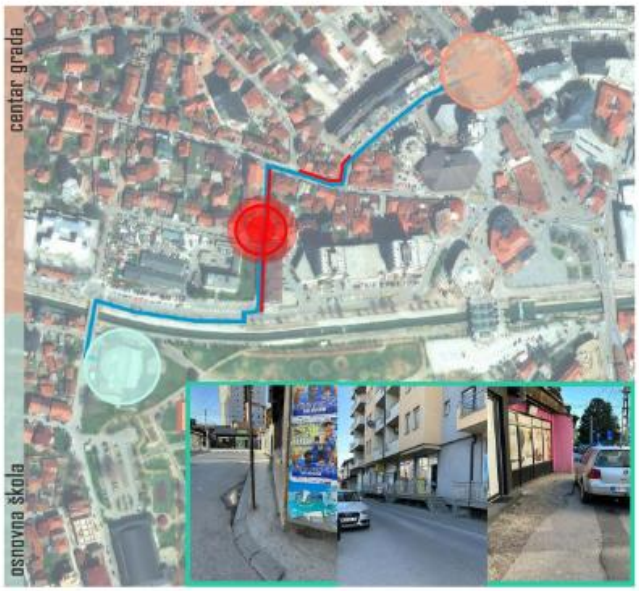
Although this route holds strategic importance, it lacks adequate conditions for the movement of mothers with strollers. Sidewalks are obstructed by various fixed and mobile obstacles, including structures, fences, garages, shops, linear infrastructure elements, and concrete planter barriers. Višegradska Street poses a high risk for pedestrian movement. Nevertheless, as the shortest route connecting the city center with the neighborhoods of Hadžet, Paralovo, and Iskra, it remains heavily trafficked.



Factor	Rating (1-5)	Comments
Sidewalk width	1	Minimum width is only 0.10 m, which is extremely narrow and inadequate for pedestrians.
Obstacles on sidewalk	2	Presence of fixed barriers (structures or parts of structures) and mobile barriers (parked cars).
Surface quality	3	Mixed materials (asphalt and paving blocks) may create an uneven walking surface.
Pedestrian safety	1	Very narrow sidewalks and obstacles significantly reduce safety.
Accessibility	2	Irregular surfaces and obstacles make accessibility difficult.
Green space	1	Tree coverage is minimal (1/5), providing little to no shade or greenery.
Traffic and congestion	2	On-street parking and limited pedestrian space contribute to congestion.

3.1.3. City Center – "Mladost" Kindergarten

One of the public kindergartens in Novi Pazar, "Mladost," is located on Lug Street, 750 meters from the city center. The route follows the streets: AVNOJ, Rifata Burdževića, Isa-beg Isakovića, and Lug. According to Google Maps, completing this route takes approximately 10 minutes.



Factor	Rating (1-5)	Comments
Sidewalk width	2	Minimum width is only 0.40 m, which is inadequate for comfortable pedestrian movement.
Obstacles on sidewalk	2	Fixed barriers (structures or parts of structures) and mobile barriers (parked cars) restrict movement.
Surface quality	3	Combination of asphalt and paving blocks may create an uneven surface.
Pedestrian safety	2	Narrow sidewalks and obstacles reduce pedestrian safety.
Accessibility	2	Limited sidewalk width and obstacles make accessibility challenging.
Green space	1	Very little greenery (1/5), providing minimal shade.
Traffic and congestion	2	Presence of on-street parking contributes to congestion and reduces pedestrian space.

The main issues along this route are:

1. Obstruction of sidewalks by structures (in certain sections, sidewalks are entirely absent due to encroachment).
2. Residential buildings that have been repurposed for non-residential uses.
3. Lack of ramps (curbs are high along most of the route to prevent parking).
4. Encroachment of sidewalks by fixed and mobile elements, including traffic signs, linear infrastructure components, concrete planters, and similar obstacles.

3.1.4. City Center – "Rifat Burdžović – Tršo" Elementary School

The "Rifat Burdžović – Tršo" Elementary School is located on Oslobođenja Street, 800 meters from the city center via Gradska Street and Oslobođenja Street. According to Google Maps, completing this route takes approximately 12 minutes.



Factor	Rating (1-5)	Comments
Sidewalk width	2	Minimum width is only 0.30 m, which is highly inadequate for comfortable pedestrian movement.
Obstacles on sidewalk	2	Fixed barriers (structures or parts of structures) and mobile barriers (parked cars) obstruct movement.
Surface quality	3	Mixed surface (asphalt and paving blocks) may create uneven walking conditions.
Pedestrian safety	2	Narrow sidewalks and obstacles reduce pedestrian safety.
Accessibility	2	Limited sidewalk width and obstacles make accessibility challenging.
Green space	1	Minimal greenery (1/5), providing little shade or natural elements.
Traffic and congestion	2	Presence of on-street parking contributes to congestion and reduces pedestrian space.

The primary challenges along this route stem from the obstruction and, in some areas, the complete absence of sidewalks due to encroachment. In front of newly constructed residential buildings, sidewalks have often been repurposed into ramps, further limiting pedestrian space. Additionally, various fixed and mobile elements, such as traffic signs, linear infrastructure components, and concrete planters, frequently disrupt pedestrian pathways, making movement more difficult and unsafe.

3.2. Analysis and Discussion of Results

In this analysis, we focused on key factors of pedestrian infrastructure in Novi Pazar, such as sidewalk width, the presence of obstacles, surface quality, pedestrian safety, and overall connectivity in the urban environment. Based on the collected data, we have identified several key findings that have significant implications for pedestrian mobility in this city.

- Sidewalk Width and Accessibility

Many streets have narrow sidewalks, creating difficulties for pedestrians, especially those with strollers, the elderly, and individuals with disabilities. In older parts of the city, limited space increases accident risks and reduces mobility quality, a problem common in other Eastern European cities.

- Obstacles on Sidewalks

Parked cars, kiosks, and urban furniture frequently obstruct sidewalks, forcing pedestrians onto the street and increasing accident risks. Similar planning issues are found in other cities in the region.

- Surface Quality and Maintenance

Sidewalk conditions vary, with central areas being better maintained than peripheral and older neighborhoods. Poor surface quality particularly affects mobility for the elderly and disabled, as noted in related studies.

- Pedestrian Safety

Inadequate lighting and poorly marked crossings increase accident risks, especially at night. Pedestrian safety is often overlooked in urban planning, making walking more hazardous.

- Connectivity

While central areas are well connected, peripheral neighborhoods face limited pedestrian accessibility, a common issue in cities with similar urban structures (Tomić, 2020).

Table 1: Table of Summarized Data

Route	Route 1	Route 2	Route 3	Route 4
Route Length	650 m	1,000 m	750 m	800 m
Maximum Sidewalk Width	2.0 m	1.0 m	1.50 m	1.20 m
Minimum Sidewalk Width	0.80 m	0.10 m	0.40 m	0.30 m
Street Without Sidewalks	x	1/3	1/4	1/2
Fixed Barriers	- Kiosks	- Structures or parts of structures	- Structures or parts of structures	- Structures or parts of structures
	- Streetlight poles			
Mobile Barriers	- Parked cars	- Parked cars	- Parked cars	- Parked cars
Material	- Asphalt	- Asphalt	- Asphalt	- Asphalt
		- Various types of paving blocks	- Various types of paving blocks	- Various types of paving blocks
Tree Lines	1/3	1/5	1/5	1/5
Street Furniture	x	x	x	x
On-Street Parking	x	1/2	1/5	1/5

The Department for Inspection Affairs of the City Administration of Novi Pazar has confirmed that it annually prepares a report on its activities. During 2021, there were 58 procedures for the clearance of public spaces and 18 misdemeanor charges filed. These figures are exclusively related to the occupation of public spaces through the placement of planters, bollards, stones, firewood, construction debris, waste, and other obstacles on public areas. However, the actual situation on the ground is different. Novi Pazar has a total of 170 streets, which practically means that there was an average of 0.34 instances of roadway, sidewalk, or other public space occupation in each street over the past year, intended for free movement and use by citizens. Visual documentation of the situation on-site tells a different story. If one were to walk through several streets in Novi Pazar in a single day, registering and counting obstacles on the sidewalks, the numbers would be quite different. There are numerous obstructions on the sidewalks throughout the city. It is evident that the construction inspection and municipal police need to operate more efficiently. The issue of parking is being addressed through the placement of barriers along the sidewalks, directing vehicles to designated parking zones. Additionally, the reconstruction of electrical and telecommunication networks is necessary to relocate utility poles. The city needs to be enhanced with tree lines and street furniture, as the previous analysis has concluded that none of the four analyzed routes feature street furniture, and only one route has 1/3 of a tree line.

4. CONCLUSION

This research has identified the influential factors affecting the quality of surfaces that are unfavorable for a specific group of pedestrians—mothers with strollers. The analyses revealed that the low quality of sidewalks is due to poor design dimensions, the unplanned placement of linear infrastructure elements, inadequate materialization of the pavement, and the encroachment of sidewalks by fixed and mobile elements. The study focused on streets that serve as connections between the city center and densely populated areas, as well as links to public facilities and various institutions. From this perspective, these are among the most important routes in Novi Pazar. Their condition was assessed as poor, making them unfavorable for the movement of mothers with strollers. Despite being considered "more organized" streets in the city, the overall situation is very poor and alarming.

Addressing this issue begins with the planned modification of street profiles, the introduction of pedestrian zones, installation of protective barriers, continuous intervention by municipal and traffic police, and the establishment of new measures to be enforced by construction inspections. However, a crucial aspect for future planning and changes is the education of the population and raising awareness about public spaces. While all the measures listed are essential, considering the very slow pace of plan revisions and implementation on the ground, it is necessary to first address these problems temporarily, as described in the previous chapter, while also working on the development of new plans that will introduce quality pedestrian pathways. Future research

will focus on further analyses and finding the best solutions for pedestrian issues, primarily for mothers pushing strollers, in the given area.

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TRENDS IN ARCHITECTURE TOWARDS A SUSTAINABLE FUTURE: MAPUTO IMPROVEMENT CENTRE, THE NEW ARCHITECTURAL CONCEPT FOR RELIGIOUS BUILDINGS

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ABSTRACT

The construction of public utility buildings in African countries has seen significant growth, leading to an increased demand for sustainable construction techniques that cater to the specific needs of the users. This study focuses on the construction of the Messianic Church in Maputo, Mozambique, highlighting the challenges faced during the design process. It aims to incorporate the aspirations of the church's congregation while reflecting the messianic philosophy, which emphasizes altruism, the beauty of nature, and the promotion of natural agriculture. The church is being built in the Alto Maé neighborhood of Maputo, where the varying terrain has allowed for the organization of different functional areas. The design and modelling of the building was developed using ArchiCAD 25. The architectural style is inspired by Mokiti Okada, the church's spiritual leader, with careful attention paid to the positioning of the building volumes. This consideration was made to optimize protection from the sun and prevailing winds, enhancing the comfort of the interior spaces. The planned building adheres to modern architectural principles aimed at promoting sustainability and prioritizing human needs. It features a multi-purpose design, ensuring that the internal spaces foster community interaction. The layout includes various interconnected areas, such as a sacred space, cultural area, children's zone, and a garden, all designed to enhance the user experience. This building aims to introduce new architectural experiences to the city, focusing on plant cultivation and vegetable gardens, while creating environments that respect and resonate with users' emotions.

Keywords: *contemporary and minimalist architecture, sustainability, Church, Maputo, Natural Light.*

1. INTRODUCTION

The architecture of cathedrals, basilicas, temples, and churches is characterized by their large size and adherence to traditional forms, functions, and styles derived from early Christianity (Hitchcock and Johnson, 1932). These buildings display complex structures that represent the pinnacle of architectural design, showcasing the talents of the finest specialists of their time. Often regarded as masterpieces of their region, these structures evoke a strong sense of pride within local communities. Many cathedrals, basilicas, and various abbey churches rank among the most significant architectural achievements in the world (Gympel and Egan, 1996).

Although Africa is rich in cultural and historical diversity, the architecture of monumental buildings, particularly churches and cathedrals, has largely been influenced by the expressions of colonizing countries. The United Nations Development Report (Baumann and Development, 2021) guides African nations in implementing the Sustainable Development Goals (SDGs), declaring this the decade for accelerating development across the

continent. Through this initiative, we aim to make a meaningful contribution to building for humanity, which in turn will influence architectural trends—moving towards a sustainable future for Africa. This project incorporates the characteristics of contemporary and minimalist architecture into the philosophy of the Messianic Church, which views humans as extensions of God, signifying that God resides within them. Consequently, the building design seeks to dismantle the traditional concept of heavy church volumes, promoting the church as a space for connecting not just with God, but also with nature, beauty, art, food, and all that surrounds us (Dos Anjos, 2013). The Messianic philosophy is rooted in spirituality based on altruism, the beauty of nature, natural food and agriculture, health, art, and culture, all aimed at creating a better world (Okada, 1980). The Maputo Improvement Centre (*in the messianic liturgy, it refers to a regional church),* project will offer unique experiences that emphasize the values and perspectives of the people using the building, as well as the natural environment around them. To take advantage of the local warm climate, the building will feature a circular façade and large windows, creating a direct connection with the surrounding environment—an aspect often absent in contemporary church designs. For example, Tadao Ando, in all his works, uses thick concrete walls to define enclosed spaces, with light serving as a critical controlling factor (Ando and Frampton, 1990).

To complement the concept of contemporary architecture, the Maputo Improvement Centre project will address the challenges encountered in its design, capturing the aspirations of the church's faithful while reflecting the local culture and embodying the Messianic philosophy. Therefore, this study aims to develop a building that contributes to the contemporary and minimalist architecture movement. Seeking to add a pillar in architecture, (holistic and transcendental) to introduce into Mozambican society, especially in the city of Maputo, a religious building focused in the human search for truth, goodness and beauty.This article is structured as follows: the second chapter reviews existing literature; the third chapter outlines the methods used; the fourth chapter presents the results; the fifth chapter discusses the findings; and the sixth chapter offers conclusions and final remarks.

2. LITERATURE REVIEW

Contemporary architecture is defined by trends that reflect the social, cultural, technological, and environmental changes of recent decades (Carlson, 1971). Some of its main characteristics include technological innovation, sustainability, minimalism, integration with the environment, form and functionality, flexible spaces, experimental aesthetics, geometric forms, use of glass and transparency, and an eclectic, globalized style (Carlson, 1971). Minimalist architecture, on the other hand, is characterized by simple, functional design, emphasizing simplicity and the elimination of superfluous elements (Sözmener, 2012). Its key characteristics include: wide open spaces, clean lines and geometric shapes, use of natural materials, a neutral color palette, elimination of ornamentation, integration with the environment, and a focus on functionality (Vesper, Butterfill et al., 2010).

Tadao Ando's Church of Light in Osaka, Japan, completed in 1989, is one of his best-known works. Ando employs only three materials—concrete, glass, and light—but orchestrates them in such a way that the space appears both heavy and ethereal (Andō, 1995). Here, light becomes a tangible architectural feature; unlike many modern structures that rely on artificial lighting, this church uses only natural light to shape the spatial experience (Baek, 2009). For Ando, light is not merely a design element; it is a material in its own right (Ando and Frampton, 1990). The São Francisco de Assis Church, designed by Óscar Niemeyer, is one of the most emblematic works of his career and is located in Belo Horizonte, Brazil. The church merges elements of modernist architecture with a profound connection to spirituality and symbolism (Martínez, Muñoz et al., 2019). This church exemplifies how Niemeyer reinterpreted religious architecture, blending modernism with spirituality in an innovative manner. Its fluid forms, use of reinforced concrete, and integration with the landscape have established it as a landmark in both Brazilian and global architecture (Comte, 2003). It is evident that, while both buildings are contemporary, Ando's Church of Light makes a bold departure from traditional church architecture, whereas Niemeyer combines modernity with tradition (Turkienicz, Mayer et al., 2015). The Church of St. Anthony, designed by Portuguese architect Álvaro Siza Vieira, is another significant work of modernism with unique characteristics that reflect the architect's sensibility and style. Completed in 2004, located in Figueira da Foz, Portugal, the church features elements that blend modernity and tradition while maintaining a strong connection to its context and landscape (Sampaio, 2015). For Siza, the church arose from a rigid and abstract concept that emphasized order and programmatic clarity, considering both its immediate surroundings and its relationship with the historic environment (Soares, 2002). Álvaro Siza has

stated, “Without being a monumental church, it is a church with a strong presence in the neighborhood. But it is silent, without imposing itself” (Testa, 1984). In one of his iconic projects, the Barcelona Pavilion, Mies van der Rohe created a testament to the power of simplicity. Rather than relying on the grand designs of historic architecture, Van der Rohe focused on clarity and minimalism. The Pavilion’s geometry is direct yet powerful; it consists of a simple rectangular plane intersected by perpendicular and parallel planes (Vesper, Butterfill et al., 2010). Mies van der Rohe stated, “Architecture is the will of an era translated into space.”

While these projects have introduced innovative combinations of materials, shapes, and forms, it remains unclear how they can be integrated into African culture, which has deep ties to nature. This study aims to address this gap by incorporating these design approaches to create spaces that foster a stronger connection to God and nature through messianic philosophy.

3. RESEARCH METHODS

3.1. Case study description

The present project is located in Alto-Maé “A” neighborhood, in the city of Maputo (Mozambique),according to the figure (a), is an old area of the city with a important historical and cultural value, (Municipio_Maputo 2008). however, close to the project area, this Located at Estrela Vermelha Market, which, due to its characteristics, conveyed to the neighborhood that it was a dangerous, disorderly and very dirty area. After purchasing the building, members of the church began cleaning the area's access roads and distributing flowers, including the market area. Months later, the area was classified in 2023 as the cleanest neighborhood in the city of Maputo. And with this feeling, the church's faithful represented bay Minister Paulo de Paula e Souza (*Minister and Vice President of the World Messianic Church of Mozambique, a category that can be compared to a religious pries*), decided to build a Maputo Improvement Center. Thus, this project aims to respond to the urban requalification of the area as well as planning and Management of Public Spaces, (de Camargo 2011) taking into account that it is a public building for religious purposes. When it is completed, it will bring a new urban Landscape to this area, us demonstrated in figure (b).

3.2. Data collection

The approach and type of research was descriptive and analytical research, in which we described the current state of contemporary and minimalist architecture, especially religious buildings. On the other hand, we used facts and information already available and analyzed them in order to make a critical assessment of the information. The following scientific methods and techniques were used for the research:

Monographic Method or Case Study, according to (Sgarbieiro and Bourguignon 2011) this method is based on the principle that any case that is studied can be representative of many others and consists of the study of certain individuals, professions, conditions, institutions and groups, with the aim of obtaining generalizations.

For approval of the project in the municipality of Maputo, several conditions were required, whereby surrounding neighbours were interviewed about the relevance of the project as well as the influence of construction that could affect their homes. That is why it was necessary to topographically survey the land and pathologically survey the surrounding buildings. Interviews with the project's key interlocutors, like representatives of the church and the community leadership of the blocks.

The work was processed with the aid of computerized cartographic material, using the following computer packages: Excel, Office word document, Scanning, for the textual information and for the modelling and imaging software was, sketchup, enscape, and ArchiCad.

4. RESULTS

This project integrates the aspirations of the church's congregation while embodying a messianic philosophy that emphasizes altruism, appreciation of nature, and the promotion of natural agriculture. These ideals are expressed through two dimensions that align with the Messianic vision, which is holistic and transcendental.

The central organization of the church is structured into three functional zones: the ground floor is primarily social, focusing on messianic practices and user interactions; the first floor is dedicated to sacred activities,

including Johrei; and the third floor serves administrative functions. This modern principle is realized through the careful organization of the building's layout. As shown in Figure (c), we aimed to incorporate aspects of the sacred into daily life to elevate the consciousness of believers. This includes activities such as tree planting, an art gallery featuring local artists, the production and sale of natural agricultural products accessible to the public, a small library, floral art and natural agriculture classes, and a canteen offering organic food. Figure (g) illustrates these concepts, particularly with the inclusion of colored glass or fiber in the tower's walls. The tower, which begins in Figure (j) and ends in (h), creates a unique interaction between natural light and the internal environment of the altar. Additionally, for the Maputo Improvement Center, we focused on connecting with nature. The design maximizes the small plot by building upwards and incorporating a vertical garden, as depicted in Figures (i) and (j). In this church, we aimed for the integration of natural light to play a central role in the main nave. This element is both functional and symbolic. The design allows natural light to enter in a manner that is bright, clear, and illuminating. In the morning, light streams through the large span of windows in the front façade Figure (i), while in the afternoon, it illuminates the nave through a crescent-shaped glass tear, demonstrated in Figures (k) and (m). This feature creates a thin arch in the ceiling, symbolizing the connection with the Creator exalted by Johrei, *a spiritual practice of the World Messianic Church founded by the Japanese Mokiti Okada (Meishu-Sama) in the early 20th century. Johrei is a spiritual purification technique aimed at transmitting divine energy to eliminate impurities and promote well-being* (Dos Anjos 2013). In Figures (c), (d), (f), and (h), elements such as the organic and curved form contribute to a cozy and serene atmosphere, while still retaining religious symbolism. Similarly, the Improvement Center strives for integration with its surroundings, albeit somewhat distinctly, presenting a calming urban intervention. The design consists of two geometric shapes—a cylinder and a rectangle—combined with expressive forms to harmonize with the surrounding landscape. The use of large windows and an unobstructed view of the sky enhances the sense of immersion in the environment.

5. DISCUSSION

This project focuses on two key premises of messianic philosophy, holism and transcendentalism, and the findings are tested its scientific relevance by comparing with previous studies. The design incorporates the concept of the capulana, a traditional fabric from Mozambique that holds deep cultural, social, and symbolic significance. More than just a piece of cloth, the capulana represents identity, tradition, and communication among people. In this context, the project utilizes glass or fiber pieces with geometric patterns and vibrant colors that convey spiritual and ancestral meanings. This reinforces local cultural identity and fosters a connection between art and nature, creating a mystical and contemplative atmosphere. It also emphasizes religious symbolism and the connection to the divine, echoing the approach of Niemeyer in the Church of St. Francis of Assisi (Pawson, 2010).

When discussing the connection with nature, it is a common characteristic in the works of the messianic church. This fusion of an inter-religious enclosure with nature is exemplified by the Temple of Sacred Ground in Guarapiranga, São Paulo, Brazil (Weinfeld, 2012). This temple is built in the shape of a ring, supported by 16 pillars that stand 18 meters tall, representing all the directions of the world. Its ceiling is the sky, and its walls are the surrounding natural landscape (Castro, 2020).

The concept of vertical gardens, popularized by French architect Patrick Blanc, is also relevant here. A pioneer of modern vertical garden techniques, Blanc developed this idea during the 1980s and 1990s, implementing an innovative system of vertical panels where plants grow in special substrates with automated irrigation. He believed that incorporating vegetation on building façades could enhance urban environments, making cities greener and more sustainable (Tabb and Deviren, 2017). Beyond aesthetic and decorative appeal, vertical gardens—illustrated in Figure (g), can improve air quality, reduce noise pollution, and contribute to thermal insulation in buildings, thereby helping to regulate internal temperatures in urban spaces (Blanc, 2008).

Another important aspect is the integration of natural light. Glass is extensively used, particularly on the front façade of the main nave, to create a sense of openness and transparency. This design allows for greater interaction between internal and external spaces (Malan and Bredemeyer, 2002). The Church of Light features an iconic glass cross on the wall, which receives direct light from outside, seemingly ‘breaking’ the solidity of the concrete (Baek, 2009). Niemeyer’s Church of St. Francis of Assisi exemplifies a combination of modernist architecture with religious symbolism and integration with its surroundings (invalid citation; Oliveira, 2018; Martínez, Muñoz et al., 2019). Similarly, Siza Vieira's St. Anthony's Church presents a blend of modernity and tradition, maintaining a strong connection to its context and landscape (Sampaio, 2015). Both churches have

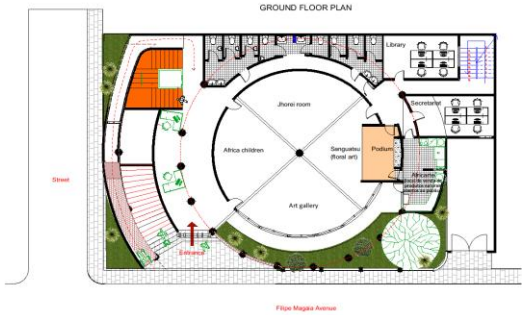
been designed to harmoniously integrate with their urban and natural contexts, reflecting a commitment to respecting the environment and the surrounding landscape.

The seventh concept focuses on organic and curved forms. The fluid and innovative internal space is characterized by circular and rectangular shapes that connect seamlessly, a hallmark of Niemeyer's style. Soft, organic lines replace rigid geometric shapes, creating an impression of movement and lightness. The center features a substantial cylinder that resembles a dome, inspired by the dome of the Church of St. Francis of Assisi, which appears to float above the space (Turkienicz, Mayer et al., 2015). While this study emphasizes the seven principles of contemporary and minimalist architecture mentioned above, it also includes an additional principle of adaptability, inspired by the approach of Behet Bondzio Lin Architekten in the Seed Church in Guangdong, China. This principle reflects the need for flexibility and multifunctionality in a constantly changing world (Davis, Christodoulou et al., 2011).

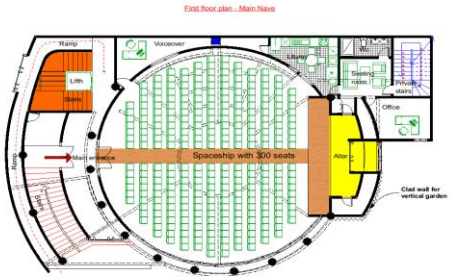


(a)

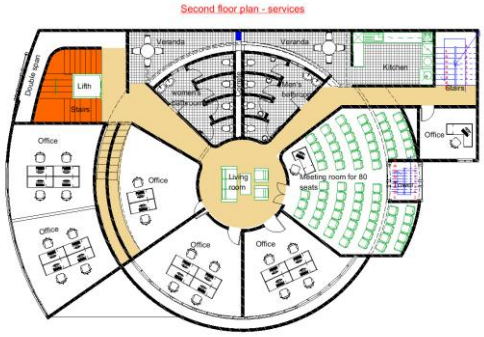
(b)



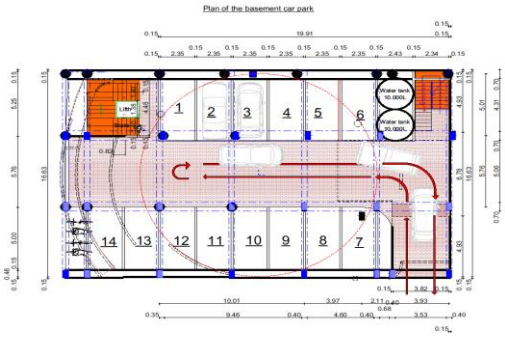
(c)



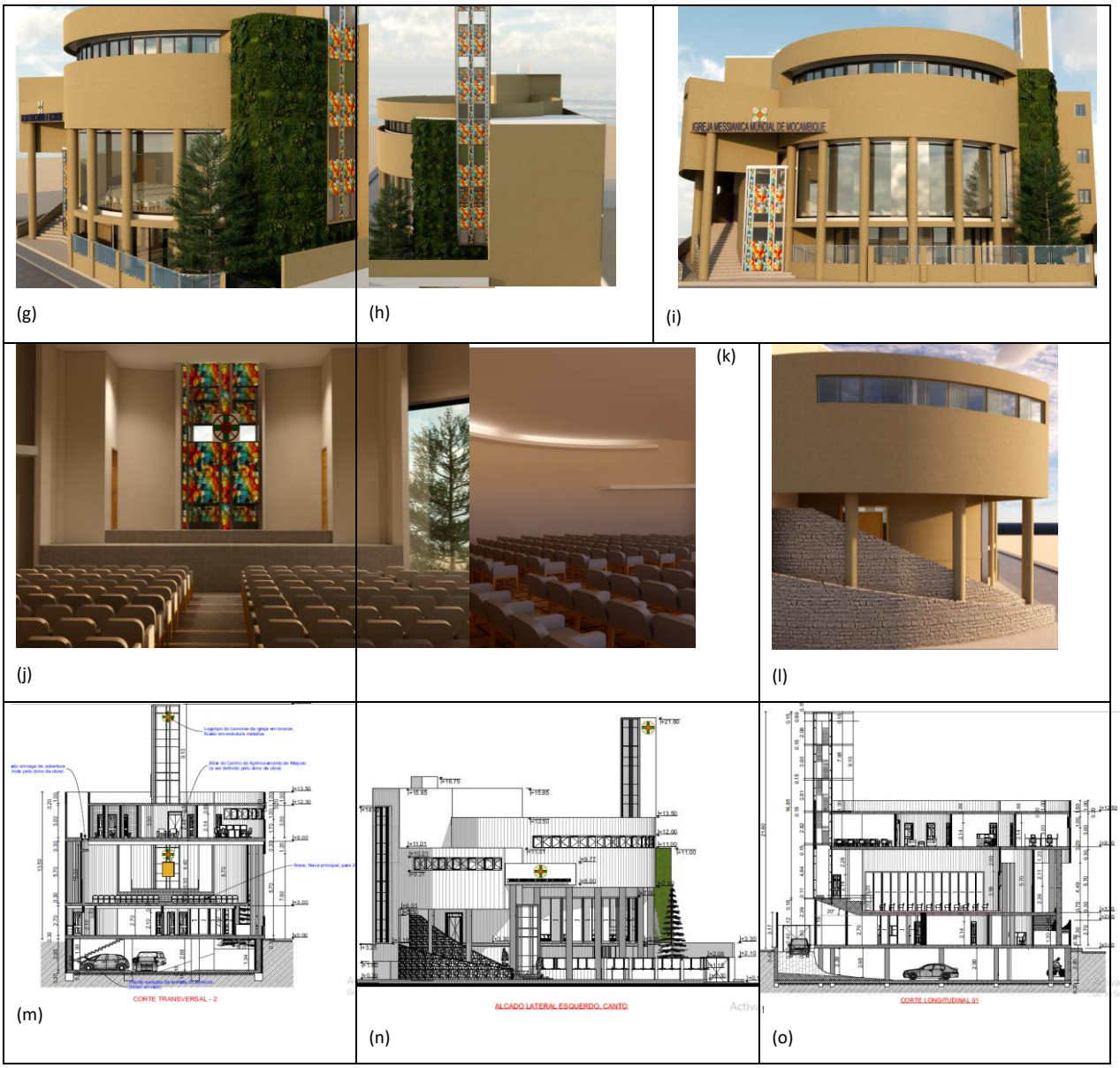
(d)



(e)



(f)



(g) (h) (i) (k) (j) (l) (m) (n) (o)

IMAGES RESULTING FROM THE MODELLING OF MAPUTO IMPROVEMENT CENTRE BUILDING.

Figure (a), location of the Alto Maé neighbourhood; Figure (b), location of the Maputo Improvement Centre and urban setting; Figure (c), ground floor plan; Figure (d), first floor plan (main nave); Figure (e), second floor plan; Figure (f), basement parking plan; Figure (g), image of right side perspective; Figure (h), Axonometry general view, Figure (i), perspective front view; Figure (j), interior image, nave and altar; Figure (k), interior image nave showing natural light entering through the ceiling; Figure (l), left side view, showing the stone on the stairs and ramp; Figure (m), Cutaway of the detail of the light entering from the ceiling; Figure (n), Left side elevation; Figure (o), cutaway showing the nave's double span.

6. CONCLUSIONS

This study aims to contribute to the understanding of contemporary architecture by introducing a new trend for public and religious buildings. This trend is referred to in the article as holistic and transcendental architecture. It arises from the challenges faced in the design process, incorporating the aspirations of the church's faithful as reflected in local culture. This approach externalizes the messianic philosophy, as taught by Mokiti Okada, which emphasizes that the Messianic Church is not merely a religion but encompasses a broader spiritual experience. This understanding guided us to create a building that embodies the holistic and transcendental movement. In addition to these characteristics, we prioritize adaptability, flexibility, and multifunctionality in the project. With this vision for the church, we believe it is possible to establish a strong urban presence that defines new territorial coordinates, transforming a “destroyed and forgotten” place into a hub that unites social and religious life. In this way, we aim to recover the iconographic value and centrality of

the church within the urban fabric, allowing its impact to permeate the surrounding area and become an emblematic reference for the neighborhood—a new point of interest. Ultimately, what was once absent gives way to presence, facilitating the reconnection of the city's structure. The church becomes a participant in the city, and conversely, the city becomes a participant in the church.

ACKNOWLEDGMENTS

I would like to express my heartfelt gratitude to everyone who contributed to the preparation of this project. First and foremost, I want to thank the World Messianic Church of Mozambique, particularly Minister Paulo de Paula e Sousa. I would also like to extend special thanks to Dr. Clássio João Mendiate, Virgílio Tamele, Pedro Cardoso, Emídio Chissano, Pedro Malite, and Faizal Julay for their enriching discussions. As well as to Elton Xavier Gomes, Taiguara Ramos da Costa, Ruben Helder Mario Joaquim Vicente and LDM Company, for the preparing the structural rendering and modalation, always broadened my perspectives on the project. I would also like to thank minister Nerino Monteiro for clarifying and supporting some church nomenclatures.

Finally, I would like to thank my children and friends for their emotional support and encouragement throughout the development of this work. Without their support, this project would not have been possible.

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CHALLENGES OF VALORIZING CITY INFRASTRUCTURE AS CULTURAL HERITAGE

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ABSTRACT

This paper addresses the urban infrastructure as a platform that can overcome the natural-urban dichotomy. Abandoned railway infrastructure is recognized as one kind of architectural feature representing this separation. Successively, environments are examined through the prism of 'first nature', which exists outside human influence, and 'second nature', representing the human-made landscape. Contemporary circumstances raise questions regarding the character and programming of a 'third nature', responding to today's urban lifestyle. The hybrid relations are examined, in which architecture becomes a new complex ECO system – a cyborg of nature and culture. Through a case study conducted at the Old Railway Bridge in Belgrade, the city is intervened through the programmatic and spatial articulation of the phenomenon that can be defined as 'Emerging Heritage', problematizing the treatment of the insufficiently recognized legacy of the Industrial Revolution. The research and project development were implemented with a group of master's students from the University of Belgrade - Faculty of Architecture. The students were tasked with exploring how infrastructure can become a catalyst for a sustainable future, focusing on three key aspects – ecologically restorative, culturally rich, and socially just. Through the review of the students' works, possible interventions will be shown concerning the interpretations of the project brief and the site context. Architecture is positioned as a tool for questioning the present and shaping the future, opening up broader critical themes related to ecologically-driven design while addressing the economic, ethical, social, and other values inherent in the practices of hybrid natures in the city.

Keywords: *cultural heritage; industrial heritage; emerging heritage; city nature; ecological niche; city infrastructure*

1. INTRODUCTION

The condition of abandoned and inherited urban infrastructure testifies to the underdeveloped strategies for its treatment. Contemporary issues concerning the ecological sphere, economic sustainability, and social inequality highlight the need to approach them rather from these very same perspectives. Referring to the UN Blueprint of 17 Sustainable Development Goals[1], design concepts for possible interventions at the site of abandoned railway infrastructure in Belgrade have been developed. The location of the Old Railway Bridge in Belgrade was chosen for the case study. This significant infrastructural structure is viewed as a testing ground for research. Recognizing both opportunities and challenges, students responded with original and alternative solutions that align with new interdisciplinary approaches to architectural design. This urban experiment aims to reassess the potential for the alternative use of infrastructural objects as elements for the broader recovery and resilience of the city.

The term 'alternative' refers to solutions that deviate from the discourse of the previous railway bridge's primary function. Developed concepts are used to reanimate this dormant space, responding to today's

1 THE 17 GOALS | Sustainable Development. (n.d.). https://sdgs.un.org/goals

problems. In the context of climate uncertainty, anthropocentric visions of spatial production have been abandoned, and instead, the inherited structure is considered in terms of spatial reorientation (Janković, 2024). Ephemeral structures have been explored, which should occupy or parasitize the site, akin to a new naturalness that creates a kind of cyborg of inherited and new structures. However, when discussing terms such as occupation or parasitism, it is important to emphasize that they refer to relationships of mutual symbiosis (Gissen, 2009). Revival here targets issues such as recycling, improving air quality, creating hybrid habitats for birds, or for example, exploring the potential of river algae, among others.

The proposed solutions result from student projects developed within the course in the third semester of the master's program. The course was organized as a workshop, where results were assessed and monitored. The stripped-down structure of the bridge served as a framework or shell for an ecosystem to be conceived within or around this iconic example of Belgrade's industrial heritage. The project brief recommended considering the bridge's structure as an integrative architectural element, given its evolution over time into an urban landmark and a significant historical symbol. Any negation of this structure would depart from the fundamental intent of viewing inherited infrastructures as sites of new possibilities. The projects will be presented in this article through an overview of student works, where a quantitative and qualitative analysis will be conducted to assess their responsiveness to the assigned aspects of contemporary issues. The primary aspects considered are ecological justification, cultural richness, and social equity.

The innovative concepts developed during the course of the study transform elements of heavy industry into elements of the creative industry. By utilizing the old bridge structure, processes of recycling, reuse, and repurposing are simultaneously activated, all with the aim of achieving a sustainable future for this urban artifact. The main idea behind the project assignment was to make the heritage elements constituting the bridge structure visible, presented, and accessible to a specific target user group. The interpretation of the inherited structure aligns with approaches to the creative interpretation of heritage—creating a cyborg of what is preserved with what is newly constructed. Although it can be debatable whether this mode of exhibiting heritage departs from traditional museological principles, it is important to recognize that the authentic heritage substance is preserved, inherently conveying information about the past.

2. BACKGROUND AND METHODS

Firstly, it should be started with a brief historical overview related to the chosen location. As previously mentioned, the subject of the project and research task was the Old Railway Bridge in Belgrade. What undoubtedly makes this city train road a cultural heritage is its rich historical background which will be presented briefly. Secondly, innovative methods in the treatment and approach to project and research tasks of this delicate sphere of cultural heritage will be explained below.

2.1. Historical context and Spatial framework

The old railway bridge was built in 1884 which makes it the oldest existing bridge in Belgrade. It was built as a road on the former border between Serbia and Austria-Hungary (*Beogradski mostovi – od oblica do pilona* [Bridges of Belgrade – From Logs to Pylons], n.d.). The construction of the bridge represented the establishment of a route toward developed Europe, positioned along the path of the Orient Express[2]. This broader context of social, geopolitical, and cultural frameworks defines the bridge as a significant example of industrial heritage—one that also conveys a message of modernization, progress, and sustainable social development. It can be said that this bridge also has a history of discontinuity as it was demolished and reconstructed multiple times due to the circumstances of the world wars (*Most koji je Srbiju šinama spojio s Evropom* [The Bridge That Connected Serbia to Europe by Rails], n.d.). The symbolically proposed revival interventions would go hand in hand with this cyclical life of the structure, emphasizing its resilience and ongoing transformation.

With the next phase of urbanization, which took place during the period of the Second Yugoslavia, Belgrade acquired a new modern railway bridge, which largely assumed the burden of railway traffic. Despite this, the Old Railway Bridge continued to serve as an auxiliary crossing until June 2018, when it was officially decommissioned. According to the urban planning documents, the Old Railway Bridge should not be classified as an endangered heritage, because its revitalization is envisioned as part of future development plans.

2 In 1885, the route through Vienna, Budapest and Belgrade to Niš was put into traffic.

Speaking about the spatial scope, we refer to a structure approximately 377 meters in length, a height of around 12 meters, and featuring a single railway track. These grand dimensions, along with its persistence for over 140 years, certainly categorize this infrastructural facility as one of the urban landmarks. As an indispensable element of the city's visual identity, this truss structure embodies the imprint of industrial development and stands as a testimony of the past. This imprint in time provides certain predispositions both formally and contextually. The patinated truss structure permeates every project, making it impossible to deny it. The bridge thus becomes a center for the heritage industry—a sector that merges creative industries with heritage values. Former symbols of the Industrial Revolution, such as coal and steel, are now transforming into ecological oases, embodying Mumfordian visions of the future that propagate the development of industry as a creative process (Popadić, 2015).

2.2. 'Cyborgization', Ecology and Heritage

The role of techniques and technologies is recognized as a heritage value primarily of Western civilization in modern times (Popadić, 2015). A UNESCO study from 2001 raised questions regarding the recognition of this type of heritage, marking the beginning of its revaluation (Falser, 2001). Perhaps the turn of the millennium itself represents a pivotal moment in the industrial revolution, as it transitioned to a more cybernetic level. In this sense, 'cyber' denotes something originating from the artificial or digital realm (Popadić, 2015). The transition from one stage of the revolution to another leaves behind memories that require processing.

Popadić (2015) introduces the concept of 'heritage cybernetics,' which serves as a platform for organizing multilayered activities in the treatment of heritage. The process of 'cyborgization' of heritage stands as the core intention of each proposed design solution, in order to achieve a contemporary interpretation of this more recent heritage. The message conveyed by bridging reflects traces of communication and connection. This concept is also considered in the contemporary context, where strategies for bridging green corridors are developed. These strategies consist of integrating environmental elements or, conversely, setting the frameworks for entirely new machine systems aimed at urban recovery. The regeneration of the inherited structure should once again invite the city's inhabitants, reinstating it as a place of passage. This passage may be physical, from one side to the other, but also more spiritual—a transition from one level of awareness to a higher one. By raising awareness of ecological issues, cultural diversity, and social equity, sustainable development is achieved.

Repairing the devastation of this structure represents only one aspect of revitalization. It is equally essential to address all other ideas related to the repurposing of this urban infrastructure. Repurposing is not viewed merely as a process of altering usage and functionality, but also as a shift in the perception of how certain spaces are valorized. The concept of ecology should be viewed beyond just the natural environment, emphasizing the interconnectedness of different dimensions – 'three ecologies', of human existence that are reflected through cultural heritage (Guattari, 2014). The definition of 'emerging heritage' is based on the evolution of the understanding of this matter throughout the 20th and 21st centuries, increasingly advancing concerning the valorization of cultural assets influenced by the speed at which changes and social transformations are performing nowadays (Emerging Heritage – HERSUS Sharing Platform, n.d.).

The repurposed bridge should be seen as a living infrastructure with a broader range of new meanings and values. According to Janković (2024), new models of use encourage the fragmentation of urban spaces and greater extraction of urban experiences, generating dynamic spaces with never fully enclosed modes of use. By reconsidering new forms of utilization, infrastructure development simultaneously fosters a reassessment of user communities, their mutual interactions, and their experiences in redefined public spaces. These new spatial models exist on the boundary between formality and informality. Fragmentation and modularity create urban forms that can be adapted and transformed as needed, with the bridge serving only as a predefined framework. These proposed interventions can be interpreted as designed informality within the formal constraints of spatial possibilities.

2.4. Methodology

Since architectural design is a complex process involving the abstraction of concepts of liveness, and ideas are often difficult to express in words, it was decided to use art-based methods (Tarr et al.,2017). The research was designed as a case study within which a workshop was conducted with architecture students as participants. Workshops possess methodological potential as a dynamic approach that could combine case studies with design studios, field studies, and site visits. In that way, participants become directly engaged with

old building practices and deepen their valorization of heritage and sustainable values (Yunxuan et al., 2025). The workshop took place during the first half of the semester as part of the design studio course in the second year of the master's program. The tasks of the workshop were precisely and systematically designed to achieve relevant results—i.e., outcomes that could be compared and analyzed. In contrast, the students' responses, in the form of proposed project solutions, were monitored and developed spontaneously followed by productive discussions. In order to define the methodology, the protocol is best described as a case study within which a professional workshop was conducted. The subject of the case study research is the previously mentioned Old Railway Bridge in Belgrade. Through discussions with students, various topics were processed, including sustainability, the future of the city, and the broader contextual environment. On the one hand, ecological issues emerged as a distinct concern; on the other, questions of social equity arose, alongside the aspiration to integrate infrastructure into cultural trends. The UN 17 Sustainable Development Goals Blueprint was set as a starting point for developing concepts. Based on the analysis of the student's work, the objectives were synthesized and classified into three clusters of the UN blueprint: (1) ecologically restorative; (2) culturally rich; and (3) socially just. Once the key objectives to which students responded with their proposed concepts were profiled, these goals were used as analytical aspects for reviewing the projects in this article.

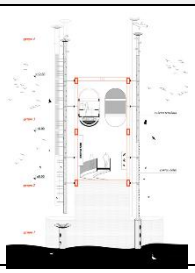
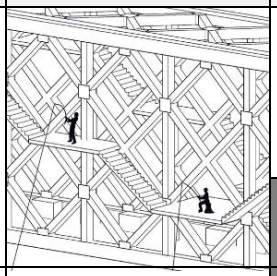
3. RESULTS AND DISCUSSION

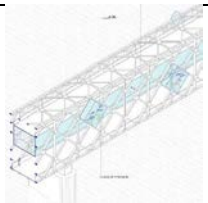
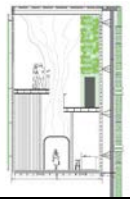
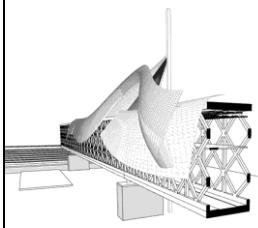
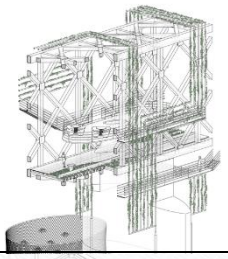
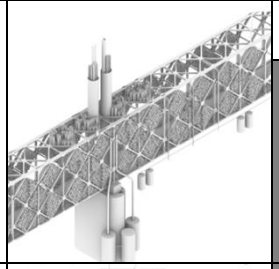
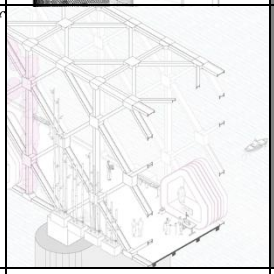
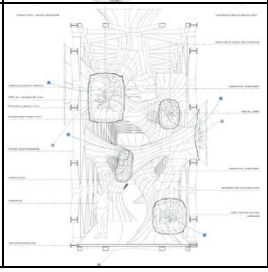
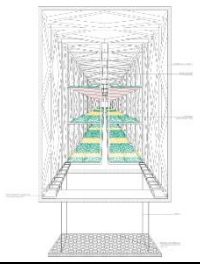
The analysis results indicate that all the examined proposed concepts predominantly covered the three targeted aspects. The project proposals mutually differ in terms of the level of elaboration in specific areas. The reviewed works have all, in terms of creativity, successfully addressed the theme. Around 30% of the students predominantly focused on the ecological aspect of the work. The social aspect, in approximately 60% of the cases, is associated with high grades in the cultural domain, and vice versa. This result supports the common idea that cultural heritage is a social problem, and we all have witnessed some cases of the management of heritage value in conflict with contemporary community life (Landorf, 2009). It is also observed that high percentages in the cultural domain often cause low scores in the ecological sphere. The level of elaboration in all three areas was highly achieved in four student works, while minor discrepancies were recorded in the remaining design solutions. When observing the first column, which addresses the ecological sphere, six projects placed ecological values at the forefront. It is noticeable that in five projects when ecological values are prioritized, there is a tendency for social issues to be addressed to a lesser extent.

A high percentage is recorded in the columns representing cultural richness, which may indicate that this aspect is the driving force behind interventions in the subject field. Additionally, there is a noticeable tendency that when cultural richness is emphasized, there is a significant decline in the other aspects. This observation may suggest that cultural richness is in disproportionate relation or inverse correlation with the aspects of ecological and social sustainability. This finding may indicate traditions from the past where it used to be common to draw distinctions between nature and culture, arising partly out of a desire to control the environment (Pretty et al.,2009).

The following section presents the results in a schematic form, illustrating the score to which the set goals were achieved, as assessed based on the monitoring of the workshop process.

Table 1: Review of student projects

Code	*Project name, Keywords, Author*	*Illustration*	*ER* *	*CR* **	*SJ* ***	*Code*	*Project name, Keywords, Author*	*Illustration*	*ER* *	*CR* **	*SJ* ***
PP01	*Migratory station* *bird rescue, endangered species, seasonal migrations* *Aleksa Vučković*					*PP02*	*Hook bridge* *sport fishing, fish market, fishing* *Anđela Borić*				
PP03	*Aquarium of the Sava River*					*PP04*	*CHLORO NEXUS*				

	city aquarium, fish spawn, presentation of the river *Đurđa Petković*				*river health, algae, water purification* *Emanuela Ilić*			
PP05	*Cycle corridor* *cycling, connection, City routes* *Emilija Petrović*				*PP06* *Triathlon bridge* *recreation, sports infrastructure* *Jovan Popović*			
PP07	*Ornitorium* *tropical birds, tropical vegetation, ornithological station* *Kosta Đurić*				*PP08* *Aquaponic garden* *aquaponics, water purification, river resources, cultivation of herbs* *Kristina Kotorčević*			
PP09	*Climate shelter* *city cooling, refreshment, urban oasis, ceramics* *Lana Trajković*				*PP10* *Breaking the cycle of homeless* *inclusive design, transitional shelters, modular housing systems, urban resilience* *Milica Perić*			
PP11	*Membrane memory* *air pollution, air purification, HEPA filters, Bernoulli grip* *Slađana Lukić*				*PP12* *Oasis in motion* *artificial islands river greening restoring land* *Tamara Kuzmanović*			

Legend: PP - Project Proposal; * ER - Ecologically Restorative; ** CR - Culturally Rich; *** SJ - Socially Just

When analyzing individually, the results that show interesting tendencies in the development of concepts will be highlighted. Among the first, the work under code PP01 demonstrates an example of a highly developed concept in the ecological sphere. The bridge is considered as a temporary habitat for migratory birds, thus representing an urban point along the annual migration route of birds. The entire concept carries a high level of cultural wealth, educating people about the bird species passing through the city. The bridge is positioned as a symbol for the preservation and observation of birds. A lower grade was given in the social sphere, as the concept does not provide sufficient insight into how broader social issues are addressed. The designed ecosystem does not have a significant impact on issues from this cluster, such as the primary goals of poverty or hunger prevention, etc.

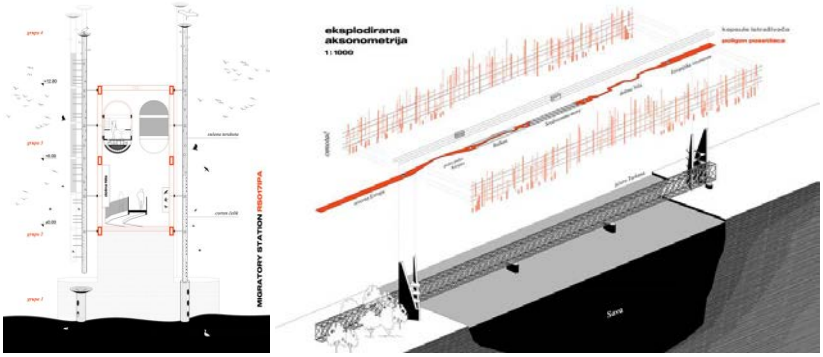


Figure 1: (a) Migratory station - Section, and (b) Migratory station - Axonometric view

An example of the work under code PP03 represents a typical example of a concept with a high level of cultural diversity, which is disproportionate to the other aspects, particularly the ecological sphere. The Aquarium of the Sava River is a concept aimed at presenting river aquatic life. The solution is highly attractive and educational in itself, but we might say that sustainability issues are placed on a lower level. A sustainable system for the realization of such a potential project and its ecological impact and footprint has not been deeply considered. Apart from its ideas of accessibility and educational character, there is no greater influence on social issues. It can be said that this example most clearly reflects the impact of highly attractive projects driven by cultural popularity, where the influence on other spheres is often sidelined.

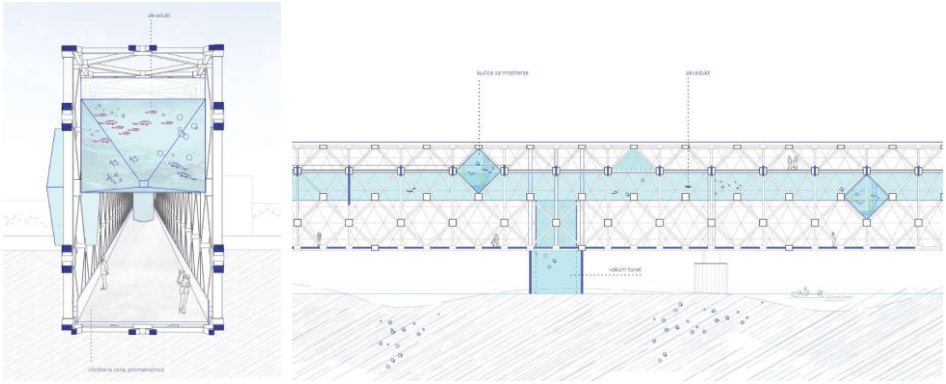


Figure 2: (a) (b) Aquarium of the Sava River – Section

The work under code PP10 perhaps best demonstrates the integration of the three considered aspects into a single cycle, where each intervention brings with it a solution from different approaches, aspects, and disciplines. If we consider poverty as the driver of this work, the bridge is taken as a suitable location for shelters. Life in this community is designed through a series of activities that encourage users to engage in recycling, craftsmanship, and art. Finally, the cycle concludes with the use of accumulated textile products as part of permaculture for greening the bridge.

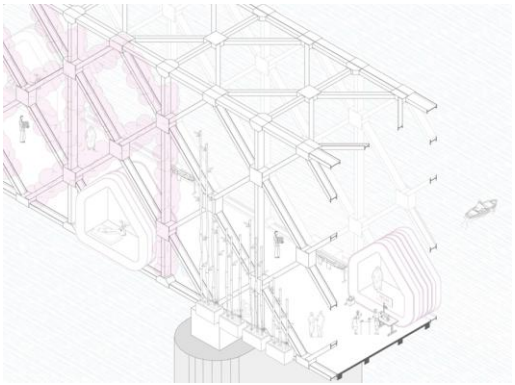


Figure 3: Breaking the cycle of homeless

An interesting example, primarily from the field of technological advancement and a form of 'cyborgization' of cultural heritage, is seen in the work under code PP11. A system for purifying urban air has been developed. The bridge's position, located on natural wind currents, is identified for the installation of a massive membrane operating on the principles of a filter and Bernoulli's tube. This interesting concept is situated in the field of technological innovation, but in addition, it also holds aesthetic and sculptural value as a new urban landmark. In this way, the concept achieves high marks in all three fields, starting with ecology as the driving force, followed by cultural diversity, and ultimately, broader social significance.

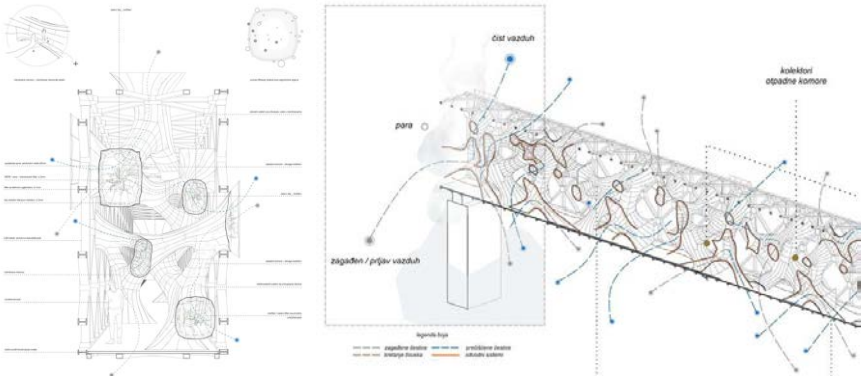


Figure 4: Membrane memory

By comparing the highlighted examples, it can be concluded that three categories have emerged that characterize each proposed solution. These are:

- Program and content
- Technological advancement
- Aesthetic values

Therefore, we can classify the works as follows: under the first point, the works guided by this category are PP 1, 2, 3, 5, 6, 7, and 10. Solutions in the field of technological advancement were sought in the works under codes PP 4, 8, 9, 11, and 12. Aesthetic values are an important part of each proposed solution, but they are especially prominent in the works under codes PP 1, 6, 9, 10, and 12.

4. CONCLUSIONS

Analyzed student projects show a high level of creativity which indicates a wide range of opportunities for repurposing abandoned urban railway infrastructure. In the context of 'third nature' responding to contemporary urban lifestyle and perception, project solutions experiment with innovative and alternative approaches to the design process. The innovative concepts developed during the course of the study transform elements of heavy industry into elements of the creative industry by a holistic approach that combines utilizing the old bridge structure, processes of recycling, reuse, and repurposing, and all with the aim of achieving a sustainable future for this urban element. Profiliated spheres of interventions cover ecological restorative, culturally rich, and socially just aspects referring to the UN Blueprint of 17 Sustainable Development Goals. The protocol of the conducted methodology is best described as a case study within the workshop, design studio, and field studies. The results of the workshop with students were actively tracked and valorized. Approximately 30% of students focus primarily on the ecological aspect. In about 60% of cases, strong social aspects were accompanied by high scores in the cultural domain, and vice versa. However, high scores in the cultural domain often correlate with lower scores in the ecological sphere. Comparing the highlighted examples, three key categories were identified as essential components of each proposed solution: (1) Program and content, (2) Technological advancement, and (3) Aesthetic values. Overall, the analysis reveals the potential of architectural workshops as educational, scientific, and professional practices to foster innovative concepts that balance sustainability, social equity, and cultural richness.

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3D BUILDING MODELS GENERATION FROM AIRBORNE LIDAR AND PHOTOGRAMMETRY DATA

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ABSTRACT

This paper considers procedures and software tools for generating 3D models of buildings using airborne laser scanning and aerial photogrammetry data.

Various software tools, such as Agisoft Metashape and DJI Terra, can be used for generating 3D point clouds and 3D meshes using photogrammetry and computer vision techniques. 3D point cloud can be used as a geometric reference for 3D modelling of buildings. Other solutions are based on extracting building footprints and calculating building heights necessary for 3D buildings extrusion. Advanced algorithms enable more or less automatic generation of 3D building models with varying Levels of Detail (LOD), with LOD2 providing sufficient representation for urban planning and visualization without capturing intricate architectural details. Additional editing of obtained models is required if high-quality models are required.

The research is focused on assessment of different procedures and tools in terms of their efficiency and the quality of the reconstructed 3D models. Applicability of different approaches for generating city-wide 3D models of buildings is also considered. Therefore, the main objective of this study is the assessment of the effectiveness and efficiency of various tools in automating the process of generating 3D building models from diverse data sources. This assessment is based on processing the data captured for selected study areas by using different tools and procedures.

Data preprocessing involved point cloud classification, with a focus on the roof and terrain classes, which are critical for model generation. Following classification, points were clustered to represent individual buildings, resulting in the creation of 3D building models.

Keywords: *3D building modelling; airborne laser scanning; photogrammetry; automation*

1. INTRODUCTION

3D building models are widely used in urban applications. The results of these applications serve as inputs for planning and decision-making processes aimed at making cities cooler, more sustainable, greener, better accessible, and CO_2-neutral (Biljecki et al. 2016). Building models can be generated at different Levels of Detail (LoD) according to the CityGML standard (OGC 2012): LoD0, LoD1, LoD2, and LoD3 for the building's outer shell, and LoD4 for its interior (Figure 1). A higher Level of Detail (LoD) is preferred over a lower one, as higher LoDs more accurately represent reality. However, higher LoDs are significantly more complex to reconstruct automatically from source data, as well as more time-consuming and expensive than lower LoDs. Usually, LoD2 provides sufficient representation for urban planning and visualization without intricate architectural details.

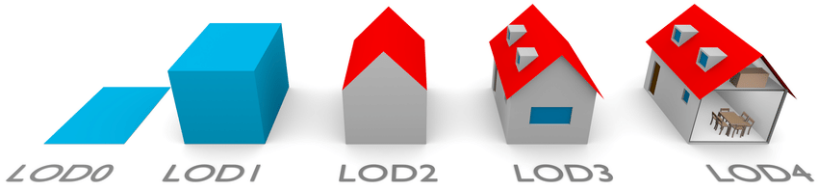


Figure 1: The geometric detail and the semantic complexity increase, ending with the LOD4 containing indoor features (Biljecki et al. 2016)

A LoD1 model for each building can be automatically generated relatively easily from 3D point clouds and 2D building polygons, i.e., footprints (Ledoux et al. 2021). With respect to LoD2 models, many roof shapes can be generated fully automatically. However, LoD2 reconstruction remains an active research topic, as both the quality of available survey data and new 3D reconstruction algorithms continue to improve (Rottensteiner et al. 2014; Pârvu et al 2018). Additional elements for LoD3 models are extremely difficult to reconstruct automatically. Therefore, these are either generated manually or derived from converted IFC models from the BIM domain (Colucci et al. 2020).

2. RELATED WORK

3D building models can be generated using various techniques. These models can be purely artificial, such as design models created by using computational geometry (procedural modelling), e.g. Building Information Modelling (BIM) models. More realistic models can be obtained by using remote sensing techniques for data acquisition and tools for processing the data and creating building models.

Airborne LiDAR (Light Detection and Ranging) is fast and accurate active remote sensing technique for mapping Earth topography, and obtained results are in form of 3D point clouds (Mallet 2011). These point clouds represent the external surfaces of objects or structures in great detail. Buildings are usually extracted from these 3D point clouds by points that do not belong to the vegetation and ground. Reconstructing buildings from point cloud data involves specialized techniques designed to account for the regular and deliberate nature of architectural structures (Brenner et al., 2001). When using aerial images, building models are most commonly generated by using photogrammetry and/or computer vision methods such as *Structure from Motion* (*SfM*) to extract 3D point cloud or to create 3D mesh (Ullman et al. 1997). Hybrid approaches are based on combination of airborne LiDAR and photogrammetry methods.

One of the techniques used to automatically generate 3D building models is procedural modelling, which is based on computer graphics and refers to several techniques for creating 3D models and textures using predefined rules, combined with the randomization of some parameters (Tekavec et al. 2020). This technique is especially useful for creating large-scale urban environments where manually modelling each structure would be too time-consuming. Most recent approaches are learning-based which reconstruct buildings as 3D polygonal meshes from airborne LiDAR point clouds (Liu et al. 2024). In their research, a neural network-based generative model named Point2Building was developed to directly generate 3D polygonal meshes from input 3D point clouds, addressing the diversity of shapes as well as inhomogeneous and incomplete object coverage. When sufficient 3D data is unavailable to generate a LoD model, a method was proposed that uses 2D aerial images and building footprints, along with a machine learning technique (random forest), to predict building height and extrude it vertically to create LoD models (Biljecki et al. 2017). Some of authors used combination of *SfM* method with deep-learning-based segmentation techniques (Pantoja-Rosero et al. 2022). Here, using a multiple-view images of a building, a three-dimensional (3D) planar abstraction (LoD2 model) was generated using *SfM* technique. For obtaining LoD3 models, deep learning was applied for semantic segmentation of windows in the two-dimensional (2D) images and applied to LoD2 models. Before this research, a group of authors already used a deep neural network to generate LoD3 models from LiDAR-based LoD2 by detecting

windows and doors in rectified images using bounding boxes and adding them to the model (Hensel et al. 2019).

3. MATERIALS AND METHODS

3.1. Study Area

For this study, data were collected using a drone DJI Matrice 350 RTK equipped with a DJI Zenmuse L2 sensor. This sensor features a frame LiDAR and a 4/3" CMOS RGB mapping camera with 20 megapixel resolution for efficient geospatial data acquisition. Data collection took place in February 2024 in a part of the Palilula municipality in Belgrade (44°48'45.4"N 20°28'38.7"E). For this research, only a block of buildings between streets Stanoje Glavaša, Draže Pavlovića and Velbuška was analyzed (Figure 2). This study area contains up to 30 tall buildings.



Figure 2: Block of buildings from municipality Palilula used as a study area – highlighted red (Google maps 2025)

The collected data were processed and saved in the WGS 84/UTM zone 34N (EPSG: 32634) coordinate reference system. This included directly georeferenced images and a georeferenced LiDAR point cloud. The flight mission was conducted at a height of 80 meters above ground, resulting in a *Ground Sampling Distance* (*GSD*) of 2.3 cm.

A total of 945 images were captured over the study area from both nadir (vertical) and oblique viewpoints, taken from two orthogonal directions. This flight strategy was used to avoid occlusions in the urban environment. However, only 499 images were used for processing, as they specifically covered the block of buildings of interest. The LiDAR point cloud density in open areas was approximately 2,000 points per square meter.

3.2. Software tools for 3D point cloud extraction and 3D mesh generation from aerial imagery

Photogrammetry workflow is similar for DJI Terra (DJI Terra 2025) and Agisoft Metashape Pro (Agisoft Metashape 2025). In DJI Terra this process is called 3D Reconstruction. First, photo alignment is performed using Bundle Block Adjustment (BBA) along with image tie point detection to obtain precise image positions and orientations. This step is carried out even if the system has already collected precise RTK and IMU positioning data. After that, dense point cloud generation is performed. This 3D point cloud could be later used for 3D mesh generation while high quality texture is taken from images. 3D mesh could be also generated directly from depth maps created during dense point cloud generation. The obtained 3D mesh is valuable for the subsequent generation of building models with different LoDs (Pantoja-Rosero et al. 2022). In this paper, 3D meshes generated using different software tools will be compared in terms of texture quality, level of detail, and fidelity.

The 3D mesh created using this approach is suitable for later simplification, manual editing, or serving as a base for constructing 3D building models. Starting with a detailed mesh and then simplifying it can reduce model

complexity, making it easier to handle. This process often involves reducing the polygon count while preserving key features. Once the basic mesh is obtained, it can be manually edited and refined to enhance details such as windows, doors, and textures. When used as a base for 3D building models, the mesh acts as a 'skeleton' onto which specific architectural elements, materials, and other details can be added.

3.3. Software tools for generating building models from LiDAR 3D point cloud

Another approach to generating building models is using a 3D point cloud as a data source. This method is commonly applied in architecture, urban planning, construction, and industries such as heritage preservation and gaming. In this process, a classified 3D point cloud (ground class) is used for terrain modelling, typically involving the extrusion of building footprints to determine the actual height of buildings. Additionally, the point cloud can be clipped using building footprints to separate individual structures. This isolates the point cloud for each building footprint, allowing it to be modelled into 3D solids.

Several software solutions can be used for this purpose, but for this paper, Feature Manipulation Engine (FME) by Safe Software is used. In this software, the Digital Terrain Model (DTM) is created as a Triangular Irregular Network (TIN) using points classified as terrain. Building models are generated by using building footprints and performing extrusion from the terrain surface to the building height for LoD1.

4. RESULTS

4.1. Comparison of software tools for mesh generation from aerial imagery

Point cloud generation from available imagery for study area was performed specifying a similar point count and density, and 3D mesh creation was carried out with a comparable triangle count. This approach allows for assessing which software provides higher detail and better occlusion avoidance when generating the mesh. Additionally, quality of the texture was evaluated and compared. The high-quality texture is especially important for further refinement and model correction.

The generated meshes were compared using CloudCompare software (CloudCompare 2025). Some differences were detected, particularly when viewing the model from the side and focusing on the building facades. In certain areas, the textured mesh appears deformed, especially near terraces and balconies, with this effect being more pronounced in the mesh generated by Agisoft (Figure 3).



(a) (b)

Figure 3: (a) Textured mesh of the building facades created using DJI Terra, and (b) created using Agisoft Metashape Pro

This issue primarily arises due to occlusions in the surfaces that need to be reconstructed. Lowering the drone to capture additional images from the sides of buildings or in inaccessible areas is particularly challenging due to GPS signal reception issues in these areas. However, 3D meshes generated from vertical images generally do not face these issues—roofs are well-reconstructed, and the texture quality obtained from both software solutions is good, though slightly better for those obtained from DJI Terra (Figure 4).

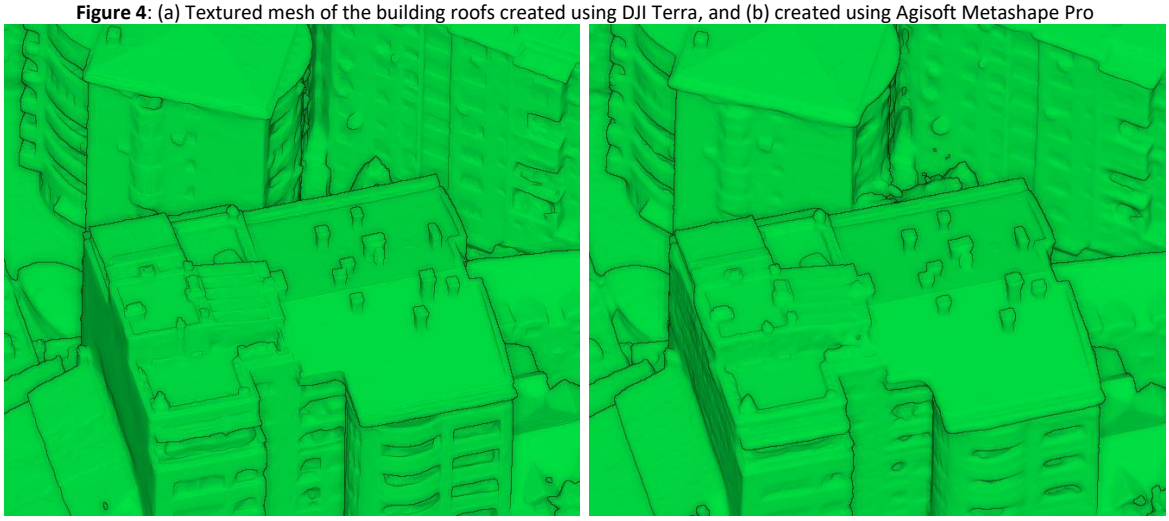
Another difference between these software tools can be observed in the level of detail and mesh morphology when examining the shaded models. The mesh generated with DJI Terra exhibited finer morphological details compared to the one created with Agisoft Metashape (Figure 5).

There is a difference of 39 378 triangles between the mesh created in Agisoft Metashape Pro (610 355) and the one generated in DJI Terra (570 977). It is not possible to assign the exact number of triangles for the mesh to be generated.



(a) (b)

Figure 4: (a) Textured mesh of the building roofs created using DJI Terra, and (b) created using Agisoft Metashape Pro



(a) (b)

Figure 5: (a) Shaded mesh of the buildings created using DJI Terra, and (b) created using Agisoft Metashape Pro

As it can be seen from the mentioned comparations, DJI Terra produces mesh with better texture, morphological details and less deformations when compared to the mesh generated in Agisoft Metashape Pro. This statement agrees to some extent with the conclusions from research papers where these and similar software solutions are compared (Jarahizadeh and Salehi 2024).

Another aspect of comparison was the time required for mesh generation in each of the software solutions (Table 1). The table presents the time needed for *Aerotriangulation* and *3D Reconstruction*. In both software, the *High* processing option was used for these steps. DJI Terra required nearly 10 minutes more than Agisoft Metashape Pro.

Table 1: Time needed for mesh generation in DJI Terra and Agisoft Metashape Pro

Software	*Aerotriangulation / Photo Alignment*	*3D Reconstruction*		
		Point Cloud Generation	*3D Mesh Generation*	*Texture Building*
DJI Terra	*02min 39s*	*Total: 46min 22s*		
Agisoft Metashape Pro	*02min 54s*	*20min 53s*	*13min 08s*	*02min 33s*
		Total: 36min 34s		

4.2. Evaluation of software tools for generating building models from LiDAR 3D point cloud

For this purpose, building footprints were extracted as separate clusters of points, each representing a building. The building height was determined by subtracting the average roof height from the surrounding terrain. Using several functions available in FME, a 3D model was generated in the form of a Triangulated Irregular Network (TIN) from points classified as terrain and buildings, represented as LoD1 models—simple solids without roof details (Figure 6). This is a basic 3D city modelling, which can be performed automatically in FME using the provided data.



Figure 6: LoD1 3D modeling using functions incorporated in FME (red represents the terrain, while grey represents the buildings)

5. DISCUSSION

As observed, the mentioned photogrammetry software tools produced similar results in generating high-quality 3D meshes suitable for further 3D modelling of buildings. DJI Terra provides a slightly better building models in terms of texture quality and fidelity (morphological detail and fewer deformations) compared to the one created in Agisoft Metashape. Additionally, the Agisoft mesh contained slightly more triangles than the DJI Terra mesh, which is not in favour of Agisoft. The difference in the level of deformations and morphological details is quite noticeable, especially in areas with windows, terraces, and balconies. This could be due to DJI Terra being optimized for drone flight missions using the drone systems developed by the same company. DJI also offers a software solution called DJI Modify for modifying 3D meshes, but this was not tested in this research. Agisoft, on the other hand, offers more options for adjusting the processing level, which could potentially lead to better mesh quality, though this would likely extend the processing time. Regarding processing time, Agisoft performs slightly faster, but DJI Terra provides an all-in-one processing step, making it much more intuitive.

In this study, the automatic generation of building models from a 3D point cloud was achieved, but only for creating LoD1 building models. This serves as a good starting point for further detailing into LoD2 and LoD3, either manually or with advanced algorithms.

6. CONCLUSIONS

The results of this study demonstrate that both photogrammetry tools produced comparable, high-quality 3D meshes, making them suitable for further 3D modelling of buildings. However, DJI Terra has a slight edge in texture quality and fidelity of building models, particularly around windows, terraces, and balconies, likely due to its optimizations for the drone system used. All of these factors should be considered when further refining and converting the model in higher LoD.

For the scale of this project and the number of images involved, Agisoft required slightly less processing time than DJI Terra. Both software solutions offer unique advantages—DJI Terra provides an intuitive all-in-one processing step and Agisoft offers more customizable processing options.

While the automatic generation of building models from a 3D point cloud is feasible, it is currently limited to LoD1 or, at best, LoD2 models. Generating LoD2 models becomes particularly challenging when roofs are too complex or when multiple buildings are merged. Future research should focus on using deep learning techniques to segment windows in images and project them onto 3D models to achieve LoD3 model of buildings.

ACKNOWLEDGEMENTS

The authors are thankful to the Ministry of Science, Technological Development and Innovation of the Republic of Serbia for their support under research project No. 2000092.

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ICUP2025
5th international conference on urban planning

PREDICTING URBAN LAND COVER CHANGES BASED ON DATA-DRIVEN MODELS

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ABSTRACT

Urban Land Cover Changes (ULCC) refers to the modifications in physical characteristics of the Earth's surface and the human-made structures, as urban landscapes evolve over time. Understanding of ULCC is pivotal in powering urban Green Agenda initiatives as well as combating climate changes and preserving biodiversity. This research showcases the Data-Driven Spatial Planning possibilities through predicting the land cover distribution of Belgrade's urban area in the following decades. The proposed approach is based on non-guided "trend" urban development, which aims to capture the historical trend and then apply it to predict possible future scenario. The proposed methodology has been successfully utilized to predict LC maps over the Belgrade metropolitan area for years 2030 and 2040. The subsequent analysis highlighted trends to be expected in the following decades. As expected, an intensive urbanization and increase in artificial surfaces is expected, mostly on account of agriculture and high-vegetation areas. Obtained results provide spatial planners and policy makers with an efficient tool for informed decision-making, predictive analysis, efficiency improvement and sustainability.

Keywords: *Urban land cover changes; data-driven spatial planning; random forest; Belgrade metropolitan area;*

1. INTRODUCTION

Urban Land Cover Changes (ULCC) are a complex interplay of physical transformations and human activities. ULCC usually refers to the modifications in physical characteristics of the Earth's surface and the human-made structures, as urban areas evolve over time (Wu et al., 2021). Such complex interplay of natural transformations and human induced pressures ultimately affects climate parameters on different scales and has great environmental and socioeconomic implications. These include the loss of natural and close to nature elements, increased effects of heat islands and frequency of flash floods which cumulatively have negative effects on economic growth. Thus, understanding of ULCC is pivotal in powering urban Green Agenda initiatives as well as combating climate changes and preserving biodiversity (Amini et al., 2022).

Traditionally, ULCC are guided and controlled through a variety of planning documentation. There are numerous challenges and problems that can arise during the development and implementation of a city's planning documentation, including insufficient data, financial constraints, environmental challenges, public perception, and trust issues (Al-Baai et al., 2023). Remote Sensing and Data-Driven Modelling allow for the alleviation of these problems. Remote sensing enables high-quality and very detailed observation of ULCC even for decades ago, both at the global, national and regional levels. Such historical datasets provide input for Data-Driven Modelling in order to forecast what tomorrow's urban land cover will look like, by analyzing historical data and forecasting future changes in urban land cover patterns, environmental impacts and urban growth (Islam et al., 2021; Samardžić-Petrović, 2014). This "look into the future" is particularly useful for monitoring the process of urbanization, providing an efficient tool for its channeling through timely action and reducing unwanted effects.

This research showcases the Data-Driven Spatial Planning possibilities through predicting the land cover distribution of Belgrade's urban area in the following decades. The proposed approach is based on a non-guided "trend" urban development, which aims to capture the historical trend and then apply it for predicting possible future scenario.

2. METHODOLOGY

2.1. Study Area

The study area is the whole Belgrade metropolitan area covering 3,235 km^2 (Figure 1.). Belgrade is the capital and largest city of Serbia, serving as its administrative, economic and cultural center. Located at the confluence of the Sava and Danube rivers, the city lies on the border between Central Europe and the Balkan Peninsula, at the heart of the geographical region known as Southeast Europe.

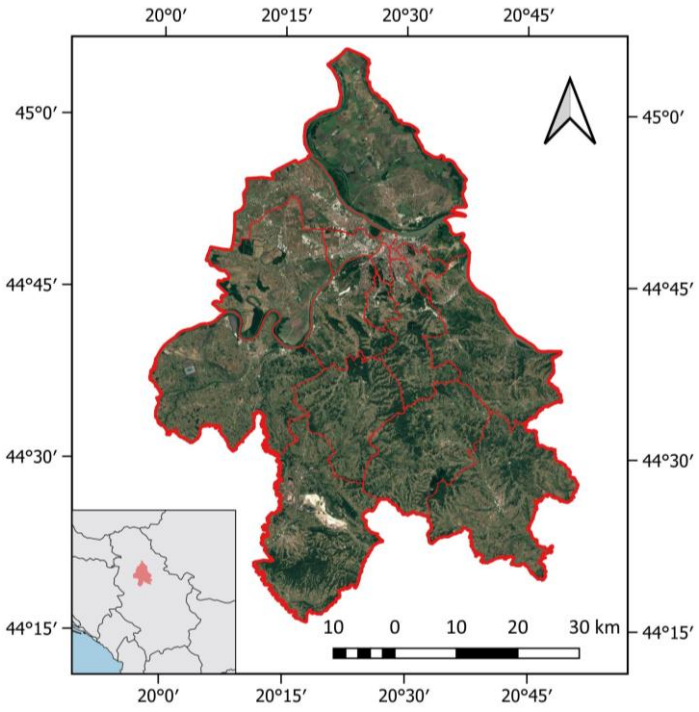


Figure 1: Study Area – Belgrade metropolitan area (basemap Google Satellite®)

Belgrade metropolitan area has a diverse landscape, including high-density urban areas, industrial complexes, riverbanks, forested areas and parks. Its spatial structure is characterized by continuous urbanization, with significant expansion of built-up areas in recent decades, particularly in suburban settlements. According to the last three censuses, the population of Belgrade has steadily increased, from 1,576,124 inhabitants in 2002, to 1,659,440 in 2011, and 1,681,405 in 2022 ("Republički zavod za statistiku Srbije", 2025). This continuous population growth, along with economic development and infrastructure expansion, has led to substantial changes in land cover and land use patterns. Belgrade's geographical location and climate play a significant role in shaping its urban dynamics. The city experiences a temperate continental climate, with hot summers and strong, predominantly Carpathian winds (Košava) during winter. The annual average precipitation in Belgrade is approximately 680 mm, with rainfall fairly evenly distributed throughout the year. The highest amounts occur in spring and autumn, while summers tend to be drier.

In addition to its rapid urbanization, Belgrade serves as a major transportation hub, with an extensive network of roads, railways, and an international airport that facilitate both national and international connectivity. The city's strategic location, combined with its expanding infrastructure and urban growth, makes it a key center for economic activities in the region. Furthermore, Belgrade holds significant historical, cultural, and architectural value, with a rich heritage reflected in its monuments, historical sites, and urban development. These factors, alongside the challenges posed by rapid urbanization, underscore the need to study urban land cover changes and plan for sustainable urban growth.

Given these circumstances, the Belgrade metropolitan area provides an ideal case study for analyzing urban land cover changes through remote sensing and data-driven modelling.

2.2. Data and Methods

Random forest is used as a backbone method to predict ULCC. Random Forest is an ensemble learning technique that constructs and uses multiple decision trees and aggregates their outputs to improve classification accuracy and reduce overfitting (Breiman, 2001). The algorithm operates by randomly selecting subsets of training data and features to build each tree, ensuring diversity among the individual trees in the forest. During classification, each decision tree independently predicts a class label, and the final classification result is determined by majority voting among all trees (Belgiu and Drăguţ, 2016). This approach enhances model stability and reduces its sensitivity to noise, making it particularly effective for handling large, complex datasets with high-dimensional feature spaces. Due to its robustness and ability to capture nonlinear relationships, Random Forest has been widely applied in remote sensing and land use change studies, where it has demonstrated high classification accuracy compared to traditional machine learning methods (Rodriguez-Galiano et al., 2012).

The CORINE Land Cover (CLC) dataset, which provides a pan-European overview of land cover changes from 1990 to 2018 at a spatial resolution of 100 m, was used as the main input for the analysis and modelling. The CLC maps from 1990 to 2018 were visually inspected over study area and then generalised into six key land cover types: agriculture, artificial surfaces, water, grassland, low-vegetation and high-vegetation. Beside CLC maps, additional publicly available data sources were used as auxiliary data. These include traffic infrastructure, demographics, administrative divisions, distance from water and natural areas and terrain data. The complete list of predictors and their sources are shown in the Table 1.

Future LC prediction model is defined in a form to capture trend of ULCC occurring in the 10 years' time. The proposed ULCC model assumes that the historical ULCC will enable capturing the trend of the changes, which will be then employed to predict future LC maps. This means that the proposed approach assumes that observed trends will also be present in the future. This can be formalised in following:

$$\mathbf{LC}_{\mathrm{FUTURE}} = \mathbf{LC}_{\mathrm{PRESENT}} + \mathbf{LC}_{\mathrm{BEFORE}} \qquad (\text{Eq.1})$$

Future predictions were made stepwise and in a 10-year interval. First, all historical CLC maps are used to test and validate optimal RF model (training on 1990-2000 and validating on 2012). After that, future predictions are determined in two steps: years 2012-2018 to predict 2030 and then years 2018-2030 for 2040 prediction.

Table 1: Predictor variables and their sources used for future ULCC prediction

Type/Source	*Predictor*	*Years*
Land Cover – CORINE (Büttner et al., 2021)	*Land Cover*	*1990, 2000, 2012, 2018*
Traffic data - Open Street Map (Contributors, 2025)	*Distance from railways and trams*	*present*
	Distance from railways	
	Distance from trams	
	Distance from all roads	
	Distance from motorway roads	
	Distance from primary and trunk roads	
	Distance from secondary roads	
	Distance from tertiary roads	
Population data – Statistical office of the Republic of Serbia ("Republički zavod za statistiku Srbije", 2025)	*Population count*	*1990, 2000, 2012, 2018, 2040 (estimate)*
Administrative areas – Republic Geodetic Authority Serbia ("Otvoreni podaci | Geosrbija", 2025)	*Municipalities*	*present*
	Settlement	
Terrain characteristics – Copernicus DEM (Copernicus Data Space, 2025)	*Elevation*	*present*
	Slope	
	Aspect	
	TPI	
	TRI	
	Roughness	
	Flow direction	
Water and protected areas (Contributors, 2025; "Otvoreni podaci | Geosrbija", 2025)	*Water areas (True/False)*	*present*
	Distance from water areas	
	Protected areas (True/False)	
	Distance from protected areas	

3. RESULTS AND DISCUSSION

The results indicate that significant changes in the representation of land cover types are expected in the Belgrade metropolitan area from 2018 to 2040 (Figure 2. and Figure 3.). The representation of water, grassland and low vegetation will change slightly. The changes are most evident in the case of agriculture, artificial surfaces and high-vegetation (Table 2.). The representation of high-vegetation is expected to decrease by over 1%, which in 2018 occupies 31.63%, while in 2040 the representation of 30.39% is predicted. At the same time, the representation of areas for agriculture is lower by almost 1.3% and it will decrease from 48.12% in 2018 to 46.91% by 2040. The decrease in these land cover types is primarily a consequence of intensive urbanization, which is reflected in the of artificial surfaces from 13.37% to 15.93%. This increase in the proportion of artificial surfaces by one fifth represents the most pronounced change expected in the observed period.

Degree of changes of LC classes also varies over time (Figure 4.). The period 1990-2012 shows a strong change, where mostly conversion of agriculture to artificial surfaces happens. The next period 2012-2018 displays mostly minor LC changes. Then, in the period of 2018-2040, stronger changes are expected again. This includes mostly substitution of agriculture and high-vegetation by artificial surfaces, where majority of these changes will occur by 2030 and the remaining smaller part by 2040.

Table 2: Representation of land cover classes in the Belgrade metropolitan area from 1990 to 2040

Land cover class	*1990*	*2000*	*2012*	*2018*	*2030*	*2040*
Agriculture	*52.50%*	*51.61%*	*48.16%*	*48.12%*	*47.11%*	*46.91%*
Artificial surfaces	*10.24%*	*11.44%*	*13.37%*	*13.37%*	*15.53%*	*15.93%*
Water	*2.87%*	*2.86%*	*2.91%*	*2.92%*	*2.87%*	*2.86%*
Grassland	*1.34%*	*1.18%*	*1.24%*	*1.17%*	*1.11%*	*1.11%*
Low-vegetation	*1.74%*	*1.41%*	*2.82%*	*2.79%*	*2.79%*	*2.80%*
High-vegetation	*31.32%*	*31.49%*	*31.49%*	*31.63%*	*30.59%*	*30.39%*

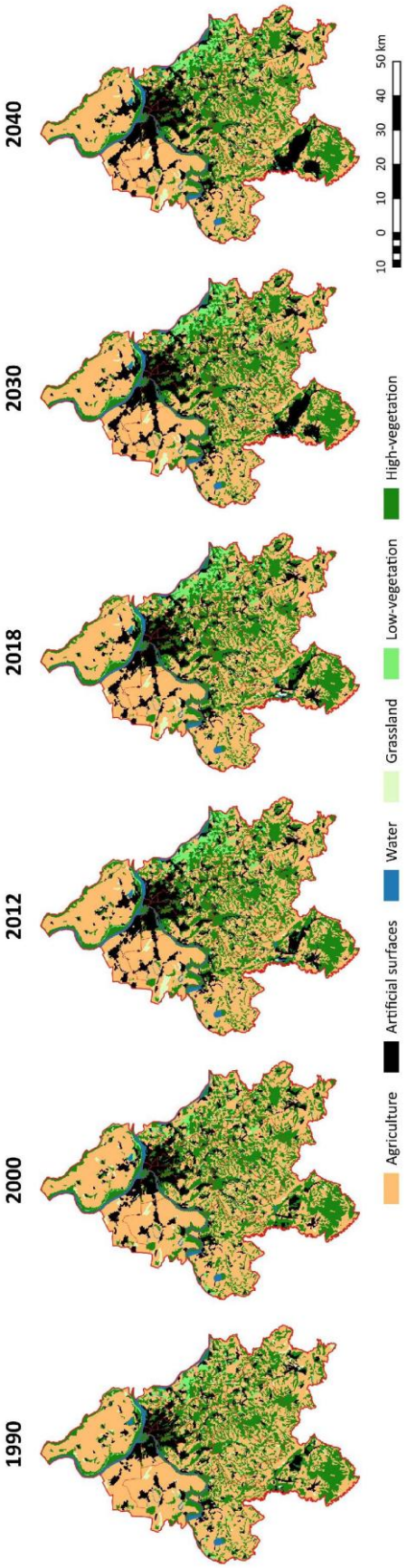


Figure 2: Land cover maps over the Belgrade metropolitan area from 1990 to 2040

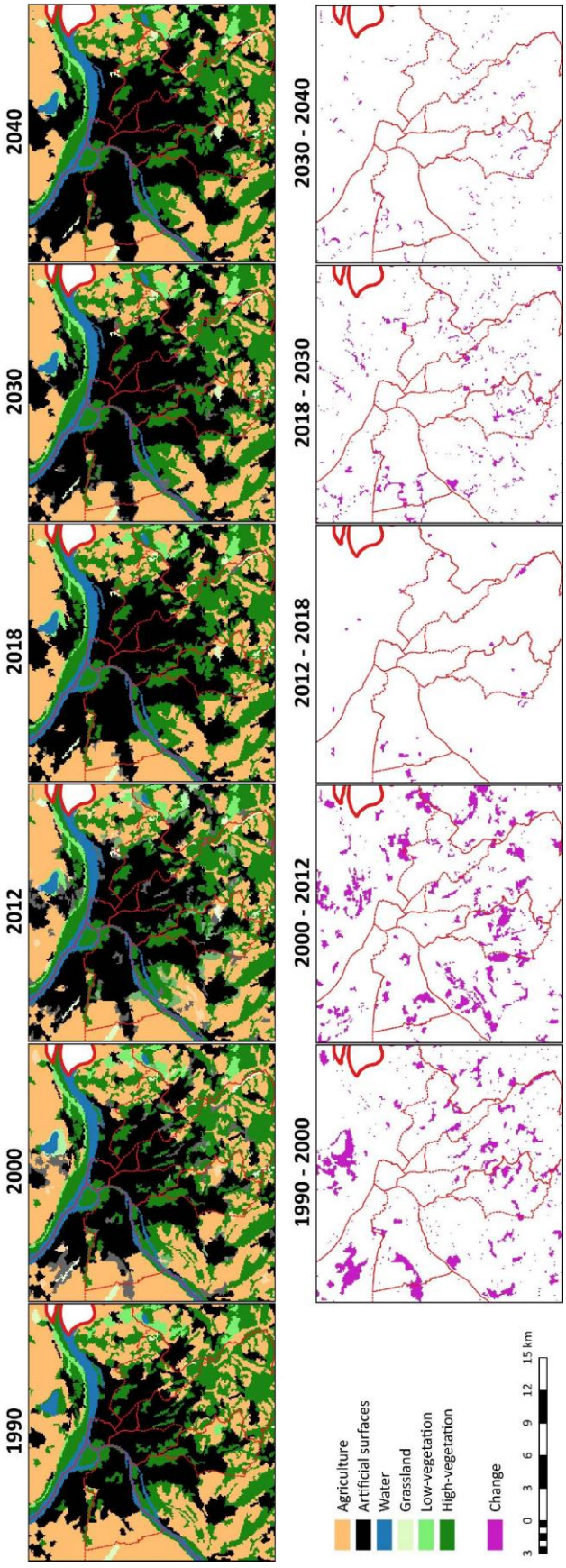


Figure 3: Land cover changes over the Belgrade urban center from 1990 to 2040

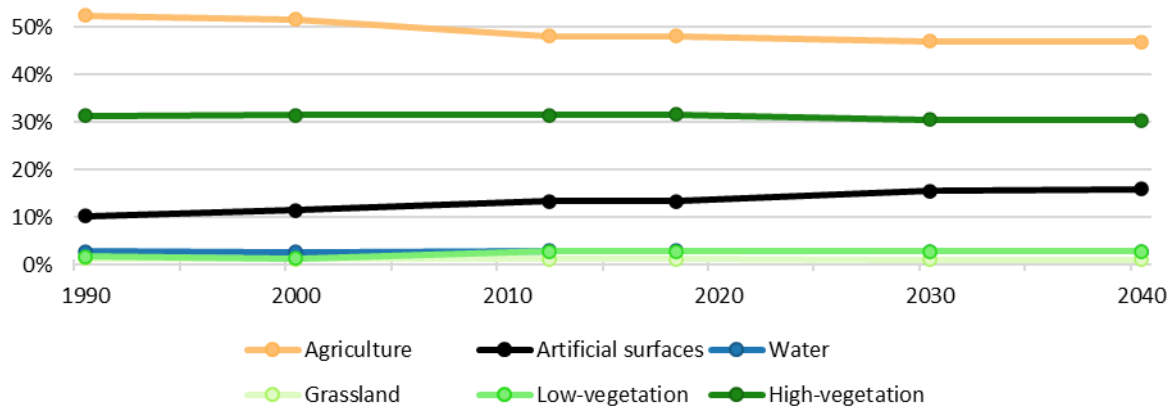


Figure 4: Changes of land cover classes in the Belgrade metropolitan area from 1990 to 2040

The previously mentioned trends of changes from 2018 to 2040 are not the same over all municipalities of Belgrade metropolitan area (Table 3.). The decrease in the proportion of class Agriculture is strongest in the municipalities of Novi Beograd (-4.47%), Rakovica (-4.06%) and Lazarevac (-3.53%), where the decrease is over 3%. The proportion of arable land is also decreasing in all other municipalities, but it is more moderate and amounts to up to 2%. Pronounced effects of urbanization exist in all municipalities and are manifested through an increase in the presence of class Artificial Surfaces. An extreme increase in artificial surfaces is expected in the municipalities of Lazarevac (+10.96%), Rakovica (+6.77%) and Novi Beograd (+6.67%) (Figure 5.). In the municipality of Lazarevac, this is predominantly a consequence of the increase in mining, while intensive construction is expected in the other two municipalities. Construction is a dominant factor in all other municipalities, but the increase in artificial surfaces by 2040 is expected to be less than 3%. Grasslands and low vegetation have insignificant changes in all municipalities, with changes amounting to less than 1%. High-vegetation will have a lower presence in most municipalities, where the municipalities of Lazarevac (-6.39%), Rakovica (-3.05%), Novi Beograd (-2.20%) and Savski Venac (-1.72%) are with the most decrease, while in other municipalities the decrease will be under 1%.

Table 3: Relative change in the representation of land cover classes by municipalities in the Belgrade metropolitan area by 2040, expressed in relation to 2018

Municipality	*Agriculture %*			*Artificial surfaces %*			*Grassland %*			*Low-vegetation %*			*High-vegetation %*		
	2018	*2030*	*2040*	*2018*	*2030*	*2040*	*2018*	*2030*	*2040*	*2018*	*2030*	*2040*	*2018*	*2030*	*2040*
Barajevo	49.27	-0.38	-0.36	6.92	+0.95	+0.95	0.43	+0.03	+0.02	0.82	0.00	-0.01	42.56	-0.60	-0.60
Čukarica	33.42	-1.34	-1.50	23.86	+2.14	+2.37	0.39	0.00	0.00	0.00	0.00	0.00	38.52	-0.79	-0.87
Grocka	24.34	-0.67	-0.79	12.32	+1.09	+1.20	0.63	+0.02	+0.02	21.31	-0.01	+0.03	36.95	-0.43	-0.46
Lazarevac	40.61	-2.77	-3.53	11.19	+9.31	+10.96	1.20	-0.62	-0.63	0.00	0.00	0.00	46.25	-5.52	-6.39
Mladenovac	53.95	-0.24	-0.03	8.22	+0.47	+0.68	0.11	0.00	0.00	1.10	+0.03	+0.06	36.54	-0.26	-0.71
Novi Beograd	22.24	-3.67	-4.47	58.62	+4.99	+6.67	0.02	0.00	0.00	0.00	0.00	0.00	11.76	-1.32	-2.20
Obrenovac	61.67	-1.40	-1.47	7.91	+1.78	+1.91	0.36	-0.09	-0.10	0.20	-0.01	-0.01	25.36	-0.28	-0.32
Palilula	60.47	-0.18	-0.05	9.71	+0.97	+1.07	0.49	0.00	+0.0	2.63	-0.0	-0.0	20.56	-0.76	-1.0
Rakovica	17.25	-2.17	-4.06	46.68	+4.47	+6.77	2.05	+0.22	+0.35	0.00	0.00	0.00	34.03	-2.52	-3.05
Savski venac	0.00	0.00	0.00	80.50	+1.59	+1.72	0.00	0.00	0.00	0.00	0.00	0.00	15.33	-1.59	-1.72
Sopot	42.72	-0.06	-0.05	6.39	+0.22	+0.22	1.42	+0.01	+0.01	2.84	+0.01	+0.01	46.62	-0.18	-0.20
Stari Grad	0.00	0.00	0.00	66.78	+0.34	+0.34	0.00	0.00	0.00	0.00	0.00	0.00	11.36	0.00	0.00
Surčin	67.85	-1.44	-1.83	10.02	+1.40	+1.76	5.53	+0.14	+0.18	0.23	+0.0	+0.0	12.11	-0.10	-0.11
Voždovac	29.38	-0.78	-1.17	22.03	+0.97	+1.12	1.28	0.00	-0.03	0.00	0.00	0.00	47.31	-0.19	+0.08
Vračar	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zemun	61.02	-0.95	-1.73	28.23	+1.37	+2.26	1.90	-0.01	-0.03	0.00	0.00	0.00	2.96	-0.38	-0.48
Zvezdara	13.26	-1.74	-2.41	51.76	+2.20	+2.35	2.50	+0.33	+0.60	0.30	-0.03	-0.06	32.18	-0.75	-0.48

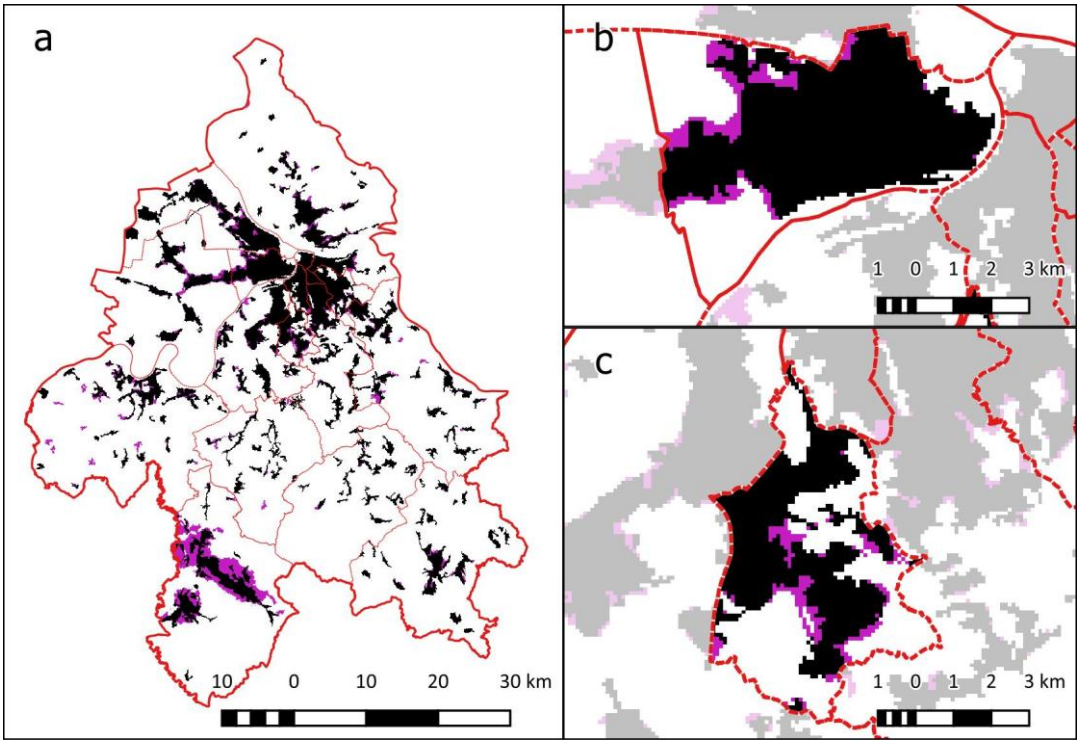


Figure 5: New areas of artificial surfaces in the period 2018-2040 (a) Across the complete study area, (b) Municipality Novi Beograd and (c) Municipality Rakovica

4. CONCLUSIONS

The proposed methodology has been successfully utilized to predict LC maps over Belgrade metropolitan area for years 2030 and 2040. The subsequent analysis highlighted trends to be expected in the following decades. As expected, intensive urbanization and increase in artificial surfaces is predicted, mostly on account of agriculture and high-vegetation areas. Such results provide spatial planners and policy makers with an efficient tool for informed decision-making, predictive analysis, efficiency improvement and sustainability.

The proposed approach is based on a non-guided "trend" urban development, where historical trends are expected to persist and be the main driving force of future ULCC. This means that the creation and enforcement of planning documentation can influence and modify such trends. The future steps include enhancing the proposed methodology to include the available planning documentation as constraints and guides to predictions, thus enabling more robust and realistic future scenarios. Additional research is underway to address these assumptions.

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ICUP2025
5th international conference on urban planning

BIOPHILIC CONCEPTS IN THE REVITALIZATION OF EXISTING EDUCATIONAL FACILITIES

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ABSTRACT

Sustainability, adaptability, and human-centered design are some of the leading architectural trends today. Sustainable, eco-friendly architectural design, adaptive reuse, smart technology, and the application of biophilic principles have become key features of modern practice. This work focuses on biophilic concepts in the revitalization of existing educational facilities. Aspects of the application of biophilic principles are explored through representative examples of current architectural realizations. This study employs a mixed-method approach, combining case study analysis, environmental psychology principles, and spatial assessment of existing educational buildings. The advantages of the biophilic approach in the revitalization of existing buildings are determined and the aggravating circumstances in this process are pointed out. At the end, the paper discusses future directions and tendencies in the development of the relationship between biophilic concepts and the revitalization of educational facilities.

Keywords: *biophilic principles; educational buildings; revitalization; improving; modern practice*

1. INTRODUCTION

Today's architecture is undergoing major transformations. Along this path of change, with innovation in design and technology, the architecture of the future is characterized by creating spaces for human connection, and sustainability, and adaptability. As a result, the application of biophilic principles has become a key feature of modern practice. While the application of biophilic principles has been extensively explored in healthcare facilities, workplaces, and residential architecture, their role in educational built environments remains relatively under-researched. Existing studies primarily focus on newly designed buildings, often overlooking the potential of integrating biophilic strategies into the revitalization of existing educational facilities (Browning et al., 2024; Aye et al., 2019). Moreover, while prior research has demonstrated the psychological and cognitive benefits of exposure to nature in learning environments (Nguyen et al., 2024), a comprehensive methodology for systematically incorporating biophilic elements in older educational buildings is still lacking. This research seeks to bridge that gap by exploring strategies for retrofitting biophilic concepts into existing educational buildings, enhancing both environmental and educational outcomes.

Connection with nature is particularly important for vulnerable populations such as children and youth, who spend a significant portion of their time during the day in educational buildings. The application of biophilic principles in the design of early childhood schools, primary and secondary school buildings, or higher education buildings has been widely researched. This paper explores the possibilities for the application of biophilic concepts in existing educational facilities in the process of their revitalization, with the aim of improving the quality of the built environment.

The necessity of the biophilic design arises from the need to bridge the gap between the existing buildings and the natural environment in order to enhance the existence of the nature within the built space. Biophilic design is an invigorating environmental approach that benefits both human well-being and ecological sustainability (Kellert et al, 2015). By incorporating natural materials, integrating vegetation inside the building and enabling flow of natural ventilation and light into building, it has become an essential element of the architectural design. Therefore, adopting biophilic design in educational spaces is a crucial issue in order to provide the student with a healthy learning environment. Such an approach is an attempt to revitalize the connection between the built environment and nature in order to ensure students with a special place for them to be creative and innovative. This study employs a mixed-method approach, combining case study analysis, environmental psychology principles, and spatial assessment of existing educational buildings. The research examines selected case studies where biophilic strategies have been implemented in educational settings, evaluating their impact on spatial quality, user experience, and environmental sustainability. The paper begins with an exploration of biophilic design principles and their integration into educational environments, followed by a comparative analysis of selected case studies. The discussion then contextualizes the findings within existing theoretical frameworks, ultimately presenting key recommendations and concluding insights. The overall findings suggest that integrating biophilic elements into the revitalization of educational buildings can significantly enhance student well-being, cognitive performance, and environmental sustainability, making it a vital strategy for future school renovations.

2. THEOTRETICAL FRAMEWORK

In scientific research, studies dealing with biophilic spaces in school and preschool facilities are the most present, in terms of pedagogical and psycho-social aspects of their functioning, while the spaces of secondary and higher education facilities are somewhat less represented as a problem. However, the issue of applying biophilic concepts to existing educational facilities in order to improve dominant processes and conditions can be considered insufficiently addressed. Therefore, the theoretical framework of this research consists of separate studies that deal with the topic of the application of the biophilic concept, treating this aspect as a means of improvement for existing facilities intended for different age populations of users within educational spaces.

Environmental psychologists, focusing in their studies on the interrelationship between the physical environment and the students in educational processes, highlight the importance of space for the psycho-physical development of children and their social activity. Researchers have demonstrated that the characteristics of space can contribute to achieving better results in learning, i.e. favor the expression of mental abilities and the development of more positive emotional states (Ko et al., 2020; Bratman et al. 2015).

In order to examine the connection between biophilic design strategies and their impact on student performance, a thorough literature review was conducted, identifying the relevant benefits of specific biophilic restorative strategies for humans. The studies found significant connections between biophilic design elements and human health and productivity outcomes, including anxiety and stress (Li et al., 2016), attention (Bernardo et al., 2021; Kim et al., 2020), cognitive function (Zhong et al., 2022), engagement in class and physical health (Gillis et al., 2015).

There are few studies on implemented biophilic practices in existing school buildings. Starting from the hypothesis that even minimal and modest biophilic design interventions can improve academic and other performance among school children, researchers first conducted experiments for the application of biophilic design to individual classrooms comparing them with standard ones (Bowman et al., 2019). Subsequently, based on a comparison of academic outcomes before and after the intervention, a study was conducted on a completely new school that replaced the existing one (Browning et al., 2024). Studies have shown that with simple design interventions such as bringing access to daylight, views of nature and the implementation of biophilic elements in the classroom can help make students more happy, healthy and improve learning.

Secondary schools, as hubs of adolescent development, provide an ideal platform for biophilic education. This approach encourages students to view themselves as part of a broader ecosystem, promoting empathy, curiosity, and a sense of stewardship. Classrooms designed with biophilic elements such as plants, natural light and organic materials, create environments that support mental clarity and engagement. Students immersed in nature-rich environments demonstrate higher academic performance and improved mental health (Baber et al., 2024; Duffy, 2024). Furthermore, students develop critical life skills, including teamwork and resilience. In the long run, these students are more likely to advocate for sustainable practices, contributing to a generation that values ecological preservation and well-being. By fostering their connection to nature, the groundwork is laid for holistic, future-ready citizens. This approach bridges the gap between students and the natural world, fostering an empathetic generation. The resulting benefits include healthier minds, enriched learning, and a greener planet.

When it comes to university buildings, the environment of intense competition and high academic demands poses a challenge to many students in managing their stress levels (Ghaziani et al., 2021; Peters et al., 2020). Students often struggle to find one's own identity in different circumstances and relationships. Therefore, university students can benefit from incorporating biophilic design elements into classroom spaces to create stress-reducing environments that also foster creativity and cognitive development. According to studies and evidence from the literature, there are key characteristics that directly improve students' academic achievement. These elements include visual connections with nature (Parsaee et al., 2021; Benfield et al., 2015), the presence of water, light and color (Espinoza-Sanhueza, et al., 2024) material connection to nature (McGee et al, 2022), a sense of refuge (Ondul et al., 2021), and thermal variability (Ko et al. 2020).

3. MATERIALS AND METHODS

This research aims to determine the dominant strategies for the application of biophilic principles in different types of existing educational buildings with the goal of improving the qualitative characteristics of their spaces. This study draws on a mixed-method approach to analyse the integration of biophilic patterns and elements into buildings, and the application of biophilic strategies in architectural practice. The case study analysis was preceded by the development of a framework based on the benefits of natural elements in buildings, as identified in the existing literature. Biophilic revitalization case studies explore the design process to reveal how these projects developed from initial ideas to completed buildings. Information about the educational buildings was gathered through site observations, such as interviews with the authors, and analysis of design documents, drawings and photographs available online.

As this study focuses on two categories of biophilic design, nature incorporation and natural inspiration (Zhong et al., 2022) and the associated patterns, Table 1 presents the strategies related to ten biophilic design patterns (Browning et al., 2024).

Table 1: Patterns and the associated strategies (Adapted from Ghaziani et al. 2021)

No	*Nature Incorporation Patterns*	*Strategies*
1	*Visual Connection with nature*	*Work spaces next to windows with a view to nature; Plants, flowers, and green walls; Animals; Natural landscapes and ecosystems.*
2	*Non-visual connection with nature*	*Sound (animals, conversation, music, and water); Smell (perfume and fragrant plants); Touch (hand rails and water for cooling).*
3	*Non-rhythmic sensory stimuli*	*Indoor kinetic facades; Interactive design displays; Swaying grasses; Falling water; The sound of insects.*
4	*Thermal and airflow variability*	*Openable windows, manually or individually; Work areas with external balconies; Visible mechanical ventilation.*
5	*Presence of water*	*Water walls; Fountains; Aquariums; Paintings of ocean/water life; The colour blue.*
6	*Dynamic and diffuse light*	*Daylight from multiple angles; Firelight; Light distribution; Ambient diffuse lighting on walls/ceiling; Personal dimmer controls.*
7	*Connection with natural systems*	*Work spaces with patios or roof gardens; Native planting that grows and dies with the seasons; Cultural and ecological attachment to place; Transitional spaces.*
	Nature Inspiration Patterns	
A	*Biomorphic Forms and Patterns*	*Organic shapes; Natural colours; Naturalistic forms and shapes; Spirals; Fractals; Curves; Natural geometries; Evoking nature; Biomimicry*
B	*Material Connection with Nature*	*Age, changes, and the patina of time; Materials that reflect native ecology such as specific woods, clay, stones, and other fabrics;*
C	*Complexity and Order*	*Organised complexity; Integration of parts to wholes; Repetitive and symmetrical shapes; Pattern order and flooring design; Exposed structure and mechanical systems facades; hierarchy; Floor plan Spandrel and window in wallpaper*

The actual design and implementation play a crucial role, as the mere presence of plants alone does not sufficiently provide insight into the quality of biophilic intervention. In this section, four examples are presented to illustrate the effect of natural elements on spatial quality. The selection of case studies is based on well-defined criteria that align with the research objectives, ensuring a comprehensive analysis of biophilic strategies in educational environments. The chosen examples—(1) Cheer Kindergarten in Shenzhen; (2) Primary school in Heemstede; (3) Keizer Karel College in Amstelveen, and (4) University of Twente in Enschede —represent a diverse range of educational facilities, spanning different age groups, spatial scales, and urban contexts. Key considerations in the selection process included:

- The selected buildings are recent constructions, chosen based on the extent and diversity of applied biophilic principles, ensuring a comprehensive analysis of their impact on educational environments.
- Typology of educational facilities: The case studies encompass kindergartens, primary and secondary schools, and university campuses, allowing for an examination of biophilic principles across various learning environments.
- Spatial characteristics: The selected buildings exhibit distinct spatial layouts, including atriums, courtyards, open learning areas, and multi-level circulation spaces, providing a rich basis for understanding the integration of biophilic design elements.
- Potential for biophilic interventions: Each project demonstrates innovative approaches to integrating natural elements, whether through direct incorporation of vegetation, maximized natural light and ventilation, or the use of organic materials.

Table 2: Four building cases (Author)

Biophilic criteria	*(a)Cheer Kindergarten Located in Nanshan District, Shenzhen, China. Authors: Hibinosekkei + Youji no Shir, 2023*	*(b)Heemstede Primary School Located in Heemstede, the Netherlands Authors: derksen|windt architecten, 2023*	*(c) Keizer Karel College Located in Amstelveen, the Netherlands Authors: LIAG Architects, 2022*	*(d)University of Twente Located in Enschede, the Netherlands Author: Civic Architects and VDND, 2023*
				
Integration of natural elements	*Central courtyard tree; climbing net structures; bird's nest concept*	*Indirect connection through daylight optimization*	*Transformed courtyards into green learning hubs*	*Four nature-filled atriums with distinct environmental themes*
Use of natural materials	*Rammed earth walls; laminated bamboo; preserved existing structure*	*Laminated timber; warm-toned wood accents*	*Wooden elements combined with bright colors*	*Repurposed concrete structure with wood, stone, and water elements*
Spatial configuration and social interaction	*Open atrium for movement and social play; interactive climbing spaces*	*Defined layout with skylights creating a warm ambiance*	*Open and flexible learning hubs replacing traditional classrooms*	*Large communal staircase; flexible workspace organization*
Daylight and ventilation strategies	*Large windows; open hallways; natural ventilation through courtyard*	*Skylights for natural illumination and ventilation*	*Custom double-glazed window system for ventilation & noise reduction*	*Open atriums ensure daylight penetration and passive ventilation*
Sustainability and adaptive reuse	*Minimal intervention approach; reusing existing building elements*	*Adaptive reuse of an old structure; circular construction principles*	*Energy-efficient design optimizing spatial use*	*Repurposed abandoned 1970s laboratory; flexible and demountable structure*

The analyzed projects—Cheer Kindergarten, Heemstede Primary School, Keizer Karel College, and the University of Twente—demonstrate different approaches to integrating biophilic design in educational buildings, each responding to specific spatial, environmental, and educational needs. A comparative evaluation based on key biophilic design criteria reveals similarities and distinctions in their strategies for revitalization. Cheer Kindergarten in Shenzhen, China, integrates biophilic elements through an open atrium, climbing structures, and a central tree, fostering children's connection to nature. Natural materials, large windows, and

ventilation strategies enhance sustainability and sensory engagement. The design promotes physical activity and interaction with natural elements. Heemstede Primary School in the Netherlands focuses on adaptive reuse, preserving the original structure while improving natural lighting and air circulation. A new wooden volume enhances spatial quality, and skylights contribute to a warm, inviting atmosphere. The renovation emphasizes sustainability through circular construction methods and prefabricated elements. Keizer Karel College in Amstelveen transforms its courtyards into vibrant learning hubs filled with daylight and greenery. The design fosters collaborative learning, enhances student well-being, and improves energy efficiency. A special double-pane window system reduces noise and pollution while ensuring ventilation. The school's redesign creates a more engaging and adaptable learning environment. The University of Twente repurposes a former chemistry lab, preserving its concrete frame while adding flexible workspaces organized around courtyard gardens. Natural materials and green atria provide fresh air and light, enhancing sustainability. The design embraces imperfections, making nature a central element in the learning environment.

4. RESULTS AND DISSCUSION

This study has distinguished the essential benefits of biophilic design in educational settings. These findings are supported by an extensive body of literature that underlines 12 of biophilic restorative design elements as crucial for reducing stress, enhancing cognitive engagement, and improving student performance. Through a comparative analysis of biophilic restorative patterns, the most effective but also accessible strategies for educational buildings were established. These include the presence of water, fresh air flow, daylight intrusion, presence of plants, views of animals, landscape visibility, exposure to weather conditions, diverse spatial forms, nature-inspired imagery, application of natural materials, mechanisms reflecting time, and seasonal changes (Table 3). Although some biophilic elements cannot always be implemented due to aggravating structural constraints, this list enables the use of compatible biophilic restoring strategies that can be applied in special conditions with limitations of individual buildings.

Table 3: Comparative analysis (Adapted from Zhong et al. 2022)

Representative buildings cases	*Water*	*Air*	*Daylight*
Cheer Kindergarten	*Yes, There is a pool on the roof terrace*	*Yes, Indoor vegetation contributes to fresh air*	*Yes_Glass roofs in atriums bring sunlight into the building for both humans and indoor plants.*
Heemstade Primary School	*No*	*Yes*	*Yes, Daylight is introduced zenithally*
Keizer Karel College	*No*	*Yes, Glass placed 50 cm from the facade are used to repel noise and dust, which allows opening the window for the necessary ventilation*	*Yes*
University of Twente	*No*	*Yes, Trees and other plants provide fresh air and natural light throughout the building.*	*Yes*
	Plants	*Animals*	*Landscape*
Cheer Kindergarten	*Yes, Plants in the inner space*	*No*	*Yes*
Heemstade Primary School	*Yes*	*No*	*Yes, Skylights- installed in the roof planes.*
Keizer Karel College	*Yes*	*No*	*Yes*
University of Twente	*Yes*	*No*	*Indoor landscape with other green spaces a coherent landscape axis*
	Weather	*Shapes*	*Images*
Cheer Kindergarten	*Yes, Clear glass windows,*	*Yes*	*Yes*
Heemstade Primary School	*Yes*	*Yes*	*Yes, on a large wall surface*
Keizer Karel College	*Yes*	*Yes*	*No*
University of Twente	*Yes, Aromatic flowers,herbs*	*No*	*No*
	Materials	*Mechanisms*	*Time and seasonal changes*
Cheer Kindergarten	*Yes*	*No*	*Yes*
Heemstade Primary School	*Yes, wooden materials for the interior and facades*	*No*	*Yes*
Keizer Karel College	*Yes, Bright colored materials*	*No*	*Yes*
University of Twente	*Yes, wood, water and stone*	*No*	*Yes*

Four educational buildings were analyzed: Cheer Kindergarten, Heemstade Primary School, Keizer Karel College, and the University of Twente (Table 3), all of which incorporated biophilic patterns in their revitalization.

The most innovative biophilic interventions were implemented at Cheer Kindergarten. A children's pool was created on the roof terrace of the lower part of the building. Daylight was introduced zenithally. Through the glazed section of the roof, it reaches the central interior space, which features lush vegetation.

Heemstade Primary School is distinguished by the use of natural materials, primarily wooden elements for the roof structure visible from the interior, and wooden materials for the interior and facades. Skylights are integrated in the roof planes. They allow diffused zenithal light to enter, creating a warm and inviting atmosphere.

The new high school, Keizer Karel College, has several distinctive features. Learning spaces are versatile and adaptable, with greater visibility for teachers. A special type of window with additional glass placed 50 cm away from the facade was used. These windows repel noise and dust, allowing them to be opened for necessary ventilation. Bright, colored materials were used in the renovation. Overall, a pleasant atmosphere was achieved for the students' benefit.

The University of Twente, after the renovation of its building with deep and dark spaces, gained four central atriums and trees planted directly into the ground. Trees and other plants provide fresh air and natural light throughout the building. By using wood, water, and stone, each of these spaces became distinctive in its own way.

5. CONCLUSION

Indoor spaces where educational processes take place are considered crucial environments that influence both academic performance and the overall development of children. Biophilia as a design concept that finds a contribution to the well-being of the users of the space in the cooperation of the interior space with nature has found wide application in the design and implementation of educational facilities.

In the paper, research was conducted with the aim of determining the dominant forms of biophilic patterns for certain types of educational buildings particularly in the revitalization of the existing fund. This research examines examples where nature-inspired strategies improve learning environments, evaluating their effects on spatial quality, user experience, and ecological sustainability. The study utilizes a diverse methodological approach, incorporating case-based analysis, principles of environmental psychology, and spatial evaluation. Results indicate that embedding biophilic elements in revitalisation process of educational buildings enhances student well-being, cognitive abilities, and ecological resilience. It has been established that the imagination of the designers is most evident in preschool facilities. Along with the presence of plants in the interior space, other natural elements, such as water surfaces and natural, mostly wooden materials, are represented in the processing of interior details.

A similar situation is observed in primary schools. In secondary schools and universities, different biophilic aspects take precedence, reflecting the needs of older students who experience daily stress due to academic competition. Therefore, elements that help mitigate these stressors are prioritized. It is primarily the visual contact with open spaces and the surrounding nature that are made possible by larger glazed facade surfaces. It is desirable that the windows are openable so that the weather and sounds from nature reach the students in the classrooms. The restorative effect is also achieved in larger green spaces, most often in common halls with lots of sun and daylight that penetrates from the roof glazing.

Implementing biophilic design in existing educational facilities represents a specific problem. Often, the specific condition of the building is a limiting factor in the application of the desired procedures. Significant construction interventions are inherently complex, and therefore in many ways increase the overall project costs. A more feasible approach to incorporating biophilic elements in the interior spaces of educational buildings is the use of different natural materials and colors in in flooring, walls, and other surfaces.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the

Faculty of Civil Engineering and Architecture, University of Niš – Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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ICUP2025
5th international conference on urban planning

EXPLORING THE SMART CITY CONCEPTS: THE POSSIBILITIES AND BENEFITS OF ITS IMPLEMENTATION IN THE CITY OF NIŠ, SERBIA

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ABSTRACT

The advancement of information and communication technology (ICT) has significantly enhanced cities' management and facilitated efficient information exchange among key actors shaping the urban environment, including citizens, government, and enterprises. The smart city concept, primarily based on ICT, emerged to promote sustainable urban development and improve quality of life by addressing challenges such as extreme climate change, population growth, excessive urbanization, and resource inefficiency. While no official definition exists, since the concept arose from empirical experience, this paper synthesizes the concept based on existing literature and analyses various European smart city case studies. Additionally, large cities face pressing issues related to public transportation and air pollution. Finding a balance between growth, resource preservation, environmental protection, and quality of life enhancement is crucial for creating safe, healthy, and attractive urban environments for their residents. This research focuses on the role of ICT in European smart city initiatives, exploring their potential for generating public value, citizen welfare, and ecological sustainability in urban areas. The city of Niš is used as a case study to examine how integrating smart tools can inform spatial and urban planning, emphasizing the importance of adapting planning systems to modern trends. Building on this analysis, the main objective of this research is to explore the advantages of ICT-based smart city concept and its implementation possibilities in the city of Niš, focusing on strategic orientations in urban development. To seize opportunities and build sustainable prosperity, cities need to become "smarter" to cope with the challenges of the future.

Keywords: *smart city concepts; digital city; sustainability; possibilities and benefits of implementation; urban development; high technologies*

1. INTRODUCTION

While the focus of smart city development is often placed on large metropolitan areas, smaller cities, such as Niš, also face a lot of challenges that could be solved using smart city principles (Giffinger et al, 2007). Modern urbanization is characterized by accelerated city growth, the rise of megacities and expanding urban conurbations, as well as the concentration of growth in underdeveloped and developing regions. According to United Nations data, over 50 percent of the world's population lives in urban areas, and each week about 1.5 million people move to cities, which is approximately 200,000 per day or about 140 per minute (United Nations, 2016). Although global attention is often focused on cities with more than one million inhabitants, there were only 12 in 1900, compared to 512 in 2016, most urban settlements are actually medium-sized cities like Niš, which serves as an important regional centre, making it a relevant case for examining smart city potential. In the future, cities will continue to expand much faster than the surrounding rural areas, as capital remains concentrated in urban centres, making them favourable for business development. The constant expansion of urban populations and the complexity of city management drive local governments to increase use of technology, particularly Information and Communication Technology (ICT), to improve the quality of urban areas and the accessibility of public services (Dameri, 2013). In addition to the benefits of urban density, cities present a great chance to combine different networks and systems into a cohesive whole, promoting a more sustainable way of living. Cities continuously face challenges related to sustainability, pollution, climate change, traffic jams, and limited resources (Dirks et al, 2009). Many local efforts are already being

implemented by city initiatives to introduce innovative building and construction techniques, revitalize public transportation, invest in renewable energy, and use smart technologies to reduce energy consumption. Solutions should not be based on one specific technology, as it becomes outdated over time with rapid development. A broader understanding of the problem's context is necessary to ensure more flexibility and sustainability. A crucial factor for the adoption and implementation of smart city principles is the willingness and capability of society to use ICT tools, as it cannot be expected that technology, on its own, will contribute to the development of cities without key actors (Cosgrave et al, 2012).

The paper will examine the role of ICT in shaping smart cities, focusing on its application in planning, public participation, and decision-making processes, with insights based on both literature and practical examples in city policies. The methodology of the research includes a comprehensive literature review, the description of good practice examples, and a detailed analysis of the city of Niš. This analysis specifically focuses on evaluating the strategic document 'The Development Plan of the City of Niš for the Period 2021-2027,' which outlines the city's development goals and priorities. Additionally, the research examines existing applications and initiatives related to the implementation of ICT technologies in urban development. The aim of the study is to explore the connection between urban development and the improvement of quality of life through the use of smart city principles, as well as the possibilities for their implementation in urban practice, with a focus on the city of Niš.

Since the goals of a smart city are often closely linked with the goals of a sustainable city, environmental sustainability becomes a key objective due to critical urban issues such as traffic, pollution, and waste. Technology should be integrated to monitor energy production, mobility, water systems, waste management, and more. Quality of life is one of the broader objectives, but it is reflected not only through smart initiatives but also through all local government policies, including those related to culture, education, the environment, and sports activities. Cities are responsible for almost 70% of the world's CO2 emissions, which indicates that cities consume about 80% of the world's total energy production. Furthermore, social divisions are often more evident in cities, where poor neighbourhoods and business centres can be found in the same small region. In summary, the cities of this world are far from sustainable; therefore, by using technology, cities can better control and measure consumption and monitor urban development (Copenhagen Cleantech Cluster).

2. DEFINING SMART CITIES: CONCEPTS, IMPLEMENTATION, AND URBAN TRANSFORMATION

'The 19th century was a century of empires, the 20th century was a century of nation states. The 21st century will be a century of cities.'- Wellington E. Webb. 'Cities are the most complex artefact created by human beings and their most significant investment. They drive cultures, they embody their values and are crucial to development. Cities are hubs of creativity and potential.' (Landry et al, 2014). The concept of the smart city is developing based on empirical experiences, while its systematic theoretical exploration still remains limited (Dameri, 2013). According to most of the study papers, smart cities are those that make use of cutting-edge technology, especially ICT tools, to improve resource management, reduce pollution, and raise the standard of living for their residents (Teofilović et al, 2022). Addressing food supply issues at the international level, water supply over long distances, local waste disposal, and urban traffic management are key aspects of social and environmental sustainability, which serve as major strategic components of smart cities (Caragliu et al, 2009). Long-term urban development requires the sustainable and responsible use of natural heritage in a world with limited resources, where cities depend more and more on tourism and natural resources for economic prosperity.

According to the simplest method, a smart city's boundaries should line up with the city's administrative borders. However, it is important to recognize that ICT and the Internet tend to transcend physical and geographical boundaries, creating virtual cities and communities that are distant from the traditional concept of a city. As the digital sphere offers new kinds of communication and interaction that beyond the boundaries of physical geography, this change puts to doubt the traditional understanding of urban space and presents prospects for more flexible, decentralized urban networks (Taylor, 2004). Cities do not grow in a vacuum: this means they are part of a nation, and local management policies should be coordinated with national policies to ensure the cohesive growth and development of smart cities that supports both local needs and broader, national goals.

A city consists of multiple interconnected systems, whose functionality directly influences its development. Nevertheless, the smart city concept transforms these systems into instrumented, interconnected, and intelligent networks. Digitalization transforms systems into measurable data, enabling easier communication and mutual advancement. Finally, intelligence is applied to process the obtained information, allowing for rapid

and precise responses, informed decision-making, and further system optimization and improvement (Dirks et al, 2009). The main components that define and create smart city strategies include smart governance, smart economy, smart environment, smart living, smart people, and smart mobility. These principles should be applied through the development and use of electronic communications in various fields, including healthcare, administration, education, transportation, culture, spatial planning, and more (Damjanović et al, 2017). Transparency of reliable and trustworthy information and active citizen participation in important public issues and decision-making processes are essential for effective smart governance. To help government institutions coordinate, a strong communication infrastructure is also necessary (Teofilović et al, 2022). The transportation system, which causes problems like traffic congestion, air pollution, public transport, and similar concerns, is a key component of smart cities. A smart mobility system takes care of providing high-quality, eco-friendly transportation solutions that meet the needs of the local population (Kovačević, 2022). The goal is to predict problems, such as traffic jams or high energy consumption, in order to minimize the impact of disruptions to urban services and operations. For this to function effectively, it is essential to coordinate the resources of various agencies to respond fast to issues. One of the main aspects of this approach is the use of open data principles, which make it easier for citizens to get involved and help in the creation of policies. People in charge can respond quickly by synchronizing data, and experts believe this helps create a smart economy, smart mobility, smart living environments, and smart governance. To achieve this, smart networks and sensors, open platforms for citizen participation, and urban service applications are required. However, reducing human interaction and evaluation introduces a risk of poor decisions by automated systems, as they may overlook the broader context. Therefore, a critical component of the concept is the involvement of knowledgeable and skilled individuals who will monitor and improve smart city systems (Landry et al, 2014). People are the essential immaterial aspect of smart cities: they are not just the aim of smart initiatives, but should themselves also be "smart." This implies that citizens must be actively engaged and equipped with the tools, knowledge, and mind-set to interact with and benefit from the smart systems around them. Their involvement is not merely passive but a dynamic component of the city's development, ensuring that the technologies implemented serve the actual needs and aspirations of the community.

Universities, research institutions, and high-tech companies are the main actors in this model: they are pioneers in developing the concept of the smart city, using their expertise to design and implement smart solutions that foster better urban living. Their work results in a variety of projects and initiatives, which ultimately lead to the creation of products and services that form a small, but integral part of the smart city mosaic. (Dameri, 2013). It is important to involve city residents both in the political decision-making process and in the process of business innovation. Companies that manage to develop integrated business models, taking into account all of these variables, have significant potential in the global smart city market. By actively engaging citizens and incorporating their perspectives, these companies can create solutions that are not only technologically advanced but also socially relevant, ensuring that smart city initiatives truly reflect the needs and values of the communities they serve.

The current EU energy standards for new buildings – which will be further strengthened in the coming years – require high standards in planning and architectural quality. The task is to implement maximum efficiency standards for buildings, as well as integrated generation and storage of renewable energy resources (e.g., solar thermal energy, photovoltaic panels, heat pumps). In order to ensure that the smart city is a reality, it is also crucial to provide the proper foundation conditions for urban planning. This involves not only technical innovations but also smart planning that promotes a smooth integration of sustainability into the urban structure, making energy efficiency and renewable resources essential parts of building design and urban development.

3. GOOD PRACTICE EXAMPLES OF SMART CITIES

The best way to demonstrate that change is possible is to use examples of cities that have already incorporated smart systems into their strategies. This illustrates that such transformation is already happening and that residents of these cities experience better living conditions, both economically and socially. By highlighting real-world examples, it becomes clear that smart city initiatives not only improve efficiency and sustainability but also enhance the quality of life. Creating spaces where science, advanced manufacturing, and startup entrepreneurs come together to focus on connecting education, as well as integrating public institutions and the private sector. Cycling and walking, electric cars, and car-sharing are dynamically promoted, while traffic is monitored and regulated in real-time. These cities are focused on dramatically

reducing CO_2 emissions and transforming energy consumption and transportation into more sustainable practices in an effort to slow down the rapid change of climate. The smart city concept in these cities has been integrated into a broader goal of promoting social inclusion, encouraging innovative development, implementing ICT, and reducing resource consumption. This holistic approach not only addresses technological advancements but also prioritizes the well-being of residents and the sustainable growth of urban environments.

3.1. Good practice example of Copenhagen

Denmark's first urban planning law dates back to 1925, and this tradition of comprehensive, inclusive planning continues to this day making Denmark one of the leading smart societies. Primarily, the city of Copenhagen plays a leading role in the market for testing and developing green technologies, transforming the city into a "living laboratory." Secondly, they focus on ensuring that the decisions made are in collaboration with private partners, which increases the chances that solutions will be accepted by all stakeholders. This approach encourages a shared sense of responsibility and collective progress, making Copenhagen a model for sustainable urban development. Modern cities have become central hubs for smart devices. These devices are either integrated into the city's infrastructure, like smart meters, sensors, and cameras, or constantly in motion across the urban environment, found on buses, trains, or carried by people on the streets. The value of these smart devices lies in their ability to collect, store, and share data about city's surroundings. By constantly monitoring the city's state, they offer real-time insights into urban conditions. The potential to use this data to develop efficient and intelligent solutions for urban challenges is vast and unlimited. While the technology can collect data and communicate with other system, truly intelligent technologies are multifunctional. This means they provide solutions to multiple problems. For instance, sensors and smart meters distributed throughout the city can provide digital information about traffic flow, available parking, energy consumption, traffic accidents, weather conditions, and more. This information can then be made accessible to city residents via smartphones or other smart devices, helping them make well-informed decisions as they navigate the city. As a result, the city's infrastructure becomes more flexible and adaptive. The role of ICT has been pivotal in Copenhagen's transformation into a smart city, as it enables the integration of data-driven solutions, enhancing the efficiency and adaptability of urban services. For a smart city to truly thrive, it is important to develop new management models. Beyond incorporating new smart technologies into the system, we need governance models that are less "top-down" than traditional structures. These models should emphasize horizontal collaboration, encouraging partnerships and networking among different societal actors.

Copenhagen's "Giv et praj" app, launched in 2012, is a prime example of an ICT-enabled system that enhances urban management by allowing residents to use smartphones to report issues such as graffiti, damaged infrastructure, and full trash bins. By encouraging cooperation between the municipality and its citizens, this initiative improves municipal responsibility. As part of its smart city strategy, Copenhagen aims to become the world's first carbon-neutral capital by advancing waste management, water systems, renewable energy, and transportation. To maximize energy efficiency and sustainability, a crucial component of this concept is the integration of decentralized energy sources, such as heat pumps, solar panels, and wind turbines, into a more adaptable and intelligent power grid (Copenhagen Cleantech Cluster). Cycling, which reduces carbon emissions and traffic congestion while promoting public health, must be actively encouraged through improved infrastructure and supportive policies. Car-sharing and ride-sharing programs should be expanded to further decrease urban carbon footprints. Additionally, the city's streets have adopted smart lighting systems that automatically adjust based on real-time needs, conserving energy without compromising safety. Cities like Copenhagen serve as exemplary models for those striving to implement smart urban principles, demonstrating how integrated mobility solutions and innovative technologies can create more sustainable and livable urban environments (Region Hovedstaden, 2015).

3.2. Good practice example of Amsterdam

Amsterdam's transition to a smart city began in 2009 with the introduction of the Amsterdam Smart City project, initiated by the independent organization Amsterdam Innovation Motor and grid operator Liander in collaboration with the Municipality of Amsterdam. The initiative aims to reduce carbon emissions and energy consumption through a collaborative approach involving government agencies, private companies, knowledge institutions, and citizens. Innovative technologies are tested in small-scale projects before broader implementation, promoting both efficiency and behavioural change. Main initiatives include smart education, sustainable mobility, smart grids, and digital solutions such as the "Apps for Amsterdam" platform, which

applies open city data to drive innovation and urban improvement (Mora et al, 2017). Amsterdam has the second-largest internet exchange point in the world and is ranked as the second-best city globally in terms of technological advancement. To support its smart city development, the Municipality of Amsterdam launched the "City Data" portal in 2015. This platform collects and shares a large amount of data across eight policy domains: traffic and infrastructure, tourism, geography, population, public spaces and green areas, urban development, well-being, and energy, making data accessible for innovation and informed decision-making. A main element of Amsterdam's smart city development is the integration of ICT technologies, which enable the collection, processing, and analysis of real-time data, supporting data-based decision-making and encouraging the development of innovative responses to urban problems. What makes Amsterdam different from other cities is that its smart solutions and strategies are not just based on modern technologies but also make use of cultural capacities to develop practical innovations. As the "cycling capital of the world," Amsterdam has introduced smart mobility solutions, including smart cycling, electric vehicles, and car-sharing services for private transport. The Amsterdam Smart City initiative also provides an integrated digital platform for public transport, easily accessible to residents and visitors via mobile applications. Additionally, it employs an intelligent traffic management system to optimize traffic flow and is developing the "Amsterdam Practical Trial," a project envisioning a future where cars, navigation systems, traffic lights, and information signs are interconnected and automated. One of the main goals of the City-Zen project, an international collaboration operating in Amsterdam and Grenoble, has been integrating innovative energy solutions into existing buildings and systems (Noori et al 2020) One example of a smart application is Mobypark, which makes parking in Amsterdam more suitable by helping users easily find available spots. The data collected through the app allows the city to track parking demand and monitor traffic flow. Mobypark connects drivers with private parking spaces in city centres and near airports, aiming to cut down on the time spent searching for a spot and reduce congestion (Mobypark). In addition, many households in Amsterdam have switched to smart electricity meters, with rewards for those who actively lower their energy consumption. The city has also implemented flexible street lighting, which helps manage more efficient traffic.

3.3. Good practice example of Vienna

After the economic crisis and growing concerns over limited resources, the "Smart City Vienna" initiative was launched, focusing on development and investments of global importance. As the city's population grows and interactions become more frequent, Vienna focuses on improving transportation efficiency rather than just expanding capacity. The city's transformation aims to implement high-quality, smart infrastructure requiring innovation, flexibility, and collaboration, with a particular focus on areas such as environmental sustainability, housing, social cohesion, and research. Additionally, the initiative also aims to position Vienna as a leader in urban technology research, driving economic growth and creating quality jobs. The core aspects of energy, infrastructure, mobility, and buildings are closely linked to urban development, reflected in the Urban Development Plan STEP 2025. The plan includes multimodal mobility options, integrated energy and spatial planning, and new energy consumption standards in future urban developments, emphasizing a collaborative approach and adaptability in response to challenges (Region Hovedstaden, 2015).

4. THE POTENTIAL FOR IMPLEMENTING SMART CITY PRINCIPLES IN THE CITY OF NIŠ

Despite the fact that smart city development is typically associated with mega-cities, smaller cities like Niš also face various challenges that could be resolved by applying smart city principles. By integrating ICT solutions and innovative technologies, Niš has the opportunity to enhance urban living, optimize services, and promote sustainable growth. According to the Sustainable Urban Development Strategy, first adopted by the National Assembly of the Republic of Serbia in 2019, the smart city concept is not explicitly addressed. However, the strategy emphasizes the promotion of ICT, expanding open digital platforms designed for collaboration and user engagement, and integrating geoinformation technologies. Similarly, the European Union's Urban Agenda identifies digital transition as one of its 12 priority areas, with a strong focus on data collection, more efficient use, and data management (Strategija održivog urbanog razvoja Republike Srbije do 2030. Godine).

The Development Plan of the City of Niš for the Period 2021–2027 emphasizes the insufficiently developed organizational and management system in local institutions as a key issue. To strengthen management capacities and optimize processes, it is essential to implement digitalization and introduce "smart services" based on Industry 4.0 technologies. The following outlines how ICT can be applied across different sectors, with a focus on strengthening the city's transition to a smart city model:

- **Urban Planning**. Geographic Information Systems (GIS), which integrate all spatial data to improve spatial planning and land management, are one way in which ICT can enhance urban planning. The integration of smart buildings, capable of monitoring energy consumption and resource use, contributes to sustainable urban growth.
- **Citizen Participation**. A centralized strategic and operational approach, the development of a centralized smart city platform for data collection and analysis, and the encouragement of public participation will be essential steps.
- **Public Transport**. ICT solutions can optimize traffic flow through smart traffic management systems using traffic sensors and analytics. These systems can adjust traffic signals based on real-time data, reducing congestion, enhancing safety, and improving overall mobility.
- **Circular Economy**. ICT can optimize waste management with smart sensors in bins to monitor fill levels and improve collection efficiency. Additionally, data analytics can monitor resource use, supporting recycling and contributing to a circular economy.
- **Renewable Energy and Energy Efficiency**. Smart grids integrating renewable energy sources like solar power ensure efficient distribution, while ICT-driven building management systems optimize energy use. Also, smart lighting reduces energy costs, supporting responsible energy use.
- **Environmental Monitoring**. Air quality sensors, providing real-time data on pollution levels, can be installed throughout the city using ICT technology. This allows local authorities to respond quickly to pollution events and inform the public.
- **Interoperability and Data Sharing**. A centralized platform for data sharing promotes collaboration among public institutions, private companies, and citizens, ensuring a coordinated response to urban challenges. ICT can also strengthen public-private partnerships, facilitating the development and deployment of innovative solutions for urban issues. This approach promotes interoperability and the full digital networking of urban data, enhancing cooperation among various stakeholders. A smart city application, which integrates urban services, provides timely information, and promotes transparency and citizen engagement, requires particular focus. (Plan razvoja grada Niša za period od 2021. do 2027. godine).

Public transport in the city of Niš is provided only by buses and operates within the framework of a public-private partnership. The network consists of 52 lines, covering both urban and suburban areas, with 14 of them being urban lines (JKP Direkcija za javni prevoz grada Niša). Regarding smart initiatives, the most recent development is the new application that allows users to track the bus route, current location, and estimated time of arrival at their station. Additionally, the app enables users to purchase tickets. Based on the connectivity and walking distance to urban bus stops, as well as the use of the application, it can be said that the public transport system functions well. However, there is potential for further improvement. Citizens have pointed out several issues, including the need for more frequent departures during peak hours, delays or cancellations, and the shortening of routes due to snow during the winter. Nevertheless, the most significant problems identified are the poorly maintained and outdated bus stops, as well as the lack of accessibility for people with disabilities to all buses. According to statistics, approximately 75,000 people use public transport every day, which accounts for 30% of the population of Niš. If buses were modernized, the population educated on the importance of using public transport to reduce pollution, and the need for additional departures monitored through technology, a larger portion of the population would likely adopt buses as the primary mode of transport, reducing both traffic congestion and pollution (Dobrovoljni lokalni izveštaj grada Niša, Republika Srbija, 2024.).

The use of solar energy in Serbia is still not widespread enough. According to studies, the potential for solar radiation in Serbia is 30% higher compared to Central Europe, where many solar power plants have been installed. Based on the number of sunny hours per year, it can be concluded that the area of Niš and its surroundings is suitable for using solar energy for electricity production. A Geographic Information System (GIS) would be used to analyze the most suitable locations in order to ensure maximum efficiency. The selection of locations would not only depend on physical characteristics, such as closeness to roads or settlements, but also on economic, social, political, and environmental factors. It is also important to avoid occupying highly fertile land. Through the decentralization of the system and energy sources, smart technologies can track consumption and identify areas where the construction of solar parks is most needed, minimizing energy losses

during transmission. Finally, the importance of clean, renewable energy sources for the environment should not be overlooked (Centar za unapređenje životne sredine).

Last but not least, the visibility of spatial and urban planning documents, as well as the participation of citizens in their creation and decision-making processes, is of great importance. Encouraging citizens to take an active role in decisions about the city that affect them is essential. There is also a noticeable need to improve the Geographic Information System (GIS) for the city of Niš, where all relevant information for urban planning would be accessible in one place. The main feature of GIS is the integration of various data sources to make all relevant information transparent and available in only one location. The integration of data from different sources provides the necessary information for effective decision-making. The use of GIS in this field represents a new approach that offers a different perspective on space, its development, and shaping. It enables the analysis and modelling of various processes that take place within it, as well as their mutual relationships and impact on spatial development. Through the development of an application for Niš, all plans, along with their amendments and additions, would be consolidated in one place, while construction and planning regulations would be unified and visually presented. Moreover, data essential for decision-making in urban planning and architecture would be integrated through improvements in the quality of spatial analysis processes and public services (Xhafa et al, 2015).

These are the initiatives with the greatest potential and the highest possibilities of being implemented in the near future. The most important step toward any initiative that moves Niš toward becoming a smart city, besides the expected advancement of technology, is educating the population. Through panels and initiatives, children and young people should be introduced to the importance of smart city concepts. Niš has a rich culture and is well-connected by transport to other cities in Serbia and Europe, providing significant potential to develop and represent even more smart initiatives. The city has the potential to become a successful pilot city, encouraging other cities in the region to implement smart initiatives adapted to their own needs. Evaluations foster healthy competition in regional development strategies, encouraging stakeholders to make their decisions transparent and understandable.

5. CONCLUSION

Cities have become more aware of the need for change when they face significant challenges and risks to sustainability across all interconnected systems. To secure future prosperity, they must take action now. A large number of well-developed projects remain in the pilot phase because the transition to a smart city requires continuous and long-term investments, not just initial ones, for results and financial justification to become evident over time. Changing established human habits, such as reliance on private car transport, is challenging. Moving towards a smart city and 'smart people' requires significant time and education. While urban agendas for smart cities are clearly defined, this does not necessarily mean their easy implementation. Nowadays, urban performance depends not only on a city's physical infrastructure but increasingly on the availability and quality of communication, knowledge, and social infrastructure, such as human and social capital. The transition will be difficult, but it will bring a wide range of benefits, including significantly improved air quality in our cities, the preservation of food and water security, and the maintenance of economic and political stability. A smart city depends especially on awareness since some potentials are activated only by residents, companies, or the government understanding the state of the city, that is, understanding the city inside as well as the urban system in which it is located. Niš faces several problems in becoming a smart city, including insufficient citizen participation and awareness about the benefits of smart technologies. There is also a lack of developed digital services and applications, as well as underdeveloped IT infrastructure that slows down the digital transformation of public services. To overcome these problems, increased awareness, education, and involvement of both citizens and private companies, along with a more coordinated strategic approach, will be crucial. Overall, Niš has the potential to become a smart city. While there are significant challenges ahead, the city's cultural wealth, strategic geographical position, and ongoing infrastructure improvements provide a solid foundation for transitioning into a smart city. With the right investments in technology, education, and public systems, Niš could lead by example, becoming a model for other cities in the region. However, it is important to approach this transformation thoughtfully and critically to ensure long-term success and sustainability.

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THE SIGNIFICANCE OF URBAN REGENERATION IN MULTI-FAMILY HOUSING COMPLEXES: INVESTIGATING THE IMPLEMENTATION POTENTIAL IN RESIDENTIAL BLOCKS OF NIŠ - INSIGHTS FROM EUROPEAN CITIES

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ABSTRACT

Urban regeneration of housing complexes is becoming increasingly essential for the effective functioning of urban areas, driven by rapid city development, urbanization, and technological advancements. The continuous evolution of human needs necessitates diverse living conditions, leading to the adaptation of existing residential complexes that have aged both functionally and aesthetically. This process is particularly crucial in parts of cities that have deteriorated over time due to neglect, physical degradation, and the emergence of crime groups or socially vulnerable populations. Utilizing the existing frameworks and structures of residential buildings offers a cost-effective approach to creating environments that meet contemporary demands and attract future residents. This paper describes various case studies of urban regeneration within housing complexes, analysing the challenges and conditions prior to regeneration, as well as the results achieved after the intervention. Through the examination of successful examples from Europe, it is possible to observe that urban regeneration can lead to significant economic and social development. The primary objective of this research is to evaluate the potential for implementing urban regeneration principles in selected residential areas of Niš, drawing insights from completed projects in the Netherlands and Great Britain. Additionally, the study investigates the significance of urban renewal on local economies and the enhancement of quality of life for residents. By highlighting the transformative potential of urban regeneration, this study aims to contribute to the discourse on sustainable urban development and the revitalization of aging housing complexes.

Keywords: *urban regeneration; multi-family housing complexes; urban sustainability; urban renewal; residential complexes*

1. INTRODUCTION

With the rapid development of cities and technological progress, urban regeneration of residential complexes is increasingly essential for the proper functioning of cities. As human needs evolve, modern living requires different conditions, prompting the need to adapt outdated residential complexes to meet current housing demands. In parts of cities that have deteriorated because of poor upkeep, physical deterioration, or social problems like crime and vulnerable populations, urban regeneration is required. Reusing existing structures and creating spaces that satisfy present users' requirements while drawing in new ones is more cost-effective. The process of urban regeneration is multifaceted and necessitates significant financial commitment as well as cooperation among various stakeholders. However, it ultimately improves the quality of life in urban areas.

This paper analyses the urban regeneration of the Bijlmermeer and Park Hill residential complexes, examining both the issues prior to regeneration and the outcomes achieved. The main goal is to explore the potential for applying similar regeneration principles to residential areas in Niš, specifically *Kriva Livada* neighbourhood and the Old and New railway colonies. The study examines the social and economic growth created by urban renewal through comparative analysis and evaluates how these ideas might improve the quality of life in Niš. The methods include case studies of Park Hill and Bijlmermeer, analysing the issues before regeneration and how new urbanism principles improved living quality. By gathering data on residential areas in Niš and examining issues caused by socialist-era developments, the paper explores the possibility of applying similar principles to Niš neighbourhoods to meet the needs of modern users.

2. THE SIGNIFICANCE OF URBAN REGENERATION IN NEGLECTED MULTI-FAMILY COMPLEXES

To understand the concept of urban regeneration, it is first necessary to review the political and sociological conditions of the environment in which we live. Countries that are going through economic and production difficulties are subject to changes in the standard of living that significantly affect the formation of society, and poverty appears as a negative outcome. Individuals and groups of people experience such a phenomenon by indulging in vices and immoral activities, which create an environment prone to decay. Structures of society that violate security start the process of devastation of space and when we talk about the needs of multi-family residential complexes, in addition to the functionality and quality of housing units, the most important thing is security, which is a prerequisite for the formation of a healthy living environment. Other needs are free spaces, greenery, parking lots, and good connections with other locations, which significantly increase the quality of life and must be considered a 21st century standard that leads to more humane cities. Parts of cities affected by this disease seek purification in urban regeneration, and as a result of successful recovery, new city centers are created. The process of urban regeneration itself is very demanding, and in order for it to be successful, in addition to financial resources, the most necessary thing is the knowledge of various professions that will rationally dispose of investments and space. Examples of successful renovation projects in famous cities show that in addition to financial support and expertise, political support is also a very important aspect of implementation. It is the city municipalities or even the state that can be the main promoters of such ventures, inviting investors to invest funds as well as future users of renovated spaces, in order to reanimate abandoned areas together (Vaništa Lazarević,2003). The situation with Serbia is different. The change of the socialist regime brought with it a change in ownership structure, meaning that what was once social property became private. However, some public spaces still have unresolved ownership, which further complicates maintenance. Private ownership does not prevent people from jointly maintaining and arranging the spaces they use, but it has been shown that socialism took away the sense of community, if it even existed. Of course, aside from the necessary sense of contribution to the environment, financial limitations are often a restricting factor. The focus is directed towards survival, while unresolved political issues pointed towards a new war. During the gloomy period of transition, buildings and common areas of the residents slowly continue to deteriorate.

3. A CRITICAL REVIEW OF TWO EXAMPLES OF BEST PRACTICES IN URBAN REGENERATION IN EUROPE – AN ANALYSIS OF THE EXISTING CONDITIONS OF SELECTED AREAS

3.1. Pre-regeneration condition of Bijlmermeer neighbourhood in Amsterdam

Bijlmermeer is a residential urban neighbourhood located in the southeastern part of Amsterdam, separated from the city centre. After World War II, the Netherlands faced a housing shortage, prompting the need for the construction of a large number of apartments. Le Corbusier's urban design ideas served as the foundation for the modern, functional city of Bijlmermeer, designed to reduce high urban density. It was an innovative urban planning experiment in the Netherlands, integrating utopian principles to create a futuristic living environment for middle-class families. The original design featured large residential blocks with spacious, well-lit apartments, separated motor traffic, and dedicated pedestrian and cycling paths, all designed to improve living conditions (Humanity in action).

Construction of the residential blocks began in 1966, but by 1968, the massive and monotonous architecture was already criticized. Initially, investors and authorities were optimistic, but the middle-class target group was unwilling to live in the relatively expensive conditions. A total of 31 buildings, each 300 to 500 meters long with 11 floors, were quickly constructed (figure 1a). The apartments were offered at subsidized rates, attracting

poorer residents, mostly immigrants from Suriname, a former Dutch colony. Initially lacking a metro connection to the city centre, Bijlmermeer became known for poverty and crime, leading many residents to leave. Around 50% of the population was unemployed and dependent on social welfare. The area's distance from the city and poor public transport hindered access to employment, education, and culture. Bijlmermeer became a massive, underutilized complex with endless, monotonous corridors and ground floors used only for storage (figure 1b). The landscape, intended to be in the English style, was poorly maintained, creating a desolate atmosphere (Historiek).



(a) (b)

Figure 1: The appearance of Bijlmermeer residential blocks before regeneration: (a) Aerial view of the residential area, and (b) Corridor view of the residential buildings

3.2. The urban regeneration of Bijlmermeer and sublimation of project effects after implementation

The Bijlmermeer urban district faced challenges that were addressed through strategies based on modernist CIAM principles. The regeneration project unfolded in two phases during the 1990s and 2000s. The first focused on constructing a metro line, improving connectivity to the city centre and reducing isolation. Though the original plan included public facilities such as sports halls, swimming pools, police stations, and religious buildings, financial constraints delayed their construction until the 1980s. The second phase of regeneration focused on altering the apartment structures to resemble individual housing. Three main components form the basis of the regeneration strategy: social structure revitalization, management restoration, and spatial renovation. Spatial renewal covered 50-60% of the original area, involving the demolition of some buildings, subdivision of others into smaller units, development of new housing structures, and a tenant division into one-third social housing, one-third higher-income residents, and one-third homeowners to foster social cohesion (Figure 2a). Park guards were employed to keep an eye on the area, and the safety concerns were addressed by redesigning the landscaping to remove dense vegetation that obstructed sight and replace it with clearly defined and maintained green spaces (Figure 2b) (Helleman G., Wassenberg F., 2004).

When roughly 25% of the flats were still unoccupied in the early 1990s, the process of urban renewal and the ensuing sublimation of project effects got started. Efforts to maintain and enhance the district continued even if the complex was not valued correctly by the real estate market. This initiative gained support from the City of Amsterdam, the Zuidoost District Council, and the Nieuw Amsterdam housing association. Improving urban services and recreational facilities was one of the main initiatives to improve people's quality of life. Safety was prioritized through increased surveillance, community policing, and improved lighting in public spaces. New commercial and cultural facilities were also added to the neighborhood, including movie theaters, a new metro line, a football team, and more. Efforts also focused on improving green spaces and encouraging interaction among residents. In order to provide a more environmentally friendly and healthful living space, the project's environmental aspect involved developing sustainable design and waste management technologies. The district's reputation was greatly enhanced by these beneficial developments, which increased demand in the real estate market and made the region a more lively and appealing place to live (Helleman G., Wassenberg F., 2004).

Managing properties that were split up among multiple corporations was one of the earlier issues, which resulted in inefficiency and unhappy residents. A better solution was consolidating the management under a single company, improving responsiveness to residents' needs. Traffic and parking issues were also addressed, with free parking provided to residents. The initial architectural concept was found to have problems by architects, resulting in a massive and monotonous design. To improve environmental sustainability, several of

underground garages were transformed into waste collecting sites, and other ground-floor sections that had previously been unutilized were put to residential use. The regeneration project incorporated principles of New Urbanism, with the renovation of housing units offering various layouts for different social groups. Public amenities were developed within pedestrian-friendly distances, integrated with residential areas to create a mixed-use community. Open spaces were designed following Dutch architectural and urban design principles (https://garcia-somoza.com/en/noticias/amsterdam-la-transformacion-de-bijlmermeer/?utm_source=chatgpt.com).

After the completion of all regeneration stages, the Bijlmermeer district underwent significant transformation, with only fifteen of the original buildings remaining. Six buildings, located in the eastern part, were preserved as part of the Bijlmermeer Museum due to residents' desire to protect them from demolition. The regeneration project, the largest of its kind funded and promoted by the Dutch government, includes plans for additional parking, public and educational facilities, and new public transport lines. The district now features a lively environment with various public amenities, high-quality housing, and opportunities for contemporary living. The improvements in traffic connectivity to the city centre initially helped residents become part of Amsterdam's active life, but over time, the regeneration plans transformed Bijlmermeer into an independent hub of activity, evolving into a new urban centre. Constant communication with residents through surveys, meetings, and discussions played a crucial role in identifying and addressing issues. These efforts paved the way for a cleaner, healthier environment where people from various nationalities, religions, and financial backgrounds can find housing. Bijlmermeer has become a prominent example of preserving part of the modernist urban and architectural vision while adapting to the new needs and demands of residents.



(a) (b)

Figure 2: The appearance of Bijlmermeer residential blocks after regeneration: (a) Facade, and (b) Landscaped Green Spaces and Pedestrian Pathways

3.3. Pre-regeneration condition of Park Hill neighbourhood in England

The history of the Park Hill housing complex dates back to the period after World War II when many people were left homeless. Located on the site of the former Victorian-era "Cardboard Settlement," the complex replaced 800 houses with thirteen-story high-rise buildings, radically transforming the area. Designed by young architects Ivor Smith and Jack Lynn, the project aimed to include the residents in the regeneration process due to their attachment to the old community. They considered Le Corbusier's "Unité d'Habitation" to be a perfect example of healthy and sustainable multi-family housing. Completed in 1961, the complex's brutalist architectural style reflected the trends of the time (Municipal dreams; https://streetsinthesky.weebly.com/history.html).

Park Hill was built on a hill, with architects integrating the settlement into the terrain and surrounding landscape. To facilitate movement within the complex and ensure easy circulation, streets were organized horizontally, and ramps were designed for people with disabilities to minimize the need for elevators. The entire complex was connected to nearby parks and the city centre, including bridges, allowing residents to engage with the broader community. Each third floor was constructed with a different colour of flint brick, a revolutionary approach at the time. The size of the terraces allowed for the social functions of traditional streets, encouraging interaction, play for children, and even deliveries of essential goods. The project aimed to create a densely populated community that, despite its size, would function as a cohesive unit, sharing common values and traditions, an outcome made possible by the post-war sense of unity and nationalism (figure 3). The perception of Park Hill changed in the 1980s when it gained a reputation as one of the most

notorious housing estates in Britain, marked by high levels of crime, antisocial behaviour, and poverty. The steep decline began with the collapse of the steel industry, the main source of income and employment in Sheffield. The citywide economic crisis led to the closure of pubs and shops, once central to community life, while the complex's wide terraces and maze-like streets became hotspots for antisocial and criminal behaviour. As a result, Park Hill became an unsafe area, plagued by poverty and crime, and earned the nickname "a cloud of bad smell hanging over Sheffield," symbolizing the city's decline (Dezeen).



(a) (b)

Figure 3: The appearance of Park Hill residential area before regeneration: (a) View of the residential area, and (b) Facade

3.4. The urban regeneration of Park Hill and sublimation of project effects after implementation

Park Hill has served as a symbol of Sheffield's social, cultural, and political history since its founding in 1961. It started out as a cardboard settlement but developed into a strong social community and a shining example of brutalist architecture, providing residents and visitors to the open spaces with a safe place to live. However, after the collapse of the steel industry, the area became an epicentre of antisocial and deviant behaviour, with open spaces and abandoned buildings facilitating criminal activity. Improving Park Hill was the main objective, and it was a component of a larger plan for Sheffield as entirety. At the very forefront of modern design, the Park Hill plan aimed to build one of the nation's largest public housing estates, making a major contribution to the sustainable growth of the city. Modernizing the original design while emphasizing building quality development, public space activation for long-term safety and well-being, and greening the region was one of the regeneration's primary goals. Reorganizing residential areas and offering a diversity of apartment types were among the strategic goals. In 1998, English Heritage listed Park Hill as Grade II, recognizing its architectural and social significance despite proposals for its removal (Archdaily).

“Urban Splash“ company was enthusiastic about the brutalist architecture of Park Hill. The structures were stripped down to their concrete shells as an initial step in the rehabilitation process. Brightly coloured anodized aluminium panels were used to replace the exterior facade, providing a more vibrant contrast to the old walls. Concrete fences were replaced with specially designed ones, providing a higher-quality finish (Figure 4). Dark bedrooms were redesigned to allow more natural light by opening up elevations facing north and east. The northwest block's western face now features a glass-enclosed lift core and new spiral stairs made of stainless steel, providing stunning views of Sheffield. Windows were doubled in size, and patterned floor tiles and coloured chipboard details were added to entrances, enhancing the feeling of hospitality and ownership for residents. The interior featured exposed concrete walls, originally concealed, as a reminder of the building's history. Renovated apartments are more spacious and functional, with increased natural light, enhancing the quality of life. These initiatives sought to improve living standards and align with the principles of new urbanism. To further revitalize the area, new stores, pubs, restaurants, and bars were added in addition to the iconic buildings being restored. Many residents now claim the complex functions better than when it was first built, demonstrating the positive impact of regeneration based on new urbanism. This transformation has contributed to greater security, benefiting residents and users. This conversion and improvement project demonstrates how raising living standards can be achieved through multifamily housing complex revitalization.



(a) (b)

Figure 4: The appearance of Park Hill residential area after regeneration: (a) View of the residential area, and (b) Facade

The table 1. summarizes the project's outcomes, condensing the key points discussed in the preceding text. It outlines the transformation brought by the regeneration process, which aimed to address existing challenges and enhance the overall urban environment, creating a more sustainable and engaging community.

Table 1: Presentation of the sublimation of project outcomes Post-Regeneration in comparison to the Pre-Regeneration condition

Table	*Pre-Regeneration Condition*	*Post-Regeneration Condition*
Quality of residential	*Poorly functional and uniform housing units*	*Different types of housing units designed according to user needs and improved functional organization*
Resident safety	*Security compromised due to the rise of deviant and antisocial behaviour and the gathering of criminal*	*Improved due to the renovation of open spaces and the addition of public amenities*
Facade appearance	*Brutalist architecture and monotonous facades with a lack of windows*	*Renovation of facade materials, increased glass surfaces, and adding colours*
Arrangement of outdoor	*Neglected greenery without designated gathering spaces or pedestrian pathways*	*Rearranged green areas, organized pedestrian paths, and spaces for gathering and socializing*

4. EXAMINING THE POTENTIAL FOR IMPLEMENTING BEST PRACTICE EXAMPLES FROM EUROPE IN THE NEIGHBOURHOODS OF THE CITY OF NIŠ

4.1. Present condition of two multi-family housing complexes in Niš – neighbourhood *Krive Livade* and Old and New Railway Colonies

The *Krive Livade* neighborhood, built in the 1970s as a socialist-era multi-family residential complex, is the largest of its kind in Niš. Located on the city's former eastern periphery, it is bordered by the Nišava River to the north and Boulevard Nemanjića to the south. Its urban layout follows socialist planning principles, with housing units grouped into residential zones, featuring slab blocks (G+4 to G+12) and freestanding buildings (G+4 to G+16). Following socialist planning principles, the neighborhood was designed with well-structured functions, traffic organization, green spaces, and pedestrian connectivity (Figure 5a). It benefits from proximity to public transport (lines 6 and 13) and *Sveti Sava* Park. However, common socialist-era issues such as oversized, monotonous prefabricated architecture and insufficient parking (1 space per 20 residents) emerged early on, alongside the lack of originally planned commercial and social amenities. Due to factors such as housing privatization, land restitution, planning document revisions, and the rise of private capital, transformations within the block evolved over time. Investors often opted for low-cost additions, such as extra floors or attic conversions, without proper land acquisition or infrastructure upgrades. These modifications, frequently state-sanctioned, disregarded architectural integrity, safety regulations, and urban planning principles. Infill construction, where new ground-floor structures are added next to existing buildings or on open spaces, is a common post-socialist trend, primarily for commercial use. Another defining phenomenon is "garage capitalism," where residential ground-floor spaces are converted into small shops or service businesses. In *Krive Livade*, this was influenced by its proximity to the city center, location along a major road, and the presence of pre-existing commercial spaces from the socialist era. Urban development has reduced green spaces and created parking issues, with residents converting greenery into parking lots. Irresponsible actions by residents and developers are leading to the gradual collapse of urban environments, reducing green spaces and causing ecological problems such as heat islands. High population density and uniform, impersonal buildings contribute to social isolation, reducing opportunities for meaningful interaction and making these spaces less safe and livable (Djekić, 2016).



(a) (b)

Figure 5: The appearance of neighbourhoods: (a) *Krive livade*, and (b) New Railway Colonie



(a) (b)

Figure 6: The Situational plans with building heights (a) The analysed part of the Krive Livade neighbourhood, and (b) New and Old Railway Colonie

The Old Railway Colonie was established in 1940/41 as one of Niš's first modern residential areas, built for employees of the Yugoslav Railway Company. Together with New Railway Colonie, it forms a low-density multi-family housing complex, well-connected to the city center, but currently facing infrastructure and maintenance challenges (Vranić, 2012). The neighborhood, built in the spirit of modernist architecture, balanced social diversity without compromising housing quality, fostering an inclusive community (Figure 5b). Old Railway Colonie, though centrally located, functioned as a gated and semi-gentrified community, reinforcing both its physical and social identity. Since its construction, Old Railway Colonie has remained socially stable, with only two major interventions—in 1977 and 1994—when high-rise buildings were added on the eastern side. These changes hinted at future development, but most of the neighborhood remained unchanged. Although revitalization was long overdue, the city failed to recognize the need until 2004, when an urban plan was finalized without clear criteria for prioritizing building renovations (План детаљне регулације блока „Стара Железничка колонија“ у Нишу донешен на седници скупштине града Ниша 10. јуна 2004. године). Between 2004 and 2009, Old Railway Colonie underwent significant transformations, doubling building heights and altering its architectural identity. While security improved and housing capacity increased, these changes led to urban issues, including loss of green spaces, unregulated parking, and architectural inconsistencies. The uncontrolled expansions disrupted the modernist aesthetic, reduced natural light access, and created safety hazards due to mixed pedestrian and vehicle zones. Addressing these challenges requires targeted urban regeneration efforts to restore both residential buildings and shared open spaces.

4.2. Considering opportunities to apply case study principles at the conceptual level in the neighbourhoods of Niš

The urban regeneration project for the Old and New Railway Colonies could be led by either the residents or the local government, with city officials taking the lead to collaborate with urban planners, architects, and community representatives to develop a comprehensive plan. This initiative would aim to improve livability, infrastructure, and economic vitality, while residents' involvement would help expedite the project's

development and ease its realization. The aim of the urban renewal project for the Old and New Railway Colonies would be to enhance the quality of life by improving the space for both residents and visitors, with a focus on creating a more humane environment. Key objectives include the revitalization of recreational areas, improving safety measures, the renewal of residential buildings, and fostering social cohesion through community engagement. The project would also prioritize environmental sustainability and ecological improvements to create a vibrant and sustainable urban space that meets the growing needs of the community. The approach involving mass and cubist forms might preserve the cornices, but it would result in the loss of the slanted roofs that are present on all buildings in the area. This solution would require flat roofs, which could optionally be green and/or equipped with solar panels to reduce the consumption of non-renewable energy sources. To address parking issues, an underground parking solution would resolve conflicts between vehicular and pedestrian traffic, potentially increasing parking spaces and creating safer, more accessible pedestrian paths. This would free up space for greenery, improving the area's appearance and aligning with new urbanism principles, enhancing life quality for residents. A holistic approach would also include community education, consultations with residents for collaborative decision-making, and providing job opportunities for unemployed residents, promoting economic stability, security, and social integration.

The main initiators of the urban regeneration project on the block of *Krive Livade* would be the dissatisfied residents, who would require support from the city and investors to implement it. Architecture students or firms, in collaboration with the Urban Planning Institute, could also contribute by analyzing the current conditions and assessing residents' needs. In the case of the block on *Nemanjic* Boulevard, this could be done by addressing the limited parking, expanding green spaces, adding missing urban furniture, such as benches, playgrounds, and recreational areas, and introducing additional amenities to enrich the environment, and facilitate social interactions and create more opportunities for communal activities. Another goal is to promote the block to attract new buyers of apartments or business spaces, potentially increasing investor interest, and fostering social interaction among residents, encouraging their participation in actions that will improve their surroundings. The existing issue of insufficient green spaces could be addressed by transforming unused or underutilized concrete areas into green zones, thereby improving the microclimate and offering a more pleasant environment for residents. Additionally, greening the building facades would not only create a more attractive aesthetic but also help mitigate the effects of heat during summer. The parking issue, a major concern for the area, can be resolved through the construction of an underground parking facility, creating valuable surface space for green areas, pedestrian paths, and additional amenities. Moreover, encouraging the use of public transportation, especially given the proximity to the city center, could help reduce the number of cars on the streets, further enhancing the area’s walkability and reducing traffic congestion.

5. CONCLUSION

Based on the observed problems described in the previous chapters, it can be said with certainty that the regeneration of the analyzed areas in the city of Niš is very necessary and absolutely possible. By analyzing examples of good practice, the conclusion was drawn that it is possible to integrate certain principles in selected blocks in Niš where similar problems were observed as in successfully implemented examples in the Netherlands and England. The similarities we noticed were the mismatch between the architectural design and functionality of the space with today's trends in architectural design. The lack of gathering space resulted in a lack of social interaction among the users of the space. All of these problems have initiated regeneration in the analyzed examples abroad. In Serbia, the main problem is the financing of these projects, because very often the investor's request is a quick profit, without much need to make the solution high-quality from an urban and architectural perspective. What would be the main problem, and it is related to this approach to investor projects, is their sustainability. Although there would be large financial resources for the implementation of urban regeneration projects, it is necessary to take into account that their constant maintenance is necessary, as well as the will of the users to preserve these spaces in order to constantly adapt to changing living standards. That's why community and a sense of social cohesion is very important, because for the sake of the same goal, which is a quality space, people want to be involved and contribute to further improvement.

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PARTICIPATORY PLANNING IN MINING AREAS – THE RESEARCH OUTLINE OF THE MINIPART PROJECT

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ABSTRACT

This paper presents the research outline of the MINIPART project – Improving Participation in Spatial Planning of Mining Areas. The project is developed and supported under the PRISMA program by the Science Fund of the Republic of Serbia, grant #7598. It addresses issues arising from large-scale mineral extraction, which often leads to substantial changes in local communities and the environment, predominantly negative ones (e.g. monofunctional economy; environmental degradation; health issues; and resettlement). Opposition from communities and experts against mining in Serbia has intensified since the 2000s, underscoring the significance of meaningful public participation in urban and regional planning of mining areas.

MINIPART is designed as an exploratory study that employs both qualitative and quantitative research methods. Its objective is to identify the most suitable participation methods, tested and tailored to stakeholders in mining areas, including vulnerable groups. A database of participatory methods will be developed through a literature review, insights gained from a study visit to a mining area abroad, and discussions with external collaborators. Best-tailored methods will be selected through a survey in the case study mining area – the City of Bor and Majdanpek Municipality – as well as interviews with stakeholders and testing with focus groups. The novelty of this project lies in the active involvement of diverse stakeholders in the development of the most appropriate participatory methods.

Keywords: *participation; mining areas; spatial planning; scientific project; Serbia*

1. INTRODUCTION

The aim of this paper is to present the MINIPART scientific national project, starting from explaining the initial scientific-financial surrounding that enabled it at the first place, i.e. the Science Fund of the Republic of Serbia and the specific PRISMA program. Further, this research aims to reveal the research outline of the MINIPART project, through introduction of the theoretical analysis of participatory planning experiences in mining regions in Serbia and worldwide. Applied methodology and planned dissemination of results will be discussed, as well as some of the already accomplished results.

The Science Fund of the Republic of Serbia is a public organization established in March 2019 with the primary aim of providing continuous support for scientific and research activities. Funding for its programs is secured through the budget of the Republic of Serbia, as well as international support - primarily from the European Union and the World Bank. Projects within the Fund's programs are financed through public calls for proposals.

The public call for the PRISMA program was launched in June 2022. This program is intended for scientists and researchers employed in accredited research organizations in the Republic of Serbia. It supports basic and applied research projects in all scientific fields without predetermined topics (Science Fund of the Republic of Serbia, 2025). The program allows researchers to define their own research agendas, form their own teams, and collaborate with relevant laboratories, research centers, and businesses in Serbia and worldwide. One of its key objectives is to engage young researchers in scientific work and strengthen the professional capacities of researcher team members. The total budget for the program is 25,000,000 euros. A total of 656 project proposals were submitted. The Program Evaluation Committee, composed of international experts, conducted a two-stage evaluation process. According to the final ranking list published in October 2023, 97 projects were approved for funding. Within the Social Sciences and Humanities sub-programme, only 11 projects were selected. The MINIPART project – Improving Participation in Spatial Planning of Mining Areas – was ranked 4th in this category and approved under grant #7598. It will run for 36 months (till January 2027) with a total budget of 196,463.33 EUR.

Researchers from the Institute of Architecture and Urban & Spatial Planning of Serbia (IAUS) formed a small multidisciplinary team in collaboration with the Technical Faculty in Bor (TFBor), the Faculty of Geography (UBGEF) and the Institute for Philosophy and Social Theory (IFDT), all affiliated with the University of Belgrade. This team brings together sociologists, technological and physical chemist, metallurgical and mining engineer, environmental and political scientist, and urban and regional planers with expertise in participatory planning and development of mining regions. In line with the requirements of the PRISMA call, a young researcher – a PhD student from IFDT – is involved in the project. The team's collaboration is further strengthened by the involvement of a diaspora expert in participatory planning from University College Dublin, Ireland, and an international expert in mining community development from the University of Eastern Finland.

2. THEORETICAL BACKGROUND

Large scale resource extraction induces diverse and significant negative impacts on local community and environment, rising issues of both social and environmental justice (Chauhan, 2018; Manojlovic and Kabanga, 2023). Therefore, mining companies that neglect to implement corporate social responsibility (Jenkins and Yakovleva, 2006) and fail to collaborate effectively with local communities risk losing public approval, often referred to as the "social licence to operate" (Conde, 2017; Heffron et al., 2021). This lack of local community approval frequently leads to considerable challenges that are hard to handle - such as worker strikes and public protests, which disrupt production and decrease profitability, and also have negative impact on stock prices (Tsotetsi, 2022). A major factor driving opposition to mining activities is the absence of trust within the local community (Lesser, 2021). In recent decades, conflicts among local communities, mining companies, and governments have been on the rise globally, including in the EU and Serbia (Mononen et al., 2022; Stepanovic, 2022). Negative events at the local level can shape public perceptions of mining on a regional or even transnational scale, as illustrated by the controversy surrounding the Rio Tinto Jadar mine project in Serbia (Ivanović et al., 2023; Proctor, 2022).

In Serbia, government and mining companies often deliberately overlook citizens' perspectives and social values related to proposed mining projects (Maričić, 2014; Ivanović et al., 2023). Whether public participation is genuinely meaningful or merely manipulative largely depends on several factors: the attitudes of investors and experts, the timing of public involvement in decision-making, the types of participation methods employed, and whether decisions are made independently of public disapproval and social consequences. Without a comprehensive methodology for public involvement, polarization between opposing groups tends to be driven by political agendas and power dynamics rather than by accurate and transparent information (Taylor et al., 2004).

The Planning and Construction Act (2009) of the Republic of Serbia mandates public consultation and participation, including early public insight since 2014 (Nikolić, et al., 2021), in urban and regional planning processes. However, in practice, only the minimal, legally required level of participation is typically implemented, while decision-making often remains opaque and subject to manipulation (Maričić et al., 2018; Slavković et al., 2021). Balancing individual and collective interests presents a significant challenge for urban and spatial planners as well as decision-makers. In this context, understanding the social values and attitudes of affected communities through genuine civic participation is crucial for achieving fair and sustainable planning outcomes.

Beyond formal participatory methods defined in legislation, developed societies actively develop and use informal methods. Informal participation methods play a crucial role in broadening stakeholder engagement, particularly in the context of mining projects where trust in formal institutions is often low (Pantić, et al., 2021). The integration of digital technologies into participatory processes significantly enhances their reach and effectiveness by enabling wider and more flexible involvement. Virtual participation tools allow stakeholders to engage in discussions and decision-making regardless of geographical or time constraints, reducing logistical burdens and financial costs for both organizers and participants (Pantić & Čolić, 2023). Moreover, digital platforms facilitate real-time interaction, data collection, and transparent communication, fostering inclusivity and responsiveness. To fully harness the advantages of informal participation, it is essential to embrace digitalization and develop user-friendly, accessible technologies that empower diverse stakeholders to actively shape mining-related decisions (Imottesjo, 2018; Dubov & Shoptaw, 2020; Rajhans, 2020).

3. RESEARCH OUTLINE OF THE MINIPART PROJECT

Development in large-scale mineral extraction areas leads to significant changes in both local communities and the environment. While it can bring economic progress, mining and related activities also generate negative impacts, such as a monofunctional economy, environmental degradation, health issues, involuntary resettlement and more (Maričić, 2014). In Serbia, the accumulation of these problems and the absence of effective solutions have led to increasing dissatisfaction and protests among local communities and experts, particularly since the 2000s. A key contributing factor to this discontent is the lack of meaningful public participation in the planning processes of mining areas.

The primary goal of MINIPART is to identify the most effective participatory methods tailored to all stakeholders in mining areas. These methods will empower stakeholders to meaningfully influence decision-making processes, ultimately improving their quality of life and work—socially, environmentally, and economically—while promoting sustainable development. The project defines a few specific objectives, too:

- Develop a comprehensive repository of participatory planning examples in mining areas.
- Actively engage all stakeholders—including citizens, the mining industry, government agencies, NGOs, and environmental groups—through interviews, surveys, and focus groups to identify the most effective participation methods.
- Address the needs of vulnerable groups such as women, ethnic minorities, rural populations, persons with disabilities, the elderly, and youth to ensure inclusive participation strategies.
- Design and refine participatory approaches that foster meaningful and inclusive community engagement in mining-related planning and development.
- Disseminate findings widely to project participants, national and local government bodies, NGOs, citizens in Serbia and beyond, academia, professionals, and the general public.

The MINIPART project is an exploratory study that uses a combination of qualitative and quantitative research methods. Its goal is to identify the most effective participation methods tailored to stakeholders in mining areas, including vulnerable groups. A database of participatory methods will be created through a literature review, insights from a study visit to a mining region in Ireland and discussions with external collaborators. The most suitable methods will be selected based on a survey conducted in the Bor and Majdanpek mining areas, followed by interviews with stakeholders and testing with focus groups. SPSS software will be used to analyse the primary data collected through the survey, while a grounded theory approach will be applied to the audio data from interviews and focus groups.

Disseminating the project's findings through multiple channels—including the project website (available in both Serbian and English), high-impact scientific journals, international conferences, and a comprehensive Layman's report—will play a crucial role in raising awareness and fostering engagement among a wide range of audiences. By making the research outcomes accessible to academia, professionals, decision-makers, and the general public, the project aims to inspire and motivate these groups to actively participate in meaningful public involvement processes. This inclusive approach will not only enhance knowledge exchange but also promote informed decision-making and collaborative planning, ultimately contributing to more transparent and democratic governance in mining regions and beyond.

3.1. Methodology applied in the MINIPART project

The MINIPART project assumes that participatory methods can be identified and developed only through collaboration with end users, including citizens, the business sector, and governmental and non-governmental

organizations. Therefore, MINIPART is structured as an exploratory study integrating both qualitative and quantitative research methods. Since participation is particularly relevant in regions undergoing major spatial changes, such as mining areas, the fieldwork focuses on one of Serbia's most prominent mining regions—the Bor and Majdanpek mining area. This region faces significant social and environmental challenges, including environmental pollution, resettlement, inadequate expropriation compensation, and the neglect of workers' rights. These issues have led to conflicts and increased civic activism against the mining company, manifesting in protests and road blockades, especially since 2019 (Balkan Green Energy News, 2019; N1 Belgrade, 2020; Bor030, 2021; Radio Slobodna Evropa, 2022).

The search for the most suitable participatory methods follows a funnel approach, with each phase narrowing down to the final selection of methods. The first phase involves selecting participatory methods through desktop analysis, which includes reviewing literature, projects, reports, and other documents. Discussions with external collaborators and a study visit to the Tara mine in Ireland provide additional insights and perspectives from the mining industry.

The second phase focuses on assessing the knowledge and attitudes of urban and rural communities in the Bor-Majdanpek mining area. A representative sample of 300 respondents from a total population of 60,000 is surveyed to identify the most relevant aspects of participation that motivate or enable their involvement in the planning process. The results help narrow down the initial pool of participatory methods. SPSS software is used to analyze the survey data.

The feasibility of implementing new participatory models in planning is to be evaluated through in-depth interviews with key stakeholders who influence the selection of participation methods in decision-making. These stakeholders include representatives from ministries responsible for spatial planning, mining, and environmental protection, local governments of Bor and Majdanpek, public institutions involved in urban and spatial planning, national spatial planning bodies, national and local NGOs, and public enterprises managing nature protection near mining sites. Coding the interview transcripts using a grounded theory approach helps identify criteria that decision-makers consider when selecting effective participatory methods, the potential for introducing new methods, and the factors influencing their adoption.

The final phase of narrowing down participatory methods is based on focus group discussions. A workshop is to be organized in the case study area (City of Bor), bringing together representatives from governmental, non-governmental, business/industry, and civil sectors. In addition, focus groups are structured to represent vulnerable groups identified as disadvantaged in participation studies: youth, the elderly, rural populations, people with disabilities, ethnic minorities, and women. Participants discuss the most suitable participatory methods within and between their groups. Around 30 participants are expected, with some taking part in multiple focus groups.

The focus group workshop provides an opportunity to test selected participatory methods. Participants engage with a variety of methods, ranging from traditional approaches like submitting written complaints to less conventional methods like online surveys (Braun et al., 2020) and innovative solutions using E-applications (Philpot et al., 2019). An E-participation application is to be developed within the project to facilitate this process. Based on the data collected from the workshop, the project team makes the final selection of the most suitable participatory methods for mining areas. The results are to be published in a Layman's report to inform the general public.

3.2. Dissemination of results

In addition to achieving high-quality results, it is essential to effectively promote the project and its results to academia, professionals, citizens and government stakeholders. This is also expected to enhance the visibility and positioning of team members within the academic community. Therefore, well-planned dissemination activities are crucial. To maximise the visibility of the MINIPART project, the team has planned several dissemination strategies, including the creation of a bilingual website (Serbian and English) at www.minipart.rs. The website serves as a central platform for sharing project results. Other dissemination activities include presenting project results at national and international conferences, publishing research findings in high-impact international scientific journals, and releasing an international monograph and a Layman's report with practical recommendations for a broader audience. All the project achievements are publicly accessible on the project website, which will remain active for at least three years after the project concludes. Shared results include a database of participatory methods, research on participatory methods, an infographic database, an e-participation application and Layman's report. Publishing exclusively in open-access,

high-impact journals will increase the visibility and citation of the project results. The international monograph will be published in English and involve not only team members but also researchers from other SROs and abroad. The international monograph, published in English, will feature contributions not only from team members but also from researchers from other Serbian Research Organizations (SROs) and international collaborators. This collaborative approach will enhance the project's visibility within global academic communities. In addition, scientific publications will be accessible through the RAUMPLAN repository (http://raumplan.iaus.ac.rs) – the Repository of Architecture, Urbanism, and Planning at the Institute of Architecture and Urban & Spatial Planning of Serbia (IAUS).

The dissemination strategy is tailored to maximize impact:

- Journal Publications will enhance international visibility and academic recognition for team members;
- Open Data (e.g., databases) will be made available for other researchers to utilize in their studies, fostering further research and collaboration;
- Layman's Report will serve as a practical resource for national and local governments, professional institutions in urban and spatial planning, public companies, industry stakeholders, and NGOs. It aims to improve participatory methods, enhance cooperation with citizens, and empower communities and NGOs to advocate for the implementation of effective.



(a) (b)

Figure 1: (a) Project logo, and (b) Project webpage layout

4. PRELIMINARY RESULTS

The preliminary results presented in this chapter refer to the first year of the MINIPART project, which constitutes one-third of the project's total duration. This initial phase focused on comprehensive data collection from both secondary and primary sources, laying the foundation for subsequent research activities.

During the first year, the project team conducted extensive desktop research on academic literature addressing public participation in mining areas. In addition, mining-related urban and spatial plans in Serbia were gathered and analysed, alongside a review of public participation methods outlined in European legislation. These secondary sources provided essential insights into existing frameworks and identified gaps in participatory practices within mining-affected communities.

Primary data collection efforts included a study visit to the Tara Mine (Ireland) in September 2024, enabling direct observation and engagement with stakeholders involved in participatory processes. Furthermore, a survey was conducted among the local population in the City of Bor and Majdanpek during the summer of 2024, aiming to assess public awareness, engagement levels, and perceptions of participatory governance in mining areas.

A portion of the collected data has already been made publicly available on the project's webpage, where a dedicated database showcases urban and spatial planning documents related to mining areas. The remaining data are currently being analysed for publication in peer-reviewed research articles. Upon publication, additional databases will be integrated into the project website, facilitating access to information through interactive filtering options. These databases will allow users to search for academic papers on participation in mining areas by country, methodology, and keywords, as well as to explore both legally binding and informal participatory methods employed in different European/worldwide contexts.

To date, the preliminary results of the project—encompassing survey findings and desktop analysis—have been disseminated through a collaborative presentation at University College Dublin (September 2024). Additionally, findings were shared at the International Conference on Public Policy and Public Administration (ICPPPA-25), held in January 2025, in Salvador, Brazil. The conference presentations, along with proceedings, are accessible via the project webpage and the RAUMPLAN repository.

Initial findings from the project highlight several critical observations:

- Legally binding participatory methods in Europe exhibit only minor variations across countries. However, the diversity and abundance of informal participatory approaches documented in the literature far exceed those found in official regulations;
- Public familiarity with participatory opportunities in mining areas remains insufficient. A key contributing factor is the low level of trust in institutions, compounded by inadequate dissemination of information regarding participation mechanisms.

The second year of the project, scheduled for 2026, is expected to yield significant outcomes through further dissemination at both national and international conferences and the publication of several research papers. This phase will also involve the collection of additional primary data through expert interviews and focus groups, aiming to deepen the understanding of participatory practices in mining-related spatial planning.

5. CONCLUSIONS

The MINIPART project is a research initiative funded by the Science Fund of the Republic of Serbia under the PRISMA program. Its primary objective is to identify the most effective participatory methods tailored to diverse stakeholders in mining areas, ensuring that participation is a meaningful process rather than a formality. By fostering inclusive engagement, the project aims to mitigate tensions commonly associated with large-scale mining projects.

This three-year project employs a mixed-methods approach, combining secondary data collection with primary research through surveys, expert interviews, and focus groups. The research benefits from the collaboration of four Serbian scientific institutions—the Institute of Architecture (lead partner), the Faculty of Geography, the Technical Faculty in Bor, and the Institute for Philosophy and Social Theory (University of Belgrade)—as well as external partners from University College Dublin (Ireland) and the University of Eastern Finland. Key activities have been successfully completed, including a study visit to Ireland and a survey conducted in Bor and Majdanpek.

Preliminary findings from the first year emphasize the need to enhance institutional transparency and communication to strengthen public participation in decision-making processes related to mining areas. As the project advances, these insights will continue to inform the development of more effective participatory governance frameworks, contributing to sustainable and socially responsible mining practices.

ACKNOWLEDGEMENTS

This research was supported by the Science Fund of the Republic of Serbia, Grant #7598 and the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Grants No. 451-03-66/2025-03/200006 and 451-03-137/2025-03/200091).

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GIS-BASED EVALUATION OF URBAN GROWTH PATTERNS IN SKOPJE'S PERIPHERAL ZONES

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ABSTRACT

The rapid urban expansion in North Macedonia's Skopje region, fueled by population growth, migration, and economic development, is transforming the land use dynamics, especially in the city's peripheral zones. However, there is a research gap in understanding how these changes impact sustainable land management and the implications of governance policies on urban expansion. This study addresses this gap by analyzing the patterns, drivers, and consequences of urban growth within the Skopje region, emphasizing the role of decentralization and policy decisions in shaping urban landscapes. Using Geographic Information System (GIS) tools and databases like Corine Land Cover (CLC) and Microsoft Building Footprints, the study provides a detailed cartographic view of land use transformation, focusing on case studies in Vizbegovo (first contact zone) and Ilinden 1 (second contact zone). Findings indicate a significant increase in built-up areas - 300% in Vizbegovo and 92% in Ilinden 1 between 2002 and 2020 - primarily due to industrial and commercial development. The study reveals that unchecked urbanization is resulting in the degradation of agricultural land and natural habitats, underscoring the need for sustainable urban planning frameworks. This research contributes valuable insights into urban monitoring and data-driven evaluation, informing policymakers, urban planners, and local authorities on the importance of balanced spatial planning to ensure sustainable growth. By implementing comprehensive governance models, the Skopje region can address urbanization challenges while preserving essential ecological and agricultural areas for future generations.

Keywords: *urban expansion; GIS; Skopje region; digital transitions; regional observation*

1. INTRODUCTION

Urban expansion, a global phenomenon driven by population growth, policy, and economic development, presents complex challenges for sustainable urban development. In North Macedonia, the degree of suburbanization is recognizable through the uncontrolled dispersion of built facilities (Gorin, et al., 2022). Functional transformations in the country tend to occur in the peri-urban zone, between the urban and the rural areas. In this space, there are usually deviations from the planning directions for the arrangement of settlements and the area as a whole. These challenges are particularly pronounced in rapidly developing regions of the country like the Skopje Region, where peripheral zones often experience significant transformations in land use and built environment.

This research presents a fragments of previous broader studies on the urban dynamics of the Skopje Region (Veljanoski, 2024a; Veljanoski & Markoski, 2025), analyzing built facilities and urban agglomerations through global datasets and publicly available information. By examining two distinct case studies within its periphery, the study investigates urban expansion patterns over the past two decades. Vizbegovo, a cadastral municipality within the first contact zone, and Ilinden 1, an agglomeration unit in the second contact zone of the general urban plan (GUP) of the city of Skopje, are selected as areas with most significant and evident development which offer a unique opportunity to examine the diverse factors influencing urban growth and land use change in different peripheral contexts.

By employing GIS-based methods to analyze changes in built-up areas and land use patterns over time, this study aims to provide valuable insights for informed planning and policy decisions, contributing to more sustainable urban development in the Skopje Region

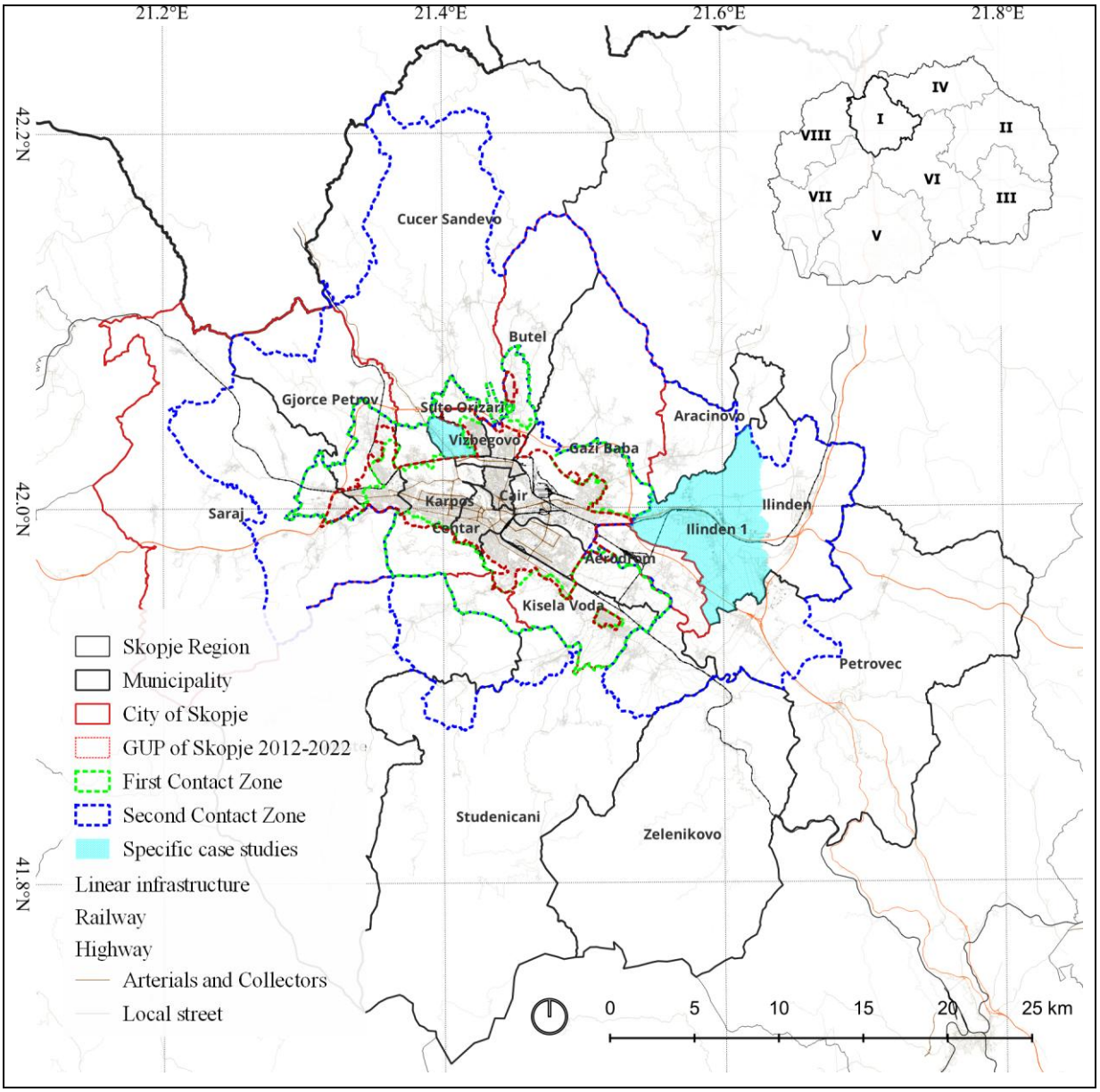


Figure 1: The administrative-territorial organization of the Skopje Region, exanimating the relation between the general urban plan (GUP), first and second contact zones, and the two specific case studies

2. THE FAILURE OF THE CLASSICAL URBANIZATION MODELS IN CONTEMPORARY URBAN EXPANSION

Urbanization theories offer various perspectives on city growth and development. Classical models like concentric zone (Burgess, 1925), sector (Hoyt, 1939), and multiple nuclei theories (Harris & Ullman, 1945), while foundational, often fall short of explaining contemporary urban expansion, particularly in rapidly developing contexts. Classical urban models also fail to account for the prevalence of informal settlements in developing regions. A study by Hill & Lindner (2010) emphasizes that rapid urban growth under poverty has outstripped the capacities of planning authorities, leading to unplanned urban expansion that these traditional models cannot adequately represent. The increasing diversity of urban areas worldwide, in political, economic, social, and cultural terms, has necessitated a revised role for urban planning. Traditional models, which often assume homogeneity, struggle to accommodate the complex socio-economic patterns observed in rapidly urbanizing areas of developing countries (Jenkins et. al., 2007). Contemporary urban planning must consider the dynamics of informal settlements, cultural and economic diversity, and technological advancements to effectively address the complexities of modern urban growth.

3. STUDY AREA AND CONTEXT

The Republic of North Macedonia covers a total area of 25,713 km², with a population of 1,836,713 as per the 2021 census. The Skopje Planning Region, located in the northern part of the country and extending into the Skopje Valley, occupies 1,812 km², accounting for just 7.3% of the country's total land area. However, it is home to 607,007 inhabitants, representing 33% of the national population, and has the highest population density in the country, at 336 inhabitants per km². Additionally, the Skopje Planning Region contributes significantly to the national GDP, with 43% of the total economic output, according to 2018 data from the State Statistics Office.

The city of Skopje, the capital and a separate unit of local self-government, covers 569.34 km², or 31.5% of the Skopje Planning Region. It spans 22 km in length and 11 km in width, with its urban limits defined by the General Urban Plan (GUP) for the period 2012-2022, which covers 87.9 km², or 4.85% of the region's total area. As of the 2021 census, Skopje's population is 607,007, with 69.6% living in urban centers and 30.4% in rural areas.

4. DRIVERS OF URBAN EXPANSION IN THE SKOPJE REGION

Understanding the drivers of urban expansion in the Skopje Region is essential for effective planning and management. These drivers are diverse and interrelated, spanning demographic, economic, and policy factors.

- **Demographic Drivers**: Population growth, fueled by natural increases and migration (rural-urban and international), is a primary driver of urban expansion. Studies emphasize migration's role in suburban growth, often at the expense of agricultural land (Hegazy & Kaloop, 2015; Melchiorri et al., 2018; Hennig et al., 2016). In Skopje's first contact zone, comprising 20 settlements, the population reached 61,333 in 2021, accounting for 10.1% of the regional total, a 15.6% increase since 2002. The second contact zone, with 57 settlements across 14 agglomerations, grew to 96,970 residents (16%), marking a 15.2% rise (Veljanoski, 2024a). Shifting household structures and rising housing demand further drive expansion.
- **Economic Drivers**: Economic growth, industrialization, globalization, and land market dynamics are critical influences on urban development (McCann, 2013). Skopje's transitional zones reflect these changes, with 53.4% of built-up areas within city boundaries. Peripheral zones account for 40%, with 15.8% in the first contact zone and 24.2% in the second. Industrial units occupy 6.74 km², with 62.9% within the General Urban Plan (GUP) and 36.3% in peripheral areas, showing concentrated urban-industrial development alongside peripheral expansion (Veljanoski, 2024a).

- **Policy and Planning Drivers**: Land-use policies, zoning regulations, infrastructure investments, and decentralization significantly influence urban expansion. The 2004–2007 decentralization program and the 2002 Law for Local Self-Government in North Macedonia significantly influenced development patterns by empowering municipalities in planning and implementation.

5. APPLIED METHODOLOGY AND SOURCES

The research employs a linear process using QGIS software to analyze geospatial data, remote sensing of land cover changes, built facility data, planning documents, and satellite imagery, with results presented in mapped and tabulated formats.

5.1. Geospatial datasets for remote sensing and land use (LU) and land cover (LC) classification:

The analysis of land use (LU) and land cover (LC) changes is based on data from existing geospatial datasets, classified and developed by long-term Earth observation missions which uses high-resolution satellite data to produce digital LU and LC maps of Functional Urban Areas (FUA) for the most populated cities in Europe:

- Corine Land Cover (**CLC**)
- Urban Atlas (**UA**)

5.2. Data sources for detection and analysis of built-up area:

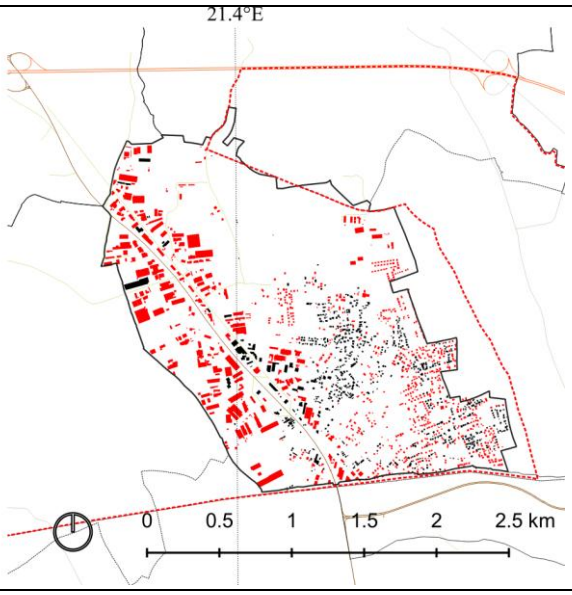
Built facilities are a basic generative element of urban expansion and are analysed through GIS data processing. Two additional sources are used to upgrade the database for this procedure, namely:

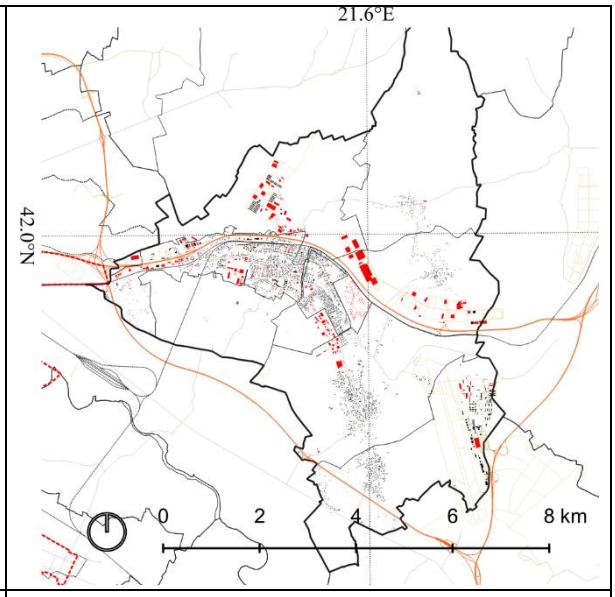
- **BingMapsAI** - Microsoft Building Footprints
    - Retrieved on 15. October 2022
    - Parts: 00051; 00179/
- **OSSP** - Distribution Portal of the Real Estate Cadastre Agency
    - Order made on 1. November 2022
    - Sheet number: 682 – 3 – 3; 682 – 3 – 4; 732 – 1 – 1; 732 – 1 – 2/

The GIS model for the Skopje region in 2022 aggregates data on 129,000 built facilities, with 10.1% sourced from the Real Estate Cadastre Agency (2.5 km² built-up area) and 89.9% from Microsoft's AI mapping program (22.2 km² built-up area), processed into tabular documentation detailing features like surface, region, and purpose.

5.3. Planning documentation applied at national and local levels:

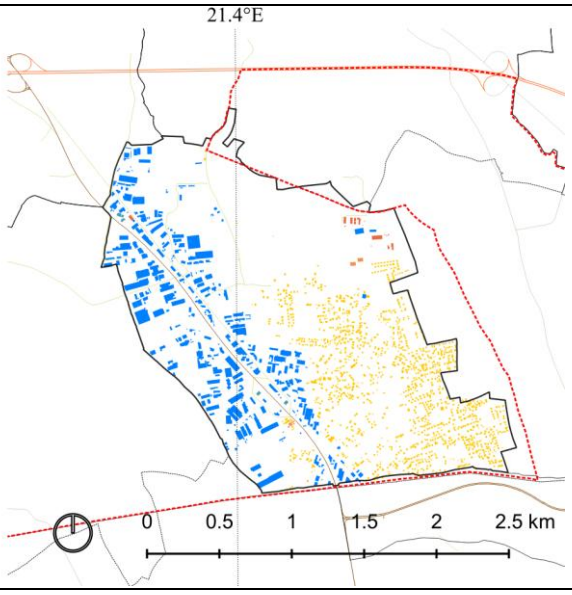
The research examines specific case studies within Skopje's first and second contact zones, analyzing detailed urban plans from 2008 to 2018, aligned with the hierarchical spatial planning framework comprising the regional spatial plan, Skopje's general urban plan (GUP), and detailed urban plans. Two sectoral studies that precede the final version of the GUP and look at the relationship between the general planning boundaries of the city of Skopje and its immediate surroundings were consulted (Penev, 2011; Trpenoska-Simonovikj & Lukikj, Korobar, 2022). These sectoral studies focused on Skopje's contact zones, defining two areas: individually recognized settlements in the city's immediate periphery (first contact zone) and grouped agglomerations of suburban villages in its wider periphery (second contact zone), based on specific criteria and relationships with the city.

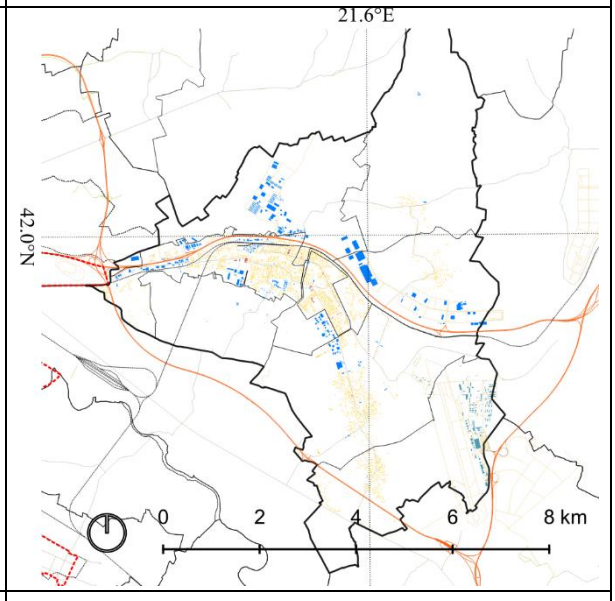




Vizbegovo | **Ilinden 1**

2002		2020		Σ		*I*		2002		2020		Σ		*I* (%)	
km²	%	km²	%	km²	%	*i*	%	km²	%	km²	%	km²	%	*i*	%
0.13	24.3	0.39	75.7	0.52	100	400	300	0.69	51.9	0.64	48.1	1.33	100	192	92
M=1:50,000								M=1:150,000							





Vizbegovo | **Ilinden 1**

	2002		2020		*I*			2002		2020		*I*	
	km²	%	km²	%	*i*	%		km²	%	km²	%	*i*	%
A1	0.09	67.7	0.19	36.6	211	111	A1	0.47	69.3	0.54	40.9	115	15
G2,G3, G4	0.04	30.6	0.32	61.1	800	700	G2,G3, G4	0.09	13.6	0.60	45.1	666	566
M=1:50,000							M=1:150,000						

Figure 2: Chronological trends of the built-up area and planning use class for the territorial fragments of the cadastral municipality of Vizbegovo and agglomeration of Ilinden 1, 2002-2020

5.4. Satelite data:

The historical position is determined using an orthophoto map for a period beginning with 2003. The material is taken from the online platform of Google Earth Pro and is georeferenced in the appropriate research datasets:

- Google Earth Pro V 7.3.6.9345 (August 18, 2002). Skopje region. Cadastral Municipalities of Ilinden, Marino, Kadino, Mralino, Bunardzik, Ajvatovci. 41O59'41.70"N, 21O37'03.79"E, Eye Alt 11625 ft. Landsat / Copernicus. Maxar Technologies 2023.
- Google Earth Pro V 7.3.6.9345 (May 20, 2003). Skopje region. Cadastral Municipality of Vizbegovo. 42O02'19.09"N, 21O24'15.67"E, Eye Alt 16640 ft. Landsat / Copernicus. Maxar Technologies 2023

6. RESULTS

The broader analysis revealed significant expansion in the north-eastern and south-western peripheries of Skopje. These areas transitioned from predominantly agricultural land to mixed-use urban zones, often lacking coordinated planning and infrastructure. This section presents a comparative analysis of built-up area growth and land use changes in two case study areas within Skopje's peripheral zones: Vizbegovo and Ilinden 1, representing the first and second contact zones, respectively. The analysis examines chronological trends between 2002 and 2020, focusing on:

- Percentage of built-up area
- Dominant land use classes

6.1. Growth of Built-Up Area

Vizbegovo experienced a dramatic increase in built-up area, with a growth index of 400, representing a 300% increase between 2002 and 2020. Ilinden 1 showed a substantial but less pronounced growth, with an index of 192, indicating a 92% increase over the same period.

6.2. Changes in Land Use

Two dominant land use classes were identified in both case studies:

- Class G: Sub-classes G2, G3, and G4.
- Class A: Primarily sub-class A1 (housing in residential houses).

Other land use classes represented a significantly smaller percentage and are not included in this analysis.

Vizbegovo: In 2003, Class A1 dominated with 0.09 km² (67.7%) of the total built-up area, while Class G (G2, G3, G4 combined) occupied 0.04 km² (30.6%). By 2020, Class G became dominant with 0.32 km² (61.1%), surpassing Class A1, which occupied 0.19 km² (36.6%).

Ilinden 1: Similarly, in 2003, Class A1 dominated with 0.47 km² (69.3%), while Class G comprised 0.09 km² (13.6%). By 2020, Class G had grown to 0.60 km² (45.1%), while Class A1 remained substantial at 0.54 km² (40.9%).

6.3. Growth Trends by Land Use Class

The growth of Class G was significantly higher than Class A1 in both case studies. In Vizbegovo, Class G experienced an 800-point growth index (700% increase), while Class A1 grew by 211 points (111% increase). In Ilinden 1, Class G showed a 666-point growth index (566% increase), while Class A1 increased by 115 points (15% increase).

These findings reveal a drastic expansion of production, distribution, and service-related land uses in both case study areas, outpacing the growth of residential housing, although residential growth remains notable. This trend reflects the broader development patterns observed in Skopje's suburban region.

7. DISCUSSION AND CONCLUSION

The cartographic and alphanumeric results of this research inform a methodology for continuous regional observation of potential growth and urban expansion. The rapid growth of Class G land uses (production, distribution, and services) in Skopje's peripheral zones, outpacing residential development, highlights critical challenges for sustainable urban planning. This unbalanced growth exerts pressure on infrastructure, contributes to environmental degradation, and exacerbates social inequalities. To address these issues, this study recommends the following:

- **Integrated Land-Use Policies:** Zoning regulations must balance economic activities with residential areas, green spaces, and public amenities. Adopting integrated policies promotes more livable and sustainable communities (Hall, 2002).
- **Community-Centered Design**: Engaging local communities in planning ensures that development aligns with residents' needs. This participatory approach identifies priorities for infrastructure and public services, fostering equitable outcomes, by multiple avenues of engagement, including quantitative data collection, qualitative photo and text inputs, and integrative analytics, all spatialized through GPS and mapping (Mondschein et al., 2019).
- **Strategic Infrastructure Investments:** Strategic Infrastructure Investments: Expanding built-up areas require efficient transportation, public spaces, and utilities. Sustainable infrastructure supports economic growth and improves residents' well-being. The linear city model, emphasizing transportation corridors and clustered development, offers a relevant framework to guide organized, sustainable growth in such environments (Veljanoski, 2014b). Similarly, Transit-Oriented Development (TOD) theory could be applied to promote compact, mixed-use development centered around efficient public transit systems (Stojanovski, 2019).
- **Monitoring Mechanisms:** GIS-based tools enable ongoing assessment of urban growth and planning interventions. Regular monitoring helps identify trends, evaluate strategies, and adapt plans to ensure sustainable development (Hegazy et al., 2015).
- **Model Selection and Validation:** Various land use change models, including cellular automata, agent-based models, and statistical models, offer different approaches to simulating and predicting urban growth (Clarke et al., 1997). Selecting appropriate models and rigorously validating their results is crucial for ensuring the reliability of analysis and projections.

These recommendations, aligned with global best practices, emphasize land readjustment as a key instrument for achieving balanced urban expansion in Skopje's periphery. By integrating systematic data analysis into planning, land readjustment can improve spatial efficiency, optimize resource allocation, and foster sustainable territorial management. Collaboration between government, academia, and local communities is essential to advancing inclusive, resilient urban development.

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5th international conference on urban planning

A PRELIMINARY STUDY OF COMMUNITY PARTICIPATION IN MICRO-RENEWAL PROJECTS: KEY FACTORS, CHALLENGES, AND SUCCESS INDICATORS IN TRADITIONAL CHINESE RESIDENTIAL NEIGHBORHOODS

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ABSTRACT

This study explores the critical role of community participation in micro-renewal projects within traditional Chinese neighbourhoods, emphasizing the need for modernization while preserving cultural heritage. Currently, few systematic reviews address community involvement in these projects. To fill this gap, this research conducts a comprehensive review of community participation's impact on micro-renewal, guided by PRISMA standards.

The study has two objectives: (1) to identify key factors influencing community participation, and (2) to analyse challenges in implementation. Using a Systematic Literature Review (SLR) approach, it identifies essential success factors, including strong policy support, cultural identity, resident engagement, and effective government-community interaction. Key mechanisms such as diverse participation channels, structured feedback, and community self-management help align community needs with project goals.

However, challenges persist, including limited resources, resident resistance, and stakeholder conflicts. Findings highlight that sustained community engagement, government support, and adaptability to evolving neighbourhood needs are essential for lasting success. This review underscores the theoretical and practical value of a community-cantered micro-renewal framework, balancing cultural preservation and modernization, and provides a foundation for integrating community participation into effective urban renewal strategies.

Keywords: *Community Participation; Micro-Renewal Projects; Traditional Residential Neighbourhoods; Urban Regeneration*

1. INTRODUCTION

China's accelerated urbanization has significantly reshaped its urban environment, particularly affecting traditional residential neighbourhoods. These historically rich communities are now increasingly vulnerable to physical deterioration, infrastructural inadequacies, and the erosion of cultural identity due to rapid modernization(Kim et al., 2020; PAN, 2023). Manifestations of these challenges include aging infrastructure, insufficient public services, and underutilized public spaces, which collectively undermine residents' quality of life and threaten the social cohesion of these communities (Zhu, 2023).

To address these multifaceted challenges, the micro-renewal strategy has emerged as a progressive and adaptive urban regeneration approach(Kim et al., 2020; Yang et al., 2022). Unlike large-scale redevelopment, micro-

renewal emphasizes incremental, small-scale interventions that aim to enhance both the physical environment and social dynamics of communities while preserving their spatial characteristics and cultural heritage (Beel et al., 2017; Duan et al., 2021; Lévy, 2012). Empirical evidence underscores the superiority of micro-renewal strategies in fostering community resilience and sustainable development compared to disruptive, large-scale urban redevelopment(Duan et al., 2021; Pan & Hutter, 2022; Tang et al., 2022) .

Active community participation is fundamental to the success of micro-renewal projects. Engaging residents in decision-making processes not only ensures that projects align with local needs and cultural values but also fosters community ownership, enhances project adaptability, and promotes long-term sustainability (Chen et al., 2022; Rosol, 2010; Yang et al., 2022). However, limited systematic studies have explored the comprehensive dynamics of community engagement in these initiatives, leaving a critical gap in both theoretical understanding and practical application.

This study addresses this gap by systematically investigating the critical role of community participation in micro-renewal projects within traditional Chinese residential neighbourhoods. Guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards, this research aims to identify key factors influencing community engagement, analyse the challenges impeding effective participation, and highlight success indicators critical to sustainable micro-renewal outcomes. By integrating theoretical frameworks and empirical findings, this study provides an in-depth understanding of how community-cantered approaches can effectively balance modernization with cultural preservation, thereby offering actionable insights for sustainable urban renewal strategies in China.

2. LITERATURE REVIEW

2.1 Theoretical Foundations of Community Participation

Community participation is a cornerstone of successful urban renewal, particularly in micro-renewal projects where sustainable outcomes hinge on proactive resident engagement. A robust theoretical foundation underpins the mechanisms through which community involvement can be effectively fostered. Social Capital Theory (Putnam, 1993) underscores the significance of trust, shared norms, and social networks in facilitating collective action, thereby strengthening collaboration between residents and stakeholders in urban regeneration efforts. Complementing this, Arnstein's Ladder of Citizen Participation (1969) delineates eight hierarchical levels of citizen engagement, advocating for the empowerment of communities through meaningful participation in decision-making processes to achieve equitable and effective urban renewal outcomes.

Collaborative Planning Theory (Healey, 1997) and Participatory Governance Theory (Fung, 2006) further emphasize the necessity of inclusive, dialogue-based planning and robust institutional frameworks that systematically integrate community perspectives into project development. These theories advocate for participatory mechanisms that ensure diverse stakeholder engagement, fostering transparency and shared responsibility.

Incremental Urbanism Theory (Kelbaugh, 2002) promotes gradual, small-scale, and context-sensitive interventions that are responsive to local needs and identities, aligning closely with the adaptive nature of micro-renewal strategies. Additionally, Place Attachment Theory (Scannell & Gifford, 2010) elucidates how emotional and psychological bonds between individuals and their environment serve as intrinsic motivators for active engagement in community-led renewal initiatives.

Collectively, these theoretical frameworks offer a comprehensive and multidimensional understanding of how inclusive governance, stakeholder collaboration, and resident empowerment intersect to drive the success and sustainability of micro-renewal projects.

2.2 Global Experiences in Micro-Renewal Projects

Empirical evidence from global micro-renewal projects highlights the pivotal role of community participation in achieving sustainable urban regeneration. To provide a broader understanding of global contributions, Figure 1 visually summarizes the geographic origins and thematic focus of the reviewed studies. This analysis reveals that China, the United States, and the United Kingdom are the most represented countries in the literature, focusing on topics such as traditional neighbourhood renewal, participatory governance, and heritage conservation. Meanwhile, Japan, the Netherlands, and Australia provide complementary insights into incremental renewal, co-design approaches, and urban sustainability.

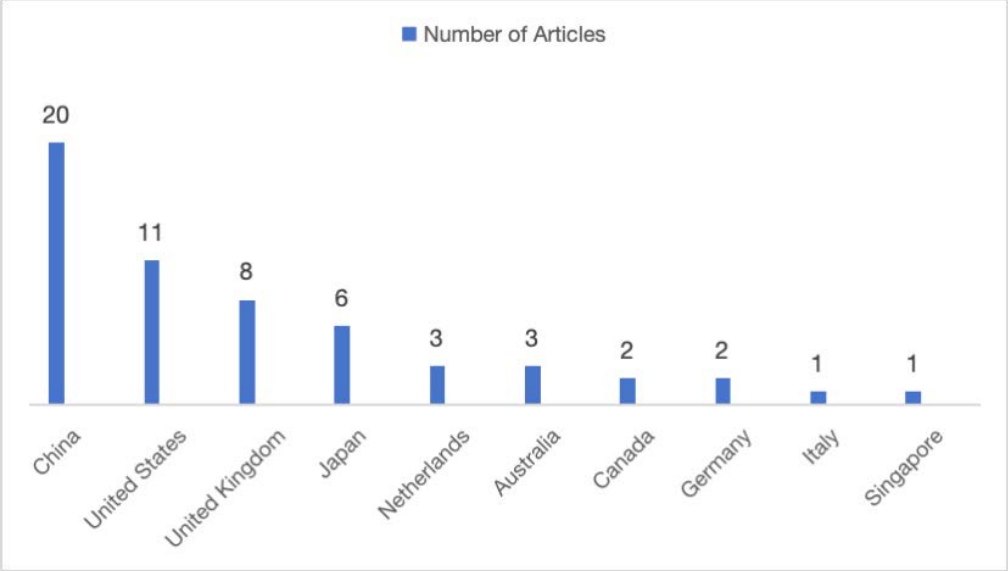


Figure 1: Geographic Distribution of Reviewed Studies

Building on this geographic overview, selected case studies presented in Table 1 further illustrate effective strategies implemented in micro-renewal projects across different contexts. For instance, the Shikumen Renewal in Shanghai exemplifies cultural heritage preservation integrated with modern functionality, while the King's Cross Regeneration in London demonstrates the value of extensive public consultations in harmonizing heritage conservation with contemporary urban needs. These examples highlight the common themes and best practices discussed below.

Table 1: sample of Urban Micro-Renewal projects

No.	*Project Name*	*Location*	*Key Strategies and Outcomes*
1	*Xinyuanxili Renewal*	*Beijing, China*	*Multi-stakeholder engagement enhanced community satisfaction and social cohesion.*
2	*Shikumen Renewal*	*Shanghai, China*	*Preservation of historical architecture combined with infrastructural upgrades revitalized the area.*
3	*Enning Road Micro-Renewal*	*Guangzhou, China*	*Cultural heritage conservation coupled with incremental renovations rejuvenated the community.*
4	*Yanaka Neighbourhood*	*Tokyo, Japan*	*Gradual improvements and community-led activities strengthened neighbourhood cohesion.*
5	*King's Cross Regeneration*	*London, UK*	*Extensive public consultations harmonized heritage conservation with modern urban functions.*
6	*IJburg Community Renewal*	*Amsterdam, NL*	*Co-design approaches empowered residents, fostering participatory governance and self-management.*
7	*Nantou Ancient City*	*Shenzhen, China*	*Integrated historical preservation with modern functionality to enhance cultural recognition.*

The global experiences presented in Table 1 highlight key strategies that have been successfully implemented in various micro-renewal projects. Each listed project exemplifies one or more of the following approaches:

- Multi-Stakeholder Collaboration: Projects like King's Cross Regeneration in London and IJburg Community Renewal in Amsterdam emphasize the importance of inclusive partnerships. These initiatives involved governments, private sectors, and local residents working together, enabling shared responsibility and efficient resource mobilization. Such collaborations have fostered trust and sustained community participation, as seen in their successful urban transformations (Bai et al., 2023; S. Li et al., 2022; Yang et al., 2022)
- Cultural Heritage Integration: The Shikumen Renewal in Shanghai and Enning Road Micro-Renewal in Guangzhou projects effectively balanced the preservation of historical identity with modern functionality. By integrating cultural elements into the urban landscape, these projects ensured cultural continuity, strengthened social cohesion, and revitalized the community (Huang et al., 2022; S. Li et al., 2022; Tang et al., 2022)
- Incremental and Adaptive Design: Yanaka Neighbourhood in Tokyo and Nantou Ancient City in Shenzhen exemplify the benefits of small-scale, flexible interventions. Both projects adopted incremental approaches that allowed communities to adapt over time, minimizing disruption while

addressing evolving local needs. This adaptability ensured the long-term success and sustainability of the renewal efforts (Kelbaugh, 2002; Zhao & Huang, 2020)(Huang et al., 2022; Jang et al., 2017).

- Participatory Design and Co-Management: In projects like Xinyuanxili Renewal in Beijing(Rosol, 2010) and IJburg Community Renewal in Amsterdam, residents were actively involved in the design and management processes. This participatory approach cultivated a sense of ownership among the community members, fostering long-term commitment and ensuring that the outcomes aligned with their needs and aspirations (Healey, 1997; Fung, 2006).

The successes and lessons from these global cases provide valuable insights for developing community-cantered micro-renewal frameworks in China. Tailoring these strategies to local socio-cultural contexts can enhance the effectiveness and sustainability of micro-renewal projects in traditional Chinese neighbourhoods' that trust and social networks drive collective action (Putnam, 1993), while Arnstein's Ladder of Citizen Participation (1969) underscores the importance of empowering communities through meaningful involvement in decision-making. Collaborative Planning Theory (Healey, 1997) and Participatory Governance Theory (Fung, 2006) highlight the need for inclusive, dialogue-based planning and institutional support to integrate community voices. Additionally, Empowerment Theory (Zimmerman, 1995) focuses on enhancing community capacity to influence urban renewal processes. Together, these frameworks provide a comprehensive understanding of how inclusive governance, stakeholder collaboration, and resident empowerment contribute to successful and sustainable micro-renewal initiatives.

3. RESEARCH METHODOLOGY

3.1 Research Design

In this study, the Systematic Literature Review (SLR) method was employed to examine the existing body of literature, following a rigorous research design grounded in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. SLR is widely regarded as a highly effective approach for systematically searching, evaluating, and interpreting key literature within a specific scientific domain (Abrar et al., 2020). It provides a focused and comprehensive review of a select number of studies, addressing specific research questions to derive precise findings (Barn et al., 2017). By employing the SLR method, researchers can gain an in-depth understanding of a particular field (Hou and Wang, 2020). SLR enables the extraction of specific data from prior scientific studies, facilitating the development of more comprehensive insights (Sheikh et al., 2019; Mangaroo-Pillay and Coetzee, 2022; Kraus and Proff, 2021).

A systematic review approach was adopted to comprehensively analyse the role of community participation in micro-renewal projects. This multi-method strategy enables a holistic understanding of how resident engagement influences the success and sustainability of urban renewal initiatives in traditional Chinese neighbourhoods. In this context, SLR was instrumental in identifying key factors from previous studies on urban regeneration, including community participation, cultural identity, and feedback mechanisms. The use of review protocols, such as SLR, minimizes research bias and enhances the accuracy and reproducibility of findings (Kitchenham et al., 2010). This study implemented the SLR methodology through the PRISMA framework, which comprises four main steps: identification, screening, eligibility, and data extraction and analysis （See figure 1）. These systematic and transparent methodological steps make the PRISMA approach highly effective for achieving SLR research objectives.

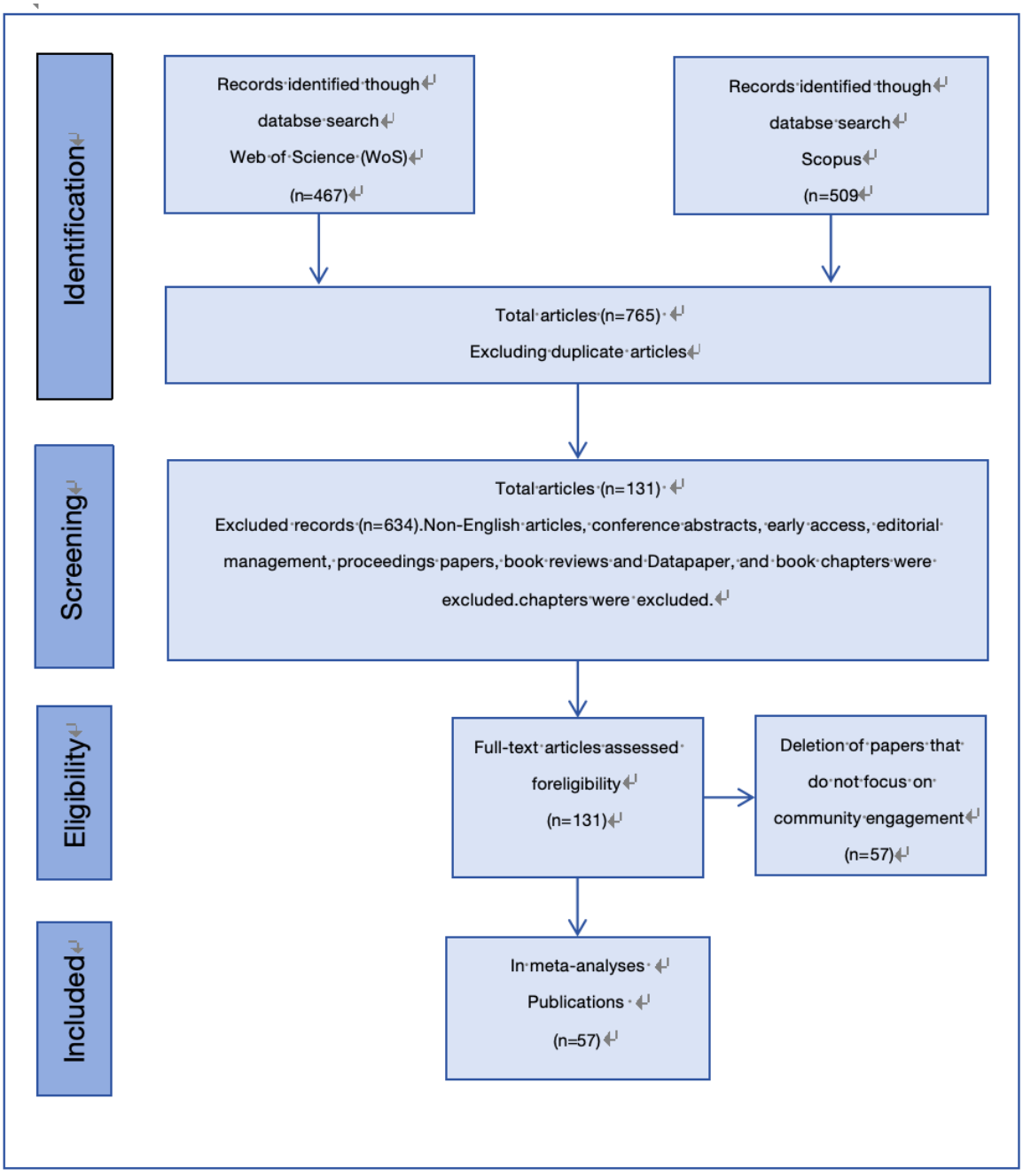


Figure 2: The flowchart of the PRISMA approach used in the SLR study

3.2 Data Collection

The identification step in the systematic literature review (SLR) process involves determining relevant keywords for the materials to be searched (Ismail et al., 2021a, 2021b). These keywords are then used to construct search strings for querying digital library databases. The basic search string is applied to the titles, keywords, and abstracts of articles in the selected databases. Boolean operators such as AND and OR are utilized to refine the search strings, allowing for more precise queries (Abrar et al., 2020). As noted by Moher et al. (2009), the use of at least one database is essential for a systematic review.

In this study, two leading databases were employed: Web of Science (WoS) and Scopus. The WoS database is frequently used in systematic reviews and is recognized as a reliable source for locating scientific articles (Arallena et al., 2019). Scopus, known as the world's most comprehensive abstract and citation database, encompasses peer-reviewed literature, including scientific journals, books, and conference proceedings. The

search strategy incorporated the keywords “micro-renewal or regeneration,” “community,” “public,” and “tradition.”

The initial search identified a total of 976 articles, with 467 documents retrieved from WoS and 509 from Scopus. After removing duplicate entries, 765 articles remained for abstract screening. Following a thorough evaluation of the abstracts, 131 articles were selected for full-text review. Ultimately, 57 articles meeting the established criteria were included in the in-depth analysis. This rigorous, multi-step selection process ensured the inclusion of high-quality, relevant studies aligned with the research objectives.

3.3 Data Analysis Methods

To extract meaningful insights, this study employed a combination of qualitative and quantitative analytical methods. Content analysis was conducted to systematically identify recurring themes, success factors, and challenges related to community participation in micro-renewal projects. Additionally, a Systematic Literature Review (SLR) framework facilitated the categorization and synthesis of diverse research findings. Quantitative analyses, including Structural Equation Modelling (SEM) and regression analysis, were applied to assess the relationship between the level of community engagement and project success. This mixed-methods approach provides a robust foundation for understanding how various factors interact to influence the effectiveness of community-driven urban renewal efforts.

4. ANALYSIS OF KEY FACTORS

Through a systematic thematic analysis of 57 peer-reviewed articles, this study identified seven critical factors influencing community participation in micro-renewal projects. The analysis involved an iterative coding process, where articles were systematically reviewed to categorize data into themes such as cultural identity, resident engagement, and policy support. The coding framework was refined through pilot testing to ensure consistency and relevance.

To validate these themes, findings from the thematic analysis were cross-referenced with real-world case studies. Successful micro-renewal projects in cities like Beijing and Shanghai demonstrated the practical significance of factors such as cultural identity, diverse participation channels, and community self-management. This triangulation with case studies confirmed the contextual relevance and robustness of the identified factors as key drivers of successful micro-renewal projects.

The study identified the following seven critical key factors（See figure 2） influencing residents' participation in micro-renewal projects:

- **Cultural Identity:** Residents' recognition and appreciation of community history and culture significantly enhance their willingness to engage in micro-renewal projects. Research indicates that cultural activities and historical preservation efforts strengthen residents' sense of belonging, fostering active participation (Chen et al., 2022; S. Li et al., 2022; Tang et al., 2022).
- **Resident Engagement:** Residents' initiative and awareness directly impact the progress of micro-renewal projects. Studies reveal that awareness of project objectives, access to diverse participation channels, and the frequency of internal community interactions all contribute to varying levels of engagement(Chen et al., 2022; Rosol, 2010; Yang et al., 2022) .
- **Policy Support:** Government policies and regulations serve as guiding forces for resident participation. Strong policy incentives, financial support, and legal protections effectively facilitate the smooth implementation of micro-renewal projects (Cinà et al., 2018; Huang et al., 2022; L. H. Li et al., 2014).
- **Government-Community Interaction:** Constructive interaction between government entities and community residents is a crucial factor in project success. Regular communication meetings, public consultations, and feedback mechanisms enhance residents' understanding and support of the projects(CHEN, 2009; LIU, 2009; Shen et al., 2024) .
- **Diverse Participation Channels:** A variety of engagement platforms—such as online forums, community meetings, and volunteer activities—cater to different demographic needs, thereby improving overall participation (Rosol, 2010; Tang et al., 2022; Yang et al., 2022).
- **Effective Feedback Mechanisms:** Establishing efficient feedback systems encourages greater resident participation. Timely responses to residents' suggestions and concerns foster trust and satisfaction, enhancing project acceptance (Chen et al., 2022; X. Li et al., 2020; Zhu, 2023).

- **Community Self-Management:**Empowering communities with self-management structures promotes long-term engagement and project sustainability. Initiatives that support autonomous community governance encourage residents to take responsibility for local development and decision-making processes. Projects emphasizing self-management report higher levels of participation and foster a sense of collective ownership(Chen et al., 2022; Rosol, 2010)



Figure 3: Key factors for community participation in micro-renewal projects

5. SUCCESS INDICATORS

The success indicators in this study were validated using Structural Equation Modelling (SEM) and regression analysis, providing a rigorous framework to examine the relationships between key factors and project outcomes. SEM quantified the influence of factors such as cultural identity, resident engagement, and policy support on critical outcomes, including resident satisfaction, participation rate, and community cohesion. The path coefficient (β) measures the degree to which the dependent variable changes in response to a one-unit change in the independent variable. For example, a β value of 0.68 signifies that a one-unit increase in cultural identity corresponds to a 0.68 unit increase in resident satisfaction. A positive β value, such as 0.68, represents a direct positive relationship, indicating that as the independent variable increases, so does the dependent variable. Conversely, a negative β value would imply an inverse relationship. The associated p-value determines the statistical significance of the relationship, with $p < 0.01$ denoting a highly significant relationship and $p < 0.05$ indicating moderate significance. For instance, the relationship between cultural identity and resident satisfaction ($\beta = 0.68$, $p < 0.01$) is both strong and statistically significant, underscoring the importance of cultural identity in fostering resident satisfaction.

Regression analysis further complemented SEM by examining specific causal relationships, such as the impact of feedback mechanisms on adaptability and participation rates. Together, these methods combined theoretical insights with practical validation, creating a robust framework for advancing effective and sustainable community-cantered micro-renewal initiatives.

While Community Self-Management is identified as a critical key factor in driving community participation, it is not included as a direct success indicator in this study. This is because self-management functions as a structural enabler rather than a measurable outcome. It underpins the broader outcomes like participation rates, resident satisfaction, and project sustainability by fostering autonomy and collective responsibility. Its impact is therefore embedded within the other success indicators rather than standing alone as a distinct measure.

Resident Satisfaction ($\beta = 0.68$, $p < 0.01$): A strong positive relationship exists between cultural identity initiatives and resident satisfaction. Projects that integrate cultural preservation and community events achieve higher satisfaction levels by fostering a sense of belonging and pride among residents (Chen & Li, 2021; Zhang et al., 2019).

Participation Rate ($\beta = 0.72$, $p < 0.01$): Transparent communication and diverse participation platforms, such as online forums and in-person meetings, significantly boost resident engagement. Communities with accessible and inclusive channels exhibit consistently higher participation rates (Liu & Zhao, 2020; Sun & Guo, 2018).

Community Cohesion ($\beta = 0.64$, $p < 0.01$): Collaborative decision-making and consistent government-community interaction strengthen social cohesion and trust within communities. These interactions create a sense of shared purpose, fostering unity and long-term collaboration (Chen & Li, 2021; Liu & Zhao, 2020).

Policy Implementation Efficiency ($\beta = 0.59$, $p < 0.05$): Strong policy frameworks and financial backing directly enhance the execution of micro-renewal projects. Efficient government interventions supported by clear legal guidelines ensure timely and effective implementation (Wang et al., 2020; Zhang et al., 2019).

Adaptability and Project Flexibility ($\beta = 0.66$, $p < 0.01$): Adaptive management practices that incorporate resident feedback are critical for long-term success. Projects demonstrating flexibility in addressing evolving community needs achieve greater sustainability and acceptance (Sun & Guo, 2018; Zhao & Huang, 2020).

Table 2: Relationship Between Key Factors and Success Indicators in Micro-Renewal Projects

No.	*Key Factors (Independent Variables)*	*Success Indicators (Dependent Variables)*
1	*Cultural Identity*	*Resident Satisfaction ($\beta = 0.68$, $p < 0.01$)*
2	*Resident Engagement*	*Participation Rate ($\beta = 0.72$, $p < 0.01$)*
3	*Policy Support*	*Policy Implementation Efficiency ($\beta = 0.59$, $p < 0.05$)*
4	*Government-Community Interaction*	*Community Cohesion ($\beta = 0.64$, $p < 0.01$)*
5	*Diverse Participation Channels*	*Participation Rate ($\beta = 0.72$, $p < 0.01$)*
6	*Effective Feedback Mechanisms*	*Adaptability and Project Flexibility ($\beta = 0.66$, $p < 0.01$)*
7	*Community Self-Management*	*Embedded Within Other Indicators*

These success indicators highlight the critical pathways through which community participation drives the success of micro-renewal initiatives. The integration of cultural preservation, policy support, adaptive strategies, and participatory governance ensures that projects remain inclusive, sustainable, and responsive to the evolving needs of urban communities. Regular monitoring and evaluation of these indicators will guide future micro-renewal efforts toward greater effectiveness and impact.

6. DISCUSSION AND RECOMMENDATIONS

The analysis of key factors and success indicators underscores the critical role of community participation in the success of micro-renewal projects. The findings reveal that cultural identity, resident engagement, policy support, government-community interaction, diverse participation channels, effective feedback mechanisms, and community self-management are pivotal to achieving sustainable urban regeneration.

6.1 Discussion

The strong positive correlations identified in the quantitative analysis emphasize that community-centered approaches significantly enhance project outcomes. Cultural identity emerged as a fundamental driver of resident satisfaction ($\beta = 0.68$, $p < 0.01$), highlighting the importance of integrating cultural heritage into renewal strategies. Resident engagement, supported by diverse participation channels and transparent communication, was directly linked to higher participation rates ($\beta = 0.72$, $p < 0.01$), reinforcing the need for inclusive and accessible engagement mechanisms.

The efficiency of policy implementation ($\beta = 0.59$, $p < 0.05$) and the adaptability of project frameworks ($\beta = 0.66$, $p < 0.01$) further illustrate the necessity of responsive governance and flexible planning. Effective collaboration between government entities and communities fosters social cohesion ($\beta = 0.64$, $p < 0.01$), promoting long-term project sustainability. These findings align with existing research, affirming that participatory governance and adaptive management are essential for successful micro-renewal initiatives.

6.2 Recommendations

Based on these findings, the following recommendations are proposed to enhance the effectiveness of community participation in micro-renewal projects:

- Integrate Cultural Preservation into Planning: Urban renewal strategies should prioritize the preservation of local cultural identity. Incorporating cultural elements into design and planning fosters stronger community engagement and support.
- Diversify Participation Channels: Establish multiple and accessible platforms (e.g., online forums, community meetings, volunteer activities) to engage diverse demographic groups and ensure inclusive participation.
- Strengthen Policy Frameworks and Financial Support: Governments should develop coherent policies and provide financial incentives to facilitate sustained community engagement and smooth project execution.
- Enhance Government-Community Collaboration: Implement structured communication and feedback mechanisms to build trust and promote transparent decision-making.
- Promote Community Self-Management: Encourage and support autonomous community governance structures to empower residents and ensure long-term project sustainability.
- Adopt Adaptive Management Strategies: Incorporate flexible planning processes that allow for adjustments based on continuous community feedback and evolving needs.

Implementing these recommendations will improve the alignment between micro-renewal project goals and community needs, ultimately fostering sustainable, inclusive, and culturally sensitive urban regeneration.

7. CONCLUSION

This study highlights the pivotal role of community participation in the success and sustainability of micro-renewal projects in traditional Chinese neighbourhoods. Through a systematic analysis of key factors and success indicators, it demonstrates that cultural identity, resident engagement, policy support, government-community interaction, diverse participation channels, effective feedback mechanisms, and community self-management are integral to achieving impactful urban regeneration.

The findings underline the importance of integrating cultural preservation into urban renewal strategies, fostering inclusive and accessible engagement mechanisms, and enhancing governance through policy support and adaptive management. Quantitative analysis, including Structural Equation Modelling (SEM) and regression analysis, validated the influence of these factors on outcomes such as resident satisfaction, participation rate, and community cohesion, establishing a robust framework for understanding the dynamics of successful micro-renewal projects.

This research contributes to the theoretical understanding of participatory governance and adaptive management in urban planning, offering practical recommendations for policymakers and practitioners. By emphasizing the alignment of renewal goals with community needs and promoting long-term engagement through autonomous governance structures, this study provides a roadmap for fostering inclusive, sustainable, and culturally sensitive urban development.

Future studies should explore the longitudinal impacts of community participation and assess how emerging technologies, such as digital tools and platforms, can further enhance engagement and project adaptability. These efforts will strengthen the theoretical and practical foundations of community-cantered micro-renewal frameworks, contributing to the broader discourse on sustainable urban regeneration.

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ICUP2025
5th international conference on urban planning

URBAN REGENERATION OF SOCIALIST MASS HOUSING: BENSKA BARA ESTATE IN ŠABAC, SERBIA

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ABSTRACT

All important cities in the former Yugoslavia got multi-family residential estates during socialism (1945-1991), which are among the main 'symbols' of this period today. Although this type of residential development in Yugoslavia, as well as in the other European socialist countries, was ideologically supported as a key one for socialist proletariat, many other factors contributed to its prominence, too. The most important is a 'rural flight'. Many people from rural hinterlands migrated into urban areas during several socialist decades, causing a pressure to develop the socialist multi-family estates that would house there as many new residents as possible. In this situation, social infrastructure of these estates suffered.

Although the former Yugoslavia had a bit different socialist system, their housing has had the similar problems like in many other (post-)socialist countries. Therefore, challenges in regenerating mass housing estates are still present. In many cases, cities implement market-led solutions, which are mainly an architectural refurbishment then comprehensive urban regeneration, which covers both buildings and open public spaces. The rare affirmative cases of urban regeneration, which additionally includes the participation of local residents in all development steps, are therefore worth mentioning. The case of Benska Bara Estate in the City of Šabac in western Serbia is chosen for this paper. Its entire open public space was regenerated in the late 2010s, to enable its socio-economic renewal. This case study is put in contrast to the mentioned market-led solutions, to better scrutinise all the reasons and outcomes of this positive approach in urban regeneration.

Keywords: *Mass-housing estate; housing renewal; post-socialist urbanism; residential regeneration; urban participation*

1. GENERAL INFORMATION

Henri Lefebvre, famous French philosopher and sociologist, argued in his book "The Production of Space" (1974) that (urban) space is the construct of social relations and human production. Very same standpoint can be said for housing, which also carries the strong reflections of socio-economic relations. Aside of the well-known right to proper housing as a basic human need, it also represents a significant commodity in the modern capitalist world. Furthermore, housing is a spatial element, which cannot be excluded from its urban and

architectural context (Lojanica, 2019). This only underlines the complex and multi-layer character of housing (Petrović, 2004).

This complex nature of housing in urban space is visible even in the most ideological examples of housing developments, such as mass housing estates built across the eastern half of Europe during the socialist period (1945-1991). Today, they are one of the main 'emblems' of post-socialist cities in this part of the world (Tsenkova, 2009). The scientific estimations shows that 20-40% of all residential units in post-socialist countries are in mass housing estates and blocks built during socialism; in contrast, they make just 7% in the western half of the continent (Dimitrovska Andrews, 2005; Temelová et al, 2011). In some socialist cities, especially those ones developed as monofunctional cities during socialist times, such as new mining cities, this type of housing is predominant or even the only one (Antonić, 2018). Therefore, mass housing in post-socialist countries is so important that any national or regional urban or housing policy, as well as the master plans of post-socialist cities can not omit socialist mass housing estates as a developmental challenge in their agenda.

Although a primary aim behind the mass housing development in socialist cities was ideological, to enable a decent life for workers as a priority group in a socialist system (Kopp, 1970), there are some other albeit not so visible factors that essentially influenced their formation, design and construction. One of them is a demographic boom in the in the first decades of socialist system, caused by rural exodus. Actually, rural population was more than prevailing in this region before the establishment of a socialist counties. In many new socialist countries more than 60%, or even 80% of all people lived in villages (Thompson, 1993). Hence, many of newly-built mass housing estates were formed to mitigate the exploding numbers of new urban dwellers, whom cities received through this process (Tosics, 2005). First, many new mass-housing estates were built on unbuilt land at urban periphery to minimise construction costs, while rare cases in historic cores are rather specific, mainly the results of the postwar urban reconstructions of the cities severely damaged during the World War II (Diener & Hagen, 2015). Second, many such projects had higher densities that it was initially planned, simply to accommodate more dwellers. Third, this rather urgent situation in the new estates left a little for the other urban functions critical for modern housing as it was initially in the agenda of socialist city, such as schools, kindergartens, parks, playgrounds, urban greenery, etc. At the end, many of new mass housing estates across socialist space were built with bellow-standard social infrastructure and open public space, eventually becoming unattractive and monotone due to these deficiencies (Medvedkov & Medvedkov, 2005).

Another important side of post-socialist housing is its regional characteristics. In European post-socialist perspective, the housing in the space of the former Yugoslavia presents a unique regional case in many ways due to the specific legacy of this former socialist state. Although the second Yugoslavia (1945-1991) was a socialist country, it made a radical shift after the Yugoslav-Soviet split in 1948. The socialist Yugoslavia then developed a specific political system of workers' self-management, from 1950 (Liotta, 2001). This political shift also opened deep cooperation with the capitalist West, enabling a unique development political and economic amalgam. At national perspective, it meant a strict political decentralisation, quite different comparing to the other socialist countries, while, at international perspective, Yugoslavia became one of the founders and main proponents of non-aligned movement and only major non-aligned country in then cold-war Europe. All these political moves had a profound impact on all spheres of life, including urban and architectural tendencies (Stupar, 2015). Finally, this specific political and economical system had a profound impact on Yugoslavian housing.

With the fall of socialist system in Europe in the early 1990s, the challenges on how to both refurbish and upgrade socialist mass housing estates have arisen. Their problems are pretty different than modernist mass housing estates in the Western Europe due to the afore mentioned frequency and legacy of the socialist system and urbanisation (Musterd & van Kempen, 2005; Szafrańska, 2013). Besides their higher share in the overall housing stock and the lower quality of their urban infrastructure in general, there is also the negative image of this type of housing as 'ghosts' from socialist times (Cieśla, 2012).

In the case of the space of the former Yugoslavia, this problem has been even more acute due the turbulent decade of the Yugoslavian Crisis in the 1990s, which has had huge negative consequences on cities in this region (Vujošević et al, 2012). Three decades after the fall of socialism, many ex-Yugoslavian cities still struggle to regenerate socialist mass housing estates: both physically and functionally, as well as at both urban and architectural levels. Results are modest in most cases due to a gap between strong private interests and weak public sector. This is the main reason behind this paper. It presents one of the relatively rare positive examples of the urban regeneration of socialist mass housing estates in Serbia. The case study is Benska Bara Estate in

the City of Šabac in western Serbia. This case is not positive just due to final physical improvements in open public space and the overall look of the estate, but also due to the whole process, which included and promoted citizen participation in every step of the regeneration. Hence, the aim of paper is to understand which reasons and gains can be highlighted to promote this type of urban and residential regeneration in Serbian and ex-Yugoslavian cities.

2. METHODOLOGY

This research is shaped as a combination of a scientific review and case study. The first 'methodological pillar' – a scientific-review approach – is chosen to adequately address the specific case of the Yugoslavian socialist housing and its legacy through the post-socialist transition. In such way, this is also a contextual scientific review, with a focus on local and regional specificities. Such approach is especially suitable for space-related research (Barnes & Melles, 2007). The second methodological approach is a case study. In this case, this is a single-case study, which is usually implemented to exemplify or explain specific and atypical cases. This is already underlined for chosen Benska Bara Estate in the introductory section.

A linking element between two chosen approaches in urban regeneration. The main cause to use urban regeneration as a policy programme is urban decay and necessity for economic revitalisation (Caves, 2004). Therefore, the aim purpose of implementing urban regeneration is to respect the values of the past in urban fabric by transferring it into contemporary urban life (Vaništa Lazarević, 2003). There are several crucial elements to appropriately identify and successfully implement urban regeneration. Basically, affirmative urban regeneration is implemented in (1) already formed urban areas, such as mass-housing estates from socialist period, with (2) economic problems as the main driver for local regeneration, where (3) physical and functional interventions are done as 'improvements' within the umbrella of the regeneration process that (4) respects inherited social milieu during in all its phases.

3. CONTEXT: HOUSING IN SERBIA

Mass housing development in the space of Serbia was a completely new phenomenon after the former Yugoslavia became a socialist country after the World War II, in 1945. Multi-family housing in the historic cores of Yugoslavian cities was negligible at national level due to the underdevelopment of urban areas before the war. Rural dwellers made more than ¾ of the entire population in the first postwar population census in 1948 (Petovar, 2003). Furthermore, local economic base and cities as the main economic centres was severely damaged in the war. This situation enabled the radical change of the course of territorial, urban and housing development for a new, socialist government, which became highly centralised in the first postwar years (Pušić, 1987). Nevertheless, the implementation of a 'pure' socialist city model was soon prevented by the aforementioned split between Stalin and Tito in 1948. After this, Yugoslavian government started to develop a unique socialist system with a strong influence of market-led economy. This had the profound impact on national urban and housing policies. The main postulates of Yugoslavian housing were established as a unique amalgam of the two political and economic systems. They were more visible in the last socialism (1970s-1980s).

It should be repeated that the former Yugoslavia preserved the main postulates of socialist urban and housing policy, with so-called "urbocentric development" and state-owned housing with tenant rights (Petovar, 2003). Urban housing was supported, but without the strong emphasis on mass housing. Actually, single-family houses were the dominant type of housing development except in a few major cities – the seats of Yugoslavian republics – where the only huge complexes were formed, usually for big state-run organisations, such as the Yugoslavian People Army (Fig. 1a) (Petrović, 2004). Due to significant territorial decentralisation, each municipality and city had its own rules and standards for housing (Tsenkova, 2009). This situation produces a variety of local approaches relating ratio between new single- and multi-family housing, the share of housing types, the location of new housing in urban area (within-city urban reconstruction vs. suburban sprawl), the size of mass housing estates, etc. (Antonić, 2018). The decentralisation policy also enabled the higher quality of new housing in both architectural and urban sense (Fig. 1b) and prevented the mass-use of a prefabricated panel system, typical across the socialist world.



(a) (b)

Figure 1: (a) Urban blocks 61-64 for the employees of Yugoslavian People Army are typical mass housing in New Belgrade, the main urban project of the socialist Yugoslavia (Author: Antonić, 2021); (b): A socialist mass housing estate in Kikinda, northern Serbia: many such projects were well-designed due to decentralised housing policy and developed local housing rules and standards (Author: Antonić, 2018).

The full implementation of the decentralisation in housing was firmly backed by local housing cooperatives (Tsenkova, 2009). This institution, locally known as housing funds, was very specific for housing in the late years of the former Yugoslavia, as it combined the elements of planned economic and market-led system in the provision of new (mainly multi-family) housing. The provision was done between different state-run companies in 'quasi-housing market', where the buyer-companies negotiated and agreed the price of the apartments with the companies from construction sector that built them. Hence, these housing funds were in a sharp contrast to a simple provision of new housing in many socialist states (Petrović, 2004). Finally, the decentralised housing system of the socialist Yugoslavia had also negative sides, as it could not produce enough dwellings for new citizens from nearby villages. This was a constant problem during socialist period, resulting in the widespread illegal and unplanned construction of single-family houses at urban fringe, as many local authorities did not have means to prevent such development (Petovar, 2003). By this characteristic, housing in the former Yugoslavia looked more to housing in Greece or southern Italy then to the other socialist countries.

The second segment of the uniqueness of Serbian housing is related to its first and rather turbulent post-socialist decade of post-socialist transition due to the period of the Yugoslavian crisis in the 1990s. The same can be more or less labelled to housing in all ex-Yugoslavian countries except Slovenia. The most prominent phenomenon in Serbian cities from this period was enormous illegal and unplanned housing construction (Petovar, 2003; Vujošević et al, 2012). The legal forms of residential development were more than scarce. Although some western researchers underline this regression in Serbian urbanisation as a consequence of then-times politics, such 'development' had a clear continuation with illegal residential construction in the late socialism (Mitrović & Antonić, 2013). The bulk of it was still in the form of single-family housing built at urban periphery. Most new illegal houses were built by refugee population, which was numerous; this contingent made approximately 8% of the entire population of Serbia in the late 1990s (Vujadinović et al, 2011). The most striking case was Kaluđerica, the eastern suburb of Belgrade, which has got the nickname "the largest illegal settlement on the Balkans" (Fig. 3a). The rapid introduction of market economy added some elements to the illegal housing in the 1990s. Illegal construction became widespread to central urban locations. Such cases were also specific as many of them, especially in bigger cities, were built as a real estate and for profit, not for personal dwelling. Similar cases were many semi-illegal additions of new floors to the multi-family buildings from socialist period (Fig. 3b) (Petovar, 2003). It can be concluded that this urban "growth without development" of Serbian cities through (mainly) housing in the 1990s was the 'unorthodox' housing and urban policy of then Serbia (Mitrović & Antonić, 2013).



(a) (b)

Figure 2: (a) Kaluđerica, the eastern suburb of Belgrade, is known as "the largest illegal settlement on the Balkans" (Author: Antonić, 2018); (b): Semi-illegal additions of new floors to the multi-family buildings from socialist period in central Belgrade (Author: Antonić, 2020).

A new phase in Serbian housing begun with the change of political system in 2000. However, this has been more a transition from the previous system than a complete split. As this research is focused on the urban regeneration of socialist mass housing estates, it is important to highlight that multi-family housing as a sort of urban regeneration process is the focus of national agenda, especially new construction. The reason is that new multi-family housing has become one of the most lucrative sectors of Serbian economy since the early 2000s (Mojović & Žerjav, 2011). Although the projects of multi-family housing are mainly legal, they have many features of the previous illegal or semi-legal multi-family construction from the 1990s, such the maximisation of permitted building volume, the luck of greenery and parking, the low-quality materials and questionable design (Fig 3a).

A specificity for cities in the former Yugoslavia is that socialist mass housing estates are still desired place to live, which has reflected through both new residential construction and architectural renewal with adding extra floors (Vranić et al, 2015). Local studies about the locational preferences of new housing reveal that socialist multi-family housing estates are the second most popular locations for new housing, after the outer centres of Serbian cities (Antonić, 2019). In bigger cities, such as Belgrade, where each new metre square of housing is highly valuable and expensive, these projects are numerous and more challenging by many parameters, so there is more pressure to 'wedge' new multi-family buildings in older residential urban blocks. This often makes the radical transformation of their structure (Fig. 3b). The most striking fact is that the new developments do not provide significant new quality for these mass housing blocks, but use their inherited advantages, such as large open public space, parking lots, transport accessibility, etc. Their minor contributions are that new buildings and younger dwellers prevent rampant aging in these areas, as well as contribute to introduction of non-residential commercial facilities, such as retail and services.



(a) (b)

Figure 3: (a) In smaller cities, such as Sombor, some examples of the new housing are with questionable design (Author: Antonić, 2018); (b): In bigger cities, such as Belgrade, these buildings usually imply the radical transformation of the block structure, such as the case of socialist blocks in New Belgrade (Author: B. Antonić, 2023).

4. CASE STUDY: BENSKA BARA MASS HOUSING IN ŠABAC

ŠABAC is one of 26 official cities of Serbia. It is located in the western part of the country, approximately 100 km from Belgrade. About 70,000 inhabitants live in the city urban area. The city has a long history, with its zenith in the 19th and early 20th century, when Šabac was among the most prosperous cities in the Principality, later Kingdom of Serbia. It was the place where 'Europeanisation' entered Serbia; it was the 'city of firsts' at national level – the first piano, the first glass windows, the first public pharmacy, the first carriage, etc.

The World War I was especially devastating for the city, so the interwar period of the first Yugoslavia was its profound urban reconstruction with the beginnings of modernist influences. The period of socialist Yugoslavia (1945-1991) fully embraced modernist urbanism and architecture. During this period, intensive industrialisation and demographic boom happened. The comprehensive urban planning and development successfully mitigated these issues by building several big multifamily housing estates across the city territory. The post-socialist transition has brought many new challenges, including a new socio-economic focus on the historic core of Šabac and its open public spaces. This focus has caused their economic revitalisation and the rebranding of the city identity as a place of trade and retail. Therefore, the city core has been completely transformed in a both visual and functional sense in a few years.

BENSKA BARA is the largest of the aforementioned socialist housing estates of Šabac, consists of 10 urban blocks with about 60,000 sqm. 90% of built stock is residential – circa 1,200 apartments (Fig. 4). However, its

location in the historic core of Šabac is more interesting for this study, as it reflects the unique combination of both socialist and post-socialist influences.

The bulk of Benska Bara was built during the 1960s and 1970s – the "golden years" of Yugoslavian socialism. First, the estate was introduced by the General Urban Plan for the City of Šabac from 1964, done by two famous Yugoslav urbanists, Slobodan Janjić, (born in Šabac), and Uglješa Bogunović. They have envisioned a new multifamily-housing estate with then modern super-block structure with the architecture based on the principles of the functionalist city with organic elements by Le Corbusier (Fig. 5). The estate was planned next to the main city street with a new square in between (Janjić & Bogunović, 1964). The construction of the estate was a huge task as the location was the former pond, so the whole area was first drained and all buildings were built on piles. Aside of residential buildings, Benska Bara was rich on open public spaces with abundant urban greenery and several playgrounds. Although they were planned to primarily serve local population from, the location of the new estate in the relatively dense historic core attracted people from vicinity soon. The last buildings were built at the end of socialist era, in the early 1990s. They and their surroundings noticeably differ from the rest of the estate by their position, design, and aesthetics.



(a) (b)

Figure 4: (a) The general matrix of Benska Bara (Author: Alimpić, 2023); (b): The aerial photo of Benska Bara (Source: Google Earth, 2023).

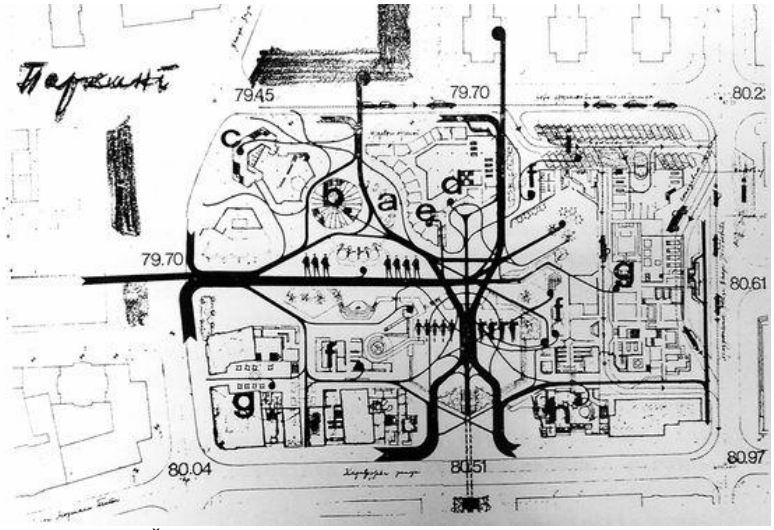


Figure 5: The concept for the city square in Šabac, an area integrated with the future mass housing estate of Benska Bara (Authors: Janjić & Bogunović, 1964);

During the first 20 years of the turbulent post-socialist transition of Serbia, Benska Bara experienced several, mainly negative trends: the general decay of housing stock and open public space, the transformation of residential ground floors into retail and service facilities and the pressure of the increase of local traffic on both streets and parking space (Fig. 8). In 2014, the half of century after the first creation of Benska Bara, city government made an initial step for its regeneration and redesign, especially for the outdated public space. As

there was no consensus about the concept of the regeneration, a comprehensive analysis of the estate with public participation was done, in order to accurately detect the problems of the local community[1]. Its main focus as open space and its impact on local life.

This analysis resulted in several separate 'projects' with local community (Fig. 6) – a conceptual design of the district centre, a sketch composition for a monument in the estate, and, finally, a detailed project for the renovation of all the public areas of Benska Bara. The common thread of all the mentioned projects is that cooperation with local population was at a much higher level than it is legally required and practically usual for such urban plans and projects in Serbia. Many related activities were conducted: (1) the survey on citizens; (2) a series of workshops with local community (3) exhibitions, (4) public meetings and presentations and (5) citizen's voting for the design solution they like the most. To conclude, the participation of the local population in the renovation of Benska Bara Estate was extremely important and significantly contributed to the success of the entire project. Urban planners had a quite challenging task since the overview of the public spaces had shown many issues that are not only architectural, but also economically and safety-oriented. To name some of them: the shortage of parking space, inadequate maintenance of both sidewalks and green areas, insufficient number of playgrounds or inadequately lighted areas. Local people highlighted the problem of parking space as the most evident one due to increase in motorisation in the entire city and the change of regulation from the period when the estate was built. As there were no underground garages, parked cars had overtaken the other public space (sidewalks, greenery) during decades. On the other side, it was also necessary to improve conditions for other users of public space – pedestrians and cyclists.



(a) (b)

Figure 6: The process of public participation in the form of a workshop between urban planners and citizens in Benska Bara (Author: Bogdanović, 2015).

Aside of these activities related to public participation, there were other ones implemented in respect to then new tools in Serbian urban design, such as a space syntax, the creation of a resource catalogue where citizens could directly choose among several proposals or the involvement of the non-governmental sector. A probably the main side-activity was the creation of the Sustainable Urban Mobility Plan for Šabac and the integration of its guidelines into the project. For example, the measures from the Strategy were directly implemented for interventions for pedestrianisation and cycling, as well as for interventions to slow down traffic in order to increase the safety of both residents and passers-by.

The regeneration of the entire housing estate was finally shaped as the Urban Study of the Public Spaces of Benska Bara. Its main goal was the integration of all users of open public space with the measures to encourage mobility by foot or cycling and the discourage excessive usage of vehicles. The other goal was to combine physical intervention to prevent unwanted vehicle movements and parking by adequate urban design (Plan Šabac, 2014). Since the results of cooperation with citizens led to their better acceptance of expected changes in the estate, the city government decided to initiate a formal document – a detailed urban project for redesigning of all public spaces in Benska Bara in 2018 – with the continuity of citizens inclusion in the decision-making process. This project encompassed the complete reconstruction of the public space of Benska Bara, with the aim to improve all elements in this urban structure, as well as to offer the contemporary and

1 The other necessity to start the urban regeneration was to upgrade the bad thermal-comfort performances of residential buildings in Benska Bara. This was done by the joint venture of the City of Šabac, city heating plant and citizen associations as a parallel process to refurbish building facades.

attractive design of these spaces for local community and other users (Infrastruktura Šabac, 2019). The most important elements of the reconstruction of open public space in Benska Bara were (Fig. 7):

(1) Widening of pedestrian paths and their improved design and new pavement;
(2) Elevated pedestrian crossings to the level of the sidewalks,
(3) Inclusion of tactile paths for the visually impaired,
(4) Design of several playgrounds for children, and
(5) Planting new tree rows with the mandatory retention of the existing green stock.



(a) (b)

(c) (d)

Figure 7: Open public space in Benska Bara – before their reconstruction (a & b) and after it (c & d) (a & c – Source: Google maps, 2020; b & d – Author: Đ. Đerić, 2020).

One of the central streets in Benska Bara became shared space (i.e., 'integrated street'), with slow-moving traffic (zone 30) and with the same elevation and pavement on driveway and sidewalks, so that entire street got a 'pedestrian-friendly character'. The central part of the estate was transformed from an undefined and underequipped concrete surface into a proper centre with shared public space divided into four categories – area for older citizens, single-level playground, playground for the youngest children and children in inclusion, and playground for older children. The goal was to satisfy the needs of all users of that public space, with main focus on the children for whom the reconstructed space is primarily intended. The same approach of inclusive design was also used for minor urban elements, such as urban furniture (Fig. 8).



(a) (b)



(c) (d)

Figure 8: The use of inclusive design for new urban furniture in Benska Bara and surroundings (Author: Đ. Đerić, 2021).

At the end, at a time when the government of Šabac often has a 'try and change' approach to local urban planning, without a visible strategy or agenda in background, the project for the urban regeneration of Benska Bara Estate had shown that great results can be achieved by the inclusion of citizens in decision-making process.

5. CONCLUSION

The sudden and unprecedented post-socialist transition with many challenging issues has left an immense impact on all cities in the former socialist countries in the eastern half of Europe. In the case of Serbia, the long-lasting consequences of the Yugoslavian crisis in the 1990s has made even more obstacles for all spheres of life. As all of these socio-economic and political challenges mirror in (urban) space, post-socialist cities in Serbia have become a 'playground' to deal with they. Thus, the main urban challenges, such the revitalisation of residential neighbourhoods and urban regeneration in general, has developed into a 'contested issues' at local level in different aspects – economic, social, cultural, political, spatial, aesthetical, etc.

In such constellation, the best practice cases, like Benska Bara in Šabac, are more then desirable as a role-model. Their position in Serbian environment is not just to show on how to move on; they are also a connection 'ordinary' examples from housing sector from more developed countries, where well-organised and implementable urban design and planning are rather a norm. Therefore, these role-model cases are adequate to research the cons and pros of the entire system of urban planning and design, as well as close sectors (transportation, ecology, landscape design, social issues, infostructure development, etc.). International best practice can be a guideline in the research, with the ultimate intention to (re)form a system to embrace the advantages of both international and local best practice.

Public participation can be a proper link between these two sides. The case of Benska Bara illustrates this very well. The urban plans and design projects that have a wide impact on a citizens' life cannot be authorised without their right to express their visions, ideas, views, and comments. The documents that are made in collaboration with citizens create a certain pressure on local government and other decision-makers to strive for its implementation. Moreover, after the renovation process is done, all parts of the conducted process are considered as 'theirs', because local community actively participated in it. This is a crucial element for the maintenance of redesigned space and the preservation of its identity. Therefore, it can be concluded that the active participation of citizens in shaping the city is not only a desirable, but necessary element for the successful implementation of urban and housing projects.

ACKNOWLEDGEMENTS

The authors of this research from Šabac thank to the City of Šabac, local administration and colleagues who participated in the creation and implementation of the case-study activities. Last but not the least, special thanks to the citizens of Benska Bara Housing estate who participated in public participation.

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PLACE FOR PEOPLE – YOUTH-DRIVEN VISIONS OF "THE HOLE" IN THE CITY OF BURGAS

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ABSTRACT

This research compares student design projects produced during the 10th International Summer School of Architecture in 2024, organized by the Center for Sustainable Spatial Development "BalkanARHitrav" from Dimitrovgrad, Serbia, in collaboration with the Faculty of Civil Engineering and Architecture (GAF) from Niš, Serbia, and the University of Architecture, Civil Engineering, and Geodesy (UACEG) from Sofia, Bulgaria. Held in Burgas, Bulgaria, with financial support from the city, the Summer School of Architecture focused on designing innovative and sustainable public space within the central urban zone - the so-called "hole." "The hole" represents the foundation pit of the once-planned shopping center from the '80s on the central city square, neglected for years. The Summer School topic was transforming "The Hole" into "Place for People." As a main scientific method, the comparative analysis evaluates three design solutions proposed by participating students, using theoretically set indicators for the quality of public space. The research aims to show how young architects perceive public spaces as vibrant for community engagement, highlighting sustainable urban development and innovation with environmentally friendly solutions. The paper also emphasizes the potential of youth-driven initiatives in shaping future cities by examining the assigned topic for project design and student visions of the topic.

Keywords: *place for people; sustainable urban development; Summer School of Architecture; youth-driven visions; the city of Burgas.*

1. INTRODUCTION

The Summer School of Architecture, organized annually since 2015 by the Center for Sustainable Spatial Development BalkanARHitrav from Dimitrovgrad, Serbia, in collaboration with the Faculty of Civil Engineering and Architecture (GAF) from Niš, Serbia, and the University of Architecture, Civil Engineering, and Geodesy (UACEG) from Sofia, Bulgaria, is a response to the increasingly obvious risk of losing the authentic identity of our villages, as well as urban areas, caused by insufficient care for space and objects, as well as due to uncontrolled urbanization, emphasizing the transformative potential of youth-driven initiatives in shaping the future. Participants of The Summer School of Architecture are professors, assistants, mentors, and students from both institutions, as well as architects from BalkanARHitrav.

This paper focuses on The 10th Summer School of Architecture "Burgas 2024", held from August 19 to 30, 2024, with financial support from the City of Burgas. Through a comparative analysis of student projects proposing innovative and sustainable design for a site in the central part of the city, colloquially known as "The Hole," the study examines how young architects envision urban space development in the contemporary context. It also evaluates the extent to which the projects addressed the design brief and requirements from the Burgas City Administration. "The Hole", located in the southeastern part of the “Troykata” square, is surrounded by cultural and historical landmarks and serves various public, residential, and mixed-use purposes. Originally intended as a shopping center in the 1980s, the site remains an unfinished construction project – the foundation pit of the once planned building. Given evolving spatial planning principles and community needs, the area requires a new design solution integrating modern functions to enhance the urban environment and support the local economy. This study aims to comparatively analyze student designs for a specific location, highlighting youth-driven innovation in sustainable urban development.

The task is to develop a volumetric, spatial, and functional concept for a "place for people", incorporating multifunctional spaces dedicated to public activities. In achieving this new design solution, the Burgas City Administration set the following critical objectives:

1) Valuable public space: alignment with Jan Gehl's public space evaluation indicators; 2) Recognition: Establishing an iconic “place for people” with unique functions suitable for the city center, municipality, and the region, effectively addressing the needs of both local residents and visitors; 3) Physical and Visual Connectivity: Ensuring seamless integration of existing and newly planned spaces; 4) Spaces for Prolonged Stay and Social Interaction: Creating an environment that fosters social engagement among diverse age groups, providing a sense of security, comfort, and opportunities for movement, rest, observation, contemplation, and conversation; 5) Human-Scaled Design: Distributing volumes harmoniously, enabling full spatial perception by pedestrians, and integrating the design into the square’s contours and the surrounding building ensemble; 6) Consistent Aesthetic Design: Harmonizing the aesthetic treatment of all spaces and structures to reflect the stylistic features of nearby cultural assets and the existing urban fabric; 7) Climate Adaptation: Incorporating climate-resilient strategies in spatial and structural organization, material selection, and landscaping within the parcel and its adjacent territories; 8) Continuous Activity: Ensuring the vibrancy of the site during all times of the day, night, weekdays, weekends, and throughout all seasons; 9) Economic Viability: Guaranteeing the financial profitability of initial investments; 10) Support for Local Economic Activity: Stimulating the local economy by introducing new or underrepresented economic activities.

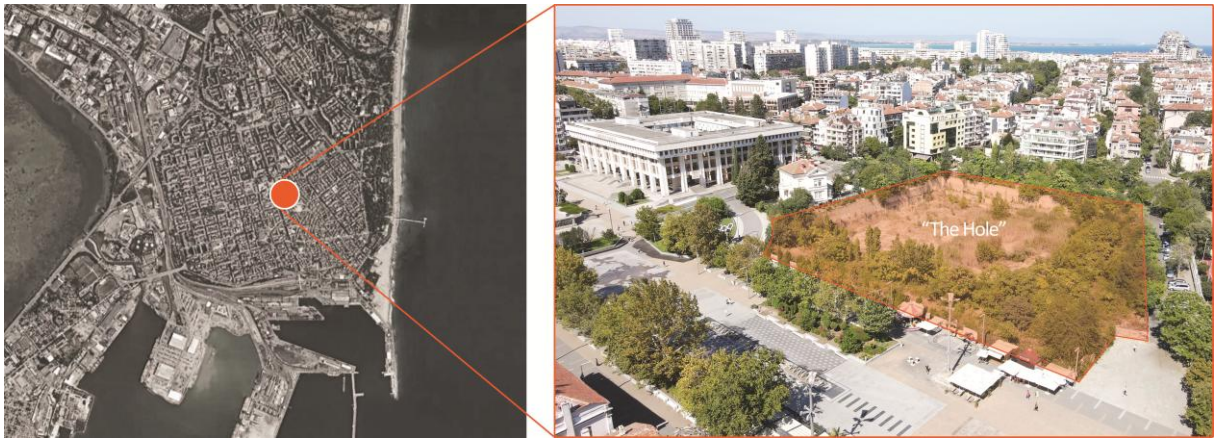


Figure 1: the position of “The Hole” in the urban matrix of the city of Burgas, Source: Authors

2. PLACES FOR PEOPLE - THE QUALITY OF PUBLIC SPACES

The quality of the environment has become a primary goal of sustainable development. This approach aims to provide universal access to safe, inclusive, and accessible public spaces. Urban public spaces are vital for enhancing a city's productivity, fostering social cohesion, and improving the overall quality of life [1]. The fundamental elements of urban architecture can be categorized as spaces intended for movement (streets) and spaces designed for experience (squares) [2]. Streets and squares, as key public spaces, support everyday interactions and contribute to a sense of place [3]. Public spaces include all unbuilt areas that citizens can access freely, accommodating various social groups. These spaces facilitate social interaction and relaxation while providing opportunities for entertainment, culture, sports, education, and seasonal activities. The quality of public spaces significantly impacts people's quality of life and the city's overall attractiveness [4]. Well-

designed and well-maintained public spaces with high aesthetic appeal increase the value of surrounding land, attract more users, and revitalize previously neglected areas [5]. Public spaces can be valorized by their morphology, urban and architectural structure, and different social, psychological, and ambient characteristics [6].

Relying on previous research, for this paper, indicators for the quality of public spaces are grouped as:

- Indicators for people protection in public space - a feeling of safety and security, and protection regarding microclimate;
- Indicators for people's comfort in public space - designing well-connected, pedestrian-friendly areas with different contents, opportunities for social cohesion and observation;
- Indicators for people's enjoyment in public space - designed to human scale, with a strong identity and sensory perception.

Indicators for protection include pedestrian and cyclist safety, removing traffic threats, creating safe crossing areas, designing lively public spaces with passive observation opportunities, good lighting, pollution, and noise reduction. This group of indicators for the quality of public spaces also involves designing in the context of microclimate (regulation of air currents and urban heat island (UHI), spots with protection from rain). Indicators for people's comfort in public space include their good connections to other places (squares, important buildings, etc.) and public transport, accessibility for cyclists, pedestrian-friendly areas, lack of obstacles and easy orientation, accessibility for all social groups, quality pavements, designing separate seating areas, spots with interesting and pleasant views, organization of seating that encourages communication, opportunities for physical activity, sports, games and outdoor entertainment, and various functions throughout the day, week and year. Indicators for people's enjoyment in public space consist of designing buildings and spaces to the human scale, creating proportions and details that stimulate the senses and clear distinction of spaces, attractive urban design, use of quality materials, a lot of greenery, plants, and water pounds. Further, this group of indicators for the quality of public spaces includes producing a sense of belonging and local and urban identity through history presentation and promotion.

3. THREE VISIONS OF "THE HOLE" IN THE CITY OF BURGAS

3.1. The vision of The Water Bubbles

This conteptual solution represents underground gallery of contemporary art nestled in the vibrant city of Burgas along the shores of the Black Sea, stands as a testament to the harmonious relationship between art, architecture, and nature. Conceived as a sanctuary for artistic expression, the gallery's design draws its inspiration from the dynamic interplay of wind and water, embodying their transformative power in both form and function. The architectural and urban design approach emulates the fluid motion of waves shaped by the wind, creating an immersive environment that invites creativity to flow effortlessly.

The gallery's layout is predominantly subterranean, blending seamlessly with the surrounding urban fabric. Its roof, a green oasis integrated into the main city square, serves as a public park—a dynamic space that not only enhances the city's aesthetic character but also strengthens its ecological resilience. This innovative green infrastructure offers multiple benefits: improving air quality, mitigating urban heat islands, fostering biodiversity, and providing a sustainable approach to stormwater management.

Central to this ecological strategy are bioretention systems and rain gardens. These meticulously designed green spaces collect, retain, and purify stormwater, ensuring it reenters underground aquifers or is slowly released into surface drainage systems. By reducing rapid water runoff, these features help mitigate urban flooding risks. Such strategies are particularly vital for Burgas, a city experiencing both population growth and intensified urbanization. The gallery thus not only becomes a cultural landmark but also a critical component of the city's sustainable development and its citizens' connection to nature.

The gallery itself spans four levels, three of which are underground, each meticulously designed to serve distinct yet interconnected functions. At ground level (elevation 0.00), visitors are greeted by the main entrance, administrative offices, and auxiliary spaces, including a café-bar and an information center. A secondary entrance seamlessly connects this level to the surrounding park, blurring the boundaries between indoor and outdoor spaces. Descending to elevation -5.00, the gallery reveals expansive exhibition spaces designed to showcase both permanent collections and temporary installations. These areas are complemented

by flexible workshop zones, a versatile conference hall with a pre-function space, and artist studios thoughtfully positioned to receive natural light through double-height openings. This level exemplifies the gallery's dedication to fostering creativity and collaboration, providing artists with an environment that is both inspiring and functional. Further below, at elevation -8.00, lies the storage zone, carefully integrated with a subterranean parking facility accommodating up to 280 vehicles. This level also houses technical facilities that extend deeper to elevation -11.00, ensuring the gallery's operations are seamlessly supported without disrupting its artistic and ecological functions.

Visitors' journey through the gallery mirrors the experience of traversing a maritime landscape, with fluid, organic pathways guiding them through spaces imbued with light, texture, and a sense of discovery. This design choice enhances the gallery's role as not just a venue for art but a sensory environment where architecture and nature converge to create a living, breathing work of art.



(a) (b)

Figure 2: The vision of The Water Bubbles (a) site plan, and (b) 3D visualisation, Source: Students from The Water Bubbles team

3.2. The vision of The Ship

The proposed conceptual solution draws inspiration from the nearby sea and aims to connect nature with the location, enhance social interaction, and provide diverse activities. Considering the current urban layout, the solution aims to connect Trojkata Square with Baba-Ganka Square and the area in front of the Church of Cyril and Methodius.

The existing 6 m deep hole in the centre of the site has been used to create a plateau in front of the building and the main entrance to the museum part. The building's design integrates the sea into the city's core. An optical illusion of a sinking ship has been created using large water surfaces, where part of the object is visible above the water. The symbol of water was also used to highlight the main entrance, where a waterfall descends along a glass surface, leading visitors to the exhibition space. The water surface in the central part of the composition symbolises the open sea, which people observe from the 'shore' created by the amphitheatre seating. This seating not only helps overcome height differences and provides a place for people to relax but also emphasises the long-term existence of the hole and serves as a reminder of the past. The amphitheatre will offer various forms of entertainment, such as plays, films, and performances, while also serving as a place for socialising. A park has been designed around the building to enhance the city centre with much-needed greenery and create a pleasant oasis for enjoyment. A skate park has been designed in the northeastern section of the site, primarily attracting younger generations.

The building is situated in the central part of the site. It consists of six levels: three underground and three above ground, and it is organised into four functional units. The first unit features an impressive museum space across levels -2, -1, 0, and 1, highlighting its captivating permanent exhibition that will engage and inspire visitors. The museum's permanent exhibition showcases its collections in strikingly high-ceilinged spaces, creating an immersive and captivating experience. The museum building houses a large entrance hall that can be used for occasional exhibitions when needed, a coffee bar, restrooms for visitors, and offices for the museum's administration. On levels 0 and 1, the second unit is designed for workshops where visitors can try various crafts typical of the Burgas area, reflecting this region's history. The highest point of the building (Level 3) features a third functional unit, a viewing platform with a fantastic view of the Burgas city centre. The fourth unit is an underground garage extending over three subterranean levels, providing 218 parking spaces for cars and delivery vehicles. The depots next to the museum and the necessary technical rooms have been designed

as part of the underground garage. The underground garage is connected to the building with vertical communications and features exits thoughtfully integrated with the park's overall design.

The urban and architectural design not only enables the continuous flow of people in and out of the building but also provides an environment conducive to relaxation and social interactions. As a result, the location evolves into more than just a constructed urban environment; it transforms into a new feature of the city, a vibrant gathering place for reunions and connections-a place for people.



(a) (b)

Figure 3: The vision of The Ship (a) site plan, and (b) 3D visualisation, Source: Source: Students from The Ship team

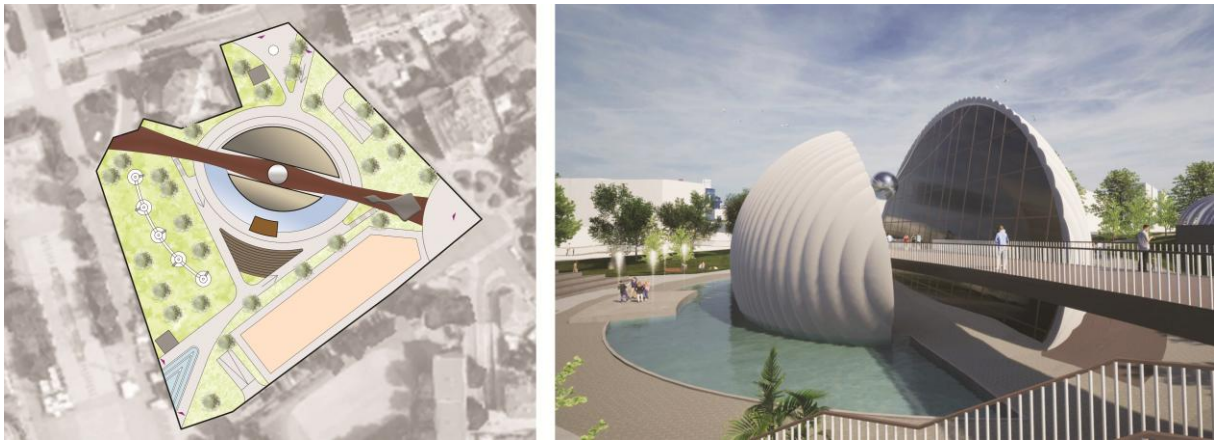
3.3. The vision of The Shell

The proposed conceptual solution is inspired by the proximity of the sea, the sandy coast, and the desire to connect nature with the location. Given the existing urban layout, a diagonal pedestrian path has been created to enhance connectivity between the main city square, where the Alyosha monument is located, and Baba-Ganka Square, as well as the area near the Cyril and Methodius Church. This diagonal footpath varies in width and takes the form of a bridge, complementing the existing "hole" symbol and the natural terrain configuration.

Using the principles of biomimicry, a central object resembling a half-open shell has been created, based on the proportions derived from the circular flow and the diagonal path's intersection. A footbridge runs between the two halves of the shell. The lower half is designated for catering facilities, while the upper half is designed to house a maritime museum. The shell segments are separated at the levels above the bridge but are connected underground through one level (-2). At this lowest level, there is an underground parking garage that accommodates 156 vehicles. A seafood restaurant spans the two above-ground levels of the lower shell, and a night bar is located on the top floor. Levels -1 and -2 include sanitary facilities and the economic section of the restaurant.

The Maritime Museum occupies three floors above the pedestrian walkway, and on the topmost floor, there is an observation deck offering views of the city and the coastline. The museum features a conference hall, exhibition spaces for both temporary and permanent displays, and interactive areas for children. An aquarium for visitors is situated on level -1, while level -2 contains technical rooms and storage depots.

In the southwestern part of the site, an amphitheater has been created in the existing "hole," complete with a stage for hosting various events. Pedestrian paths have been established around the amphitheater and shell to provide access to the stage and other open-air facilities, all positioned below the level of the bridge. A small forest has been developed in the park area, featuring viewpoints among the trees, enhanced by light elements that contribute to a pleasant atmosphere. This layout effectively separates the cultural function towards the bridge from the recreational function in the center of the park, organized along an axis perpendicular to the bridge and situated below it. The main attraction of the location is the "pearl," which floats above the bridge between the segments of the shell, using light, sound, and kinetic elements to create captivating visual effects.



(a) (b)

Figure 4: The vision of The Shell (a) site plan, and (b) 3D visualisation, Source: Source: Students from The Shell team

4. THE COMPARATIVE ANALYSIS OF THE DESIGN PROPOSALS FOR "THE HOLE" IN THE CITY OF BURGAS

Table 1 presents comparative overview of three design proposals from the perspective of the quality of public space relaying on indicators defined in Chapter 2. All three proposals responded very well to the task, fulfilling almost all of the indicators. While some indicators were partially addressed, there is scarcely any indicator that was not met to a significant degree. This suggests that the students demonstrated a solid understanding of the task and its requirements, effectively addressing the key objectives. Moreover, the proposals met the expectations of the city administration and the organizers, reflecting a thoughtful approach to the design of public spaces that aligns with both functional and aesthetic criteria.

Table 1: The comparative overview of three design proposals from the perspective of the quality of public space

Name of the indicator		*Design proposals*		
		The Water Bubbles	*The Ship*	*The Shell*
PROTECTION	*pedestrian & cyclist safety*	●●●	●●●	●●●
	removing traffic threats	●●●	●●●	●●●
	safe crossing areas	●●●	●●●	●●●
	lively public space with passive observation	●●●	●●●	●●●
	good lighting	●●●	●●●	●●●
	pollution reduction	●●●	●●	●●
	noice reduction	●●	●●	●●
	regulation of UHI	●●	●●	●●
	regulation of air currents	●●	●●	●●
	protection from rain spots	●	●●	●
COMFORT	*good connection to other places*	●●●	●●●	●●●
	connection to public transport	●●●	●●●	●●●
	accessibility for cyclists	●●●	●●	●●●
	pedestrian-friendly area	●●●	●●●	●●●
	lack of obstacles	●●●	●●●	●●●
	easy orientation	●●●	●●●	●●●
	accessibility for all	●●●	●●●	●●●
	quality pavements	●●●	●●●	●●●
	separate seating areas	●●●	●●●	●●
	seating encourages communication	●●●	●●●	●●
	spots with pleasant views	●●●	●●●	●●●

	outdoor entertainment	●●●	●●●	●●●
	outdoor physical activity	●●	●●	●●
	multifunctionality	●●	●●●	●●●
ENJOYMENT	*buildings and spaces on human scale*	●●●	●●●	●●●
	proportions & details that stimulate the senses	●●●	●●●	●●●
	clear distinction of spaces	●●●	●●●	●●●
	attractive urban design	●●●	●●●	●●●
	use of a lot of greenery	●●●	●●●	●●●
	use of water pounds	●●●	●●●	●●●
	sense of belonging	●●●	●●●	●●●
	creating local and urban identity	●●●	●●●	●●●
	history preservation and promotion	●●	●●	●●

5. CONCLUSION

The analysis of the three student projects reveals distinct approaches to revitalizing the urban space in central part of Burgas, reflecting varied priorities and creative interpretations.

The first project emphasizes ecological sustainability and artistic expression through an underground gallery of contemporary art. Drawing inspiration from wind and water, the design integrates a green roof park and bioretention systems, addressing urban heat islands, stormwater management, and biodiversity. Its subterranean layout fosters artistic creation while enhancing environmental and urban connectivity.

The second project focuses on social interaction and urban connectivity. Inspired by the sea, it incorporates water elements like waterfalls and an amphitheater, symbolizing a sinking ship. The design balances recreation and culture with spaces for a museum, workshops, and a skate park, transforming the site into a vibrant community hub.

The third project adopts biomimicry, with a shell-inspired structure housing a maritime museum, restaurant, and night bar. A pedestrian bridge enhances connectivity, while the amphitheater and forested park enrich recreational spaces. The "pearl" centerpiece, with light and kinetic effects, adds a unique identity to the site.

Each project showcases innovative strategies to integrate ecological, cultural, and social elements, offering diverse contributions to urban development and reflecting the students' creativity and technical skills.

This research has also shown how the cooperation between NGOs, universities, and City administration, as well as the collaboration between the students and professors from different schools of architecture, can have a positive impact on a better understanding and solving the design problems, contributing to the exchange of ideas and practices. By providing innovative solutions for the urban and architectural issues of the community, educational initiatives like the Summer School of Architecture can serve as incubators for creative ideas.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 and under the Agreement on the Implementation and Financing of Scientific Research Work of the NIO in 2025 - Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025. The authors thank the Center for Sustainable Spatial Development "BalkanARHitrav" from Dimitrovgrad and architects Gordana and Goran Rančev for starting the initiative to hold international summer schools and for ten years of dedication to organizing them. The authors would also like to thank the City of Burgas and Mr. Dimitar Nikolov, Mayor of Burgas Municipality, for their hospitality and financial support in organizing the 10th Summer School of Architecture "Burgas 2024". Professors and teaching associates, who are not authors of this research paper but were supervisors in the process of producing presented design solutions, also made a significant contribution from both the GAF, University of Niš, Serbia, and the UACEG from Sofia: prof. dr Miomir Vasov, prof dr Aleksandar Milojković, teaching assistant Nikolay Istatkov, M.Arch. Vladimir Topalov, Dimo Dimitrov and Antoaneta Avramova. This research would not have been possible without the architecture students,

participants of the summer school, divided into three teams: The Water Bubbles team - Jelena Novaković, Marko Jeremić, Metko Fetov, Katina Boykova; The Ship team - Mila Penčić, Marijeta Kovačević, Ramzina Mollova, Katerina Valkova; and The Shell team - Miona Momirović, Mihaela Ranovska, Nataša Mitić, Anja Otović.

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ICUP2025
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DOMESTIC ENERGY POVERTY MAPPING IN MINNA, NIGERIA

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ABSTRACT

Inaccessibility to modern energy in Minna Niger state in spite of being the power state of the country results in households' use of 'unclean fuels' for domestic purposes and the consequent need of measuring and mapping energy poverty levels in Minna metropolis. The study analysed the distribution of domestic energy poverty of households in Minna with a view to mapping energy deprived areas for possible intervention. Measuring domestic energy poverty and developing domestic energy surface maps facilitated the analysis of spatial variation in energy stress. The concepts of energy access, and poverty were reviewed to facilitate the study. The research is a survey based where Multidimensional Energy Poverty Index (MEPI) was adapted to determine energy poverty situation of Minna households. Carbon monoxide concentration levels as an indicator of energy poverty was observed in the study area. The study revealed among others that about 35.75% of the households are energy non-poor while 64.25% are energy poor. The energy poverty incidence (H) and intensity (A) are found to be 0.704 and 0.867 giving the MEPI for the study area to be 0.61 approximately. It implies that the energy poverty situation of the study area is moderate. New Maitumbi is the most deprived neighbourhood resulting from both MEPI (0.83) and composite indices analysis score (4). The research concludes inter alia that energy poverty and indoor pollution interventions based on MEPI and composite index analysis should be directed more towards New Maitumbi neighbourhood as a worst case.

Keywords: *deprivation; energy; mapping; pollution; poverty; spatial*

1. INTRODUCTION

Minna with population density of 56 persons per square kilometre is one of the growing cities in Nigeria which is as a result of increasing urbanization process when it became the capital of Niger state in 1976 (Abd'razack et al., 2012). Still developing and with the unsteady energy situation of Minna, wood fuel is one of the cheap energy forms consumed domestically resulting from its availability and affordability. Also, the city is

experiencing generating plant ownership as an alternative lighting option in times of power outage. As alternative energy, Liquefied Petroleum Gas (LPG) and Kerosene use are not encouraged since their availability are not assured, nor do they cost within urban poor's reach.

Being the "Power Generating state" of the country, it is expected for there to be 24 hours supply of electricity at least in Minna the state capital but unfortunately, access to efficient and steady energy for both domestic and other uses are yet to be attained. This plunges the city residents into domestic energy poverty situation that requires desired intervention and alleviation. In other to make up, residents' resort to the use of inefficient energy options to meet up with their energy demand and improve their condition (Ohadugha, 2018).

Regarding interventions, most of the general poverty alleviation programmes are given blanket attention in the sense that the target population might not get attention proportional to their energy situation. Therefore, this study will analyse domestic energy deprivation in order to determine its distribution in Minna metropolitan space for possible intervention through energy surface maps.

1.1. Study Area

Minna metropolis, the capital of Niger State in the North Central geo-political zone of Nigeria lies between Latitude 9o 33' and 9o 40' North of the Equator and Longitudes 6o 29' and 6o 35' East of the Greenwich Meridian as shown in Figure 1 (Max Lock, 1979). The town's development has gone beyond the metropolitan limits to accommodate sprawling settlements which are purposefully and contextually classified as the neighbourhoods (Figure 2). 2. paper length and its constituents

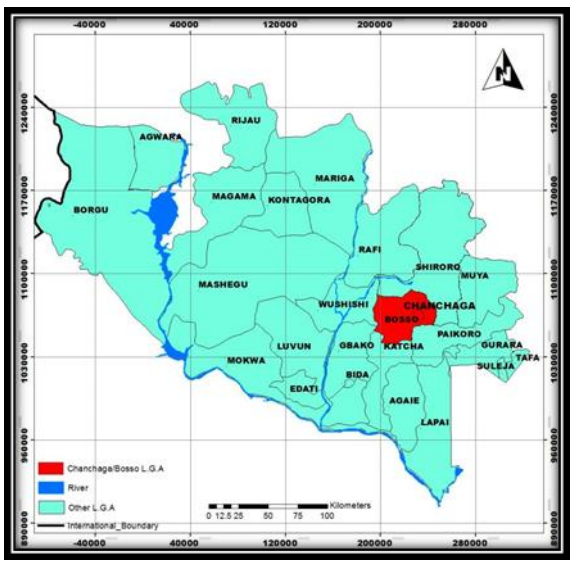


Figure 1: Niger State Local Govt Areas

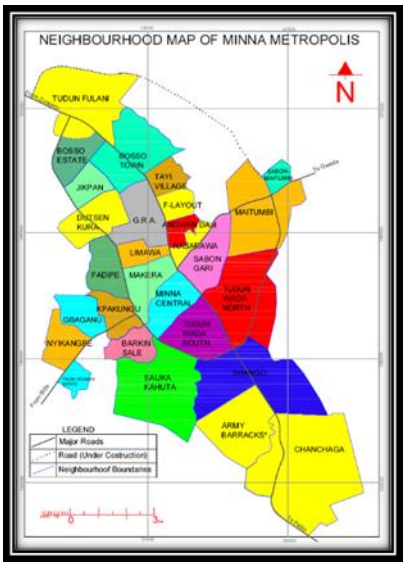


Figure 2: Metropolitan Neighbourhood

Source: Adapted from Sanusi, 2006.

2. LITERATURE REVIEW

2.1. Energy Poverty

Poverty is present everywhere in the world, both in the rich, developed nations and poor undeveloped or developing nations as well. Because the poorest populations of the world are contained in the undeveloped countries and many living in unimaginable conditions, poverty is more pronounced and rifer in relation to the industrialized countries.

Energy poverty is a perennial social anomaly affecting Nigeria and most undeveloped economies (Agba 2011). It illuminates the global inequality behind energy poverty phenomenon in spite of Nigeria being a major exporter of energy. Despite Nigeria's natural and human endowments, 44% of the households in Nigeria lack electricity (Michaels, 2015). With electricity even in Nigerian homes, the provided service quality is often intermittent while growing increasingly expensive. Edoumiekumo et al. (2013) pointed out that energy poverty measurement considers three major deprivations which are accesses to: power (electricity), modern cooking fuel and clean indoor air. They discovered that energy poverty is acute and pervasive and has migration, educational and occupational dimensions in the geo-political zone.

3. METHODOLOGY

The study adopted multi-stage sampling technique involving cluster, stratified and purposive sampling to analyse the spatial variation in energy poverty using heat maps, deprivations, GPS coordinates and indexes (MEPI and electricity). These were possible through household survey (questionnaire), observations (schedule of daily electricity supply) and the use of Geographic Information System. With growth rate of 4.8% (NPC, 2006), the population of Minna gives approximately 53,228 households. The study used Adams et al. (2007) sample size formula to determine the sample size which is approximately 400. The study used the percentages of households adopting low-level primary cooking energy (kerosene, charcoal and fuel wood), energy stacking, energy monthly expenditure, households' pollution indicator in the neighbourhoods as the variables for analysis. The study also made use of two index analysis in determining energy poverty situation of the households and they include adopting and adapting multi-dimensional energy poverty index by Nussbaumer et al. (2013) and Light index.

4. RESULTS AND DISCUSSION

Energy deprivation characteristics and poverty situation of Minna households have been aggregated and analysed as an entity. The clusters are comprised of the 28 neighbourhoods in Minna where proportionately and systematically selected households of each neighbourhood were sampled. The energy deprivation variables considered are low-level Primary Cooking Energy (PCE) options (kerosene, charcoal and fuel wood), energy stacking, energy expenditure, light index (daily electricity supply), pollution index (carbon monoxide level) and energy poverty index (MEPI).

4.1. Primary Cooking Energy (PCE)

The households' low-level primary cooking energy types reveal the proportion of the household's using kerosene, charcoal and fuel wood primarily for cooking within each neighbourhood. It was revealed that New Maitumbi (100%) is the neighbourhood where all the households use either of the low-level cooking energy for cooking while Bosso estate, F-Layout and Talba estate (0%) neighbourhoods are having non-low-level primary cooking energy using households.

4.2. Domestic Energy Stacking

The study revealed in figure 3 that 88% of the households indulge in cooking energy stacking or fuel switching in varying number and patterns while about 12% maintained one cooking energy type. Out of the households that stack cooking energy, 43%, 34%, 9% and 2% stack two, three four and five cooking energy types respectively. It implies the inadequacy in their primary domestic cooking energy availability.

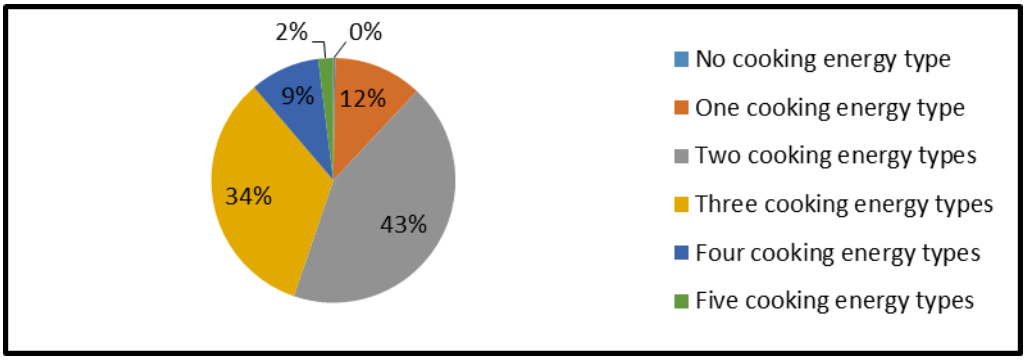


Figure 3: Distribution of Cooking Energy Stacking, Source: Author's field work, 2022.

In furtherance of domestic cooking energy stacking, there are usually various lighting alternatives whenever there is power outage especially in the night. The findings in Table 1 revealed that in times of power outage all the households indulge in lighting energy stacking in varying proportions. The lighting energy stacking proportions is as follows, 27% stack only one lighting energy type, 42% stack two different lighting energy types, 26.8% stack up to three while 4.3% stack up to four different lighting energy types. The result also implies the inadequacy of availability in their primary domestic lighting energy as the households' stack lighting energy as their coping strategy.

Table 1: Domestic Lighting Energy Stacking

Variable	*No. of households*	*Stacking households*	*Stacking one type*	*Stacking two types*	*Stacking three types*	*Stacking four types*
Lighting energy stacking	*400*	*400*	*108*	*168*	*107*	*17*
Percentage		*100*	*27*	*42*	*26.8*	*4.3*

Source: Author's field work, 2022.

4.3. Monthly Expenditure on Primary Energy Types

The descriptive statistics of the monthly expenditure of the primary cooking energy types of the households are summarised in Table 2. It shows that the average expenditure across the energy types is N2,460.08.

Table 2: Mean monthly Primary Energy Types Expenditure in Naira

Energy type	***Mean*** ₦
Electricity	*2382*
Gas	*3152.3*
Kerosene	*2593.9*
Charcoal	*1647.5*
Fuel wood	*2524.7*

Source: Author's field work, 2022.

4.4. Light Index

The power supply situation in Minna metropolis was monitored for seven days. Figure 4 shows the observed average daily supply of electricity to the households in the various neighbourhoods making up the study area.

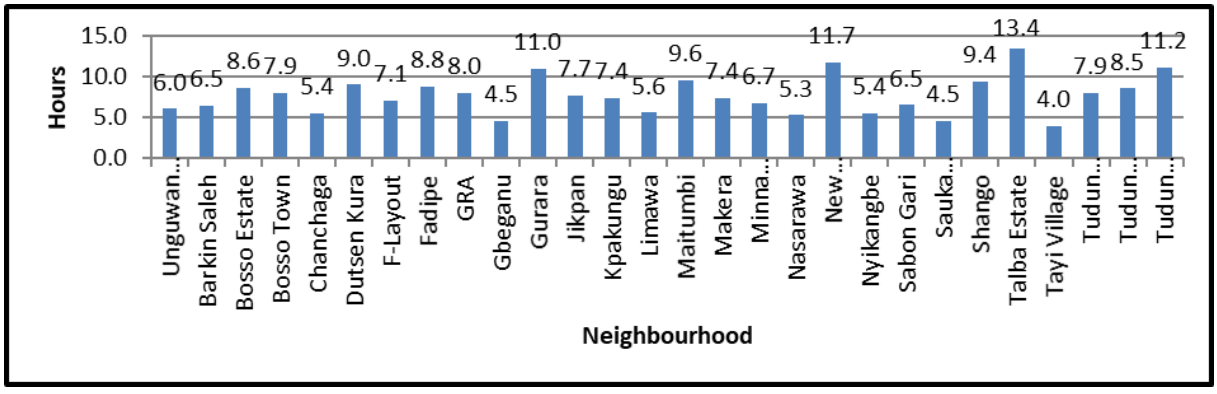


Figure 4: Neighbourhood Average Daily Electricity Supply
Source: Author's field work, 2022.

The survey revealed that Tayi Village is the least electricity powered neighbourhood with an average daily electricity supply of four hours. Talban Estate, New Maitumbi, Tudun Wada South and Gurara are the most electricity powered neighbourhoods with average daily electricity supply of 13.4, 11.7, 11.2 and 11 hours respectively.

4.5. Spatial Variation of Daily Electricity Supply in Minna

The households' electricity supply situation in Minna metropolis was monitored on daily basis for seven days and the results were classified into three as depicted in Table 3.

Table 3: Households' Electricity Supply Classification

Duration (hours)	***Classification***	***Percentage***
< 8	*Poor*	*41.25*
8 – 16	*Fair*	*57.75*
>16	*Good*	*1.25*

Source: Author's field work, 2022.

The households' daily hours of electricity within each neighbourhood were aggregated to facilitate spatial variation of energy deprivation. Based on the classification represented in Table 4.36, the average daily supply per neighbourhood, their light index and classification are shown in Table 4.

Table 4: Light Index and Classification of Average Daily Electricity Supply

Neighbourhood	***Average daily supply (hours)***	***Light index***	***Classification***
Anguwan Daji	*6*	*0.25*	*Poor*
Barkin Saleh	*6.5*	*0.27*	*Poor*
Bosso Estate	*8.6*	*0.36*	*Fair*
Bosso Town	*7.9*	*0.33*	*Poor*
Chanchaga	*5.4*	*0.23*	*Poor*
Dutsen Kura	*9*	*0.38*	*Fair*
Fadipe	*8.8*	*0.37*	*Fair*
F-Layout	*7.1*	*0.30*	*Poor*
Gbeganu	*4.5*	*0.19*	*Poor*
G. R. A	*8*	*0.33*	*Fair*
Gurara	*11*	*0.46*	*Fair*
Jikpan	*7.7*	*0.32*	*Poor*
Kpakungu	*7.4*	*0.31*	*Poor*
Limawa	*5.6*	*0.23*	*Poor*
Maitumbi	*9.6*	*0.40*	*Fair*
Makera	*7.4*	*0.31*	*Poor*
Minna Central	*6.7*	*0.28*	*Poor*
Nasarawa	*5.3*	*0.22*	*Poor*
New Maitumbi	*11.7*	*0.49*	*Fair*
Nyikangbe	*5.4*	*0.23*	*Poor*
Sabon Gari	*6.5*	*0.27*	*Poor*
Sauka Kahuta	*4.5*	*0.19*	*Poor*
Shango	*9.4*	*0.39*	*Fair*
Talba Estate	*13.4*	*0.56*	*Fair*
Tayi Village	*4*	*0.17*	*Poor*
Tudun Fulani	*7.9*	*0.33*	*Poor*
Tudun Wada North	*8.5*	*0.35*	*Fair*
Tudun Wada South	*11.2*	*0.47*	*Fair*

Source: Author's field work, 2022.

With the classification above, 60.7% and 39.3% of the neighbourhoods having between 0 – 7.9 hours and between 8 - 16 hours of electricity daily are classified as being poorly and fairly supplied respectively. Talba Estate is the most electrically served neighbourhood with an average of 13.4 hours each day and the highest index of 0.56 while Tayi Village is the least served neighbourhoods with a daily average supply of 4 hours and the least index of 0.17. No neighbourhood has been discovered to belong to the 'good' classification with >16 hours daily average of electricity supply.

The light index which is derived from the observed average daily supply of electricity to the various neighbourhoods making up the study area is computed as the observed mean light hours of households divided by expected daily supply (24 hours) of electricity. It implies that the higher the index, the higher the better the electricity situation. Light Index = average daily hours of electricity supply/expected daily hours of supply (24)

$$\frac{\text{Mean daily electricity supply (hours)}}{\text{Expected daily electricity supply (24 hours)}} = \text{Light Index}$$

It can be deduced from the study that at the city level, Minna metropolis is serviced at an average of 7.7 hours (approximately 8 hours) of electricity per day (Table 5) translating into an average of 53.8 hours (approximately 54 hours) weekly.

Table 5: Descriptive Statistics of Average Daily Electricity Supply

	Mean	SD	Min	Median	Max	Mode
Average daily electricity supply (hours)	7.7	2.3	4	7.6	13	8

Source: Derived from Table 4

The average daily hours of electricity enjoyed across the neighbourhoods is 7.7 hours per day. The standard deviation of the daily hours of electricity which is 2.3 indicates that some of the neighbourhoods receive less than or even more than the average daily electricity supply. The standard deviation value is not large implying that the data set are not dispersed rather are more concentrated around the mean.

4.6. Indoor Pollution Level

Having measured and derived the carbon monoxide concentrations from the various pollutant emitting domestic cooking and lighting energy types of households in Minna, Figure 5 depicts the various individual households aggregated pollution level. From the contour map, areas of high and low pollution level are depicted by red and blue colours respectively.

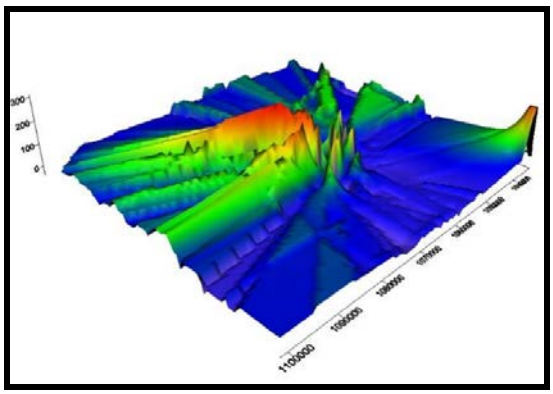


Figure 5: 3-Dimensional Pollution Level Contour Map
Source: Authors field work (2022)

The average aggregated pollution level of households in Minna was computed to derive the composite neighbourhood pollution level as shown in Table 6. Emissions from generators based on their operating distances and cooking energy type were aggregated to generate the neighbourhoods' and the city's pollution level.

Table 6: Composite Average Neighbourhood Pollution Concentration

Neighbourhood	***Average CO Concentration***	***City level (59.9ppm)***
Anguwan Daji	*43.5*	*Below*
Barkin Saleh	*86.5*	*Above*
Bosso Estate	*83.1*	*Above*
Bosso Town	*85.3*	*Above*
Chanchaga	*44.6*	*Below*
Dutsen Kura	*68.5*	*Above*
Fadipe	*17.3*	*Below*
F-Layout	*18.7*	*Below*
G. R. A	*82.3*	*Above*
Gbeganu	*47.1*	*Below*

Gurara	*81.3*	*Above*
Jikpan	*84.7*	*Above*
Kpakungu	*64*	*Above*
Limawa	*109.8*	*Above*
Maitumbi	*82.7*	*Above*
Makera	*59.2*	*Below*
Minna Central	*31.2*	*Below*
Nasarawa	*68.9*	*Above*
New Maitumbi	*123.5*	*Above*
Nyikangbe	*18.9*	*Below*
Sabon Gari	*27*	*Below*
Sauka Kahuta	*49.9*	*Below*
Shango	*15.9*	*Below*
Talba Estate	*10.75*	*Below*
Tayi Village	*74.6*	*Above*
Tudun Fulani	*81.8*	*Above*
Tudun Wada North	*76.3*	*Above*
Tudun Wada South	*40.5*	*Below*
Mean	***59.9***	

Source: Authors field work, 2022.

Weighed against the WHO and NAAQS safe limit of 9 ppm CO emission level, no neighbourhood is within the safe limit. Talba Estate is the least polluted neighbourhood with the composite average CO emission level of 10.75 ppm while the worst polluted neighbourhood is New Maitumbi with the composite average CO emission level of 123.5 ppm from cooking and lighting energy types.

In summary, the CO emission level of 46.4% and 53.6% of the neighbourhoods are below and above the mean (city level) 59.9 ppm respectively as Figure 6 depicts.

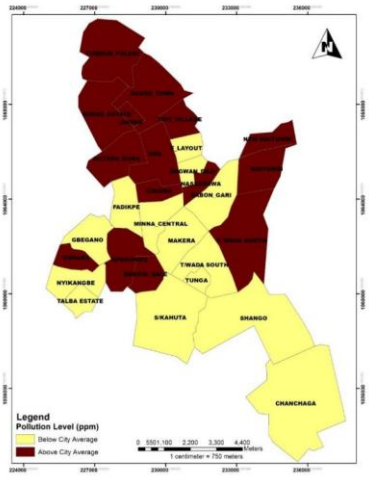


Figure 6: Neighbourhoods below and above the city CO level.
Source: Author's field work, 2022.

4.7. Spatial Variation of Multidimensional Energy Poverty Index

Multidimensional Energy Poverty Index analysis of Minna revealed that 10.7% of the neighbourhoods having very low index of incidence and intensity of energy poverty are energy non poor neighbourhoods. The energy non poor neighbourhoods include Bosso Estate, F-Layout and Talba Estate as shown in Table 7.

Table 7: Neighbourhoods' M.E.P.I Values and Classification

Neighbourhoods	*Incidence (H)*	*Intensity (A)*	*MEPI*	*Classification*
Anguwan Daji	*0.83*	*0.76*	*0.63*	*Moderate*
Barkin Sale	*0.77*	*0.69*	*0.53*	*Moderate*
Bosso Estate	*0*	*0.03*	*0*	*Low*
Bosso Town	*0.8*	*0.69*	*0.55*	*Moderate*
Chanchaga	*0.71*	*0.67*	*0.48*	*Moderate*
Dutsen Kura	*0.82*	*0.71*	*0.58*	*Moderate*
F-Layout	*0*	*0.04*	*0*	*Low*
Fadipe	*0.33*	*0.27*	*0.09*	*Low*
G. R. A	*0.54*	*0.51*	*0.28*	*Low*
Gbeganu	*0.79*	*0.73*	*0.58*	*Moderate*
Gurara	*0.43*	*0.41*	*0.18*	*Low*
Jikpan	*0.5*	*0.58*	*0.29*	*Low*
Kpakungu	*0.81*	*0.69*	*0.56*	*Moderate*
Limawa	*0.79*	*0.79*	*0.62*	*Moderate*
Maitumbi	*0.86*	*0.75*	*0.65*	*Moderate*
Makera	*0.65*	*0.56*	*0.36*	*Moderate*
Minna Central	*0.54*	*0.59*	*0.32*	*Moderate*
Nasarawa	*0.88*	*0.75*	*0.66*	*Moderate*
New Maitumbi	*1*	*0.83*	*0.83*	*Acute*
Nyikangbe	*0.86*	*0.74*	*0.64*	*Moderate*
Sabon Gari	*0.83*	*0.74*	*0.61*	*Moderate*
Sauka Kahuta	*0.62*	*0.61*	*0.38*	*Moderate*
Shango	*0.43*	*0.53*	*0.23*	*Low*
Talba Estate	*0*	*0.03*	*0*	*Low*
Tayi Village	*0.67*	*0.66*	*0.44*	*Moderate*
Tudun Fulani	*0.9*	*0.76*	*0.68*	*Moderate*
Tudun Wada North	*0.4*	*0.46*	*0.18*	*Low*
Tudun Wada South	*0.25*	*0.26*	*0.07*	*Low*

Source: Authors field work (2022)

In general, the study area's M.E.P.I qualified as moderate but the disaggregated data revealed 35.7% of the neighbourhoods having M.E.P.I value (<0.30) indicating low or energy non-poor situation. On the other hand, the energy poverty situation of 60.7% of the neighbourhoods having M.E.P.I value of between 0.30 and 0.70 is moderate. The acute energy poverty situation of 0.83 is recorded for New Maitumbi representing 3.57% of the neighbourhoods as revealed in Table 4.41. This implies that the higher the index, the higher the energy poverty.

In conclusion, Minna having M.E.P.I of 0.63 does not imply that all the component neighbourhoods are having moderate M.E.P.I as variations of energy poverty level is revealed from the study (Figure 7). The implication is that energy poverty and pollution intervention should be directed more towards New Maitumbi being the most deprived neighbourhood.

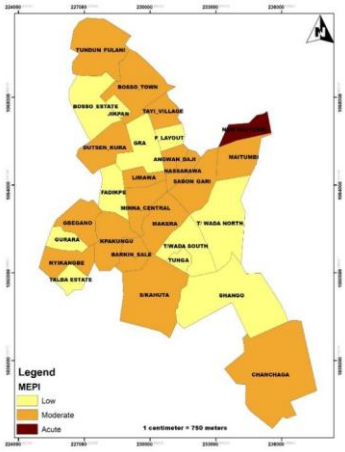


Figure 7: M.E.P.I Classification of Minna Neighbourhoods
Source: Author's field work, 2022.

In classifying energy poverty, Nussbaumer *et al.* (2012) stated that when the M.E.P.I exceed 0.7, between 0.3 and 0.7 and below 0.3, energy poverty is classified as acute, moderate, and low respectively. Any household whose weighted deprivation sum is more than or equal to 0.30 is thus energy poor and when it is less than 0.30 is energy non-poor. This implies that the higher the index, the higher the energy poverty.

Minna having M.E.P.I of 0.63 does not imply that all the component neighbourhoods are having moderate M.E.P.I as variations of energy poverty level is revealed from the study (Figure 7). The implication is that energy poverty and pollution intervention should be directed more towards New Maitumbi being the most deprived neighbourhood.

For a wider applicability, an area whose MEPI may be acute (0.7+) does not translate to all its aggregate parts being acute also as there may be variations in their individual access to energy.

4.8. Spatial Variation in Energy Deprivation

The variables considered for the spatial variation analysis in energy deprivation include primary low-level cooking energy type, energy stacking, energy expenditure, electricity supply situation, pollution from cooking and lighting energy types, and index of energy poverty. The households' energy deprivations were aggregated to the neighbourhood level as depicted in Table 8.

Table 8: Spatial Variation of Energy Deprivation Indexes

Neighbourhood	*Low level PCE (%)*	*Energy Stacking*	*Energy expenditure*	*Light index*	*Pollution level index*	*Poverty index*	*Deprivation indices score*
Anguwan Daji	*83.33*	*66.67*	*1545.83*	*0.25*	*0.03*	*0.63*	*0*
Barkin Saleh	*77.27*	*93.18*	*2749.32*	*0.27*	*0.05*	*0.53*	*0*
Bosso Estate	*0*	*65*	*2512.5*	*0.36*	*0.05*	*0*	*0*
Bosso Town	*80*	*70*	*1415.9*	*0.33*	*0.05*	*0.55*	*0*
Chanchaga	*71.43*	*76.79*	*5404.29*	*0.23*	*0.03*	*0.48*	*0*
Dutsen Kura	*82.35*	*85.29*	*1422.06*	*0.38*	*0.04*	*0.58*	*0*
F-Layout	*0*	***100***	***9023.33***	*0.3*	*0.01*	*0.09*	*2*
Fadipe	*33.33*	*88.89*	*5494.44*	*0.37*	*0.01*	*0*	*0*
Gbeganu	*78.57*	*69.23*	*6271.15*	*0.33*	*0.05*	*0.28*	*0*
GRA	*53.85*	*85.71*	*2821.07*	*0.19*	*0.03*	*0.58*	*0*
Gurara	*42.86*	*92.86*	*6791.43*	*0.46*	*0.05*	*0.18*	*0*
Jikpan	*50*	*50*	*2560.83*	*0.32*	*0.05*	*0.29*	*0*
Kpakungu	*81.48*	*85.19*	*3783.33*	*0.31*	*0.04*	*0.56*	*0*
Limawa	*78.57*	*67.86*	*4267.86*	*0.23*	***0.07***	*0.62*	*1*

Maitumbi	*85.71*	*92.86*	*3498.57*	*0.4*	*0.05*	*0.65*	*0*
Makera	*65.38*	*76.92*	*4744.81*	*0.31*	*0.04*	*0.36*	*0*
Minna Central	*61.54*	*76.92*	*1103.85*	*0.28*	*0.02*	*0.32*	*0*
Nasarawa	*87.5*	*81.25*	*3143.75*	*0.22*	*0.04*	*0.66*	*0*
New Maitumbi	***100***	***100***	*3635*	*0.49*	***0.07***	***0.83***	*4*
Nyikangbe	*85.71*	*78.57*	*5190*	*0.23*	*0.01*	*0.64*	*0*
Sabon Gari	*83.33*	***100***	*1421.25*	*0.27*	*0.02*	*0.61*	*1*
Sauka Kahuta	*61.9*	*88.1*	*5004.76*	*0.19*	*0.03*	*0.38*	*0*
Shango	*42.86*	*78.57*	*4617.86*	*0.39*	*0.01*	*0.23*	*0*
Talba Estate	*0*	*62.5*	*4862.5*	*0.56*	*0.01*	*0*	*0*
Tayi Village	*66.67*	*83.33*	*5706.25*	***0.17***	*0.04*	*0.44*	*1*
Tudun Fulani	*90*	*75*	*1855.5*	*0.33*	*0.05*	*0.68*	*0*
Tudun Wada N.	*40*	*80*	*3884.33*	*0.35*	*0.05*	*0.18*	*0*
Tudun Wada S.	*25*	*89.06*	*5633.59*	*0.47*	*0.02*	*0.07*	*0*

Source: Author's field work, 2022.

From the foregoing, New Maitumbi is the only neighbourhood where 100% of the households' primary cooking energy emits carbon monoxide. Energy stacking across the entire study area is mostly prevalent in F-Layout, New Maitumbi and Sabon Gari neighbourhoods (Table 8). It can be deduced that stacking is indulged in as a result of short falls or deprivations in modern energy types. Energy expenditure is highest (₦ 9,023.33) in F-Layout while light index is lowest in Tayi Village (0.17). Pollution is highest in New Maitumbi and Limawa both with indexes of 0.07 while poverty index (MEPI) is highest in New Maitumbi (0.83).

Aggregating these indices, New Maitumbi becomes the most deprived neighbourhood with composite indices score of four (4) based on the number of occurrences (frequency) in the deprivation parameters considered.

4.9. Energy Surface (Heat Map)

The domestic energy surface maps for this study were derived from the data on the households' primary domestic cooking energy and location coordinates of the sampling units. The coordinates are plotted on 3 dimensional platforms where (x values) and (y values) are the easting and northing values respectively while the primary domestic energy type is the z value. From the research, the dominating primary domestic cooking energy types were identified in each neighbourhood as shown in Table 9.

Table 9: Dominating PCE in Each Neighbourhood

Neighbourhood	***Dominating PCE***	***Equally used alternative***
Anguwan Daji	*Kerosene*	*Charcoal*
Barkin Saleh	*Kerosene*	*Fuel wood*
Bosso Estate	*Gas*	*-*
Bosso Town	*Fuel wood*	*Charcoal*
Chanchaga	*Kerosene*	*-*
Dutsen Kura	*Charcoal*	*-*
Fadipe	*Electricity*	*Gas*
F-Layout	*Gas*	*-*
G.R.A	*Fuel wood*	*Gas*
Gbeganu	*Charcoal*	*-*
Gurara	*Fuel wood*	*Gas*
Jikpan	*Electricity*	*Fuel wood*
Kpakungu	*Kerosene*	*-*
Limawa	*Fuel wood*	*-*

Maitumbi	*Charcoal*	*Fuel wood*
Makera	*Kerosene*	-
Minna Central	*Gas*	*Kerosene*
Nasarawa	*Kerosene*	-
New Maitumbi	*Kerosene*	*Fuel wood*
Nyikangbe	*Kerosene*	-
Sabon Gari	*Charcoal*	-
Sauka Kahuta	*Kerosene*	-
Shango	*Gas*	-
Talba Estate	*Gas*	-
Tayi Village	*Charcoal*	*Fuel wood*
Tudun Fulani	*Kerosene*	-
Tudun Wada North	*Gas*	-
Tudun Wada South	*Gas*	-

Source: Author's field work, 2022

Kerosene, the dominant cooking energy as revealed by the study is being used as primary domestic cooking fuel in ten neighbourhoods (Anguwan Daji, Barkin Saleh, Chanchaga, Kpakungu, Makera, Nasarawa, New Maitumbi, Nyikangbe, Sauka Kahuta and Tudun Fulani) and also playing the second fiddle in one neighbourhood (Minna Central). Gas as a major cooking fuel also is used in seven neighbourhoods (Bosso Estate, F-Layout, Minna Central, Shango, Talba Estate, Tudun Wada North and Tudun Wada South) while playing the second fiddle role in three neighbourhoods (Fadipe, GRA and Gurara). Charcoal majorly is used in five neighbourhoods (Dutsen Kura, Gbeganu, Maitumbi, Sabon Gari and Tayi Village) and as an alternative in two neighbourhoods (Anguwan Daji and Bosso Town). Four neighbourhoods (Bosso town, GRA, Gurara and Limawa) use fuel wood majorly as their domestic cooking energy fuel while in five neighbourhoods (Barkin Saleh, Jikpan, Maitumbi, New Maitumbi and Tayi village), it is equally used. Electricity is used mainly as domestic cooking fuel in Fadipe and Jikpan neighbourhoods only and never used as an alternative in any neighbourhood.

In the analysis, cooking energy types were considered because of the importance of food as one of the man's basic needs and it involves the generality of human kind unlike alternative lighting that could be optional. The dominating primary cooking energy type or types identified in each neighbourhood as revealed in Figure 8 are used in generating the energy surfaces heat maps. The energy surface (heat map) as employed in this study shows the neighbourhoods where a particular dominating cooking energy type prevails.

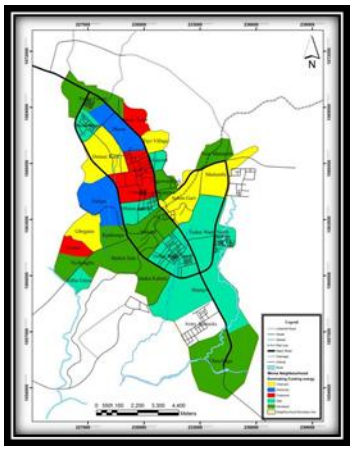
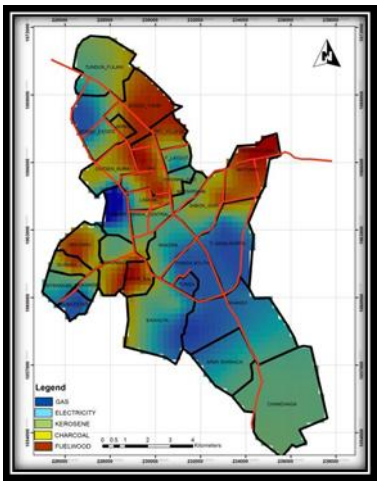


Figure. 8: Neighbourhoods Dominating Primary Cooking Energy
Source: Author's field work, 2022.

From the observations and based on the primary domestic cooking energy, 17 neighbourhoods have a single dominating cooking energy type while 11 neighbourhoods have two dominating cooking energy types being equally used by the households. Since there are neighbourhoods that have two equally dominating primary cooking energy types, two energy surfaces (heat maps) were generated.

The first heat map (Figure 9) is the single dominating primary cooking energy type that accommodated neighbourhoods where two primary cooking energy types are equally used from which the pollutant emitting energy type is contextually adopted. Figures 9 and 10 show the colour representation of the dominating primary domestic cooking energy types used in the neighbourhoods. The red and yellow patches in the colour heat map indicate the locations where fuel wood and charcoal respectively are used majorly. The light blue and blue patches indicate the areas of gas and electricity use in that order while the green patches in the colour heat maps indicate the areas where kerosene are in use majorly.



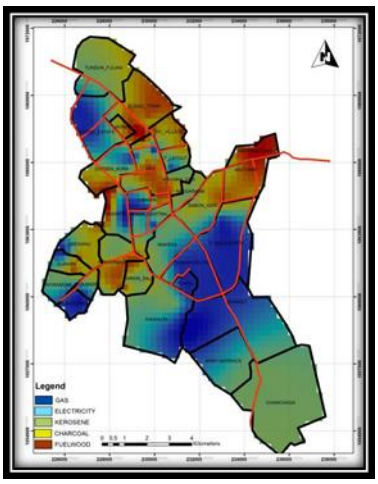


Figure 9: Single PCE Heat Map **Figure 10**: Dual PCE Heat Map
Source: Author's field work, 2022.

In general, kerosene is shown to be the dominant primary domestic energy type used for cooking. In the study area, 35.7% of the neighbourhoods have kerosene as the dominating primary domestic energy type for cooking. Gas and charcoal respectively are used majorly in 25% and 17.9% of the neighbourhoods as their primary domestic cooking energy while fuel wood is used mainly in 14.3% of the entire neighbourhoods in the study area. The implication of the heat map is that it gives an overview of the areas requiring specific energy poverty alleviation or intervention programmes.

5. CONCLUSION

One of the several reasons attached to the importance of energy poverty concept is that energy poverty indicators shed light on how a country, region or state is faring in attaining the basic energy needs of their most deprived households. The energy poverty indicators can assist in monitoring the spatial distribution and impact of the diverse energy programmes which include sector reforms, projects that are concerned with generating electric power and projecting highly qualitative cooking fuels. The energy poverty situation however, is just one out of many dimensions that indicate the overall household welfare in any nation, region or state. Spatial distribution of energy deprivation will facilitate energy interventions complemented by other infrastructure improvements obviously in directing and addressing domestic energy issues.

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IMPLEMENTATION OF URBAN GREEN INFRASTRUCTURE SOLUTIONS FOR IMPROVING OUTDOOR THERMAL COMFORT IN HIGH-RISE HOUSING AREAS: LESSONS FROM SINGAPORE AND SHEFFIELD

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ABSTRACT

This paper investigates the potentials of Urban Green Infrastructure (UGI) to improve outdoor thermal comfort (OTC) in high-rise housing areas (HRHA). Climate changes, rapid growth of the urban population and dense compact construction adversely affect the quality of the environment in cities, which is manifested through a series of negative consequences, including the increasingly frequent occurrence of urban heat islands and impairment of OTC, which are especially evident in HRHA. Ecologically oriented approaches have found wider application as a suitable conceptual and planning framework for the improvement of OTC. Among others, UGI has emerged as one of the key effective approaches for mitigating the adverse effects of climate changes on OTC. UGI solutions such as green roofs, green facades, permeable pavements, and vegetation corridors are gaining increasing importance in HRHA in the context of regulating microclimates, reducing thermal stress, and enhancing the quality of open spaces (OS). Many cities worldwide have successfully implemented UGI solutions to address problems concerning urban heat stress. The focus of this paper is on the multiple benefits of UGI application to improve OTC in HRHA. The research is based on the analysis of current theoretical knowledge and selected best practice examples. HRHA in Singapore and Sheffield were chosen as research platforms as they represent successful example of strategic improvement of microclimate in densely built environments. Findings from these examples highlight the effectiveness of UGI to improve OTC and create comfortable OS so that their urban design simultaneously satisfies functional, ecological, socio-cultural and aesthetic requirements of OS in HRHA.

Keywords: *urban green infrastructure; open spaces; outdoor thermal comfort; high-rise housing areas;*

1. INTRODUCTION

In order to respond to the key challenges that cities around the world face - improving the quality of life in cities, adapting to climate change and reducing the effects of urban heat islands (UHI) - in recent years, various ecologically oriented concepts have been applied in urban planning practice, among which urban green infrastructure (UGI) stands out. Today, almost 50% of the world's population live in urban areas [5]. Rapid urban population growth increases building construction and artificial urban pavements such as asphalt and concrete. These trends contribute to intensification of environmental problems, particularly UHI effect, which significantly impacts resident outdoor comfort (OTC) in densely built urban areas, including high-rise housing areas (HRHA). Namely, these phenomena lead to significant environmental challenges causing increasing of thermal stress in HRHA because of the dense construction and often limited open spaces (OS) and modest green areas.

OS in HRHA play a crucial role in enhancing residents' quality of life [2]. One of the key aspects of OS quality is usability which involves accessibility, inclusiveness, functionality, safety, and adaptability to residents' needs, with particular significance on potential to enable of a variety of activities of residents. Usability of OS is also recognized through their potentials to stimulate good neighborhood relations and social cohesion as well as vibrancy and sustainability with adequate urban design [3], [4] [20]. Furthermore, usability of OS in HRHA is closely tied with overall neighborhood satisfaction with quality of life [21], thus good urban design of OS represents a complex and significant challenge and task for urban planners. One of the significant conditions for usability of OS is favourable microclimate and OTC [6], besides functional, social and aesthetic values [18]. In the summer period, increases in temperature values often cause the occurrence of UHI and deterioration of OTC and intensifies the pollutant concentrations [22], thereby directly impairing the usability of OS. These negative implications are most pronounced in cities that are most sensitive to extreme weather conditions in the summer. Thus, in order to stimulate the usability of OS during summer, one of the main factors is to crate as favorable OTC as possible. Failure to meet this requirement can cause residents thermal discomfort which has negative consequences on health and low level of usability of OS [16]. In line with that, in current conditions creating more resilient open spaces in HRHA concerning OTC is becoming more and more significant.

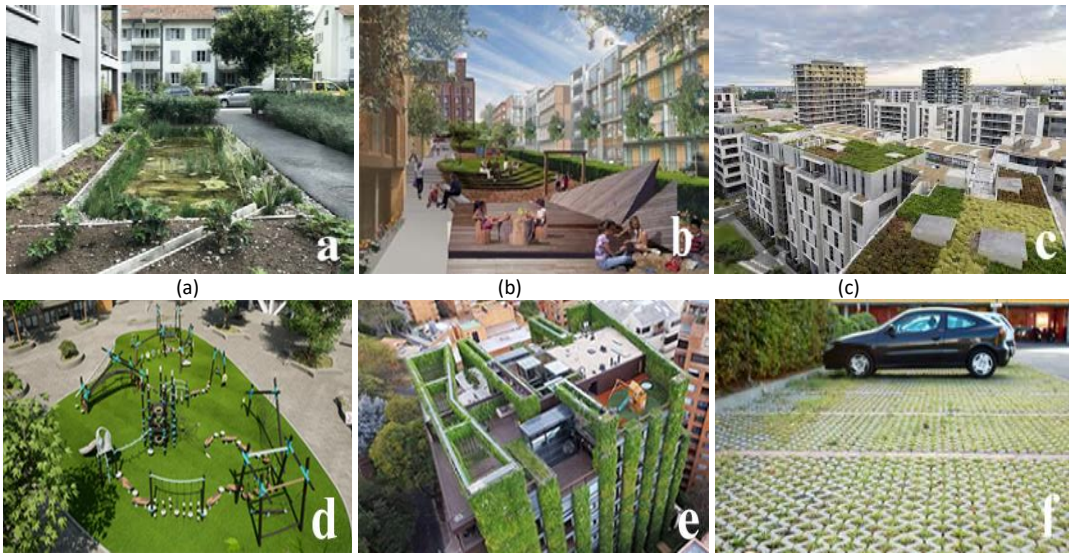
The most important and most frequently used parameters of OTC are: air temperature, thermal radiation and wind speed and humidity are required to fully describe the human thermal environment in OS [17] Among other solutions, UGI has emerged as a viable solution for enhancing OTC parameters in HRHA, mitigating UHIs, and ensuring usability and well-being of residents on OS. UGI presents a set of different types of green spaces physically connected into a single functional ecological system. Beside reducing air temperatures [19], potentials of UGI have been proven as effective tools in improving air quality [24], and promoting biodiversity [8].

The focus of this paper is to multiple benefits of UGI application on OS in HRHA with particular attention on OTC improvement. The research is based on the analysis of current theoretical knowledge and selected best practice examples. Various cities worldwide have successfully implemented UGI solutions to address OTC in HRHA. HRHA in Singapore and Sheffield were chosen as a research platform in this paper because they demonstrate how strategic integration of UGI can improve OTC in densely built environment. The findings from this paper show that whether through proactive design or urban regeneration, the implementation of UGI is a fundamental strategy for OTC improvement as well as for fostering resilient, sustainable, and liveable high-rise housing environments. These findings are valuable for urban planners, architects, and policymakers.

2. URBAN GREEN INFRASTRUCTURE - THEORETICAL BACKGROUND

Urban green infrastructure, defined by the European Union [10], represents a strategically planned network of high-quality natural and semi-natural habitats that are planned and maintained in such a way as to provide as many ecosystem services as possible, to preserve biodiversity and to create adequate OTC, i.e. ecological, social, and environmental benefits [23]. As cities face increasing temperatures and UHI effects, UGI has become essential for enhancing OTC, particularly in HRHA areas where dense building layouts limit natural cooling.

In a literature and practice, there are different typologies of UGI; however, the typology according the Green Surge project is most often observed [9]. According to this typology, there are 44 types of UGI including, among others: green walls, tree lines, community gardens, extensive green roofs, intensive green roofs, green playgrounds, large city parks, communal gardens, lawns etc. In HRHA various types of UGU can be applied as presented in Figure 1.



(a) (b) (c)

(d) (e) (f)

Figure 1: Urban green infrastructure elements
(a) Garden, (b) Pocket park, (c) Green roof, (d) Green playground, (e) Green façade, and (f) Permeable paving
Sources: (a) https://landezine-award.com/residential-complex-in-garten-winterthur-zurich-switzerland/
(b) https://www.pinterest.com/pin/563583340844468085/, (c) https://archive.curbed.com/2017/9/5/16236160/green-roof-farm-city-rooftop
(d) https://www.playlsi.com/en/commercial-playground-equipment/playgrounds/urban-park/
(e) https://www.bdcnetwork.com/blog/vertical-gardens-wellness-oases-urban-jungle, (f) https://www.istockphoto.com/photos/permeable-pavers

These UGI types have multiple benefits for sustainability and quality of life in HRHA. They contribute to OTC by providing shade on OS, reducing solar heat gain, and cooling the air through evapotranspiration [1]. Green spaces such as rooftop gardens and green walls lower ambient temperatures and help mitigate the UHI effect by reducing heat absorption from hard surfaces like asphalt and concrete and thus preventing UHI [7]. Green areas also affect OTC by releasing moisture into the air during the transpiration process, directly lowering the temperature and increasing air humidity. Additionally, UGI enhances natural ventilation by creating air corridors that allow cooling breezes to flow, further improving comfort [15]. Beyond OTC benefits, vegetation also acts as a natural air filter, improving air quality by absorbing pollutants and increasing oxygen levels, further enhancing the overall liveability of urban environments. In HRHA UGI elements enhance the usability of OS by making them more comfortable for social interactions, leisure, and recreation. Green parks, shaded courtyards, and communal gardens encourage physical activity and social engagement, contributing to residents' well-being. The integration of UGI into OS urban design in HRHA promotes environmental resilience and provides a more vibrant and sustainable urban landscape.

3. BEST PRACTICE EXAMPLES

Concerning all mentioned benefits of UGI in HRHA, the introduction of its various elements has become the practice of cities around the world. In line with that, HRHA The Interlace in Singapore and Park Hill in Sheffield, UK were selected as best practice examples of UGI solutions introduction towards enhancing residents OTC. The Interlace HRHA was chosen to demonstrate the redefinition of high-rise living by integrating various UGI solutions and providing favourable OTC residents. HRHA Park Hill in Sheffield in UK is chosen as project of urban regeneration with the aim of improvement of open and green spaces towards OTC enhancing and fostering community interaction.

3.1. The Interlace, Singapore

The Interlace is high-rise housing area located at Gillman Heights, Singapore (Figure 2a), completed in 2013. This so called „vertical village" is based on idea to find a way of creating high-density housing area without adding another tower block to Singapore's skyline. There are 31 six-story typical vertical towers in form a hexagonal, interconnected layout with large, open courtyards, sky gardens, and rooftop terraces in this HRHA (Figure 2b). Several thermal comfort strategies were applied in The Interlace: 1. shading and wind flow; 2. rooftop and sky gardens and 3. minimized paving. Namely, the hexagonal arrangement and cascading blocks create shaded courtyards and facilitate natural ventilation, improving residents OTC. Furthermore, extensive greenery provides evaporative cooling and reduces the UHI effect. Finally, reducing above-ground vehicle

circulation increases green cover and lowers heat retention. In addition to the benefits related to the creation of an extremely favorable microclimate on the OS, this HRHA is a best practice example of high level of usability of OS, which is demonstrated through diverse outdoor activity zones with strong connection to nature which enhance a sense of community amongst residents (Figure 2b). For all mentioned innovative ideas this project was awarded the World Building of the Year 2015 [11]. Beyond other benefits, UGI elements are important because they enable urban recreation activities of different residents age groups and green corridors and balconies bring nature closer to residents, enhancing well-being (Figure 3).



(a) (b)

Figure 2: The Interlace in Singapore
(a) Aerial view, and (b) Scheme of connecting different elements of UGI creating high-density residential space without adding another block
Source: (a), (b), (c) https://www.archdaily.com/627887/the-interlace-oma-2



(a) (b) (c)

Figure 3: Implemented UGI elements in The Interlace in Singapore
(a) Green playground, (b) Green roof (private sky garden, public sky garden), private balcony, and (c) Pocket park and private gardens
Source: (a), (b), (c) https://www.archigardener.com/2015/04/case-study-for-future-urbanism.html

3.2. HRHA Park Hill in Sheffield, UK

The Park Hill HRHA in Sheffield (Figure 4a), originally constructed in 1961 in brutalist-style, has undergone significant regeneration measuresv to enhance OTC and integrate urban green infrastructure, transforming it into a vibrant, sustainable community [12]. Park Hill's transformation aligns with Sheffield's city-wide commitment to urban greening. One of them is the "Grey to Green" initiative, which has converted former roadways into vibrant green spaces featuring extensive planting and sustainable drainage, serving as a model for integrating nature into urban settings. The regeneration of Park Hill emphasizes improvement of usability of green spaces that foster community interaction and well-being.

One of the main problems of this HRHA was unproper maintenance and management that contributed to the gradual deterioration of the buildings and open and recreational areas (Figure 4b). Besides that, key problem of the area was dirty and unkempt greenery as well as damaged footpaths. Furthermore, the infrastructure was outdated and the children's playgrounds were unsafe. Due to lack of parking spaces, residents parked private cars on open and green spaces. Finally, the problems were unfavorable OTC in the summer period.



(a) (b)

Figure 4: HRHA Park Hill in Sheffield in UK
(a) Aerial view, and (b) Location before regeneration
Source: (a) Google Maps (b) https://www.thestar.co.uk/heritage-and-retro/retro/then-and-now-pictures-show-the-transformation-of-sheffields-park-hill-flats-3389790

The real estate company "Urban Splash" launched a regeneration project for the Park Hill HRHA in 2018. Urban regeneration included measures related to increasing the attractiveness and quality of the urban environment, introducing green areas, maintaining the existing urban furniture and maintaining and better organization of pedestrian paths, shaping the space by planting different vegetation in order to improve the general appearance of the location and improve the microclimate of the space, and therefore a direct impact on OTC [13] (Figure 5). The redesigned landscape includes introduction of urban gardens, children's play areas, and lawns, all thoughtfully integrated to encourage outdoor activities and social engagement. These spaces not only provide recreational opportunities but also contribute to the overall aesthetic and environmental quality of the HRHA. The master plan focuses on a diverse mix of architectural forms and building heights, complemented by green spaces that serve multiple functions. This approach also includes the integration of sustainable urban drainage systems to manage surface water runoff, thereby reducing flood risks and improving water quality and contributes to OTC improvement as well. The HRHA design also prioritizes pedestrian pathways and cycling routes, encouraging active transportation and reducing reliance on vehicles [14]. This network of green corridors not only facilitates movement but also enhances biodiversity by connecting various habitats, contributing to a resilient urban ecosystem. Through thoughtful design and strategic planning, the estate has been transformed into a dynamic community space that promotes environmental health and enriches the quality of life for its residents.



(a) (b) (c)

Figure 5: Implemented UGI elements in Park Hill in Sheffield
(a) Pocket park, (b) Private garden, pocket park, and (c) Permeable paving
Source: (a), (b) https://www.urbansplash.co.uk/regeneration/projects/park-hill, (c) Google Maps

4. DISCUSSION

The findigs of this paper indicate that UGI elements in HRHA enhance OTC while providing environmental, social, and economic benefits. They have potentisals to mitigates the UHI effect, lowers ambient temperatures, and improves air quality by filtering pollutants. UGI solutions also have positive implications on social well-being by creating shaded, inviting spaces for recreation and community interaction, fostering social cohesion and enhancing quality of life. Economically, it increases property values, attracts investment, and reduces long-term maintenance costs by managing stormwater effectively. Overall, UGI is essential for sustainable and livable urban environments, whether integrated into new developments or used for regenerating existing OS.

Analysis of best practice examples of UGI solutions implementation in HRHAs in Singapore and Sheffield demonstrates the crucial role of UGI in enhancing OTC on OS. While these two examples differ in their initial design and implementation approach, both exemplify how strategic integration of UGI contributes to

microclimatic improvements, increased usability of OS, and enhanced overall liveability. A key distinction between these two cases is the degree of integration of UGI elements. The Interlace showcases a holistic approach integrating UGI from the start. Park Hill, on the other hand, demonstrates how existing HRHA can be retrofitted with UGI to mitigate climate-related challenges and improve the usability of outdoor spaces. Both approaches underscore the importance of UGI in HRHA planning, whether through early-stage integration or post-construction adaptation.

5. CONCLUSION

When choosing urban concept for designing open spaces in high rise housing areas, it is necessary to focus on solutions that will be community oriented, sustainable, resilient to climate change and which are aligned with nature towards providing higher quality of life for its residents. As demonstrated in this paper, by thoughtful urban planning and urban green infrastructure solutions implementation it is possible to create resilient living environment which among other implies enabling favourable outdoor thermal comfort on open spaces in high-rise housing areas in summer period. As demonstrated by HRHA Interlace climate-responsive architectural design that integrates UGI from the start of the project can mitigate the urban heat island effect, lower ambient temperatures, and create more comfortable and functional open spaces for residents. In contrast, Park Hill highlights the potential for urban regeneration to transform neglected HRHA into vibrant, thermally comfortable communities through targeted green infrastructure improvements. These examples provide valuable insights for urban planners, architects, and policymakers. For future HRHA developments, inclusion of UGI solutions into the initial design phase should be prioritized to achieve maximum outdoor thermal comfort benefits. In existing residential areas, retrofitting green infrastructure—such as tree planting, permeable surfaces, and community gardens—can significantly enhance outdoor comfort and usability. Ultimately, whether through proactive design or reactive regeneration, the implementation of UGI is a fundamental strategy for fostering resilient, sustainable, and livable high-rise housing environments.

ACKNOWLEDGEMENTS

This research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of the Republic of Serbia (contract no. 451-03-136/2025-03/ 200371). The research was also supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025 and Science Fund of the Republic of Serbia #GRANT No 7572, Reclaiming Public Open in Residential Areas: Shifting Planning Paradigms and Design Perspectives for a Resilient Urban Future - RePOS.

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ICUP2025
5th international conference on urban planning

GREEN INFRASTRUCTURE IN SERBIA - ANALYSIS OF PLANNING AND STRATEGIC DOCUMENTS

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ABSTRACT

The green infrastructure is considered a strategic and planned approach to developing a network of green and blue spaces in urban areas designed to provide a wide range of ecosystem services. It finds its role in different and everyday life needs. Throughout Europe, especially in European Union countries, government organizations make great efforts to integrate green infrastructure in their programs and policies and to define planning guidelines. The question is whether it is the same in other countries. The paper, in particular, studies the emergence of green infrastructure in the strategic and planning documents of the Republic of Serbia at the national level to which it is mentioned and recognized as a measure to improve life.

Keywords: *green infrastructure; urban planning; strategic planning; life improvement; policy integration; Republic of Serbia*

1. INTRODUCTION

Urban planning is a multifaceted field that includes various elements and steps to create a sustainable, functional, aesthetically pleasing urban environment. One of the elements is recognized as green infrastructure (hereinafter referred to as GI). GI can therefore be seen as a strategic planning approach with the aim of developing a network of green and blue spaces/areas in urban areas that are designed to provide a wide range of ecosystem services [1] related to provisioning services, regulation services, cultural services and support services. GI is recognized as a concept that integrates elements of different forms and spatial scales into a system of ecosystem services capable of responding to challenges, especially those brought about by urbanization.

There are several definitions of green infrastructure. One of the definitions is as follows: "Green infrastructure includes the development and planning of networks of interconnected multifunctional green spaces that contribute to the protection of natural habitats and biodiversity, enable a response to climate change and other changes in the biosphere, enable a higher level of sustainability and a healthier lifestyle, improve the liveability of urban spaces and general well-being, improve accessibility to key recreational and natural sites, support the urban and rural economy, and are part of a long-term planning process for green spaces and corridors." [2].“The EU document defines GI as follows: “GI is a strategically planned network of natural and semi-natural areas with ecological characteristics designed to provide a wide range of ecosystem services, including green areas (or blue areas in the case of aquatic ecosystems) and other physical areas characteristic of terrestrial and marine areas.” [3] The emergence of multiple definitions of the term GI and the lack of a single one stems from the fact that GI can be defined in relation to the importance that this concept has in planning and protecting life and settlements [4].

According to a European Union document defined in Brussels on May 6, 2013 [3], it is stated that GI can be used as a cheaper, healthier and more durable solution for infrastructure construction and also provides local employment opportunities.

Governments across Europe and around the world are making significant efforts and steps to integrate GI into their policy agendas and define planning guidelines [5]. In Europe, the concept and the challenges it faces have

been discussed for years. The process of initiating GI development guidelines and planning has also been further supported by the emergence of the United Nations Sustainable Development Goals defined for 2030 [6]. As part of the aforementioned movement, the role and importance of GI have been emphasized in order to achieve goals related to preserving life on land, adapting to climate change, improving biodiversity and ensuring clean water. Planning policies seek to take into account ecological networks, green corridors and biodiversity hotspots for integrated spatial planning at national and local levels in order to maximize the environmental and social benefits that GI provides.

Unlike the European Union and the existence of the European Union Strategy for the Promotion of Green Infrastructure, there is no such strategy in the Republic of Serbia. In order to even initiate the process of defining a GI strategy, it is necessary to consider the possible problems it would encounter, what are the planning elements, and to analyze the contents of scientific works that have already dealt with this issue. The research objectives of this paper relate primarily to examining the representation of green infrastructure in national strategic and planning documents of the Republic of Serbia. The paper defines the question of how green infrastructure is perceived within the framework of existing strategic documents in the European Union and Serbia? The methodology is based primarily on the analysis of relevant strategic and planning documents, after which the collected data was synthesized and systematized. At the end of the paper, the conclusions reached were discussed and the answers to the research questions were defined.

2. GREEN INFRASTRUCTURE IN STRATEGIC DOCUMENTS OF THE EUROPEAN UNION

As part of the analysis of the concept of green infrastructure in European Union strategic documents, the documents Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions, within which the European Union Strategy was defined in 2013, and the Report from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions defined in 2022.

- **Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions**

The European Union document defined in Brussels in May 2013 focuses on the concept of GI, on the possibility of its application instead of choosing gray infrastructure, as its adequate, healthier, more natural replacement. First of all, the concept of GI is defined and its contribution to EU policies is shown. GI is considered an adequate solution and a significant contribution in all policies that are based in whole or in part on healthy solutions based on nature. In the regional policy, GI is especially recognized and identified as one of the investment priorities because it is recognized as its contribution and driver of sustainable growth.

It is stated that GI is particularly important in urban areas where more than 60% of the population lives in the EU [7] considering the benefits it provides in terms of health, social and economic aspects. GI is considered an adequate response, a "tool", for climate change, which is a constant phenomenon in the world with ecosystem-based approaches and strategies. The strategy, which is specifically based on the GI, aims to explore the need for additional guidance for authorities and other decision makers. Throughout, the document refers to future guidelines that authorities should support and take advantage of. Also, the systematic inclusion of elements of GI in the planning process and making important decisions would help to minimize the loss of ecosystem services associated with future land occupation and would help to improve the restoration of soil function [8].

As part of the third point of the document, the GI strategy is presented and it is considered what needs to be done in order to encourage development at the EU level, its preservation and the achievement of the goals of Europe 2020. It is stated that one of the main goals of the Strategy is to make GI a standard part of spatial planning and territorial development that is fully integrated into the implementation of policies. It is considered that the strategy can and should be implemented in the context of existing legislation, policies, instruments and financing mechanisms [7]. The commission's task was to develop technical guidelines on how to integrate GI into policy implementation. The strategy aims at improving and strengthening the information, knowledge base, promoting innovation, access to finance and geographical indication projects at the level of the European Union.

- **Report from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions**

Another document for analysis within the EU is the Report of the Commission on the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions and deals with the macro-regional strategies of the EU which form the policy frameworks initiated by EU and non-EU countries and

are in a defined geographical area. The strategies are focused on common challenges and opportunities with the setting of common and long-term goals and have a role in facilitating the implementation of key European political initiatives across its territories, at the same time harmonizing them with regional and local initiatives. Also, they bring a territorial dimension to the green, digital and social transition. In relation to the previously analyzed EU strategies, the document from 2022 focuses on digital and social transition, in addition to specifically looking at green infrastructure. From the 2019 Strategy, as steps for future strategies, it was stated that the application of green infrastructure should be increased. The result is visible in the new strategy. All EU strategies are extremely committed to the European Green Deal and strive to facilitate the participation of the Western Balkans and other countries interested in joining the initiative.

3. GREEN INFRASTRUCTURE IN THE STRATEGIC AND PLANNING DOCUMENTS OF THE REPUBLIC OF SERBIA AT THE NATIONAL LEVEL

In recent and contemporary academic research in Serbia, the concept of green infrastructure is interpreted as a concept of urban and planning strategies in which landscapes are conceptualized as elements of green infrastructure that are used more and more as a strategic response and possible solution to the challenges posed by climate change. At the national level, the term GI and organic production will be analyzed through the following strategic documents: Spatial Plan of the Republic of Serbia from 2021 to 2035 [9], National Sustainable Development Strategy of the Republic of Serbia until 2030 [10], Agriculture and Rural Development Strategy for the period 2014-2024. [11], National strategy for sustainable use of natural resources and assets [12], Strategy for biological diversity [13], Strategy for forestry development [14].

- **Spatial plan of the Republic of Serbia from 2021 to 2035**

As part of the Spatial Plan of the Republic of Serbia from 2021 to 2035 [9] on page 138, the key problems in the realization of a sustainable spatial development plan of the Republic of Serbia were mentioned. They include, among other things, as the seventh in order, frequent occurrences of quality impairment and the degree of environmental pollution in relation to economic growth and development, as well as inadequate use and insufficiently effective protection of natural resources, the environment, biological diversity, natural and cultural heritage and landscapes. Also, the neglected development of green infrastructure is recognized as one of the problems.

The specific goals of spatial development are defined below. Under number 6, the goal is defined for the preservation of identity and strengthened resilience of space to changes and pressures, for sustainable use and protection of natural resources, environment, biological diversity, natural and cultural heritage, development and arrangement of landscape and green infrastructure.

Special goals in the field of climate change are also defined under number 6 and include the integration of the concept of so-called green and blue infrastructures in the planning of sustainable development of urban and rural settlements and sustainable use of resources.

In part 2.4 of the document entitled "Long-term spatial development strategy of the Republic of Serbia", it is stated that in the effort to improve the quality of life in the Republic of Serbia, special emphasis is placed on quality improvement and environmental protection. Also, it is stated that protection, sustainable use and connection of valuable natural heritage, biodiversity and geoheritage, preservation and arrangement of protected areas and landscapes with natural values, as well as faster construction and arrangement of green and blue infrastructure are of special importance.

The concept of green infrastructure in the Spatial Plan of the Republic of Serbia is also mentioned in the chapter related to the protection of water from pollution, where it is seen as a planned measure that should be incorporated into the construction rules during the construction of storm sewers, etc.

- **National Strategy for Sustainable Development of the Republic of Serbia until 2030**

The National Strategy for Sustainable Development of the Republic of Serbia until 2030 [10] represents the basic national strategic document in the field of sustainable development and advocates strengthening comprehensive processes that affect all aspects of life, including environmental, economic, social and instructional.

One part of the document highlights a number of priorities in the area of environmental protection, natural resources that include air, water, biodiversity, renewable energy sources, land, etc. with a focus on biodiversity, which is recognized as rich in the Republic of Serbia due to the large number of different species of flora and

fauna. The application of green infrastructure as one of the elements for realizing the goals of the strategy is recognized exclusively in the context of ecological sustainability and urban planning for the sake of improving the quality of the environment and resistance to climate change.

- **Agriculture and rural development strategy for the period 2014-2024**

Strategy of agriculture and rural development for the period 2014-2024. [11] is a basic strategic document in the field of agriculture, which recognizes the importance of sustainable agriculture. The concept of green infrastructure is recognized in the areas of Resilience to Climate Change, Water Management and Conservation and Sustainable Agriculture Practices in the form of relationships to ecological sustainability, adaptation to climate change, rural development and natural resource management.

- **National strategy for sustainable use of natural resources and goods**

The national strategy for the sustainable use of natural resources and goods [12] was adopted in 2012, and was developed on the basis of international documents, keeping in mind the alignment with EU legislation. The goal of the strategy is to promote sustainable economic development through the use of natural resources while simultaneously reducing negative impacts and existing environmental challenges. The term GI is recognized in the areas of Climate Change Adaptation and Mitigation, Ecosystem Services, Water Resources Management and Urban and Rural Development. In the mentioned areas, it is described how the principles of GI are integrated into national policies and strategic documents for achieving sustainable use of natural assets and resources in Serbia.

- **Biodiversity strategy**

The Biological Diversity Strategy of the Republic of Serbia [13], which was adopted in 2011, recognizes the importance of integrating biodiversity conservation in the sectors of agriculture, forestry, recreation, etc. and defines, among other things, goals related to biodiversity conservation, conservation of protected areas, sustainable use of biodiversity, international cooperation and climate change.

It does not contain chapters directly related to green infrastructure, but it is concluded that it treats GI as a critical component for preserving biodiversity and promoting sustainable development. In particular, the term GI is observed exclusively in the chapters Spatial planning and landscape connectivity, Habitat conservation and restoration, and Ecosystem services.

- **Forestry development strategy**

The forestry development strategy advocates defining the development of sustainable forestry and creating a balance between all functions of the forest - ecological, economic, social and cultural [14]. The goals of the strategy focus, among other things, on the preservation and improvement of the condition of forests and the development of forestry as an economic branch, preservation, real improvement, sustainable use and valorization of forest biodiversity, ensuring the sustainable development of the state forestry sector that takes into account ecological, social and cultural requirements, as well as creating the highest possible added value of forest products. Looking at the strategy, it is concluded that GI is considered in the wider context of forest management and ecosystem services. The term EI is recognized in the chapters Forest Ecosystem Services, Climate Change Adaptation and Mitigation and Biodiversity Conservation. Specifically, in the sections related to environmental protection, urban development and spatial planning and climate change mitigation and adaptation, GI is mentioned because of its role in providing basic ecosystem services (water regulation, biodiversity conservation, recreation space). The mentioned chapters describe how the principles of GI are integrated into forestry policies and practices in order to achieve the goals of sustainable development in the forest areas of the Republic of Serbia.

4. CONCLUSION

Green infrastructure is an approach to spatial planning that provides and integrates a wide range of environmental, economic, social, health and spatial functions within the same spatial structure. Land use planning, infrastructure planning, housing community needs, urban design, needs for public health and safety, environmental sustainability, etc., must be taken into account when planning space in urban areas. GI has great potential for managing potential challenges in the areas of industry, transport, agriculture, forestry, housing, water management, etc. First of all, it is seen as one of the solutions to the problems and pressures caused by climate change and constant urbanization.

In order to understand the concept of GI in the strategic and planning documents of the RS at the national level, the Spatial Plan of the Republic of Serbia 2021 to 2045, the National Strategy of Sustainable Development of the Republic of Serbia to 2030, the Strategy of Agriculture and Rural Development for the period 2014-2024, and the National Strategy for the Sustainable Use of Natural Resources were analyzed. and goods, Biodiversity Strategy and Forestry Development Strategy.

In response to the first research question "In what way is green infrastructure viewed within the existing strategic documents in the EU and Serbia?" the following states:

The analysis of European Union documents, specifically the first document from 2013 of the EU Strategy, which is related to the concept and implementation of GI, leads to the conclusion that GI can significantly contribute to the achievement of the quality of many key policies and goals of the European Union. As one of the measures for its realization is the encouragement and facilitation of geographic marking projects within the already existing political, legal and financial instruments. The analyzed document explains the characteristics of the future strategy of the European Union. From the second EU document analyzed, the conclusion is reached that the strategies are extremely dedicated to the European Green Deal and strive to facilitate the participation of the Western Balkans and other countries interested in joining the initiative. Analyzing the aforementioned planning and strategic documents of the Republic of Serbia at the national level, it can be seen that there is no strategy specifically related to the notion of green infrastructure and its planning in urban areas, which automatically answers the first research question posed in the paper.

AKNOWLEDEGMENT

The research was financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (contract no. 451-03-136/2025-03/200371).

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ICUP2025
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PLANNING FRAMEWORK FOR (RE)DEVELOPMENT OF PUBLIC OPEN SPACE IN MULTIFAMILY HOUSING AREAS IN NIŠ, SERBIA

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ABSTRACT

Public open spaces (POS) are of great importance for the quality of the urban environment and the residents' quality of life. The importance of POS was recognized and highly appreciated in the planning of socialist large housing estates (LHEs) that were abundant in open and green spaces. However, post-socialist urban development is characterized by the neglect and deterioration of POS in inherited LHEs and the almost complete absence of POS in new multi-family housing areas. Although the phenomenon of the disappearance of POS is recognized, both in neighboring countries and in Serbia, strategic and planning documents fail to respond appropriately to this phenomenon. The paper deals with the treatment of POS in planning documents for the area of the city of Niš and how it affects the state of POS in multi-family housing areas. The paper analyzes all categories of urban plans for the area of the city of Niš, as well as selected urban projects. The research has shown that the term "public open space" does not appear in urban planning documents for the area of the city of Niš, but numerous similar terms appear instead. The absence of a uniform planning treatment of public open spaces in multi-family housing areas leads to various consequences in the space, such as infill construction, fragmentation of POS and reduction of green areas.

Keywords: *public open space, urban planning documents, multi-family housing, post-socialist urban development, Serbia*

1. INTRODUCTION

Quality of life is considered one of the most important measures of prosperity and sustainable development of cities. Cities strive to improve quality of life and social equity by providing all residents with greater access to public goods, including public open spaces, which are an integral part of successful cities. Quality public spaces influence the quality of everyday life in cities, help build a sense of community, civic identity and culture. Public spaces are defined and classified in various ways, but the definition adopted by the Charter of Public Space is one of the most general and comprehensive: *„Public spaces are all places publicly owned or of public use, accessible and enjoyable by all for free and without a profit motive* (Garau et al., 2015). The Charter further distinguishes between four typologies of public space: streets, public open spaces, public facilities and public commercial spaces (UN-Habitat, 2015). Public open spaces (POS) appear in various forms, functions and sizes, and include parks, streets, sidewalks and pedestrian paths, recreational playgrounds, markets, and space between buildings. Public space has a double dimension whose two most important components are: the public (people) and the space with the entire environment that can be perceived by the senses. Therefore, public space should not be viewed only as a spatial framework, but as a space in which something happens or is expected to happen (Marković, 2022).

Urban planning is the foundation of urban development—it guides growth and seeks to reconcile a multitude of differing interests, as well as the short-term and long-term consequences of spatial interventions. As an integral component of the quality of the urban environment, public open spaces require special attention in terms of planning, provision, and maintenance. The role of urban planning is to establish and organize public spaces, while urban design facilitates and encourages their use, thereby enhancing a sense of identity and belonging (UN-Habitat, 2018).

Urban planning in former socialist countries has undergone significant transformations as part of the post-socialist transition, including changes in the legal framework, the types and hierarchy of planning documents, the stakeholders involved in the planning process, and the methods of implementing plans in practice. This paper raises the following questions: 1) Has urban planning evolved in response to the newly emerged post-socialist conditions? and 2) How have changes in urban planning influenced the state of POS? In light of these overall changes, the paper aims to contribute to a deeper understanding of the cause-and-effect relationship between urban planning principles in the post-socialist context and the condition of POS in multi-family housing areas, with a particular focus on POS in inherited large housing estates (LHEs). Given that legal and planning documents form the foundation for the development and management of POS, this paper examines both legal provisions related to urban planning and POS, as well as the treatment of POS in multi-family housing areas within planning documents at various levels. The research focuses on POS in inherited LHEs, as they occupy large areas in post-socialist cities and are under constant pressure from new construction.

2. THE ROLE OF URBAN PLANNING IN PUBLIC OPEN SPACE DEVELOPMENT

Public open space (POS) refers to areas intended for public use, offering free access to everyone. It is a vital form of land use that allows individuals to engage in various activities and connect with nature within an urban environment. Public open spaces in various forms are widely regarded as key contributors to enhancing people's well-being and fostering social interaction (Jian, 2020; Jennings, Larson, & Yun, 2016).

Urban planning and planners play a pivotal role in both securing and shaping public open spaces (POS). Their role in the creation and design of these spaces is twofold. First, planners identify the need and potential for open space development and initiate relevant projects. Second, they act as stewards in the creation of public spaces by overseeing the regulatory processes of development management (Carmona, 2019). Planning, therefore, plays a key role in coordinating different actors to harmonize policies and approaches and achieve optimal results. In the process of shaping public spaces, it is crucial to determine which processes contribute to their evolution and how planning and other forms of regulation interact with them. When it comes to POS planning, while strategic planning has long been on the agenda and is widely practiced, the idea of planning public spaces in a more systematic manner has not been as widely adopted (ibid.).

Regarding planning in former socialist countries, it suffered from a legitimacy crisis during the transition period (Hirt and Kovachev, 2006). Many of the transformative processes in the urban fabric occurred without being acknowledged by urban planning, which had a profoundly negative impact on public open spaces, leading to their reduction, fragmentation, appropriation for private use, and other issues. The issue of public open spaces is further complicated by the transformation from state/public ownership of urban land during the socialist period to still unclear land ownership in most countries, due to a prolonged and unfinished process of restitution. This is particularly evident in the case of POS in inherited large housing estates (LHEs). For example, in Bulgaria, the law on restitution was interpreted in such a way that land should be returned to pre-World War II owners as long as no constructed buildings were present on the land (Hirt and Stanilov, 2007). As a result, most of the undeveloped urban land was returned to former landowners, leading to large segments of public space disappearing into private use. There are also examples of countries that effectively resolved restitution, such as Hungary, where pre-war owners were only entitled to symbolic compensation in the form of coupons or agricultural vouchers (Lux, Cirman, & Sunega, 2017). As a result, public open spaces remained under municipal ownership and were not fragmented by the return of nationalized land to previous owners.

When it comes to urban planning, even in cases of clear ownership, and even more so in cases of unfinished restitution, POS in residential neighborhoods are not properly considered, i.e., they are not recognized as a distinct type of open space. The literature on POS planning also highlights the lack of an appropriate planning level to properly address these spaces, as well as the issue of individual plots being developed through derogatory planning documents initiated by private investors, without considering the broader context of LHEs (Marin, Berescu, & Macri, 2023).

Given the above, this paper examines the planning treatment of public open spaces in inherited multi-family housing areas, using the city of Niš in Serbia as a case study. It aims to determine the extent to which the planning approach has contributed to the current state of public open spaces.

3. PLANNING FRAMEWORK FOR (RE)DEVELOPMENT OF PUBLIC OPEN SPACE IN NIŠ

3.1. Niš in post-socialist period

Niš is a second-tier city located in the southeastern region of Serbia. It serves as a regional hub and a center of national importance. Administratively, the City of Niš is a local self-government unit consisting of five city municipalities, with a total population of 249,501 inhabitants (2023 Census) and an administrative area covering 596.78 km². The population density is 418 inhabitants/km².

The period after World War II was marked by significant demographic growth and spatial expansion in the development of Niš. From 1945 to 1980, the population and the number of apartments in Niš increased more than fourfold, while the effectively built urban space expanded more than sixfold (Krstić and Medvedev, 1983). The greatest intensity of collective housing construction occurred between 1960 and 1980, during which as much as 70% of the existing housing stock in Niš was built.

The 1990s were marked by a dramatic economic decline, the closure of major public construction companies, the absence of significant public investment in housing development, and a rise in illegal construction. The withdrawal of the public sector and the strengthening of the private housing sector in the later phases of the transition affected the type, scale, and spatial distribution of multi-family housing construction (Đekić & Vasilevska, 2021), as well as the treatment of open spaces. While LHEs were characterized by grand and well-provided POS during the socialist period, post-socialist POS in residential complexes are much smaller in scale, or even non-existent. Similar to other former socialist cities, Niš is now facing urban decay of POS in inherited housing estates due to unclear management and ownership rights, poor maintenance, intense urban densification, and the near-complete disappearance of POS in new multi-family residential developments, which have been driven by market restructuring and limited public investments in the housing sector.

The following section of the paper analyzes the influence of urban plans from the post-socialist period on the state of public open spaces in multi-family housing areas.

3.2. POS in urban planning documents

Planning documents are prepared and adopted in accordance with laws, which regulate the planning process and other elements important for the planning process. In the period from the 1990s onwards, the legal basis for the preparation of plans was the Law on Planning and Development of Spaces and Settlements (adopted in 1995) and the later Law on Planning and Construction (adopted in 2009). The aforementioned laws recognize the concepts of „public interest“ and „public areas“, but not the term „public space” nor „public open space” as defined by The Charter of Public Space. According to the Law on Planning and Development of Spaces and Settlements, which was in force in the initial phase of the transition, *„public area” is the area determined by the plan for facilities whose construction is of general interest, in accordance with the regulations on expropriation, as well as facilities intended for public use”.* The current Law on Planning and Construction recognizes „public use”, „public interest” and „areas of public use”. According to the Law *„area of public use is the area determined by the planning document for the arrangement or construction of public purpose facilities or public areas for which determination of public interest is foreseen, in accordance with a special law (streets, squares, parks, etc.)”.* Legal guidelines related to public areas are incorporated into planning documents, which will be analyzed below.

The Law on Planning and Construction also outlines the required planning documents for urban areas. The City of Niš is administratively divided into five city municipalities (CM), and in accordance with the Law, the following urban plans have been adopted for the city:

- General Urban Plan (GUP), a strategic development plan with general elements of spatial development for the whole city area;
- Plans of General Regulation (PGR) for the entire city municipality of Mediana and other city municipalities (Palilula, Pantelej, Crveni Krst and Niška Banja) divided into parts or „phases“;
- Plans of Detailed Regulation (PDR) for parts of the city area that require more detailed elaboration.

The review of the planning framework for (re)developing public open spaces (POS) in residential neighborhoods within this paper considers: 1) two general urban plans: the GUP of Niš 1995-2010 and the GUP of Niš 2010-2025; and 2) selected general regulation plans: PGR of the CM of Medijana, PGR of the CM of Palilula – Phase I, PGR of the CM of Palilula – Phase II, and PGR of the CM of Pantelej – Phase I. The elaboration through detailed regulation plans is not foreseen for the inherited large housing estates (LHEs). To assess how the building rules defined in the general regulation plan are implemented at the individual plot level, an urban design project for new multi-family construction within the framework of the inherited LHE is analyzed.

3.2.1. General Urban Plans

General Urban Plan of Niš 1995-2010 (GUP1995). The first general urban plan for the city area in the post-socialist period was adopted in 1995, in accordance with the Law on Planning and Development of Spaces and Settlements and the Law on Construction Land. According to the Law on Construction Land, city construction land includes developed land within the city, land intended for the expansion of the city as defined by the GUP, and other areas designated for residential and other complex construction. This land is publicly owned, and no private property rights can be established over it. The construction area within the scope of the GUP is divided into: (a) public areas for general use (such as roads, streets, public green spaces, etc.); and (b) construction plots intended for the development and regular use of one or more buildings that form a functional unit. Continuing the socialist tradition, multi-family housing is planned as collective housing (CH) on publicly owned land. Depending on the location, function, and population density, two zones of collective housing are distinguished: 1) CH in the reconstruction zone of the city center, with business functions and a population density of 250-450 people per hectare; and 2) CH—city and spa housing with high population density (200-250 people per hectare), which includes both existing CH and newly planned construction. Building regulations are defined for new construction in both zones. Open space within collective housing is planned according to a norm of 0.4–0.5 m² of open space per 1 m² of apartment space, and 0.1 m² per 1 m² of apartment space for playgrounds for children and adults. A minimum of 30% of open space is designated for landscaped green areas in CH zones with business functions, and 50% in city and spa housing zones. Regarding existing housing, the plan envisions its retention on the existing plots, with possible interventions primarily aimed at providing free space for the regular use of the buildings.

The GUP 1995 underwent three amendments and supplements in 2001, 2004, and 2007, which did not impact the treatment of POS.

General Urban Plan of Niš 2010-2025 (GUP2010).

As stipulated by the Law on Planning and Construction, the General Urban Plan (GUP) within its construction area distinguishes between (1) areas of public use and (2) areas of other use. Areas of public use include state-owned land intended for public facilities and associated areas, such as public services, communal activities, roads and traffic terminals, green and open spaces, and special-purpose areas. Green and open spaces of public use include recreational areas, park greenery, park forests, and protective greenery. In the case of inherited large housing estates (LHEs), greenery and open spaces between buildings are classified as „other uses“. In addition to areas of public use, the plan designates green and open spaces within „areas of other uses“ (housing, commercial activities, industry, etc.). For all types of housing, the minimum required share of greenery and open space is set at 10% of the building plot area.

The GUP 2010 underwent four amendments and supplements in 2016, 2018, 2021, and 2024, none of which affected the treatment of POS. The GUP serves as a binding document and the foundation for lower-level urban planning documents, such as the Plans of General Regulation (PGRs). As a result, the definition of „areas of public use” from the GUP is carried over into the lower planning documents as well.

3.2.2. Plans of General Regulation

Following the GUP 2010, the Plans of General Regulation (PGRs) fully adopted the guidelines set out by the GUP and the applicable law regarding „areas of public use“ and „areas of other use“. Open spaces within new housing developments are classified as „areas of other uses“, and the share of open space and greenery is determined based on the building plot area. The minimum proportion of green and open spaces varies across plans, with the range for multi-family housing typically falling between 10% and 20%, depending on the housing density (low, moderate, medium, or high). While the status of these areas is clearly defined, similar to public areas (such as streets, squares, and parks), the following sections will delve deeper into the treatment of

open spaces within inherited large housing estates (LHEs) and specific provisions concerning new multi-family residential construction.

Plan of General Regulation of the City Municipality of Medijana (PGR Medijana). The text of the PGR Medijana distinguishes the following „areas of public use": a) areas, facilities and complexes of public interest (preschool and elementary education, healthcare, public administration, cemeteries, green market, etc.); b) public greenery: protective greenery; c) traffic areas and facilities (roads, public parking lots, suburban bus station, railway station, terminals); d) infrastructure corridors, networks, surfaces and facilities; e) watercourses (regulatory belt of Nišava). Green and open areas (protective greenery, park greenery, and recreational areas) are classified as „areas of other uses", alongside housing, business, and working zones, and religious buildings.



(a) (b)

Figure 1: Treatment of LHEs in PGR Medijana graphics: (a) Plan of areas of public use; (b) Plan of predominant land use
Source: http://www.eservis.ni.rs/urbanistickiprojekti/

However, the Plan of areas of public use, designates protective and park greenery and recreational areas as „areas of public use" (Figure 1a, 1b). It distinguishes between (1) areas of public use and (2) areas of public use for the functioning of buildings and plots within the block (Figure 1a). Although labeled as „areas of public use for the functioning of buildings and plots within the block", the POS of inherited LHE are treated as „areas of other uses" within the Plan of predominant land use, and are assigned various residential uses. For instance, in the case of the Krive livade LHE, shown below, both „areas of public use for the functioning of buildings and plots within the block" and „areas of other uses" (Figure 1a) are designated as high-density housing in the urban area (Figure 1b). These inconsistencies in the treatment of POS in inherited LHEs—whether as areas of public use or other non-public uses—create ambiguities in the implementation of the plan.Following the GUP 2010, green areas within „other uses" are defined in relation to the building plot. The minimum share of green areas within housing is set at 10% of the building plot area. Unlike the GUP 2010, where the minimum percentage includes both green and open space, the PGR Medijana prescribes the minimum percentage specifically for green areas on the plot.

The Third amendments and supplements to the PGR Medijana introduced higher mandatory values for greenery. The minimum percentage of green areas is set at 25% of the building plot area, with 10% of this required to be in direct contact with the ground. Other forms of greenery, which make up at least 15% of the plot area, may include trees, green roofs, green façades, and greenery above underground floors.

Plan of General Regulation of the City Municipality of Palilula – I phase (PGR Palilula-I). Similar to other Plans of General Regulation, the PGR Palilula - Phase I recognizes: 1) areas of public use and 2) areas of other uses. Areas of public use include green areas, public services and utilities, streets and traffic terminals, and special purpose areas. Block greenery, which consists of areas adjacent to multi-family and family residences, is

classified as a green area of public use. This block greenery is intended for public use and should include walking paths, rest areas, children's playgrounds, sports areas, lawns for play and relaxation, green parking areas, and spaces for containers.

The Fifth amendments and supplements to the PGR Palilula-I introduced a new category of „area of public use“—„areas of public use for the functioning of buildings and plots within the block, where only the construction of civil engineering objects is permitted“. This category appears for the first time in this plan and refers to just one multi-family housing block in the entire planning area.

The Sixth amendments and supplements to the PGR Palilula-I introduced another additional category—„areas of public and/or other uses“—which includes mixed-use zones and supported housing. The concept of „green roads and traffic areas“, implying intensive greening (i.e., planting rows of trees on both sides of these roads), is also introduced in this plan.

Plan of general regulation of the City Municipality of Palilula – II phase (PGR Palilula-II). The network of public facilities and public areas in the PGR Palilula-II consists of: facilities for administration and state bodies, facilities for upbringing and education, culture, sports, health, communal facilities, traffic areas, public green areas, public water areas, and other areas.

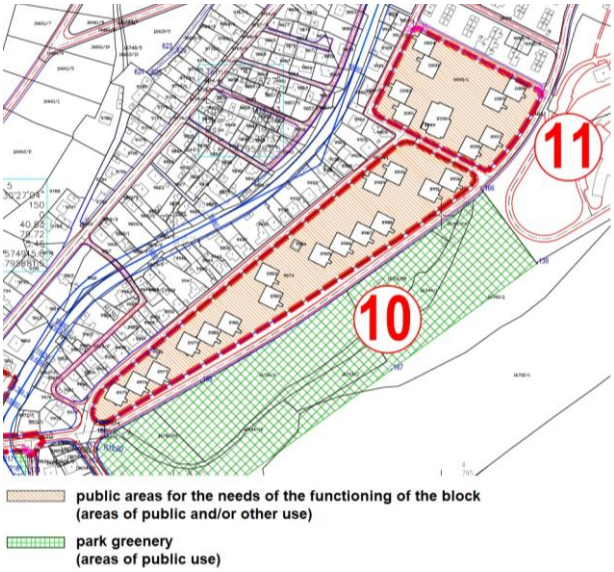


Figure 2: Second amendments and supplements to the PGR Palilula – II Phase: areas of public use
Source: http://www.eservis.ni.rs/urbanistickiprojekti/

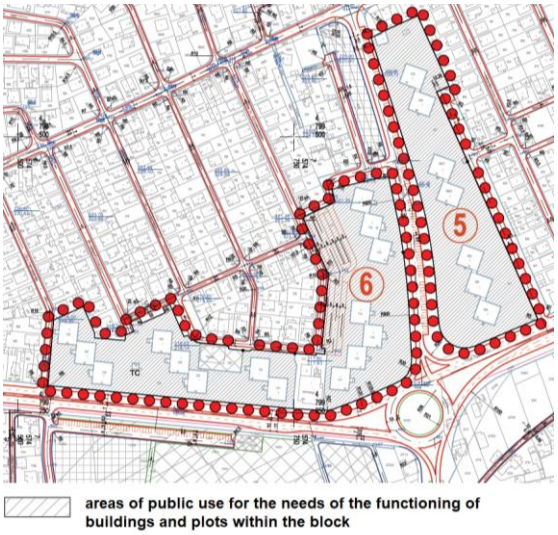


Figure 3: Second amendments and supplements to the PGR Pantelej- I phase: areas of public use
Source: http://www.eservis.ni.rs/urbanistickiprojekti/

Public green areas are divided into: (1) green areas of public use (such as parks, squares, and street greenery) and (2) green areas of limited use (including sports and recreational areas, green spaces in schools and preschool institutions, green areas in business-production-trade complexes, green areas within housing, special-purpose green areas, green areas in cemeteries, and protective green areas). Unlike PGR Palilula-I, this plan classifies green areas within housing as „areas of limited use“.

In addition to „areas of public use“, the Second amendments and supplements to the PGR Palilula-II introduced „areas of public and/or other use“, which include zones of mixed housing, supported housing, and public areas for the functioning of the block (Figure 2).

Plan of general regulation of the City Municipality of Pantelej – I phase (PGR Pantelej-I). The classification of areas of public use and areas of other uses within the PGR Pantelej-I follows the same structure as in other PGRs. The First amendments and supplements to the PGR Pantelej-I formally introduce „areas of public use for the needs of the functioning of buildings and plots within the block“, but it remains unclear which areas are specifically referred to, as they are not marked. Only the Second amendments and supplements to the PGR Pantelej-I designate the free space around buildings in inherited LHEs as "areas of public use for the needs of the functioning of buildings and plots within the block" (Figure 3).

The treatment of POS in inherited LHEs, as well as the possibilities for new construction between existing buildings, is also influenced by how the building line is defined. In some plans, the building line is drawn along the perimeter of the existing buildings (Figure 4a), which prevents construction in the area between the buildings. In other plans, the building line is defined by the outer edges of the existing buildings (Figure 4b),

which allows for new construction within the construction line, i.e., inside the block, but not in the space between the building and the regulation line. The third scenario involves the building line being drawn parallel to the regulation line (Figure 4c), which permits new construction inside the urban block with little or no consideration for the existing housing complex, except for maintaining the mandatory distances between buildings.



(a) (b) (c)

Figure 4: Building lines : a) along the perimeter of the existing buildings - PGR Pantelej I phase, b) defined by the outer edges of the existing buildings - PGR Medijana, c) parallel to the regulation line - PGR Palilula I phase

3.2.3. Urban design project for residential and business building in Niš, Boulevard Nemanjića

The the urban design project (UDP) elaborates unbuilt space between the existing buildings in LHE Krive Livade, previously intended for sports and recreation. The urban design project envisages the construction of a seven-storey residential building with commercial space on the ground floor.



Figure 5: Position of the building plot, source: authors

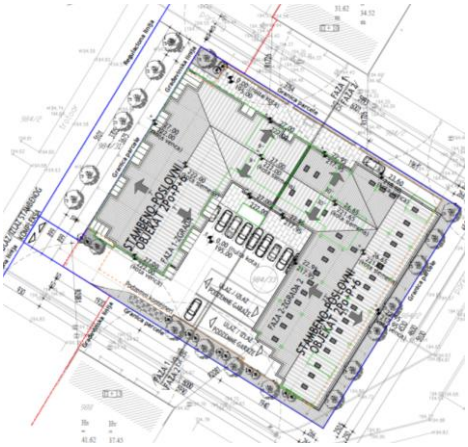


Figure 6: Urban design project for the urban-architectural development of the location, source: http://www.eservis.ni.rs/urbanistickiprojekti/



Figure 7: The appearance of the building, with the fence around the plot, source: authors

Open space within the scope of UDP is considered only in terms of achieving the given urban planning parameters and access to the building. The minimum of green areas (10% of the building plot) is achieved by forming a narrow strip of greenery along the boundaries of the building plot. Unbuilt, open space on the ground floor is intended for vehicular and pedestrian traffic and parking space (Figure 6). In order to maintain, at least formally, the connectivity and continuity of (public) open space, no fencing of the plot was planned in UDP. However, during the construction, the plot was fenced off on all sides except for the access street (Figure 7). This way, the privacy and exclusivity of the space use are emphasized as opposed to the public use.

4. DISCUSSION AND CONCLUSION

In accordance with the Law on Planning and Construction, urban plans of the City of Niš recognize „areas of public use" as a planning category but not the terms „public space" nor „public open space". Unlike the areas of public use that are in public ownership and clearly defined in planning documents, the status of open spaces in inherited multifamily housing complexes is unclear and prone to misinterpretation.

The analysis of plans of general regulation showed that there is no established uniform planning treatment of open space in inherited multifamily housing areas. While the general urban plan doesn't recognize these open spaces as „areas of public use", plans of general regulation use different terms for the description:

- areas of public use for the needs of the functioning of buildings and plots within the block;
- public areas for the needs of the functioning of the block;
- areas of public use for the functioning of buildings and plots within the block, where the construction of civil engineering objects only is allowed.

There is also a difference in the categorization of these spaces as „areas of public use" in earlier plans and/or as „areas of other uses" in subsequent amendments and supplements. Furthermore, the plans of general regulation include rules for the arrangement and construction of all areas of public and other uses, except for these „specific" areas of public and/or other use. The graphic part of the plan, which designates predominant land uses, usually marks inherited multifamily housing areas as high- or medium-density housing within urban zones. As a result, the building rules for „other uses" (housing) become relevant for construction in the„area of public use". Building lines defined within planning documents also play a significant role in preserving or occupying POS in inherited LHEs. An example of an urban design project for new construction within existing LHEs reveals a series of shortcomings in the treatment of inherited LHEs.

The planning framework for the development of POS in cities starts with the General Urban Plan for the entire city area, which is further elaborated through plans of general and detailed regulation. Since the current GUP of Niš (2010–2025) is valid until 2025, preparations are underway for the development of a new GUP. This presents an opportunity to carefully address the issues caused by inadequate planning, or lack of planning, of POS in the previous period and to comprehensively plan the future development of public open spaces

It can be concluded that many of the challenges in providing quality residential POS in the City of Niš are rooted in the treatment of POS in legislation at the national level, and the failure to recognize the concept of „public open space" (Dinić Branković and Igić, 2024). Legal provisions are incorporated into planning documents, but in an inconsistent manner, leading to ambiguities and misinterpretations of the plans, which is to a great extent reflected in the urban planning at the local level in Niš. While urban planning is based on current laws and regulations, it has yet to adapt to the changed post-socialist conditions. This is especially evident in the treatment of public open spaces, which were once state/public property but are now under various forms of ownership. The planning approach to public open spaces in the post-socialist context has had a significant impact on their current condition and continues to play a crucial role in their future development and management.

ACKNOWLEDGEMENTS

This research was supported by the Science Fund of the Republic of Serbia, #GRANT No. 7572, Reclaiming Public Open in Residential Areas: Shifting Planning Paradigms and Design Perspectives for a Resilient Urban Future—RePOS and by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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ANALYSIS OF BROWNFIELD SETTLEMENTS IN NIS AND IDENTIFICATION OF POSSIBILITIES FOR THE APPLICATION OF URBAN REGENERATION METHODS WITH A REFERENCE TO TWO EXAMPLES OF GOOD PRACTICE

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ABSTRACT

The concept of urban regeneration of brownfield settlements in recent decades has a growing influence on urban planning as well as on society, which results from the need to solve the problems of neglect, pollution and inadequate use of such spaces. Regeneration of brownfield settlements is a process of revitalization and repurposing of abandoned, neglected and often polluted spaces that once functioned as part of industry or had some other function. These areas are often unused or partially used, and urban regeneration creates an opportunity for their reuse and integration with the urban area. The goal of the research is the analysis and identification of examples of good practice - the Rami library in Istanbul and the coffin factory Sargfabrik in Vienna and the examination of the possibility of their application in two specific areas on the territory of the city of Nis - the area of the former barracks "Bubanj Heroes" and the former leather factory "Đuka Dinić''. The paper provides a detailed explanation of the urban regeneration of two examples of areas that have been regenerated through a critical review of two examples of good practice, as well as data on historical facts related to two areas in Nis, and then the possibilities of applying urban regeneration are examined in detail. Guidelines for the implementation of sustainable urban renewal strategies are aimed at improving the quality of life, preserving cultural heritage and encouraging economic activities.

Keywords: *brownfield sites, urban regeneration, sustainable development, space revitalization, repurposing of spaces*

1. INTRODUCTION

Urban development faces all the prominent challenges in terms of spatial efficiency, resource conservation and quality of life improvement. The term urban regeneration refers to the restoration of a deformed, destructive and degenerate city or part of a city, and its aim is to integrate devastated areas into the social and economic flows of urban development, transforming them from endangered social and economic systems into sustainable ones. First of all, urban regeneration refers to the improvement of the general living environment of cities and the improvement of the quality of life of the population, by applying various measures of transformation of the physical structure and local economy, which are based on long-term and strategic goals.

The term ‘brownfield’ first appears in American documents from 1992. According to the definition of the US Environmental Protection Agency (US EPA, 2002), brownfield sites are abandoned or underused industrial and

commercial spaces and buildings. Such sites arise as a result of social and economic changes integrated into the urban landscape and are mostly located in developed urban areas and require interventions to become usable again. The most common types of brownfield sites in urban areas are industrial complexes, which are often attractive urban spaces, but also significantly polluted. The loss of economic value of land, city identity and negative impacts on the quality of life of residents are problems in the urban environment (Perović, S. & Kurtović Folić, N., 2012). The city of Niš, as one of the largest urban centers in Serbia, faces numerous challenges related to abandoned and inadequately used areas, which is a consequence of industrial and economic changes. This paper provides an analysis of the specificity of brownfield sites in Niš, with a focus on the possibilities of their transformation through sustainable urban approaches. In addition, through the presentation of two examples of good practice – the Rami Library in Istanbul and the Sargfabrik coffin factory in Vienna – successful regeneration models are explored that can serve as a basis for the development of tailored strategies in the local context, in two specific areas on the territory of the city of Niš – the area of the former barracks 'Bubanjski heroji' and the former leather factory 'Đuka Dinić'.

The subject of the research of the paper covers the issues of transformation of selected brownfield sites in the context of contemporary urban development and sustainable urban regeneration strategies. The aim of the research is to define guidelines for the revitalization of these spaces, with the application of integrated approaches that combine ecological, economic and social aspects of sustainable development. The research methods applied in the preparation of the paper are data collection, data analysis, detailed description of the state of neglected areas, identification of key problems, study of spatial characteristics, historical context and other relevant aspects, then a proposal for improvement and implementation of planned measures and activities, as well as case studies.

2. EXAMPLES OF SUCCESSFUL URBAN REGENERATION OF BROWNFIELD LOCATIONS IN THE WORLD

Through carefully designed regeneration strategies, neglected, abandoned, or underutilized areas become dynamic and functional spaces with new cultural, educational, and residential uses. These processes include a wide range of measures – from the preservation and repurposing of historic structures to the implementation of contemporary urban principles. The chapter analyzes two notable examples of urban regeneration that illustrate different approaches to the repurposing of brownfield sites. The first example, the regeneration of the former Rami Barracks in Istanbul, shows how a military complex can be transformed into a cultural and educational center with a strong focus on sustainability and inclusiveness. The second example, the revitalization of the Sargfabrik coffin factory in Vienna, illuminates a model of socially engaged regeneration, where citizens and NGOs played a key role in transforming an industrial facility into an innovative residential and cultural complex. These studies highlight key success factors in the regeneration of brownfield sites, including an interdisciplinary approach, the integration of environmental and social measures, and the adaptation of new content to the needs of the local community.

2.1. Urban regeneration of the former Rami barracks in Istanbul

The former barracks, located in the Eyup regional district, a suburb of Istanbul, Turkey, is a historical military facility that played an important role in the history of the city itself. The barracks were built in the late 18th century during the Ottoman Empire. During World War I, the barracks were used to house prisoners of war, and after the war, they were used by the Turkish Armed Forces (TAF). During World War II, the complex served as a prison for German and Italian prisoners of war. The area of the area belonging to the barracks was approximately 22 ha, with Rami Barracks being the third largest barracks in Istanbul (ISAM). The military complex itself, which included military facilities and a central courtyard, occupied an area of approximately 7.5 ha, of which the built-up area, i.e. the area under the buildings, was approximately 3.3 ha.

Based on the analysis carried out, the types of problems represented are as follows: deterioration of physical structures and new demands for property and land, damage to the quality of the environment and sustainable development, irrational use of construction land, environmental problems and lagging quality of urban space (Bogdanović Protić, I., 2023). The main initiators of the urban regeneration project were entities whose activities affect the life and well-being of the area - the central authorities, which also provide financial support to the local authorities, primarily the Ministry of Culture and Tourism of the Republic of Turkey (Istanbul in, 2023). Improvement of the quality of life and sustainable development of the city stand out as the main global goals. In addition, a number of other goals are recognized, such as the removal of dilapidated buildings with the construction of new-purpose buildings, the revival of central city areas, the revival of abandoned and neglected

buildings and spaces, the harmonization of the complex with the needs of users in the narrow and wider environment, the improvement of recreational facilities within the area, the improvement of the ecological conditions of the area, and the increase of social cohesion (Bogdanović Protić, I., 2023).

During the regeneration process, among others, social measures were implemented, namely community-based actions and greater training, which is reflected in the modern design approach and the diversity of the content of the library campus, which has a capacity of 4,200 people and numerous sections, including a library for babies and children, a digital library, a library for young people, a library for adults and various specialized libraries, including spaces for people with disabilities (Fig. 1). Through numerous researches and efforts, the original structures of the barracks were preserved, restoring the damaged areas using natural materials and special techniques, which indicates the physical measures that were applied in the regeneration process itself. The existing damaged structure was restored, reinforced with additional structural elements and more open space was obtained, suitable for group work, exhibitions, lectures and the like. The complex contains five blocks and eight main sections. There are three lecture halls, four activity centers, a far-reaching library with a capacity of 2.5 million books and a museum. From the aspect of the environmental approach, planned greening and landscaping is extremely characteristic. In addition to the spacious green area, the Rami library also has an artificial lake surrounded by tall greenery (Betül Tilmaç, 2023).



(a) (b) (c)

Figure 1: (a) Entrance to the library, (b) and (c) Interior of the Rami Library - view of the different sections, Source: (a) https://ramikutuphanesi.gov.tr/en/gallery/,(b) and (c) https://www.ntv.com.tr/galeri/turkiye

The regeneration process is based on the principles of new urbanism, including flexibility, adaptability, functional diversity and spatial connectivity. Special emphasis is placed on community participation and inclusiveness, ensuring accessibility for all users. Placing the library in a densely populated area improved the accessibility and efficiency of the urban structure. The integration of cultural heritage and aesthetically attractive, functional spaces contributes to the identity of the city and the improvement of the environment. The implementation of blue-green infrastructure enabled ecological sustainability and efficient stormwater management. The key actors of urban regeneration were the Government of Turkey, local authorities, the Ministry of Culture and Tourism, municipal authorities and multidisciplinary teams. The sustainability of the project was improved by the involvement of citizens, while non-governmental organizations provided additional support in terms of citizen advocacy and community engagement (Homes, I., 2023). Considering that the building is of public purpose and financed from the budget of the Republic of Turkey, the exact amount of the reconstruction is not available, but considering the size of the complex and the library capacity, it is assumed that a significant amount was invested.

With the implementation of the project, Rami Library has become an aesthetically attractive, functional and inclusive space that contributes to the cultural and educational landscape of Istanbul. By preserving authentic buildings and integrating modern urban planning principles, sustainability has been improved through green areas, ecological technologies and rational use of space. The library now serves as a symbol of the city's cultural identity, providing an interactive library experience and promoting sustainable development. Its significance was confirmed by obtaining a sustainability certificate and candidacy for the UNESCO cultural heritage list (Istanbul in, 2023).

2.2. Urban regeneration of the former coffin factory Sargfabrik in Vienna

The coffin factory Sargfabrik, located in the western part of Vienna, used to be the largest coffin factory in the Austro-Hungarian monarchy. The area was traditionally inhabited by small workshops, in the vicinity of which there is also a cemetery (Sargfabrik, W). The factory was built at the end of the 19th century and in that period was the largest building of its type occupying an area of 4700m2. It was used for the production of coffins until 1970, when it was abandoned. During the war, the old factory was converted into a factory of discarded ammunition boxes. In that period, apart from the change of functional purpose, no transformations

were carried out in terms of dimensions and appearance of the object (Heritage, O., 2019). The observed problems were new demands for property and land, loss and lagging of the quality of urban space, environmental problems, deterioration of physical structures and intensive development and growth of the city, which tends to restructure its contents and their spatial distribution and changes in the narrower or wider environment of the city, which require certain measures and interventions on the urban fabric (Bogdanović Protić, I., 2023). It is a combined project of shared and social housing, which was realized after a strong campaign led by citizens with the support of the Vienna municipality. Today, the residential complex serves both as a residential community that integrates people of different lifestyles, ages and social backgrounds and as an important recreational center open to the public (Heritage, O., 2019). The initiator of the project was a volunteer organization - 'Association for an integrated lifestyle' which in 1989, aware of the problems and challenges that arose within the city fabric, noticed the need to convert the former factory into a multifunctional space that integrates private accommodation, common rooms and public functions. The goals of the new project were the compact and more efficient use of the inhabited urban fabric and the revival of the abandoned space, which in terms of construction and aesthetics could be revitalized through the integration of housing and culture and the creation of an open and self-defined living structure, with a strong social focus (Bogdanović Protić, I., 2023).

The original plan envisaged the preservation of the old production hall, but due to problems with orientation, construction and corrosion, it was decided to replace the building with a new one. The construction of Sargfabrik was completed in 1996, when the first tenants moved into 73 residential units (Building Social Ecology, 2021). The building uses a modular system, with different typologies, including duplex models. It is characterized by a "double facade", which improves aesthetics, thermal insulation and energy efficiency (Sargfabrik, W). The materials are reinforced concrete and glass, and balconies with concrete arcades stand out on the façade (Building Social Ecology, 2021). In addition to housing, the facility offers public services such as the Cultural Center, a restaurant, a kindergarten, a hall for events and conferences, the income of which is reinvested in maintenance and further development (Docplayer.org). Sargfabrik has a flat green roof (Fig. 2a), except for the facade facing the street, which has a sloping roof for visual harmony with the surroundings. The roofs are used for solar panels and vegetation, along with rainwater harvesting systems (Fig. 2b). The project is characterized by an environmentally friendly design and optimized energy consumption. Planned greening and a sustainable approach have created a healthier, more resilient and more pleasant urban environment (Heritage, O., 2019). Social measures implemented include improvement of housing and living conditions, improvement of social welfare, community-based actions and greater empowerment, community self-help with selective public support and emphasis on the role of the community.

In the process of urban regeneration, the key actors and interest groups, which had a significant role in achieving successful and sustainable changes, were first of all volunteer associations, local authorities, planners, the media, as well as residents. The total costs of purchasing the location and building the facility amounted to 13.6 million euros, and it was financed predominantly from the private sector with selective public sector (Sargfabrik, W). Due to the unexpected success and enormous popularity of Sargfabrik, in 1998 the association bought another smaller plot on the opposite side of the street where another experimental unit was built, known as Miss Sargfabrik (Fig. 2c) with 39 available housing units, whose occupancy began in 2000 (Delft Architectural Studies on Housing).



(a) (b) (c)

Figure 2: (a) Green roofs, (b) Display of rainwater harvesting system and (c) Miss Sargfabrik
Source: https:// www.buildingsocialecology.org

3. EXAMINATION OF THE POSSIBILITY OF IMPLEMENTING GOOD PRACTICE EXAMPLES IN TWO SPECIFIC CASES FROM THE TERRITORY OF THE CITY OF NIŠ

There are numerous abandoned and underutilized sites in the city of Niš that have significant potential for urban revitalization. This chapter examines two such sites – the former military complex 'Bubanjski heroji' and the former leather factory 'Đuka Dinić'. Both sites are characterized by disuse, degradation of physical structures and lack of functional content, which makes them suitable candidates for interventions inspired by contemporary concepts of sustainable urban development. The analysis of these examples allows for consideration of the possibility of transferring experiences from successful models of urban regeneration and adapting these principles to the specific local conditions in Niš.

3.1. Examining the possibility of implementing examples of good practice in the area of the 'Bubanjski heroji' barracks in Niš

The former military complex 'Bubanjski heroji' (Fig. 3a) is located in the municipality of Palilula, in the settlement of Bubanj in Niš, on an area of about 16 ha. The location of the barracks was convenient because it was on the outskirts of the city. Until 1992, the subject area was used for the needs of the Yugoslav People's Army (JNA). A satellite image from 2003 shows preserved objects that bear witness to military activity at the site. The video from 2023 shows the complete devastation of buildings and land. Neglect and lack of protection have led to the collapse of buildings, which is a potential safety risk. One of the key problems is the irrational use of construction land, which can be seen through the evident devastation and deterioration of physical structures in the area. This inefficient use of resources can have serious consequences for the entire urban environment. The deterioration of physical structures is not only an aesthetic problem but also a safety problem, especially if you consider that some buildings have become unsafe for the environment.

The initiators of the urban regeneration of the former Bubanjski heroji barracks could be various interest groups, local authorities, or organizations, which, seeing the potential of this area, recognize the opportunity for its regeneration. The aim of the urban regeneration of the former barracks is to create a sustainable urban space that improves the quality of life of the community. In addition to aesthetic improvement, regeneration has social, environmental and economic benefits, including the use of renewable energy sources and support for environmental initiatives. Specific goals include improving recreational facilities, urban services and safety through safely designed spaces and adequate lighting. The creation of green areas contributes to the quality of life and encourages recreation.

In the process of regeneration, the implementation of social measures through the establishment of a library campus with diverse content is key. A multifunctional concept would enable inclusiveness and encourage social cohesion. Educational and cultural programs, workshops and trainings would contribute to the empowerment of the community, while spaces for exhibitions, lectures and concerts would further enrich the social life of citizens (Fig. 2b, 2c). The physical measures of the regeneration of the former barracks include the reconstruction of damaged buildings with cultural and historical values, thus preserving the authenticity of the space. The construction of new buildings that complement the existing structures and adapt to modern needs is also planned. Flexible planning allows the space to adapt to future changes, while the integration of accessible walkways and lifts ensures inclusiveness. From the aspect of the environmental approach, the emphasis on planned greening of the library yard plays a key role in creating a sustainable and environmentally friendly urban space. The introduction of blue-green infrastructure elements further enhances the sustainability of the project, especially when it comes to channeling rainwater and preserving water resources.



(a) (b) (c)

Figure 3: (a) A military facility within the former barracks, (b) Example of improvement - Open space for group work and (c) Example of improvement - Section of Rami library for children

Source: (a) https://bubanjskiheroji.edu.rs/istorijat/, (b) and (c) https://www.ntv.com.tr/galeri/turkiye/rami-kutuphanesi-a

The principles of new urbanism include sustainability through energy efficiency, renewable energy sources, recycling and ecosystem protection. The use of biodegradable materials reduces the ecological footprint, while the flexibility of space, connectivity and mobility enhance functionality. Technological innovations, such as smart energy management and security systems, improve the quality of life. The implementation of blue-green infrastructure contributes to rainwater management, erosion reduction and groundwater conservation, while implementing sustainable rainwater collection and reuse systems.

The barracks regeneration process involves different actors and interest groups with specific goals. The local government plays a key role, while citizens and residents of the immediate environment contribute to the planning of the project according to the real needs of the community. Non-governmental organizations advocate for the preservation of cultural heritage, while private investors provide financial resources. Cultural institutions are important for heritage protection, while local companies may have an economic interest. Educational institutions can participate through the formation of educational spaces and research centers. Establishing cooperation between these actors is crucial for sustainable and balanced development. Funding for regeneration can be provided from a number of sources. Key support can be provided by the budget of the Republic of Serbia through subsidies for the revitalization of neglected military areas. Additional funding can come from private foundations, non-governmental organizations and international funds that support urban regeneration and sustainable development.

3.2. Examining the possibility of implementing examples of good practice in the area of the 'Bubanjski heroji' barracks in Niš

The 'Đuka Dinić' leather factory is located on the banks of the Nišava River, 700 meters downstream from the center of Niš, due to the high demand for water for the technological process. The 4-hectare complex in the municipality of Crveni Krst includes 14 buildings, once used for commercial-business and production-warehouse purposes (Fig. 4a). Access is possible from Ace Stojanovića Street. Today, the complex is abandoned and unused. The leather factory, built in 1910, was the most modern in the Balkans, and in 1914 it was expanded under the name 'Balkan'. During World War I, it produced footwear for the Serbian army, and in World War II it served the occupying forces. In 1949, it was merged with the 'Arsen Balkanski' factory and named 'Đuka Dinić' (Jovanovic M. & Mirić A., 2015). Two preserved rectangular buildings with an area of 3700m², storeys P+1+Pk, were built with a massive system, with a gable roof and a brick facade with large windows, characteristic of industrial buildings of that era. An additional rectangular ground floor hall of 4300m² has a skeleton structure and a flat roof.

As an example of good practice, we can recognize the problems that were observed as an example of good practice in the case of the former factory 'Đuka Dinić', which are: irrational use of construction land, new demands for property and land, loss and deterioration of the quality of urban space, environmental problems, deterioration of physical structures and intensive development and growth of the city, which tends to expand its surroundings or spread its content over a wider area city, which require certain measures and interventions in the urban fabric (Bogdanović Protić, I., 2023).

The key drivers of the renovation of the 'Đuka Dinić' factory into a residential and commercial complex could be local governments, private investors and non-profit organizations. City authorities can initiate the project, provide infrastructure support and regulate the plans, while the private sector would see the potential for investment. Non-profit organizations, such as those for the preservation of cultural heritage and sustainable development, could contribute to the protection of heritage and the improvement of public space. The goal of the project is to revitalize abandoned industrial warehouses and factory buildings, creating functional and attractive spaces for potential residents. Although the buildings are not under protection, their restoration would preserve the industrial heritage and adapt the space to modern needs. Renovation of existing buildings and transformation of the complex would be key physical measures that would contribute to the revitalization of the old part of the city and broader urban development. Within the existing hall, housing units adapted to the different needs of users could be formed, thereby improving living conditions. Innovations would include semi-level and central corridors that allow for flexible organization of space. Common spaces, such as galleries, green courtyards (Fig. 4b), playgrounds and fields, would encourage social interaction. In addition to residential buildings, the complex would also offer public facilities - a Cultural Center, a restaurant, a children's institution and event halls, while the income from these services would support its maintenance and development. A key aspect of the concept would be the public or semi-public character of the space. Social measures that could be implemented in the selected area include improving housing and living conditions, improving social protection,

community action, greater empowerment and self-help of the community, with selective public support and an emphasis on the active role of the community. The implementation of modern environmental measures, such as planned greening and sustainable land management, would contribute to environmentally friendly design and optimized energy consumption. Green roofs, in addition to their aesthetic role, would also have a functional role, allowing the installation of solar panels or vegetation. The use of rainwater collection channels and the implementation of green-blue infrastructure would improve energy efficiency and reduce harmful impacts on the environment. In addition to the implemented good practice measures, urban agriculture is planned through roof gardens, communal gardens and vertical farming (Fig. 4c).



(a) (b) (c)

Figure 4: (a) The exterior of the 'Đuka Dinić' factory (b) Example of improvement - Green gardens and (c) Example of improvement - Urban agriculture
Source: (a) https://zzsknis.rs/, (b) https://www.buildingsocialecology.org and (c) https://detroit.curbed.com/2017/2/21/14679248/urban-agrihood-detroit-mufi-campaign

The regeneration project of the former Factory would involve various stakeholders and interest groups such as investors, entrepreneurs, local authorities, residents and communities, architects and urban planners and the media. The choice of the project initiator affects the sources of financing. In the case of local governments, the funds would come from the public budget, while private investors would use their own funds. Voluntary associations or communities could take out a bank loan, which would be repaid with the income from renting out or selling the renovated space, creating a sustainable financial model.

4. CONCLUDING CONSIDERATIONS

The regeneration of brownfield sites is a key factor in sustainable urban economic development, which not only includes the restoration of abandoned spaces, but also strengthens the urban fabric, creating an innovative environment that supports various aspects of life and work. Adaptive redevelopment stands out as a sustainable model of brownfield regeneration, which involves integrating abandoned sites into the urban environment and adapting them to new uses in a new social and economic context, while imbuing the historical context of the area and the contemporary needs of society. Finally, investment in the regeneration of such sites is not only a strategic business move, but also a responsible decision aimed at creating a self-sustainable community and better living conditions (NALED, 2016).

The former Rami military barracks in Istanbul and the former Sargfabrik coffin factory in Vienna were chosen as examples of good practice. The first part of the research included an analysis of the purpose of the site, a description of the transformation from the construction period to the initiation of urban regeneration, and then, based on the analysis conducted, the problems observed were identified, i.e. the causes of the urban regeneration process itself. After a detailed analysis of the state of the selected areas before the urban regeneration process itself, there was a thorough explanation of two examples of good practice, which included the regeneration of former military barracks into an imposing library of exceptional cultural and historical significance, as well as the transformation of a former coffin factory into a residential and business complex. The explanation was carried out through criteria based on a strategic research approach. First, the main drivers of the projects and their objectives were presented, then the types of measures and activities applied, including actors and interest groups, as well as sources of financing. Finally, the sublimated effects of the projects after implementation were presented.

When analyzing the current state of two selected areas in the city of Niš – the former military barracks ‘Bubanjski heroji’ in the municipality of Palilula and the former leather factory ‘Đuka Dinić’ in the municipality of Crveni Krst, the same problems were observed as in the examples of good practice, such as irrational land use, new claims for property and social land, loss and lagging behind in the quality of urban space, and issues of urban and environmental planning. All physical, social and environmental measures applied in the examples of good practice, such as the renovation of existing buildings and the transformation of complexes, the

improvement of housing and living conditions, community-based actions, the application of modern approaches through land planning, planned greening and the introduction of the principles of new urbanism, can also be applied in the selected areas in Niš, creating healthy interaction and a more pleasant environment and improving. The only potential problem during the regeneration process could be the financial costs, which is why it is necessary to involve as many drivers as possible in the regeneration process, such as local government, private investors, non-profit organizations or citizens and local groups, who could play an important role in the regeneration process by recognizing local needs and identifying key problems at the site.

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ICUP2025
5th international conference on urban planning

ARCHITECTURAL FLEXIBILITY: DESIGNING RESILIENT, ADAPTABLE SPACES FOR A CHANGING SOCIETY

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ABSTRACT

Flexibility in architecture has become an essential consideration in designing spaces that can adapt to changing societal, environmental, and technological conditions. This paper explores the concept of architectural flexibility, examining its theoretical foundations, historical context, and growing relevance in contemporary practice. It investigates key strategies such as modular systems, adaptive reuse, and dynamic spatial configurations, highlighting their role in fostering sustainability, resilience, and inclusivity. Through the analysis of case studies, the paper demonstrates how flexible architecture can enhance social equity by accommodating diverse needs, supporting a range of activities, and extending the lifespan of buildings. Additionally, it addresses the societal implications of flexible design, including its potential to reduce resource consumption, improve community engagement, and contribute to the creation of inclusive, adaptable environments. The study also discusses the challenges architects face in integrating flexibility into practice, including balancing aesthetic, functional, and economic considerations. Ultimately, the paper argues that architectural flexibility is not only a response to the changing demands of society but also a proactive strategy for building resilient, future-ready environments that reflect the complexities of modern life.

Keywords: *architectural flexibility, adaptive reuse, resilient design, sustainable architecture, social equity in architecture, inclusive design, future-ready architecture, architecture and society, urban resilience, flexible spaces*

1. INTRODUCTION

The built environment serves as a reflection of societal needs and values. However, static architectural designs often struggle to accommodate the dynamic nature of human activity, technological advancements, and environmental demands. Flexible architecture, designs that adapt to changing functions and user needs, has emerged as a critical solution for addressing these issues [5]. Static architectural practices limit the ability of buildings to respond to shifts in demographics, work patterns, and climate change. This lack of adaptability leads to inefficiency, increased costs, and reduced user satisfaction. If building practices fail to advance toward flexible construction methods that promote the reuse and recycling of building materials, the disparity between environmental degradation and sustainable development will become insurmountable [4].

This paper examines how architectural flexibility can be employed to design public buildings that are resilient, adaptable, and sustainable. It utilizes a mixed-methods approach, combining a literature review and case study analysis. This paper focuses on the principles of flexible architecture, its implementation in public spaces, and its broader societal impact. Architectural flexibility is key to creating sustainable environments that

accommodate societal evolution. By integrating adaptable features into the design, architects can future-proof public buildings, enhance user satisfaction, and contribute to urban resilience [5].

2. LITERATURE REVIEW

Flexible architecture is not a new concept. Historical examples, such as traditional Japanese homes with sliding partitions, illustrate early approaches to adaptability. Modern movements, such as the Open Building approach championed by N.J. Habraken, formalized these principles into architectural theory [5]. The adaptability of medieval markets, which transformed based on daily trade needs, also demonstrates the longstanding importance of flexibility in public spaces. Transformation in the built environment arises from the human necessity to adapt physical surroundings to accommodate various activities, utilizing available technologies. This process implies dynamic interactions that facilitate the continuous evolution of forms and functions within the built environment [4].

The post-war housing crisis in Europe further advanced the need for flexible design. Architects like Le Corbusier introduced modular construction methods, which allowed for quick assembly and adaptability to various urban conditions. These developments laid the groundwork for modern public buildings that prioritize flexibility.

Habraken's Open Building framework emphasizes the separation of structural and infill components, allowing for long-term adaptability. This principle is particularly significant for public buildings, where changing functional requirements necessitate versatile designs [5]. Christopher Alexander's patterns of design also support flexibility by advocating for scalable, modular approaches that can accommodate diverse community needs [1]. Similarly, the principles of mass customization enable public buildings to serve varied functions without compromising efficiency.

Technological innovations, such as smart materials and dynamic building systems, are transforming flexibility from a design concept into an operational reality. Examples include responsive facades that adapt to weather conditions and reconfigurable interiors that cater to changing community events. Public buildings increasingly integrate these technologies to enhance user experience and sustainability. Additionally, urban design practices now incorporate flexibility on a larger scale. Projects like the High Line in New York City demonstrate how adaptable spaces can revitalize urban areas, serving as multifunctional public amenities.

The increasing demand for adaptable spaces reflects the need to address the complexities of contemporary urban life. A deeper understanding of societal aspirations, evolving work and consumption patterns, and the transformative paradigms introduced by technological innovation underscores the critical role of flexibility in urban design and planning [3].

2.1. Principles of Architectural Flexibility

Public buildings must embody flexibility not as an afterthought but as a central design motive. This chapter delves into the key principles that underpin adaptable architecture, focusing on their relevance to public spaces. By understanding these foundational ideas, architects can create environments that are not only functional but also capable of evolving with societal and environmental changes, ensuring their long-term relevance.

Architectural flexibility is grounded in key principles that support resilience and adaptability within the built environment. These principles encompass strategies that allow buildings to respond to dynamic needs over time, and can be classified as it follows:

- functional adaptability,
- technological integration,
- scalability,
- sustainability, and
- inclusivity.

Functional adaptability involves designing spaces that can accommodate changing uses without major structural changes. This approach emphasizes creating stable core structures with adaptable components that can be reconfigured to meet evolving needs [5]. The design process begins by defining fixed elements, with the more complex task of designing the changeable parts to ensure the building's continuous function [9]. Decisions made at the earliest stage of design, particularly those concerning spatial and functional characteristics, play a crucial role in shaping the long-term adaptability and usability of a building [10].

The integration of smart technologies enhances the adaptability of buildings, allowing them to respond dynamically to user preferences and environmental conditions. This principle resonates with Habraken's concept of hierarchical structure, where different layers of a building can evolve independently [5]. Examples include energy-efficient HVAC systems that adjust to occupancy levels, responsive lighting that adapts to natural daylight conditions, and sensor-driven automation that optimizes building performance. Such innovations contribute to both user comfort and energy efficiency, reinforcing the sustainability of flexible architecture.

Scalability ensures that buildings can expand or contract in response to changing population densities, functional requirements, or urban development trends. This concept aligns with Habraken's emphasis on incremental growth, where architectural environments evolve rather than being static, one-time constructs [5]. Public spaces, particularly in urban contexts, benefit from scalable designs that allow for phased construction, adaptable infrastructure, and spaces that can be repurposed based on demand.

Sustainability in architectural flexibility goes beyond energy efficiency; it also considers the long-term adaptability of buildings to reduce material waste. Habraken's Open Building framework supports this idea by advocating for structures that minimize the need for demolition and reconstruction, instead allowing for renovations and reconfigurations [5]. Strategies such as prefabricated components, cradle-to-cradle material use, and adaptable frameworks extend the lifespan of buildings, reducing their environmental impact and contributing to a circular economy.

Inclusive design ensures spaces meet diverse cultural, physical, and social needs, promoting social equity. Flexible public buildings can accommodate a range of users by incorporating adjustable spatial configurations, multi-sensory navigation systems, and accessible infrastructure. Such approaches promote social equity, ensuring that spaces remain welcoming and functional for all.

3. CASE STUDIES

Public buildings serve as vital hubs for cultural, social, and civic life. This section examines exemplary case studies that showcase how flexibility in design has enabled these spaces to evolve with societal needs. These examples demonstrate the transformative power of adaptability in fostering inclusive and resilient communities.

3.1. Centre Pompidou, Paris

The Centre Pompidou in Paris stands as a prime example of how flexible architecture can serve both functional and societal needs. Designed with adaptability at its core, this cultural hub embodies key principles of architectural flexibility, creating a dynamic and resilient environment that can evolve alongside changing societal, environmental, and technological contexts. The building's design, characterized by exposed structural elements and movable components, highlights functional adaptability. The flexible layout allows for various uses, including exhibitions, performances, and workshops, without major alterations to the core structure. This adaptability ensures the Centre Pompidou remains relevant in response to shifting cultural, social, and technological demands. The adaptable interior spaces allow for reconfiguration, providing a platform for diverse activities and events that reflect the ever-changing needs of the public.

The integration of advanced technologies further enhances the building's flexibility. For instance, its mechanical systems, including energy-efficient HVAC systems and lighting, adjust to occupancy levels and environmental conditions, ensuring comfort and energy efficiency. This responsiveness to user needs mirrors the principles of technological integration, where the building's infrastructure evolves independently to accommodate various uses and optimize its performance. These technologies contribute not only to the building's functionality but also to its sustainability by reducing energy consumption and extending its operational lifespan. Scalability is another key aspect of the Centre Pompidou's design. The building's modular approach allows for future growth, enabling it to adapt to changes in urban density and cultural trends. Its open, flexible floor plans allow for both incremental expansion and repurposing, ensuring that the space can evolve without compromising its core functions. This scalability also enables the Centre Pompidou to accommodate a growing public and evolving cultural landscape, making it an ideal example of how scalable designs can meet long-term societal demands.

Sustainability, integral to the building's design, is reflected in its long-term adaptability and resource-efficient strategies. The Centre Pompidou's structure minimizes the need for demolition and reconstruction by

incorporating modular elements that can be updated, reconfigured, or replaced as needed. This approach reduces material waste and supports the concept of adaptive reuse, contributing to a circular economy. By focusing on building longevity and the ability to adapt over time, the Centre Pompidou sets a benchmark for sustainable design in public spaces.

Inclusive design is another essential principle evident in the Centre Pompidou. The building's open and accessible layout ensures that it can accommodate a diverse range of users, from cultural enthusiasts to families, tourists, and local residents. Its flexible spaces, multi-sensory navigation systems, and accessible infrastructure reflect a commitment to inclusivity, ensuring that all individuals, regardless of their background or abilities, can engage with the space meaningfully. This inclusivity promotes social equity, making the Centre Pompidou a welcoming environment for all members of society.

The Centre Pompidou exemplifies the benefits of flexible architecture in public spaces. It demonstrates how a building can evolve to meet changing societal needs while fostering social engagement and equity. As a model of resilience and adaptability, the Centre Pompidou highlights the importance of flexible architecture in creating public spaces that are not only functional but also capable of adapting to the complex, ever-changing dynamics of modern life [2].



(a) (b)

Figure 1: The Centre Pompidou (a) Exposed structural elements on the facade, and (b) Interior that captures a glimpse of building's open and accessible layout

3.2. Seattle Central Library

The Seattle Central Library exemplifies how flexible architecture can enhance public engagement, sustainability, and long-term adaptability in urban spaces. Designed by Rem Koolhaas and Joshua Prince-Ramus, the library's innovative structure prioritizes flexibility, ensuring that it can accommodate evolving societal, technological, and environmental needs while remaining a vital civic institution. The library's design emphasizes flexible spatial organization, allowing for continuous reconfiguration to support diverse uses. Its "Books Spiral" system, a key innovation, enables the collection to expand and contract without disrupting the building's layout, ensuring that information remains accessible as the library's resources evolve. Open, multi-purpose areas, such as the Living Room and Mixing Chamber, provide adaptable spaces for reading, collaboration, and public programs, reinforcing the library's role as a dynamic community hub.

The Seattle Central Library incorporates advanced technologies to enhance adaptability and efficiency. Automated book-sorting systems streamline operations, allowing staff to focus on community engagement rather than logistical tasks. Smart climate control and lighting systems optimize energy use based on occupancy levels and external conditions, ensuring user comfort while minimizing environmental impact. Digital access points, interactive media stations, and flexible workspaces further enable the library to serve a tech-driven society, maintaining its relevance as digital literacy needs evolve.

Designed to accommodate growth, the library's modular layout allows for seamless adaptation to changing demands. The building's zoning strategy, which organizes spaces based on function and flexibility, ensures that sections can be reconfigured or repurposed as user needs shift. This scalability extends to its role within the urban landscape, as the library serves not only as an information center but also as a cultural and social gathering space that can adapt to broader community trends.

The library's long-term adaptability supports sustainability by reducing the need for major renovations or reconstruction. Its innovative structural framework, which maximizes open space while maintaining structural efficiency, minimizes material waste and supports energy conservation. Additionally, the extensive use of natural light, combined with energy-efficient mechanical systems, reduces the building's overall environmental

footprint. By integrating sustainable design principles, the Seattle Central Library exemplifies how flexibility can extend a building's lifespan while minimizing its ecological impact.

As a public institution, the Seattle Central Library prioritizes accessibility and inclusivity. The open, welcoming design ensures that people of all backgrounds can navigate and engage with the space comfortably. Features such as multi-sensory navigation aids, adaptable seating arrangements, and diverse programming create an environment that fosters learning, social interaction, and cultural exchange. By offering flexible spaces that accommodate different user needs, the library supports social equity and community participation.

The Seattle Central Library serves as a model of flexible architecture in the public realm, demonstrating how adaptability can enhance social engagement, sustainability, and long-term functionality. By integrating key principles of architectural flexibility, the library remains a resilient and future-ready institution. Its design ensures that it continues to meet the evolving needs of society, reinforcing the role of flexible architecture in shaping dynamic, accessible, and enduring public spaces [7].



(a) (b)

Figure 2: Seattle Central Library interior showing (a) Open design with extensive use of natural light, and (b) Accessible ramps

3.3. High Line, New York City

The High Line in New York City serves as a compelling example of how flexible architecture can transform urban infrastructure into an adaptive, inclusive, and sustainable public space. Originally an abandoned elevated railway, the project reimagined an obsolete structure into a vibrant linear park that responds to changing societal, environmental, and urban needs while fostering community engagement and long-term resilience. The adaptive reuse of the High Line demonstrates exceptional functional adaptability by repurposing industrial infrastructure into a multifunctional public space. Rather than demolishing the railway, the design preserves its structural integrity while integrating pathways, seating areas, and green spaces that can accommodate diverse activities. The park's layout supports both passive and active engagement, allowing visitors to experience the space through walking, relaxation, public events, and art installations. Its flexibility ensures that as the city evolves, the High Line remains a relevant and dynamic environment.

Technological integration enhances the High Line's adaptability and sustainability. Smart irrigation systems regulate water usage, ensuring efficient plant hydration while minimizing waste. LED lighting systems adjust based on ambient conditions, improving energy efficiency and maintaining the park's accessibility after dark. Digital wayfinding and interactive installations further enrich the visitor experience, reflecting the role of technology in enhancing public engagement and responsiveness in flexible urban spaces.

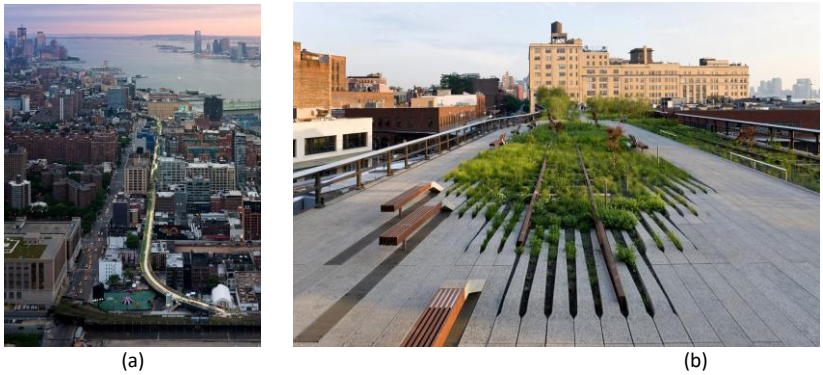
Scalability is a fundamental characteristic of the High Line, as the project was designed and constructed in phases to accommodate urban development trends and funding availability. The phased expansion allowed the park to grow incrementally, adjusting to community needs while seamlessly integrating with new urban developments. This approach highlights the potential for flexible public spaces to expand or contract in response to shifts in population density, land use, and municipal planning priorities.

Sustainability is embedded in the High Line's design, both through its commitment to environmental conservation and its emphasis on long-term adaptability. The park's landscape consists of native and drought-resistant plant species, reducing the need for extensive maintenance while promoting biodiversity. The use of reclaimed materials, such as salvaged railway tracks and repurposed industrial elements, minimizes waste and reinforces the project's commitment to sustainable urban transformation. By preserving existing infrastructure

rather than constructing anew, the High Line significantly reduces material consumption and carbon emissions associated with demolition and rebuilding.

Inclusivity is a core principle of the High Line, ensuring that the space remains accessible and welcoming to diverse visitors. The design incorporates ramps, elevators, and wide pathways to accommodate individuals with mobility challenges, reinforcing its commitment to universal access. Public programming, including cultural events, educational initiatives, and community-led activities, fosters social equity by making the space an inclusive platform for artistic expression and civic engagement. The park's design encourages interaction among people of different backgrounds, strengthening its role as a socially cohesive urban landmark.

The High Line exemplifies the potential of flexible architecture to revitalize urban spaces while addressing contemporary social, environmental, and technological challenges. By integrating functional adaptability, technological innovation, scalability, sustainability, and inclusivity, the project has redefined the relationship between infrastructure and public space. Its success demonstrates that flexibility in urban design is not only a means of repurposing obsolete structures but also a strategy for fostering resilient, dynamic, and community-oriented environments that can evolve alongside the changing needs of the city [6].



(a) (b)

Figure 3: High Line (a) Distant, and (b) Close percpective

4. DISCUSSION

Flexible architecture enhances user satisfaction, supports sustainability, and fosters urban resilience by allowing buildings to evolve alongside changing societal needs. Public buildings, in particular, benefit from adaptability as they accommodate diverse functions and extend their lifespan. Given their role as cultural and civic hubs, flexibility is essential for maintaining relevance in rapidly transforming urban environments. The case studies examined, Seattle Central Library, Centre Pompidou, and the High Line, demonstrate the diverse ways in which flexibility can be embedded into architecture, from modular and reconfigurable interior spaces to adaptive reuse of existing infrastructure (Table 1). However, while these examples illustrate the potential of adaptable design, they also reveal critical challenges that must be addressed.

Table 1: Comparison of Case Studies in Flexible Public Architecture

Case Study	*Design Features*	*Key Flexibility Features*	*Societal Impact*
Centre Pompidou, Paris, France	*Exposed structural and mechanical systems; Color-coded external pipes for different utilities (blue for air, red for circulation, green for water); Large open interior spaces with moveable partitions for flexible use*	*Open-plan floors that allow for diverse and changing exhibition layouts; Modular façade and exposed systems enable easy maintenance and upgrades; External escalators and suspended floors create a highly reconfigurable internal space*	*Democratizes access to culture by creating an open, transparent space for art and learning; Encourages experimentation in exhibition design and public interaction with spaces; Serves as a model for participatory and adaptable museum architecture*
Seattle Central Library, Seattle, USA	*Bold, geometric glass-and-steel structure; "Books Spiral" allows continuous shelving without the need for major reconfiguration; Large open spaces, including the Living Room and Mixing Chamber, to encourage social interaction; Multi-level zoning strategy based on function*	*Modular and reconfigurable interior spaces for changing library functions; Automated book-sorting system streamlining operations; Smart climate control and lighting that adjust based on occupancy and condition;s Digital workspaces and technology-integrated study areas*	*Enhances access to knowledge through an adaptable and tech-friendly learning environment; Serves as a cultural hub and community gathering space; Provides a model for future library designs focused on adaptability and technology integration*

High Line, New York City, USA,	*Adaptive reuse of an abandoned elevated railway into a linear park; Blend of green space, pedestrian walkways, and public art installations; Mix of hard and soft landscaping that integrates nature into the urban fabric*	*Phased construction allowed the park to evolve with urban development; Modular seating, open spaces, and varied pathways for different user experiences; Smart irrigation and native plantings for low-maintenance adaptability*	*Transforms underutilized infrastructure into a thriving public space; Boosts local economy by increasing foot traffic and tourism; Strengthens community engagement by fostering social interaction and cultural programming*

One of the key advantages of flexible architecture is its ability to accommodate multiple uses within a single space, ensuring long-term functionality and economic viability. The Centre Pompidou exemplifies this through its open-plan floors, which allow exhibitions and programming to change without major structural modifications. Similarly, Seattle Central Library's zoning strategy ensures that spaces can be reconfigured as the role of libraries evolves. Meanwhile, the High Line's transformation of obsolete infrastructure into a public park highlights how adaptability can extend the lifecycle of urban spaces, reducing material waste and environmental degradation. These projects demonstrate that flexibility is not merely an aesthetic or functional consideration but a critical strategy for maximizing the longevity and relevance of public architecture.

However, implementing flexibility in architecture is not without its challenges. High initial costs remain a significant barrier, as advanced materials and modular systems require greater investment compared to traditional static designs. The financial burden can discourage stakeholders from prioritizing adaptability, especially in public projects where budgets are constrained. Additionally, regulatory constraints, such as rigid building codes and zoning laws, often favor fixed-use structures, limiting the feasibility of flexible designs. The integration of adaptable features also requires close collaboration among architects, engineers, urban planners, and policymakers, making the design process more complex and potentially prolonging project timelines. Furthermore, the reliance on cutting-edge materials and smart technologies poses challenges in terms of maintenance and accessibility, particularly in underserved communities where resources for upkeep may be limited.

Despite these challenges, the potential of flexible architecture to shape future urban environments is profound. Emerging technologies, such as artificial intelligence and sensor-driven automation, could enable real-time spatial adjustments, optimizing energy use, indoor comfort, and functionality. Data-driven design approaches can further refine adaptable spaces by analyzing user behavior and environmental conditions, leading to more efficient and user-centered public buildings. Advancements in materials science, such as self-healing concrete, lightweight composites, and modular construction techniques, may reduce costs and improve the scalability of flexible architecture, making it more viable for widespread implementation.

Future research should focus on expanding the accessibility of flexible architecture, particularly in underserved communities where adaptability could address social and economic disparities. Investigating the long-term societal impact of flexible public spaces is also critical, as inclusivity and equity must be at the forefront of urban design strategies. Additionally, exploring how circular economy principles can further enhance sustainability in flexible architecture, through prefabrication, material reuse, and low-impact construction methods, will be crucial for minimizing environmental footprints.

Ultimately, flexible public buildings do more than just meet immediate functional needs; they serve as catalysts for broader urban and social transformation. By fostering cultural exchange, promoting education, and encouraging community engagement, adaptable spaces contribute to resilient, inclusive, and future-ready cities. As urban environments continue to evolve, the importance of designing public architecture with flexibility at its core will only grow, shaping the way society interacts with the built environment for generations to come.

5. CONCLUSION

Architectural flexibility is a vital strategy for designing resilient, adaptive spaces that align with the evolving needs of society. By embedding adaptability, sustainability, and inclusivity at the core of architectural practice, public buildings can transcend their traditional functions, fostering long-term usability and social engagement. The case studies analyzed, Seattle Central Library, Centre Pompidou, and the High Line, illustrate the diverse applications of flexibility, demonstrating how adaptive design can enhance cultural institutions, infrastructure reuse, and civic spaces. Each of these projects highlights different approaches to flexibility, whether through reconfigurable interiors, technological integration, or the repurposing of existing urban elements. Their success underscores the value of flexible design in prolonging a building’s lifespan, improving accessibility, and supporting dynamic urban environments.

Despite its clear advantages, flexible architecture faces persistent challenges that must be addressed for broader implementation. Regulatory barriers, including zoning restrictions and rigid building codes, continue to favor static designs over adaptable models. Economic constraints, particularly high initial costs associated with modular construction and smart technologies, further limit widespread adoption. Additionally, maintenance and long-term adaptability require careful planning to ensure that innovations in flexible architecture do not become financially or technically unsustainable. Addressing these issues requires a multi-disciplinary approach that integrates architectural expertise with advancements in technology, policy reform, and community engagement.

To advance the role of flexible architecture, several key recommendations emerge from this study. First, regulatory frameworks should be reassessed to encourage adaptable building practices, integrating flexibility as a standard rather than an exception. Second, continued research into cost-effective adaptive materials and construction techniques can lower financial barriers, making flexible design more feasible across different socioeconomic contexts. Third, greater emphasis should be placed on participatory design processes that involve local communities, ensuring that adaptable spaces truly serve their intended users. Finally, a stronger alignment between architectural flexibility and environmental sustainability should be pursued, leveraging circular economy principles to minimize waste and maximize resource efficiency.

Ultimately, architectural flexibility is not only a response to changing societal conditions but also a proactive strategy for shaping resilient, future-ready environments. It fosters cultural exchange, strengthens social equity, and supports sustainable urban growth. As cities continue to evolve, the role of adaptable public spaces will only become more critical in creating inclusive, functional, and enduring built environments. By embracing flexibility as a fundamental design principle, architects and policymakers can contribute to a more responsive and human-centered future, where spaces are not just built to last, but built to transform.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under the Agreement on the Implementation and Financing of Scientific Research Work of the NIO in 2025 - Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025.

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ICUP2025
5th international conference on urban planning

IMPROVING THE QUALITY OF HOUSING IN THE CITY OF NIŠ THROUGH REVIVAL OF NIŠAVA'S RIVERBANK

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ABSTRACT

The replacement of single-family with multi-family housing, as well as the construction of new multi-family buildings on unbuilt locations, in recent years, has led to the growth and concentration of the urban population in certain areas of Niš's urban municipalities. The increase in the population brings with it numerous other needs, among which the demand for amenities that complement residential functions stands out. The current situation in the field of housing design and construction in the city is largely influenced by investors' drive for maximum financial profit, resulting in new buildings being designed with minimal greenery, which is often not intended for the residents' relaxation or recreation, without spaces for socializing, children's play areas, and the like. In this context, residents of multi-family buildings are oriented toward public amenities of this type. However, despite the good potential, the quantitative and qualitative offer of such amenities in the city is inadequate. This paper deals with the idea of improving the quality of urban living by considering the possibilities of introducing public spaces designed for walking, rest, recreation, socializing, and children's play, along with revitalizing the banks of the Nišava River. The goal of the paper is to emphasize the need for a sustainable approach to urban planning that improves the quality of life for citizens and contributes to the preservation of natural resources. Such spaces can significantly enhance social interaction, physical activity, mental health, and the overall well-being of the population.

Keywords: *urban planning; multi-family housing in Niš; riverbanks; linear park*

1. INTRODUCTION

Increased construction of multi-family residential buildings in Niš has been evident in recent years. Multi-family residential buildings are not only being constructed on vacant plots, but also on plots occupied by family houses. Single-family housing in the urban fabric is gradually being replaced by multi-family housing, both in the downtown area and in the broader zones extending toward the periphery (Figure 1). By constructing apartments on the sites of former houses, the area of a plot that was once used by a single family is now inhabited by a much larger number of residents. One of the main characteristics of these newly built plots is their high occupancy, caused by the tendency of private investors, who are the main drivers of residential construction in Serbia, to maximize the profit. Parking spaces are often planned on the plot itself, rather than in

underground garages, for the sake of more cost-effective construction.[11] In this way, very little space remains for green areas on the plot, often none at all, and there is rarely any mention of other communal facilities that would serve for socializing, rest, recreation, or children's play. By conducting a detailed analysis of green spaces in multi-family residential buildings in Niš and the causes of their reduction, Kondić S. [11] provides guidelines and recommendations for addressing this issue, primarily emphasizing the need to revise regulations and the measures for their successful implementation in practice, through encouraging investors and raising awareness among homebuyers.



Figure 1: An example of four plots in the same neighborhood, where family houses are replaced or are being replaced by multi-family buildings, photos taken in 2013, 2014 and 2025, source: https://www.google.com/maps, Accessed 31st January 2025; https://a3.geosrbija.rs/, Accessed 31st January 2025; H. Krstić.

The quality of open spaces is an important factor that affects the quality of living. [16] Therefore, special attention should be given to this component when designing residential spaces, both at the architectural and urban planning levels. Considering the trend in residential architecture in Niš, dating back to the transitional period at the end of the 20th and the beginning of the 21st century, where the reduction of green spaces within residential buildings has become common, there is an urgent need to compensate for these spaces through public areas. Niš is a city with a decent number of parks, although their condition is unfortunately not up to an adequate level, along with large areas of undeveloped green spaces that hold enormous potential for improving the quality of life for citizens and generally enhancing the overall image of the city. One of the key potentials in this regard is the Nišava River, along the banks of which the city developed, and which will be the subject of discussion in this paper.

Considering the aforementioned facts, this paper explores the possibilities for improving housing in Niš by utilizing the potential of the Nišava River, specifically through the redevelopment and revitalization of its banks, along with the introduction of amenities aimed at enhancing the quality of life for the citizens. The aim of this paper is to identify models through urban planning that would compensate for the missing amenities in the structure of the existing housing stock, while simultaneously enhancing the overall attractiveness of the city. The methods applied in the research include analysis (primarily of the current state of multi-family housing in Niš, the potential of the Nišava River, and examples of good practices from abroad), synthesis (of the obtained results), comparison, description, and modeling. The paper is divided into six chapters.

2. THE NEED FOR COMMON GREEN SPACES IN NIŠ

Since the Rulebook on Conditions and Standards for the Design of Residential Buildings and Apartments [15] does not define open spaces (terraces, balconies, loggias, semi-loggias) as mandatory, it is possible for an apartment to be designed without open spaces or the areas of open spaces in the apartment can be maximally reduced in favor of increasing the area of residential premises. Due to the lack of space for outdoor living within the apartment and/or building, it is logical that residents turn to public open spaces in their surroundings, which highlights the significant need for such spaces in the city.

By analyzing the types of housing in the area covered by the latest General Urban Plan of Niš, the authors [12] conclude that greenery and open spaces for communal use are rarely present at the block level in residential

areas within reconstruction zones (mixed residential areas), and in newer multi-family housing, their absence is noted.

In this regard, it can be concluded that there is a need for common green spaces in Niš.

2.1. The number and quality of public green spaces in Niš.

Niš has several significant parks. The largest in terms of area are: Memorial Park Bubanj, Park within Niš Fortress, and Čair Park. Following these are medium and smaller parks, such as Sveti Sava (Saint Sava) Park, newly built parks near the Delta shopping center, parks along 7. Juli (the 7th of July) Quay and 29. Decembar (the 29th of December) Quay, as well as the parks in the vicinity of Kralja Aleksandra (King Alexander) and Sinđelić Squares. (Figure 2)



Figure 2: More important parks in Niš, source: https://a3.geosrbija.rs/, Accessed 31st January 2025.

Through field observation, it was assessed that the general condition of parks in Niš is poor in terms of equipment and physical condition. In general, the maintenance of parks by the public service responsible for them has been considered satisfactory. However, most parks are lacking urban furniture, such as benches, trash bins, lighting, playground equipment for children, outdoor exercise areas and equipment for adults, socialization spaces, water features, and fountains. An exception is the newly built park near the Delta shopping center, opened at the end of 2022. In terms of urban furniture, it is adequately equipped, but its size is not large enough to meet the needs of the surrounding buildings, whose residents gravitate towards it. The best-maintained larger park is the one within Niš Fortress, which is logical given its central location. Here, we do not consider the cultural and historical monuments within it and the adequacy of their treatment, as they are not the subject of this analysis.

It can also be observed that the majority of parks are located on the southern side of the Nišava River. If we exclude the Fortress, which is part of the old city center and its immediate surroundings, there are no significant parks on the northern side of the Nišava River.

3. POTENTIAL OF THE NIŠAVA RIVER FOR CREATING CONTENT THAT WOULD IMPROVE LIVING IN THE CITY

3.1. The importance and potential of the river in a city.

Riverbanks have historically been key factors in the development of cities, from early settlements to modern urban metropolises. They played a central role in shaping the economic, social, and cultural aspects of the city. Many ancient civilizations were founded along riverbanks, as rivers provided access to water, fertile land and transport routes, which allowed industries, crucial for the growth of settlements, such as agriculture and trade to develop.

In modern cities, riverbanks also play a key role. The numerous benefits provided by the presence of a river in a city, such as ecological (air quality, air temperature regulation, biodiversity preservation), social (community

and cultural contents, sports and recreation), and economic (tourism, for larger rivers also transport and trade), make riverbanks recognized as essential elements of the city.

In an era that is strongly fighting against global warming and its consequences, any natural element becomes a gem in the urban environment. Proper planning and preservation of riverbanks are essential for achieving sustainable development, protecting nature, and improving the quality of life in urban communities.

Ecological awareness and the understanding of the river's importance as an element of urban development have led many cities in recent decades to focus on the revitalization of their riverbanks. Rivers that were once industrial and polluted areas are now becoming spaces for tourism, recreation, and art, contributing to the renewal of the social and economic life of cities. Emphasizing the importance of riverbanks as urban spaces in cities, Raghda Najim Abed and Laila Akram discuss how the concept of humanization of the city is linked to sustainable development and that, in order to achieve a humane environment for people, it is necessary to add a human character to Riverbanks.[13] While, on one hand, ecologically and socially aware countries are working on the restoration and preservation of their riverbanks (two examples illustrating this are presented in Chapter 4), on the other hand, in many countries, the relationship between humans and nature has yet to be restored to balance, as depicted in the aforementioned paper [13], where authors point out the fact that at the present time it is noticeable "*the neglect of the human factor and a significant decline in human levels"* in riverbanks, "*as city planning focuses on creating spaces to accommodate vehicles instead of providing citizens with spaces that encourage social participation and social interaction"*, which "*has led to the lack of public spaces that enable citizens to enjoy the city*, *in addition to high pollution rates and the emergence of cities that are unfriendly to people and unsustainable"*.The study they made for the Tigris riverbank in Baghdad, also reveals many elements that could be recognized in the case of Nišava River in Niš, although these are two completely different cases in many aspects – cultural, historical, locational etc.

3.2. The potential of the Nišava River

The Nišava River cuts through the city in such a way that it becomes its focal linear element. Running in an east-west direction, it aligns with the longitudinal expansion of the city, passing through the city center itself. The riverbanks of the Nišava connect all five city municipalities, and along the river's course, it is possible to notice some significant urban parts that actively contribute to the life of the city. Heading upstream from the city center, these are the key locations: the city center (Kralja Milana (King Milan) Square – the main city square), Niš Fortress and the park around the Belgrade Gate within Niš Fortress (on the site of the former market), the University Building and University Park, the Kolo Srpskih Sestara Quay, the 7th of July Park, the 29th of December Quay, tennis courts, Delta shopping center (and two smaller parks nearby with furniture for children and their play), Green Oasis Park, Sinđelić Football Club, Merkator shopping center, and the Church of St. Vasilije of Ostrog (Sveti Vasilije Ostroški). Heading downstream from the city center, one encounters the complexes of the former Leather Factory "Đuka Dinić" and Rubber Factory "Vulkan," historical buildings and complexes with identified heritage value, which are privately owned and currently abandoned, at risk of complete devastation. [8, 9]

Based on the field analysis, the following conclusions can be drawn:

A) The banks of the Nišava River have been designed along a stretch of approximately 1.2 km between the Old Nišava Bridge and the Mladost Bridge (the Bridge of Youth), on both sides of the river. A part of the right bank of the river, approximately 460 meters long, from the Bridge of Youth to the Novobulevarski (New Boulevard) Bridge, has been partially developed. From the Bridge of Youth, passing under the Novobulevarski (New Boulevard), Pedestrian, and Proleterski (Proletarian) Bridges, along the left bank of the Nišava River, it is possible to walk up to the Vrežinski Bridge and the Church of St. Vasilije of Ostrog in Duvanište on a worn but undeveloped path, for a distance of about 3 km. In this area, on both sides of the river, wild greenery predominates, especially on the right bank, from the Pedestrian Bridge towards Duvanište. (Figure 3)

B) The Nišava River holds great potential for creating a linear park that, over a length of about 5 km, could unify the aforementioned features along the river, creating a continuous line that also connects all the city municipalities. By introducing new amenities (walking areas, cycling and fitness trails, spaces for recreation and outdoor relaxation, cultural spaces, playgrounds for children, etc.), adequately developing undeveloped areas, and improving the quality of existing ones, a significant urban zone could be created, bringing great benefits to the city.



Figure 3: A map of the developed sections along the Nišava River, source: author's drawing on a map downloaded from https://a3.geosrbija.rs/, Accessed 31st January 2025.

Based on the analysis of the current state of the Nišava riverbanks in the city of Niš, as well as a broader analysis of the main movement patterns of people in the city and an assessment of the needs of the population in residential areas adjacent to the riverbanks, the paper discusses the idea of creating a linear park along the Nišava River. This park would stretch from the Church of St. Vasilije of Ostrog in Duvanište to the complex of the former leather factory Đuka Dinić. These two points have been designated as the boundary points of the park due to their location and significance. The first, the Church of St. Vasilije of Ostrog, is a newly built Orthodox church that, even before its completion, became an important site not only for the residents of the Duvanište neighborhood but also for people from the entire city and beyond. This is evidenced by its high attendance, especially during major religious holidays, when the line to enter the church stretches far beyond the entrance. The second point, the Đuka Dinić leather factory, represents an important historical heritage from the pre-WW2 period, awaiting the continuation of its former life. The protection of cultural heritage is an imperative for every nation. Any neglect of buildings that have shaped the life of the city throughout its history is an act that directly endangers the city. In this regard, considering the importance of this complex as well as its location, this point emerged as a logical choice in defining the boundaries of the linear park. One of the possibilities proposed in this paper, drawing on similar examples from Europe and around the world, is the conversion of the mentioned industrial complexes (Đuka Dinić, Vulkan) into complexes with a primary cultural function (galleries, museums, concert halls, multifunctional spaces) and their connection to the river.

The creation of a linear park along the Nišava River has numerous justifications and strong chances for success. The starting assumption is that Niš needs functional, adequately equipped green open spaces, primarily to compensate for the lack of private greenery within multi-family housing. Additionally, Niš needs such spaces due to the inadequate condition of existing parks and the constant reduction of green areas within the city center to make way for new buildings (lack of inter-block greenery). Furthermore, in recent years, alarming cries from citizens regarding the city's pollution problem have been emerging in public. During the winter months, this primarily refers to the dangerous air pollution, for which concrete measures need to be taken. Another issue that stands out as essential is the improvement of the city's economic position.

Loss of public open space, particularly loss of green space in favour of buildings construction, is especially noticeable in the post-socialist cities due to rapid loss of greenery for a short time after the conversion from public to private ownership over land. [2] With the change in land ownership, specifically the shift from state to private investment, control over housing development is lost. The main goal of investor-driven architecture is personal profit, which leads to reducing areas that cannot be monetized to the legal minimum, while maximizing the square footage of areas that can be sold. The conditions from the Rulebook on Conditions and Standards for the Design of Residential Buildings and Apartments [15], as well as planning regulations, are followed only to meet the prescribed minimum, and in practice, there are often examples of completed buildings that show significant deviations from the regulations and/or the plan [11]. As a result, plots with a high building occupancy index emerge, with the free areas of the plots used for parking and very little or no

greenery. The greenery that appears within the plot is mostly a small grassy area, which is not functional, possibly with a few sparsely planted modest tree saplings. During the transition period, or the post-socialist period, a significant number of buildings were constructed without building permits, which were later legalized through a legalization process. Buildings constructed outside the regulations, as well as legally built multi-family residential buildings from the transition period, have greatly influenced the urban development of the city and its current appearance. During this period of construction, inter-block greenery was completely neglected, forcing residents to turn to larger public city parks. On the other hand, the situation in the field regarding public city greenery is very poor. Parks exist, but their equipment is largely inadequate (Chapter 2.1.). The need for their reconstruction and better maintenance is inevitable.



Figure 4: Linear park along the Nišava River could stretch from the former Đuka Dinić leather factory, a complex located near the city center, to the Church of St. Vasilije of Ostrog in the Duvanište neighborhood. The existing locations that could be connected are: A – Đuka Dinić and Old Vulkan Factories, B – King Milan Square (the main city square), C – Niš Fortress, D – Delta Shopping Center, E – Merkator Shopping Center, F – Church of St. Vasilije of Ostrog. Additional key points along the route are: 1 – Kolo srpskih sestara Quay, 2 – University Building and University Park, 3 – Park around the Belgrade Gate within Niš Fortress (on the site of the former marketplace), 4 – Park 7th July, 5 – Quay 29th December, 6 – Tennis courts, 7 – Park (near Delta Shopping Center), 8 – Park (near Delta Shopping Center), 9 – Green Oasis Park, 10 – Sinđelić Football Club. Source: author's drawing on a map downloaded from https://a3.geosrbija.rs/, Accessed 31st January 2025.

The need to increase green spaces in the city is essential, also due to the reduction of environmental pollution. This is especially true during the winter period, when air pollution levels in Niš are hazardous (Figure 5). Greenery would not completely solve this problem, but it would contribute to mitigating it. Rivers, particularly in urban areas, act as airways that provide the city with fresh air.[10] Built as a system, green areas improve the microclimate of settlements.[3]

From the economic point of view, the development of the Nišava Riverbank, specifically the creation of a linear park, would contribute to revitalizing the city and increasing its attractiveness. According to [14], streamside areas offer some of the most attractive sites for parks. Adequate shaping of the urban landscape can contribute to the creation of new urban landmarks. The realization of such a project would have a positive impact on the development of Niš as a tourist center. Additionally, by increasing land value, the city would attract other investments.

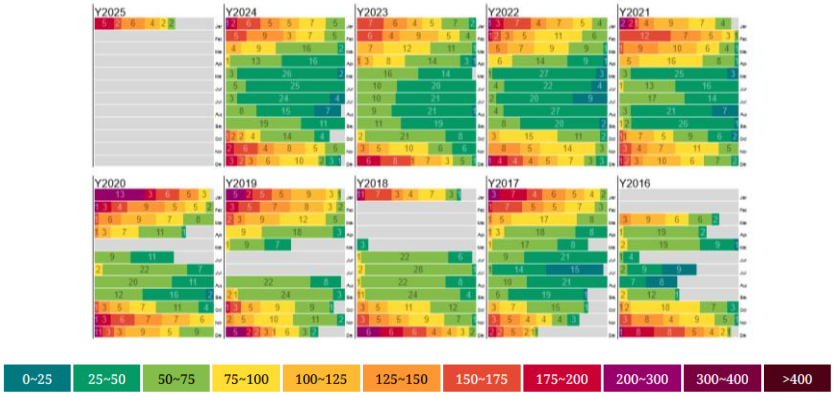


Figure 5: 2016-2025 daily average AQI measured in the Bulevard of Dr Zoran Djindjic in Niš
Scale: 0 – 50 - good, 51 -100 - moderate, 101-150 - unhealthy for sensitive groups, 151-200 - unhealthy, 201-300 - very unhealthy, 300+ - hazardous, source: https://aqicn.org/historical/#city:serbia/nis/izjz-nis, Accessed 12nd January 2025.

The Figure 4 shows an illustration of the the stretch of the linear park and the sections that, based on the analysis in this paper, would be justified to incorporate.

4.0. EXAMPLES OF PUTTING RIVERBANKS TO USE FOR CITIZENS – BEST PRACTICE EXAMPLES

Revitalization of riverbanks is an increasingly common urban intervention worldwide, particularly with the modernization of industry and its relocation outside cities. For better conclusions, this paper presents examples of successful reconstruction and regeneration of riverfronts near the central areas of two European cities. By analyzing these best practice examples and comparing them with the subject location, it is possible to discuss the advantages and disadvantages of interventions of this type.

4.1. Madrid Rio

Madrid Rio is one of the most important urban project in recent years in Madrid. [5] In order to improve traffic and reduce congestion, in the rapidly growing Madrid of the 1970s, the construction of the M-30 road began. This road, approximately 30 km long, enabled bypassing the central part of Madrid, connecting different parts of the city, and providing easier access to surrounding areas. Since the section of the road on the western side ran along the Manzanares River, this area became cut off from the central part of the city, inaccessible for pedestrians, overwhelmed by road traffic and with very few walking paths. According to Hernández-Lamas P. et al. [5], its heavy traffic turned it into an impenetrable and aggressive barrier, causing the river to remain completely isolated and disconnected from the city. It became a dividing element between the central and southwest neighborhoods, which over time led to a lack of safety and appeal in the area, turning it into a zone frequented by criminals and distancing it from the everyday use of residents. Giannelli A. et al. [4] mention that the western sector of the M-30 motorway, built between 1970 and 1974, transformed the area of the city of Madrid crossed by the river Manzanares into a "non-place".

Madrid Río (Figure 6) was developed between 2007 and 2011 after an international design competition organized by the Municipality of Madrid in 2005. The winning design, by the M-Río group specially formed for the competition, successfully brought the Manzanares River back to the people of Madrid, creating new green spaces, bridges, pedestrian walkways, bike paths, and a variety of services. These included sports facilities, playgrounds for both children and adults, cultural activities, kiosks, and restaurants. [4]

The overall project for the riverfront includes a comprehensive master plan that features 12 new pedestrian bridges, 6 hectares of public and sports facilities, as well as social, communal, and artistic amenities. It also introduces an urban beach, children's areas, the restoration of the river's hydraulic architectural heritage, and provides numerous benefits to the city of Madrid and its residents. Development plans were created for specific areas, including Salón de Pinos, Avenida de Portugal, Huerta de la Partida, Jardines del Puente de Segovia, Jardines del Puente de Toledo, Jardines de la Virgen del Puerto, and Arganzuela Park. [7]



Figure 6: (a) Spatial scope of the Madrid-Rio project, source: authors' illustration on the base of the map downloaded from https://www.bing.com/maps, Accessed 17th January 2025; (b) Madrid-Rio park, source: H. Krstić.

4.2. Rheinufer Promenade

The promenade along the Rhine was opened in Düsseldorf in 1902, along with a boulevard that was meant to ensure traffic connection with the city and the industrial zone along the river. However, progressive increase in motor traffic, primarily cars, especially after 1950, began to significantly affect the historical center of the city, as the land was turned into parking lots that started to cut off the city from its river, and the promenade became part of a highway used by around 50,000 vehicles daily, which led to the loss of the riverfront's function as an urban public space. At the same time, the city began to develop as an administrative metropolis, losing its role as an industrial center, which resulted in the consideration of new urban purposes for the former port area in the mid-1970s. A key element for urban transformation of the Rheine riverfront was the decision made in 1978 to locate the new federal parliament in the port area near the old district, as well as the construction of the communications tower in 1982. In order to build the parliament and the surrounding park, the traffic infrastructure in this area had to be reorganized, which led to the consideration of burying a section of the road along the Rhine, approximately 2 kilometers long. The realization of this idea would place motor traffic underground, freeing up the surface area that needed to be designed according to the needs of the users. Placing the main highway underground meant that the riverside promenade could be reestablished, the river with its landscape could be brought closer to the city, and the noise and other pollution could be reduced. Placing the roadway underground, not only reduced the traffic in its immediate vicinity but also throughout the entire old district, which also influenced the improvement of the residential environment. [6]



Figure 7: (a) Spatial scope of the Rheinufer, source: authors' illustration on the base of the map downloaded from https://www.bing.com/maps, Accessed 18th January 2025; (b) View of the descent into the tunnel near the Oberkasseler Brücke and Tonhalle, source: https://www.google.com/maps, Accessed 18th January 2025.

The new promenade, opened in June 1995, extends from the bridge Oberkasseler Brücke and a concert hall Tonhalle in north to the Rheinpark with Parliament buildings and high concrete telecommunications tower Rheinturm in south (Figure 7). The promenade stretches linearly through two levels: the lower one, in contact with the river, featuring outdoor seating areas and restaurant gardens, and the upper one, at the same level as the old town, with trees planted in lines. Burgplatz, located along the promenade, has regained its original significance as a gathering place for public events. The project also included the renovation of the old port area, now known as Schulstrasse, along with the restoration of the historic bastion as a reference to the old course of the Düssel River. The opening of the renovated promenade brought new spaces the citizens can enjoy, as well as the activities that transformed the area into a vibrant neighborhood. [6]

5.0. DISCUSSION – BENEFITS OF REVITALIZING RIVERBANKS

If we consider the success of the analyzed practical examples, we can conclude that the main benefits are primarily reflected in the improvement of citizens' quality of life (in terms of the availability of supplementary functions such as recreation and relaxation, the creation of spaces for social interactions and cultural events), the improvement of the living environment through the integration of the city with nature (in response to climate change, as well as contributing to the reduction of local air pollution), and the increased attractiveness of the city and its spatial value (impact on the economy, through new investments, boosting tourism), as well as the creation of a sustainable city while simultaneously promoting sustainable transport (encouraging cycling and walking), thus contributing to the humanization of the urban environment.

The positive impact can also be seen in the segment of improving public health and increasing the productivity of the population. Starting from the statement that there is an increasing need for healthy places like urban blue in cities and the assumption that these spaces are often not recognized as a beneficial health factor by planners and are regarded at best as a byproduct of green spaces, Völker Sebastian and Kistemann Thomas [17], examine the positive health outcomes and well-being generated by urban blue spaces. An exploratory case study, which deals with both health-enhancing and health-limiting aspects, concludes that health-enhancing aspects distinctly prevail over health-limiting factors presenting the evidence for the therapeutic value of urban blue.[17]

As one significant step towards creating a better city can be considered the recent amendments and supplements to the General Urban Plan of Niš 2010-2025 from 2024 [1], the fourth in line, which finally recognize the potential of the river. These amendments cover the entire area of the riverbank zone of the Nišava River, planned as the Nišava Riverbank Zone, which would be further developed through detailed urban planning. The zone extends through all five city municipalities. The conditions related to the construction of buildings and spatial planning within the Nišava Riverbank Zone should be elaborated in the general regulation plan, in accordance with the guidelines for further planning development. The amendments to the General Urban Plan foresee the planning of a continuous pedestrian, fitness, and bicycle path in the east-west direction. These modes of transport are given priority over vehicular traffic. The possibility of planning new pedestrian-bicycle bridges across the river is provided, based on needs. The guidelines related to the planning of paths through the area are as follows: The main bicycle path should be planned for cycling in both directions (one towards the east and the other towards the west), either as a one-way path or as two separate paths for each direction. The main pedestrian, fitness, and bicycle path should primarily be planned on one bank of the river, with the direction of the paths switched to the opposite bank only in the case of limiting spatial conditions. Along the main bicycle and fitness path, bicycle parking, rest stops, and resting areas should be planned, with shaded areas and access to public drinking water. Along the main pedestrian path, seating areas with shade and drinking water should be provided. The main pedestrian, fitness, and bicycle paths should be planned in such a way that at both the western and eastern ends, uninterrupted direction changes or circular movement are ensured. Linear greenery and tree rows should be planned along the bicycle, pedestrian, and fitness paths. The General Urban Plan mandates that at least 60% of the total riverbank area should be planned for predominant purposes such as recreation, sports, parks, and landscaped green spaces. A maximum of 10% of the total riverbank area is designated for all types of vehicular traffic. [1]

6.0. CONCLUSIONS

Spontaneous construction, which was characteristic of the transition period, has theoretically been 'brought into order' through the adoption of the Rulebook on Conditions and Standards for the Design of Residential Buildings and Apartments, as well as local urban planning regulations. However, numerous limitations, as well as interpretations of the regulations, influenced by investor-driven construction and the investors' desire for higher profits, while neglecting the needs of residents, have caused significant damage to the urban and architectural image of the city of Niš. The lack of space for rest, recreation, socialization, children's play, etc., as a supplement to the residential function, drastically lowers the comfort level of the residents. To compensate for this lack of amenities, the paper proposes utilizing the potential offered by the Nišava River. Due to its position in a relation to the city, the Nišava River could directly or indirectly compensate for the observed deficiency for a large number of residential blocks along its course. The paper highlights the possibility of activating a section of the Nišava riverbank, about 5 km long, through the integration of riverbanks with other urban zones, while introducing missing amenities at both the residential and public function levels.

Neglecting the riverbank causes significant harm to the city. The banks of the Nišava River hold great potential, which could significantly contribute to improving the quality of life in the city and create a more beautiful and healthier urban environment. Utilizing the potential of these area would influence the profiling of Niš as a sustainable and attractive city, focused on people. Recognizing the potential of the Nišava by planners is the initial, but very important step that could lead to the city's improvement.

ACKNOWLEDGMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under the Agreement on the Implementation and Financing of Scientific Research Work of the NIO in 2025 - Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025.

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DEVELOPING THE IDEA OF SUSTAINABLE CITIES OF THE FUTURE - FROM UTOPIA AND GARDEN CITIES TO MODERN CONCEPTS

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ABSTRACT

All over the world, cities today face a series of problems and serious threats: from the devastation of the natural and created environment, increasingly pronounced climate changes, lack of resources, overpopulation, terrorist threats, and many others. The growing awareness of the problems of modern cities has led to the emergence of solutions such as "green", "sustainable", "smart", "resilient" and projects with zero CO2 emissions, "eco-neighborhoods". A more detailed look at the main threats facing cities can serve as a basis for creating potential solutions and scenarios for cities of the future. The paper critically discusses contemporary examples that represent key elements in the development of the idea of cities of the future, starting from the earliest, even ancient, understandings of how a city should be imagined, through utopian views, garden cities, and all the way to contemporary understandings, where cases are identified in which alternative solutions of the type can be applied, with direct justification. By stimulating the imagination, we hope that this conceptual framework will help to design urban policies that are more credible and less unsustainable than those we have seen so far in approaches to the projections of cities of the future.

Keywords: *cities of the future, sustainable cities, urban solutions, garden cities, modern urban concepts*

1. INTRODUCTION

The idea of sustainable cities is a concept that has experienced a significant transformation throughout history, from utopian visions of ideal societies to concrete solutions for the challenges of modern urban environments. Sustainable cities have become a key topic in contemporary urban planning theory and practice, and their development is a response to the environmental, economic and social challenges of today's world. In recent decades, the development of the idea of sustainable cities has become a key issue in urban planning practice. In modern society, sustainability in urban planning includes ecological, economic and social dimensions, and the development of this idea can be traced through historical utopian visions, garden city projects, as well as modern practice based on smart cities and ecological innovations. From early utopian literature to contemporary urban concepts, the idea of sustainable cities has evolved according to the needs and challenges of each time period. Today's need to reduce the negative impact of man on nature and improve the quality of life in urban areas puts the concept of sustainable cities at the center of global discussions about the future.

This paper will explore the development of the idea of sustainable cities throughout history, starting from utopian visions to contemporary concepts. The hypothesis we propose in this paper is that today's sustainable cities are the result of a long-term process that began with idealistic, utopian concepts and evolved into practical, technologically advanced models, through various stages of urban development. The methodology

will include the analysis of historical texts, utopian visions and contemporary urban practices, as well as an overview of concrete examples of sustainable cities.

2. METHODOLOGY

To research this topic, a methodology was used that includes a comparative analysis of utopian urban theories and contemporary urban concepts. The methodology of the work includes the analysis of historical records, a comparative study of contemporary examples of sustainable cities and a review of scientific research in the field of urbanism and ecology. Primary and secondary sources were used, including books, scientific articles and reports from relevant organizations such as UN-Habitat. The following approaches were used:

1. Analysis of literary sources: Research of utopian texts and contemporary urban concepts, such as the works of Thomas More (1516), Ebenezer Howard (1898), and Paolo Soleri (1969), as well as contemporary works on sustainable cities.

2. Case study: Concrete examples of sustainable cities, such as Masdar City and Freiburg, are analyzed, showing how theories have been translated into practical projects.

3. Qualitative analysis: Analysis of the development of sustainable cities through social, ecological and economic dimensions, taking into account specific characteristics and challenges.

3. THE DEVELOPMENT OF THE IDEA OF SUSTAINABLE CITIES: FROM UTOPIAN VISIONS AND GARDEN CITIES

In recent decades, the development of the idea of sustainable cities has become a key issue in urban planning practice. In modern society, sustainability in urban planning includes ecological, economic and social dimensions, and the development of this idea can be traced through historical utopian visions, garden city projects, as well as modern practice based on smart cities and ecological innovations. From early utopian literature to contemporary urban concepts, the idea of sustainable cities has evolved according to the needs and challenges of each time period.

The beginnings of the idea of sustainable cities can be found in the utopian visions that emerged during the 16th and 17th centuries. In his work Utopia (1516), Thomas More describes an ideal society that functions without inequality and in complete harmony with nature. Although More did not explicitly talk about urban concepts, his vision of an ideal society laid the foundation for later thinking about perfect, self-sustaining communities. Renaissance ideas are further developed by thinkers such as Tommaso Campanella, author of City of the Sun (1623). Campanella's city was conceived as a utopian community where science and technology serve to improve the quality of life, and architecture is designed to maximize efficiency and connection with nature. During the Industrial Revolution, Robert Owen, a philanthropist and reformer, tried to put utopian ideas into practice by establishing experimental communities like New Lanark in Scotland. His model combines industrial development with care for workers, including education, health and quality housing. Although many of Owen's experiments were short-lived, they laid the foundations for later concepts of socially responsible urbanism.

Utopian visions of sustainable cities were subsequently revived in the work of European philosophers and urban planners of the 19th century. The most famous example of this type of vision is the work of the British philosopher and political activist Ebenezer Howard. In his book Garden Cities of To-Morrow (1898), Howard presented the concept of "garden cities" – cities that combine the advantages of urban life with those of rural life, providing residents with access to nature, a healthy living environment, and the necessary infrastructure for work and education. Howard wrote in his piece: "Nature offers peace and health; the city provides jobs and social life. Garden cities should combine the best of both worlds, while simultaneously eliminating their disadvantages." (Howard, 1898, p. 45) Howard's vision was to create planned communities that combined the advantages of urban and rural living. His plan included the organization of space in the form of concentrated city cores, surrounded by green areas and agricultural land.

The first practical example of this model was the city of Letchworth, built in England at the beginning of the 20th century. Letchworth has become a prototype for garden cities, with urban spaces planned to promote health and social cohesion. Later, the model was implemented in towns like Welwyn, which also showed the benefits of Howard's idea.

The idea of garden cities was conceived as a response to the excessive urbanization and pollution that existed in large industrial cities such as London (Howard, 1898). Howard's model envisioned cities that maximized traffic efficiency and resource use while maintaining ecological balance (Lee, 2015). His concept of garden cities had a major impact on modern city planning, as it promoted decentralization, efficient use of space and increased quality of life. Howard's model went on to inspire projects in many countries, including Radburn (USA) and Letchworth (UK), which integrated ideas about sustainable communities and green spaces (Calthorpe, 2011).

Garden cities are envisioned as decentralized communities that contain residential, industrial, and recreational zones, connected by efficient transportation systems. Key principles of this concept include:

1. Self-sustainability: Each garden city was supposed to be economically independent, with a sufficient number of jobs, resources and infrastructure.

2. Green infrastructure: Open spaces, parks and agricultural areas were central elements, not only for beauty but also to preserve a healthy ecosystem.

3. Social inclusion: The design of garden cities emphasizes the importance of community, affordable rent and public services for all levels of society.

Although the garden city model has had a significant impact on modern urban theory, it has often been criticized for its idealization of communities and potential isolation from the wider economy. Modern adaptations of this model, such as eco-villages, have integrated new technologies, such as renewable energy sources and sustainable waste management.

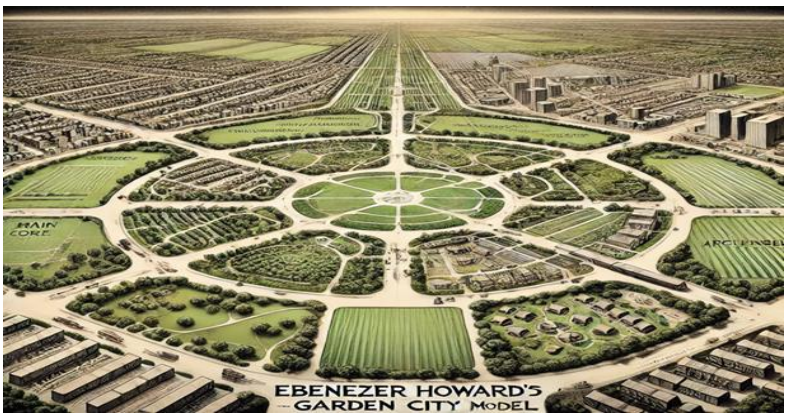


Figure 1: Sketch of the garden city concept

An illustration of Howard's concept is shown, with a central urban core surrounded by zones of agricultural land and green space. The main roads connect the central core with the surrounding settlements, while the periphery is made up of a protective green belt.

The development of garden cities had a significant impact on modern urban practice, especially when it comes to approaches that involve planning urban spaces with an emphasis on environmental protection and quality of life. During the 20th century, with the extremely rapid growth of urban areas and industrialization, the concept of sustainable cities became more than necessary. During this period, new approaches emerged that combined technological innovation with environmental and social needs.

One of the most important moments in the development of sustainable cities in the 20th century was the establishment of Green Architecture and the development of eco-cities. In this period, great urban planners and architects such as Frank Lloyd Wright and Le Corbusier tried to integrate ecological principles into the design of cities, emphasizing the efficiency of space, functionality and a good connection with nature (Wright, 1932). Although their projects were ambitious, if often utopian, they paved the way for the further development of sustainable principles in architecture and urbanism.

In the 21st century, with global challenges such as climate change and excessive urbanization, ideas about sustainability in cities have become crucial to shaping the future of urban areas. Green cities and smart cities have become synonymous with sustainable urban practices. Innovations in technology, energy efficiency and sustainable systems (such as energy efficient buildings and smart grids) have enabled the transition from theoretical models to concrete urban practices.

Garden cities have become very influential, especially in Great Britain and the USA. Although they were not fully realized in their original form, they influenced many urban projects of the 20th century, laying the foundations for understanding sustainability in the urban context. Howard's model went on to inspire projects in many countries, including Radburn (USA) and Letchworth (UK), which integrated ideas about sustainable communities and green spaces (Calthorpe, 2011).

4. MODERN CONCEPTS OF SUSTAINABLE CITIES

Contemporary concepts of sustainable cities have evolved from these utopian ideas, but with the technological innovations and environmental challenges that have emerged in the 20th and 21st centuries. One of the pioneers in this development was Paolo Soleri, who in his work Arcology: The City in the Image of Man (1969) proposed the concept of arcology - the integration of architecture and ecological systems into unique urban structures. Soleri believed that the future of cities lies in their compactness and synergy with natural systems. Today, sustainability in urbanism implies a number of different approaches and strategies based on the integration of smart technologies, energy efficiency and sustainable development. Cities like Copenhagen, Stockholm and Singapore have set examples of sustainable cities that combine green technological innovation with the social and economic needs of their citizens. In these cities, sustainability is not only an environmental, but also a social imperative, with the aim of creating inclusive, accessible and efficient urban spaces (Sachs, 2018).

4.1. Key features of smart cities

Singapore, as one of the pioneers in this domain, uses smart infrastructure for traffic management, recycling, efficient energy consumption and wastewater (Tan, 2020). Solar electricity generation in Singapore using smart technologies is shown in Figure 2. The use of *Internet of Things* devices, Big Data analysis and digitization in urban planning has created a new dimension in the development of sustainable cities, enabling cities to react in real time to changes and challenges. Also, in recent years, the development of sustainable cities has become key to reducing the carbon footprint. Cities such as Tokyo and Osaka have implemented recycling and waste reduction systems which is also shown in Figure 2, and have also set targets to reduce CO_2 emissions and increase the use of renewable energy sources (Kobayashi, 2019). In this context, sustainable cities have become not only environmentally responsible, but also economically efficient and socially just.

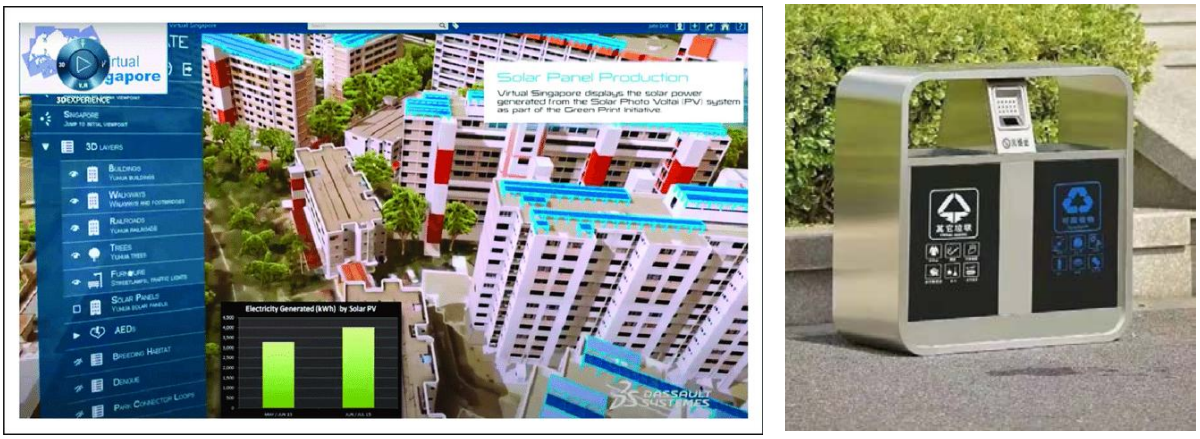


Figure 2: Virtual presentation of solar electricity production in Singapore and recycling and waste reduction systems in Japan, as the great examples of a smart cities (Charitonidou, 2022)

Smart cities represent an innovative concept of urban development, where technologies such as the Internet of Things (IoT), artificial intelligence (AI) and big data (Big Data) are used to improve the quality of life of citizens, more efficient use of resources and sustainability. These cities combine infrastructure, technology and data management to create an integrated and smart environment. At the center of the development of smart cities is the application of advanced technologies that enable the automation and optimization of everyday processes. Key features of smart cities include:

1. Smart Infrastructure: Includes sensors, connected devices and platforms to monitor and manage public services, such as energy, traffic and water supply.

2. Sustainability: Focus on renewable energy sources, efficient waste management and reduction of carbon dioxide emissions.

3. Efficient traffic management: Smart traffic lights, transport sharing applications and optimization of traffic flows through real-time analysis.

4. Connected communities: Using technologies to improve communication between citizens and local government, as well as enabling participatory decision-making.

5. Security and public order: Cameras with AI technology, facial recognition systems and real-time tracking to improve security.

6. Digital services: Electronic government (eGovernment), applications for monitoring public services and integrated platforms for payment and problem reporting.

7. Energy efficiency: Smart Grids enable the optimization of energy consumption and the integration of renewable energy sources. For example, smart meters provide real-time consumption data, enabling savings for citizens and businesses.

8. Waste management: Sensors on waste containers notify city authorities when they are full, reducing unnecessary routes and costs.

9. Smart buildings and homes: Integrated systems in buildings enable the control of lighting, heating and air conditioning, adjusting the operation of devices according to user needs and weather conditions.

10. Social dimension and inclusiveness: Smart cities should not only be technologically advanced, but also socially responsible. The goal is to reduce the digital divide and provide all citizens with access to basic services, regardless of their digital skills or socioeconomic status.

11. Health: Smart hospitals use IoT devices to monitor the health status of patients remotely, while digital platforms enable faster and more efficient communication with healthcare professionals.

12. Education: Smart cities invest in the digitization of educational resources and interactive platforms that enable personalized learning.

13. Tourism and culture: Digital guides, augmented reality (AR) and personalized tourist apps enhance the visitor experience, while smart systems help preserve cultural heritage. (Bhagya et al., 2018)

One of the most important goals of sustainable cities is the development of public transportation that does not depend on cars. Cities like Berlin and Hong Kong have developed metro, tram and bus systems that reduce carbon dioxide emissions and allow easier access to all parts of the city. Also, cities such as London have introduced electric taxi systems, reducing traffic emissions (Patel & Chen, 2021). Singapore uses sensors and AI to monitor traffic in real time. Smart traffic lights adjust their timing based on vehicle and pedestrian flow, reducing congestion. Also, the electronic toll collection system (ERP) uses GPS technology to dynamically determine toll prices depending on traffic congestion (Tan, 2016). Singapore and Barcelona use smart systems to manage traffic, reduce energy consumption and efficiently manage waste (Graham & Marvin, 2001), (Giffinger, 2021). Public housing buildings (HDBs) are equipped with IoT devices to monitor energy and water consumption, with applications that help residents reduce costs and optimize resources (Tay, 2017). Green infrastructure is one of the key principles in modern sustainable urban practice. It implies the integration of natural systems and green spaces in the urban environment. These spaces, such as parks, gardens, urban forests and green facades of buildings, serve as natural filters for pollution, reduce the effect of urban warming and improve the quality of life of citizens. We see green roofs and vertical gardens more and more in big cities, because they not only reduce carbon dioxide emissions, but also contribute to the preservation of biodiversity and increase the aesthetic value of city spaces.

Cities like Portland and Vancouver have implemented green initiatives in the form of urban farms, which allow for local food production, thereby reducing the need to transport food from other areas and reducing carbon dioxide emissions associated with transportation. Copenhagen has set a goal of becoming the first city with zero carbon dioxide emissions by 2025, which includes ambitious projects that integrate green areas and sustainable infrastructure into urban areas (Soleri, 1969), (Alberti, 2023). The "HealthHub" program integrates citizens' health data on one platform, enabling faster diagnostics and personalized healthcare. Smart health monitoring devices are used to monitor patients with chronic diseases (Goh et al., 2019). In smart cities, the

use of sensors to monitor air quality, temperature, noise and other factors allows cities to recognize and quickly solve problems. These technologies enable better prediction and management of crises, such as floods or pollution, and also help to optimize public transport and reduce congestion in cities. In modern sustainable cities, sustainable transport is the basis for reducing pollution, congestion and dependence on fossil fuels (Graham & Marvin, 2001). The use of technologies in urbanism also contributes to reducing the carbon footprint, because energy is used more rationally, and traffic is directed towards more sustainable, ecological forms of transportation (Davis, 2006). The Safe City project uses a network of surveillance cameras and AI algorithms to identify suspicious activity, thereby improving public safety. This data helps the police to respond quickly to incidents (Ng, 2015). Singapore is committed to green energy and uses solar panels on a large scale, while smart grids help balance energy consumption. Additionally, the city is investing in vertical gardens and urban agriculture to reduce food imports and increase self-sustainability (Tan & Ang, 2018). Energy efficiency is a key element of modern sustainable cities, as it reduces energy consumption and costs, while at the same time reducing the emission of harmful gases into the atmosphere. Buildings in Freiburg and Fukuoka use energy-efficient heating and cooling systems, while many buildings in Masdar City are designed with solar collectors, which reduces electricity consumption from fossil sources (Newman & Kenworthy, 1999). Freiburg, known as a "green city" in Germany, also uses renewable energy sources, including solar energy, which is used to power households and industrial facilities, as well as to heat residential spaces (Rees, 2021). The focus on the circular economy places the reduction of waste and the reuse of resources as a key element of sustainability. This approach allows reducing pressure on natural resources and reduces pollution (Hernandez & Silva, 2020). Energy efficiency is a key element of modern sustainable cities, as it reduces energy consumption and costs, while at the same time reducing the emission of harmful gases into the atmosphere (Said & Öztürk, 2022). The concept of "passive house" is increasingly present, where houses are designed to use a minimum amount of energy for heating and cooling, with maximum efficiency (Jones & Hargreaves, 2023). The use of technologies in urban planning also contributes to reducing the carbon footprint, because energy is used more rationally, and traffic is directed towards more sustainable, ecological forms of transportation (Albino et al., 2022). To ensure that no one is excluded, Singapore offers training for senior citizens and subsidies for access to technology (Sia, 2020). Thanks to these initiatives, Singapore has achieved significant efficiency in managing the city's resources and raised the quality of life for its citizens. His smart city model is often used as a model for other cities around the world (Lee, 2014).

4.2. Eco-cities

Eco-cities, or "green cities", focus on creating sustainable urban environments that minimize negative environmental impact, use renewable energy sources, optimize resource consumption and reduce carbon dioxide emissions. This concept has become a key element in the global effort to reduce the negative impact of urbanization on the planet. Key characteristics of eco-cities:

1. Sustainable energy infrastructure: Eco-cities strive to reduce energy consumption by using smart grids and renewable energy sources such as solar and wind energy. Cities such as Copenhagen and Masdar in the UAE use renewable sources as their primary energy source and implement smart systems for efficient energy distribution (Veldman & Van der Heijden, 2016).

2. Green transport: Promoting cycling, walking and low-carbon public transport reduces the need for cars and reduces pollution. Bogotá, Colombia, has become famous for its cycling infrastructure and the development of "ciclovías" (bicycle lanes), which provide a sustainable mode of transportation (Gómez & Pinto, 2017).

3. Green buildings and smart urban planning: Green building design uses energy efficient materials, solar panels and water recycling systems. Helsinki excels in the use of green buildings and sustainable urban planning, while New York promotes green roofs and vertical gardens to reduce environmental impact (Neto & Ma, 2018).

4. Urban gardens and agriculture: Cities like Toronto and Singapore are integrating urban gardens and agriculture into their urban space to reduce food imports, improve air quality, and create green oases in urban environments (Mason & McNaughton, 2020).

5. Sustainable waste management: Smart waste management systems enable efficient separation, recycling and reduction of the amount of waste that ends up in landfills. Cities like San Francisco, California have set goals to become zero-waste cities by implementing composting and recycling systems (Lyon & Thomas, 2019).

5. CONCLUSION

The development of the idea of sustainable cities from utopian visions and garden cities to contemporary concepts shows how ideas about sustainability change and adapt to the needs and challenges of each period. Today, more than ever, sustainable cities are the key to the global transition to a sustainable future. Their successful realization depends on the integration of technology, nature and society into a unique framework that promotes a long-term balance between urban development and ecological stability. From Ebenezer Howard to modern smart cities, the idea of sustainable urbanism is not just a scientific fantasy, but is becoming a key aspect in creating the cities of the future. In order to realize sustainable cities, it is necessary to integrate the ecological, economic and social dimensions of sustainability in all phases of urban planning, from theory to practice.

Contemporary concepts of sustainable cities represent a response to the challenges of global climate change, urbanization and population growth. These concepts are based on the integration of technology, ecological principles and social responsibility, with the aim of creating cities that not only meet the needs of modern generations, but also enable the long-term survival of ecological and social systems. The use of ecological technologies, smart systems, green infrastructure, energy efficiency and of sustainable transport systems enables cities to become environmentally responsible, economically efficient and socially inclusive. Cities like Masdar City and Freiburg show how utopian ideas about sustainability can be translated into concrete urban projects, while at the same time building the foundations for the future of sustainable cities around the world. Smart cities represent a new phase in the development of sustainable urban spaces. The use of digital technologies and information systems has become the key to optimizing resources, managing city functions and improving the quality of life. Smart cities use sensors, Internet of Things (IoT), big data and other technologies to efficiently manage traffic, energy, water, waste and other urban functions. Smart cities are the way to a sustainable future. Their success depends on a balanced approach that combines technological progress with social responsibility, creating cities that are not only more efficient but also more humane to live in. Smart cities strive to reduce their environmental footprint through the use of renewable energy sources, water consumption reduction and traffic optimization to reduce greenhouse gas emissions. Contemporary urban practice is aware of the necessity of achieving sustainability in urban areas. Sustainable urban planning is not only a technical challenge, but also a social, economic and environmental imperative. By using smart technologies, multifunctional spaces, green infrastructure and other innovations, cities can become more efficient, fairer and environmentally responsible. By applying sustainable principles in urban planning, we will create cities that will not only meet the needs of modern generations, but will be able to provide quality life to future generations as well.

Although the concept of sustainable cities offers many solutions, challenges such as inequality, high implementation costs and political obstacles remain obstacles to their realization. Additional challenges include the need to educate the population about the importance of sustainable living, as well as the adaptation of urban solutions to local climatic and cultural conditions. The future of the development of sustainable cities will depend on global cooperation, innovation and changes in the value systems of society. It is also necessary to strengthen the political will to implement sustainable policies at the national and local level.

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ENERGY PRODUCTION FROM ROOFTOP PV PANELS IN URBAN AREAS: A CASE STUDY OF RESIDENTIAL BLOCK IN BELGRADE, SERBIA

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ABSTRACT

Installing PV panels in buildings is an important measure to reduce buildings' energy and environmental footprint, contributing to global efforts to combat climate change. This paper presents the assessment of solar resources and potential energy production of a 1 kWp rooftop PV system in a residential block in Belgrade, Serbia using the PVGIS tool. The reduction of carbon dioxide emission was estimated considering Serbia's carbon emission factor. A flat roof area of 55168 m^2 was suitable for installing PV panels on the case study residential block, which consists of fourteen identical buildings. Simulation results showed that the annual potential energy generation of fixed and tracking PV systems was 1209 kWh/kWp and 1659 kWh/kWp, respectively. Installation of PV systems on the rooftops of observed buildings could prevent 1.02 tonnes/year of CO_2 from being released into the atmosphere. The findings may help encourage promoting and implementing PV panels in residential buildings in urban areas.

Keywords: *rooftop; CO_2; PV; retrofit; renewable energy; solar energy; PVGIS*

1. INTRODUCTION

Solar energy helps achieve several UN Sustainable Development Goals, such as SDG 7 (Affordable and Clean Energy), SDG 13 (Climate Action), and SDG 9 (Industry, Innovation and Infrastructure). Solar energy is essential in achieving the 2030 and 2050 climate targets. Solar energy is forecasted to be the leading renewable due to its potential to fulfil the global energy demand and the recent decline in the associated technology costs (Kabir et al., 2018). Solar energy is a vital component of sustainable urban development. Solar energy offers several benefits in urban environments, including reducing carbon emissions and environmental impact of buildings, cost savings, as well as enhancing energy security and independence. Roofs contribute 20 to 25 % of a building's total area. Maximizing solar energy utilization in cities can be achieved by integrating PV panels on rooftops of buildings. Many countries support large-scale application of PV panels in cities, through different incentives, national policies, and renewable national energy targets. According to Tian & Ooka (2024), the main driver for highly increased PV capacity is homeowners with rooftop PV, which accounts for most of the installed capacity today. Homeowners can sell excess electricity to the grid. Residential buildings occupy the main part of a city and therefore have the most significant potential to exploit the solar resources on building surfaces.

The energy production from PV installation on buildings is greatly influenced by the urban design, such as building layout, height, spacing between buildings, shadows from surrounding buildings and trees, etc. Urban planning and design play an important role in integrating PV panels into urban areas. It is necessary to optimize energy generation and consumption by considering the location and orientation of buildings and PV panels.

Although there are many software tools for analysing solar insolation on existing surfaces, there is a lack of methods and decision support systems to integrate the results into urban planning practice (Akrofi & Okitasari, 2022). The installed capacity of solar energy has been rapidly increased worldwide. Table 1 shows the top 5 countries by the total megawatts of solar energy installations (photovoltaic and concentrated solar power) installed as of 2023. When it comes to solar energy expansion, with a total of 609921 MW of photovoltaic capacity installed, China is in the first place. The second-place U.S. has almost four times lower photovoltaic capacity.

Table 1: Countries with highest solar photovoltaic capacity as of 2023 according to Energy Institute, Statistical Review of World Energy

Country	*Installed capacity (MW)*
China	*609,921*
USA	*139,205*
Japan	*87,068*
Germany	*81,739*
India	*73,109*

According to the International Energy Agency (IEA), buildings account for 30% of the global final energy consumption and 26% of global carbon emissions. In Europe, 40% of energy consumption and 36% of carbon dioxide emissions originated from the building sector (Eu is with You, 2024). The construction of energy-efficient and carbon-neutral buildings has become crucial in achieving the EU's ambition of becoming the world's first climate-neutral continent by 2050. The EU adopted a revised version of the Energy Performance of Buildings Directive to reduce greenhouse gas emissions and energy consumption in the building sector. According to this directive, all new buildings are required to be nearly zero energy buildings by 2030. The directive also states that solar installations must be deployed in all new residential buildings and public and non-residential buildings by 2030. Member states must reduce average primary energy use in residential buildings by 16 % by 2030 and 20-22 % by 2035. The Solar Heating and Cooling (IEA SHC) project from the International Energy Agency 2013 established a specific task force to support urban planners and architects in integrating solar panels in urban areas. In 2018, the European Union, as part of its European Strategic Energy Technology Plan (SET), established the Positive Energy Districts and Neighbourhoods program to build and replicate 100 positive energy districts across Europe by 2025. Solar integration in the built environment from the planning/urban design stage is the focus of that program.

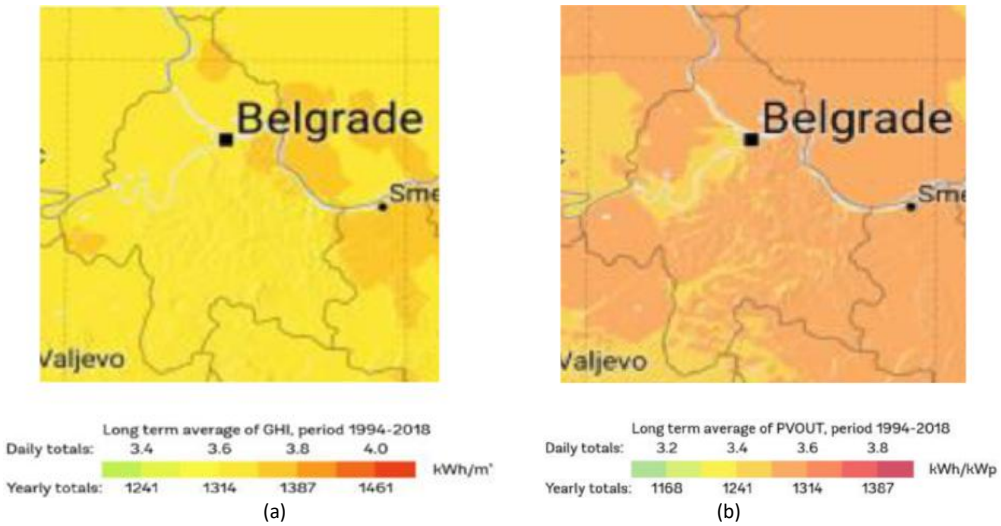
Energy demand in the building sector is a big challenge for Serbia. In the country, buildings are responsible for 32% of final energy consumption and 26% of carbon emissions (Statistical Office of the Republic of Serbia, 2024). The residential sector is estimated to consume about 70% of energy (Eu is with You, 2024). In 2022, the annual electricity demand in Serbia was 2750.792 GWh (Statistical Office of the Republic of Serbia, 2022). Almost 70% of electricity production in Serbia is produced from coal, which releases a large amount of greenhouse gases into the atmosphere. Đorđević et al., (2023) discuss that for 1 kWh of electricity generated, 0.123 kg of coal must be burned. The country urgently needs to reduce energy consumption in the building sector and increase the installed capacity of renewable energy. In Serbia, there is limited research on deploying PV panels in urban environments despite the significant solar energy resources available in this region. Đurđević (2011), estimated technically usable solar energy in Serbia, and it ranges between 0.2 Mtoe and 0.6 Mtoe. According to the Ministry of Mining and Energy of the Republic of Serbia (2016), the average solar radiation in Serbia is 30% higher than in Europe. Within such context, in this paper potential energy production of a 1 kWp roof-added PV system in a residential block in Belgrade was investigated. Also, the carbon dioxide emission reduction for the PV system was calculated considering the carbon emission factor in Serbia.

2. METHODS

2.1. Study Area

The subject area of this paper is the City of Belgrade. Belgrade and other parts of the Republic of Serbia possess good climatic conditions and significant potential to produce electricity from the PV system. Serbia has a humid subtropical type of climate (Cfa), according to the Köppen-Geiger climate classification (Kottek et al., 2006). The city has four seasons, with warm to hot summers and cold snowy winters. July is the warmest month with an average temperature of 23 °C, while the coldest month is January with an average temperature of 1.4 °C. Serbia has a solar potential above the average of most European countries. In Serbia, the average value of radiation energy per year is from 1200 kWh/m^2 in the northwestern parts to 1550 kWh/m^2 in the southeastern parts of the country (Ašonja & Vuković, 2018). However, despite the very high solar potential, the

country is exploited to a minimal extent. Figure 1 shows global horizontal irradiation in Belgrade and photovoltaic power potential in Belgrade. With a mean annual solar radiation of 1446.8 kWh/m^2, the territory of Belgrade is one of the areas in Serbia generally rich in solar energy. The city has 267 sunny days during the year, while the sunshine duration is between 1500 and 2200 h/year (Filipović et al., 2020).



(a) (b)

Figure 1: (a) Global horizontal irradiation in Belgrade, and (b) Photovoltaic power potential in Belgrade according to The World Bank and Global Solar Atlas 2.0

The subject of this paper is the New Belgrade municipality (Fig. 2) of the city of Belgrade and the potential of using PV panels in a given area. This municipality covers an area of 40.67 km^2. New Belgrade is a post-war municipality built opposite old Belgrade and developed in several phases between 1948 and 2000. It is an example of modern brutalist architecture with a layout of boulevards divided into 72 mass-housing blocks with massive concrete buildings. Similar urban forms to New Belgrade, in terms of residential blocks and green areas around the blocks, can be found in Eastern Europe and post-war social housing in Europe. New Belgrade became the central urban business district in Serbia and one of the major ones in Southeast Europe. The new commercial facilities have contributed to intensive traffic and more vehicles, lowering the quality of living in the blocks. With 209763 inhabitants, New Belgrade is by far the most populous Belgrade municipality. In New Belgrade municipality, 70% of the existing building stock has flat roofs (Lalošević, 2019).



(a) (b)

Figure 2: (a) Map of Belgrade with New Belgrade municipality, and (b) Tiered buildings in the Block 61

Block 61 (Fig. 2) in New Belgrade municipality was selected to analyse the potential retrofit of buildings with green roofs. This neighbourhood was chosen due to a large number of identical buildings built in 1970-76 with the same structural characteristics. The buildings constructed during this period are more than 40 years old, indicating the need for in-depth renovation. The block consists of the northern and southern parts, with fourteen identical tiered buildings (Fig.2) and square floor plans ranging from Gf+4 to Gf+19 stories. A condition survey of the buildings' roofs was performed to obtain objective facts about the roof condition. Buildings have flat roofs and a reinforced concrete structure that can structurally support the additional weight of PV panels. Existing roofs are poorly maintained and have issues with roof leakage and energy efficiency, thus they are

inaccessible to residents. Based on observations, there are 55168 m^2 of flat roof area suitable for PV application that belong to residential buildings.

2.2. PV potential and CO_2 Emissions

The Photovoltaic Geographical Information System (PVGIS 5.3) tool was used to simulate the performance of PV systems, as provided by the European Commission (2017). PVGIS is a GIS-based open-source research tool for the assessment of PV technology in specific locations. This software enables users to examine their sites' solar energy potential, including the amount of solar energy available, the optimal orientation and tilt angle of solar panels, and the predicted energy production. It has been widely used in previous research regarding building PV systems (Đorđević et al., 2023; Sudimac et al., 2020, and Dondariya et al., 2018). The methods used in PVGIS were described in several scientific papers (Müller et al., 2012, and Gracia Amillo et al., 2014). PVGIS 5.3 relies on meteorological datasets from satellite observations for the period from 2005 to 2023, with a temporal resolution of 1 h and spatial resolution of 5 km. Characteristics of grid-connected PV system are given in Table 2. Simulations were performed for a fixed PV system with optimal slope, azimuth angle, and a two-axis tracking PV system. The disparity in solar irradiation from a 1 kWp system among buildings in the block is insignificant. Therefore, simulations were performed for one location on the roof of the building with coordinates (44.801, 20.372).

Table 2: Characteristics of grid-connected PV system

PV Technology	*Crystalline Silicon*
Installed Peak PV Power	*1 kWp*
Mounting Position	*Roof Added*
Slope and Azimuth Angle	*Optimal*
System Loss	*14 %*

Besides energy production, one of the benefits of PV panels is the reduction of carbon dioxide emissions. The annual carbon dioxide emission that could be reduced was calculated using the following equation.

$$CO_2\ emissions = E \cdot EF \quad \text{(Eq.1)}$$

According to Nowtricity (2024), the emission factor of 0.615 tCO_2/MWh for the year 2023 was used. PV panel installations can earn carbon credits. The price of carbon credits is expected to increase during the solar power plant's lifetime.

3. RESULTS

Figure 3 shows the mean monthly solar irradiation, obtained from PVGIS, for fixed and tracking PV systems in the study area. For the considered location, the optimal slope angle is 36°, while the optimal azimuth is -1°. The in-plane irradiation for a fixed PV system is between 61 kWh/m^2 and 200 kWh/m^2. In the case of the tracking system, the in-plane irradiation ranges from 76 kWh/m^2 to 280 kWh/m^2.

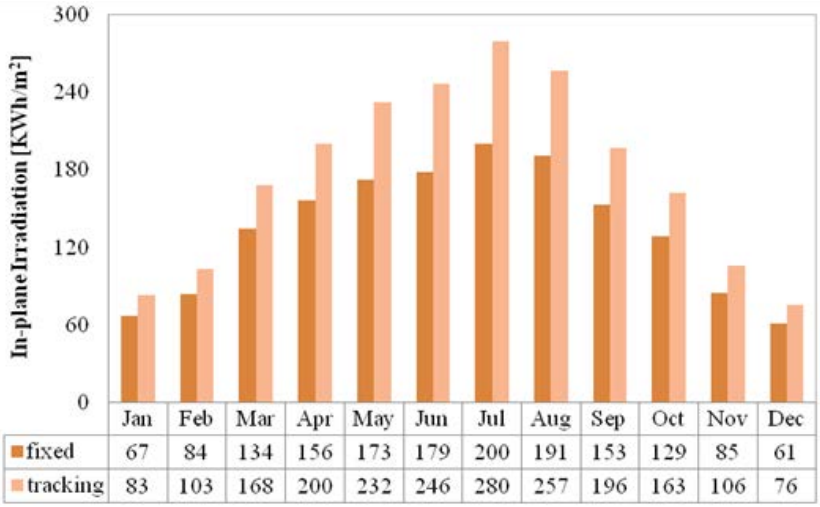
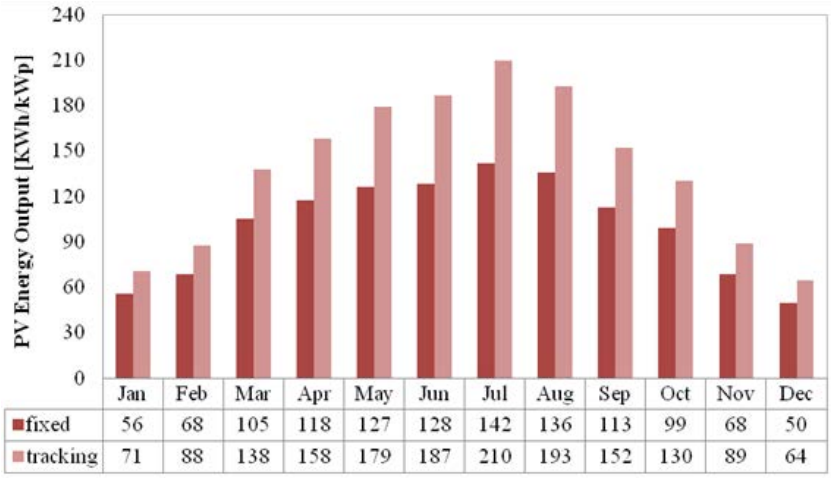


Figure 3: Mean monthly solar irradiation for fixed and tracking PV system

The lowest solar irradiation is in December, while the highest solar irradiation can be noticed in July. During the year, at this location, can be harvested between 1611 kWh/m^2 and 2110 kWh/m^2 for fixed and tracking PV

systems. Compared to the fixed system, the annual solar irradiation is increased by 24% in case of the tracking system.

The calculated mean monthly energy production from a 1 kWp fixed and tracked PV system is shown in Figure 4. Results indicate that the rooftop solar power plant can produce between 50 and 142 kWh/kWp for fixed, while between 64 and 210 kWh/kWp for a tracking system. The seasonal variability of PV energy production coincides with seasonal changes in electricity demand. Summer months (from June to August) have the highest energy production, corresponding to higher electric energy consumption, due to air conditioning. The seasonal comparison indicates a higher potential in autumn than winter, but lower than spring. During the winter months (from December to March), mean energy production is lower. Energy production during the winter does not exceed 130 kWh/kWp. December is the month with the lowest PV potential. Based on the simulation results, the annual PV energy production is 1209 kWh/kWp and 1659 kWh/kWp for fixed and tracking PV systems, respectively. The implementation of the tracking mechanism increases the energy output of the PV system by 27% compared to the fixed system. The fixed and tracking 1 kWp system could avoid between 0.74 and 1.02 tons of CO_2 emissions annually.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
fixed	56	68	105	118	127	128	142	136	113	99	68	50
tracking	71	88	138	158	179	187	210	193	152	130	89	64

Figure 4: Mean monthly energy production for fixed and tracking 1kWp PV system

The potential annual energy yield is a good indicator that a grid-connected PV system installation in this location is a technically viable energy solution. The grid-connected rooftop PV system in residential blocks in Belgrade is technically viable, and the wider implementation of these systems will have substantial benefits in terms of energy savings and the mitigation of CO_2 emissions. The installation of solar rooftop power plants can significantly enhance household energy efficiency and sustainability. PV panels can be integrated with green roofs to achieve higher energy efficiency of PV panels and contribute to climate-neutral urban environments. According to some studies (Osma-Pinto & Ordóñez-Plata, 2019, and Hui et al., 2011), depending on climatic conditions, green roofs decrease the air temperature contributing to the increase of PV system energy production from 1.3% to 4.3%. The PV panels and vegetation should be placed at a close distance to enhance the cooling by evapotranspiration, which can directly influence the panels (Van der Roest et al., 2023). Irrigated green roofs could enhance the cooling effect by increasing the water content in the growing medium and producing water mist in the air above the roof.

4. CONCLUSION

As the world strives to reduce its carbon footprint and combat climate change, the integration of solar energy into urban environments becomes a crucial topic. Rooftop PV panels can be a cost-effective and good way of achieving energy sustainability. It is necessary to evaluate solar energy potential for residential buildings in urban areas in Serbia. This paper addresses potential energy production from PV systems installed in residential block buildings in Belgrade, Serbia, using the PVGIS tool. The availability of sunshine (around 2200 h/year) and the high solar radiation intensity in the considered area, which can reach up to 280 kWh/m^2, make the PV system a good option for residential building owners to invest in renewable energy. The observed residential block has 55168 m^2 of flat roof area suitable for PV application.

A 1 kWp PV system installed at the rooftops at optimum tilt and azimuth angles can generate 1209 kWh/kWp annually. Regarding tracking PV systems, 1659 kWh/kWp can be obtained annually. The highest solar irradiation and energy output are available during the summer months from June to August, which correlates

with the high electricity consumption due to the usage of air conditioning in buildings. The lowest potential was observed during the winter months between December and February. The tracking 1 kWp PV systems can reduce carbon dioxide emissions by 1.02 t/year. This research can support the use of solar energy in residential buildings in Serbia to secure future energy sustainability. Through the implementation of PV technology in buildings, the Serbian government and individuals can significantly decrease energy consumption and carbon dioxide emissions in the building sector. Future studies should evaluate the solar energy potential for the different residential building typologies in the cities of Serbia.

ACKNOWLEDGMENT

The research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia: (Contract No. 451-03-66/2024-03/200017, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade), Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš (Registration number: 451-03-137/2025-03/200095 dated 04/02/2025) and Agreement on the Implementation and Financing of Scientific Research Work of the NIO in 2025 (Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025).

NOMENCLATURE

$\boldsymbol{E}$ – Energy production, in [MWh].

$\boldsymbol{CO_2}$ – Carbon dioxide emissions, in [t].

$\boldsymbol{EF}$ – Emission factor, in [$kgCO_2$/MWh].

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REVIEWING THE BENEFITS OF ENVIRONMENTAL, SOCIAL AND GOVERNANCE (ESG) APPROACH IN URBAN GREEN SPACES

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ABSTRACT

Incorporating Environmental, Social, and Governance (ESG) approach in achieving sustainable development has drawn a lot of interest. The advantages of applying ESG approach to urban green spaces planning, design, and management are reviewed in this study. This review aims to explore the many benefits of urban green spaces and synthesizes previous studies to identify the key benefits of urban green spaces. It also attempts to align the key benefits of urban green spaces with the ESG's principles to provide more information that can contribute to the efforts of developing strategic planning and management of green spaces for more resilient, inclusive, and sustainable urban settings.

Keywords: *ESG; Urban Green Spaces(UGS); Sustainability; Governance; Social equity; Biodiversity; Climate resilience.*

1. INTRODUCTION

Urban green areas are essential features for improving environmental, social, and governance (ESG) aspects in cities, delivering numerous advantages that support sustainable urban growth. These spaces, which include parks, community gardens, and unused lots, function as small-scale components of larger ecological systems, offering vital ecosystem services like pollination, water retention, and sustainable food production (Green et al., 2016). Research has shown that incorporating green infrastructure into urban planning enhances environmental performance and residents' quality of life (Pantaloni et al., 2022). The significance of urban green spaces has become even more apparent during crises, such as the COVID-19 pandemic. Research conducted in New York City demonstrated that residents continued to utilize and appreciate these areas for their mental and physical well-being during the outbreak, emphasizing their crucial role as urban infrastructure (Lopez et al., 2020). This highlights the necessity for inclusive decision-making and management approaches that address the varied needs and concerns of urban populations. Urban green spaces not only serve as environmental assets but also contribute to social welfare and effective city governance. They play a crucial role in moulding national identity, destination image, and economic success, as illustrated by Singapore's approach to park development (Henderson, 2013). As urban areas face challenges like climate change and increasing urbanization, the strategic planning and management of green spaces become increasingly vital for achieving sustainable and resilient urban environments.

Demonstrating their alignment with Environmental, Social, and Governance (ESG) principles. By establishing this connection, the study aims to contribute valuable insights that support the development of strategic planning and management frameworks for urban green spaces, ensuring they foster resilient, inclusive, and sustainable urban environments. This review aims to explore and identify the key benefits of urban green spaces and show how the alignment in the key benefits with the ESG's principles to provide more information

that can contribute to the efforts of developing strategic planning and management of green spaces for more resilient, inclusive and sustainable urban settings.

2. ENVIRONMENTAL BENEFITS OF URBAN GREEN SPACE WITH RELATION TO ENVIRONMENT COMPONENT OF ESG

Urban green spaces are more than just aesthetic additions to cities—they are powerful tools for environmental sustainability, climate adaptation, and public health. Rooted in the environmental principles of ESG, these spaces act as natural filters that purify the air, reduce urban heat, and preserve biodiversity, making them indispensable for ensuring the long-term well-being of urban populations. Recognising their profound impact on environmental sustainability, policymakers and urban planners must prioritize the strategic expansion and management of urban green spaces to support long-term ecological and social well-being.

Urban green spaces play a critical role in enhancing air quality. Vegetation in these places absorbs air pollutants such as carbon monoxide, nitrogen dioxide, and particle matter, while simultaneously releasing oxygen. In crowded urban areas with high pollution levels, this natural filtration system is especially important (Miakhel et al., 2024). UGS supports ESG objectives centred on environmental health and well-being by promoting cleaner air, which results in better urban settings.

To lessen the effects of climate change, urban green spaces are essential. By removing carbon dioxide from the atmosphere, they contribute to carbon sequestration by lowering the levels of greenhouse gases. Additionally, UGS makes cities more adaptable to rising temperatures by reducing the effects of urban heat islands by supplying shade and cooling through evapotranspiration (Athokpam et al., 2024). These advantages of climate adaption are consistent with ESG principles that support climate action and sustainable urban development.

By providing home for a variety of plant and animal species, urban green areas are essential for sustaining biodiversity. They serve as ecological havens, allowing certain species to flourish even in crowded cities. According to Ashinze et al. (2024), fostering urban biodiversity improves ecological resilience and aids in the preservation of natural ecosystems. The environmental pillar of ESG is emphasized by this support for biodiversity, which highlights how crucial it is to preserve ecological balance in urban development.

3. SOCIAL BENEFITS OF URBAN GREEN SPACE WITH RELATION TO SOCIAL COMPONENT OF ESG

As cities continue to urbanize, the integration of well-designed green spaces has become essential for promoting social equity, community well-being, and public health. These spaces not only serve as recreational areas but also foster social cohesion, mental well-being, and climate resilience, making them fundamental to enhancing urban livability. Furthermore, by ensuring equitable access to green spaces, cities can address social disparities, encourage civic participation, and support overall sustainability efforts. This section presents how fostering community cohesiveness, advancing health, and offering recreational possibilities, urban green spaces (UGS) contribute significantly to society and are consistent with the social component of Environmental, Social, and Governance (ESG) frameworks.

Green areas serve as essential gathering places for people, strengthening bonds among the community and enhancing personal wellbeing. UGS enhances social networks and fosters a feeling of community by offering a common space where individuals may converse, plan events, and take part in group activities (Akshay, 2024). Regular social interactions in green spaces have been linked to lower levels of loneliness, improved mental health, and a stronger sense of collective responsibility for local environments. By encouraging communal activities such as group exercise, gardening initiatives, and public gatherings, UGS not only supports individual well-being but also strengthens the resilience and social fabric of urban communities.

Better physical and mental health results are also closely linked to access to UGS. In addition to promoting active lifestyles through sports like cycling, jogging, and walking, these areas' natural surroundings also reduce stress and improve mental health. Thus, the availability of green spaces is essential for promoting holistic health benefits and lowering health disparities among urban populations (Athokpam et al., 2024; Zhang et al., 2024).

Urban green areas are vital places for leisure and recreation, which greatly improves people's quality of life. They provide a variety of leisure pursuits that are essential for unwinding and interacting with others, such as organized sports and family picnics. Because of its many uses, UGS is essential in urban environments and guarantees its commitment to socially equitable and sustainable development. (Akshay, 2024).

4. BENEFITS OF URBAN GREEN SPACE WITH RELATION TO GOVERNANCE COMPONENT OF ESG

The Urban green spaces (UGS) offer many advantages, from increased biodiversity to better public health, but fair access to these resources necessitates efficient governance. By lessening the differences in environmental resources between urban neighbourhoods, ensuring equitable distribution and accessibility to UGS solves social justice issues. To ensure that marginalized and underprivileged groups have access to green spaces, promote inclusion, and improve community well-being, governance is essential to the development and execution of these initiatives (Ashinze et al., 2024; Zhang et al., 2024). This is consistent with the Environmental, Social, and Governance (ESG) frameworks' governance component, which emphasizes responsibility, transparency, and equity in the distribution of resources.

For UGS to be integrated into urban planning in a sustainable manner, comprehensive policy development is equally essential. The long-term success of green space projects is influenced by policies that place a high priority on environmental sustainability and actively involve communities in the decision-making process. Under the ESG model, governance frameworks support the creation of policies that not only increase cities' ecological resilience but also encourage local stakeholders to actively participate. Policymakers can guarantee that green spaces satisfy the requirements of various urban populations while furthering common environmental objectives by including UGS planning into larger sustainability agendas (Athokpam et al., 2024).

5. ALIGNMENT OF BENEFITS OF URBAN GREEN SPACES WITH ESG PRINCIPLES

Incorporating Environmental, Social, and Governance (ESG) principles into urban green spaces is essential for establishing a comprehensive framework that enhances their role in sustainable urban development. This approach ensures that green spaces are effectively planned, designed, and managed to support the United Nations' Sustainable Development Goals (SDGs) while promoting environmental resilience, social well-being, and responsible governance. Table 1 summarizes key findings from previous studies, illustrating the relationship between urban green spaces and ESG principles, as well as their impact on achieving long-term sustainability objectives.

Table 1: Summary of key findings on urban green spaces and alignment with the ESG principles

Focus area (Align with ESG principles)	*References*	*Key Findings*
Environmental	*(Brancalion & Holl, 2020)*	*Outlines methods for planting trees in urban areas that will improve environmental sustainability.*
	(McPherson et al., 2011)	*Evaluates the environmental advantages of LA's tree planting program, such as improved air quality and carbon sequestration.*
	(Lin et al., 2017).	*Examines the potential of pocket parks to reduce urban heat islands in compact cities.*
Social	*(Cohen et al., 2014)*	*Examines the ways in which pocket parks might enhance public health and encourage physical exercise.*
	(Liu & Wang, 2021)	*Assesses how pocket parks contributed to the COVID-19 pandemic's social and health advantages.*
	(Balai Kerishnan et al., 2020)	*Examines Kuala Lumpur's pocket parks' utilization trends and problems while providing information on their social advantages.*
Governance	*(Pincetl, 2010).*	*Examines the Million-Tree Initiative in Los Angeles' governance issues and achievements.*
	(Li, 2023)	*This study looks at the governance issues surrounding major urban greening projects, including the MillionTreesNYC project. It draws attention to how these initiatives, although good for the environment, can have unforeseen repercussions like gentrification, underscoring the necessity of equitable governance techniques in urban planning.*
	(Ruiz-Apilánez et al., 2023)	*The regulation of urban green infrastructure accessibility is examined in this study, with an emphasis on environmental justice in European contexts. To guarantee that all urban dwellers take advantage of environmental amenities, it offers insights on how governance systems can affect fair access to green spaces.*

6. DISCUSSION ON ENHANCING URBAN GREEN SPACES FOR SUSTAINABLE DEVELOPMENT

Urban green spaces (UGS) play a crucial role in fostering sustainable urban development by addressing environmental, social, and economic challenges. These spaces contribute to urban resilience, climate adaptation, and improved quality of life. As cities continue to expand, integrating green spaces into urban planning becomes increasingly vital. This discussion section highlights key strategies from the review in ways improving UGS to enhance ecological resilience, public health, and community well-being while aligning with environmental, social, and governance (ESG) principles to ensure long-term sustainability.

a) **Policy development for sustainable urban green spaces:** the integration of UGS within urban planning requires robust policy frameworks that prioritize environmental sustainability. Effective policies should incorporate community participation in decision-making processes to ensure that green spaces meet diverse urban needs while fostering ecological resilience. Governments and urban planners should establish clear regulations that promote equitable access to green spaces, incentivize private sector investment in green infrastructure, and incorporate sustainability metrics into development projects.

b) **Alignment with ESG principles:** ESG principles provide a holistic framework for assessing and enhancing the sustainability of urban green spaces.

c) **Environmental considerations**: Green spaces play a significant role in mitigating climate change by acting as carbon sinks, reducing urban heat islands, and improving air quality. ESG-driven UGS policies should prioritize ecological restoration, biodiversity conservation, and climate resilience to maximize environmental benefits.

d) **Social dimensions:** UGS contribute to social equity by providing inclusive and accessible public spaces that improve mental and physical well-being. Urban planning should incorporate community input to ensure that green spaces cater to diverse populations, fostering social cohesion and promoting active lifestyles.

e) **Governance and investment:** the governance of UGS should emphasize transparency, accountability, and stakeholder collaboration. Private sector involvement through ESG-aligned investments can drive the development of high-quality green spaces. Sustainable financing models, such as green bonds and public-private partnerships, can ensure long-term maintenance and expansion of UGS.

f) **Biodiversity conservation and ecological resilience:** the design and maintenance of UGS should support diverse plant and animal species to enhance biodiversity. Preserving natural ecosystems within urban settings is essential for maintaining ecological balance, ensuring climate adaptability, and fostering long-term environmental sustainability. Incorporating native vegetation, green roofs, and wildlife corridors into urban landscapes can significantly contribute to ecological resilience.

g) **Air quality improvement through green infrastructure**: expanding UGS can significantly contribute to air quality enhancement by reducing urban pollutants and increasing oxygen production. Vegetation within green spaces acts as a natural air filter, mitigating the adverse effects of air pollution and promoting healthier urban environments. Strategic placement of trees and green belts in high-traffic areas can effectively reduce exposure to harmful pollutants, contributing to better respiratory health among urban populations.

h) **Community engagement and social cohesion:** public participation in the planning and management of UGS is instrumental in strengthening social networks and fostering community well-being. Accessible and well-designed green spaces provide opportunities for social interaction, recreational activities, and cultural engagement, thereby enhancing the overall quality of life in urban areas. Citizen-led initiatives, such as urban gardening programs and community tree-planting events, can empower local populations to take ownership of their green spaces and ensure their long-term sustainability.

i) **Economic and health benefits of UGS**: green spaces offer significant economic benefits by increasing property values, attracting tourism, and reducing healthcare costs associated with pollution-related illnesses. Research indicates that access to green environments can lower stress levels, reduce the incidence of cardiovascular diseases, and improve overall mental health. Employers and urban

developers should recognize the economic value of UGS and integrate them into workplace and residential environments to enhance productivity and well-being.

By implementing these strategies and aligning UGS development with the esg principles, urban planners and policymakers can optimize the role of green spaces in promoting sustainable urban development. Ensuring a balance between ecological preservation, social inclusivity, and governance transparency will be key to fostering resilient, equitable, and thriving cities for future generations.

7. CONCLUSION

There is a great chance to promote sustainable urban development by incorporating the environmental, social, and governance (ESG) approach into the planning, design, and administration of urban green areas. The many advantages of urban green spaces have been emphasized in this study, and their alignment with ESG principles has strengthened their function in building inclusive, resilient, and sustainable cities. It is clear from a summary of earlier studies that urban green spaces support social cohesion, environmental sustainability, and efficient political systems. As a result, implementing an ESG-driven framework can improve strategic planning and management, guaranteeing that urban green spaces will continue to benefit communities and the environment in the long run.

8. ACKNOWLEDGEMENTS

This review paper is the result of a collaborative effort, and we appreciate the contributions of all involved.

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ICUP2025
5th international conference on urban planning

COOKIE-CUTTER SUBURBS OR IS THE COPY-PASTE HOUSING REALLY HUMAN?

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ABSTRACT

Cookie-cutter suburbs, also known as tract housing, represent a planning model widely implemented across the globe, particularly in suburban areas of cities experiencing significant urban growth and the resulting demand for affordable housing. The mass construction of uniform residential neighbourhoods emerged as a popular approach in the latter half of the 20th century in United States and Canada, later spreading to other countries. This model facilitated the rapid, efficient, and relatively inexpensive provision of housing for large populations.

From an architectural perspective, the development of such large-scale neighbourhoods presents numerous challenges, including a lack of individuality, the monotony of form, limited spatial flexibility, and various environmental issues. The aim of this paper is to explore, through the analysis of selected case studies of cookie-cutter suburbs to determine whether these developments, despite their negative architectural attributes, offer specific advantages for residents.

Keywords: *suburbanization, cookie-cutter housing, tract housing, suburbs, mass-produced housing, individuality.*

1. INTRODUCTION

The second half of the twentieth century witnessed the extensive development of residential neighborhoods characterized by the repetitive use of identical architectural housing models. These neighborhoods initially emerged as suburban extensions of major cities in the aftermath of World War II, primarily in response to the growing demand for affordable housing. However, what began as a solution to affordability and diverse buyer needs gradually evolved into a widespread form of low-density urban typology, extending across various nations. This type of suburbia has come to be synonymous with uniform residential blocks, often referred to as "cookie-cutter suburbs" or "tract housing." By definition, this urban planning model entails the creation of residential neighborhoods through a process where a developer or builder acquires a large parcel of land, subdivides it into smaller plots, and constructs multiple identical or similar homes in a repetitive manner, resulting in a homogeneous residential area (Levittown, 2024). Over recent decades, this approach to suburban development has faced considerable criticism from experts, particularly due to the socio-psychological and spatial implications it has on its inhabitants.

Nevertheless, despite such criticisms, suburban areas continue to expand as extensions of metropolitan centers or as entirely new, planned urban developments in various regions worldwide. This ongoing trend raises an important question: does this model of urban planning contribute to fostering a sense of community, identity, and human-centered spaces?

This research aims to explore the phenomenon of suburbia and cookie-cutter housing developments through selected case studies from different regions globally. The primary objective of the study is to assess whether this suburban urban planning model results in a living environment that is truly humane and conducive to a positive quality of life.

2. RESEARCH METHODOLOGY

The research methodology employed for analyzing the spatial form of cookie-cutter settlements is grounded in the analysis and synthesis of numerous case studies. Alongside these methods, techniques such as generalization, concretization, and specialization were utilized, with comparison serving as an integrative approach. The study draws on both inductive and deductive reasoning, selecting five characteristic examples for in-depth analysis. These case studies were chosen based on their distinct features and geographical locations. The selection criterion for the global locations aims to demonstrate that this form of settlement develops under diverse conditions across various continents. The first case study is Levittown, USA, which is widely regarded as the first modern example of tract housing in the world. The second case study is Irvine, California, a more recent suburban model located near Los Angeles. The third example is Mississauga, Ontario, Canada, one of the largest suburban developments in the country. The fourth case study is Craigieburn, Melbourne, a suburban settlement in Australia. Finally, the fifth example is Jumeirah Park, a relatively recent development in the United Arab Emirates, showcasing a modern iteration of tract housing in the past decade.

The analysis of these case studies aims to highlight the urban planning and architectural characteristics of each settlement, providing a foundation for evaluating the extent to which this housing model addresses human needs and contributes to the creation of a humane living environment.

3. THE DEVELOPMENT OF SUBURBIA AND COOKIE-CUTTER SETTLEMENTS

Suburbs, like cities, are significant and complex public spaces deeply intertwined with economic and social processes. The suburbanization of cities, as a typological form of urbanization, originated in the United States and Great Britain, with its roots traceable to around 1815 (Jackson, 1987). The rise of a new, affluent social class, alongside the advent of tram transportation, prompted the urban bourgeoisie to seek residence closer to nature, away from the pollution and challenges of industrial cities (Mace, 2009). As a result, the wealthiest households moved from the urban core to the periphery, while the poorest populations remained in the city center. The households migrating to the suburbs were generally wealthier than those who had previously resided there (Lee, 2020).

The conclusion of World War II in the United States led to a significant influx of returning soldiers, accompanied by a rapid population increase. This resulted in both a housing shortage and a surge in demand for affordable housing. To address this issue, the U.S. government introduced policies to promote the large-scale development of suburban housing projects specifically aimed at low-income veterans. This resulted in the mass production of standardized residential buildings. The first modern suburban development was initiated in 1947 with the establishment of Levittown, a suburban extension on Long Island, New York. Developed by Levitt & Sons, Inc., Levittown was a pre-planned, mass-produced housing complex featuring over 17,000 affordable homes, along with supporting amenities such as shopping centers, playgrounds, swimming pools, community halls, and schools. Levittown thus became a national symbol of suburban expansion during the post-war construction boom. Following its success, the same company replicated this model in Pennsylvania (1951) and New Jersey (1958), where homes were designed for the upper-middle class, with larger and more expensive housing models (Castillo-Soriano, 2021).

Modern suburbia is characterized by low-density residential areas, typically situated on the periphery of urban centers, and is defined by single-family homes with limited commercial and recreational facilities. As a developmental process, suburbanization represents the systematic and rapid expansion of urban peripheries from the core city, encompassing various forms of growth, from planned communities to informal settlements. This process reflects diverse global trajectories of suburbanization, having evolved significantly since its inception, particularly in the context of post-war urban planning and societal aspirations (Lozynskyi, 2022). One of the most notable socio-spatial characteristics of such suburban environments is their homogeneous social structure, where residential units are predominantly occupied by homeowners who rely on private automobiles as their primary means of transportation (Abbott, 2023). The identity of suburban residents is influenced by their social status, daily practices, and leisure activities, which collectively contribute to the distinct character of suburban spaces (Lozynskyi, 2022). Traditionally, the suburb was conceived as a physical

space consisting of detached and semi-detached houses with yards and lawns on the outskirts of urban areas. However, it also represents a complex web of expectations and values centered around homeownership, family life, and continuous economic prosperity.

The evolution of suburbia led to the emergence of a specific developmental model known as cookie-cutter or tract housing. This typology refers to the design of "tract homes," wherein residential complexes are built by subdividing land into smaller parcels, with numerous identical or similar houses constructed. In its literal sense, a "tract house" refers to "one of many identical houses in a row." Initially, this typology was intended for single-family housing units, characterized by simple designs, standardized functional layouts, and cost-effective materials (Martin, 2000). A defining feature of these settlements is their location on urban peripheries, where a single developer purchases a large tract of land and constructs a significant number of uniform houses. As such, the first defining characteristic of tract housing is standardization, which arises from practical considerations, such as the use of identical designs and materials to reduce construction costs and time. While architectural uniformity can foster a sense of community, it can also lead to social homogeneity, potentially restricting diversity and individual expression among residents (Slate, 1994). A further critical issue associated with cookie-cutter suburbs is their low population density, which contributes to urban sprawl, thereby putting additional pressure on infrastructure and natural resources (Slate, 1994).



(a) (b)

Figure 1: (a) 1950s Aerial of a development of single family houses near Woodbridge , and (b) Plan Levittown, the first American-style suburb, built by William Levitt on Long Island
(Source: (a) Photo by R. Krubner/ClassicStock/ Getty Images,
(b) https://www.reddit.com/r/Suburbanhell/comments/ual7mw/this_is_levittown_the_first_americanstyle_suburb/?rdt=53539)

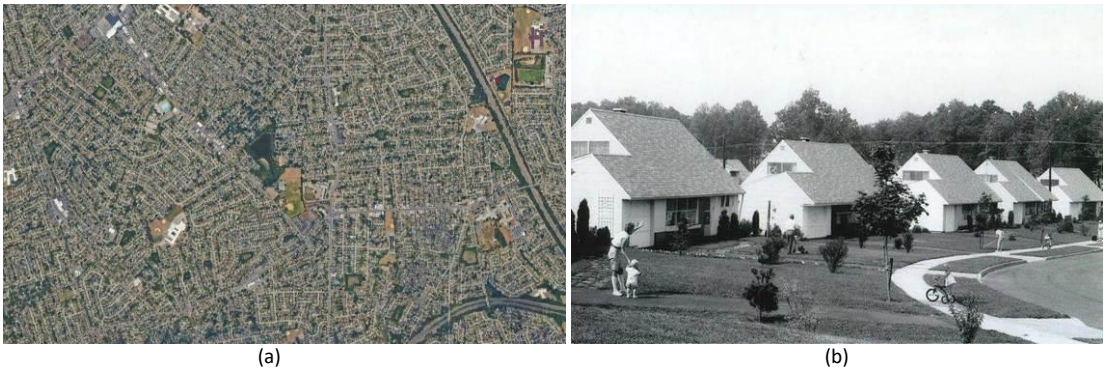
4. ANALYSIS OF SELECTED CASE STUDIES

4.1. Levittown, New York, USA

Levittown represents the first large-scale, mass-produced residential development, constructed between 1947 and 1951. It emerged as a response to the growing housing demand in the United States and served as a prototype for post-war planned communities (Rybczynski, 2017). Levittown provided affordable homeownership opportunities for veterans and their families, significantly contributing to the rise of the middle class and the expansion of consumer culture in post-war America. As such, it became a symbol of the "American Dream," allowing thousands of families to achieve homeownership (Levittown, 2018).

The typical Levittown house was a single-story dwelling in either Cape Cod or ranch style, with a living area of approximately 75 to 100 square meters. These homes generally featured two bedrooms, a living room, a kitchen, and a bathroom. The standardized architectural design of Levittown led to a lack of architectural diversity, resulting in a monotonous and uniform aesthetic (Levittown, 2024). Over time, few houses remain in their original state, as many have been modified to accommodate the evolving needs of homeowners, leading to greater individualization of the neighborhood. Levittown set a precedent for suburban development in the United States, influencing the design and construction of future suburban communities. It showcased the potential of mass-produced housing to meet the needs of a growing population while reinforcing the American ideal of homeownership. However, it is essential to note that the original Levittown sales contracts explicitly excluded people of color, which contributed to racial segregation and restricted diversity within the community (Marshall, 2015).

Over the decades, Levittown has outlived both its most enthusiastic supporters and its harshest critics. Today, it stands as a more complex symbol, representing not just the success of the American Dream or the conformity and uniformity it initially fostered, but also the shifting dynamics of suburban life and the ongoing evolution of its social and cultural significance.



(a) (b)

Figure 2: (a) Aerial shot of Levittown, New York and (b) The original appearance of houses in the 50s in Levittown (source: (a) https://www.gmaps.com, (b) https://www.reddit.com/r/Suburbanhell/comments/ual7mw/this_is_levittown_the_first_americanstyle_suburb)

4.2. Irvine, Los Angeles, USA

The planned city of Irvine, located in Orange County, California, serves as a notable example of cookie-cutter suburban development within the Los Angeles metropolitan area. Established in the 1960s as a development project by the Irvine Company, the city was initially conceived as a residential area for the company's employees. Over time, however, this suburban settlement evolved into a thriving city, home to numerous corporations and universities.

Urbanistically, Irvine is characterized by a meticulously planned layout, with clearly defined residential and public zones. Similar to other suburban developments, its residential organization is divided into tracts, consisting of nearly identical housing units. The development and aesthetic of the city are strictly regulated, with specific zoning laws governing elements such as roofing styles, color schemes, and landscaping in certain areas. Despite its highly controlled design, Irvine integrates bicycle paths, parks, and green belts, all of which connect to environmental reserves, enhancing the city's sustainability. Furthermore, some of the older districts, such as Northwood, which developed in the early 1970s, were built independently of the Irvine Company, and as such, they exhibit less rigid design regulations. Architecturally, the residential units primarily follow standardized designs, predominantly reflecting California-style architecture. Since the 1960s, many homes have undergone modifications and expansions, gradually altering the once-uniform appearance of the community.

This evolution in the appearance and layout of Irvine reflects a dynamic interplay between standardized suburban development and the individualization of homes and neighborhoods as residents adapt to their changing needs and aspirations.



(a) (b)

Figure 3: (a) Aerial view of Irvine, California, and (b) The appearance of the residential buildings in Irvine (source: (a) www.gmaps.com (b) https://www.ocregister.com/2023/01/12/irvine-may-change-how-city-officials-are-elected/)

4.3. Mississauga, Ontario, Canada

Mississauga exemplifies a prototypical North American suburban city, predominantly composed of tract housing developments characterized by extensive rows of similar or identical single-family residences. This city serves as a model of planned urban expansion, emphasizing uniform residential districts, expansive front and back yards, and low population density. The housing typology primarily consists of single-family detached homes, supplemented by townhouses and semi-detached houses. However, to mitigate the "copy-paste" effect, design strategies have been implemented, incorporating variations in façade cladding, construction materials, and colour schemes. These modifications aim to alleviate the visual monotony of the neighbourhood while preserving a coherent architectural aesthetic.



(a) (b)

Figure 4: (a) Aerial view of Mississauga, Ontario, and (b) The appearance of the houses in Mississauga, Ontario (source: (a) https://www.gmaps.com, (b) https://www.reddit.com/r/Suburbanhell/comments/iqsnse/dystopian_suburbia_in_mississauga_ontario_canada/?rdt=56130)

4.4. Craigieburn, Melbourne, Australia

Craigieburn is a rapidly growing suburb of Melbourne that exhibits all the characteristics of cookie-cutter housing. This area illustrates the challenges of suburban expansion, as it is predominantly composed of houses with similar designs and dimensions, constructed on relatively small plots and arranged in tracts, contributing to the uniform appearance of the neighborhood. This approach enables efficient land use and ensures housing affordability for many families. Architecturally, the houses share a similar aesthetic; however, this trend has begun to shift in recent years. Public amenities are strategically planned within designated zones while remaining well-integrated with residential areas. Although residents primarily rely on private vehicles for transportation, the suburb maintains strong connectivity to the city centre.



(a) (b)

Figure 5: (a) Aerial view of Craigieburn, Melbourne, and (b)) The appearance of the houses in Craigieburn, Melbourne (source: (a) https://www.gmaps.com (b) https://www.pomsinoz.com/articles.html/where-to-live-in-australia/victoria/craigieburn-melbourne-suburbs-r178/)

4.5. Jumeirah Park, Dubai, UAE

Jumeirah Park represents a master-planned residential community in Dubai, developed by a single company, encompassing all the characteristics of tract housing. This residential area spans over 380 hectares and includes more than 3,000 luxury villas. Unlike the previously analysed examples, Jumeirah Park offers a form of more luxurious housing. In terms of typological features, the houses are designed on individual plots as detached units. To partially break the uniformity of the neighbourhood, the buildings are designed in three

primary styles: heritage, inspired by traditional Arabian architecture; regional, combining elements of both Arabian and Islamic architecture with flat roofs and terraces that provide additional outdoor space; and legacy, influenced by European styles, characterized by pitched roofs, decorative arches, and classical façades (Jumeirahpark, 2013). A key distinction of this development from the originally built suburban neighbourhoods is the inclusion of numerous recreational facilities, which cater to contemporary lifestyles.



(a) (b)

Figure 5: (a) Aerial view of Jumeirah Park, Dubai, and (b)) The appearance of the houses in Jumeirah Park, Dubai, (source: (a) https://www.gmaps.com (b) https://www.propertyfinder.ae/blog/jumeirah-park/)

5. DISCUSSION

Suburbanization, as an urban planning model, represents an inevitable process within the expansion of major cities. Its fundamental role in the development of global urbanism is indisputable, as it contributes to shaping contemporary urban spaces (Lung-Amam, 2024). Modern suburbs, characterized by low density and low-rise structures, stand in contrast to central urban areas, which are defined by high-density, high-rise developments. According to relevant statistical data, more than half of the population in the United States resides in suburban areas, with this number exhibiting a continuous growth trend (Parker et al., 2018).

In American culture, beginning with the construction of Levittown and subsequently other residential developments, an idealized concept of "achieving the American Dream" emerged, embodied in the image of a happy family in front of a uniform, single-family house. This imagery fostered a widespread aspiration to reside in cookie-cutter neighbourhoods. The combination of this idealized suburban vision and the rapid construction of large numbers of identical houses has led to the establishment of an urban pattern that has extended beyond the United States and remains prevalent today.

On the other hand, suburban housing models are generally not characterized by significant architectural value, although their urban planning relevance cannot be disputed. Contemporary lifestyles have undergone substantial transformations compared to the social and economic conditions that prevailed in the 1950s and 1960s. Consequently, it is imperative that suburban developments evolve in accordance with present-day requirements. Based on the findings of this study, life in copy-paste housing can be considered functional and rational, given that suburban areas are systematically planned and supported by organized infrastructure. However, the overall quality of life in such neighbourhoods is influenced by numerous factors, which could serve as the subject of future research.

6. CONCLUSION

The development of suburban areas near major urban centers experienced significant expansion in the mid-20th century due to the rapid increase in housing demand following World War II. The first large-scale example of a suburban settlement was Levittown, constructed in the 1950s with over 17,000 standardized housing units, providing affordable housing for returning war veterans. The creation of a uniform architectural aesthetic led to the emergence of a distinct suburban typology, commonly referred to as "cookie-cutter" neighborhoods or "tract housing." In this context, the term "tract" denotes a series of identical houses, mass-produced with standardized designs to enable more efficient and cost-effective construction of large residential complexes (Kunert, 2023).The large-scale construction of thousands of identical housing units streamlined the building process, reducing costs and accelerating development, ultimately resulting in neighborhoods composed of uniformly designed homes built from the same materials and in the same color. The uniformity of these communities has raised the question of whether living in copy-paste houses can truly be considered humane.

A case study analysis of five distinct "cookie-cutter" neighborhoods, constructed in different periods and across various geographic locations, has provided insights into this inquiry. Suburbs represent dynamic urban spaces that reflect broader societal trends and challenges. While the original "tract housing" models faced criticism for their uniformity, over time, certain modifications—such as variations in color schemes and façade aesthetics—have been introduced, partially mitigating the issue of monotony.

The question posed in this study has been examined through selected case studies of five different "cookie-cutter" neighborhoods built in different time periods and locations. In this context, several key conclusions can be drawn: suburbs function as both physical environments and dynamic spaces that mirror broader social trends and challenges. The initial appearance of tract housing, along with professional critiques that emerged over time, contributed to the gradual diversification of housing models, even though this primarily entailed aesthetic modifications—such as variations in color—rather than structural differences, thereby only partially addressing the initial problem of uniformity.

In contemporary suburban planning, there is a greater emphasis on green spaces and public areas. Modern urban design approaches aim to accommodate evolving lifestyles, particularly in terms of connectivity and sustainability. This form of housing largely meets human residential needs on multiple levels, while the challenges related to organization, design, and overall quality remain within the scope of future urban planning and architectural solutions. The primary goal remains the enhancement of residential quality and the adaptation of suburban environments to contemporary living requirements.

ACKNOWLEDGMENT

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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DESIGN AND FUNCTIONAL CHARACTERISTIC OF PODIUM ROOFTOP GARDENS IN MULTIFAMILY RESIDENTIAL DEVELOPMENTS

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ABSTRACT

The rising cost of land has significant implications for both urban planning and architectural regulation and practice. Occupancy rates and building heights are constantly increasing, particularly in dense urban areas, affecting that contemporary residential developments often lack sufficient communal and green spaces. The development of podium-type buildings could address these challenges by expanding commercial spaces, thereby enhancing the profitability of construction projects, while facilitates the creation of elevated courtyard spaces, above the ground level, in a form of green roofs. Such spaces enhance spatial fluidity of open areas by removing secondary functions, such as pedestrian or bicycle transit, privacy concerns, and security risks, that often hinder ground-level open spaces.

Current urban regulations allow podium-type buildings only in the form of high-rise housing, limiting their application in cities like Niš to a few individual cases. However, Western practices suggest that, when properly designed and organized, this typology could have a much broader impact on residential development.

Keywords: *podium courtyard, podium gardens, common open spaces, multifamily housing, residential development*

1. INTRODUCTION

Progressive urbanization, that characterizes the last few decades of urban development, has led to the rapid expansion of cities and densification of existing urban fabrics. Within urban areas, the residential function represent the dominant type, occupying the largest portion of urban territory — approximately 70% (Dinić Branković & Mitković, 2019). These circumstances have resulted in such contemporary housing models that are increasingly focusing on the residential typologies that enable higher housing densities. This trend is further influenced by the constant increase in urban land prices. Consequently, contemporary housing construction has increasingly adopted typologies and structures that maximize residential densities through higher land-use efficiency (e.g., greater occupancy rates) and increased building heights. One such typology is the podium-type building.

1.1. Podium type buildings

Podium construction, also referred to as pedestal or platform construction, typically involves multiple stories of residential or commercial space positioned atop a single or multi-story podium (base). This base often accommodates commercial amenities, but may also serve as a parking facility. The roof of the podium is frequently designed as a landscaped garden, providing a shared outdoor space for the adjacent residential or commercial structures. These podium gardens function as viable alternatives to traditional ground-level open spaces, contributing to the integration of green infrastructure within dense urban environments.

This architectural approach enhances the economic efficiency of limited urban land by combining substantial commercial spaces with high-quality residential environments enriched with greenery and communal amenities. Depending on the spatial configuration of structures atop the podium, podium rooftop gardens can be categorized into three distinct types: (1) linear, (2) courtyard, and (3) complex podium rooftop gardens (Figure 1).



(a) linear podium rooftop gardens (b) courtyard podium rooftop gardens (C) complex podium rooftop gardens

Figure 1: Classification of podium rooftop gardens

Podium-type construction is typically associated with high-rise developments, featuring one or more towers positioned atop a podium structure (Figure 2). In such cases, podiums generally range from four to six stories in height. The height of the podium may vary, and podium gardens can be incorporated at multiple levels. The podium structure is designed for mixed-use functions, whereas the towers may accommodate either residential or commercial purposes.



Figure 2: High-rise podium-type construction, example of Arborescence Apartments / WY-TO architects + Crespy & Aumont Architectes
Source: https://archello.com/jp/news/alison-brooks-architects-references-classic-berol-eagle-pencil-in-design-of-mixed-use-development

However, throughout North America and Western Europe, this typology is also applied in the form of mid-rise residential developments. In such cases, podium structures typically consist of a one- or two-story base, with upper levels designed as three- to four-story residential buildings. The upper structures may be arranged in various configurations, including parallel blocks, U-shaped blocks, or multiple blocks positioned atop the base. While the podium level serves as a mixed-use space, the upper structures are designated for residential purposes.

Granville1500 Housing (Figure 3) exemplifies a mid-rise, podium-type student housing development in Los Angeles, United States. The podium structure consists of a single-story base, incorporating mixed-use facilities for social and commercial purposes along its outer perimeter, directly engaging with the surrounding streetscape. The inner section of the podium is designated as a parking facility.

The residential complex comprises three wedge-shaped buildings, each featuring distinct floor plans. These structures are interconnected by narrow bridges on the upper floors. The open spaces at the podium level, situated between the residential buildings, form passageways with seating areas and small, landscaped courtyards. Additionally, the largest platform within the development accommodates a communal swimming pool, enhancing the shared amenities available to residents.



a) Street elevation b) Podium garden

c) Ground floor level d) Podium garden level

Figure 3: Mid-rise podium-type construction, example of Granville1500 Housing / Lorcan O'Herlihy Architects
Source: https://www.archdaily.com/1019377/granville1500-housing-lorcan-oherlihy-architects

2. METHODOLOGY

This paper examines the planning and design principles governing the organization of podium open spaces within multi-family housing developments. It explores the potential benefits of podium gardens in enhancing housing quality and identifies design strategies that can encourage the effective use of these open spaces.

The central hypothesis of this research, supported by contemporary urban planning and architectural literature, posits that the implementation of podium-type residential developments—particularly within the dense urban fabric of Niš—can contribute to an overall improvement in housing quality. Accordingly, the primary objectives of this study are: (1) to explore the advantages of podium open spaces, both in terms of increasing green urban areas within residential neighbourhoods and fostering social cohesion by strengthening community bonds, and (2) to establish urban planning and architectural guidelines for the design of podium garden open spaces in multi-family housing developments.

This paper analyses podium-type developments with a particular focus on the spatial organization and design of open spaces at the podium level, by using a literature review as its primary methodological approach. To illustrate the benefits of podium gardens, the study examines a best-practice example selected for its ability to effectively demonstrate the advantages of this residential typology. The findings from this analysis serve to highlight the potential applications of podium-type developments within the urban zones of Niš.

Furthermore, the study includes an analysis of the current urban planning regulations in Niš to assess the feasibility of integrating this residential typology into the existing urban fabric. This evaluation also outlines the

potential for podium-type developments to contribute to the future residential growth of the city and to foster the creation of higher-quality housing environments.

With a population of approximately 260,000 inhabitants (2011 Census), Niš is the third-largest city in Serbia and a representative example of a medium-sized post-socialist city. The post-socialist transition period has had a profound impact on Niš's urban landscape, characterized by increasing urban density and a reduction in public open spaces and green areas.

3. BENEFITS OF PODIUM GARDENS

Common outdoor spaces are a fundamental factor in the sustainability of multi-family housing, offering social, economic, and environmental benefits (Milanović & Vasilevska, 2018). In contemporary residential developments, podium gardens have emerged as highly desirable features, providing a wide array of advantages to residents. Shared and green open spaces enhance the quality of life by offering both functional and aesthetic benefits, which significantly elevate the living experience. There are numerous benefits of having common open spaces on the podium level.

Land efficiency. Elevating common outdoor areas to the podium level enables housing developments to optimize land use. The higher occupancy rates allowed by podium structures facilitate more efficient land utilization. By developing the podium structure across multiple levels, substantial commercial space can be integrated, thereby improving the economic efficiency of new housing projects. Additionally, these non-residential spaces can offer additional amenities without compromising the comfort of residential areas.

Ambient value. Podium gardens serve as distinctive architectural elements, enhancing the visual appeal of residential buildings and adding value to the living environment. These spaces often feature landscaped greenery, water features, and even artistic installations, which contribute to the overall ambiance and aesthetics of the development. Shared outdoor spaces on the rooftop podium level often benefit from improved views and increased natural light. Elevated podiums can offer scenic vistas of the surrounding area and allow more sunlight to reach residential units.

A Safety and Privacy. As podiums are elevated, the podium gardens create a safe and secure environment away from street-level traffic and potential hazards. This elevation enhances safety, especially for families with children. Additionally, podium offers residents more privacy compared to ground-level amenities. Shared amenities, green and recreational areas are shielded from public view, giving residents a private and serene environment and thus influence the enhanced privacy.

Improved shared open space. The podium structure provides additional space for recreational activities, promoting a healthy and active lifestyle. Many podiums feature amenities such as swimming pools, fitness areas, and children's playgrounds, among others, enhancing residents' access to diverse recreational options.

Social value. Podium gardens function as communal spaces where residents can interact and cultivate a sense of community. Shared areas such as gardens, seating zones, and multipurpose spaces encourage social interactions among neighbours. These spaces, intended for use by a single residential group, positively influence the strengthening of social bonds. The frequent presence of familiar individuals and children fosters the development and reinforcement of established social connections.

4. DESIGN PRINCIPLES IN ORGANIZATION OF PODIUM GARDENS

This section summarizes the design features relevant for the development of green and common open spaces on the podium rooftop level. The usage comfort of podium rooftoop gardens within dwellings is examined through two key aspects: 1) physical needs (for leasure and recreational activities, protection against noise, wind, etc.) and 2) socio-psychological needs (protection from view of neighbors, safety, security, the availability of visual control, the availability of various forms of social interaction, etc.). (Milanović & Vasilevska, 2018). Examples of good practice have shown that from the social and utilitarian aspects, only those solutions that bring these two aspects into balance can be considered successful.

Sense of community. Creating a sense of community is a significant element in enhancing the social quality of living environment. The development of a sense of community is greatly influenced by the enhancement of social interactions. Since podium gardens provide a comfortable environment for people to meet their neighbours, they can contribute to fostering positive relationships among users. Research by Lai Man Liu & Youngchul Kim (2017) reveals that the most significant aspect of these spaces, according to their users, is

socialization, and they express a desire for more people to use the podium gardens. An increased number of users makes podium gardens more social and, consequently, enhances the sense of community.

In order to attract more users to the podium garden, some design features must be present on site. The most important ones is given in the continuation of the paper.

Physical features. As the potential for social interactions increases with the rise in physical contact within a space (Unger & Wandersman, 1985; Huang, 2006), the existence of shared spaces within residential areas that initiate and support interactions among residents has a positive impact on the quality of housing. This primarily refers to the creation of spaces that are welcoming to a broad spectrum of users, equipped with seating areas and greenery, as the main features that promote social interactions (Figure 4). The presence of seating furniture has been identified as the most significant element for the development of social activities, as it allows for prolonged stays in the space, thereby increasing the potential for social interactions (Carr et al., 1992; Huang, 2006).

Spaces for children play a significant role in establishing social interactions and forming stronger social bonds (Gleeson & Sipe, 2006). They usage is very intensive, as the need for outdoor activities is most pronounced among the youngest. Additionaly, these spaces not only initiate interaction among children, but also foster contact between the individuals supervising them (Huang, 2006; Farida, 2013; Krellenberg et al., 2014).The way these spaces are used—frequent visits by the same children and, consequently, the same parents—positively influences the further development and strengthening of the established social connections.

The third element significant for the quality of interactive spaces is the presence of greenery. Research has shown that the higher intensity of use of shared spaces has been recorded in areas richer in greenery (Barbosa et al., 2007), thereby increasing the potential for social activities (Sullivan et al., 2004) and fostering stronger social cohesion among residents (De Pooter, 1997; Skjaeveland & Garling, 1997; Huang, 2006).



Figure 4: Design features of podium rooftop gardens

Visibility. The visibility of the podium plays a crucial role in promoting a sense of safety (Lai Man & Youngchul, 2017). A podium garden should be highly visible from the surrounding apartments. This relates to the visual angle and the distance from the surroundings. Better visual connective and visual integration influence that residents can more easily use the podium space. Children's playgrounds, for instance, should be clearly observable from the surrounding residential units, especially those on higher floors. Furthermore, areas with low visibility or covered areas in the podium gardens often experience safety and hygiene issues. Improving public monitoring and avoiding hidden space in podium gardens can enhance safety and security. Visual connections between different functional spaces in podium gardens should also be considered. The height of plantings and fences should be adjusted to avoid view obstructions. Transparent materials can be used for fences to maintain openness and visibility.

To further ensure safety and accessibility, podium gardens should be adequately illuminated to maintain high visibility and facilitate public monitoring. Daylight admission is crucial for the overall environment of the podium garden. Transparent materials can be selected for a canopy to control weather conditions. Furthermore, pedestrian-scale lighting can be installed to illuminate the podium gardens at night, promoting safety during evening hours. The more visible the podium space is, the safer and cleaner it will be.

Accessibility. Properly accessible podium garden can attract more users and enhance social activities and interactions. If the podium garden is more accessible more people will go there and more social activities will take place. In particular, podium gardens should be easily noticeable, with clear guidance to direct people to

the space. Ideally, podium gardens should be located near residential units, offering residents multiple route options for accessing the garden, thereby encouraging interactions and enhancing community engagement. As more people become active in the podium garden, residence have greater chances of developing community interactions. Podium gardens designed in such manner increase the people sense of community.

5. PODIUM TYPE BUILDINGS IN SERBIA, THE CITY OF NIS – IMPLEMENTATION AND POSSIBILITIES

5.1. Common open spaces in residential areas in the context of current urban regulation

One of the most frequently debated issues, concerning new housing developments in Serbia, is the absence of common outdoor spaces, both in peripheral suburban areas and in urban infill projects.

Market-oriented urban policies significantly influence the management of such spaces, often leading to their marginalization and degradation due to their lack of direct profitability. Investor binding regulation impose high occupancy rates while only nominally defining common and green outdoor areas, without mandating their actual implementation. Furthermore, inadequate on-site oversight in enforcing the provisions outlined in project documentation exacerbates this issue, resulting in the majority of new housing developments lacking communal outdoor spaces. Paradoxically, contemporary multifamily housing projects exhibit a marked decline in residential quality compared to earlier socialist-era housing models.

A potential solution to these challenges is the adoption of podium-type construction, a housing model that integrates high occupancy rates with substantial common outdoor areas. This approach could enhance the quality of new residential developments in Serbia, particularly in the city of Niš.

5.2. Podium type buildings in the context of urban regulation

Podium buildings represent a new residential typology in Serbia. This typology is introduced in the local legislation framework a few years ago, as a form of high-rise housing model. In particular, in the urban planning regulation, currently applicable in the city of Niš, the high rise building are defined as followed: “A high-rise building consist of the following parts: 1) The Base (Podium) of the high-rise building (B), 2) The Body of the high-rise building (T) and 3) The Top of the high-rise building (V).

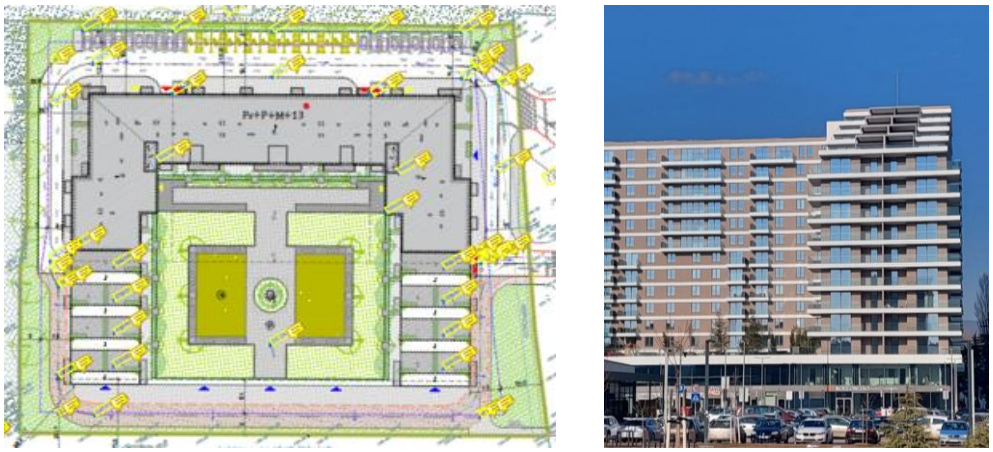
Applicable regulation defines the minimum plot requirements for this typology – the surface area of 5000m², and minimal street frontage of 50m. The Base (Podium) of the high-rise building (B) should consists of a single volume structure, either as single story or multi-story structure, with maximum height of 18m. Space inside the base is intended for commercial activities, or an above-ground garage, and a green roof garden. The Body of the high-rise building (T) comprises the structure above the Base (Podium) of the high-rise building (B), designed for multi-family housing with accompanying technical facilities. The Top of the high-rise building (V) can be specially designed with open and semi-covered spaces, as well as technical and auxiliary spaces. Above this, it is planned to install the necessary antennas and other technical poles and mechanisms. Total height of the building should not exceed 50m.

Regarding the maximum coverage ratio, the horizontal projection of the podium (base) at ground level constitutes 60% of the total plot area, while the high-rise building (tower) occupies 30%. A minimum of 30% of the total plot area must be allocated to shared and green spaces. The calculation of these percentages includes both shared open and green spaces at ground level and the green roof atop the podium. Considering these values, it can be inferred that the rooftop podium surface accounts for up to 30% of the total plot area, while unbuilt land at ground level comprises up to 40%. This suggests that the implementation of podium-type buildings can achieve a significantly higher proportion of overall outdoor space compared to traditional residential blocks, thereby enhancing the quality and functionality of communal areas.

An additional advantage of podium-type structures in the provision of common outdoor spaces within residential blocks lies in their treatment of unbuilt land. In traditional residential blocks, even when a significant percentage of land remains unbuilt, these areas are only partially designated for outdoor leisure activities. Due to direct street access, such spaces are often repurposed for parking lots, access pathways, and other infrastructural elements, which can diminish their aesthetic and functional value. In contrast, podium-type structures elevate outdoor areas, effectively segregating them from vehicular circulation and enabling their exclusive organization as communal gardens and leisure spaces. This suggests that, regardless of surface area, the actual potential for high-quality outdoor spaces is greater in podium-type developments compared to traditional residential blocks.

The Complex Planet Residence is the first and, to date, the only podium-type building constructed in Niš. However, in the time of the research this development remains unoccupied (Figure 5). Designed as a mixed-use complex, it features commercial facilities on the ground level. The podium structure, which is two stories high, accommodates commercial spaces along its eastern and southern sides, while a two-level parking area is located at the rear. Rising above the podium is a U-shaped, 12-story residential tower. The podium's roof serves as an outdoor space, partially allocated as private gardens for the apartments situated at this level, while the central open area is designed as a communal green space featuring leisure amenities and a children's playground.

The total plot area is 12,103 m², with a total building height of 49.95 meters—comprising a 9.36-meter-high, two-story podium base and a 13-story residential tower. The base structure covers 57% of the total plot area, while the horizontal projection of the tower accounts for 30%. In accordance with urban planning regulations, at least 30% of the plot area must be designated as open and green spaces, with a minimum of 10% of that area in direct contact with the ground. The conceptual design of open and green spaces is structured into four spatial units: a) ground-level spaces adjacent to commercial areas, b) perimeter green zones, c) a communal green rooftop garden on the podium level and d) private green rooftop terraces on the podium level, designated for individual residential units.



(a) site plan (b) elevation

Figure 5: Residential complex Planet Residence, Nis, Serbia

The on-site conditions are highly favourable, with 10% of the green space situated along the periphery of the block, featuring high vegetation, and 50% of the green outdoor space integrated into the podium-level green roof. The communal green roof area, designated for public use, comprises 40% of the total plot area, while private gardens associated with individual apartments account for 12%. The podium garden, intended for public use, is conceptually designed as an elevated condominium-style open space on top the podium. It includes shared amenities for all building residents, such as a park, children's play area, and recreational spaces. As the most secluded and tranquil section of the open and green spaces within the development, this area is designated exclusively for pedestrian use. The green rooftop terrace is constructed on a reinforced concrete slab, with designated planting areas designed as roof gardens featuring a substrate depth suitable for growing grass and low shrubs. As the central open space within the semi-atrium configuration of the high-rise structure, the rooftop garden naturally serves as a visual focal point and a key element of the landscape design. Additionally, a designated area on the rooftop terrace has been allocated for a sculpture or spatial installation, although this feature has yet to be installed. The private green rooftop terraces, directly linked to residential apartments, function as active green roofs that require intensive maintenance. Consequently, these spaces have been strategically positioned in areas where residents are directly responsible for their upkeep, ensuring their long-term sustainability and usability.

5. CONCLUSION

In Niš, as well as in Serbia, podium-type construction represents a relatively new approach to residential development, as do podium rooftop gardens as a form of communal outdoor space. Given the scarcity of public outdoor areas within the urban fabric of Niš, the development of residential podium constructions with integrated podium gardens has the potential to enhance the balance between public and private residential spaces, while improving overall residential conditions. Furthermore, podium gardens, as shared outdoor

spaces, can foster social interactions, enhance community cohesion, strengthen social bonds, and promote a sense of community.

To ensure that podium gardens reach their full potential, their spatial organization must meet specific requirements concerning the physical features of the site. Foremost among these are the inclusion of leisure and resting areas equipped with seating furniture, children's play equipment, and green spaces. Well-designed podium gardens not only enhance housing comfort but also contribute to the overall improvement of the neighbourhood, fostering a more socially engaging and liveable environment.

Current local urban planning regulations define podium-type structures exclusively for high-rise residential developments. However, Western urban planning practices demonstrate that this typology can be applied more broadly. By adjusting urban parameters related to minimum plot size and building height, mid-rise podium-type developments could be incorporated into local planning regulations. As this typology represents a novel residential form in the local context, conducting an analysis of residents' satisfaction with such dwellings and their associated communal spaces would provide a valuable foundation for future urban planning decisions regarding the implementation of podium-type structures.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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URBAN PLANNING AS A SUSTAINABLE SOCIAL MECHANISM OF PRESERVATION OF ARCHITECTURAL HERITAGE

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ABSTRACT

Preservation of architectural heritage in the era of expansion of the construction industry is a challenge faced by large cities. Urban planning in the service of architectural heritage preservation is becoming a key segment of the sustainable development of many European cities. The integration of the protection of architectural heritage with modern urban needs enables the preservation of the identity of the ambient units of settlement while responding to the challenges of modernization.

The paper analyzes case studies of European cities that protected architectural heritage through adequate urban planning and stood out as examples of good practice. The paper aims to determine the principles of adequate urban planning that can be applied in Serbia.

Keywords: *preservation of architectural heritage; urban planning*

1. INTRODUCTION

Architectural heritage is a testimony of the cultural, historical, urban, economic, and social development of a community. It includes buildings that are several decades and centuries old, archeological sites, monuments, memorials, fortifications, religious buildings, historical cities, and ambient units of settlements. Its preservation is a complex multidisciplinary task. Starting from the basic needs of preservation in the original state through regular restorations and conservations, the challenge brought by nowadays is also the issue of the coexistence of the architectural heritage with newly built structures in the urban tissues of the settlement [1].

Given their importance, historically, architectural heritage buildings represented the backbone around which urban structures were concentrated. Hence, it is not surprising that today the largest number of these buildings are located in the central zones of the urban fabric. It is precisely these locations that have been most affected by the intensive construction that has taken place in recent decades. Demolition of parts or whole buildings

and wholes of architectural heritage, additions, inadequate interventions as well as new construction that hides buildings or wholes, are just some of the negative consequences of that intensive construction [2].

In Serbia, the largest number of architectural heritage buildings are under state protection. Institutions dealing with heritage protection are the Ministry of Culture and Information, the Republic Institute for the Protection of Cultural Monuments, and the system of provincial, regional, and city institutions. Protected structures are divided into the following categories: cultural monuments, spatial cultural-historical complexes, archaeological sites, and landmarks. However, there is a significant fund of architectural heritage that has not been recognized and valued enough to apply some kind of protection to it. By not looking at the wider picture of the ambient wholes, the identity and integrity of the architectural heritage are collapsing. Therefore, urban planning is a starting point in protecting architectural heritage. Its importance is reflected in the creation of a legal, technical, and spatial framework that ensures the long-term protection of heritage while simultaneously responding to the needs of modernizing society.

The topic of the paper is research on the impact of urban planning on the preservation of architectural heritage. Using methods of description, comparison, and case studies, examples of good practices of successfully implemented urban interventions in the cities of leading European countries were analyzed, all to define recommendations and guidelines that could find their application in preserving the architectural heritage of our country.

2. PRESERVATION OF ARCHITECTURAL HERITAGE IN EUROPE AND SERBIA - SITUATION, PROBLEMS AND CHALLENGES

According to the UN report (2017), by 2025, about 69% of the world's population will be concentrated in urban areas [3]. Great pressure on the existing urban infrastructure inevitably causes changes in its morphological structure. The first to be hit were the structures of the architectural heritage, which for decades and centuries formed authentic micro-ambient entities that became reference points of those settlements. The developed countries of Western Europe faced this challenge at the very beginning of major construction expansions, in the first decades after the end of World War II. They laid the legal foundations by issuing a series of legal acts, documents, and regulations and thus developed urban planning strategies that balance the preservation of architectural heritage and the satisfaction of modern needs. Great Britain adopted an act in 1947 that introduced the obligation to plan and regulate construction to protect historical buildings [4]. The French "Malraux" law from 1962, named after the then Minister of Culture Andre Malraux, introduced the concept of "protected zones" enabling the preservation of urban areas in France [5]. In 1985, with the "Galasso" law, Italy extended the protection of artistic and architectural assets to natural areas surrounding cultural monuments [6]. Also, numerous international charters and conventions such as the Venice Charter from 1964, and the UNESCO World Heritage Convention from 1972, regulated the relations between urban planning and new construction on the one hand and the preservation of architectural heritage on the other [7]. Given the dynamics of contemporary social needs, technological changes, and new challenges in the preservation of architectural heritage, these legal regulations are often changed and upgraded to keep up with the times.

Urban planning in Serbia in the context of the preservation of architectural heritage faces numerous challenges stemming from complex social, economic, and institutional factors. These problems make it difficult to effectively protect and valorize cultural-historical buildings and entities. The increasing tension between past and present, inherited structures, and modern demands, is identified through quantitative indicators that are more economic and less social and cultural [8]. Due to the ever-increasing need for new residential and business facilities, especially concentrated in the central city areas, urban development has marginalized the buildings of architectural heritage, thus damaging their integrity and, in the last case, their existence [9]. According to our law on planning and construction, when creating urban plans, the participation of institutions that deal with the protection of architectural heritage is necessary. This implies their involvement in the preparation of planning documents of various categories - from spatial plans, and regulatory plans to detailed plans. In this way, the law enables the prevention of possible problems that could arise in the later phase of their implementation [10]. However, the problem of the treatment of architectural heritage that arises in practice concerns the relationship between the ambient units that the heritage creates and which is not taken into consideration in the development of plans. In contrast, each heritage structure is viewed as a separate unit isolated from its environment. The Convention for the Protection of the Architectural Heritage of Europe (1985) reminds us that even units that are not under institutional protection have an important role in creating a quality urban and rural environment, and therefore it is necessary to include them in restoration and

preservation programs. Also, the European Convention on Landscape from Florence (2000) talks about these units and recognizes the protection category "cultural landscape". Unfortunately, although our country is a signatory to that convention, the category "cultural landscape" is not recognized in the current legal framework. Therefore, in practice there are dissonant tones between protection and construction expansion - the desire to preserve the architectural heritage and historical ambient units on the one hand, or their degradation and new construction within the framework of valid legal regulations [10]. When considering urban development, it is necessary to adapt to the special characteristics created by individual ambient units [11]. This deficiency in our practice often leads to the fact that the same building rules apply to all parts of individual settlements, regardless of the differences in their micro-ambient units. Niković A. and Manić B. (2018) state insufficient recognition and differentiation of urban structure characteristics in planning procedures. Partial construction, and inadequate interventions, lead to a permanent disturbance of the balance of ambient units [10]. Another problem that arises in our practice is the insufficient interest and participation of the general public in making and implementing decisions regarding urban planning and the protection of architectural heritage. One of the reasons for this is insufficient information, the lack of a culture of public debates, as well as the passivity of social activism in this sphere.

3. EXAMPLES OF GOOD PRACTICE

3.1. Florence, Italy

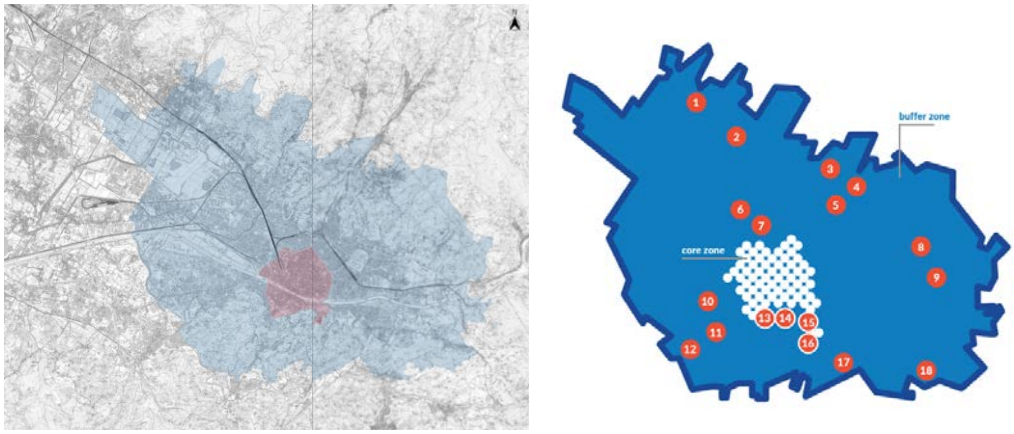
The city of Florence, located in the central part of Italy, is one of the most important cultural and historical centers of Europe. The wealth of its architectural heritage is reflected in the buildings that date back to the Etruscan and Roman times. The most important buildings of Florence are certainly the Renaissance buildings of the Medici period. The historical center of the city is surrounded by the remains of walls from the 14th and 16th centuries. In 1982, this zone was included in the UNESCO World Cultural Heritage List [12].



Figure 1: Landscape of the historic center of Florence [13]

The management plan for the historic center of Florence was created in 2006. According to the plan, only restoration and conservation works are allowed within the historic center. In 2021, the protection perimeter of the historic center was extended to include the complex of San Miniato al Monte and its immediate surroundings [12]. The intensive expansion of the city in recent years has begun to threaten the identity and silhouette of the historic core. That is why the city administration, in cooperation with the University of Florence, developed a study and an urban plan for the buffer zone of the historic core. The perimeter of the buffer zone is defined based on the following factors:

- the most representative lookouts with a view of the historical center and from it are located, which will be reference points for analyzing the impact of new construction;
- the conditions that the new construction should fulfill in order not to have negative effects on the historical center are defined;
- Long-term plans have been defined for monitoring the impact of new construction and the relationship between interested parties to enable smooth communication between the relevant protection institutions, investors, and residents of Florence [14].



(a) (b)

Figure 2: (a) Map of the historic center of Florence and the buffer zone of protection, and (b) Map of the location of representative viewpoints of Florence [15]

After the approval of the World Heritage Committee, the buffer zone plan was implemented in the urban plan of Florence in 2014 and is 10,453ha [12]. New protection provisions have been introduced to protect the values of the site and protect the panoramic view from and towards the historic core. The panoramic view of the historic center of Florence is protected by defining 18 characteristic viewpoints, 14 with a view towards the historic center, and 4 with a view from the city center [15]. In this way, any intervention within the defined buffer zone is analyzed about these 18 points, which represent instruments of control and assessment of the impact on architectural heritage.

3.2. Carcassonne, France

Carcassonne is a city located in the south of France. It is known for its fortification, which dates back to the Roman period. The fortress is located on the southeast side of today's settlement on a hill and dominates the plain that surrounds it from the south, west, and east. During the medieval political and military turmoil, the fortress was demolished and rebuilt. Due to neglect and poor condition, in 1843 a decision was made to demolish it [16]. However, thanks to the initiative of prominent people of that time, the fortress was preserved. Conservation works were carried out and the fortress shined in its full glory. Today, it represents one of the biggest tourist attractions in France with millions of visits a year.



Figure 3: View of Carcassonne fortress and its surroundings [17]

The fortress is protected by the law on the protection of natural monuments and sites of artistic, historical, scientific, legendary, and picturesque significance in 1930 [18]. Since 1997, the fortress has been protected by UNESCO. In 1998, to protect the surrounding environment, 608 ha of the area around the fortress itself was also protected. In the previous 2 decades, the protection perimeter of the area around the fortress was increased [16]. In 2016, a management project for this locality was created under the name "Operation Grand Site". Based on the provisions of this project, the law on the preservation of the fortress was amended and the urban plan was amended. The general objectives of the project were as follows:

- preparation of an urban plan with the aim of sustainable protection of the locality and the landscape it forms with the surroundings;

- creating a space management project to meet the needs of visitors and the smooth life of the local population;
- rehabilitation of the natural environment of the fortress with the introduction of new pedestrian and bicycle paths [16].

As part of the project, the perimeter of landscape protection was increased, which is bounded on the north side by the Grezailles hill and the course of the Ode River, on the northwest side by the current settlement, while on the south, east, and west sides the perimeter reaches the farthest points of the plain from which the view of the fortress can be seen. It is this area with grapevine plantations and natural landscapes with cultivated areas, forests interspersed with hiking and cycling paths, that is the most recognizable landscape of the Carcassonne fortress. The fortress with an area of 11 ha, with a protection perimeter covering an area of 1170 ha, is today an area where construction that would threaten its identity and the landscape it creates is prohibited [16].



(a) (b)

Figure 4: (a) Landscape created by the fortress of Carcassonne with fields of grapevines [17], and (b) Map of the fortress of Carcassonne and its perimeter of protection [16]

3.3. Bath, England

The city of Bath is located in the south of England, not far from Bristol. It is known as a spa town with thermal springs. The city's architecture dates back to the pre-Roman period. In the city, you can find archaeological remains of a spa from the Roman period as well as from the Middle Ages. The most famous objects date from the Georgian period [19]. Due to its unique architecture, urbanism, and landscape ambient units, in 1987 it was included in the UNESCO World Heritage List [20].



Figure 5: View of the city of Bath [21]

The city received its first protection of architectural heritage in 1968. Then selected groups of buildings were recognized as worthy of preservation. Years later, the protection measures were expanded so that today the protected area covers an area of 1,486 ha [22]. Given that the protected zone is inhabited by about 50,000 people and that it is a tourist spa town, new construction was not stopped, but in 2010 a strategy for sustainable development and construction in the city was drawn up. It defines the possibility and method of construction in a protected area. An analysis of city neighborhoods was performed, based on which 5 protection zones were defined. Zones are defined based on their architectural and cultural-historical peculiarities. For each of these zones, guidelines were given on the appropriate method of new construction - the height and appearance of the buildings, to ensure the protection of exceptional heritage values and also to facilitate the tourist development of the city. The following zones are defined:

- Georgian City: the cornice height of the new building must be identical to the cornice height of the nearby Georgian buildings. A one-story extension is permitted with a pulling-in relative to the street frontage. The appearance, slope, and materialization of the roof should be identical to the neighboring buildings;
- Immediate Setting of Georgian City: the height of the new building must not be higher than the height of the existing buildings;
- Valley Floor - the maximum allowed floor height is 4 floors. It is possible to add another floor with a pulling-in relative to the street frontage;
- Hillslopes: the height of the ridge of the new building must not be higher than the height of the ridge of the existing neighboring buildings. In suburban one-story zones, it is possible to add another floor, provided that it does not disturb the built landscape and the green character of the area;
- Plateaux: the maximum allowed floor height is 2 floors, 4 floors are allowed on the university campus. The addition of another floor is allowed, provided that it does not exceed the height of the street tree line [23].

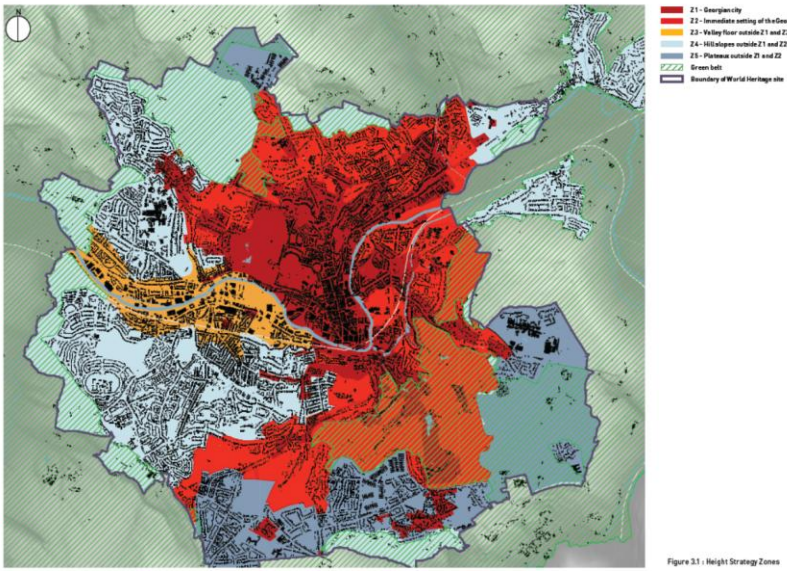


Figure 6: City of Bath Protection Zone Plan [23]

4. DISCUSSION

Table 1: Comparative presentation of the protection measures of the analyzed examples of good practice

Location	*FLORENCE, ITALY*	*CARCASSONNE, FRANCE*	*BATH, ENGLAND*
Graphical representation			
Protected zone	*10,453 ha*	*1,170ha*	*1,486ha*
Permitted construction	*Construction in compliance with very strict rules*	*No*	*Yes*
Protection measures	*New construction is not permitted within the historic core. Viewpoints are defined within the protection buffer zone, the landscape of which must not be disturbed by the new construction.*	*Protection measures include the prohibition of new construction as well as the maintenance of the natural and created landscape.*	*New construction is allowed. 5 protection zones have been defined, each of which has specific rules for new construction.*

The table shows a comparative analysis of the applied protection measures of selected localities. Based on the attached data, it can be seen that the protection measures are subordinated to the same goal - the protection of the landscape of the locality. Also, the measures do not refer to individual buildings, but to rounded ambient units. In the first example (Florence, Italy), protection enabled the preservation of the characteristic silhouette (domes of the Florentine cathedral, towers of the Vecchio palace, etc.) that represent the symbol of the city. Another example (Carcassonne fortress, France) shows the need to preserve the symbiosis of the natural and built environment. The fortress would lose its identity without the endless fields of grapevines and woods. Therefore, the preservation of the biodiversity of the surrounding fortress is unquestionable in its protection. In the third example (Bath, England), construction is possible only on the condition that the new buildings, with their size, aesthetics, and materialization, fit into the architectural characteristics of each of the defined zones. Also, one of the conditions in the new construction is the preservation of the dominance of the city greenery.

5. CONCLUSION

Architectural heritage represents an important element of a nation's identity. By preserving it, the history, culture, and memory of economic and social development are preserved. In the majority of cases in our country, the law protects individual buildings or localities without taking into account the entire ambient unit that they create with the natural and created environment. After the changes in their environment, they as individual structures lose the identity and significance they had. That is why urban planning should be the starting point in protecting architectural heritage. Western European countries have been improving heritage protection in recent decades, protecting not only individual structures but also the landscapes they form with the natural and built environment. To find opportunities to improve the protection of our architectural heritage, the paper analyzed examples of good practices of successful urban planning and legislative interventions in Florence, Carcassonne, and Bath. Various approaches were presented and summarized in the discussion, which includes the creation of large protection perimeters within which new construction is limited or minimized, all to preserve the landscape that creates architectural heritage with the natural and created environment. Based on everything presented, the conclusion is that it is necessary to supplement our legal framework with the term "protection of the cultural landscape" following the example of the leading countries in heritage protection. Also, it is necessary to improve the mechanisms for compliance with existing regulations in their entirety. Finally, it is necessary to animate the wider community to participate more actively in decision-making and strategies for preservation of architectural heritage.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025, and Agreement on the Implementation and Financing of Scientific Research Work of the NIO in 2025 - Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025.

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ICUP2025
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THE DISMANTLING OF URBAN STREETS: A PATH TOWARD LOSING THE CITY'S SOUL

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ABSTRACT

The 1950s and 1960s of the 20th century in Europe marked a period of crisis in urban planning. The post-war economic boom led to rapid urban expansion and reconstruction, which architects sought to address through large-scale architectural interventions. During this period, urban planning prioritised the needs of motorised traffic, resulting in the dismantling of traditional urban streets and their replacement with megastructures and thoroughfares designed primarily for cars. This shift represented a stark departure from the human-scaled, vibrant streets that once characterised European cities. Terms like "linear communication platforms" and "traffic corridors" replaced the concept of streets, reflecting a car-centric approach to urban design where motorised traffic parameters became the primary criteria. Consequently, a new urban landscape emerged—one that was detached from the traditional notion of streets as spaces for social interaction and community life. The question remains: Do these megastructures and traffic corridors have the potential to create human-scale urban spaces that support vibrant street life, or do they merely alienate people from their cities? This research investigates how modernist planning principles transformed urban streets from multifunctional social spaces to traffic corridors, utilizing historical analysis and illustrative examples to identify effective strategies for human-centered street revitalization.

Keywords: *urban design; urban streets; walkable streets; pedestrian-centered design; car-centered urbanism; street programs.*

1. INTRODUCTION

The seductive ideals of the modern movement in architecture not only resulted in iconic architectural masterpieces but also fundamentally reshaped urban environments. Buildings designed for optimal functionality and stripped of ornamentation became symbols of progress, yet their translation to the urban scale often left much to be desired. Streets and boulevards, once vibrant spaces of human interaction, were reimagined as conduits for motorized traffic. This transformation reduced the richness of traditional streets into mere thoroughfares, prioritizing efficiency over the complexity and diversity of urban life.

Traffic engineers, under the influence of these modernist ideals, approached streets as problems to be solved rather than as spaces to be lived in. The intricate network of streets and public spaces that had previously served as the backbone of cities was increasingly dismantled to make way for traffic corridors and vehicular infrastructure. Traditional streets, rich in social, economic, and cultural functions, became collateral damage in this quest for modernity. The design of these new traffic corridors often failed to accommodate pedestrians, leaving them marginalized in spaces that were once built to human scale.

At the urban scale, zoning principles introduced during this era sought to address issues such as pollution, traffic congestion, and privacy by segregating distinct areas resulting in degradation of the organic connectivity that had defined cities for centuries. The victim of this modernist approach was the traditional urban street, which had long been a space for community, commerce, and culture. The dismantling of these streets not only disrupted the physical fabric of cities but also eroded their social and cultural identities. The loss of vibrant, walkable streets replaced by traffic-dominated spaces led to a sense of alienation and disconnection among urban residents.

This paper examines the dismantling of traditional urban streets, tracing its roots in modernist principles and their implementation during the mid-20th century. By analyzing historical contexts, theoretical perspectives, this study seeks to understand the socio-spatial impacts of this transformation. It asks whether it is possible to reclaim streets as vibrant, human-centered spaces and proposes strategies to balance the demands of functionality with the need for social and cultural vitality in contemporary urban design. Confronting this problem, this paper is addressing the following questions: (1) How did modernist zoning policies specifically contribute to the decline of mixed-use urban streets? (2) What are the measurable social and economic impacts of prioritizing motor traffic over pedestrian movement on urban streets? (3) Which urban design strategies have proven most effective in making the urban street more human centric? Furthermore, the central objectives of this study are to analyze the specific design features of modernist urban streets that negatively affect pedestrian experience, evaluate the effectiveness of contemporary street revitalization projects and finally, and most importantly, to propose a framework for integrating human-centered design principles into future planning initiatives.

While much of the existing literature is focused on theoretical critiques of modernist planning, this paper aims to fill this gap through going beyond theory. By analyzing historical contexts, theoretical perspectives, and practical examples, this study seeks to understand the socio-spatial impacts of this transformation. It asks whether it is possible to reclaim streets as human-centered spaces and proposes strategies to balance the demands of functionality with the need for social and cultural vitality in contemporary urban design. This research contributes to urban design discourse by offering a comprehensive framework for revitalizing streets as multifunctional urban spaces.

2. METHODOLOGY

This study employs a qualitative research approach to examine the transformation of urban streets from vibrant social spaces to traffic-dominated corridors, analyzing the impact of modernist planning principles on street design and urban life. The research methodology combines historical analysis, theoretical examination, and illustrative examples, to investigate this phenomenon comprehensively. A qualitative approach was chosen as a research design for this study due to its suitability for exploring complex social phenomena and urban transformations over time. This method allows for a nuanced examination of the historical, social, and design factors that have shaped urban streets, aligning with the research objectives of understanding the evolution of street design and its implications for urban life.

In terms of data collection, the study was collected through three primary methods: (1) Literature Review, on academic literature, urban planning documents and historical records in order to trace the evolution of urban street design. Key sources included works by Spiro Kostof, Jane Jacobs, and Le Corbusier, among others. (2) illustrative examples. Paris and London, were selected as case studies to illustrate the transformation of urban streets. These cities were chosen for their rich urban history and significant modernist interventions in the 20th century. And finally (3) Archival Research. Historical urban plans, architectural documentation, and photographic evidence were examined to provide visual and contextual data on street transformations over time.

The collected data was analyzed using a phenomenological approach, categorizing streets according to form, function, and social attributes. This classification system, inspired by Aldo Rossi's approach to urban morphology and Jean Tricart's three-level analysis system, allowed for a comprehensive examination of streets as complex urban phenomena. Thematic analysis was employed to identify key trends and patterns in the evolution of street design, with particular focus on the shift from human-scaled environments to traffic-dominated corridors. The analysis also considered the theoretical underpinnings of different approaches to street design, from traditional to modernist principles.

3. HISTORICAL OVERVIEW: THE EVOLUTION OF URBAN STREETS

To understand the phenomenon of streets in urban design, it is essential to examine historical records, theoretical frameworks, and examples, focusing on post-industrial and contemporary cityscapes. In what follows, we will provide an overview of theories and historical overview of the evolution of urban street. Urban expansion historically created neighborhoods with distinct functions—residential, commercial, or industrial—interlinked by a hierarchical street network. This network, resembling a branching structure, balanced main thoroughfares with side streets, fostering a dynamic urban fabric. Streets were not merely conduits for movement but spaces reflecting cultural values and societal life. Their design harmonized with human-scale rhythms, enabling accessibility and vibrant community interactions. This symbiotic relationship between urban form and lived experience underpinned the spatial logic of historic cities.

In *The City Shaped*[1], Spiro Kostof provides a nuanced approach to understanding urban morphology, avoiding the strict classification of cities into architectural styles such as Romanesque, Gothic, or Rococo. Instead, Kostof emphasizes the chronological development of cities, focusing on periods of intervention and construction that reflect broader socio-political and economic changes. He argues that cities, or at least their most significant parts, are better understood through the historical contexts that shaped their growth and transformation. Kostof categorizes cities into three broad typologies: pre-industrial, industrial, and socialist.[2] This framework moves beyond stylistic labels to address the functional and structural elements of urban design. From the perspective of design and urban format, he identifies many cities as mannerist, shaped by the interplay of aesthetic intentions and practical requirements. By framing urban development within these broader categories, Kostof illuminates the underlying forces—economic systems, governance, and societal values—that have historically dictated the evolution of urban environments. This approach situates urban morphology within a dynamic, interdisciplinary framework, encouraging a deeper exploration of how cities are not merely collections of architectural styles but living entities shaped by their historical and cultural contexts. Kostof's work provides a foundational perspective for understanding the evolution of urban forms, making it an essential reference for contemporary urban studies.

The transformation from pre-industrial to industrial cities was gradual. The Renaissance shifted focus from the divine to the human, creating conditions where religious and secular authorities shared influence over wealth distribution. Pre-industrial economic changes paved the way for cities to emerge as economic and cultural hubs. Urban expansion, driven by population growth, economic demands, and technological advancements during the Industrial Revolution, repurposed agricultural land for industrial, residential, and commercial uses. This shift necessitated new urban planning approaches and streets designed for specific functions—wide streets for industrial freight and narrower, human-scaled streets for residential areas.

Urban streets became critical in shaping cities, supporting growth through densification and expansion along established routes, while adhering to historical traditions and standards of living. This reflected cities' advanced economic organization and adaptability.[3] Their streets simultaneously met the needs of the users whose place of work and housing had not changed for centuries despite the different styles of economic activity (on an urban, territorial, and finally, on a state level).

* * *

In the early 19th century, emerging specializations in industry, production, and building often focused on ad hoc repairs rather than comprehensive urban planning, hindered by a lack of cohesive vision and thorough documentation. Only during periods of universal attitudes and cohesive planning did urbanism evolve into a deliberate process of strategic decision-making. Sigfried Giedion[4] highlighted late Baroque urban plans as examples of functional and aesthetic foresight, often crafted by lesser-known architects or speculative investors, laying a foundation for modern urban development.

It is important to mention that the good-quality solutions resulting from the 18th century's vision of ideal society have remained valid and functional – long after the dissolution of the societies in which they were planned and realized, after numerous changes in the circumstances in which they were to exist and of the functions they were to perform, and which their architects could not even imagine. But, even when the visions of the future

1 Kostof S., (1991), The City Shaped,
2 Kostof S., (1991), The City Shaped, p. 27
3 Корте Ј.В., (1968), Основи пројектовања градског и међуградског саобраћаја, p. 5
4 Giedeion S. (1997), Space, Time and Architecture, p. 708

development are significantly influenced by specialists, the solutions arrived at can often fail to meet the needs of the time in which they were planned or realized.[5]

Late Baroque urbanism emphasized the grandeur of outdoor spaces, with a strong focus on the relationship between buildings, nature, and social planning, connecting palaces to gardens and squares via tree-lined streets. Reflecting absolutism, urban developments served the ruling classes, neglecting the needs of ordinary people, who lived without access to green spaces or adequate sanitation. While Baroque ideals persisted into the 19th century, industrialization disrupted these traditions, as slums and urban expansions prioritized functionality over spatial values. Paris exemplified Baroque planning with its clear axes and cohesive design, whereas London, shaped by landowners and the church, lacked such order. The Great Fire of 1666 offered an opportunity for urban renewal, but Christopher Wren's reconstruction plan was rejected, leaving London fragmented and unprepared to adopt Baroque trends like monumental avenues and integrated networks seen in Rome and Versailles. One of the interpretations claims that it was so because London enjoyed a certain degree of self-government and independence from the Crown. This implies that neither Wren, nor the local government, found it acceptable to organize London around the Royal Palace. Wren drew his monumental axes radially from the Exchange on the east side, while to the west he positioned the cathedral church St. Paul. And in the given circumstances it was difficult to win the consent of the owners of the burnt down locations through which these new axes of the city had to pass.[6]

3.1. Transformation of cities: industrial revolution and urban transport

As cities transitioned from pre-industrial to industrial forms, the nature and function of streets underwent significant changes, driven by new technologies and social dynamics of the Industrial Revolution. Urban streets adapted to accommodate railways, freight vehicles, and increased traffic, shifting the focus from pedestrian movement to the speed of mechanized transport. Architects and planners faced the challenge of redefining streetscapes and addressing urban problems under higher-level decision-making influences. In Paris, new boulevards replaced traditional street networks to facilitate faster security movement and improve sanitation through updated infrastructure. Significant streets, boulevards, and public spaces created during this era laid the foundation for modern urban design, integrating functionality, aesthetics, and connectivity.

The transformation of Paris between 1850 and 1870 exemplified urban modernization. Haussmann's wide boulevards, squares, and interconnected greenery improved sanitation and infrastructure while enhancing visibility and accessibility for security forces. Initially planned for pedestrians, streets like the Champs-Élysées adapted to accommodate motorcars and diverse traffic, evolving into multifunctional urban arteries.

In his book *The Shape of the City*, Radović would rightly say that:

> …Traffic systems have an effect on the physical structure of all cities. Their technology and functions, capacities and character, speed and quality, which all together makes up an important structural framework of the city system as a whole, and their physical and constructive appearance and characteristics upon which, serve as a basis for the further development of their physiognomy, morphology and physical environment…[7]

These conclusions encompass the entire role of the thoroughfares and the intensity with which they participate and influence the organization of the cities and the planning of their landscape. History corroborates that at the end of the 19th and the beginning of the 20th century, this role of traffic became an imperative and was of crucial importance for the survival or demolition of entire parts of the existing city from the permanent urban weaving.

By the late 19th and early 20th centuries, traffic became a key factor in urban planning, driving the transformation of cities to accommodate motorized vehicles. Streets evolved into primary arteries for traffic, reshaping urban layouts, building design, and social dynamics. Colin Buchanan highlighted the environmental and spatial inefficiency of private cars, advocating for public transport to prioritize sustainability and public space. However, car-centric planning has persisted, leading to urban sprawl, reduced walkability, and environmental costs. Frank Lloyd Wright's Broadacre City proposed decentralizing cities and redefining streets

5 Op. Cit. p. 709
6 Ibid., p. 717
7 Радовић Р., (2003), Форма града, p. 58

as infrastructure for goods rather than people, offering a visionary alternative. Revisiting such models and embracing sustainable policies is essential to create livable, human-centered urban environments.

3.2. The multifaceted phenomenon of urban streets in modernist and historical context

The late 19th and early centuries saw traffic become a dominant factor in urban planning, setting the stage for modernist interventions that would fundamentally reshape the concept of urban streets. For a theoretical observation of the phenomenon of the city with all its elements and their harmonious and conflicting relations, we need to reduce of the notions to the abstract level of phenomena, that is to say, real phenomena that, unlike the imaginary ideas, have an essential influence on the shape of the city, its structure and its utilitarian, economic, cultural and anthropological role in the life of its inhabitants.

These phenomena will be referred to and treated as classes of phenomena. Basically, streets are always identified as one of the first levels of organization of urban space. In his extensive review of architectural theory, Michael Hays pays special attention to Aldo Rossi's interest in the tasks of so-called human geography and urban morphology.[8] In Rossi's opinion, this discipline has the task to study urban structure in correlation with the places where it emerges. This is in fact a sociological study within a limited space. To start the analysis of the place, however, it is necessary to determine in advance the limitations within which it (the place) will be analyzed. For this purpose, Rossi refers to Jean Tricart's three orders or levels:

- Street level, that comprises the buildings and the unoccupied space that surrounds them;
- The level consisting of several blocks with shared characteristics;
- The level of the entire city, taken as a sum of all city quarters.[9]

It would be inconceivable to start any morphological explanation of the city and its structure without starting from the street level. For generalization purposes and for the needs of this research, streets and thoroughfares will be treated as phenomena and will be grouped in different classes.

A street can be understood as a road in an urban context, or an urban space whose function is to fulfil the right of passage. The street seen as a road is the usual starting point when planning traffic. Traffic engineers see the designing of the street as a special case of designing a road that has to face several 'complicating factors' of urban planning that might work as an obstacle in the designing of a good road.

Architects see the street on the second level. For architects, streets are ensembles of buildings, sequences of various spaces with their different functions. One of these functions is transport itself and it works as a 'complicating factor' that prevents them from designing a beautiful space. Under the influence of Modernism, streets were predominantly treated and viewed as urban roads. Simultaneously, foundations were laid to the approach that sees the street as a multifunctional urban place.[10]

When comparing the level of services offered by the classes of phenomena generated on the basis of the principles of Modernism and those originating from the principles of Haussmann's Paris, the potential of the latter to create a richer program and the highest level of pedestrian experience, dwelling and usage of the streets for needs much richer and deeper than the need for movement, transport and other utilitarian functions be Jean Tricartmes evident.

Le Corbusier's vision of the new modern city did not include main streets such as boulevards or avenues. This implied that no cafeterias along the pavements were envisaged, no Champs-Élysées.[11] The new city had a function. It consisted of parts – zones. Its streets were replaced by thoroughfares that were to connect these parts in a most optimal technical and economic way. People were to migrate on a daily basis to various parts of the city, but also outside it. Seen more generally, the zoning emerged as a reaction to the uncontrolled development of the industrial city in a period when the space in the city itself was exhausted or failed to meet the technical demands for new factories and other production venues, and the new spaces were developed along the access roads leading to and from the city itself. The striving for some sun, clean air, appropriate infrastructure

8 Hays M., (2000), Architectural theory since 1968, p. 509
9 Роси А., (1966), Архитектура града, (The Architecture of the City), p.37
10 Marshall S., (2005), Streets & Patterns, p. 23
11 Ibid. p. 45

network and space fit for humans, when applied on a level of urban planning, resulted with disassembling of the large body of qualities offered by the traditional city and streets.

According to Marshal, this omission of the street in Corbusier's vision is not accidental. Intuitively, he recognized the power of the street to connect different parts and functions of the city – in a traditional way. Therefore, in his attack of the traditional city, Le Corbusier did choose the right target indeed.[12] The exceptional pressure of the economic aspect on the positioning of the dense urban weaving in the historical quarters of the cities resulted with reprogramming of the functions in these quarters and even in spaces that failed to meet the basic physical criteria to qualify as streets. One such example are the pedestrian paths in the medieval city centers. These pedestrian paths were ergonomic for humans and their size while the large thoroughfares were designed primarily for the purposes and needs of motorized traffic. On them pedestrians occupy only a secondary position and are taken into account only when defining the safety measures and standards for physical protection.

The issue of regulating or street lines is one of the issues that have to be taken into account when trying to define streets as a planning category. This is so because these regulating lines are the limits along which the purposes of the land for public and individual use are defined. No standardization of the ways, kinds and types of regulation of the building land and of the elements of regulations has been achieved to the moment of the writing of this text. There are standardized dimensions and elements of the traffic infrastructure, there are typologies of building lots according to their purpose and use, of urban blocks according to their form, purpose, parceling and organization, but these typologies are not standardized and only serve as a basis for orientation data for the professional community.

In the general quest to secure some identity for the different parts of the cities in the fifties, in circumstances of polycentric urban development, the Smithsons had two ideas based on the communications design: roadway networks and traffic buildings. The roadway networks were applied in disregard of the existing level of the streets and were designed as multileveled loops instead of crossroads, while the traffic buildings were covered pedestrian streets with moving pavements. Despite the several traffic arguments in favor of the advantages of this approach, the real reason why Alison and Peter Smithson favored it was their belief that these megastructures, superposed onto the various scattered parts of the city, would be like the erstwhile city walls and defense ditches in the medieval towns, thus giving the city its new identity.[13]

One-sided approaches to the transport and traffic solutions lead to disruption of the connection with the environment for which the lay-out and the solutions were devised in the first place. The inclination toward a comfortable, safe and fast transport results with solutions that envisage a minimal number of intersection points. The theoretical model, and later on, the real projects and buildings, involve changes of direction through curves with enormous radiuses (because of the high speeds), and envisage traffic participants passing each other on different levels and complete physical separation of the pathways of all different traffic participants. This extreme is the exact opposite pole of the street phenomenon. It is the zenith of the thoroughfare.

According to Moughtin,[14] the basic definition of the classes of phenomena termed as paths, roads, streets, avenues, boulevards, etc., should be founded on the emphasis on the difference between the road and the street. The first class of phenomena is observed in a shape of a two-dimensional strip-lake structure that extends across the ground and serves as a traffic connection between inhabited places. All kinds of traffic instruments move along them (depending on the historical period in which they emerged). This linear structure has its beginning and end. The street can have similar features, but it is observed primarily as a road that passes through an inhabited place (a village or a city).

Moughtin refers to the basic definition for street in the Shorter Oxford English Dictionary that defines street as a 'public road in a city, town or a village, typically with houses or buildings on one or both sides.' It is interesting that, on the basis of these definitions, Moughtin adds a third dimension (the height of the buildings on the sides of the street) that makes the crucial difference between the class of roads and the class of streets, and he says: '…For the purposes of this analysis, streets will be perceived as closed three-dimensional spaces between two lines of consecutive buildings…'[15]

12 Ibid.
13 Ibid., p. 392
14 Moughtin C., (2003), Urban Design: Street and Square, p. 129
15 Ibid., p. 129

There is another distinction between roads and streets and that is the degradation of pedestrian movement in favour of motor traffic. With the increase of the degree of motor traffic service, there ensued a proportional reduction in the number of pedestrians or other kinds of non-motorized traffic participants. The aim of roads and motorways was thus reduced to serve the high-speed motorized traffic. Moughtin considers this distinction a result of the modernist doctrine, while urban planning and cities themselves are a result of functional planning, zoning, but, above all, of the need to solve the utilitarian function of transport.

Solving the sanitary needs on the level of buildings and on city level in circumstances of accelerated industrial growth resulted in a doctrine according to which the basic aim of planning was to provide the surfaces and volumes necessary for locating functions. The intensified growth of the cities during the period of Modernism, after the Second World War, created disproportionately greater surfaces for different functional urban zones compared to the traditional urban weaving, so much so that the meanings of the notions used to denominate the phenomena in their original form were lost.

In the great post-industrial cities with many million-strong populations, it was necessary to restructure the physical dimensions of the streets, buildings and the entire infrastructure. The former wide promenades, such as Les Champs-Élysées in Paris, or Ocean Parkway in New York acquired a new role – servicing the ever more intensive, faster and more numerous motor traffic. In these circumstances, Walter Benjamin's urban walker (flaneur) became a category of the urban cultural life whose space was reduced and narrowed.

The satisfaction of the needs of the urban inhabitant for safe (from motor traffic) socialization, communication and living in the 19th century city took place in the covered streets, or arcades. This need was unavoidably linked to the dream about the ideal concept of a pedestrian's experience of the great city. And for this purpose, these spaces were covered, with façades facing inside, feeding the illusion that the users are actually in an 'outdoors' space. This dream had the intensity of a child's experience of the street as a set for the activities of the show called the city.[16] This attitude was in complete contradiction to the postulates of functionality, rationality and standardization of urban planning of space, as determined at the International Congress of Modern Architecture (CIAM), held in Athens in 1993.

Stephen Marshall is explicit in his explanation of the 'dismantling' of the street under the influence of factors that originate primarily from the principles of Modernist urban planning. The street is a collateral damage of the Modernist schism between canalizing transport, open public spaces and constructed urban forms in the shape of complexes instead of buildings, which are part of the traditional urban structure.[17]

The Modernist approach to urban planning emphasized mechanical efficiency, focusing on zoning and connecting areas for work, recreation, and housing. This process prioritized traffic engineers over architects, sidelining holistic spatial planning. Marshall highlighted how traffic-focused planning reduced urban design to mathematical calculations, optimizing variables like peak-hour vehicle flow while neglecting other elements. Roads were designed for specific functions, with high-capacity thoroughfares segregated from pedestrian and non-motorized traffic, minimizing intersections and direct access. Existing streets were stripped of their social and spatial character, transformed into utilitarian expressways, leaving them devoid of their essence.[18]

The city limits, and the connection between its various parts are directly related to the speed of its transportation means. One of the chief tasks of traffic planning in cities is the temporal and spatial system that determines the borders of the region that is to be serviced in a moderately short time and at an affordable price. Urban design thus gains a fourth dimension. Upon the three spatial dimensions, the dimension of time is superposed in order to help us perceive the city as a living social environment. Because of this, according to Korte, planning and time and space relations have become the alpha and omega of contemporary urbanism and traffic. All specific measures and details are derived from these two, until the regulating and construction lines are determined.[19]

4. URBAN PRINCIPLES FOR REVIVAL OF HUMAN-CENTERED STREET DESIGN

The transformation of urban streets in the mid-20th century cannot be fully understood without addressing the seminal critiques offered by Jane Jacobs in her groundbreaking book *The Death and Life of Great American*

16 Graafland A. ed, (2001), Cities in transition, Dieter Hassenpflug's text, Walter Benjamin – Looking at the dream – side of the City, pp. 252, 253.
17 Marshall S., (2005), Streets & Patterns, p. 7.
18 Marshall, S., (2005), Street &Patterns, p. 8
19 Корте Ј.В., (1968), Основи пројектовања градског и међуградског саобраћаја, p. 19

Cities.[20] Jacobs vehemently opposed the modernist urban planning doctrines that dominated her era, particularly the large-scale redevelopment projects that prioritized vehicular efficiency and monofunctional zoning over the complexity and vibrancy of human-scale urban life. Her work provided a counter-narrative to the traffic-dominated paradigms discussed earlier, emphasizing that streets are not mere conduits for movement but dynamic spaces for social interaction and community engagement. Jacobs argued that streets thrive when they support a diversity of uses, blending residential, commercial, and recreational activities. She famously asserted that 'eyes on the street' were critical for creating safe and vibrant urban environments. This principle highlighted the importance of pedestrian activity, small-scale commerce, and informal social surveillance in fostering a sense of belonging and safety within urban neighborhoods. By contrast, the zoned, car-centric approaches of the modernist era segregated these functions, eroding the organic, multifunctional character of traditional streets.

Jane Jacobs critiqued urban renewal projects that demolished neighborhoods for wide roads and high-rise developments, arguing they disrupted the social networks and vibrancy of traditional streets. Unlike modernists like Le Corbusier, who prioritized efficiency and zoning, Jacobs championed incremental, small-scale development and the preservation of historical urban fabrics. Her vision emphasized streets as living spaces for interaction, culture, and community, contrasting the mechanistic approach of 20th-century planning. Jacobs' advocacy for walkability, mixed-use design, and "eyes on the street" remains a powerful counterpoint, highlighting the essential role of streets in fostering vibrant and connected urban life.

The historical evolution of streets, as previously examined, reveals that their role has always been shaped by the prevailing socio-economic and technological forces of the time. In the pre-industrial city, streets were multifunctional spaces that mirrored the rhythms of human life. The Industrial Revolution marked a turning point, as the demands of mechanization and mass production reshaped streets into corridors for goods and vehicles. Modernism further entrenched this shift, privileging the needs of cars over those of pedestrians. Jacobs' work challenges this trajectory, offering a vision for reclaiming the lost potential of streets as inclusive, human-centered spaces. The lessons of Jacobs become even more urgent when considering the environmental and social challenges of contemporary urban life. As Colin Buchanan observed, private vehicles consume disproportionate space and contribute significantly to urban air pollution, undermining the quality of life in cities. Public transport and walkable streets, as Jacobs advocated, present viable alternatives that align with both environmental sustainability and social cohesion. Her vision calls for a rebalancing of priorities, where the human scale takes precedence over the mechanistic demands of traffic flow.

5. CONCLUSION

This research has examined the transformation of urban streets from vibrant, multifunctional social spaces to traffic-dominated corridors, tracing the historical evolution of streets and analyzing how modernist planning principles fundamentally altered their character and function. The findings reveal both the profound losses associated with car-centric urban design and potential pathways toward reclaiming streets as essential public spaces that support diverse aspects of urban life. Our analysis demonstrates that the future of urban streets lies in following insights and examples from both historical and contemporary perspectives. The traditional streets of pre-industrial cities offer valuable lessons in human-scale design and multifunctionality, while modernist approaches highlight the importance of addressing mobility needs in increasingly complex urban systems. Jane Jacobs' work provides a crucial bridge between these paradigms, advocating for streets that are both functional and vibrant, serving as arteries of movement and spaces for social and cultural exchange[21].

This research contributes to urban design discourse by developing a theoretical framework for understanding streets as complex urban phenomena rather than merely technical infrastructure. By examining streets through phenomenological and typological lenses, the study highlights the multidimensional nature of streets as simultaneously physical, functional, and social entities. This perspective challenges the reductive approaches that have dominated much of 20th-century street design, opening possibilities for more nuanced, context-sensitive interventions that respond to the full range of human needs and activities.

Looking forward, the challenge for urban planners and designers lies in reconciling competing priorities to create inclusive, sustainable urban environments. Reclaiming streets from vehicular dominance and restoring their social, cultural, and economic functions requires a deliberate shift in design priorities. By integrating human-

20 Jane Jacobs, The Death and Life of Great American Cities (New York: Random House, 1961)
21 Jacobs, J., (1977), The Death and Life of Great American Cities, p. 37

centered principles with necessary infrastructural considerations, cities can develop streets that are not only efficient but also foster community connection and enhance quality of life.

This research underscores the need for integrated approaches to street design that balance mobility requirements with opportunities for social interaction, economic activity, and cultural expression. Future studies should explore innovative strategies for implementing these principles in diverse urban contexts, considering factors such as technological advancements, changing demographics, and environmental sustainability. Ultimately, the revitalization of urban streets as multifunctional public spaces is essential for creating more livable, resilient cities that can meet the complex challenges of 21st-century urban life.

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ICUP2025
5th international conference on urban planning

URBAN GREENERY WITHIN MULTI-FAMILY RESIDENTIAL PLOTS IN NIŠ, SERBIA: REGULATIONS AND REALITY

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ABSTRACT

Green spaces within multi-family housing areas are an important measure of the quality and well-being of the residential environment. They are directly and indirectly beneficial for residents, because in addition to providing a physical framework for rest and recreation, they are responsible for improving aesthetics, regulating the microclimate, providing habitat for wild animals, as well as carbon sequestration. Since living near landscaped green areas can significantly contribute to physical and mental health, the presence of quality common greenery could become an important factor when choosing a future apartment. Although applicable regulatory plans require a certain percentage of the plot area to be covered with greenery, depending on the location and the intended housing density, unfortunately, the practice is often different. This paper deals with the analysis of the quality and size of green areas on plots intended for multi-family housing in the City of Niš. The research included a qualitative analysis of the content and design of green areas and their quantitative analysis in relation to the required parameters from the related planning documentation. The paper also analyzed examples of good practice from abroad, the experiences of which can be useful for improving the housing environment in the local context. The findings of this paper indicate that during the design and construction phase of multi-family residential buildings, the greenery within the plot is often not taken into account enough, that the real situation often deviates from the project documentation, as well as that the maintenance of the existing green areas is at an unenviable level, which additionally contributes to the deterioration quality of greenery and residential environment in general.

Keywords: *green areas; multi-family residential plots; regulations; housing quality*

1. INTRODUCTION

The physical environment is a crucial determinant of environmental health, and green spaces are among the most significant measures of the quality and well-being of the urban environment (1). Green spaces within multi-family residential areas have multiple roles and are directly and indirectly beneficial to residents. They provide a physical framework for rest and recreation of dwellers, as well as places for social interactions among neighbors; they are responsible for improving aesthetics and environmental beautification; they are important for regulating the microclimate, benefits of cooling effect and energy saving, as well as carbon emission reduction; they are also interlinked with providing a habitat and is important for biodiversity (1, 3, 6). Greenery could have a positive effect on the human psyche and body, and the presence of high-quality common green spaces could become an important factor when choosing a future apartment (1, 6).

The concept of a green city – a city as an ecological system that is part of nature and is connected to the surrounding landscape – has been known for more than a century. Today, it is aligned with the Agenda 2030 of the United Nations and is important for achieving the Sustainable Development Goals (4). Nevertheless, sustainable development ideas in Serbia are being implemented with a delay, sporadically, and unsystematically. When it comes to the construction of multi-family residential buildings in the private sector, green areas within the plots are generally implemented in the final phase of construction or during the use phase of the facility. While architects focus more on technical solutions that would achieve a satisfactory energy balance, other design aspects remain neglected, including the quantity and quality of greenery. Although this area is regulated by planning documentation, we are witnessing the fact that greenery within multi-family housing plots is often absent which degrades the residential environment in many ways. Still, with limited land resources, as is the case in central urban areas, it is significant to effectively combine multiple greeneries and quantitatively optimize the greenery design (7).

The amount of greenery in multi-family residential areas is a valid indicator of sustainability and quality of housing. However, not only the quantity of greenery is important, but also its density and health. Furthermore, two key components of urban vegetation, trees and grass, have different impacts on the environment and different ecological functions and services. Some research observed a significant positive relationship between physical activity and treed areas and suggested that greater exposure to vegetation, especially trees outside of parks, may be associated with better health (5). Others claim that air temperature, energy consumption, and carbon emission decrease with an increase in the trees-grass area ratio (7). Also, as the cooling effect of trees is significant, outdoor activities of residents as well as the establishment of social contacts are more pronounced in areas that have combined trees and grass than in areas with only grass.

2. METHOD OF THE RESEARCH

The research field of this paper included green areas on plots intended for multi-family housing in the territory of the City of Niš, more precisely the city municipality of Mediana. Mediana is the central and most densely populated city municipality, which has been undergoing intensive and rapid transformation in recent decades. The neighborhoods of this part of the city, where single-family housing has prevailed for decades, are changing their appearance due to changes in regulatory plans and new urban planning parameters. The demand for housing in the city center is increasing and multi-family housing is replacing one family house at a time. In this transformation, the square meters of residential and business space, as well as parking places, are the most important for investors, while greenery is reduced to only the minimum required by the plan, although often not even that. Unfortunately, it implies a significant densification of physical structures and an additional increase in housing density, which often results in permanent and irreversible devastation of the quality of the housing environment.

The General Regulation Plan (GRP) (2) for this city municipality, through the Building Rules in the earlier version, required that at least 10% of the plot area intended for housing be under greenery. The quality and type of planted greenery were not defined by this document. Following amendments to the Plan at the end of 2021, the minimum percentage of the plot area for greenery was increased to 25%, with at least 10% of the plot area to be greenery in direct contact with the ground. Moreover, the amended Plan distinguishes between different categories of greenery (trees, green roofs, green facades, greenery above underground floors) whose share in the total green area is calculated differently. Thus, one tree is valued as five square meters of greenery, green roofs, green facades and greenery above underground floors are counted as 50% of the area, while greenery in direct contact with the ground is counted as 100% of the area of greenery.

The paper first presented three good practice examples from abroad which show that the presence of different types of greenery on the multi-family housing plot contributes to the functional, ecological and aesthetic improvement of the quality of the residential environment. The examples selected for analysis are fully comparable to the domestic sites analyzed below in terms of their purpose, size and position in the urban fabric.

Then five projects from the municipality of Mediana were presented. These are plots with multi-family housing buildings that were built in the last 5 years. The first three projects were built in accordance with the GRP before the amendments, and the remaining two with the plan after the amendments. For each of the projects, a site plan was presented indicating the layout and content of green areas. The values required by the plan and those foreseen by the project for plot occupancy, floor area ratio and green area were shown side by side, as well as the number of residential units and the potential number of residents. Also, photos were shown that unequivocally show whether, and to what extent, the planning document and the design were complied with.

3. GOOD PRACTICE EXAMPLES

3.1. ParkLife Apartment Building, Brunswick, Australia (Austin Maynard Architects)

ParkLife Apartment Building consists of two parallel, connected structures and is attached to neighboring buildings on two sides. The design is characterized by high plot occupancy, of about 85%. As much as 85 square meters out of the approximately 105 of unoccupied area on the ground was covered with greenery. Towards the street, the building line and the street line coincide. On the opposite side, towards the public park, the building was set back from the boundary of the plot by 3 meters and that area contains three small gardens that belong to the apartments on the ground floor. Although they represent private open areas, these gardens contribute to the overall quality of the building with their greenery. Two open spaces between the parallel parts of the building were also planted. In addition to providing daylighting for apartments, their content enriches the common and private spaces in the building that are oriented towards them. The stepped setback of the northern facade created spacious private terraces that were equipped with large planter boxes so that this side of the building gives the impression of hanging gardens. Green areas were also located on the flat roof, in the form of a grassy part for free activities and the so-called productive garden. The building was designed to build community and prioritize social, economic and environmental sustainability. (Figure 1)

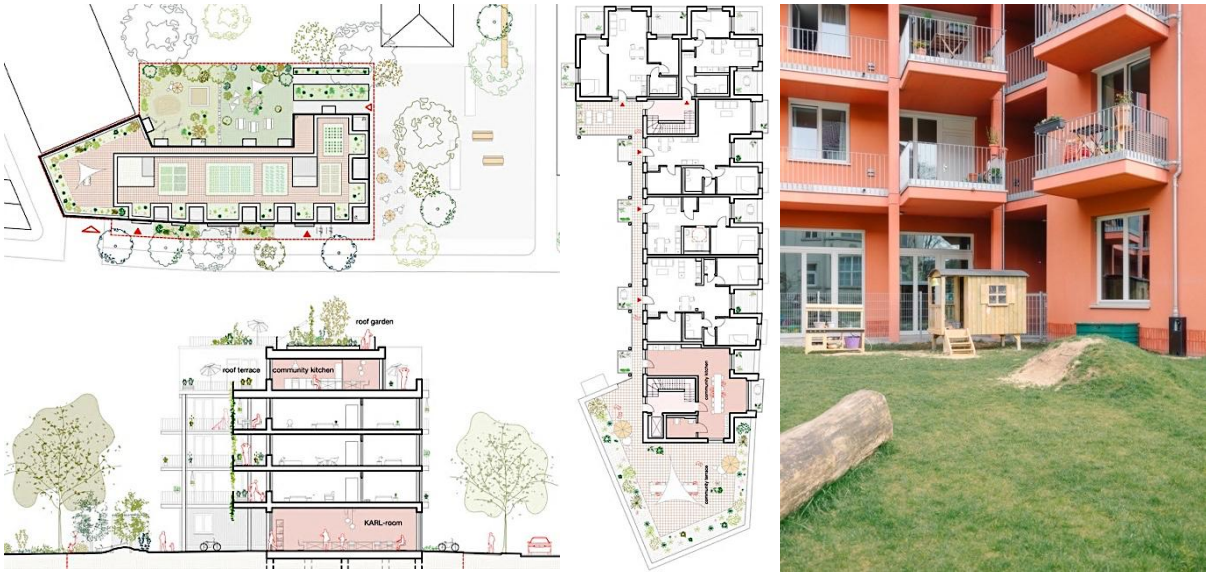


(a) (b) (c) (d)

Figure 1: ParkLife Apartment Building (a) Ground level floor plan, (b) Seventh level floor plan, (c) North facade, (d) Courtyard view

3.2. KARL Cooperative Housing, Bremen, Germany (Praeger Richter Architekten)

KARL Cooperative Housing is a detached building located on a street corner. The longer side of the building was set back from the street line. This created a bicycle parking and a small front garden of the kindergarten located on the ground floor, which further enriched and beautified this facade. On the other side, towards the interior of the urban block, a back yard has been formed. It was completely planted, with a large grassy area in the central part and shrubby and tall vegetation around the perimeter. The back yard was functionally divided into two parts: kindergarten outdoor area and community garden, suitable for communal dining, celebrating, socializing, and relaxing. Semi-private access galleries connect the common areas, individual outdoor spaces, and living rooms. In order to ensure the privacy of individual balconies towards the semi-public garden, climbing plants were provided within and above the balcony railing. As an open communication zone facing the courtyard, these access galleries form a lively, social façade. In this way, the greenery fulfilled not only its ecological and aesthetic but also its functional and social purpose. The last floor was set back, which forms a common terrace for residents to socialize with planters around the perimeter, while the roof terrace is used for social interactions and urban gardening. (Figure 2)



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

Figure 2: KARL Cooperative Housing (a) Site plan, (b) Section, (c) Top floor plan, (d) Backyard view

3.3. Vilela 2, Buenos Aires, Argentina (Estudio Planta)

The Vilela 2 apartment building was located on a narrow and long plot and was designed as two parallel, connected residential structures. The back yard, which makes up about 30% of the plot area, was fully planted, with lawn and trees around the perimeter, while the open space between the parallel parts of the building was covered with fine gravel. However, the main feature of this building is the greenery on the facades. On the street and back yard facades, it was planted in planters placed along the entire length of the facades, while on the court yard facades it was planted in flower pots placed under the windows. Precise plant diagrams on the facades define exactly which plant should be planted where. In terms of plant typology, three parts are distinguished: the street facade (tropical plants with large leaves, palm trees and ferns), the courtyard facades (asparagus and specially selected types of flowering shrubs and plants) and the back yard facade (evergreen climbing plants and particularly chosen types of flowering shrubs and plants, different from those on courtyard facades). This innovative approach to solving the greenery within the plot contributes simultaneously to all aspects of sustainability. At the customer's request, the plants are rather bushy and the bars, for possible climbing plants, are only at the height of the balcony railing. (Figure 3)



(a), (b) (c) (d), (e), (f)

Figure 3: Vilela 2 (a), (b) Façade plant schemes, (c) Courtyard facade, (d) Ground level floor plan, (e) Second level floor plan, (f) Backyard view

4. RESULTS OF THE RESEARCH AND DISCUSSION

Figure 4 shows a map of the part of the city municipality of Mediana and the position of selected multi-family residential projects that are included in the research.

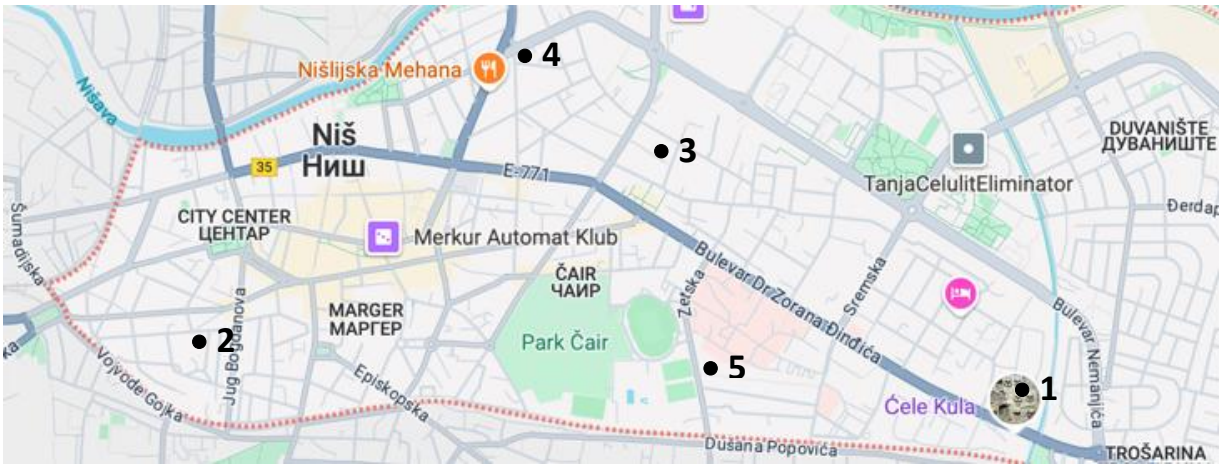


Figure 4: Map of the part of the city municipality of Mediana with the positions of selected multi-family residential projects

Table 1 provides a comparative overview of the basic urban planning parameters for all five projects.

Table 1: Comparative overview of the urban planning parameters

	Plot Area	Number of Floors	Number of Units	Number of Residents	Plot Occupancy		Floor Area Ratio		Green Area	
					Plan	Design	Plan	Design	Plan	Design
1	622 m^2	G + 4	16	44	60%	56.10%	3.20	2.92	10%	11.60%
2	620 m^2	G + 6	32	79	70%	69.77%	4.20	4.20	10%	10.07%
3	380 m^2	G + 3	6	27	60%	59.99%	2.40	2.38	10%	11.01%
4	157 m^2	G + 3	2	6	60%	60%	2.40	2.31	25%	26.10%
5	418 m^2	G + 4	13	37	60%	58.19%	2.40	2.39	25%	45.62%

4.1. Project 1

The apartment building was set back by 2m from the street line, which created a small front garden in front of the entrance to the building, where several thuja trees and coniferous shrubs were planted. The areas with trees that were planned along the side boundary of the plot, between the parking places, were not implemented, but this entire area was paved. Also, the planned grassy area with shrubs and trees behind the building was not created, nor was the garden bed along the back boundary of the plot, but the entire back yard was paved and turned into a parking lot. The only piece of greenery is a tiny planting bed at the back of the plot with two thuja trees. It is obvious that the green area achieved in this project is far below the prescribed minimum, which significantly reduces the quality of housing and the living environment. Greenery planted in front of the building, apart from partially beautifying the front appearance of the building, does not contribute more significantly in terms of climate, energy and social aspects. (Figure 5)

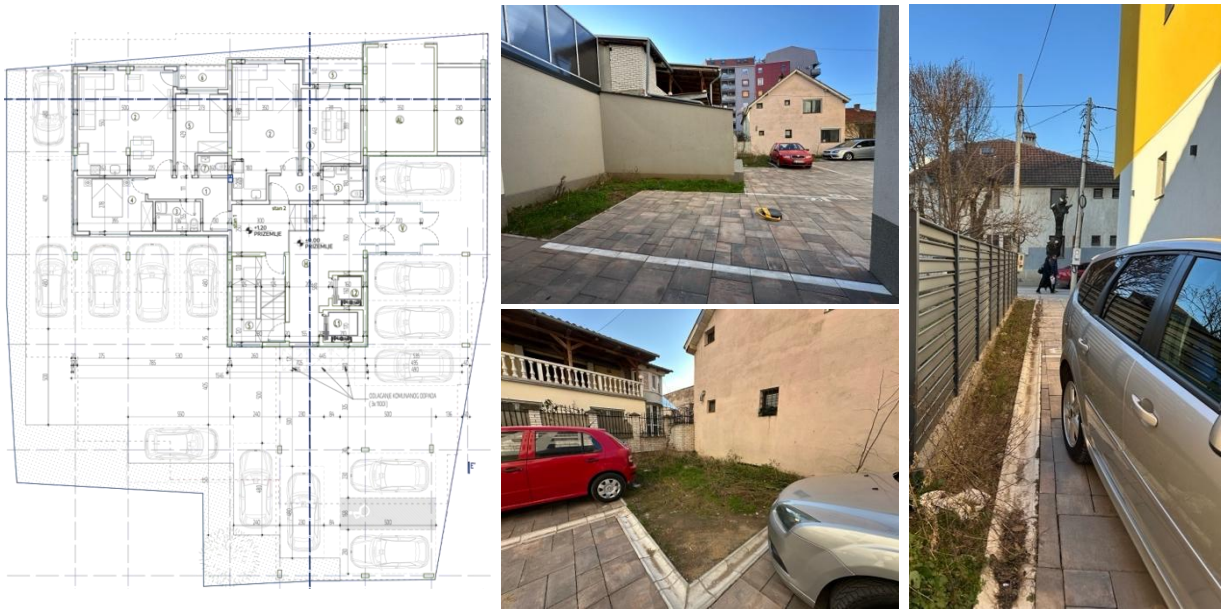
4.2. Project 2

The residential building was positioned on the corner of two streets, on both street lines. The design envisaged green areas behind the building, in the form of green strips of different widths along the perimeter of the plot, suitable for planting grass or shrubs, and only in a few places for planting trees. Although created in accordance with the design, the green areas show a number of weaknesses of this kind of solution. The design did not envisage the formation of a compact green area that residents could use for growing plants or other outdoor activities. The already small green area was further rendered dysfunctional and unusable by reducing it to narrow strips. Areas planted with grass are very unsightly due to poor maintenance and spoil the appearance of the backyard. The lack of equipment on grassy surfaces also does not favor their more intensive use. At the same time, the building was intended for housing up to 80 users, which emphasizes even more the insufficient area of greenery and its inadequate design. Greenery on the plot does not improve the building either functionally or aesthetically. There are no trees or shrubs within the plot, so the environmental contribution of greenery is minimal. (Figure 6)



(a) (b), (c) (d), (e)

Figure 5: Project 1 (a) Site plan, (b), (c), (d), (e) View of the unoccupied part of the plot



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

Figure 6: Project 2 (a) Site plan, (b), (c), (d) View of the unoccupied part of the plot

4.3. Project 3

This residential building was set back 3m from the street line. A designed parking place in front of the building blocked the formation of a pleasant front garden so the architect reduced it to a few planters, only one of which exists on the site. It was planted with bushy plants and defined the entrance to the business premises on the ground floor in a pleasant way. The design envisaged two green areas behind the building, one in the form of a narrow strip along the back boundary of the plot and the other, slightly larger, adapted for the unhindered development of trees. However, there is only a narrow green strip framing the parking lot behind the building. Shrubs and dwarf trees were planted in these narrow garden beds. They are quite well maintained and add to the aesthetic quality of the back yard. A mature tall coniferous tree additionally enhances the appearance and quality of this space. The tree was obviously on the site before the construction of the facility and its retention was beneficial in several ways. Although the paved part of the yard is entirely intended for parking, the selection of plants, as well as their condition, make this environment pleasant for spending time and outdoor activities. If the green areas were the size envisaged by the design, the quality of open spaces would be improved even more. (Figure 7)



(a) (b), (c) (d), (e)

Figure 7: Project 3 (a) Site plan, (b), (c), (d), (e) View of the unoccupied part of the plot

4.4. Project 4

As this residential building was built after the amendment to the GRP, new norms related to green areas on the housing plot were in force. The design therefore envisaged greenery in contact with the ground on 15.9 square meters (10.1% of the plot area) and five trees, which according to the building rules is equivalent to 25 square meters of green area (16% of the plot area). Planting beds have been created on the site, but for now there is no greenery or trees, even though the facility is already in use. The unoccupied part of the plot, despite the fact that the building is new, looks messy and unpleasant. Disregarding the rules of planning documentation clearly harmed the quality of housing and the residential environment. (Figure 8)



(a) (b) (c)

Figure 8: Project 4 (a) Site plan, (b), (c) View of the unoccupied part of the plot

4.5. Project 5

The design for this apartment building envisaged 61.45 square meters of green area in contact with the ground (14.70% of the plot area), more than 200 square meters of green roof (of which 50% is counted in the total green area) and five trees (calculated as 25 square meters of greenery). In the final calculation, this amounts to 190.71 square meters of green space, or even 45.62% of the plot area, which is a significant green space for a residential plot in the wider city center. However, the actual situation on site is quite different. Although the building was set back from the street line by 1m and the design envisaged the formation of narrow grass strips in front of the building, they were not realized and this space was completely paved. The remaining areas on the ground intended for greenery were somewhat reduced in relation to the design, but what is the main feature is that they were not planted but covered with artificial grass. Although the garden beds arranged in this way look green and tidy, there is no positive ecological impact on the environment. Furthermore, the spacious green roof does not exist either, but has been replaced by a regular flat roof, so the whole greenery design can be considered a big failure. (Figure 9)



(a) (b) (c)

Figure 9: Project 5 (a) Site plan, (b) View of the unoccupied part of the plot, (c) Flat roof view

5. CONCLUSIONS

This research points to several findings. First, there is a positive change by which the legislator increases the minimum green area within residential plots in the planning documentation and distinguishes between different categories of green areas. This measure is in line with the principles of sustainability and has an impact on improving the quality of housing and the residential environment, and encourages architects to implement innovative solutions. However, as a higher floor area ratio usually implies a larger number of housing units and users, it would be desirable to also take this index into consideration so that buildings with a larger number of users would have proportionally more green areas. Secondly, it is necessary to raise the awareness of investors regarding the direct and indirect benefits of greenery within multi-family housing plots on residents. Improving the housing quality is a category that benefits not only future residents but also investors. In this context, the influence of the presence of high-quality green areas in the immediate vicinity of an apartment on the choice of apartment, as well as on the price of the property, should be particularly emphasized. Third, it has been observed that investors circumvent building regulations relating to green areas on the plot in various ways, thereby irreversibly damaging the quality of housing. It is therefore clear that control mechanisms must be stricter so that investors in the future cannot deviate from the design during the construction phase. Last, but not least, it is desirable to provide architects with additional training related to the design of green areas on residential plots in conditions of limited land resources. Solutions that can be seen in developed and environmentally aware communities could inspire domestic architects in their design tasks, which could give our cities creative and ingenious green housing projects.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš – Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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ICUP2025
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MARINE SPATIAL PLANNING DEVELOPMENT IN THE EASTERN PART OF THE ADRIATIC SEA

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ABSTRACT

Marine spatial planning (MSP) can be defined as the process of analysing and organising temporal and spatial human activities in the marine environment in order to achieve ecological, economic and social goals. In European Union (EU) countries, MSP has been established as a concept with clear goals and timing for its implementation in practice. The European Parliament and the Council of the European Union adopted Directive 2014/89/EU on July 23, 2014, which establishes a framework for MSP in the EU. EU countries have an obligation to follow the Directive. The problem with the majority of non-EU, is the lack of a systematic and global approach to the topic. They are less focused on MSP due to implementation problems, for instance, lack of regulations, governmental interest, etc. In the paper it will be analysed state of MSP in Slovenia and Croatia as EU countries compared to state of MSP in Montenegro, Bosnia and Herzegovina and Albania. All five countries belong to the eastern part of the Adriatic Sea. The questions that are raised by the paper are whether these countries have something in common in the MSP field and should they learn from each other's models (if the country has any MSP model at all). Another question is should they consider what is going on, in the MSP field, on the other side of their state border and should they make some adaptations. From the results of the overall research, it can be concluded that Slovenia adopted its MSP and Croatia is on their way to do the same in a year or two. Other countries analysed by the paper are not even close to their MSP adaption due to lack of legislative and sometimes even political problems they have at the moment. As can be concluded from the research, eastern coast of the Adriatic Sea countries, have developed certain communication in information exchange, but it could and should be improved.

Keywords: *marine spatial planning; Adriatic Sea; EU countries; non-EU countries; development*

1. INTRODUCTION

Marine spatial planning (MSP) is the process of analyzing and organizing temporal and spatial human activities in the marine environment in order to achieve ecological, economic and social goals (URL 1). MSP today is an extremely important topic for maritime countries within the European Union, but also for non-European countries. This is because of the need for joint protection of marine areas. Despite the borders at sea, nature does not recognize this element. Sea currents make events in the marine areas of one country significantly influential in each country towards which seawater moves. Seas and oceans have been unknown for a long time. That is the reason why it has not been given enough attention in the past. Today, the significance of marine areas, their economic, social, cultural and ecological importance, has been recognized.

In 1975, at the Convention for the Protection of the Mediterranean Sea against Pollution, the Protocol on Integrated Coastal Zone Management was signed in Barcelona, and together with it the legal framework of the Mediterranean Action Plan was made. The Protocol was the successor to the United Nations regional approach to the problem of pollution of the world's seas and oceans adopted at the Stockholm Conference in 1972 (Trumbić, 2004). Exactly 30 years later, the proposal for the Protocol on Integrated Coastal Zone Management of the Mediterranean was created. In 2008, the new Protocol was signed in Madrid, as the first international document dealing with management on a multidisciplinary basis that includes spatial planning, ecology, protection of cultural and built heritage and economic activities in the function of sustainable development, agriculture, tourism and fisheries (Seršić,1995).

More than 30 years ago, a Sea Use Plan for the Northern and Southern Adriatic Sea was prepared. Since then, many pilot projects of the Adriatic Sea area were established. The development of the Blue economy and Blue growth have given an additional push to the development of MSP throughout Europe (Figure 1), including the East Mediterranean (Figure 2) and Adriatic Sea.

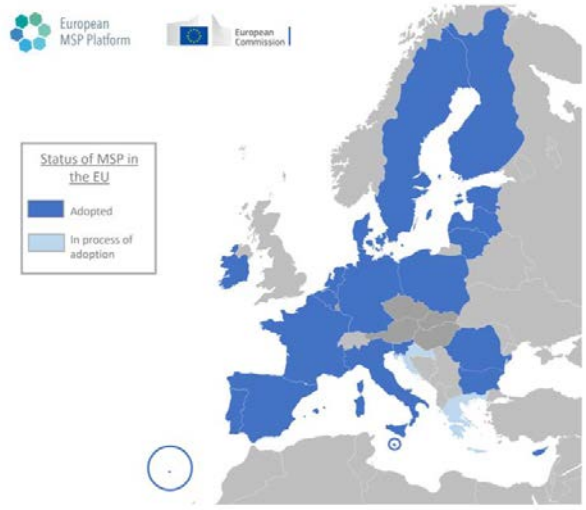


Figure 1: Status of MSP in the EU countries (URL 2)

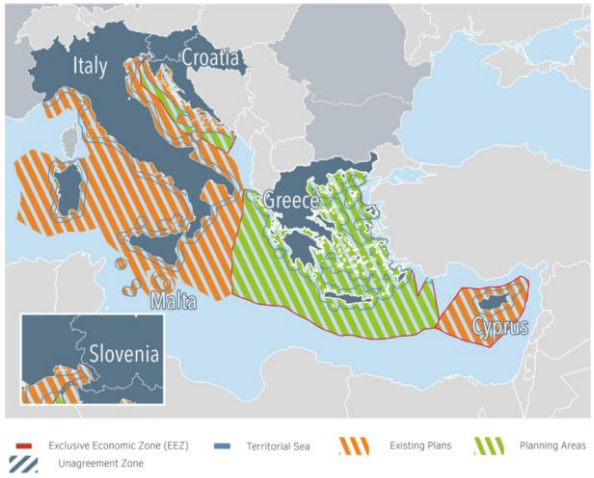


Figure 2: MSP in east Mediterranean (URL 2)

The paper will present the status of the establishment of MSPs in the Eastern Adriatic countries, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro and Albania. Based on their status, further steps will be proposed for countries that have not established MSP yet. In the paper, methods of extracting data from various, publicly available, mostly legislative sources were used.

2. MSP IN CROATIA AND SLOVENIA AS EU COUNTRIES

2.1. Croatia

Croatian national waters cover an area of 31,479 km² (35.7% of the total territory), while the coastline is 6,278 km long. The coastline consists of 1,880 km on land and 4,398 km on islands. There are 1,244 islands, islets, rocks and reefs (602 islands and islets, 642 rocks and reefs, 47 islands are permanently inhabited (URL 2)).

A general MSP plan for the Croatian offshore area has not been developed yet (Figure 3). As a starting point, there are various spatial plans for micro-locations on land and at sea, mainly within counties jurisdiction. Plans for protected land and sea have been developed (URL 2). They can be reached on Spatial Planning Information System (ISPU) Geoportal (URL 3).

The Spatial Planning Act (Official Gazette, 153/13, 65/17, 114/18, 39/19,96/19, 67/23) constitutes the legislative basis for spatial planning of the maritime area. It enables the full transposition of the EU MSP Directive 2008/56/EC (further in paper: Directive) into the legislation of the Republic of Croatia. It includes provisions relating to the definition, objectives and principles of MSP, cooperation between Croatia and other EU Member States in the field of MSP in the Adriatic Sea, cooperation with non-EU countries and the definition of competent authorities for MSP. In this vein, the authors of the paper set out to analyse the current and future framework for cooperation between countries which marine waters belong to the eastern part of the Adriatic Sea.



Figure 3: MSP area in process of adaption in Croatia (URL 2)

Directive requires Member States to take measures to achieve or maintain good status of the marine environment. The Directive creates a framework for EU Member States towards the sustainable management and use of natural resources of the marine environment. The aim of the Directive is the development and implementation of marine strategies within which the ecosystem approach to the management of human activities is applied (URL 4). It is important to note that the Directive emphasizes cooperation between EU member states and non-EU countries on the way to its accession.

With the adoption of the Decree on the establishment of a framework for the activities of the Republic of Croatia in the protection of the marine environment (Official Gazette 136/11) and the Decree on the creation and implementation of documents of the Marine Environment and Coastal Area Management Strategy (Official Gazette 112/14, 39/17, 112/18), the Marine Strategy Framework Directive was transposed into the national legislation. The Decree regulates the starting points and benchmarks for the creation, development, implementation and monitoring of the implementation of the Marine Environment Protection Strategy, which has its legal obligation to create the Environmental Protection Act (Official Gazette 80/13, 78/15, 12/18, 118/18).

MSP of the Exclusive Economic Zone (EEZ) is in progress. In accordance with the requirements of Directive, the preparation of the Spatial Plan of the EEZ has been initiated, based on amendments to the Physical Planning Act (Official Gazette 67/23) entered into force in July 2023. Croatia's competent authority for MSP is the Ministry of Physical Planning, Construction and State Assets (URL 2).

The whole process is taking longer than the Directive prescribes. One of the reasons is the situation with the COVID-19 pandemic and the long-standing definition of borders with the countries with which Croatia borders at sea. These are Italy, Slovenia, Bosnia and Herzegovina, and Montenegro. The current state of the borders at sea is as follows, with Italy and Montenegro are agreed; with Bosnia and Herzegovina are in provisional application; with the Republic of Slovenia is not awarded and remains unchanged as of 1991 until Croatia and Slovenia reach the final delimitation (URL 2).

It is positive that a comprehensive legal framework has been developed to date on the basis of which an MSP for Croatia can be developed. In 2024, a comprehensive initiative was launched to implement the provisions of the Directive. For that purpose, a Decision on the development of a spatial plan for the exclusive economic zone was adopted in January of 2024. The Decision defines that the responsible party for the development of the Spatial Plan for the Exclusive Economic Zone of the Republic of Croatia in the Adriatic Sea is the Ministry of Physical Planning, Construction and State Property. The tasks of the Responsible Party will be performed by the Directorate for Spatial Planning and Permits of State Importance in the Ministry of Physical Planning, Construction and State Property. The professional developer of the Spatial Plan for the Exclusive Economic Zone of the Republic of Croatia in the Adriatic Sea is the Institute for Spatial Development in the Ministry of Physical Planning, Construction and State Property. The Decision defines the reasons, objectives and program starting points within which spatial planning solutions are planned in the process of developing the Plan (Official Gazette 153/13, 65/17, 114/18, 39/19, 96/19, 67/23).

A working group has been formed for the implementation of Directive on the establishment of a framework for maritime spatial planning, the so-called of the Directive, in order to monitor, in horizontal coordination between the Ministry of Physical Planning, Construction and State Property and 9 ministries, the most important topics related to maritime spatial planning. In this phase of the implementation of the Directive, the main activities of the Ministry and the working group are focused on the process of drafting and adopting the Spatial Plan for the Exclusive Economic Zone of the Republic of Croatia in the Adriatic Sea. In June of 2023, the Dubrovnik-Neretva County Spatial Planning Institute, the Expert Analytical Basis for the development of the Spatial Plan of the Exclusive Economic Zone of the Republic of Croatia in the Adriatic Sea was prepared (URL 5). An expert conference on spatial planning of the marine area was held in Dubrovnik in May 2024. The conference brought together domestic and foreign experts, representatives of states and scientific institutions and competent bodies for MSP from Italy, Montenegro and Germany. Experiences in the field of MSP of Italy, Germany, Montenegro and Croatia were exchanged (URL 6).

2.2. Slovenia

Slovenia's internal waters cover 46,3km² and its territorial sea, out to 12 nautical miles (as defined by UNCLOS) cover 166,9 km² (URL 2)

Slovenia adopted its Maritime Spatial Plan in July of 2021, by the adoption of the Decree on the Maritime Spatial Plan of Slovenia. Full text of Maritime Spatial Plan of Slovenia can be found on web page URL 7. It was a result of the pilot project SUPREME which started in 2018.

Directive is transposed into national legislation through the Spatial Planning Act adopted in 2017 (Official Gazette 61/17). The Spatial Planning Act requires the MSP plan to be prepared in the form of the Action Programme for the implementation of the Slovenian Spatial Development Strategy at sea. The latter is a strategic document which applies to both land and sea. Slovenia's competent authority for MSP is the Ministry of the Natural Resources and Spatial Planning. Currently, the Ministry is coordinating the preparation of a new Spatial Development Strategy for Slovenia in 2050 (URL 2).

The Maritime Spatial Plan of Slovenia establishes the spatial and temporal arrangement of relevant existing and future activities and purposes, provides a framework for their mutual coordination and establishes measures for their implementation. The MSP establishes spatial and management measures in the sea and coastal area (Figure 4), implementation deadlines and the implementers of the measures responsible for their implementation, and the effectiveness of the plan's implementation is monitored by indicators specified by the plan (Radulić, V., 2023).



Figure 4: Established MSP in Slovenia (URL 2)

The MSP enables effective coordination of activities and usage with the objective of comprehensive spatial development in the Slovenian part of the Adriatic Sea and its coastal area. It enables achievement of a good environmental state. It takes into account the fact that the Slovenian coastal area is a particularly vulnerable environment due to climate change, expected rise of the sea surface and a complex interconnection of activities and usages at the Slovenian sea and in the coastal area (URL 7).

The plan of usages and activities at sea is divided into content fields: mariculture; fisheries, research facilities and infrastructure, extraction of oil, gas and other sources of energy, minerals and aggregates for the production of energy from renewable sources; maritime affairs and maritime transport routes; activities in the field of defence and protection against natural and other disasters at sea; extraction of raw material; scientific research; laying of submarine communications cables and pipelines; tourism, sport and recreation: education; underwater works and professional diving, cultural heritage protection and urban development. The Maritime Spatial Plan determines guidelines for spatial distribution of activities and usages at sea URL 7.

3. MSP IN MONTENEGRO, BOSNIA AND HERZEGOVINA AND ALBANIJA AS NON-EU COUNTRIES

3.1. Montenegro

Montenegro has an area of less than 2500 km² of the Adriatic Sea, of which 362 km² are internal sea waters, and the territorial sea covers an area of 2098 km² (Figure 5).



Figure 5: Montenegro coast and sea (Radulić, V., 2023)

Montenegro laid the foundations in the field of spatial planning and urbanism through the South Adriatic project 1966-1970. within which the General Urban Plan of the Bay of Kotor was developed in 1970. Today, the National Strategy for Integrated Coastal Zone Management from 2015 and the Special Purpose Spatial Plan for the Coastal Zone of Montenegro from 2018, which was developed at the same time as the CAMP Project, with mutual coordination, are in force. The Plan and the Project were the first steps towards concretely defining the purpose of the marine area. The GEF Adriatic Project (2017-2020) was a project with a goal to implement the ecosystem approach in the Adriatic Sea through marine area planning. The goal was to contribute to the harmonization of the monitoring of the state of the marine ecosystem and to improve the reporting of monitoring data, as well as to encourage the creation of a spatial plan of the marine area (Radulić, V., 2023).

The adoption of the Spatial Plan of Montenegro, amendments to the Law on Maritime Resources and other regulations, in addition to already adopted strategic documents related to the sea and the coast, will complete the regulatory framework according to which the administration in the area should be reformed and create preconditions for quality planning and management of the sea and the coast (Mrdak, 2024). Montenegro has a legal framework for the development of the National infrastructure of geospatial data. The law in question is the Law on State Survey and Real Estate Cadastre. The Law on Marine Assets prescribes the establishment and management of a marine asset cadastre, which should contain data on the marine asset and the objects on it in terms of their location, shape, surface, as well as data on the rights to the marine asset and their users.

All of the above indicates that in Montenegro there is an adequate initial legal framework for the development of spatial information systems that would also include the sea area. The problem is the implementation of all the mentioned regulations in practice. That was also recognized in the National Strategy for Integral Management of the Coastal Area from 2015, where one of the planned priority actions is the realization of the first phase of the spatial information system. The Ministry of Spatial Planning, Urbanism and State Property is primarily responsible for the project of creating the MSP of Montenegro, but other ministries will be involved in the resolution of this issue, in the segment of their portfolios (GEF Adriatic, 2021).

As a preparatory action, the realization of numerous activities is underway with the aim of identifying potential areas of the ecological network of importance for the EU (Natura 2000), which is based on the implementation of the EU Habitats Directive and the EU Birds Directive. As a candidate country for EU membership, Montenegro is obliged to establish the Natura 2000 network of protected areas (GEF Adriatic, 2021).

3.2. Albania

One of Albania's first attempts to establish an MSP was, as in other countries in the region, through education through pilot projects on a given topic. The micro-location of the port, of great importance for Albania, Vlores, was chosen. The project took place in the period 2019-2020 (URL 8). As part of the project Guidelines for Marine Spatial Planning process in Albania were prepared. MSP Pilot Project was prepared in synergy with SUPREME and GEF Adriatic projects outcomes, to be implemented within the Bilateral Cooperation Contract with the Italian Ministry of Environment, Land and Sea (IMELS). The project is financed by IMELS and is implemented by SPA/RAC under the coordination of the UNEP/MAP Coordinating Unit. Guidelines make possible to implement GIS-based MSP, including monitoring and regular evaluation (Modugno et all., 2021). Further steps regarding the development and implementation of the MSP have not been taken. MSP is not included in the legal framework and officially has not started yet (Bocci et all., 2020).

3.3. Bosnia and Herzegovina

There is no MSP in Bosnia and Herzegovina, so far. MSP is only a part of general Spatial Planning, legally regulated on Federal, Cantonal (for Herzegovina-Neretva Canton) and Municipal level - Neum Municipality, as only one Bosnia and Herzegovina exit to the Adriatic Sea. On municipal and cantonal level Spatial plan is harmonised and defines maritime area. On federal level Spatial Plan is not yet finalized (PAP/RAC et all., 2021)

4. CONCLUSIONS

By looking at the situation of the development of the MSP in the Eastern Adriatic in the EU Member States and those that are EU accession or potential accession states, the following can be determined. EU Member States have made much more progress in the development and implementation of the MSP. Specifically, Slovenia has established the MSP, and Croatia is in the process of adaptation and in 2024 it seriously started finalizing the establishment of the MSP, and will continue to do so in 2025. Both countries have established the legal framework for the development of the MSP as significant initial steps. Then, in a

series of projects that included micro and macro locations, they educated their experts who gained experience in establishing a global MSP framework, for the maritime area of the entire country. Within the framework of micro and macro projects, experts from countries that have gone through the entire process and established the MSP in their countries were engaged. Looking at the countries in the eastern Adriatic that are not EU members, according to available information, Montenegro has advanced the furthest, having a somewhat established legal framework and developed spatial plans and is currently working on establishing Natura 2000. Albania is next, it has a great support from Italy in the process itself. Bosnia and Herzegovina has the biggest problems with establishing the MSP framework, due to its complex structure and cantonal structure of governance. Non-EU countries should follow the example of countries that have established MSP. The engagement of experts from these countries, who have extensive experience in the establishment process itself, is also needed. It is important for all the countries mentioned in paper that there is awareness of the importance of establishing MSP, both in these countries and in all the countries of the Adriatic Sea and the Mediterranean. The interdependence of all maritime states in the water area is the starting point for the success of its implementation. Therefore, mutual cooperation and exchange of experiences is of primary importance and it is necessary to continue with it and improve it.

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ARCHITECTURAL DEVICES AND THE SPATIAL EXPERIENCE OF THE CITY - THE ARCHITECTURE FESTIVAL "IASI OPENS ITS COURTYARDS"

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ABSTRACT

The architectural installation, the central subject of our research, represents an intervention that transcends the conventional boundaries of the architectural profession and discipline. It departs from the predominant functionalist determinism, revealing a classical tradition deeply rooted in architectural theory and practice. The purpose of the research is to demonstrate the significant role of the architectural installation in the development of urban and architectural projects, highlighting the importance of recognizing this form of expression. Our hypothesis considers the architectural installation as an active construction in public space, addressing contemporary urban challenges. In a context where freedom is influenced by strategies of organization, public control, and technological efficiency, the architectural installation intervenes to fill existing gaps. It capitalizes on social and cultural agitation, reflecting fundamental characteristics of architecture, the city, and the individual. The research examines practices and discourses that go beyond traditional definitions, exploring concepts such as instability, events, intervention, and ethics. In this sense, the architectural installation becomes a gateway to broader issues within the discipline, offering critical perspectives on its limits. By highlighting the contributions of installations to urban and architectural challenges, our research underscores how these architectural interventions can transform urban experiences, redefining the way we build and perceive space. The "Iasi Opens its Courtyards" Architecture Festival offers the opportunity to present architectural installations set in the prestigious setting of the courtyards of historical Iasi.

Keywords: *installation; festival; experiment; architecture; city; courtyards*

1. INTRODUCTION

Festivals represent significant moments of intense creativity, serving as platforms where various forms of art converge. Over the years, festivals have evolved into essential cultural events that shape urban and regional dynamics. Major cities worldwide actively promote their festivals, leveraging them to project a dynamic and attractive image capable of drawing thousands of visitors. Among these, the Venice Architecture Biennale has distinguished itself through its unique architectural installations. Attendees are no longer solely interested in engaging with artists and architects; rather, they seek an immersive experience that allows them to explore novel spatial environments. Consequently, architecture-focused festivals have emerged with increasing frequency, offering an avenue for the continuous reinvention of architectural practice. This trend raises fundamental questions regarding the future of architecture as a discipline: Can ephemeral architectural interventions reshape the urban landscape?

Architectural festivals, in general, extend beyond temporal artistic expressions, incorporating architecture and art to enhance urban experiences and redefine spatial interactions. These festivals frequently feature installations designed to stimulate multisensory engagement. The use of vibrant colours, dynamic lighting, and innovative material compositions - including textiles, coloured glass, steel, and canvas - creates immersive atmospheres tailored to unique thematic narratives. Furthermore, the proliferation of social media has amplified

the significance of visual aesthetics in festival design, as images of these installations are widely shared, transforming them into potent communicative tools that contribute to the festival's identity and recognition.

The ephemeral nature and spatial configurations of architectural installation festivals foster dynamic exchanges and creative interactions. By bringing together diverse participants within a defined spatial and temporal framework, these festivals establish temporary artistic and social microcosms. The act of collectively experiencing and interacting with these installations cultivates unique communal engagements and enhances public appreciation of spatial design.

One such initiative, the architecture festival "*Iasi Opens Its Courtyards"* was funded through the Architectural Stamp and integrated into the Romanian Creative Week. This festival provided a platform for architectural installations strategically placed within the historic courtyards of Iasi. The installations, selected through a competitive process, were developed by interdisciplinary teams of students, architects, and visual artists. This initiative highlighted the innovative contributions of emerging professionals who explored novel concepts tailored to site-specific contexts.

The conceptual foundation of "*Iasi Opens Its Courtyards*" aligned with the Romanian Creative Week's overarching theme celebrating the present as a force of creative potential. Acknowledging the significance of the built environment as a shared resource, the festival encouraged participants to engage in a speculative exploration of urban spaces. The selected architectural installations embodied a pursuit of knowledge and a reimagining of urban futures. Participants undertook intellectual and artistic journeys, immersing themselves in the city's concealed spaces to uncover, interpret, and reinterpret its spatial narratives. Through this process, they articulated visions of the built environment that challenge conventional paradigms and provoke critical discourse.

The festival aimed to cultivate an appreciation for cultural and artistic heritage by fostering sensitivity to national and global cultural values. The associated architecture competition sought to identify, promote, and support high-quality creative initiatives while recognizing and rewarding exceptional talent. The establishment of aesthetic and evaluative criteria was integral to these endeavours, encouraging imagination, critical discourse, and respect for diverse perspectives. Additionally, by emphasizing the reciprocal relationship between competition and collaboration, the initiative nurtured a spirit of intellectual and artistic exchange.

A key objective of the project was the revalorization of underutilized spaces - particularly those at the intersection of public and private realms, such as the courtyards of heritage buildings. The exploration of the spatial dynamics between place, conceptual intervention, and artistic expression was central to the project's methodology. The process of identifying these relationships was considered as significant as the resultant installations themselves.

In this context, the impact of an intervention was assessed not only in terms of its functional efficacy but also its ability to generate human engagement and contribute to urban vibrancy. Public interaction and emotional resonance emerged as critical indicators of success. Consequently, the study examined contextual parameters, analysed site-specific characteristics, and synthesized a coherent conceptual approach that responded to the unique spatial and cultural dimensions of the city.

The findings underscore the transformative potential of ephemeral architecture in contemporary urban discourse. By fostering experimental design practices and participatory urban experiences, such initiatives contribute to the evolving dialogue on the intersection of architecture, art, and the public realm.

2. INSTALATIONS

The Architecture Festival "Iasi Opens its Courtyards" offered the opportunity to present architectural installations set in the prestigious setting of the courtyards of historic Iasi. The Architecture Festival invited visitors to get in touch with a rich architectural heritage by offering architectural installations resulting from an architectural competition. These architectural installations have been placed in the inner courtyards of some of Iasi's outstanding historical monuments or architecturally prestigious buildings. Each installation, created by mixed teams of students, architects or visual artists, highlighted the work of a young generation that will propose, invent, explore or experiment with new concepts adapted to a specific environment.



Figure 1: Courtyards plan Iasi

3. CITADEL

Bianca Orbocea and Lucian Zdrob, through their Installation - *Citadel*, placed in the courtyard of the "G.M. Cantacuzino" Faculty of Architecture, depict a small fortress as the last refuge of the student community. The heart of the arrangement, symbolized by the "heart of the citadel", is a social space developed around the courtyard tree. The towers within the installation are composed of identical modules, stacked in various ways, with the height of the modules progressively decreasing towards the hearth, where each module becomes a resting place. The mirrored surface of the cubes fragments the space and forms different shapes depending on the viewing angle.



(a)



(b)



(c)



(d)

Figure 2: Citadel - (a)(b)(c)(d) The courtyard of the "G.M. Cantacuzino" Faculty of Architecture

4. SOLITUDE OF THE PENETRATING TREES - AN ANTI-DEFORESTATION MANIFESTO

The team consisting of Sabrina Ene-Butnariu, Dan Alexandru Roșu, Ovidiu I. Bălășoiu, Beatrice-Maria Boghean, Bianca-Andreea Tudoran, Delia-Adriana Vlăsceanu, and Sergiu C. Petrea are the creators of the

Installation in the courtyard of the Administrative Palace of Iasi, *Solitude of the Penetrating Trees - An Anti-Deforestation Manifesto*. The proposed installation conveys a message about lost values and how we can (still) reclaim lost worlds, expressing a deeper sense of space utilization. The objects define a *topos* of returning to the archetypal forest. Their scale and materiality suggest deforestation and losses.

They can transform the vague space of the courtyard into architecture, utilizing elements of language specific to architectural discourse, yet undeniably remaining symbols of a dysfunctional world. They are essentialized because they speak about a nature in agony, a victim of consumerist pursuit that glorifies gain at any cost. That is why the constituent elements are simple, raw, without the technological value of contemporaneity. With a sass, they clarify and give meaning to the space around them. The wooden cabinets create sub-spaces, generate pathways, open or close perspectives, and create meaning. The repetition of similar shapes creates an almost stenographic rhythm that emphasizes the only remaining untouched tree, a small living, rebellious, defiant universe.

The plot generates the limits of a transitory space, a matrix of archetypal forest, in which the laws of nature are practiced according to a miniature system, inviting the viewer/explorer to meditate and convoke. The essentialized reduction of vegetal richness to a simple vertical symbol is a gesture of reverence that calls for introspection and the basic needs of the human being. In a world where walking in nature has come to be therapeutically prescribed to counteract the onslaught of information and nervous exhaustion caused by the stimuli of contemporary society, the abstract skylight inserted in the courtyard is a paradox that draws attention to the fundamental values of the world. On a deeper level, the spatially developed vertical wooden grid invites us to explore a metaphor of the forest, that silent and secret refuge where man hid and where the gods had their dwelling place.



(e) (f)

Figure 2: Solitude of the Penetrating Trees - An Anti-Deforestation Manifesto - (e)(f) The courtyard of the Administrative Palace of Iasi

5. BEHIND THE MASKS

The Braunstein Palace, along with the Select Hotel and the residential building, delimits the three sides of the triangular courtyard that describes the third location of the Installation *Behind the Masks*. Teodora Nedelcu, Raluca Chiriță, Andra Ciobanu and Ana Brânzilă described their installation as a visual representation of both positive and negative emotions. The colourful structures constituted a journey through the most common emotions experienced by young students when confronted with the constant changes and events in their hectic university lives: happiness, love, confusion, anger, curiosity, the inner child in need of care, separation, daydreaming, jealousy, etc.

The faces of the masks convey multiple feelings at once, so depending on the viewing angle, different messages could be perceived.



(g) (h) (i)

Figure 3: Behind the Masks. (g)(h)(i) The courtyard of The Braunstein Palace, along with the Select Hotel

6. LEGATO

For the fourth courtyard of the Calimachi Palace, which belongs to the "Grigore T. Popa" University of Medicine and Pharmacy, music can be the most effective way to fill a space. The rhythm and vibration of the piano, as the central element of the installation, are inspired precisely from the pulse of the urban organism. The space is not only for those who see it but also for those who can feel it through the Braille alphabet, by means of diagrams engraved on the device around the piano. In this sonic context, balloons float, completing the protective space for playful engagement.



(j) (k) (l)

Figure 4:Legato. –(j)(k)(l) The courtyard of the Calimachi Palace
which belongs to the "Grigore T. Popa" University of Medicine and Pharmacy

Daria Frunză, George Sava, and Cristiana Ailenei named their installation *Legato*. The name of the installation signifies a musical term that means "to be together," used for groups of notes played smoothly, without interruption. The courtyard of the "Grigore T. Popa" University of Medicine and Pharmacy becomes the backdrop of an architectural projection, like a nucleus that pulses impulses from within to the outside, opening and

invoking a call. These impulses are projected onto the city, seen as an urban organism, and can be intercepted through various sensory means.

The created framework focuses the senses on the architectural installation, transcending the visual barrier and dissipating into the courtyard's exterior through music. The installation consists of three elements: a piano as a meeting place, leisure zones for listening to music, and a suspended balloon network as an orientation indicator.

The participatory space around the piano, functioning as a meeting point, communicates in the rhythm of the music, as well as through other languages inscribed on its platform's surface. The Braille alphabet, descriptive texts, or various engraved diagrams explain the architectural installation's concept, serving as a point of interest, gathering, and unity in this transformed protective courtyard.

7. MILLE MULINI

Alexandra Berdan, George Olaru, Anca Spînu, Georgiana Covaliu proposed an interactive installation named *Mille Mulini*, consisting of 1000 windmills that invited visitors to a sensory dialogue against the generous backdrop of the courtyard of the Faculty of Psychology and Educational Sciences within the "A.I. Cuza" University. It was a transposition into a broader context of a historical landscape arrangement. Thus, the imagery of a flower garden is abstractly represented through the stylized form of the windmills. In the heart of the city, an artificial natural garden grows, looking and moving like a field of flowers swaying in the wind.

As a symbol of human presence in nature, the central fountain completes the image of the garden. The intervention was seen as a contemporary translation of components belonging to the landscape design of the era, resulting from a sequence of gestures that respect the broader context of the Faculty of Psychology building.

The imagery of the flower garden is abstractly rendered through the stylized form of the windmills. The artificial imitates the natural but gains semiotic autonomy: the windmill becomes a contemporary flower, loaded with playful value yet sensitized to the challenges of the present. On one hand, the windmills evoke the simplicity of childhood: when we see a toy windmill, the first reaction is to blow on it to make it spin. On the other hand, the rotational movement of the windmills under the wind's influence adds a new layer of significance: the need to look towards renewable sources of energy.

The installation thus functions as a participatory art project, intended to create a memorable experience of nostalgia, joy, and reflection on both a personal and societal scale.



(m)



(n)

Figure 5 - Mille Mulini

- (m)(n) The courtyard of the Faculty of Psychology and Educational Sciences within the "A.I. Cuza" University

8. AS ABOVE, SO BELOW

The project *As above, so below* by the mixed team of Iuliana Georgiana Damir - architect, Abigail Almaguer - interior designer, Corina Boboc - fashion designer and scriptwriter, was situated in the courtyard of the University Palace in Iași, within the courtyard of the Faculty of Electronics, Telecommunications, and Information Technology of the "Gh. Asachi" Technical University. The building, an architectural landmark since 1897, holds significant historical importance and memory. This is the edifice where the first modern university of Romania was founded, and today, it comprises 15 faculties and numerous research centres. It's located in one of the

historical neighbourhoods of the city - Copou. Moreover, it houses the "Lost Steps Hall," containing 19 mural paintings created by the painter Sabin Bălașa, conceived as a representation of Romanian spirituality.

The two courtyards, shaped like two theatre curtains, which delimit the "Carmen Sylva" Great Hall, became the setting for the development of the *As above, so below* project. It aimed to draw attention to the built heritage of Iași, enhancing the spatial duality, the conceptual metaphors derived from the history of the place, and the story of Sabin Bălașa's paintings.



(o) (p) (q) (r)

Figure 6: As above, so below

- (o)(p)(q)(r) The courtyard of the Faculty of Electronics, Telecommunications, and Information Technology of the "Gh. Asachi" Technical University

Duality is inherently the defining word for the two courtyards that mirror each other and are connected by a pedestrian passage that becomes a metaphor for unification. Similar to the title *As above, so below*, and Sabin Bălașa's paintings, the project illustrates through textile material the duality between the microcosm - the individual, and the macrocosm - society. Additionally, the microcosm can act as a miniature version of the external world, the macrocosm. Anything that happens in one component is bound to affect the other.

Therefore, the visual representation is provided by a textile scarf that metaphorically starts from the astral plane - the second floor of the University Palace, reaches the earthly horizontal plane, ascends to the pavilion at the point of unification between the two courtyards, and mirrors in the same manner in the other courtyard. This creates a visible connection of the University's building structures, as it also manifests in the physical realm of knowledge.

9. CONCLUSION

Simultaneously, this project aimed to recover and enhance the value of ambiguous spaces, located at the crossroads between the two forms of public and private ownership – the inner courtyards of heritage buildings or those with prestigious architectural significance.

Identifying the place - idea - intervention relationship and illustrating the search for these links was the aim of this project. Awareness of the process itself, in all its stages, was as important as the result. In this context, it was not only relevant to what extent an intervention satisfies certain functional requirements, but also how it succeeds in attracting, even if only for a limited period, human interest and sustaining urban dynamics. Feedback from the passer-by becomes the essential landmark, the generation of emotions and feelings becomes an end. The study focused on analysing the context, highlighting the main characteristics, and generating a coherent idea, justified by the specificity of the site.

At the same time, this project aims to recover and capitalize on ambiguous spaces, the interstice between the two forms of public and private possession - the inner courtyards of heritage buildings or those with prestigious architectural value. The revitalization of these residual spaces - in this project the interior courtyards that are now abandoned - constitutes a pretext for future interventions exclusively through projects conceived by students and graduates in the field of Architecture, Art and Design. In other words, these young people have access to commissions, without necessarily having a portfolio, but they can enrich it and, above all, contribute with their still fresh imagination to offering solutions to the problem of “different spaces.”

The architectural installation does not create an object (or just one with a fleeting presence) but produces an event. The ephemeral installations create a new scene against the festive backdrop of the courtyards, demarcating an imaginary world that disrupts the senses at these events by the loss of reference points. Now, according to the existentialist philosopher Heidegger, it is through a “sensible world” that the being is “able to invest fully in its own future and thus to construct itself”. Heidegger thus reverses the traditional conception of the work of art: 'it does not open us to a beyond the realm of sensible things, but rather to an underneath them. Its very essence is, therefore, to expose a dimension beneath things, a depth that is withdrawn and unfathomable".

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COLLECTION AND MONITORING CROSS-NATIONAL URBAN MOBILITY DATA – ISSUES, LIMITATIONS AND PERSPECTIVES

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ABSTRACT

One of the key challenges in analyzing urban mobility, especially on a cross-national scale, lies in the collection of high-quality and methodologically comparable data. This includes not only transport data but also spatial, socio-economic, and environmental data necessary for a comprehensive analysis. Comparable urban and transport data for different cities around the world and across different time periods are rarely available. Since the pioneering work of Newman and Kenworthy, there have been few attempts to create such a database. The main reasons for this are inconsistent data collection methods, a lack of primary data, ambiguity in different indicators, and varied definitions of metrics, among others. These challenges hinder the creation of a comprehensive understanding of urban mobility, making it difficult to assess the impact of existing policies and interventions. The problems arising from these issues include difficulties in developing accurate and effective policy recommendations, identifying best practices, and evaluating sustainability progress, as well as challenges in forecasting future mobility trends. This is particularly evident in developing metropolises, which are experiencing the greatest demographic growth, the highest urbanization rates and improvements in living standards—factors that contribute to significant and urgent urban mobility challenges. This study aims to examine the issues and limitations associated with cross-national urban mobility data collection and propose strategies for improving data harmonization, methodological consistency, and the integration of modern technologies such as big data analytics, IoT, and GIS*. By addressing these challenges, the study seeks to contribute to the development of a standardized framework that enhances global urban mobility data collection, enabling policymakers to make informed decisions that support sustainable urban development.*

Keywords: *urban transport; sustainable mobility; urban planning; data collection;* big data analytics; GIS

1. INTRODUCTION

Urban mobility plays a central role in shaping sustainable cities, addressing climate challenges, and improving overall quality of life. On a cross-national scale, the ability to collect and monitor urban mobility data provides critical insights for global policy-making and international comparisons. However, significant challenges hinder the collection and comparability of such data across countries and regions. These include inconsistent methodologies, variations in data definitions, and disparities in technological capacity, particularly between developed and developing cities.

Rapid urbanization and demographic growth, especially in developing nations (primarily in Asia and Africa), further underscore the urgency of robust data collection systems. By 2050, it is projected that nearly 68% of the global population will reside in urban areas, with much of this growth concentrated in cities across Asia and Africa (Department of Economic and Social Affairs of the United Nations, 2019). This unprecedented urban expansion places immense pressure on existing infrastructure and demands innovative, harmonized data collection approaches to guide sustainable urban planning. Without such systems, urban areas risk exacerbating environmental degradation, increasing social inequality, and creating unsustainable mobility patterns.

In addition to supporting urban planning, harmonized urban mobility data are critical for addressing climate change and achieving global targets such as the Sustainable Development Goals (SDGs). The transportation sector remains one of the largest contributors to greenhouse gas emissions, making effective policy interventions reliant on high-quality, comparable data across nations.

The objective of this article is to explore the issues, limitations, and future perspectives related to cross-national urban mobility data collection. By identifying these challenges and proposing pathways for harmonization and innovation, the article aims to contribute to the development of a global framework that supports informed decision-making and sustainable urban development. Furthermore, this article highlights the transformative potential of leveraging modern technologies, such as big data analytics, IoT, and GIS, to overcome traditional barriers.

Given these challenges, this study aims to critically examine the limitations and obstacles inherent in cross-national urban mobility data collection and explore potential solutions for improving data harmonization, methodological consistency, and the integration of emerging technologies. Specifically, this research seeks to answer the following question: How can urban mobility data collection be standardized across different national contexts to enable more reliable cross-city comparisons and support evidence-based policymaking?

By addressing this question, the study contributes to the ongoing discourse on urban mobility data governance and provides insights into best practices for creating a globally comparable urban transport database.

In examining these issues, this study adopts a qualitative research approach, primarily relying on a literature survey and documentary research to analyze the challenges and limitations associated with cross-national urban mobility data collection. A comprehensive review of academic literature, policy reports, and institutional datasets has been conducted to assess existing methodologies for data harmonization and standardization.

Additionally, this research draws on case studies, examining previous large-scale urban mobility databases and initiatives (such as the work of Newman and Kenworthy) to identify best practices and gaps in data collection efforts. Reports from international organizations such as the UITP, and UN-Habitat were reviewed to evaluate policy frameworks influencing urban mobility data governance.

By synthesizing findings from these sources, the study aims to provide a structured assessment of methodological inconsistencies and propose pathways for improving the comparability and reliability of cross-national urban mobility data.

2. EVOLUTION OF URBAN MOBILITY RESEARCH

Urban mobility (or urban transport) research has evolved significantly over the past decades. Initially, the focus was primarily on transportation data, such as traffic volumes and modal splits, with limited attention to broader urban planning implications. However, the seminal work of Newman and Kenworthy in the 1980s brought to light the critical connection between urban form and transportation strategies. Their research highlighted how urban density influences car dependency, energy consumption, and emissions, providing a framework for integrating mobility data with urban planning strategies. As noted in their studies, urban form is not only linked to transportation energy use but also plays a crucial role in shaping long-term sustainability strategies (Kenworthy and Newman, 1989).

The International Sourcebook of Automobile Dependence in Cities, 1960-1990 (Kenworthy, Laube and Newman, 1999) expanded on this foundational work by tracking trends in automobile dependence over three decades, highlighting the growing disparity between car-dominated cities and those prioritizing sustainable transport. These insights had a strong influence on policy changes and urban planning practices in metropolises worldwide. They reinforced the importance of longitudinal data in understanding urban mobility dynamics over time. Additionally, the Millennium Cities Database for Sustainable Transport (Kenworthy and Laube, 2001) attempted to standardize urban transport data across 100 cities, but it exposed challenges in methodology harmonization and data quality, particularly for developing regions. These challenges remain relevant today and emphasize the need for robust frameworks for cross-national data collection.

One of their most significant contributions was their use of the ‘net urbanized area’ methodology. This approach, which excludes non-urban land uses like water, forests, and agricultural areas, offers a more precise understanding of urban dynamics. Indicators like ‘net urban density’ and ‘net job density’ derived from this methodology continue to be influential. They provide a clearer framework for analyzing transportation systems and urban form, especially in the context of land-use planning and mobility efficiency.

Despite its groundbreaking nature, Newman and Kenworthy's work faced significant challenges, including limited financial resources, the extensive time required to harmonize methodologies across global cities, and the lack of standardized spatial data definitions. Their struggles were emblematic of the broader issues in global mobility research, as highlighted by Vračarević (2021), who noted that while their databases inspired numerous studies, they also exposed difficulties in achieving global comparability.

Recent technological advancements, such as GPS tracking, mobile phone data, and IoT sensors, have expanded the scope of urban mobility research, enabling the collection of high-resolution spatial and temporal data. However, inconsistencies in defining key indicators such as 'urbanized area', 'trip', or 'accessibility' persist, limiting the potential for global benchmarking .

3. KEY ISSUES IN DATA COLLECTION

Cross-national urban mobility comparisons are vital for tackling shared global challenges such as climate change. By standardizing data and methodologies, countries can monitor progress, identify best practices, and collaborate on scalable solutions. These comparisons are particularly critical for achieving global goals such as the Sustainable Development Goals (SDGs) and the Paris Agreement targets.

The disparity in data availability and quality between developed and developing nations complicates these efforts. While cities like Singapore and Copenhagen leverage cutting-edge data platforms (Zhang *et al.*, 2018; Mepparambath *et al.*, 2023), many rapidly urbanizing cities in the Global South face challenges such as underdeveloped statistical systems and unreliable data sources (Vračarević, 2021). This gap is particularly concerning given the demographic explosion, urbanization, and rising living standards in these regions, which have significant global implications for sustainability (Department of Economic and Social Affairs of the United Nations, 2019).

To develop a comprehensive understanding of urban mobility, various types of urban mobility data must be collected and integrated. This typically includes:

a) **Transport Data**: Data on the use of cars, public transport, bicycles, and walking, highlighting modal shares and shifts. For instance, modal split data often relies on the number of trips, which, while useful, does not fully capture traffic intensity, energy consumption, or emissions (Vračarević, 2023).

b) **Socio-Economic Indicators**: Information on income levels, employment, and demographic trends that influence travel behavior, transport patterns, accessibility of private modes of transport etc.

c) **Spatial Data**: Land use patterns, urban density, job density, locations and sizes of central business districts (CBDs), and connectivity, which determine accessibility and travel demand. Spatial data collection faces unique challenges, as cities expand beyond rigid administrative boundaries. The economic definition of urban areas or functional urban areas must be considered to accurately assess mobility patterns (Vračarević, 2023; He *et al.*, 2024).

d) **Environmental Indicators**: Air quality, energy consumption, GHG emissions, and noise pollution, which are essential for evaluating the sustainability of urban mobility.

Despite the availability of such data in some cities, methodological and definitional inconsistencies, such as whether gross or net urban area is used, often lead to incomparable datasets. Addressing these inconsistencies clearly requires a unified framework for urban mobility research.

One of the primary challenges in cross-national urban mobility data collection lies in the lack of standardized definitions and metrics. For instance, terms like 'urbanized area' vary significantly across countries. Some nations define urbanized areas based on population density, while others rely on administrative boundaries or land-use patterns. Similarly, the concept of a 'trip' may differ, with some datasets focusing only on commuting trips while others include recreational or non-motorized journeys. These discrepancies make it difficult to compare datasets and draw meaningful conclusions about mobility patterns.

Existing cross-national urban mobility databases suffer from significant gaps in coverage and detail. Unlike economic datasets, which often have established global standards and reporting mechanisms (e.g., IMF or World Bank data), urban mobility data lacks a unified platform for systematic collection and dissemination. This absence of a central repository limits the accessibility and usability of mobility data for researchers and policymakers.

Many databases focus on specific aspects of mobility, such as public transport usage or road network density, without providing a holistic view of urban transport systems. For example, the Eurostat database includes extensive data on European cities but offers limited insights into cities outside the EU. Similarly, the World Bank's urban transport data is often aggregated at the national level, obscuring city-specific variations and trends. Vračević (2023) also critiques UITP's datasets (which focus heavily on public transport) for inconsistencies in methodologies and illogical discrepancies between observation periods.

Another major limitation is the scarcity of longitudinal data that tracks changes in mobility patterns over time. Longitudinal data is essential for understanding the impacts of urbanization, policy interventions, technological innovations, and socio-economic shifts on urban mobility. However, most existing databases rely on cross-sectional data (often derived from census sources), which provide only a snapshot of mobility conditions at a specific point in time.

Additionally, granular data (such as detailed origin-destination flows, travel times, and individual travel behavior) is often lacking. This kind of data is critical for designing targeted interventions, evaluating equity in transport access, and forecasting future mobility trends. The lack of granular data reflects broader challenges in data collection, including high costs, privacy concerns, and limited technological capacity in many cities (Bricka, Zhang and Schroeder, 2020; Mihaljevic *et al.*, 2021).

4. PERSPECTIVES AND POSSIBLE SOLUTIONS

The lack of global standards for urban mobility data collection and analysis is a persistent challenge. To address this, efforts might focus on the development and implementation of standardized frameworks. For example, the United Nations has recently introduced the Global Urban Monitoring Framework (UMF) which aims to harmonize global urban monitoring, facilitating standardized data collection methodologies for urban mobility (UN-Habitat, 2022). Also, recently developed global methodology employs the concept of Functional Urban Areas (FUAs) to define urban boundaries based on socio-economic and commuting patterns rather than administrative boundaries in order to facilitate international statistical comparisons (https://unhabitat.org/sites/default/files/2020/06/background_document_on_degree_of_urbanization.pdf). Adopting this approach enables more accurate comparative analyses of urban regions. Such standardization efforts would provide a foundation for meaningful cross-national comparisons and policy-making.

Recent advancements in data collection, processing, and analysis have significantly influenced urban mobility research, addressing many of the challenges related to cross-national data comparability and offering unprecedented opportunities to overcome traditional data collection challenges. Technologies such as big data analytics, artificial intelligence (AI), Internet of Things (IoT), and Geographic Information Systems (GIS) are transforming how researchers and policymakers assess urban transport.

The integration of AI, Big Data, and IoT is transforming urban mobility by enabling real-time traffic monitoring, congestion analysis, public transport optimization, and predictive modeling. By automating urban mobility data collection from diverse sources such as GPS, sensors, surveillance cameras, and connected vehicles, these technologies provide valuable insights for smarter, more efficient mobility management (Zannat & Choudhury, 2019; Nikitas *et al.*, 2020). AI-powered analysis of mobile phone and GPS data has also provided deeper insights into travel behavior patterns, addressing limitations of traditional survey-based methods or on infrequent census datasets. Advanced machine learning algorithms process large and complex datasets to predict urban growth, refine urbanized area classifications, and simulate future transportation scenarios. These AI-driven models assist policymakers in optimizing transit routes, improving multimodal transport integration, and designing more efficient mobility networks.

Geographic Information Systems (GIS) play a crucial role in mapping urban transport trends, integrating land use, socio-economic, and mobility data, and facilitating comparative studies across different urban structures. In European cities, GIS-based urban accessibility studies have been instrumental in evaluating transport equity and measuring progress toward sustainability goals (Grasser *et al.*, 2017; Telega, Telega & Bieda, 2021). Additionally, GIS-powered transit data models provide real-time operational insights, improving route optimization, and network efficiency. These models enhance network evaluations by analyzing key metrics such as route density and transfer coefficients (Zeng, Chang, & Lv, 2010).

Projects like the curation of public transport datasets for 25 cities (Kujala *et al.*, 2018) highlight the importance of structured, accessible mobility data for urban research and planning. Establishing uniform data formats allows cities to better analyze transport systems and implement evidence-based policy decisions.

There are more than a handful of successful examples of modern technologies implementation. Singapore's smart mobility systems integrate real-time data from public transport, road traffic, and micromobility to optimize urban mobility. The Land Transport Authority (LTA) leverages AI and IoT to monitor and predict traffic flows, reducing congestion and improving efficiency (Sanchez-Sepulveda *et al.*, 2024). Also, European Urban Data Platform (https://living-in.eu/groups/solutions/urban-data-platform) has successfully harmonized mobility and environmental data across EU cities, enabling regional comparisons and fostering sustainable transport planning. Recent studies (Ghaffarpasand and Pope, 2023, 2024) demonstrated how telematics data can estimate emissions and traffic patterns, showcasing the power of real-time data integration for environmental policy-making.

By leveraging these technological advancements, cities can create data-driven, efficient, and sustainable urban mobility solutions, ensuring improved accessibility, reduced congestion, and enhanced environmental outcomes.

Future research should focus on integrating these technologies more systematically into cross-national urban mobility studies, ensuring that data-driven approaches enhance both policy design and practical transport solutions.

5. CONCLUSION

The collection and analysis of cross-national urban mobility data are fundamental to fostering sustainable urban development and achieving global climate and social equity goals. As cities around the world grapple with unprecedented urbanization, the need for high-quality, comparable data has never been more critical. However, significant challenges remain, including inconsistent methodologies, the lack of standardized definitions, and disparities in technological capacities across countries.

In addressing these challenges, international organizations and governments play pivotal roles. Expanding funding programs for capacity building in developing cities and promoting international collaboration can drive the adoption of modern technologies and the standardization of data collection methods. This will enable cities to capture high-resolution data, essential for informed decision-making and effective policy interventions. Moreover, creating unified frameworks for data collection that align with international standards, such as the Global Urban Monitoring Framework can help bridge existing gaps in comparability.

At the same time, the transformative potential of modern technologies such as IoT, big data analytics, GIS, and machine learning offers new opportunities to enhance data collection and overcome traditional barriers. As exemplified by cities like Singapore and platforms such as the European Urban Data Platform, leveraging these technologies can significantly improve data accessibility, real-time analysis, and decision-making. However, to ensure these advancements benefit all cities, especially those in the developing countries, efforts must focus on addressing data gaps, improving data quality, and fostering global cooperation.

In conclusion, while challenges in cross-national urban mobility data collection persist, they are not insurmountable. By adopting standardized frameworks, leveraging modern technologies, and fostering international collaboration, cities worldwide can build a comprehensive, accurate, and globally comparable understanding of urban mobility. This will ultimately empower policymakers to develop sustainable, equitable, and effective urban transport solutions, contributing to the realization of global development goals and the creation of livable, resilient and human-centered cities.

ACKNOWLEDGEMENTS

Ministry of Science, Technological Development and Innovations of the Republic of Serbia, No. 451-03-137/2025-03/200091

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THE STRUGGLE FOR CONTESTED URBAN SPACES: THE CASE OF JUSTIFICATION OF CLAIMS TO OPEN PUBLIC SPACE IN BANJALUKA

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ABSTRACT

With the aim of continuous economic development and accumulation of capital, cities are facing intensive exploitation of public resources within the framework of urbanization. The shrinking of open public spaces which became subject to privatization, affected the practice of urban planning which is often unable to offer alternative solutions for overuse of city territory and create liveable urban environment. This paper deals with the role of urban activism in struggling for contested open public spaces in post-socialist cities. The aim of the paper is to underline the transformative potential of civil initiatives and to research how the ways in which local communities participate in urban contestation shape their activities against top-down urban planning decisions and what are the worths they advocate for to legitimise their claims to contested places. The research is based on the premises that public justification of claims is indispensable element of urban space contestations for "strong" and "weak" publics. The case of the civil initiative for the preservation of open public space in a residential urban block in Banjaluka is presented. The case indicates the importance of informal and formal forms of organizing citizens to preserve the interests of the community. Also, the case argues that the functional institutionalized means of struggle was the most effective legitimization strategy for preservation of contested space. Finally, the paper emphasized the need for the development of new planning tools for more effective participation of citizens in initial phase of urban planning in Banjaluka to avoid creating spaces of contestation.

Keywords: *urban activism; civil initiatives; contested values; open public place; Banjaluka.*

1. INTRODUCTION

With the aim of continuous economic development and accumulation of capital, cities around the world are facing intensive exploitation of public resources. This neoliberal urban development is qualified as a 'growth-oriented by means of liberalization, deregulation and privatization of public goods and space and the outsourcing of public services' (Wehrhahn, 2015: 97). As a result of neoliberal politics of development, a great contradiction emerges between understanding of urban spaces as real estate, which is advocated by city administration and investors, and urban spaces as public good. Furthermore, the same politics reduces public governance and participatory options of the civil society, raises serious questions about democratic legitimacy, and usually increases social polarization (Wehrhahn, 2015: 97). Therefore, in such an uneven balance of power, the needs of citizens are not recognized or are completely ignored, even in urban governance of democratically developed societies.

The shrinking of public spaces and their privatization, urban gentrification and allocation of finances, affect the practice of urban planning which became uncapable of finding solutions against the overexploitation of urban territory and social inequalities. Due to the inability of the neoliberal state and market to provide citizens with institutional support to meet their social and economic needs, alternative models of space production and organization are emerging. Profit oriented model of city planning and development is very often resisted by city dwellers who organize themselves in different initiatives against transformation of urban public spaces. Urban spaces that citizens strive to protect are considered contested spaces. In literature, contested places are 'geographic locations where conflicts in the form of opposition, confrontation, subversion, and/or resistance

engage actors whose social positions are defined by differential control of resources and access to power' (Low and Lawrence-Zuniga, 2003: 18). Within this framework of urban contestation, the phenomenon of urban activism and movements comes up to challenge neoliberal urban policies and their consequences (Mayer, 2007). In developed civil societies, civil engagement and awareness of the importance of public resources and public goods in cities are important factors of urban governance. Citizens organize themselves worldwide to preserve shared urban spaces such as streets, squares, empty spaces as commons goods (Müller and Köpper, 2023). Urban civil society, which includes the private sector, community-based organizations, associations, and non-governmental organizations, is eager to take part in governance of shared urban spaces and thus contribute to the more socially sustainable and just urban development, making interests of the weak and strong public more balanced.

The urban activism and citizens engagement in urban development processes, as well as alignment of interests of various actors, are particularly challenging in urban governance of post-socialist non-EU countries with less developed civil society. In these countries democratic principles are more slowly adopted and the transition to a democratized open-market society is still ongoing due to war in 1990's and isolation on the global scene. Post-socialist urban planning has been influenced by a slow transition from protected and highly directed economies to systems based on competition, international trade, and free markets (Keresztély and Scott, 2012). Also, local governments have acquired wider administrative responsibilities and a new political importance due to decentralization, what has reinforced the political power of new political elites and business interests (Keresztély and Scott, 2012: 2). The reduced role of the state in the economic system, the established capitalist principles of private ownership and market-lead economy have significantly influenced changes in the management of urban development, which is mainly driven by short-term goals and private interests. The main development directions are defined by partial area plans, which are 'easily modified without extensive legal wrangling to suit the aspirations of any private developer' (Hirt, 2012: 76). The emerging practice of developers 'usually do not take care of social justice requirements, subject to which all citizens are entitled to have access to basic urban services and resources and to enjoy a good quality urban environment' (Cavric et al., 2008: 49). This often results in the emergence of urban activism and resistance movements against encroachment of shared urban resources. In post-socialist context urban movements are not developed as mass scale actions engaged in protests or mobilized around political or social issues, but small-scale actions that tend to directly influence changes in urban development and improve the quality of the urban environment. Also, informal forms of activism are the most common in implementation of policies of urban development. Over the years of social, political and economic transition various forms of movements emerged such as: organizations from former socialist regime, non-governmental organizations, local grassroots activism and mobilization through the social network (Jacobsson, 2015). Some actions initiated as local neighbourhood activities over time develop into formal organization dealing with local problems. Most actions are developed as reactive, but this trend has changed in the last decade and urban movements are becoming more proactive gaining important role in formal urban planning.

Despite many different forms of urban activism emerging in post-socialist cities, the phenomena of civil society, urban activism and movements have not been significantly researched in literature, and especially in one that refers to non-EU cities. This paper deals with the transformative potential of civil initiatives in urban transformation planning. The aim of the paper is to research how the ways in which local communities participate in urban contestation shape their activities against top-down urban planning decisions and what are the worths they advocate for to legitimize their claims to contested places. The research is based on the premises that public justification of claims is an indispensable element of urban space contestations for 'strong' and 'weak' publics. The paper is structured as follows. First, a theoretical framework for studying the concept of urban contestation, civil society, urban activism and movements is presented. This is followed by elaborating the theoretical principles of the sociology of critical capacity, which clarify the values that all parties refer to in their disputes. Further, the case study of civil initiative for preservation of open public space in a residential urban block in Banjaluka is presented. The qualitative analysis was backed by the collection of data on activities of civil initiative and proposed visions of development. This includes data from the civil initiative websites, social media posts and blogs, articles in local newspapers in addition to data obtained directly from members of social movements during the meetings. This initiative is an example of successful self-organization of citizens which managed to preserve green public space and thus became informal partner in governance of the contested space. Eventually, the paper emphasized the need for the development of new planning tools for more effective participation of citizens in the initial phase of urban planning in Banjaluka to avoid creating spaces of contestation.

2. URBAN CONTESTATION AND POST-SOCIALIST SPATIAL PRACTICE

In order to understand the justification of claims within the process of urban contestation and activities of local community against top-down urban planning decisions it is important to describe different interests of urban actors that underline urban conflicts and spatial practices, reasons for their actions, and their actions. The profit-oriented politics of urban planning turns urban places into contested spaces in which strong publics 'are capable of forming opinions and making political and managerial decisions (city administrators and parament members, investors and developers), oppose weak publics whose discursive practice are limited to opinion formation (citizens and activists)' (Tykanova and Khokhlova, 2015: 141). Therefore, strong publics use urban space to build their power and influence by imposing development solutions through urban planning, architecture and design. Furthermore, in discourse of city development city authorities cherish the value of rationality, aesthetic appeal and profitability while city dwellers tend to consider the city in light of their memories, narratives and habits rejecting the new development discourse (Tykanova and Khokhlova, 2015). Regarding these different social orders, two different spatial practices usually take place. According to Low, social production of space is 'the process responsible for the material creation of space (redevelopment, gentrification, urban development programs and so on) that is the prerogative of governments and business elite' (Low, 2000: 128). The same author describes the responses of the weak publics to this challenge as the 'social construction of space- transformation and (re)interpretation of material setting through social interchanges, commemoration practices, images and everyday use' (Low, 2000: 128). Furthermore, Low argues that the city is a space exposed to the implementation of projects initiated by dominant political elites to make a profit. These plans are rarely in accordance with the interests and needs of the citizens, which results in raising social movements aimed at defending urban space and development of local activism (Low, 2000).

Within the process of contesting urban spaces, strong and weak publics legitimize their positions referring to 'formal norms and regulations, financial advantage, progressive urban development, individual or collective images and routines' (Tykanova and Khokhlova, 2015: 143). Aiming to protect their urban space, citizens allude to everyday practice such as walking, naming, commemorating and narrating. To claim space as theirs, personal experience of urban space is crucial and it refers to the memories of space, social interaction with other actors, etc. On the other hand, strong publics such as governmental bodies and investors legitimize their claims and interest by referring to the values of progressive urban development and the common good. Eventually, these very different and opposing views on how the contested spaces should be organized and managed make the local community gather and resist the decisions of authorities engaging in many different protest activities.

Urban contestation in post-socialist cities is a very dynamic and complex process which refers to the reconfiguration of urban spaces by local authorities, the influence of global trends, and the ways ordinary people respond to these changes. Urban spaces around which conflicts between authorities and citizens are mostly created are spaces in public property. Since local communities have insufficient financial resources to implement public policies, the role of the private sector in urban development is dominant. The authorities control and dispose of urban spaces by making amendments of regulation plans, changing the status of property, replacing plots, (re)parcellation, etc. The main value they advocate for legitimizing their position in the process of urban contestation is profitability. On the other hand, citizens legitimize their position by referring to motives such as preserving collective identity and public good. They feel great attachment to urban spaces that is based on mutual trust and the value of collectivity which are socialist legacies. In the absence of institutional means of struggle citizens get involved in protest activities. The framework of urban contestation regarding interests of the weak and strong publics, tools they use and values they advocate for, as well as spatial practice, is presented in table 1.

Table 1: Framework of urban contestation in post-socialist cities

	WEAK PUBLICS	*STRONG PUBLICS*
INTERESTS	*Forming opinions*	*Forming opinions* *Making political and managerial decisions*
TOOLS	*Institutional means of struggle* *Protest activities (small-scale and reactive initiatives)*	*Amendments of regulation plans* *Changing the status of property* *Replacing plots* *(Re)parcellation*
VALUES	*Mutual trust* *Value of collectivity* *Collective identity* *Public good*	*Profitability*
SPATIAL PRACTICE	*Social construction of space*	*Social production of space*

The level of citizens' engagement in urban processes and protest activities in post-socialist cities is in strong relation with the traits of civil society. In literature, civil society is defined as weak, meaning that it lacks power to promote and improve citizen engagement and mobilization in public affairs as well as at the grassroots level (Bitušíková, 2015). Similarly, Howard (2003) argues that post-communist civil society is distinctively weak, characterized by low level of organizational membership and participation by ordinary citizens. Making research on collective patterns of (non)participation in voluntary organizations throughout post-communist Europe, Howard infers that variations in weakness among countries are relatively small. The same author discusses three main causal factors which back his main assumption about weakness of civil society in post-communist countries. The first one refers to mistrust of citizens in organizations even when participation is voluntary. Second, many people find private and informal networks that developed under communism and persist today in a new institutional environment discouraging to join formal organizations. Finally, the disappointment of post-communist citizens with the new political and economic system, which hasn't lived up to their hopes and ideals, caused them to withdraw from public activities. All three factors involve experiential reinterpretations of people's past experiences within newly constituted institutions and have a negative effect on membership and participation in voluntary organizations (Howard, 2003: 10). The weakness of civil society has also been challenged by other researchers arguing that organizational membership is not the only aspect of citizen engagement in post socialist cities (Petrova and Tarrow, 2007). Petrova and Tarrow (2007) indicate the significance of the level and frequency of citizen participation and the type of engagement in public politics. Besides, Císař (2014) clarifies the main rationale behind the phenomenon of low level of civic participation asserting that collective actions remained associated with communist system since previous regime relied strongly on political mobilization. Also, political freedom, as the main paradigm of post-communist society, is not understood as an opportunity to express social needs and participate in politics, but as an idea of freedom from politics (Císař, 2010).

Besides participatory activism that might be qualified as weak, other types of activism are present in post-socialist context literature: transactional activism (advocacy-based activism focused on inter-organizational networking), radicalism (extra-institutional activism) and civic self-organization (organization- independent and episodic) (Polanska Vergara, 2015: 199). Similarly, Bitušíková recognizes two main categories of urban activism: 'a) formal organizations and movement, or organized or semi-organized groups, organizations and movements with proactive strategies aimed at strengthening social capital by supporting citizen participation in various areas of urban development; and b) informal and ad hoc movements and initiatives, or protests and pressure groups and initiatives that mobilize citizens in the city's public spaces against neoliberal politics, mainly through opposition to new construction and development projects with the aim of protecting urban heritage' (Bitušíková, 2015: 226). The informal and spontaneous self-organized urban grassroots activism arises in response to urban policy measures and manifests itself in proactive or reactive community initiatives, protest and petitions to protect public spaces, green areas or heritage sites (Bitušíková, 2015: 222). Collective mobilizations around resistance activities and movement are organized by dedicated individuals. Mobilizations tend to be numerous and small with protests and non-violent demonstrations as main actions. These informal movements challenge the city authorities' non- transparent decision making in the sale of public property to private investors and aim to stop new development that would jeopardize public space and interests. Finally, considering urban contestation as a process within post-socialist civil society and urban activism, it can be inferred that urban contestation is not just a collective practice of engagement of citizens and authorities into the urban processes, but the practice of reappropriation and transformation of the dominant power relations, and initiation of progressive social changes, aiming to produce new forms of urban spatiality.

3. PUBLIC JUSTIFICATION OF CLAIMS: SOCIOLOGY OF CRITICAL CAPACITY

The fundal element of urban contestation for strong and weak public is public justification of claims they express. Therefore, in this section the role of justifications, their general character, and the plurality of possible justifications are introduced. The main theoretical framework to research public justification is principles of sociology of critical capacity developed by Boltanski and Thévenot (2006). These authors deal with everyday debate and negotiations in a very complex social context of uncertainty. Finding a solution to the dispute and reaching agreement is possible by following predefined rules and principles of just qualification valid for the 'typical situation' (Spasić and Biršev, 2012: 158). Boltanski and Thévenot (2006) argue that all parties opt for advocating their interest and legitimizing their claims by appealing to the communicative world of justification, which are values that both parties refer to in their disputes.

In moments of dispute actors activate the appropriate idea of '*worth'* and the corresponding principle of qualifying people and objects (Spasić and Biršev, 2012: 158). This principle presupposes that orders of value, organized around a particular conception of justice, act as normative references of action (Spasić and Biršev, 2012: 158). Worth is defined as 'the way one expresses, embodies, understands, or represents other people (according to modalities that depend on the world under consideration). Worth is thus associated with a capacity for expression in general terms' (Boltanski and Thévenot, 2006: 132). These orders of worth provide strong and weak parties with shared moral principles that can be used to justify what they consider morally legitimate.

The heart of this theory is the idea to distinguish seven *worlds* or *orders of worth* adequate to describe many everyday conflicts and ordinary situations. Boltanski and Thévenot (2006) propose a justification analysis based on principles of common good: inspiration, personal relations and dependency, fame and honour, solidarity among citizens, efficiency, and fair price. Justifications in public disputes are based on seven orders of worth (inspired, domestic, the polity of fame, civic, industrial, market and green) that represent seven basic principles of common good to which humans refer (Boltanski and Thévenot, 2006). All these different orders reflect a framework that explains how actors justify their claims by embedding them in particular moral orders. These principles of common good are tested, challenged and proved by particular types of tests. In such manner, their worth in civic order is tested by tests of solidarity and equality, whereas the worth of a good price is tested by market competitiveness (Moskvina, 2022: 62).

At the beginning, *inspired worth* is characterized by the presence of strong emotions. The common good of this worth is rooted in the presumption that everybody can benefit from inspiration and creativity (Thevenot, 2001 in Tykanova and Khokhlova, 2015). Therefore, the main trait of people whose actions are directed at the world of inspiration is creativity, and their typical way of acting is 'to dream, to imagine, to rebel, or to have living experiences' (Boltanski and Thévenot, 1999: 370). *Domestic worth* is based on a hierarchy of trust based on a chain of personal relationships. According to Boltanski and Thévenot the political link between beings is seen as a 'generalization of kindship and is based on face-to-face relationship and on respect for tradition' (Boltanski and Thévenot, 1999: 370). In this worth, respect for tradition becomes a powerful source of legitimacy. The same authors claim that, to evaluate someone's worth, one must know his place in the network of dependencies from which this person draws his own authority. *Opinion worth* encompasses values based on fame, popularity, publicity and public recognition. In this worth, well-known people, stars, opinion leaders and journalists are considered experts (Thevenot, 2001 in Tykanova and Khokhlova, 2015). They are worthy when they are famous, recognized and successful. Therefore, the worth is the result of other people's opinion, and the measurement of this worth depends on conventional signs of public esteem (Boltanski and Thévenot, 1999). In *civic worth*, people advocate for common interests and collective welfare and are willing to give up their private interests (Tykanova and Khokhlova, 2015). Individuals are relevant only if they are members of collective bodies. Therefore, important subjects in this worth are federations or communities or their representatives and delegates. Their basic qualities are official and characterized by the conformity with law (Boltanski and Thévenot, 2000). The civic worth opposes the personal dependencies on which domestic worth is based and opinion of others which is in core of the opinion worth. Further, *market worth* is based on 'competition, commercial exchange, investments, selling and purchasing, benefits and property relations' (Tykanova and Khokhlova, 2015: 147). The subjects of this world are 'buyers and sellers characterized by the opportunism in the use of market resources and the lack of personal ties or emotional restraint' (Tykanova and Khokhlova, 2015: 147). The value of *industrial worth* is based on efficiency and control of production, and it is measured on a scale of professional capabilities. In this worth the most important actors are experts who are worthy when they are efficient, productive and operational (Boltanski and Thévenot, 1999). Also, their relationships are considered harmonious when organized, measurable, functional, standardized. Finally, *green worth* is based on the values of environmental stability and security.

Based on the theoretical framework of urban contestation and public justification of claims in post-socialist cities it can be inferred about actors and object of urban contestation, as well as strategies of justification mobilized to protect common good (table 2). In post-socialist cities spaces around which conflicts between authorities and citizens are mostly created are rapidly shrinking open places in public property, which are very often subject to privatization. Once open to all, those spaces are now controlled by wealthy elite. According to Darieva and Katscuba (Darieva and Katscuba, 2011: 16) the main feature of those urban spaces is liminality defined by the coexistence of old and new social orders for place production, control and its social construction. In this regard, accessibility to places and everyday practices is contested by an emerging plurality of place identifications in a formerly uniform city (Darieva and Katscuba, 2011: 16).

Table 2: Urban actors, contested place and public justification of claims in post-socialist cities

POST-SOCIALIST URBAN CONTESTATION		
URBAN ACTORS		*CONTESTED PLACE*
WEAK PUBLICS	*STRONG PUBLICS*	*Rapidly shrinking open public places (subject to privatization and controlled by wealthy elite)*
Inhabitants (citizens and activists)	*City officials Urban planners Market actors*	
PUBLIC JUSTIFICATION OF CLAIMS		
WEAK PUBLICS		*STRONG PUBLICS*
Civic worth Domestic worth Industrial worth		*Market worth*

The main actors in post-socialist urban contestation are people who inhabit urban places and experience the changes in their environment imposed by officials, city planners and new actors on the market. As explained in previous section, post-socialist residents are not only passive admirers or losers of rapidly changing urban landscapes, but also actors who negotiate the ways in which public spaces can be used and reproduced. However, protest of local communities often doesn't go beyond short-term NIMBY (not in my backyard) movements and come apart straight after the extinction or realization of the outer threat (Tykanova and Khokhlova, 2015). Who the main actors in urban contestation are depends on the extent to which the representatives of local communities feel responsible for urban places. The level of actors' involvement in the protection of urban places is based on the distinction between their and not their space. Therefore, urban actors' responsibility often only embraces their immediate places of residence, urban blocks that they reside in and city parks or other public places.

To find the solution to dispute and to reach an agreement, strong and weak publics legitimize their claims by appealing to all seven worlds of justification. However, due to the importance of the experience of collectivity, memories of space and interpersonal ties for considering space as one's, the main legitimization strategy weak publics use is civic worth. Also, they claim domestic and industrial worth in case of self-organizing mode of action to defend contested place. On the other hand, strong publics mainly advocate for the market worth in disputes referring to the values of progressive urban development that requires private capital.

4. THE CASE OF A CIVIL INITIATIVE FOR THE PRESERVATION OF CONTESTED SPACE IN BANJALUKA

The green public space located at the corner of Dragiše Vasića street and Tina Ujevića street in the settlement Nova Varoš has been a neighbourhood park for decades. The park is a part of the urban block which consists of three multi-story buildings of collective housing, a parking place and the green area. The park has no sport facilities or facilities for children but still is a very valuable green area for the residents only equipped with a few benches. Besides, in the context of the whole settlement this park was the place of residents' joint activities and gathering and was widely known as 'by the stone benches' (former market place) (figure 1a). Nova Varoš was built in the 1980s and is one of the most desirable residential settlements in the city with the most expensive square meter apartment. The area of the apartments ranges from 40 m^2 to 60 m^2. The settlement is characterized by the presence of two or three generations of residents without many newcomers.

In March 2017, Banjaluka City assembly made decision on the development of the Regulatory plan for the interpolation of buildings of social content in the inner core of the city Banjaluka. The proposal of the Plan envisioned that buildings of social content are built on seven different locations, one of which is the area at the corner of the said urban block covering 830 m^2 (figure 1b). The main reason for initiating the Plan development was the need for defining the treatment of existing temporary buildings owned by the City of Banjaluka in which social activities are carried out, and which are planned to be demolished due to the bad physical condition or outdated planning solution in certain locations. The main goal of this planning document is to offer locations for new buildings of social facilities (local communities, kindergartens and family medicine buildings), as well as the realization of planning assumptions for enabling their realization through some of the financing models (public-private partnership, construction contract, concession, etc.).

The story about civil initiative for preservation of green area in the neighbourhood Nova Varoš started in 2018 during the public insight of the Plan. Quite by chance, a pensioner women saw the notice of the Plan being put on public insight inside the building of local community. Prompted by this, and together with a few other residents, she initiated the first meeting of residents to discuss the plan proposal. They created a Facebook group, printed leaflets and pasted posters to invite as many people as possible. All residents were exclusively against the construction of the new six story building that would mainly be residential with a small portion of

social facilities. Also, they believed that it would cause traffic congestion, decrease already reduced public green space and space for children's play. Residents suspected city authorities and experts of acting in collusion with developers. The said meeting was held at a well-known place next to the benches. Meanwhile, they found out that the public insight had already lasted 15 days. The representatives of the local community and the president of local community, who at the same time run one city institution, were present at the meeting. Residents asked the Council of the local community to make a statement about the construction on the green area and submit a written response. Activists opted for peaceful tactics using all legally available means, advice from organizations dealing with urban activism and marketing tools. Right after the first meeting they went to submit objections to the Plan proposal. They also asked the local community to make their offices available for submitting objections on weekend days and weekdays in the afternoon. Residents organized themselves and created a group of six people who were already experienced in urban activism and were able to lead the main activities of the initiative. Over time, the activists included an increasing number of people with different backgrounds and positions. They had private relationships with representatives of the media and city administration, so they had information about future steps related to the adoption of the Plan. Throughout the struggle, citizens regularly gave information to the media, which informed the public about activities related to this place. During the initiative there were two groups of residents that differed according to their general willingness to participate. The first group didn't believe in possible success and considered that the effort was in vain, while the other group was willing to struggle and join the initiative, but they were not skilled enough in activism. There were also bots that tried to deter the activists from submitting objections and their other intentions by saying that no matter what they do the authorities will adopt the Plan.



(a) (b)

Figure 1: (a) Image of green public space in Nova Varoš, and (b) Plan of spatial organization (excerpt from the proposal of the plan)

Shortly after the fist, the activists organized a second meeting which was educative, and residents learned how to write objections to the plan proposal. In order to provide expert comments professors from the University of Banjaluka were invited to make their contribution. The team made a list of 936 objections to the Plan proposal which mainly referred to ecological, construction and traffic issues that would impair the quality of life in the settlement. They addressed the same objections to the Citizens Office, Department of Spatial Development and Mayor`s Office, and appealed to the Institution of Human Rights Ombudsman to protect their citizens' rights. Since objections should have been submitted one by one to the city authorities, many volunteers were involved in their submission. This jeopardized the work of the city administration because all objections had to be considered. Residents kept putting pressure on city authorities to abandon the Plan, using the means of the media, and that is why they were accused of creating social unrest. Meanwhile, the residents received a written opinion that the Council of the local community is against the construction on the green area and that its representatives will try to challenge the Plan in cooperation with city authorities. Contrary to this, the mayor claimed that the local community was the main initiator for the new construction of the building of social content and the adoption of the Plan, and the main rational behind this claim was the permissibility of the construction according to Spatial plan of Banjaluka.

In the following period, the activists made an effort to invite as many residents as possible to attend the public hearing which was to take place in the great hall of Banski dvor. Many citizens, especially residents of Nova Varoš, and other activists, attended the public hearing. The oldest participants were 92 and 98 years old. However, young people were not interested in participating, while retired people came in large numbers. It is important to note that during the public hearing only one objection was submitted regarding the new construction on the other six locations that were encompassed with the same Plan proposal. The discussion was very lively, and the activists were organized and prepared with clear argumentation. After the public hearing, the activists received an official answer that the Plan was not adopted because, due to many

objections, there were major changes to the Plan. After a long struggle and a lot of effort, the activists succeeded in their intention and organized a celebration. They were presented with a certificate of appreciation and a plaque by another successful initiative in the city. This case initiated many changes in the behaviour of the residents. They started organizing regular gatherings and meetings to discuss neighbourhood issues and paying full attention to the work of the local community not to miss any new notifications about future plans.

In this very top-down approach to decision-making representatives of the local community implemented various strategies and tactics for coping with the problem of imposed plan proposals. Struggle within the limits of legislation and in the context of official legal procedures regarding public participation in the urban planning process, regulated by Law on Spatial Planning and Construction (Official Gazette of RS, 40/13, 160/15, 3/16), made industrial worth the most efficient legitimation strategy the local community relied on. Furthermore, since the position of the activists in the public dispute was not defined by law, they needed to justify themselves within the civil order of worth via different means. This is done by petitions, open letters, emails, etc. The activist referred to the values of the civic worth willing to increase their responsibility and mutual trust and to mobilize as many residents as possible. In doing so, they organized an informal movement with shared responsibility. They also referred to the opinion worth demonstrating the impact of public media on the struggle over the contested green area. Referring to the attachment to neighbourhoods, habits and mutual memories and relationships, actors were expressing warm values of domestic worth. Finally, market worth served as a powerful strategy in discrediting the activities of city authorities and investors. On the other hand, the representatives of the strong public advocated for the legality of urban development initiative, meaning that they mainly resorted to the values of industrial worth. Eventually, the use of all these strategies of legitimation depended on the main aim of initiative to preserve the green area, the purposes of the local community and the context of negotiation around contested space.

5. CONCLUSION

The aim of this research is to provide better understanding of the transformative potential of civil initiatives in urban disputes and planning. Regarding this, a new theoretical model of understanding of urban contestation in post socialist cities and legitimization strategies that local communities use to protect contested places is developed. The model is based on the theoretical framework of urban conflicts, different interests and spatial practices, as well as sociology of critical capacity. This model is backed by identified features of contested places, level of actors' involvement in the protection of urban places and defined worths of justification used in the process of urban contestation. The new model can be applied as an analytical tool for the analysis of public disputes. In other words, it is an analytical tool for identification of worths that all parties refer to in their disputes, and those that are the most powerful in legitimization of claims and reaching agreement in urban contention. Moreover, the use of orders as legitimation tool depends on the purposes of the local community and the context of negotiation around contested space. Therefore, the application of the model and results of the analysis can improve transformative potential of civil activism in urban contestation and contribute to the protection of contested places in post-socialist cities.

The case of the civil initiative for preservation of the green area in the neighbourhood Nova Varoš in centre of Banjaluka is presented in the paper. This case is a symbol of persistent activism and urban resistance of informal group of people who got professional support from formal city organizations. The main actors of the initiative were residents of the neighbourhood, the ones that feel more responsible for preservation of the contested green area. The actors of the initiative were consistent, shared the same aims and supported each other in the group. Strong organizational capacity made communication channels with city authorities clear and transparent. This is the initiative in which citizens' self-organizational capacity improved over time and was gradually built through mutual activities and involvement of professionals, which is the reason why this community was given more credibility in disputes and negotiations with city officials. This case showed that pre-existing social ties within the community were beneficial for common actions because there was already mutual trust between members of the initiative. Social homogeneity of the residents of the Nova Varoš and the convergence of their interests generated the concordance of opinions on the desired future of the green area and coordinate appeal to a wide range of orders of worth. Therefore, activists used the whole range of orders of worth to increase their solidarity and encourage self-organization. However, they chose the legal means of struggle and used legitimation tools that seemed most effective in the context industrial, civil and domestic orders of worth. Similarly, the representatives of the strong publics mainly resorted to the values of industrial worth claiming that developer's actions conform to legal norms and thus there shouldn't be no impediments to

their development. However, this initiative is an example of successful self-organization of citizens which managed to preserve green public space and thus became informal partner in governance of the contested space. Presented case study is also an example of justification analysis methodology. Identified worths of justification contributed to the transformative potential of initiative in neighbourhood development project. However, since justification analysis is more precise and situation-based than discourse analysis, to prove the general link of transformative potential of the initiative with the public justification of claims more case studies in Banjaluka need to be conducted.

The results of this research show that civil initiatives have transformative potential in urban disputes and contestation. Civil initiatives are becoming more important actors of urban change because they identify problems, challenge the decisions of the authorities, and become new informal partners in the urban planning process. The results also showed that indispensable element of urban space contestations for 'strong' and 'weak' publics is public justification of claims. Eventually, the case study indicated that there is a need for more effective and meaningful participation of citizens in the initial phase of urban planning in Banjaluka to avoid creating spaces of contestation.

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ICUP2025
5th international conference on urban planning

VULNERABILITY OF THE URBAN AREAS TO CLIMATE CHANGE - THE CITY OF NOVI SAD AND NIŠ

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ABSTRACT

Due to the intensive urbanization process and the increased effect of heat islands, urban areas represent a high risk for climate change. In recent years, these areas have been increasingly exposed to extreme climate events - such as heavy rainfall and flooding, heat waves and droughts - and, on the other hand, less and less extreme cold. Long-term climate change and extreme events can increase economic losses, damage buildings and infrastructure, and disrupt the supply of electricity, heat, health and social services and safe drinking water to the population, jeopardizing public health and quality of life in urban areas.

The aim of the work is to identify the most frequent climatic extremes that occurred in the area of the cities of Novi Sad and Niš in the period 2000-2020, then the adaptability of these areas and finally their vulnerability to climatic extremes. The degree of vulnerability is determined based on the methodology 'FUTURE CITIES Adaptation Compass' (FC, 2013) for the following climatic extremes: heat waves, droughts, extreme precipitation/flooding and extreme cold.

Due to the aforementioned risks and consequences of climate change for urban development, 'adaptive urban planning' is required to ensure an appropriate system for adapting the urban environment to climate change. As a conclusion of the work, adaptation measures for the urban environment are proposed, which should be implemented depending on the level of climate change risk presented.

Keywords: *climate change; extreme climate events; vulnerability; urban areas; Novi Sad; Niš*

1. INTRODUCTION

The urban environment is not only affected by the climate, but also by global environmental changes in many ways. 'The impact of the urban environment on human health has become a critical issue for global society as the number of people living in urban areas continues to increase' (Dabberdt, et al, 2000). Due to high population density, large built-up areas and the emergence of the heat island effect, urban areas are highly vulnerable to future climate change. 'The vulnerability of cities is a combination of their economy, socio-demographic characteristics of their population, state of infrastructure, governance and other aspects' (EEA Report, 12/2020). Within the framework of the Horizon 2020 research project Reconciling adaptation, mitigation and sustainable development for cities, assessed the vulnerability of 571 European cities using a range of indicators from thematic domains including human capital, governance and institutions, socio-economic conditions, built environment and natural capital. The cities were clustered according to their vulnerability to heatwaves, flooding and droughts. The research results show that there are no clear spatial patterns of vulnerability in European cities, but numerous cities in Central Europe, Estonia, parts of Germany, Latvia and Romania, as well as cities scattered across Europe, have been identified as being vulnerable to all climate extremes (Tapia et al., 2017).

'The impacts of extreme climate events on local communities and the wider environment are the result of complex interactions between natural, physical and social factors' (Bell, et. al, 2018). Adaptation to climate change within the existing framework primarily considers sectors such as agriculture, water resources, forestry, fisheries and health, and to a much lesser extent urban planning, which increases the vulnerability of cities to climate change (Barsley et al., 2013; Schneiderbauer et al., 2020). According to EEA Report (12/2020) there is an urgent need to change the way we plan and construct our cities in the changing climate, because unsustainable urban development — built-up floodplains, progressive surface sealing, small amounts of green space or urban sprawl encroaching on wildfire- and landslide-prone areas — magnifies the impacts of climate-related hazards.

Climate adaptation planning is defined as a systematic approach used to identify the threats and hazards that might impact a community given plausible future climatic conditions. The process involves assessing the risk posed by these threats or hazards and positioning the community to avoid or minimize the consequences of climate-related disruptions (FEMA, 2024). In Europe, there are numerous examples of 'climate-resilient (adaptive) planning' that have been created to ensure optimal conditions for the life of the population in urban areas that are extremely vulnerable and risky due to climate change. One of the pioneers of climate-resilient urban development is the 'Aspern Seestadt' project in Vienna. The Austrian Institute of Technology participated in the development of the microclimate simulation model that was implemented for the project area to provide microclimate indicators for the specific layout of the apartment blocks. Based on the indicators determined, guidelines for the planning and design of the new district were defined in terms of block layout, street orientation, building height distribution, open space design and the proportion of green areas. This ensured climate-resilient urban design as the basis for sustainable planning for future development, and Aspern Seestadt became the prototype for integrated climate-resilient planning in Vienna. A master plan was created for this project (Aspern Seestadt Master Plan Revisited, 2017).

Resilient and inclusive long-term development of urban areas in the Republic of Serbia is basically a strategic goal to be achieved by 2030, according to the current Strategy of Sustainable Urban Development of the Republic of Serbia until 2030 ('Official Gazette of the RS', 47/2019). One of the five specific objectives of the Strategy is dedicated to environmental quality and climate change, and two sets of measures have been defined to achieve them, of which the following are important from the perspective of climate change adaptation: Application of green infrastructure, green roofs, restriction of motor vehicle traffic in central urban areas to improve air quality; Encourage and promote the improvement of energy efficiency in buildings; increase the use of renewable energy sources; apply modern rainwater control measures to reduce the risk of flooding; fill in urban watercourses to reduce erosion; prevent the construction of illegal buildings; reforestation and construction of retaining walls to combat landslides, etc. Measures in the action plan that specifically target climate adaptation include: Urban renewal of settlements affected by degradation processes, application of regulatory parameters in urban planning practices and alignment of new street design standards with the heat island effect. Based on the defined measures and objectives of the strategy for the proposed period, it is clear that future planning of urban areas will need to consider mitigation and adaptation measures to future changing climatic conditions to a large extent.

2. METHODOLOGY

The methodology 'FUTURE CITIES Adaptation Compass', which was developed within the EU project FUTURE CITIES (FC, 2013), is used to assess the vulnerability of the cities of Novi Sad and Niš to extreme climatic conditions. This methodology is recognized as one of the possible options for adaptation planning in the EU (Georg et al., 2016) and is included in the list of available tools on the European Commission's central portal for adaptation to climate change - ADAPT. Based on this methodology and the defined impact matrix, vulnerability was assessed as a combination of the area's sensitivity/exposure to extreme climate conditions and adaptive capacity. In order to assess the degree of sensitivity/exposure of the beneficiary, data on extreme climate events in the area of Novi Sad and Niš in the period from 2000 to 2020 were collected from the database of the Digital Climate Atlas of Serbia (https://atlas-klime.eko.gov.rs/). The degree of sensitivity/exposure is divided into low, medium and high. Adaptive capacity was analyzed based on the identification of existing measures and activities in the field of adaptation and the assessment of adaptive capacity based on financial, technological or social preparedness to cope with extreme climate events. If the beneficiary is well prepared and able to cope with such events without additional investment, the adaptation capacity is classified as high. If the recipient is only partially prepared for such events and/or has a lower capacity and readiness due to the need for additional investment, the adaptive capacity is classified as medium.

A recipient that is not prepared and able to deal with such events on its own has a low adaptive capacity, and any adaptation to such events is associated with high investments in financial resources, technology and people.

Table 1: Impact matrix for determining vulnerability class

Vulnerability class		*Adaptation capacity*		
		Low	*Medium*	*High*
Sensitivity/ exposure	*High*	*High*	*High*	*Medium*
	Medium	*High/ Medium*	*Medium*	*Medium/low*
	Low	*Low*	*Low*	*Low*

Based on the assessed exposure/susceptibility levels of the area and adaptive capacity, the degree of vulnerability of the area in question, i.e. receptors - population, infrastructure, natural resources - within the boundaries of the general city plans of Novi Sad and Niš is determined.

3. ANALYSIS OF EXTREME CLIMATE EVENTS

In order to determine the sensitivity/exposure of the Novi Sad and Nis areas to heat waves, droughts, cold waves, extreme precipitation and floods, data from the Digital Climate Atlas portal was collected in the period 2000-2020. year. In the observed twenty-year period, an increasingly frequent occurrence of extreme climate events was recorded (Table 2) – a large number of summer and tropical days, frequent heat waves of long duration, droughts and extreme precipitation. As for the SPEI index, i.e. the drought index used in the period March-August (approximately the growing season), it shows that the extremely dry years in Niš and Novi Sad were 2000, 2003, 2007 and 2012. The paramatar 'Number of days with accumulated daily precipitation of 20 mm and 30 mm', which represents a critical threshold for the occurrence of floods, shows that intense precipitation was recorded in 2001, 2004, 2010, 2014 and 2020.

When analysing the data in the observed period, it was found that the year 2007 was recorded as extremely dry (extremely negative value of the SPEI index), and on the other hand, about 6 days with a daily rainfall of over 20 mm were recorded, which only confirms the fact that they are becoming more and more frequent. extreme. In 2012, 6 heatwaves were recorded, in 2008 and 2015 there were 4 each. The long duration of heatwaves poses a particular risk, especially for the chronically ill, cardiovascular patients, the socially vulnerable, the elderly and children under 5 years of age, as the body has no opportunity to rest during the duration of heatwaves (tropical nights often occur during heatwaves). Regarding the number of frost days (FD), it was observed that there are 71 days (Novi Sad) to 78 days (Nis) on average, and cold waves were registered, among others, in 2000, 2003, 2005, 2011.

Based on this part of the analysis, it is concluded that the area of Novi Sad and Niš is exposed, and therefore sensitive, to extreme climate events, especially heat waves, droughts and extreme precipitation.

Table 2: Presentation of the average, minimum and maximum values of extreme climatic events in the period 2000-2020 of Novi Sad and Niš

		TX25[1]	*TX30*[2]	*HW*[3]	*HWND*[4]	*FD*[5]	*RR20*[6]	*RR30*[7]	*SPEI*[8]
MIN	*NOVI SAD*	*78.67*	*15.72*	*0*	*0.11*	*35.89*	*0*	*0*	*2.4061*
	NIŠ	*85.17*	*20.67*	*0*	*0*	*48.17*	*0.83*	*0*	*3.0755*
AVERAGE	*NOVI SAD*	*103.70*	*39.39*	*23.47*	*4.32*	*71.72*	*3.63*	*1.22*	*-0.4913*

1 TX25 – Number of days per year with temperatures above 25°C ('summer day')
2 TX 30 - Number of days per year with temperatures above 30°C ('tropical day')
3 HW - Number of days in the year on which a heat wave or more occurred (a heat wave is defined as a period in which for 6 or more consecutive days the daily maximum temperature was in the range of or above 10% of the warmest days (for the corresponding period of the year)
4 HWND - Number of heat waves during the year
5 FD – Number of frost days
6 RR20 - Number of days with daily accumulated precipitation greater than 20mm (extreme daily accumulation)
7 RR30 - Number of days with daily accumulated precipitation greater than 30mm (extreme daily accumulation)
8 SPEI - Standardised Precipitation-Evapotranspiration Index. Drought index for the period from the beginning of March to the end of August

	NIŠ	*108.12*	*45.87*	*22.26*	*2.75*	*78.57*	*3.63*	*0.74*	*-0.7491*
MAX	*NOVI SAD*	*132.56*	*66.28*	*46.44*	*8*	*105.17*	*9.33*	*3.11*	*-3.09*
	NIŠ	*134.33*	*78.67*	*52.83*	*6.5*	*110.83*	*6.67*	*3*	*-3.0779*

Source: https://atlas-klime.eko.gov.rs

4. ADAPTATION CAPACITY ANALYSIS

Adaptive capacity is an important segment in determining the vulnerability of certain sectors, as it represents the financial, technological or social capacity and readiness to cope with extreme climate events. Namely, if the system is exposed to one of the extreme climate events and if it is financially and technically prepared for it, this increases the resilience of the system and thus reduces its vulnerability. Adaptive capacity is classified as low, medium and high in relation to the identified existing and planned measures and the estimated adaptive capacity of the system.

According to Garschagen and Romero-Lankao (2013), countries undergoing intense urbanization and economic transformation have been found to face significant challenges in terms of vulnerability to climate change and lack of capacity to cope with climate change, and the situation is even less favorable in economically fragile communities.

The identification of existing measures requires the collection and systematization of data on current or planned policy measures in the area concerned. 'It is assumed that if climate change adaptation measures are defined as part of the measures already foreseen or planned for the management and organization of space, such environments will create greater resilience to future changes' (Milutinovic, 2018). As direct measures are considered more important due to their effectiveness in the fight against climate change, they are highlighted in the analysis in Table 3 (if registered). In 2024, the City of Novi Sad adopted the Sustainable Energy and Climate Action Plan (SECAP), which is a unique initiative to combat climate change, strengthen resilience and ensure equitable distribution of sustainable energy resources.

Table 3: The review of policies, plans and strategies of Novi Sad and Niš and their relate to direct or indirect climate change adaptation measures

Policies, plans and strategies		*Direct climate change adaptation measures*	*Indirect climate change adaptation measures*
NOVI SAD	*Spatial plan of City of Novi Sad*	-	*Priority planning solutions in the area of: Water infrastructure*
	General Urban Plan of the City of Novi Sad until 2030	-	*Planning solutions in the area of 'Protection and organization of space in the event of natural disasters' and 'Ecological housing'*
	Strategy for the development of the green space system of the City of Novi Sad 2015-2030	+	+
	Action Plan for Sustainable Energy and Climate (SECAP) for the City of Novi Sad	+	+
NIŠ	*Spatial Plan of the administrative area of City of Niš*	-	*Plan of measures for the chapter Planning solutions in the area of 'Protection against natural disasters - flood protection'*
	General Urban Plan of Niš 2010-2025	-	*Flood protection measures; hydrotechnical melioration; spatial protection and landscape design.*

Based on the review of policies, plans and strategies, Table 2 shows the extent to which they relate to direct or indirect climate change adaptation measures. In the valid planning documents of Novi Sad and Niš, mainly indirect adaptation measures are represented, which are part of the legal obligation during their preparation and concern protection against natural disasters and the environment, water infrastructure, etc. Direct measures are included in the Strategy for the Development of the Green Space System of Novi Sad and the Sustainable Energy and Climate Action Plan (SECAP) of Novi Sad, while it is unknown when these documents will be prepared for the city of Niš.

Table 4: Identification of adaptation capacity for Novi Sad and Niš

	City of Novi Sad	*City ofNiš*
Identification of current measures	*Low*	*Low*
Financial capacity	*High*	*Medium*
Institutional capacity	*Low*	*Low*
Adaptation capacity	*Medium*	*Low*

Knowledge of institutional and financial capacities, as well as the identification of existing and planned measures for the near future, is of utmost importance in determining the adaptive capacity of each sector to specific climate extremes. According to previous studies, 'high (Novi Sad) and medium (Niš) financial capacities were identified based on the GDP of the Republic of Serbia, while the institutional capacity was assessed as medium for Novi Sad and low for Niš based on the existence and work of competent institutions in the field of environmental protection, and especially based on their engagement in the field of climate change adaptation' (Filipović, Duškov 2024). The result is the final assessment of adaptation capacity - medium level for the city of Novi Sad and low level for the city of Niš.

5. ANALYSIS OF VULNERABILE SECTORS TO EXTREME CLIMATE EVENTS

When analyzing the vulnerability of urban environments, certain sectors are distinguished based on the natural and socio-economic conditions in a given area. The following describes some of the sectors of Novi Sad and Niš that could be vulnerable to some of the extreme climate conditions, such as infrastructure facilities, population (public health/vulnerable social groups), certain natural resources such as surface waters and their quality, the urban green system and biodiversity. The first part presents the basic characteristics of each of the analyzed receptors of the city of Novi Sad and Niš.

5.1. Analysis of vulnerable sectors of Novi Sad

Population and public health: According to the 2022 census, Novi Sad has 368,967 inhabitants with an average age of 40.8 years, which is below the national average (43.85 years). Novi Sad is the health center of Vojvodina, and the facilities of health institutions consist of 29 Health Centers, 19 pharmacies and the Clinical Center (one of 4 in Serbia).

Water and water quality: The main watercourse is the Danube and the DTD Novi Sad - Savino selo hydrosystem (as part of the unique Danube-Tisa-Danube hydrotechnical system) with defined water levels and river courses.

Infrastructure systems: The transportation infrastructure consists of important corridors - international road E-75, international railroad E-85, international waterway - corridor X and international port 'Novi Sad'. The total length of all roads in Novi Sad represents a modern road network (Municipalities and regions in the Republic of Serbia, 2024). **The water infrastructure** consists of the water supply system and includes the springs 'Ratno ostrvo', 'Petrovaradinska ada' and 'Štrand', from where water is supplied to the existing water treatment and distribution plant 'Štrand'. **The wastewater infrastructure** has been established in Novi Sad and Petrovaradin, and the recipient is the Danube without prior treatment, which significantly affects the water quality. In total, 84.60% of households in the city of Novi Sad are connected to the sewage system and 97.40% of households are connected to the water supply (municipalities and regions in the Republic of Serbia, 2024). The most important **energy infrastructure** facility is the thermal power plant (TE-TO) 'Novi Sad'. The city's heating system consists of systems for the production, distribution and supply of thermal energy, and in the urban area there is a gas supply directly from the gasification system in parts of the city with single-family houses and in working zones.

The green system of the City of Novi Sad consists of urban (parks, squares, street greenery, greenery of residential blocks, greenery for other purposes and protective green belts in the urban fabric, greenery for the purposes of family housing) and suburban greenery (protective belts and park forests, places for leisure and active recreation along the border of the construction area). Among the central city parks, Kamenički Park stands out; among the zonal parks, Danube Park, Liman Park, Futoški Park, University Park, Park by the Old Furnace; special-purpose parks - the green area of the Petrovaradin Fortress and others. The green system of the urban part of Novi Sad consists of 2,901.75 ha (Study of Green and Recreational Areas, 2021).

Biodiversity: Different ecosystems are represented on the territory of Novi Sad. Protected natural areas that are significant for biodiversity conservation are: National Park 'Fruška Gora', Natural Monuments 'Dunavski

park',’Futoški park’,’Kamenički park’, ’Koprivić’, ’Maple-leaved plane tree in Novi Sad’, American plane tree on Sajlovu', 'Plane tree in the courtyard of Miloš Crnjanski School', 'Ginkgo tree', 'Luznjak oak', 'Koprivica tree in Miroslava Antić Street in Novi Sad'. There are also international importance area - the "Koviljsko-Petrovaradinski rit" area proposed for the EMERAL ecological network, which is also protected by the Ramsar Convention; internationally important areas for birds (IBA) and plants (IPA) - 'Fruška Gora' and 'Koviljsko-Petrovaradinski rit'. International ecological corridor Danube, regional ecological corridor Canal DTD and local ecological corridors Mali Kameranski potok, Novoselski potok, Rokov potok, Bukovački potok and Selište brook, Dunavac near Koviljski rit.

5.2. Analysis of vulnerable sectors of Niš

Population and public health: According to the 2022 census, Niš has a total population of 249,501 and the average age is 43.37 years, which is close to the average for the Republic (43.85 years). Health care in Niš is provided by primary (Health centers, Institutes for emergency medical care, worker and student protection), secondary and tertiary services (Clinical Center, Institute for Health Protection, Institute for Prevention, Treatment and Rehabilitation of Rheumatic and Cardiovascular Diseases, Institute of Forensic Medicine).

Water and water quality: The hydrographic network is well developed – there are two major rivers, the Juzna Morava and the Nišava, and in the Niš area there are also a large number of tributaries, rivers and torrents. The two main rivers are the Nišava and the Juzna Morava. Based on water samples taken to examine the physical, chemical and bacteriological properties of the water, it was determined on the Aleksinac profile (as the closest to Niš) that the Juzna Morava River belongs to Class III/IV of watercourses. The water quality of the Nišava River was examined by sampling on the Dimitrovgrad (border profile), Pirot, Bela Palanka and Niš profiles and was found to belong to quality classes III and IV.

Infrastructure systems: The most important **transport infrastructures** are the E75, E80 and E771 highways, as well as the 1st and 2nd order state roads (1st order state road M-1.12, M-25, 2nd order state roads R-214, R-274, R-241, R-241a). The entire transport infrastructure consists of modern roadways (Municipalities and regions in the Republic of Serbia, 2024).

The wastewater infrastructure is insufficiently developed - only 34.36% of the population is connected to the wastewater system at the level of the entire administrative territory of the City of Niš (Municipalities and regions in the Republic of Serbia, 2024). There is no wastewater treatment on the territory of Niš. **Water supply:** The settlements are supplied with water by public systems. Four independent sources are used for water supply: the ‘Studena’ spring, the ‘Medijana’ spring, the ‘Ljuberadja’ regional system and the ‘Moravski’ system. About 98.87% of households use water from the Niš water supply system, according to data from the Institute of Statistics of the Republic from 2024. **Energy infrastructure**: Thermal energy is supplied via a centralized urban heating system, local boiler houses and individual boiler houses. The central urban heating system consists of central heat sources within the PUC 'Gradska toplana' and a network of main heating pipes. The wastewater infrastructure is not satisfactorily developed. Of all the settlements, only Niš and Niška Banja have a built and functioning sewage system (approx. 450 km long). Of the suburban settlements, only some have a partially developed sewage system.

Biodiversity: The most important protected naturals areas are ‘Sićevo gorge Nature Park’ and ‘Jelašnica’ gorge Nature reserve, springs in Sićevo and Gornja Studena, ‘Cerjanska Cave’, caves and pits in the Sićevo area, Miljkovac Canyon, Canyon in Seličevica, Prozorac in the Jelasnica Gorge.

Green areas: According to estimates, the city has 5m^2 of green areas, while the normative requirement is at least 12m^2/inhabitant (according to GUP Niš by 2025). The green spaces are in the form of: Parks (15 parks, 3 squares, the old quay, the quay in Niška Banja) with an area of 49.01 ha; Forest park ('Bubanj' with 50.45 ha and 'Koritnik' in Niška Banja with approx. 40 ha); Protective greenery, which includes greenery along watercourses that are overgrown with wild vegetation and therefore do not fulfill their function.

6. RESULTS

Based on the impact matrix for determining vulnerability to extreme climate events (Table 4), high, medium and low degrees of vulnerability of the city of Novi Sad and Niš to heat waves, cold waves, droughts and extreme precipitation/flooding were identified. The vulnerability of the population, i.e. vulnerable groups, to heat waves and cold waves as well as extreme precipitation with the risk of flooding in Novi Sad and Niš was assessed as high due to the high exposure of this receptor to the above-mentioned climatic extremes.

Particularly vulnerable to these types of extremes are the elderly (over 65), chronically ill, cardiovascular patients and socio-economically disadvantaged and marginalized social groups. Vulnerability to drought is rated as medium, as this receptor is indirectly threatened by the consequences of drought through the vulnerability of other receptors (agriculture, water infrastructure, etc.).

Table 5: Overview of the adaptation capacity and vulnerability of the population of Novi Sad and Niš to extreme climate conditions

Public health/vulnerable groups		*Vulnerability*			
		Heat wave	*Cold wave*	*Extreme precipitation/ floods*	*Drought*
Novi Sad	*Adaptive capacity*	*Low*	*Low*	*Low*	*Medium*
	Vulnerability	*High*	*High*	*High*	*Medium*
Niš	*Adaptive capacity*	*Low*	*Low*	*Low*	*Medium*
	Vulnerability	*High*	*High*	*High*	*Medium*

The electrical infrastructure, water supply and sewage systems in Novi Sad and Niš are the most vulnerable to all climatic extremes (Table 6). During the duration of heat and cold waves, the objects of electrical infrastructure and district heating are subjected to additional stress, which can lead to damage and/or interruptions in the power supply and the supply of electrical and thermal energy at key moments. Extreme rainfall and flooding can also physically damage and destroy these facilities, preventing their normal operation and functioning. The transportation infrastructure is moderately vulnerable to cold waves, heat waves and flooding as the entire transportation infrastructure of the study area consists of modern roads, which increases its resilience to extreme climate events.

Table 6: Overview of the adaptation capacity and vulnerability of the infrastructure of Novi Sad and Niš to extreme climate conditions

Receptor			*Vulnerability*			
			Heat wave	*Cold wave*	*Extreme precipitation/ floods*	*Drought*
Novi Sad	*Transport infrastructure*	*Adaptation capacity*	*Medium*	*Medium*	*Medium*	*Not relevant*
		Vulnerability	*Medium*	*Medium*	*Medium*	*Low*
	Electricity and district heating	*Adaptation capacity*	*Low*	*Low*	*Low*	*Not relevant*
		Vulnerability	*High*	*High*	*High*	*High*
	Water supply and sewage	*Adaptation capacity*	*Medium*	*Medium*	*Medium*	*Medium*
		Vulnerability	*High*	*High*	*High*	*High*
Niš	*Transport infrastructure*	*Adaptation capacity*	*Medium*	*Medium*	*Medium*	*Not relevant*
		Vulnerability	*Medium*	*Medium*	*Medium*	*Low*
	Electricity and district heating	*Adaptation capacity*	*Low*	*Low*	*Low*	*Not relevant*
		Vulnerability	*High*	*High*	*High*	*High*
	Water supply and sewage	*Adaptation capacity*	*Low*	*Low*	*Low*	*Low*
		Vulnerability	*High*	*High*	*High*	*High*

The natural resources of Novi Sad and Niš are highly vulnerable to almost all climate extremes, with the exception of cold waves, for which a medium vulnerability has been identified (Table 7). Water resources and their quality can be at risk during heat waves and droughts, but also during floods. 'There is then a risk of the occurrence of numerous microorganisms and epidemics of infectious diseases' (Opopol et al. 2003). The green system is very vulnerable to heat waves and droughts, as during their duration the water supply to vegetation

is significantly reduced, leading to its degradation, and during this period the costs of its maintenance increase (increased irrigation, watering). The spread of infectious diseases and pollution during floods have a negative impact on flora and fauna, which is why the green system is very vulnerable to these extreme climatic events. Similar to the green system, protected natural resources, i.e. biodiversity in the Novi Sad and Niš area, are most vulnerable during heat waves and droughts due to their low adaptive capacity and high exposure/sensitivity. Plant and animal species, although under additional protection regulations, need significantly more time to adapt to the increasingly frequent climate extremes. Vulnerability to cold spells and extreme precipitation is classified as medium.

Table 7: Overview of the adaptation capacity and vulnerability of the natural resources of Novi Sad and Niš to extreme climate conditions

Receptor		*Vulnerability*				
			Heat wave	*Cold wave*	*Extreme precipitation/ floods*	*Drought*
Novi Sad	*Water resources and quality*	*Adaptation capacity*	*Medium*	*Medium*	*Medium*	*Medium*
		Vulnerability	*High*	*Low/ not relevant*	*High*	*High*
	Green areas	*Adaptation capacity*	*Low*	*Medium*	*Low*	*Low*
		Vulnerability	*High*	*Medium*	*High*	*High*
	Biodiversity	*Adaptation capacity*	*Low*	*Medium*	*Low*	*Low*
		Vulnerability	*High*	*Medium*	*Medium*	*High*
Niš	*Water resources and quality*	*Adaptation capacity*	*Medium*	*Medium*	*Medium*	*Medium*
		Vulnerability	*High*	*Low/ not relevant*	*High*	*High*
	Green areas	*Adaptation capacity*	*Low*	*Medium*	*Low*	*Low*
		Vulnerability	*High*	*Medium*	*High*	*High*
	Biodiversity	*Adaptation capacity*	*Low*	*Medium*	*Low*	*Low*
		Vulnerability	*High*	*Medium*	*Medium*	*High*

7. CONCLUSION AND SUGGESTED ADAPTATION MEASURES

Adaptation planning is about implementing policies, management strategies and long-term investments as part of a wider community approach to reducing the risks posed by climate change. For this reason, spatial and urban planning is an important 'tool' as it provides a long-term view of spatial development and can thus prepare the community to avoid material and human losses. It is necessary to integrate adaptation measures into relevant new and existing spatial development plans and strategies within relevant sectors and at different hierarchical levels, and this requires changes to the existing regulatory and legal system from the republican to the local community level.

Current spatial and urban planning practice has not sufficiently addressed the issue of climate change, particularly in terms of adaptation. Part of this research dealt with the identification of measures within the current policies, strategies and plans of local municipalities (Novi Sad and Niš) and the conclusion is that there are not sufficient direct adaptation measures in their content. Part of the indirect measures recognized in these documents concern planning solutions that are part of the legal obligation in the development of planning documents. However, for the successful implementation of adaptation measures and with the aim of actively combating the consequences of climate change and increasing the adaptive capacity of local communities (and beyond), it is necessary to identify the most vulnerable sectors in the initial stages of the planning process and prioritize them in the implementation of planning solutions and the provision of funding for their implementation.

As the study area is highly exposed to extreme climate events, which have become more frequent in the last twenty years, adaptation measures are needed in many sectors. The following is a proposal for adaptation measures for the receptors analyzed in relation to the vulnerability identified:

The population, i.e. public health/vulnerable groups, is among the priority sectors, and is indirectly covered by the proposed measures within other sectors (for example, electrical and water infrastructure, green system, etc.). In order for the population to prepare and adapt to climate extremes to the greatest extent possible, it is necessary to strengthen and expand the capacities of health institutions so that they can react in a timely manner and provide assistance to the population during heat waves and droughts, provide a system of timely warning of the population about upcoming climate events, ensure the protection and suspension of outdoor workers during heat waves, etc.

Infrastructure, as one of the most important systems for the smooth functioning of the urban environment, is very vulnerable to floods, heat waves, droughts and cold spells. Electrical infrastructure, water supply and wastewater disposal are particularly vulnerable to all extremes. The proposed adaptation measures for the infrastructure systems examined are Construction of flood protection walls, modernization and expansion of water supply and wastewater networks of Novi Sad and Niš, construction of wastewater treatment plants (provided for in the relevant documents), application of standards for construction of 'resilient infrastructure', adequate protection of water sources to prevent water quality problems, introduction of measures to improve the water distribution system, etc.

Water resources and water quality in Novi Sad and Niš are vulnerable to heat waves, droughts and floods, which can affect water quality and availability of water resources. Therefore, the implementation of flood protection and water conservation measures as well as the improvement of water supply and utility infrastructure will significantly improve the adaptation of this sector to extreme climate conditions.

Adaptation of **green areas** of the cities of Novi Sad and Niš would primarily aim at increasing the area of public urban green areas, especially green areas for public use and special purposes with the right selection of species resistant to droughts and heat waves. An indispensable part of the adaptation measures is the mandatory introduction of the concept of green infrastructure, i.e. the linear connection of green spaces (rows of trees, gardens, parks, forests, watercourses, etc.).

Biodiversity in urban areas is particularly threatened by droughts and heatwaves. To adapt, it is therefore necessary to improve the management of protected areas and increase the protected area, develop a system to monitor and spread invasive species and pests (due to heat waves and droughts), establish ecological corridors, preserve habitats and vegetation and the water balance.

The lack of consistent and comprehensive adaptation planning and definition of measures at the local community level, especially in urban areas, prevents a more accurate assessment of the level of preparedness for climate change. The future system of planning and management of urban areas must be based on the provisions of the concept of 'urban resilience' in order to enable the sustainable transformation of these areas in times of climate change. The vulnerability results and proposed adaptation measures for urban areas can be used in planning the future development and management of these communities, and the model used can be representative in determining the vulnerability of spaces in other environments.

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ICUP2025
5th international conference on urban planning

DESIGN FEATURES AND SYMBOLISM OF MEMORIAL COMPLEX ARRANGEMENTS

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ABSTRACT

The memorial complexes, which are the subject of the analysis of this work, were built after the Second World War on the territory of the Republic of Serbia in order to remember the suffering and sadness that the people experienced. Urban-architectural spaces are built as high-level spatial solutions, where the central place is a memorial with a characteristic design and form. They are characterized by innovative architectural expression and a harmonious connection between the building and the place where the complex is located. These monuments of culture still attract attention today with their form, but also with the use of symbolism in the design concept. The goal of the work is precisely the interpretation of the message that these urban-architectural complexes send to visitors. Interpreting the interaction between architectural design and spatial solution, along with an overview of historical and political influence, the design process of the complex and their symbolic expression will be analyzed.

Keywords*:* *memorial architecture, memorial complex, design, form design, symbolism*

1. INTRODUCTION

The memorial complex represents testimony of the past and is a keeper of memories for future generations. The memorial represents the heritage of a people that archives memories, which is a combination of art, architecture and historical facts. In the second half of the 20th century, in the territory of the SFR Yugoslavia, the construction of memorial monuments was initiated by the state through the organization of a series of architectural-urbanistic competitions. The task was entrusted to sculptors and architects, who were given artistic freedom in the process. The goal of most of the memorials built during the existence of socialist Yugoslavia was to present the evolution of society and, through constant improvements, to reflect and influence the changes in reality. Memorials are there to convey a message of suffering, remembrance, evoke emotions of sorrow and hope, and help us better understand the space and time in which they were created. Monuments and memorial complexes are at the same time works of art and architectural achievements, through which art is combined with historical facts.

In the second half of the 20th century, in the territory of the SFR Yugoslavia, the construction of memorial monuments was initiated by the state through the organization of a series of architectural-urbanistic

competitions. The work was entrusted to sculptors and architects, who were given artistic freedom in the process. “The goal of most of the memorials built during the existence of socialist Yugoslavia was to present the evolution of society and, through constant improvements, to reflect and influence the changes in reality”[7]. Memorials are there to convey a message of suffering, remembrance, evoke emotions of sorrow and hope, and help us better understand the space and time in which they were created. Monuments and memorial complexes are at the same time works of art and architectural achievements, through which art is combined with historical facts.

Memorial Modernism [6], which emerged in the 1960s, refers to a new, abstract approach to monument design. “The acceptance of modernism as the dominant political, cultural, and artistic paradigm at the end of the 1950s and during the 1960s enabled some of the most impressive realizations of monumental modernist sculpture to be achieved precisely in the genre of memorial sculpture, not only in the Yugoslav context but also in the European context [5]. Monuments of large dimensions with specific designs were built across the world in communist countries. However, what makes those built on the territory of the SFRY unique is the “immense scale of the Yugoslav project, coupled with its intricate planning and ideological engineering” [10]. These projects strengthened national identity and created a strong framework for collective memory.

Leaving behind traditional monument designs such as busts, obelisks, and plaques, many artists and architects during this period embraced a new approach, basing their ideas on specific forms and the clear use of geometric shapes [11], as well as symbolism, to fully convey the experience of these memorial complexes. The forms they created led to a unique architectural expression that continues to attract the attention of both researchers and visitors. “The symbolism of the architectural expression in memorial architecture serves the function of conveying the message about the significance of each individual work. Without the use of symbolic meaning in the elements of form and spatial arrangement, a comprehensive approach to designing memorial architecture is not possible” [1].

The focus of the research is the analysis of these symbolic forms used to create unity between function and form in these memorial monuments.

2. IMPACT ON DESIGN FEATURES DURING MEMORIAL COMPLEX ARRANGEMENTS

Memorial objects built during the time of the SFR Yugoslavia are highly regarded in international expert circles. Monuments have been the subject of numerous analyses to better understand the political and economic conditions under which they were created, providing an overview of historical facts. They have also been the focus of many studies by artists and architects who directly influenced the appearance of these monuments. What has recently renewed interest among the professional public and sparked further study of these complexes is the 2019 exhibition at the Museum of Modern Art (MoMA) in New York, which placed a particular emphasis on the form and identity of these objects. A crucial aspect of studying monuments lies in the architectural elements involved in the creation of these objects and their layered, long-lasting impact. When observing the specific form of memorials, apart from the personal evaluation of their appearance and the emotions they evoke, we can interpret them through the application of:

- Massiveness and proportion of the monuments: The monument's size emphasizes the emotion of suffering while also representing the scale of human courage and achievement.
- Materialization applied to most monuments from the analyzed period: The characteristic choice of materials, such as concrete, which represents strength, enhances the significance of these works, symbolizing power and stability.
- Choice of location and placement in the appropriate natural context: The monuments are positioned at the locations of significant battles or suffering, away from urban areas, where they become the central point of observation.
- Application of geometric shapes and their integration: Through the transformation and combination of geometric surfaces, the planned appearance is achieved, resulting in a distinctive and recognizable design [11].
- Applied symbolic expression: Architects use symbolic elements to create a characteristic style that remains recognizable and relevant today. The symbolic influence refers to the visual representation of the monument, which we will explore further.

Considering all these characteristics, the final design of the memorial complexes is realized. Through this layered approach, in which a characteristic form is created, a monument is produced that, in addition to clear architectural principles, allows the visitor various interpretations and emotional experiences. In the interpretation of the architectural work, the symbol creates a visual expression, which in these examples represents the connection between form and meaning that the architect wants to convey to us.

3. SYMBOLIC ARCHITECTURAL EXPRESSION IN MEMORIAL COMPLEXES

The term "symbol" is often used for conventional signs such as letters, numbers, and various markings [2]. When we talk about applied symbols in architectural works, we are referring to a metaphorical approach where symbolism does not provide a concrete image of reality. In this case, the use of symbols is more spontaneous, encouraging the visitor to reflect on the work and the historical moment it represents. "Symbol in architecture and art represents a universal aesthetic category, which is uncovered and identified through its relationship with related categories – on one side, architectural forms; on the other side, the meanings, or functions, of the architectural work" [1]. By interpreting the symbolism of architectural expression, considering the analysis of functional and spatial aspects, as well as the applied elements of form, we can understand part of the message or meaning of a piece of memorial architecture. Cassirer [4], who dealt with symbolic form, states that the human mind is constituted in such a way that it gives meaning to the observed element, and human consciousness understands the form. In other words, humans perceive the world through symbolic forms, meaning that they represent a path to interpreting reality. The symbolic form of the observed object offers the visitor a multitude of associations and provides the idea of recreating a memory of a specific event. Through such observation, symbolism in memorial architecture gives the object a certain degree of mysticism, offering the visitor a variety of experiences and providing researchers with endless material for study.

In this paper, selected characteristic examples will be analyzed in order to observe a clear connection between the design and the symbolism by which these monuments are recognizable.

3.1. Analysis of the symbolic expression on selected examples

The Bubanj memorial park contains a memorial path that leads to a plateau covered with grass around which paving has been laid, where the "three fists" are located [Fig.1], which are often depicted as a symbol of the city of Niš. The monument was built in 1963 and was erected in memory of the mass executions that took place at this site. The memorial park was created to honor the 10,000 prisoners of the Crveni Krst concentration camp. [7] The design of the monument was entrusted to sculptor Ivan Sabolić, who conceptualized the project as "three imposing clenched fists, raised toward the sky in a proud and defiant gesture, symbolizing a call for rebellion and resistance by all free people against terror." [10]



Figure 1: Bubanj monument, source: autors

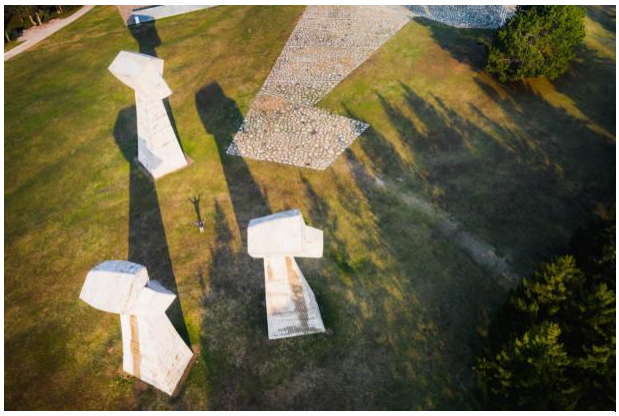


Figure 2: Bubanj memorial park, source: https://www.gettyimages.fr/photos/bubanj-memorial-park

The three fists symbolize defiance, and the author's intent to depict the resistance of the people to new struggles and suffering is clear. he symbolism here is easily recognizable, as the clenched fist stands out clearly. Even though the observer is small in relation to the monumental structure, they can feel the power and magnitude of the resistance against the injustice that took place at this location. However, if we delve deeper into the analysis of the symbolism, we may ask why three raised fists. They symbolize that "not only men, but also women and children lost their lives here."[10] With this arrangement and the varying heights of the fists

(16m, 14m, and 13m), the author emphasizes the intensity of the suffering, indicating that entire families perished at this location. It is also interesting that the symbolism of the fist appears in the paving, where from a bird's-eye view, one can see a large fist. This hidden fist points toward the monument and is visible from the air[Fig.2], clearly symbolizing that this place is not just the site of a memorial, but also a place where people and children suffered and died during World War II.

The monument on Kosmaj is the work of the design team consisting of architect Gradimir Medaković and sculptor Vojin Stojić, who won the architectural-urban planning competition [Fig 3]. The memorial complex was constructed in 1970. and is dedicated to the Kosmaj Partisan Brigade. It consists of five separated 40 meter tall concrete double pointed fins [10]. As for the shape of the symbol of the Kosmaj monument, in some sources the arrangement of the arms is interpreted as a five-pointed star worn by members of the detachment[10]. This is exactly what makes this monument interesting, because newspapers from that period state that the author's intention was for the branches to form a flower facing the sky in honor of the heroes of Kosmaj. Also, in this article from 1971, it is stated that "it is a matter of the individual and his imagination what kind of symbolism he will find between what he knows about Kosmaj, his legendary squad, his fighters, the people of Kosmaj region and what is in front of their eyes"[12]. Composing more symbols strengthens the mystique of the memorial complex and sends a message to the visitor about the meaning of the memorial complex, makes him think and research about the meaning of the historical background that caused the whole complex to come into existence.



Figure 3: Kosmaj monument source: https://www.spomenikdatabase.org



Figure 4: Memorial complex Popina; source: https://www.spomenikdatabase.org/popina

Like the previously analyzed monument, the memorial complex is reached by a long staircase through wooded terrain, leading to a spacious viewpoint where the monument is located. This urbanistic arrangement is characteristic of many memorial complexes and is also one of the symbolic aspects. The visitor undergoes the effort of reaching the monument, climbing the long staircase, and arriving at a spacious plateau where they are greeted by massive memorials hidden among the greenery. The symbols associated with the specific location and the events that occurred at the site of suffering or the gathering of the unit enhance the individual narrative that the visitor can use to understand the monument's message. Thus, "the location is not only historically charged but also plays an important role in building the meaning" [9].

Another memorial with a similar significance in terms of location selection is the Popina Memorial Complex [Fig.4], located in the village of Štulac, near Vrnjačka Banja, and built in 1981. The Popina Memorial Complex, with its exceptional symbolism and carefully chosen location, truly reflects the deep connection between architecture, history, and space. The monument is located at a site where an important battle took place, and the architectural approach, particularly through geometric shapes, reflects the simplicity and seriousness of the theme. Architect Bogdan Bogdanović, through the arrangement of three elements—two semicircles and a pyramid—created a monument that is not only visually striking but also carries a strong message of struggle and resistance. The combination of geometric forms with openings in the concrete, which resemble bullets that

have pierced these structures, provides deep symbolism. This can be interpreted as a reflection of the fight against violence, resistance to aggression, and the strength and endurance of the army and the people during the war. The spatial placement of the monument, with a path leading the visitor toward the center, allows for the gradual discovery of the monument itself, enabling visitors to emotionally experience the message it carries. Just like in the previous examples, the designer creates a connection between the visitor, the space, and the symbols, making the experience of the monument even more intense.

The Monument in Brezovica, designed by Svetomir Basara, was built in 1964. and is dedicated to the Partisan unit from the Šar Mountains. It consists of two massive concrete elements connected by intertwined steel pipes [Fig.5]. "If the steel structure symbolizes revolution and struggle, and the concrete element symbolizes protection, the message that the monument should convey to the observer can be interpreted in two ways. The monument serves as a guardian of the revolution, but also emphasizes power, resilience, and sturdiness." [3] This monument contains symbolic elements that combine historical and natural context, as well as an urbanistic design aspect. The concrete elements, shaped like lung wings connected by steel threads, effectively convey the symbolism of the strength of life and struggle, linking the monument to the nature and history of the region.

The urbanistic layout, with a path leading visitors to the monument, clearly enhances the experience of the monument – the gradual revelation of the monument as one approaches allows the visitor to gradually connect with its message. This is a powerful way of communication through architecture, where space becomes a means for emotional and intellectual engagement.



Figure 5: Brezovica Memorial complex, source: https://www.spomenikdatabase.org/brezovica



Figure 6: Šumarice Memorial Park, source: autors

The Šumarice Memorial Park [Fig.6] is one of the most well-known and most visited memorial parks in Serbia. It consists of several memorial structures with a museum space spread over 350 hectares. The central feature is the monument by Miodrag Živković, built in 1963, which is reached by long pedestrian paths that traverse the entire complex. The tragic event, which is taught in schools and represents one of the most painful reminders of how merciless World War II was, especially to children, is designed as a concrete structure about 8 meters high. The relief on the monument depicts schoolchildren, while the symbolic shape of the monument refers to the roman number 5, representing the class that was led to execution (V3).

What lies behind the clear symbolism of this monument is also the fact that the position of the concrete elements resembles spread wings, which could be a message from the author about the freedom and innocence of the victims, freeing them from the fear they had endured.

The entire complex, with its pedestrian paths leading to the monument, allows visitors to gradually immerse themselves in the atmosphere of the memorial park, thus deepening the experience of the message the author sought to convey. It is a serious, yet powerful reminder of the importance of remembering the victims, while also providing a space for reflection on peace, freedom, and the values that should be preserved.

4. CONCLUSION

Selected examples of memorial complex, both in terms of architectural solutions and location choices, clearly demonstrate the deep connection between architecture, history and symbolism. Although different architects and sculptors worked on these projects, there is a common thread that connects their works – the

careful selection of locations, the use of symbolic elements, and the effort to convey a powerful message through form, space, and the arrangement of elements. The architects integrated the natural features of the site into the design, making the monument itself not only aesthetically striking, but also emotionally connected to the location on which it was built. The urban layout of the elements in the memorial complexes in all examples is such that it contributes to the feeling of mysticism, the gradual revelation of the message and encourages the visitor to think about the suffering and the symbolism that the memorial park and the monument itself convey.

This approach to architecture and urban planning allows each of these monuments to become more than just a landmark. They become spaces for personal reflection and connection with past events in a way that is deeply emotional.

The conclusion is that with these memorial park monuments, the influence of the symbolism of the architectural expression can be observed on three levels: one characteristic detail of the monument, the entire monument and, finally, the entire memorial complex. This approach allows for a deep understanding of how each element contributes to the overall impression and message that the monument or complex wants to convey.

Characteristic Detail: On the level of detail, symbolism is often very precise and direct. For example, certain elements such as a clenched fist (like the one at Bubanj, where the memorial takes the shape of a fist) or reliefs depicting specific scenes (like those in Miodrag Živković's monument) have clearly defined symbolic meaning. These details lay the foundation for a deeper understanding and significance of the entire monument.

- Complete Monument: On this level, the architectural design can represent a broader message through shapes, symbols, and proportions. For instance, the choice of geometric forms (such as pyramids, semicircles, and circular openings in Popina) creates a strong, minimalist form that evokes a sense of struggle, resistance, and the ongoing fight for freedom. Each change in the shape of the monument can carry symbolic meaning – for example, the height, massiveness, or the material of the monument (such as concrete) can symbolize the weight of historical reality or the sacrifices made by those who fought.

- Memorial Complex as a Whole: On this level, the architectural arrangement of the entire complex plays a key role. Long paths that gradually lead visitors to the monument are not merely practical elements; they also have deep symbolic meaning. Walking through the park, with increasingly clear views of the monument, creates an atmosphere of reflection, remembrance, and deeper engagement with the monument's significance. The entire complex can be viewed as a process that guides the visitor through stages of thought and emotional connection to the importance of the memorial.

These three levels together create a unique experience, where each element – from the smallest detail to the broader compositions – contributes to the overall message. In this way, each monument becomes much more than just an object. It transforms into a dynamic space where visitors can connect emotionally, ensuring that the message about past events and sacrifices is deeply understood and felt.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under the Agreement on the Implementation and Financing of Scientific Research Work of the NIO in 2025 - Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025.

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ICUP2025
5th international conference on urban planning

NEW (PSEUDO) PUBLIC SPACES IN SHOPPINGMALLS

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ABSTRACT

This research focuses on shopping malls as public facilities that, from their inception, were designed as unified shopping hubs aimed at fulfilling the basic needs of the modern individual by enabling purchases to be completed in a single location. Over time, shopping malls have evolved into some of the most commercialized and intensively used public spaces of the modern era. Today, shopping malls are no longer solely retail venues but multifunctional commercial spaces that primarily serve as social gathering points. The spatial organization of shopping malls, regardless of their construction type, consistently includes public features such as streets, squares, urban furniture, greenery, and water elements, effectively replicating the characteristics of traditional public spaces. Shopping malls are particularly suited to addressing social needs, providing free access to spaces where people can meet, interact, and socialize in a comfortable environment. Within the "pseudo-public spaces" of shopping malls, the negative aspects typically associated with urban "living public spaces" are absent.

This paper presents a comparative analysis of genuine public spaces and the pseudo-public spaces created within shopping malls. Current trends in the development of new concepts, driven by user lifestyles and preferences, are increasingly focused on expanding the range of public and social amenities, aiming to create environments that encourage longer and more enjoyable stays for individuals of all age groups.

Keywords: *shopping malls, public spaces, social spaces, servicescapes*

1. INTRODUCTION

This paper analyzes traditional public spaces and shopping malls through their definitions and functional characteristics. As a contemporary concept, shopping malls are increasingly playing a significant role in urban development, taking on functions of gathering, recreation, and leisure, which were originally associated with traditional social spaces. In this way, shopping malls are evolving into new forms of public spaces, incorporating elements of the traditional urban environment within an architectural context. Through a comparative analysis of public and pseudo-public spaces in shopping malls, key differences, advantages, and disadvantages have been identified based on predefined criteria.

2. PUBLIC SPACE

From the earliest forms of urban settlements in ancient Greece, the agora—a central square designated for gatherings, trade, and debates—represented the origin of the concept of public space as a key element of the city. The definition of public space encompasses a broad spectrum of philosophical, political, social, and urban-architectural interpretations, reflecting its complexity. It is defined through the interrelationship of

functional, ownership, compositional, and aesthetic characteristics. Traditional public space is an integral part of the urban context, shaped throughout history and adapted to the social needs of the community. It represents a public good, filled with various urban amenities intended for citizens regardless of their heterogeneity, class, race, nationality, or any other affiliation. Public space includes public areas such as squares, parks, streets, promenades, and other spaces that are, as a rule, accessible to all and serve various forms of gathering, lingering, and other individual or collective user needs.

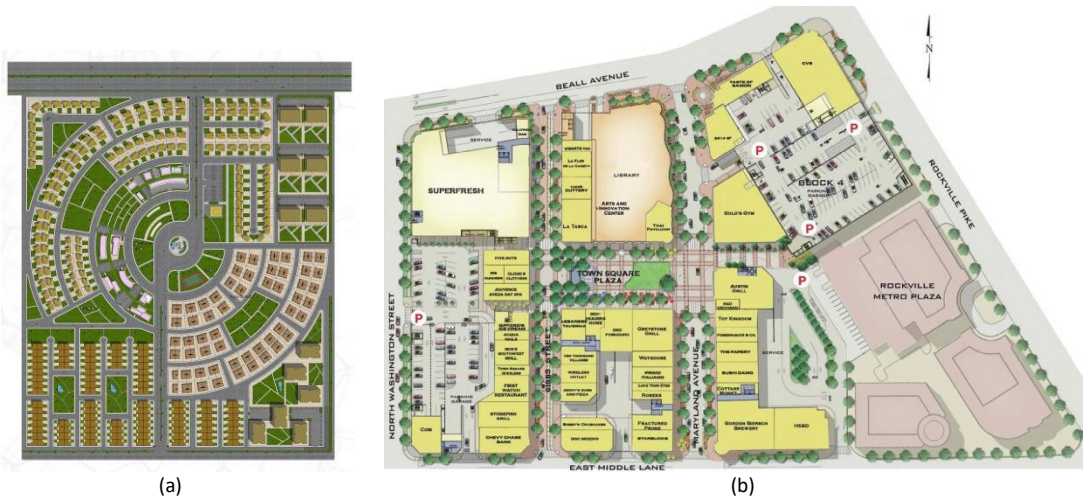
Public space reflects the conditions of the urban social community, which, in a socio-cultural context, largely depends on the habits of the majority population that uses it. Public spaces contain symbolism important to citizens and also play a social-integrative role, contributing to the formation of collective identity. The sustainability of public spaces is of great significance for the quality of life and the health of people in urban environments. The quality of public space is determined by the level of use and activity, as well as comfort, image, openness, accessibility, connectivity, and sociability.

Public space is an open space that can be defined in three ways:

- **Design perspective** – Public space under public ownership, including squares, parks, courtyards, and all areas designated for recreation and leisure.
- **Political perspective** – Public space as an area for discussion, debate, or social interaction.
- **Sociological perspective** – Public space that is accessible to everyone, reflecting the idea of basic equality, social freedom, and anonymity (6).

From a design perspective, public spaces serve as **"**nodes**"** of urban identity, encompassing all so-called public gathering places (squares, parks, open markets, etc.), which are framed by pedestrian pathways (promenades, quays, stairways) or streets and intersections primarily designated for other types of traffic. Many functions occurring in public spaces are often distributed across multiple levels, both below and above ground.(1)

The fundamental elements of urban public space are the **street** and the **square**. They differ in their dimensions, function, dynamics, and movement. In contemporary urban planning theory, a square is defined based on three characteristics: **structure, function, and cultural identity**. (1) When these aspects are considered, a square is a part of the urban structure distinguished by a well-defined, adequate, and organized relationship between open space and the surrounding buildings. Streets of various ranks serve as linear communication links between significant urban nodes, around which different architectural content and other open spaces are organized. Public spaces are not necessarily publicly owned; they can also be leased.



(a) (b)

Figure 1: (a) Settlement plan (square, streets..), and (b) City plan, *The Rockville Town Centre*

2.1. Negative impacts in public space

Public spaces are subject to strong positive and negative influences during their use, which can be categorized as natural and anthropogenic. **Natural influences** include climatic conditions, wind patterns, levels of sunlight exposure, and the presence of vegetation. **Anthropogenic influences** refer to socio-economic, cultural, technological, and other factors that depend on human activities.

Unfavorable climatic conditions, wind exposure, pollution, lack of natural light, or absence of vegetation negatively affect the quality of public spaces. As a result, certain areas are used only during specific seasons, as they are directly susceptible to climate changes. For example, in countries with extreme high or low temperatures, staying outdoors for extended periods or engaging in recreational activities is often not feasible. In Scandinavian countries, during winter, the lack of natural light reduces the functionality of public spaces compared to other seasons. Sun exposure can also be observed on a micro-locational level—areas that are constantly in shade are often perceived as less favorable and less healthy for prolonged use. Vegetation, either directly or indirectly, plays a crucial role in the quality of all forms of public space. Its most important function in urban environments is mitigating traffic noise, filtering air (creating buffer zones), and forming a pleasant ambiance. The absence of green areas, as well as high, medium, and low vegetation, negatively affects the quality of these spaces. Additionally, vegetation directly contributes to the improvement or deterioration of the previously mentioned natural conditions.

Public spaces, once primarily intended for gathering and social interaction, have increasingly become victims of uncontrolled commercialization and privatization in modern cities. The impact of globalization, particularly in post-socialist countries such as Serbia and the surrounding region, has significantly redirected the course of urban development. Post-traditional society is simultaneously an information society, within which two spatial logics emerge—the space of place and the space of flows (Castells, 2000). The so-called **"space of place"**, or physical public space, has become an attractive tool for economic profit but also a fertile ground for various forms of misuse, driven by capitalist and market mechanisms. On the other hand, the **"space of flows"**, or virtual space, is increasingly occupied by advertisements and promotions of powerful corporations, which dominate over local businesses. However, this phenomenon has become an inseparable part of contemporary public spaces. Publicly owned spaces, which are fundamentally intended to be accessible to all, have a strong local socio-cultural impact, which in certain cases can lead to negative effects such as social exclusion of specific population groups. Moreover, public spaces are often exposed to uncontrolled destruction of urban furniture, vandalism of cultural monuments, degradation of green areas, disorder, and graffiti on facades, all of which result from inadequate care by local authorities and the behaviors of certain social groups. In the context of increased control by local authorities, **spontaneity**—which can be both an advantage and a drawback in public spaces—is reflected in users' sense of **security** and **safety**.

2.2. DEVELOPMENT PERSPECTIVES OF PUBLIC SPACE

The development of public spaces is a continuous process of essential importance for society and the community, realized in various ways. The first and most common method of development occurs through **regeneration** and **transformation** of existing spaces, while the second involves the creation of new public areas. Regeneration most frequently takes place in central urban zones, where it often represents the only viable solution due to the existing urban regulations, the presence of significant cultural monuments, or other relevant factors. In European cities, this process is most evident in relocating parking spaces to underground or above-ground levels to preserve and green public areas, as well as converting roadways into "green" pedestrian zones. These processes, which are inevitable due to technological and social development, can significantly impact the functionality of urban areas, the demographic structure, and the creation of new urban habits.

High-quality urban-architectural design has a broad impact on the environment and public health (6). Key principles for good urban and architectural design include:

- *The way a place functions within a broader context,*
- *The quality of public areas—safety, comfort, vibrancy, and an optimal mix of uses,*
- *The scale and proportion of buildings,*
- *The character and architectural heritage,*
- *Natural environmental qualities,*
- *Ecologically sustainable design.*

Rapid or unplanned urban expansion poses a risk to the environment (3). *The widespread practice of occupying free spaces in urban development worldwide has led to increased spatial discontinuities, visual interruptions, and an aggressive urban landscape that negatively affects human health and the identity of urban environments. Therefore, focusing on underutilized areas—both built structures and their surrounding open spaces—is imperative for enhancing the environment and ensuring sustainable urban development*. As most

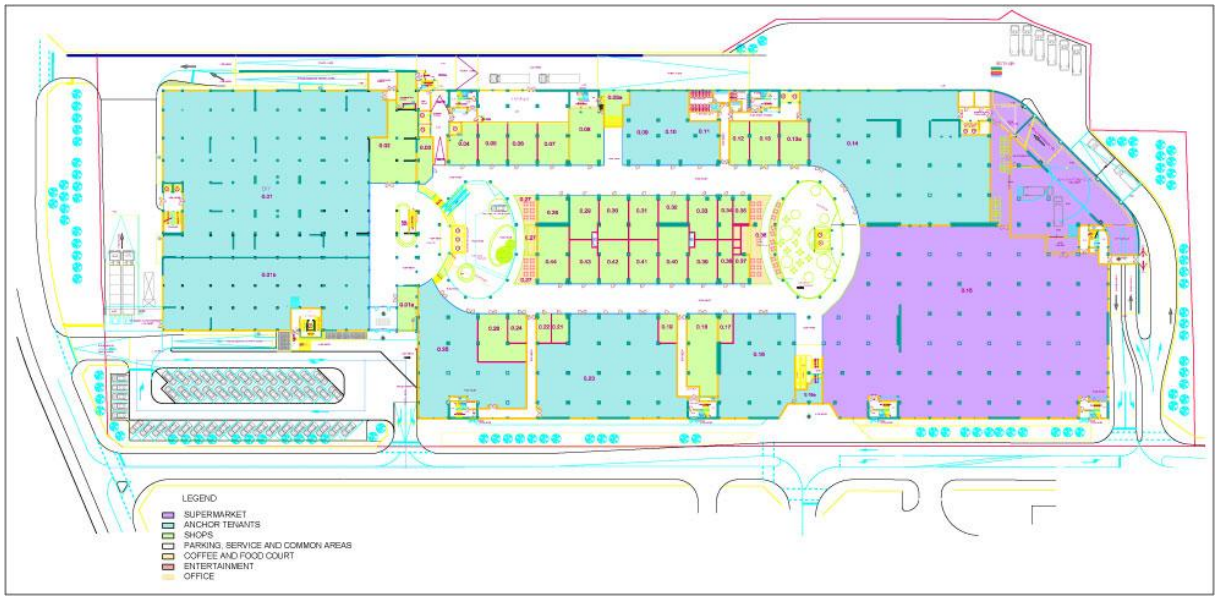
cities worldwide face the challenge of preserving free public spaces amid rapid urban growth, one of the key sustainability trends is the regeneration of existing built structures, industrial complexes, and contaminated areas, commonly referred to as “brownfield” redevelopment.

3. ARCHITECTURAL CHARACTERISTICS OF SHOPPING MALLS

- Shopping malls are public-use buildings that, in the modern architectural context, represent multifunctional spatial entities composed of retail and public spaces, as well as associated parking areas.
- A shopping mall can be defined as a closed, climate-controlled, and illuminated space. Given that shopping malls are generally large-scale buildings, new demands arise regarding the application of modern technologies to maintain optimal microclimatic conditions. This primarily includes the regulation of temperature, humidity, air quality, lighting, and acoustics in enclosed spaces. (5)

The characteristic functional zones of a shopping mall include:

- Traffic zones (parking areas and automotive infrastructure solutions),
- Pedestrian zones (vertical and horizontal communications)-“streets”, elevators, escalators
- Gathering zones (squares, open and multifunctional public spaces),
- Service and entertainment zones (food courts, cinemas, sports areas, playrooms, etc.),
- Retail zones,
- Supporting sanitary and
- Technical support areas.



(a)

Figure 2; A characteristic example of an architectural/functional solution – ground floor plan, Plovdiv SM

4. SHOPPING MALLS AS NEW OR PSEUDO-PUBLIC SPACES – A COMPARATIVE ANALYSIS

In the modern context, shopping malls have assumed the role of informal social spaces. This phenomenon is not only related to functional solutions that resemble traditional gathering places but also to the broader impact of the entire complex on its macro-location. A comparison of the fundamental characteristics of urban public spaces and the functional aspects of shopping malls reveals a strong similarity. The operational concept of a shopping mall is based on simulating public space through its key characteristics. Unlike traditional public spaces, which are spontaneous by nature, shopping malls function as commercial aggregates, developed and planned according to a clear concept, and managed as an integrated entity by a single governing body (8).

In developed countries, the "leisure culture" has become increasingly prominent. Literature defines leisure time as time that should be spent freely and personally, without social expectations or obligations (Veal, 1992). The role of shopping mall management is to cater to user needs by valuing their preferences and interests, ensuring that architectural design makes the space attractive, innovative, and comfortable, thus encouraging visitors to spend their leisure time there. According to DeLisle, time spent in a shopping mall—where large numbers of people gather for entertainment and socialization—represents a form of social engagement, particularly for the middle class. Shopping malls provide opportunities for social interaction, offering free access, public seating, fountains, greenery, and a pleasant ambiance that encourages meetings and gatherings. The service environment (servicescape)—the built ambient setting of a service—is an integral part of the mall's design concept. In addition to external and internal ambient spaces, there is also a social environment, which includes distinctive symbols and spatial elements influenced by sociological factors (2).

A shopping mall is a controlled spatial entity that is privately owned by a company. In this "pseudo-public" space, many negative aspects of "living" urban public spaces—such as pollution, graffiti, homelessness, and safety concerns—are absent. Users feel comfortable, secure, and relaxed. Consequently, shopping malls can be perceived as an illusion of public space, an artificial "micro-city" within a controlled indoor or outdoor environment, free from external disruptions and featuring enhanced climatic and micro-locational conditions. The primary goal of mall management is to improve business performance by using spatial design to attract and retain tenants and potential consumers.

Depending on their location, size, offerings, and consumer habits, shopping malls hold varying significance within local communities. The simulation of public spaces or the artificial city model—built specifically for commerce—is most evident in high-capital countries with extreme climates (e.g., the Middle East, Asia). In these cases, such "climatized cities" serve as the only viable and highly profitable way to expand public spaces, drawing inspiration from various models of urban public spaces.

In some cases, where mega and hybrid malls form the core of urban development, a completely new architectural typology emerges—the Town Mall. Similarly, some shopping complexes base their architectural concept on the imitation of popular tourist cities, resembling film sets. These malls integrate traditional architectural elements, local ambiance, and cuisine, offering visitors an artificially constructed urban experience that conveys the "spirit and cultural-historical heritage" of the city being represented.

Table 1: Comparative Analysis of Public Space and the Functional Architectural Design of Shopping Malls

Aspects	**Traditional public spaces**	**Shopping mall- pseudo public**
Accessibility	Open to everyone, without restrictions	Accessible, but under private control (possible access restrictions)
Architectural Organization	*Informal, develops over time*	*Planned and purposfully designed*
Function	*Social interaction, mobility, recreation, culture*	*Shopping, entertainment, social activites*
Spatial elements	*Streets, squares, parks, urban furniture*	*Simulated indoor streets, squares, parks, urban furniture, atriums and*
Safety and Control	*Limited control*	*High control and surveillance*
Social interaction	*Spontaneous, includes all social groups*	*Organized and consumer-oriented*
Spatial economy	*Non-profit nature, used for public benefit*	*Commertial nature, profit- driven*
Flexibility and Adaptability	*High*	*Limited- commertial orianted*

Ownership	*Public*	*Private*

CONCLUSION

Shopping malls are increasingly assuming the social and functional role of public spaces. In many ways, they mimic the functionality of traditional public spaces, with the notable absence of spontaneous or created negative influences that typically characterize urban public areas. The key distinction lies in ownership, flexibility of use, security, comfort, and spatial management. While traditional public spaces offer greater freedom of use and community participation, shopping malls are strategically designed and focused on commercial objectives and profit. This fundamental difference plays a crucial role in the planning and design of spaces that should support sustainable development and enhance the quality of urban life.

ACKNOWLEDGEMENTS

This research was supported by the ministry of science, technological development and innovation of the republic of serbia, under the agreement on financing the scientific research work of teaching staff at the faculty of civil engineering and architecture, university of niš - registration number: 451-03-137/2025-03/200095 dated 04/02/2025**.**

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TESTING MEMBRANE STRUCTURES AS THERMAL BARRIERS IN WINTER CONDITIONS: A STEP TOWARDS A SUSTAINABLE BUILT ENVIRONMENT

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ABSTRACT

Tensioned membrane structures are widely recognized and frequently used to cover or enclose spaces. They are quick to install, cost-effective, and visually appealing. Their applications range from sports facilities to protective structures and warehouses. However, due to the thinness of the membrane material, they provide minimal thermal insulation. This often results in overheating during summer and significant energy consumption for heating in winter when buildings are entirely enclosed by membranes. While numerous studies have examined their thermal performance in summer conditions, research on their behaviour in winter settings remains limited. This paper outlines the preparation for a measurement campaign conducted in Podgorica, Montenegro, focusing on a specific membrane structure. The proposed methodology is described, along with the anticipated usefulness of the collected data. A follow-up paper will present and analyse the results of the completed measurements.

Keywords: *membrane structures; thermal comfort; built environment; green membranes*

1. INTRODUCTION

In the pursuit of material-efficient construction, tensioned membrane structures have been developed as a lightweight and cost-effective solution. These structures consist of thin membranes stretched to avoid compression or bending, making them highly material-efficient. A beneficial side effect is their double-curved surface, which enhances visual appeal and aligns with minimalist architectural principles. Additionally, their fast installation and reusability contribute to sustainability. Membranes can be combined with other structural systems, typically serving as a cover while another structure provides load-bearing support. Alternatively, the membrane can function as both the load-bearing and covering element. Their applications range from small to extremely large spans, with common uses in sports facilities, public spaces, protective structures, and warehouses.

However, the structural efficiency of membrane buildings comes with a downside: their thinness results in poor thermal insulation. This leads to high energy costs for heating and cooling, making them less sustainable. Consequently, membrane structures are rarely used for residential purposes. Their primary role is not thermal insulation but protection from sunlight, wind, and precipitation. They are often used as semi-enclosed or open

structures, and when enclosing a space entirely, they do not always provide optimal indoor conditions. Some sport facilities use HVAC systems to compensate for this, but this results in energy inefficiency. Others rely on passive conditioning, which may not ensure comfortable conditions for users.

This research was motivated by discussions with owners and users of several membrane-covered sports facilities in Podgorica, Montenegro. These individuals strongly believed that, under certain conditions, the indoor temperature was lower than the outdoor temperature. They claimed that the membrane amplified external temperature effects, making it hotter inside during warm weather and colder inside during cold weather, particularly at night. The research team initially found this claim illogical. While higher indoor temperatures can be explained by solar radiation, no clear reason was found for a temperature drop below outdoor levels. This led to the formulation of a hypothesis: either the users' perception of temperature differences was incorrect, or other factors unrelated to the membrane were causing the temperature inversion.

2. LITERATURE BACKGROUND

The thermal behaviour of tensile membranes has posed a challenge for researchers. Although the thermal properties of membrane materials have been investigated [1], it is generally believed that little can be done to significantly improve them. This is primarily due to their thinness, which remains insufficient even if the membrane possessed the properties of common insulating materials. Consequently, enhancing insulation would require either the membrane to function as a superinsulator or to become significantly thicker—neither of which appears feasible. However, alternative strategies exist for improving the thermal performance of membrane-covered buildings. These include the creation of multi-layered structures and the addition of insulation on the membrane itself [2].

The European Design Guide for Tensile Surface Structures provides a comprehensive overview of key publications from the early development of membrane structures [3], whereas this is not the focus of Prospect for European Guidance for the Structural Design of Tensile Membrane Structures [4]. More recent reviews of thermal properties have been conducted [5], with newer research analysing various subtopics. Instead of solely focusing on reducing energy consumption, some studies explore the harvesting of solar energy on membrane structures using photovoltaic technology [6, 7]. A comparative analysis of the thermal and energy performance of traditional and membrane-covered sports halls has been presented [8]. The impact of membranes on the thermal environment of semi-covered spaces has also been examined [9, 10]. Additionally, research has been conducted on the effects of single versus double membranes on indoor temperature under summer conditions [11], as well as on the properties of the air layer between membrane layers in double-membrane constructions [12]. The heat transfer of solar radiation through membranes has also been studied [13].

Studies are further categorized based on the function of membrane-covered buildings. For example, the potential thermal benefits of using membranes as partitions in residential buildings have been explored [14]. Research on industrial buildings covered with membranes has also been conducted [15, 16]. Several studies focus on indoor conditions in sports facilities, including assessments of internal conditions in large-span stadiums [17] and the impact of retractable membrane roofs on the internal environment of swimming halls [18, 19]. Air-supported membrane structures differ from mechanically prestressed membranes in that they have a double-curved shape with positive curvature. Their thermal performance and optimization have been analysed through numerical simulations [20], while a thermal comfort model has been developed for ice-skating rinks in severe cold regions [21]. Additionally, a study on winter thermal comfort in a membrane-covered gymnasium in a severe cold region has been carried out [22], as well as thermal performance of membrane roofs in hot dessert climates [23].

3. PROPOSED METHODOLOGY

Although the study is intended to be relatively straightforward, several key factors and decisions had to be considered during the research design phase. The primary objective is to determine, with certainty, the relationship between the indoor and outdoor temperatures of membrane-covered buildings. If the results confirm that the indoor temperature is indeed lower than the outdoor temperature at certain times, further investigation will be required to identify the underlying causes of this phenomenon. The first phase of the research focuses on ensuring that the conditions for measurements are unobstructed, allowing for accurate and reliable results. Figure 1 show the exterior and interior views of a typical membrane-covered sports facility in Podgorica. The hall represents a common example of such structures in the city.



(a) (b)

Figure 1: Typical membrane-covered sports facility in Podgorica (a) exterior (b) interior

3.1. Location

The study was initiated in Podgorica following informal discussions with users of membrane-covered sports facilities, who expressed concerns regarding indoor temperature variations. Given the local context, it was deemed reasonable to first investigate these claims in this specific setting. Podgorica's climate is classified as transitional Mediterranean, influenced by both the Adriatic Sea and the surrounding mountains. The city experiences hot summers and mild winters, with frequent rainfall. With about one rainy day out of three, it is often quoted as the rainiest capital in Europe. These climatic conditions provide an appropriate backdrop for studying the thermal behavior of membrane-covered structures during winter.

3.2. Building

Membrane-enclosed buildings are a common sight in Podgorica, with over 20 such structures identified. The majority use membranes as covers, supported by arch-shaped structures made of steel or glued laminated timber. While these buildings serve various functions, such as warehouses and sports facilities, the focus of this study is on their use for sporting activities. The geometry and floor materials of these structures vary slightly depending on the type of sport they accommodate, with flooring options ranging from artificial turf to clay and vinyl.

3.3. Influencing factors

Several external factors could influence the temperature measurements within these buildings. The presence of HVAC systems is one of the most significant variables, as artificial heating or cooling would interfere with the study's goal of capturing unaltered temperature variations. For this reason, only buildings without active HVAC systems will be considered. Occupancy is another key factor; since these buildings are frequently used by both private owners and schools, it is essential to ensure that measurements are taken during unoccupied periods to prevent human activity from affecting the indoor temperature. Other variables, such as the presence of high-rise buildings that cast shadows, membrane damages that allow for natural ventilation, and direct connections to other structures, must also be accounted for.

3.4. Measuring

Since the focus of the study is on low temperatures, winter has been chosen as the most suitable period for conducting measurements. Data collection were planned for December 2024 and January 2025. To obtain meaningful insights, measurements should ideally span at least half a day, with a preference for continuous monitoring throughout the day. The primary data to be recorded includes the air temperature inside and outside the membrane-covered building. Additional measurements, such as the temperature of the membrane surface, the temperature of the supporting structure, wind parameters, solar radiation, and precipitation, may be collected to supplement the analysis.

3.5. Measuring equipment

The University of Montenegro will provide the necessary measuring equipment. At a minimum, two temperature sensors will be used—one placed inside the building and another outside to capture the primary

temperature variations. If additional air temperature sensors are available, they will be deployed to assess temperature distribution within the enclosed space. Any available surface temperature sensors will be used to monitor the temperature of the membrane and the supporting structure at different points. Other relevant meteorological data, such as wind speed and solar radiation, will be obtained from official sources. The recording interval for the measurements will be set to less than 30 minutes to ensure a sufficient data resolution for analysis.

4. EXPECTED RESULTS

Once the measurements are successfully completed, two outcomes are possible. Either the results will show that the indoor temperature gets lower than the outdoor, or that it does not drop below outdoor temperature. The research team expects the second option to be confirmed, despite the opposite belief of the users. The reason for this is that there are no obvious reasons for such behaviour. Two factors are expected to have the main influence on the indoor air temperature, the temperature of the outdoor air and the sun radiation. Therefore, when there is no Sun radiation, the indoor temperature should follow the outdoor temperature, with a small lag caused by membrane thermal resistance.

Following the completion of the measurements, two possible outcomes are anticipated. The first scenario is that the results confirm the perception of users, showing that the indoor temperature drops below the outdoor temperature at certain times. The second, and more likely scenario according to the research team, is that the indoor temperature does not fall below the outdoor temperature. It is expected that two primary factors will have the most influence on the indoor air temperature: the outdoor air temperature and solar radiation. During the day, the indoor temperature should generally follow the outdoor temperature, with minor delays due to the thermal resistance of the membrane. In addition, the heating effect of solar radiation is anticipated to raise the membrane temperature, which in turn will increase the indoor air temperature above the outdoor temperature. This process resembles the greenhouse effect, where the membrane allows some sunlight to enter while trapping heat inside the structure.

After sunset, the temperatures of both the indoor and outdoor air are expected to equalize relatively quickly. Since the building is completely enclosed, it is protected from wind, eliminating one potential source of rapid cooling. Moreover, stratification effects should not be significant enough to cause the interior at any height to become colder than the exterior. The absence of heating or cooling systems further supports the expectation that the indoor temperature should remain similar to or slightly above the outdoor temperature. Additionally, the floor, which has a certain thermal mass, should act as a heat reservoir, helping to stabilize indoor temperatures rather than contributing to a decrease.

If, contrary to expectations, the results show that the indoor temperature does drop below the outdoor temperature, further research will be needed to determine the cause. Possible explanations could include heat loss mechanisms, unexpected ventilation effects, or material properties of the membrane that have not been accounted for.

Alternatively, if the results confirm that the indoor temperature remains equal to or slightly higher than the outdoor temperature, the research will shift toward understanding why users perceive it differently. Several factors could contribute to this perception. One possible explanation is indoor humidity, which could make the environment feel colder, warranting additional humidity measurements. Air movement within the structure could also influence thermal comfort, creating a sensation of coolness. Another possibility is related to user behavior; individuals engaged in sports activities may experience rapid cooling due to perspiration, especially if they transition from warm outdoor clothing to lighter athletic wear upon entering the facility. Psychological factors may also play a role, as users may expect the building to feel colder due to their awareness that it lacks heating, potentially reinforcing a collective perception of lower temperatures.

Regardless of the outcome, this study will provide valuable data on the thermal performance of membrane-covered buildings in winter conditions. If user perception differs from recorded temperature data, future research may explore strategies to enhance thermal comfort, such as passive heating techniques, improved ventilation strategies, or modifications to membrane materials. The findings will contribute to a broader understanding of how membrane structures interact with their environment, ultimately informing future design improvements to enhance energy efficiency and occupant comfort.

5. CONCLUDING REMARKS

The wider adoption of membrane structures for enclosing buildings is significantly hindered by their low thermal resistance. Despite their advantages, including low cost, lightweight construction, and ease of installation, their poor insulation properties make them energy-inefficient for temperature-controlled environments. As a result, they struggle to meet sustainability standards when used as fully enclosed buildings. While considerable research has focused on the issue of overheating in these structures during summer, their behavior under winter conditions has been largely overlooked.

This paper presents the preparatory phase of a research study aimed at understanding the thermal performance of membrane-covered buildings during cold weather. The study was motivated by observations and discussions with users of such facilities in Podgorica, Montenegro. These discussions revealed a widespread belief among users that, under certain conditions, the indoor temperature of these buildings was lower than the outdoor temperature, particularly at night. This perception contradicts intuitive expectations about thermal behavior, prompting the need for a scientific investigation. The first phase of the research seeks to establish whether this claim is accurate by measuring and comparing indoor and outdoor air temperatures. If the study confirms the users' perception, further research will be needed to identify the causes of this temperature inversion and determine whether the membrane itself plays a role.

The methodology for conducting the temperature measurements has been outlined in this paper, along with the expected results. The findings will either confirm or refute the users' belief that it is colder inside the membrane-enclosed buildings than outside. If the results demonstrate that the indoor temperature remains at or above the outdoor temperature, additional steps will be taken to understand why users perceive the space as colder. Conversely, if the data shows that the indoor temperature does drop below the outdoor temperature, further research will be conducted to determine the mechanisms responsible for this unexpected behavior. Following the completion of this phase, the next step will focus on investigating potential strategies to mitigate the identified thermal discomfort.

This study represents a small step toward making membrane-enclosed buildings more sustainable by improving their energy efficiency and thermal comfort. By addressing knowledge gaps related to their winter performance, this research contributes to the broader effort of creating environmentally responsible and energy-efficient structures within the built environment.

ACKNOWLEDGEMENTS

This research is funded by the European Union.

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GEOTHERMAL ENERGY IN THE CITY OF NIŠ

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ABSTRACT

The use of geothermal energy in the city of Niš is aimed at establishing the potential for deep geothermal energy, i.e. supplying one part of the city with a high-enthalpy resource, sufficient for the initial energetic coverage of parts of the municipality of Niška Banja and Crveni Krst in terms of energy for heating. Related to the demographic situation of municipalities, with indicated rapid decline in birth rates and the disappearance of the built stock, geothermal energy is indicated as one of the possibilities for mitigating these changes. Utilizing an accessible local energy source is in the context of approaching the European principles of the Sustainable Development Agenda, Serbia's accession to the EU and cross-border cooperation projects with neighbouring countries. Its use is of wider regional importance, because by creating a map of geothermal tourism and connecting it to the historical context of the use of geothermal energy for heating and balneology on the territory of the Republic of Serbia, socio-techno-economic transformation processes are accelerated.

Keywords: *spatial plan; geothermal energy; sustainability; history*

1. INTRODUCTION

”But the decisions about planning- I am not sure they would have been so much different, because there are other factors that affect, rather than worries about energy and something else like that. But people today think quite different… both of those things (hot water and power generation) in terms of planning... do- not affect that much our emphasis in planning. even though we have these resources- hot water and geothermal power and of course hydropower as well in Iceland, they do not affect much how we plan the cities or towns in Iceland. [sic] [1]”

2. THE POWER OF GEOTHERMAL ENERGY

The most promising aspect of geothermal technology refers to Geothermal energy’s (GTE) capability not to depend on outside temperatures of the air and is the most stable form of renewable energy source if properly treated within the cycle of extraction and re-injection. This is especially true in a combination of many different energy sources in the “energy mix” of smart grids and district heating and power grids. Such technologies are advancing as we speak. The 4th generation thermal grids are able to employ these different sources and make use of them more efficiently, should be better understood by planners and architects and engineers.

As for general population, there is a discrepancy between the latest research on the 4th generation DH (District Heating) technology (4GDH) utilization and prices of individual GSHP (Ground Source Heat Pumps) or geothermal drillings for the community or town to endeavour into GDHS (Geothermal District Heating System) instalment. Once done, however, it is an ignition force to drive the community to sustainability both in terms of energy use and having indirect influence on physical planning by focusing on a more alleviated development of its resources. This again serves the purpose of combating the energy inert city of today and, indirectly fights sprawling caused by access to cheap transportation fuel and social segregation of neighbourhoods.

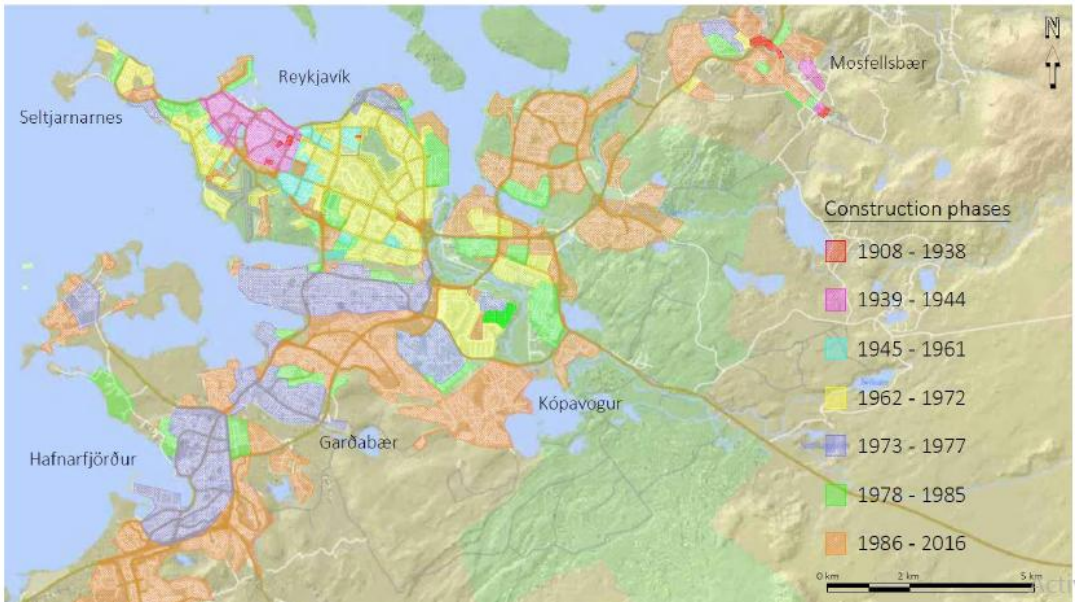
2.1. Figures on Iceland

The images include Figure 1, Geothermal distribution network in the Icelandic town of Heimaey, showing district heating based on geothermal energy from local lava eruption, allowed for attaining benefits from a

disaster. Iceland is one of the most potent countries when it comes to geothermal energy, source: www.verkis.is, presentation by T. Johanesson, Cornell University, November 2016, by courtesy of the presenter



a)



b)

Figure 1: (a) I, Geothermal distribution network in the Icelandic town of Heimaey (b) Plan of Reykjavik with the development phases of geothermal energy by year, source: www.verkis.is, presentation by T. Johanesson, Cornell University, November 2016

Despite having abundance of geothermal energy and utilized as convenient resource within the GDH network, Reykjavik's urban morphology shows hardly any use of energy- conscious planning, leading to urban sprawling, see Fig.1 (b)

2.2. Technical and social acceptance reasons to employ ge in cities

The expert from the architectural field based in the USA pointed out the importance of a multifaceted approach to Renewable Energy Sources (RES) and cities [2]. The interviewee said that cultural circumstances of the utilization of solar, geothermal, wind power and any other RES form are highly dependent on socio-economic and cultural awareness and are dependent on the understanding of people and their leaders for the benefits of its applications. As this expert has had extensive experience abroad, his opinion refers to international projects both outside of and within the transatlantic region.

Based on the results of interview with Austrian expert in the field of engineering [3] there could be far greater value of GTE in many mechanical processes used for cooling in the future, especially in larger cities. Another interviewee specializing in GE based in Austria confirmed the importance of GE for larger cities. [4] The expert had background in geology and vast experience in GTE projects in Austria and Germany. The same interviewee saw major changes in the settlements in Altheim and Braunau/Simbach over the years and confirmed that it

was very hard to persuade the communities of these small towns to transfer to geothermal heat based on DHS. This expert confirmed that the initial change in thinking among people and public was of utmost importance for switching to GE in a town or a community. In larger cities, it is easier, as the density of energy demand is greater:

Interviewer: "So in the larger towns as for example Graz or Vienna this would be easier to accomplish (integration of GTE)? Interviewee: Yes. It is easier. Of course, there we would have the supply structure completely different. There are big power plants that have big economic influence and they are the ones which do the geothermal projects. And there you could demand the attachment to the net by the individual users. [4]"

Regional and economic development expert from USA emphasized the Smart Grid projects in Utica as initial changes to more efficient energy supply of the city. The expert also confirmed the preceding statement that initial projects in RES and Sustainable Communities (SC) helped people to accept projects, such as geothermal energy utilization at a city or neighbourhood level and opt for these solutions within their households. Also, companies that have installed GSHP in the USA and experts within the sample dealing with technology were in accordance with the statement from the expert based in Austria, that main obstacles to GE utilization in cities may be the resistance to change, or to be more precise, being used to consuming fossil fuels and not being able to see the ways how technologies such as GTE contribute to the overall loosening up of the environmental burden created by humans. [5] [6] [7]

Majority of all public administration, regional development and economic experts, as well as private companies' CEOs (being 10 interviewees out of 31 in the overall sample of interviews only, excluding the workshop interview results) recognized the same opportunity for enhancing GE applications in cities within the population. "A significant number of interviewees (four out of ten) pointed to the changing situation with accepting "green technologies "among the general population. The new generations are more willing to accept changes in the way that they perceive their environment. This would help boost more geothermal utilizations in cities. Interviewees from companies based in Utica that used geothermal energy in their buildings said that geothermal energy had been beneficial for their refurbishment projects, offering an opportunity and setting an example for other home owners in Utica in the future. They also pointed out to the obstacles, referring to people not believing in something they could not see with their own eyes. This means that having one initial building project utilizing geothermal energy helps to achieve a domino effect, causing the building next door to be transformed as well, with the same or other RES and their combinations. [8]"

2.3. Methods used in the paper

I have used expert interview methodology from three different countries (Austria, Iceland and USA) which I then used the most important findings to make a comparative analysis with Serbia. This implies that a proportional sample was done in Serbia, for the reason of comparison., majority of which were based in Niš (9 out of 10). The sample structure excerpt is presented below.

Table 1: Expert interviews- The sample structure excerpt

Country	*Austria*	*Iceland*	*USA*	*Serbia*	*Total Number*
Number of experts	*4*	*6*	*12 (11+1)*[1]	*10*	*32 (31+1)*
Percentage in the overall sample	*12.50%*	*18.75%*	*37.50%*	*31.25%*	*100%*

2.4. Cross comparison with Niš

According to the 2015 Paris Agreement on Climate Change, which was adopted and confirmed by the National Assembly of the Republic of Serbia within the framework of the Law, the per capita carbon footprint of the city of Niš should be reduced, and according to the UN SDG strategy [9], in order to achieve the goals adopted by the United Nations, Serbian cities should be brought to correspond as much as possible to these principles in the coming period. Regarding the UN SD Goal of Access to clean and affordable energy, the most relevant target is 7.1.2- Proportion of population with primary reliance on clean fuels and technology. According to this proportion, only 5 % percent of the poorest population in Serbia relies on clean fuels and

1 There were 31 results in the overall sample of interviews, with one workshop interview result

technology, with half of the total population relying on it, mostly middle and upper classes (https://sdg.indikatori.rs/en-US/area/affordable-and-clean-energy).

Geothermal energy through the core of geothermal manifestations and in order to connect to the geothermal district heating system is a concept that has existed in the world for many years, and recently projects have begun in Serbia that go in this direction. An example is Bogatić, where geothermal manifestations are used to meet the needs for heating and balneology, and in most spa towns this use is a common occurrence.

Geothermal energy (GE) in the sense of meeting the heat requirements of individual users and networking is a relatively new concept. Primarily, because the lower enthalpies of hydro geothermal fluid are often ignored as insufficiently potent to be techno-economically profitable, so in the context of energy transition, the debate about their utilization is reopened, in the absence of other, mainly fossil, energy resources on the territory of the Republic of Serbia.

Solar energy, which is also abundant in the Niš region, is a significant resource with a capacity of 0.6 million toe per year at the national level. For comparison, hydro geothermal potential (installed) is estimated at 0.2 million (toe) per year in the Republic of Serbia. [10]

Some of the measures to enhance GE utilization are as follows:

- Examples of good practice, in which some partner countries and their development agendas in Serbia support the thermal transition to more environmentally friendly energy sources (Germany), and some directly focus assistance on green cities (Singapore). Some also focus on waste energy (France), as well as social cohesion and security and social entrepreneurship (Singapore, Germany, France, among others). Through the energy transition, it is possible to integrate geothermal energy in case studies of revitalizing cities that are in a phase of decline, such as Niš. [11], [12].
- Identifying geothermal energy potential in the context of heating/cooling capacities

On the territory of the City of Niš, geothermal manifestations have been indicated in Niška Banja with a flow rate of 14-42 l/s, temperatures of 12-37 degrees at the Suva Banja spring and Glavni izvor (Kraljev izvor) with a flow rate of 35-40 l/s and a temperature of 38.2-38.9 degrees Celsius, finally at the Školska česma spring with a temperature of 17-19 degrees and a yield of 2.5 l/s. In Topilo Spa, the water temperature is 34 degrees and a yield of 2.7 l/s [13], and all 18 springs are included in the capacities. Then follow the Ostrovičke terme, namely Terma Banjica with a temperature of 21-22 degrees and a flow rate of 2 l/s. Alluvial thermal springs are also present, as indifferent thermal springs with thermal capacities, a temperature of 16-18 degrees and a flow rate of 15 l/s, noted in 1965. Periodic springs within this group are Lujčovsko and Gužvinsko vrelo. The former contains a lower and upper spring, with a flow rate of 1l/s and 0.2 l/s, respectively, and a temperature of 20.5 °C, while Gužvinsko vrelo has a flow rate of 2 l/s and a temperature of 20.5 °C - which coincides with the temperature of Lujčovsko vrelo. The fissure thermal springs Košarište and Ždrelo have variable temperatures of around 22.5 °C and a flow rate of 0.2 l/s, 1.5 and 5 l/s, respectively.

- Analysis of the necessary energy requirements of the endangered areas

The construction capacities that need to be heated or cooled are smaller in the rural area of the Niš's Spatial Plan (which adoption is set for 2025), because these settlements are mainly located in rural areas and it is necessary to establish what the motives are that can initiate the use of geothermal energy in these areas, without them being exclusively of an economic nature, due to the unfavourable demographic situation, the departure of young people from these areas and the inability to maintain this rural construction fund or to ensure a long-term perspective.





Figure 2: The geothermal well of Topilo Spa (left), with a yield of 2.7 l/s and a temperature of 34°C; in addition, Topilo Spa has 17 springs of varying quality and potency

Figure 3: Village of Ostrovica (right), source: Anadolija, Saša Djordjevic, https://n1info.rs/vesti/mestani-niskih-sela-vakcinu-primaju-u-svojim-domovima/, access 30.07.2024

3. THE POTENTIAL FOR USING HEAT PUMPS; CENTRAL HEATING SYSTEM INTEGRATION OF LOCAL RESOURCES

For the use of heat pumps in the City in the context of building construction, it is necessary to establish the geothermal gradient of the soil in the area of the plan, in order to proceed with the design of the heat pump system, both for the open loop system and for the closed loop variant. Given that the possibility of high-temperature geothermal phenomena being present in the surrounding terrain around the facility has not been investigated, this option should not be excluded in the further expansion and phases of the plan. This should be conditioned by the analysis of geothermal manifestations in the wider area of the Municipality of Crveni Krst and the Municipality of Pantelej and other municipalities belonging to the City.

Given that to date, no tests have been carried out with wells that would be deep enough for the use of geothermal energy from high-enthalpy fluids, and that there are geothermal manifestations of significant capacity in the locations of Ostrovica, Niška Banja, and Banja Topilo (Topilo Spa), the possibility of including elements of geothermal energy use in the spatial plan of Niš in the form of strategic planning exists. The wells would serve to present to incoming investors the possibility of locations that would be more energy-sustainable for their business, and in turn, in terms of planning, more adequate for the City and for the preservation of rural infrastructure and the improvement of the income preservation system of these endangered areas. In terms of the accession of the Niš region and the Republic of Serbia to the European Union, as well as partnership with countries that support the postulates of sustainable development, geothermal energy is one of the indicated possibilities for the development of the Niš region. Especially in the context of cross-border cooperation and projects, which are included in the policy of accession to the European Union. [14]

Given the umbrella strategies of the Republic of Serbia such as the National Architectural Strategy [15], the accelerated construction in recent years lays the foundations for a re-examination of cultural identity, especially in the context of spatial development, which is not systematically valorised and determined. To preserve cultural identities, it is necessary to try to encourage staying in villages through systems of using local sources, by upgrading district heating to geothermal resources at the City level, through the prism of tourism development and in accordance with the aforementioned strategy and the National Plan of the Republic of Serbia 2030, to further brand a part of the City within the spatial determination of Niš region for ecological and adventure tourism according to the Niš's Spatial Plan, building on and considering GTE in synergy with these and other sustainable development strategies. The next step towards the conception of a planning solution in the context of GTE is the specific location of resources and the development of a pilot project, which would supply part of the City's territory with a geothermal source. Through the development of a planning solution, a comparison with case studies should be made. One of the possibilities for successful implementation is to apply the EU Horizon 2020 - the European Union's innovation framework, as an element of integrated planning. Given that it has been stated that the service sector has not been adequately treated in the planning system in the Republic of Serbia [16], the integration of RES as an element of development as an opportunity is indicative, with monitoring of the achievement of results on a five-year level and measurement according to sustainable development parameters. The application of the Quadruple and quintuple innovation helix framework methodology at the level of planning and drafting of a spatial plan and strategy for the development of the use of RES in the territory of the City of Niš is also indicative, for a more detailed analysis of alternative solutions for the city. Is this imperative in the context of sustainable development and accession of the region to the EU and in general whether this is necessary to be applied at the level of Niš, and whether there is interest in some form of partnership that would be a model for implementation, is a question that is raised. A reference example at the EU level is within the framework of the Austrian-German cooperation Simbach-Braunau am Inn, as a model for the development of border towns under which funds were received from the EU for enlargement in 1998. This model has also shown success in the form of further upgrading of the concept [17].

In its current format, geothermal energy represents only a localized tourist and balneological data on the plan, and its consideration in terms of sustainable development of the rural fund is lagging behind - which is presented as an additional limitation for any further implementation of GTE, and not as an opportunity. The

element of geothermal use must not be dominant and megalomaniac in the concepts of the development of the City, primarily, in order to avoid the mistakes that its neighbours had on their way to the utilization of deep geothermal energy [18]; and despite the potentials that are significant at the national level [19] and very similar to certain regions in the Republic of Serbia, such as the Niš region, the utilization of GTE must be approached systematically, in the long term and in accordance with the development and sustainability of the entire building fund.

4. IN CONCLUSION

- In order to achieve geothermal energy utilization in Niš which would enhance the spatial perspectives of Niš in the long run, following Examples of good practice, in which some partner countries and their development agendas in Serbia, together with Identifying geothermal energy potential in the context of heating/cooling capacities and performing the analysis of the necessary energy requirements of the endangered areas, are necessary for any spatial interventions regarding systematic GE utilization
- No matter how far along planners and city hall representatives are determined to follow the Green agenda principles and invest time in planning for geothermal use according to the above mentioned steps, only investing time and resources that lead to a change of perspective among the general population is to lead to acknowledging geothermal energy as sustainable resource in Niš. As this is not easily achieved, more focus on geothermal history of Niš can be the first step, both in terms of gaining positive perspectives and analysing the reasons for missed opportunities for development.

ACKNOWLEDGEMENTS

I wish to thank the interviewees for agreeing to participate in the research and for sharing details and views on the topic of geothermal energy and planning.

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ICUP2025
5th international conference on urban planning

TOWARDS THE DATA-BASED [X] MINUTE CITY: OUTLINE OF THE SUMO_15 PROJECT

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ABSTRACT

The paper presents the design and ambition of the project "Sensor Data Fusion for Urban Mobility in the 15-Minute City" (SUMO_15), one sub-project within the research cluster HAWICC (Hanseatic Wireless Innovation Competence Center). The ambition of SUMO_15 is to complement the discourses regarding the 15-Minute City with an evidence-based approach based on the usage of real time data from advanced urban sensor and communication technologies. The project rationale is that in order to achieve the overarching goal of a city of short distances and high accessibilities – generally called the [x] Minute City – the professional disciplines of urban planning and traffic management need to be closely linked and supplemented by advanced digital instruments for integrated planning. For this end, SUMO_15 targets a platform that provides data- driven planning and decision-support tools built around complex models for urban simulation and analysis. The models in turn are generated by Machine Learning algorithms on the basis of real- time situation data of urban environments and mobilities, static information about the built and social environment, as well as synthetic data from fusion generators. The tools as well as the respective planning and decision-making processes will be tested in a Hamburg urban living lab, and checked for their transferability to other cities in Germany and beyond.

Keywords: *Urban Planning; Urban Mobility, 15-Minute City, Data Platform, Toolbox*

1. INTRODUCTION AND BACKGROUND

Currently a leading paradigm in urban and mobility planning, the "15 Minuty City" (15mC) may be compared to prominent leitmotifs like the "Garden City" a century ago, or the concept of the "Smart City" that has dominated the last decade (Moreno et al., 2021). The 15mC idea pursues a double goal: on the one hand, it aims to fulfil local citizen's need for better urban mobility solutions; on the other, it wants to mitigate global climate change by sustainable approaches for transportation and construction – which are the second-largest source of green-house emissions (Allam et. al., 2022; Tiseo, 2024). Although presenting a novel approach to these problematics, the 15mC has yet to find concrete evidence of its feasibility and replicability in accordance to such goals. Targeting such evidence, this paper introduces a project within the "German Center Mobility of the Future" (Deutsches Zentrum Mobilität der Zukunft, DZM), a research funding priority by Germany´s Federal Ministry of Transportation and Digitalisation (BMVD) in support of novel approaches to future mobility in cities and regions,

with a special focus on the opportunities deriving from contemporary digital technologies (Kustra et al. 2017).



Figure 1: German Center Mobility of the Future (DZM) – four clusters (Source: TÜV Rheinland AG)

DZM's approach is centered around the creation of living labs in different contexts to foster the evaluation of practical mobility solutions. One out of four funded clusters within the DZM is the Hanseatic Wireless Innovation Competence Center (HAWICC), located in the city state of Hamburg (Fig.1). HAWICC investigates how wireless communication and sensor networks can be used for resolving pressing mobility challenges. Lead coordinator of the HAWICC cluster is HafenCity University Hamburg (HCU), a university dedicated to research of the built and metropolitan environments. HCU itself is located within the largest ongoing urban development project in Europe, Hamburg´s HafenCity.

One out of two funded initiatives within the HAWICC cluster is the project "Next Generation City Networking" (NGCN), which brings together three independent yet complimentary subprojects. The first subproject PIONEER_6G targets wireless communication infrastructures in cities, while the second subproject EMERGENCY explores the specific use case of medical emergency aid. The third subproject SUMO_15 investigates how urban and mobility planning can be integrated on the basis of new real time data sources – its abbreviation stands for "Sensor Data Fusion for Urban Mobility in the 15 Minute City".

Recognizing the multi-layered constellation of DZM, HAWICC and NGCN, this paper focuses on the outline, ambition, and project design of SUMO_15 alone. Still, the three parallel subprojects are interlinked in multiple ways on thematic and operational level. Like the other HAWICC projects, SUMO_15 runs over a period of three years, having started in January 2025 nd being coordinated by the chair of Digital City Science at HCU.

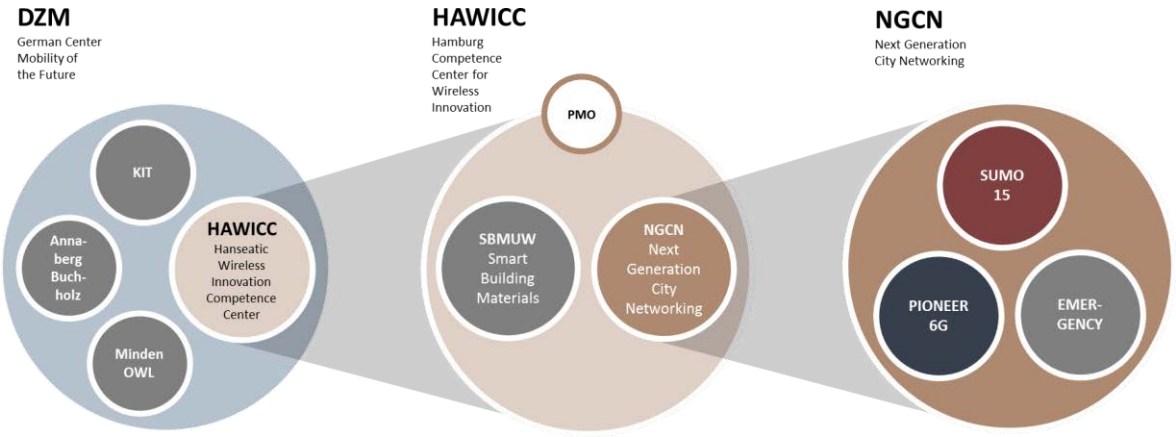


Figure 2: Constellation of clusters and projects

Targeting the support of integrated urban planning and mobility management with data-driven instruments and AI tools, SUMO_15 functions as a "conceptual middleware" between the other two subprojects within NGCN. On the one hand, PIONEER_6G is to create a novel wireless communication infrastructure for urban

environments based on radar technology that is supposed to provide real-time data and situation intelligence. EMERGENCY one the other hand is to show how such data can be meaningfully applied, putting forward a very specific medical use case. EMERGENCY is to show whether the delivery of crucial emergency aid to patients can be optimized with the help of short-latency information about traffic conditions, spatial situations, and relevant events happening in streets or neighbourhoods. This, however, is only a peak-example from a wide range of use cases in which time-sensitive urban mobility depends on knowledge about actual events in the city, about spatial and infrastructural conditions, as well as about social and demographic structure. The goal of short travel times and distances, of high accessibility and connectivity within urban environments not only applies for emergency aid.

In planning and design, the term “15 min City” has become synonymous for this quality. Requisite access time for reaching vital urban services, however, may highly differ. While an EMERGENCY case calls for a “5 min (or less) city”, the provision of high-end cultural amenities may be served well by a “30 min city” approach. To address the challenge, recent literature has therefore shifted to the more flexible term “[x] Minute City” (Logan et. al., 2022). In general, it has been understood that the achievement of much desired [x] Minute City qualities depends on the linkage and integration of urban planning, traffic and mobility management. This is also the role of SUMO_15 within HAWICC: it is to equip the respective disciplines with a comprehensive platform by which real time data from PIONEER 6G´s wireless infrastructure (among others) will be transformed into knowledge for purposeful planning and decision-making in support of the [x] Minute City, e.g. for exemplary use cases like EMERGENCY. Derived from a plethora of urban data sources by way of AI and ML technologies, the platform´s new tools are to comprehend and model the complex influences and interdependencies that shape an [x] Minute City (Urban et al., 2021).

2. THE 15 MINUTE CITY – STATE OF THE ART AND RESEARCH GAP

Having access to a substantially new data and technology basis, the project SUMO_15 sets out to advance ongoing discourses related to the 15mC. The idea of the 15mC holds that cities and transportation should be designed in a way that ideally all places of relevant daily use can be reached in 15 minutes by active mobility (on foot or bicycle) or by public transport (Moreno et al., 2021). In the 15mC, routes and travel times are short, inclusiveness and accessibility of all relevant places is high – and there is no unnecessary city traffic over long distances (Nicoletti et al., 2023).

While the 15mC concept has gained much attention and a large audience in the past years, several questions remain. Despite the rhetorical power of the “quarter hour” slogan, the applicability and usefulness of this spatial-temporal range is subject to discussion (Pozoukidou & Chatziyiannaki, 2021). Further controversy about 15mC regards potential social control e.g. concerns about confining citizens to certain urban districts. To avoid such argumentative traps, and to maintain meaningful flexibility, this text – and the project SUMO_15 in general – will widely the broader term “[x] Minute City” already mentioned (Stanley et al. 2015; Logan et al., 2022; Starrico 2022).

Although the 15mC idea has gained prominence in public as well as in scientific discourses, only few approaches in planning have reliable quantitative data science models and decision making processes, in order to form a fundament for far-reaching decisions in urban development, infrastructure engineering and mobility management (Weng et al., 2019; Olivari et. al., 2023). Aligning with established approaches in urbanism, the majority of 15mC discourses is carried out in qualitative and argumentative manner. Only few quantitative approaches have been established that support an objective measuring of the 15mC (Lopez Baeza et al. 2020, 2021; Vale & Soares Lopes 2023). On such premise, SUMO_15 aims to put forward with its platform a data- based toolbox that enables more evidence-based urban and mobility planning.

Previous research indicated the 15mC may not be a task to be answered only by concepts from urban planning nor mobility management. While improvements in mobility can contribute to the 15mC in the short term e.g. by integration of transportation modes or the optimisation of route and schedule planning, it is urban planning in the long run that ensures that cities will have good accessibility and connectivity, appropriate density and intelligent clustering of functions. Smart urban planning in such sense can minimize unnecessary mobility while providing requisite transportation at the right places. Only the combination of both perspectives and professional approaches can achieve the overarching environmental and social goals such as reduction of emissions, social equity, or healthy living (Noennig et al. 2018). As target users of the platform and its tools SUMO_15 will therefore address urban planners and mobility planners alike – and derive the respective specifications from their perspectives (Noennig & Stelzle, 2019; Degwitz et al., 2021).

The linkage of a long-term urban planning and development scope with shorter-term approaches of transportation and mobility management implies a flexible methodology as well as versatile tools. The instruments should have a capacity to link disparate types of data and information (spatial, social, economic), and support different kinds of planning and decision making (projective scenario analysis, multi-objective infrastructure optimisation).

3. PROJECT APPROACH AND METHODOLOGY

The overall project design and methodology of SUMO_15 follows a "storyline" (Fig. 3) that spans from the description of use cases and application fields (Value Creation Level) via platforms and tools concepts (Data Science Level) to the requisite digital infrastructures (Technology Level). These levels represent the key aspects that are required for the integrative, value-driven design of digital cities (Noennig et al., 2016; Hick et al. 2018; Jonas et al. 2021).

To achieve the overall societal target of the [x] Minute City, SUMO_15 conceptually links the professional disciplines and application areas of urban planning, transportation engineering and mobility management. This connected expertise is supplied with a data-, model-, and tool platform holding smart instruments for cognitive assistance in planning and decision-making. The tools in turn rest on complex models for simulation and analysis generated by Machine Learning from large data resources – real-time sensor networks, planning documents and 3D spatial information, as well as from synthetic data generators (Glass et al., 2022, 2023). Tested in an urban living lab in Hamburg, the new tools and processes assessed as to their transferability to other cities in Germany, and beyond.

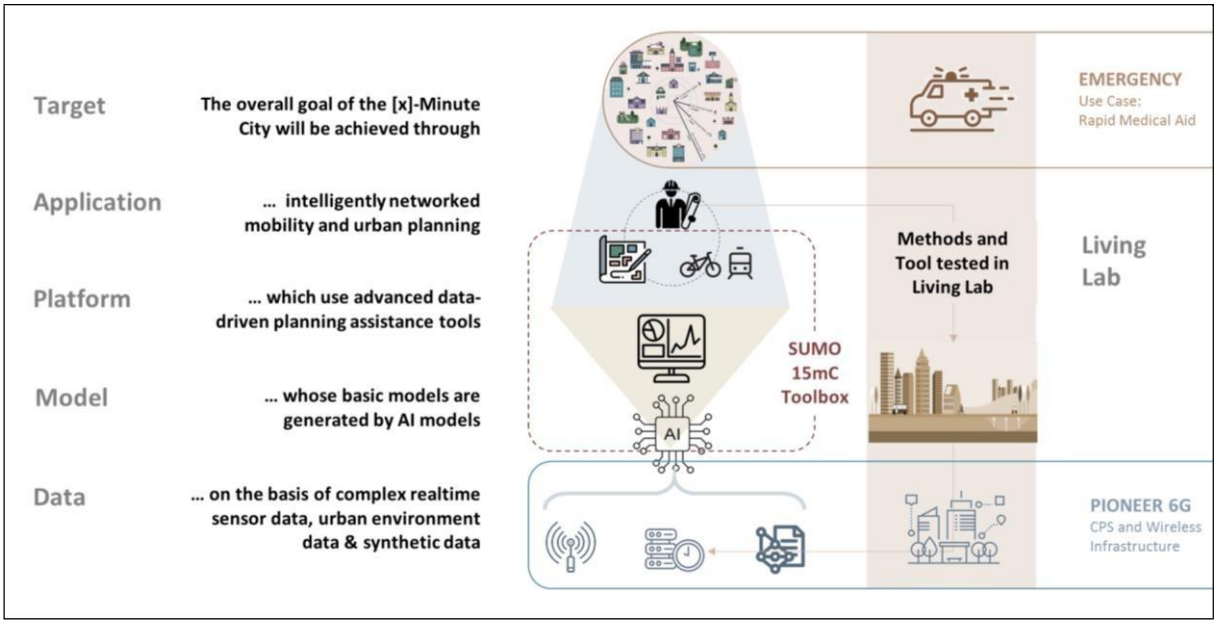


Figure 3: Overall Project Logic of SUMO_15

Within the HAWICC project "Next Generation City Networking", the other two subprojects will connect to SUMO_15 on the top and bottom level of the project scheme given above (this is what makes SUMO_15 the "conceptual middleware" of the entire NGCN constellation). On the application and use case-level, EMERGENCY represents one extreme case of the [x]-minute city – in the context of rapid medical aid, distances must be passed in extremely short possible time, any obstacles and detours be avoided. Every single minute counts. On the urban technology level, on the opposite, PIONEER_6G provides an exemplary digital infrastructure to record and communicate the situation "on the ground", providing a rich data basis for informed decision-making and planning.

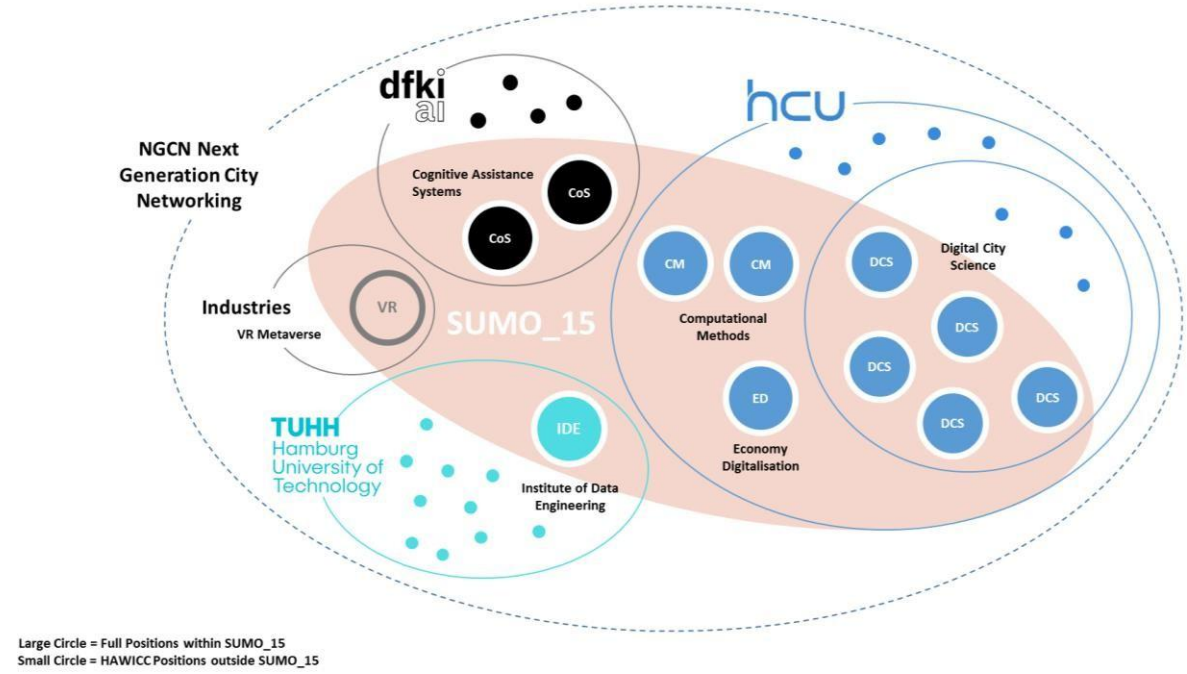


Figure 4: Consortium composition – institution and expertises (Source: authors)

To comply with the complexity of the presented approach, SUMO_15 brings together scientific expertise from three institutions, forming an overall workforce of more than 15 researchers. The lead partner Digital City Science from HafenCity University will bring in competence in digital tooling, urban analysis and planning (Noennig et al., 2022; Humann et al. 2022). HCU chair of Computational Methods provides spatial models and algorithmic approaches, while HCU chair of Digitalization and Economy contributes value generation approaches based on urban data as well as new forms of human, machine and data interaction. The German Institute for Artificial Intelligence (DFKI) with its Group for Cognitive Assistance Systems will investigate data- based model generation and assisted decision-making processes. Technical University of Hamburg addresses aspects of data engineering and systems design. Additional industry partners will be involved as technical service providers e.g. for interactive collaboration spaces for the project consortium or for VR representation of digital city twins (Fig.4).

4. EXPECTED OUTPUT AND RESULTS

The envisioned key output of SUMO_15 is a prototypical toolbox based on the project´s central data, model and knowledge platform (which must be conceived as a "platform of platforms"). Keeping the human in the loop as key decision maker in urban design and mobility planning, the toolbox provides intelligent assistance and decision-support instruments for the solution of complex challenges resulting from the convergence of mobility and urban planning aspects. The toolbox is to enable the creation and assessment of complex [x] Minute City concepts and scenarios – and thus become a catalyst for evidence-based planning in this thematic context. A potential technical framework for such a toolbox is the "Cockpit for Collaborative Urban Planning" (COUP), an integrated simulation environment that brings together different modules e.g. for the simulation of pedestrian movement, wind flow, noise propagation or sun exposure (López Baeza et al. 2021a, 2021b). (Fig. 5) While the COUP is designed for the analysis of design proposals for urban environments to be built in the future, the addition of further analytic layers for mobility and transportation (e.g. route and station planning, vehicle movement) a more integrated view of urban environments under mobility aspects and vice versa becomes possible.

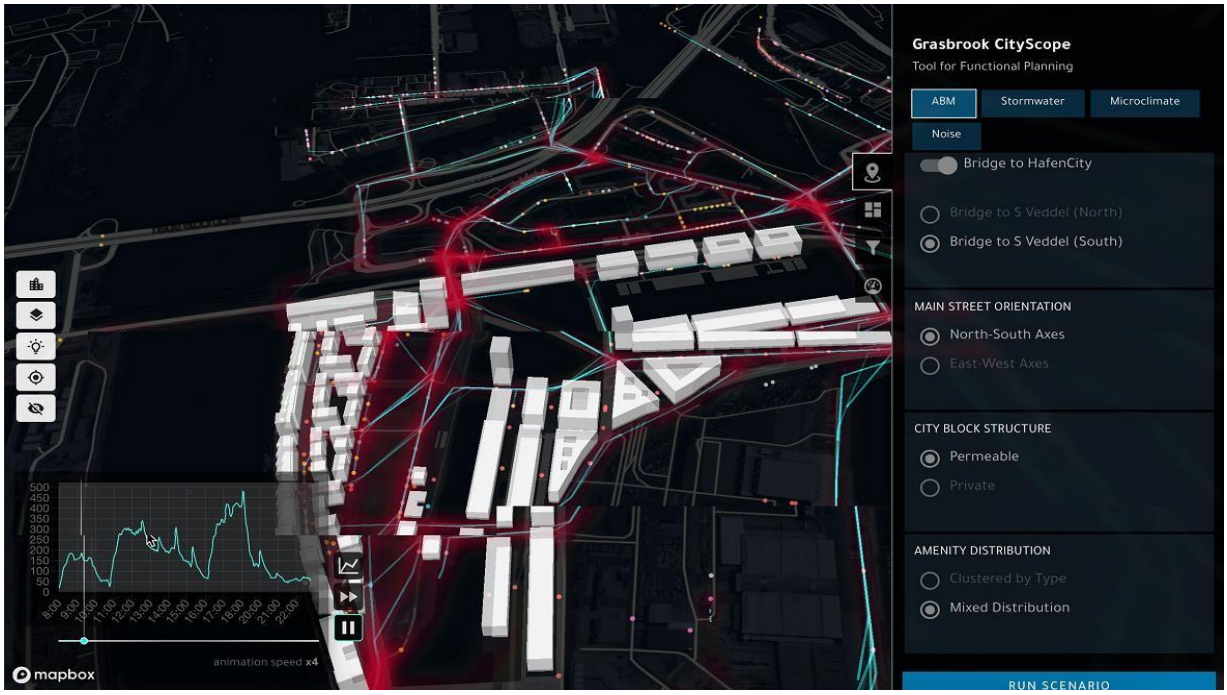


Figure 5: Cockpit Collaborative Planning (COUP) – simulation environment for future urban environments (Source: HCU Digital City Science)

In addition to the creation of new scientific and technological solutions for 15mC, another outcome of the project will be the implementation of a living lab in Hamburg, in order to give a proof-of-concept for the applicability of new urban IoT and wireless technologies, and the potential value creation from the data generated by them. Various urban development projects in the city of Hamburg (e.g. HafenCity, Science City Hamburg Bahrenfeld, Kleiner Grasbrook) suggest themselves as possible testbeds and will be checked accordingly. Above mentioned COUP has been designed and developed in support of the planning of the Kleiner Grasbrook, a new central urban district that is flagged as “10 minute neighbourhood”.

Finally, substantial interdisciplinary knowledge gains can be expected to emerge from SUMO_15, on theoretical as well as on methodological level. A key element of the complex architecture of sister clusters and projects at the beginning of this paper (Figs. 1 and 2) is the systematic cross-linkage of initiatives and activities. The project “Next Generation City Networking” features for this purpose a variety of synergetic work packages (so-called “Syn-APs”) that provide for regular exchange between SUMO_15, PIONEER_6G and EMERGENCY. Thus, not only a horizontal cross-project will be facilitated but also a vertical integration: technical infrastructures of the projects will be linked via data-, model- and knowledge platforms in order to create practical value and utility (e.g. in medical aid), allowing for the propagation of relevant insights and results up and down, and across, the entire project stack. Beyond HAWICC and NGCN, results are to be connected to the other initiatives within the DZM. For this purpose, HAWICC researchers will run summer schools, cross-project conferences and establish shared data- and knowledge bases that secure the flow of information across projects and regions.

5. OUTLOOK

The presented SUMO_15 project has just been started (January 2025), and is just at the beginning of its three-year runtime. This paper therefore could only present the ambition of the project and its envisioned research roadmap. Certain impacts and implications of the project, however, can be stated already at this stage.

The complexity of topic as well as of consortium constellation needs careful scientific coordination and synthesis. The built-in, specific formats for knowledge exchange and cross-pollination, however, promise substantial knowledge gains not only in regards to the [x] Minute City but also to overall data-based research on urban mobility and sustainability. The project is “programmed” to give evidence for the applicability and feasibility of 15mC concepts, and will propose novel computational approaches in this respect. Likewise, the project will take a critical review of the 15mC concept, and potentially put forward alternative concepts and theories of higher

applicability, scientific and societal reliability. Building on already existing technical frameworks like COUP and other digital twin technologies, the SUMO_15 will offer new and more effective instruments for planners and decision makers in the longer run. Within the project runtime, the new solutions are supposed to reach prototype level – functional demonstrators that proof their fundamental technical and conceptual potential. Their further development towards mature solutions with higher professional applicability and "market readiness" is subject to a potential follow-up and technology transfer project envisioned after SUMO_15.

ACKNOWLEDGEMENTS

The project Next Generation City Networking / SUMO_15 received funding from the Federal Ministry for Digital and Transport (BMDV) within the Funding Priority Deutsches Zentrum - Mobilität der Zukunft (DZM). The article is based on contributions from Michael Feld, Alexander Kölpin, Akif Ortak and Göktürk Köse.

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ICUP2025
5th international conference on urban planning

NATURE-BASED SOLUTIONS FOR RECLAIMING PUBLIC OPEN SPACE IN MULTI-FAMILY RESIDENTIAL NEIGHBOURHOODS: THE EXPERIENCE OF KRONSBERG

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ABSTRACT

Nature-based Solutions (NbS) is the umbrella concept of ecosystem-based approaches, which implies restoring natural elements of blue and green infrastructure into the urban landscape and renaturing paved surfaces, while contributing to the environment and people's health and well-being. As essential components of sustainable and resilient public open spaces (POS) in residential areas, NbS are increasingly integrated into contemporary POS (re)development projects. This paper presents the experience in NbS implementation of Kronsberg neighbourhood in Hanover, Germany, through a case study. The Kronsberg neighbourhood was chosen as a model eco-development that enables long-term environmental and social sustainability. Additionally, this particular example includes a variety of NbS elements and measures implemented within POSs of various scale, conceptualized within different urban forms, and with various functions of space. The aim of the paper is to explore the modalities of NbS application in Kronsberg, and to highlight environmental and social benefits that NbS brings to POSs within multi-family residential areas.

Keywords: *nature-based solutions; technical elements and measures; public open space; eco-district; integrative and participatory planning approach*

1. INTRODUCTION

In recent decades, ecologically oriented concepts have gained importance not only in academic discourse but also in urban planning practice, as decision-making processes and planning activities increasingly rely on them. Nature-based Solutions (NbS) is the umbrella concept of ecosystem-based approaches to address societal challenges (IUCN, 2020), which was introduced into practice in 2013 by the International Union for Conservation of Nature (IUCN) as part of the Global Program for 2013-2016. From the next Global Program, NbS became its fundamental element (IUCN, 2020), and is considered to be one of the key measures of disaster risk reduction and climate change adaptation and mitigation in the New Urban Agenda (UN-Habitat, 2017).

NbS imply restoring natural elements of blue and green infrastructure into the urban landscape, as well as renaturing paved surfaces, with the overall aim to contribute to the environment and people's health and well-being. NbS can help in minimizing the vulnerability to risks such as heat stress, air pollution and flooding from extreme rainfall (Pauleit et al, 2017), which may be perceived as indirect health gains. Reintroducing nature

into urban fabric presents direct benefits to people's health (Raymond et al, 2017), such as improving mental health and encouraging healthy lifestyles and recreation. Since NbS solutions are identified as crucial elements for creating sustainable and resilient public open space (POS) in residential areas, multiple contemporary re(creation) projects for residential POSs favor the implementation of NbS concept.

Depending on how much engineering of biodiversity and ecosystems is involved in NbS, and how many ecosystem services and stakeholder groups are targeted by a given NbS, Eggermont et al. (2015) define three types of NbS characteristics: (1) for better use of natural/protected ecosystems, (2) for sustainability and multifunctionality of managed ecosystems, and (3) for design and management of new ecosystems. The application of NbS in cities and built environments is categorized as Type 3: *Highly intensive ecosystem management or the creation of new ecosystems*. Type 3 is often associated with the concept of green and blue infrastructure, and aims to restore severely degraded or polluted areas (Eggermont et al, 2015). Within this category, UNaLab (2022) has proposed the technical elements and measures of NbS presented in Table 1.

Table 1: Technical elements and measures of NbS. Source: UNaLab (2022)

Type 3	*Sub-type*	*Elements/measure*
Highly intensive ecosystem management or the creation of new ecosystems	*Green space*	*Residential park, Green corridor, Urban garden*
	Trees and shrubs	*Single line street trees, Boulevards, Group of trees*
	Soil conservation and quality management	*Living fascine, Revetment with cuttings, Planted embankment mat*
	Green built environment	*Extensive/Intensive green roof, Constructed wet roof, Smart roof, Green façades, Free standing living wall, Mobile vertical greening, Moss wall*
	Natural or semi-natural water storage and transport structures	*Constructed wetland, Retention/detention pond, Daylighting, Underground water storage*
	Infiltration, filtration and biofiltration structures	*Bioswale, Rain garden, Infiltration basin, Permeable paving system, Biofilter (water purification)*

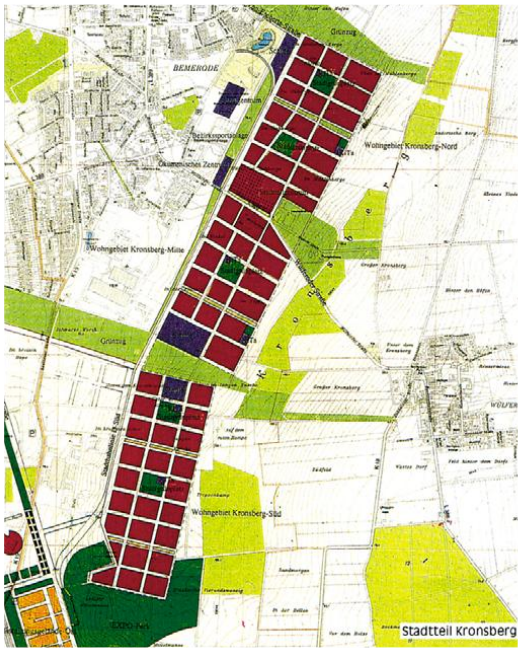
This paper aims to explore the modalities of NbS application in residential areas and determine the benefits that their implementation brings to POSs within multi-family housing zones. By using the review of relevant literature and web sources, the methodological framework is conceptualized on a case study of Kronsberg neighbourhood in Hanover, Germany, involving the description and analysis of applied NbS technical elements and measures, and the synthesis of study findings used for establishing the effects of NbS implementation. The Kronsberg neighbourhood was chosen as a model eco-development with enhanced social life and great scale-up potential, that involves a comprehensive completed residential project whose effects can be evaluated. Characteristics of NbS strategies and elements in the case study are determined on the basis of available publications, planning documents and satellite photo images.

2. KRONSBERG DEVELOPMENT

2.1. Urban brief

Kronsberg is a residential eco-district being developed on a former greenfield site in Kronsberg hill, in the south-west area of Hannover. The neighbourhood emerged in the late 1990s in connection with the EXPO 2000 event, in the proximity of Hanover Fairground. It was a unique opportunity to develop an entire city district aligned with the principles of Agenda 21, promoting careful use of natural resources while also meeting high social and cultural standards (KUKA, 1998). Within a compact urban planning concept, Kronsberg development employs the principles of ecological design, with a strong emphasis on high-quality POS conveniently located near housing. When completed, the project will sustainably house 15,000 residents complemented by integrated commercial spaces, within a 150-ha area.

Initial planning activities occurred in the period of 1990-1994. In 1993, the Hannover City Council announced an urban design and construction competition to define planning for the new residential settlement of Kronsberg. The results were incorporated into a masterplan with a simple framework concept, which became the baseline for further project development (Figure 1a). The masterplan envisions three neighbourhoods with their own distinct identity, each of them grouped around a focal POS. Until today, two communities were fully developed, central and northern neighbourhood (Phase I), while the southern residential neighbourhood is still under construction (Phase II) (Figure 1b).



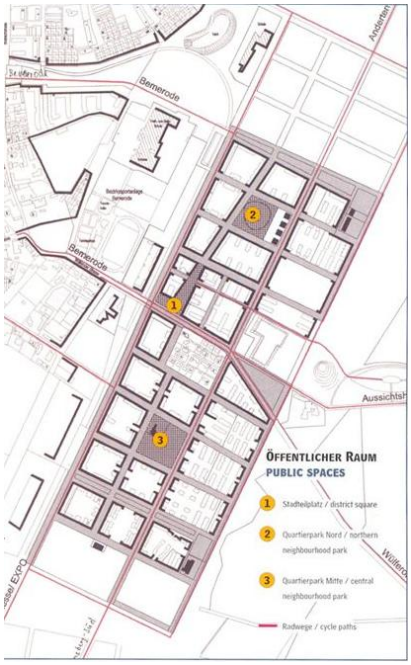
(a) Masterplan
Source: Directorate of Environmental Services and Directorate of Construction and Planning (2004).



(b) 3D view
Source: earth.google.com

Figure 1. Kronsberg settlement, Hannover.

The completed part of the settlement developed in Phase I is shaped like a rectangle, and laid out as a grid in the north-south direction (Figure 2a). It covers the area of 70 ha and accommodates 7,500 people in 3200 dwelling units, with residential density of 107 persons/ha (Codispoti, 2021). The grid layout creates a network of public spaces and green areas partly framed by residential buildings, thereby setting the spatial conditions for social interactions among residents. The design provided for two neighbourhood parks and a vibrant centre for the entire Kronsberg district (Figure 2a), integrated into the system of quality open spaces also involving the landscaped surroundings (Figure 2b).



(a) Phase I with POSs
Source: https://images.slideplayer.com/22/6416078/slides/slide_46.jpg



(b) Landscape and the system of open spaces
Source: Directorate of Environmental Services and Directorate of Construction and Planning (2004)

Figure 2. Kronsberg settlement, Hannover.

2.2. Contextual Background

Kronsberg was an intensely farmed area, which had been designated for urban development in the 1980s. As a regional planning principle, residential development was envisioned to expand along local rail public transport routes, with appropriate urban densities in the catchment areas of stops and stations. The EXPO 2000 World Exhibition provided the opportunity to transform hitherto agricultural land. To facilitate this, the City of Hannover acquired most of the land on the western slope of Kongsberg hill.

The City Council formed working groups in the Environmental, Construction and Social Affairs departments, who joined forces to implement an eco-planning approach, and avoided having the district built on by one single large developer (Landeshauptstadt Hannover, 2013). As the primary landowner and contractor, the City allocated the land to various property developers (KUKA, 1998), guiding the development process with a focus on environmental dimension, and setting quality standards to ensure sustainability.

The project was initiated by the local government/municipality, and unfolded within a participatory approach. The municipality of Hannover established specific criteria for residential buildings and open spaces that were mandated in the lot sales contracts (Codispoti, 2021). Among others, these requirements reflected on NbS, and involved the obligation to take part in rainwater management programs, and abide to regulations for tree planting and environmental compensation (Directorate of Environmental Services and Directorate of Construction and Planning, 2004).

On the other hand, the design and development of Kronsberg was also based on strong public involvement and cooperation between public and private actors. Community involvement included both engagement in consultations (workshop, surveys, community meetings), and raising public awareness with dissemination of information and education (una.city). The process of planning occurred concurrently at every level, with a high degree of cooperation, flexibility and adaptability from all stakeholders. Kronsberg Environmental Liaison Agency (KUKA) was set up in 1997 jointly by the City of Hannover and project's shareholders, as an environmental communication body to coordinate and support the process long-term, and create broad-based acceptance at different levels (Directorate of Environmental Services and Directorate of Construction and Planning, 2004). During the Kronsberg development period, KUKA provided training sessions for planners and expedited courses for craftsmen on-site, while also coordinating with new residents as they moved into their homes.

The focus of the project was set on developing new green spaces, preserving and managing urban nature, while enhancing knowledge and raising public awareness on the use of natural resources related to energy, waste, water, ground, countryside and agriculture (una.city; Stadtwässerung Hannover, 2002). Planning and constructing for sustainability involved a variety of ecological themes, such as use of renewable energy, energy efficiency optimization, stormwater management and waste management. The model district for sustainable urban development was grounded in the compact urban planning concept, with above-average housing quality and accompanying open spaces, environmentally responsible transport, and extensive social infrastructure (community centre, commercial uses, kindergartens, schools) (Landeshauptstadt Hannover, 2013).

3. IMPLEMENTATION OF NATURE-BASED SOLUTION

An important feature of Kronsberg's planning concept is the abundance of open space and nature areas. The share of open space in this district was raised by 5–10 % compared to conventional urban planning in Germany (Directorate of Environmental Services and Directorate of Construction and Planning, 2004). The transverse green corridors and the green belt parallel to the development link the residential district with the adjacent countryside. Within the neighbourhoods, open space involves a variety of public, semi-public and private areas in the immediate surroundings of housing: gardens in single-family plots, neighbourhood parks and planted public areas for recreation and sports.

Numerous and differing green spaces within a system of interconnected POSs in the Kronsberg district and the settlement's surroundings have helped to set the spatial conditions for NbS. Table 2 summarizes the multiple Nature-based Solutions, their technical elements and measures that were implemented. NbS and their elements in Kronsberg's open spaces have different features, a distinct character, and a different role in achieving the overall ecological aim of the project. They are further elaborated in this study in line with the planning and design concept provided by the Directorate of Environmental Services and Directorate of Construction and Planning (2004).

Table 2: Implemented NbS elements and measures in Kronsberg residential district. Source: una.city

Nature on buildings (external)
• *Green roofs*
Grey infrastructure featuring greens
• *Alley or street trees and other street vegetation* • *Green playgrounds and school grounds*
Parks and urban forests
• *Large urban parks or forests* • *Pocket parks/neighbourhood green spaces* • *Green corridors and green belts*
Blue infrastructure
• *Lakes/ponds* • *Rivers/streams/canals/estuaries*
Green areas for water management
• *Rain gardens* • *Bioswales and filter strips* • *Sustainable urban drainage systems*

Green belt. The eastern edge of the development is defined by a double row of trees lining the border avenue. Beyond them is the open grassland used for mowing and grazing (Figure 2b). Grassland transitions into newly established woodland areas on the crest of Kronsberg hill, and extends into surrounding farmland on the eastern hillside. Some spots within the woodland area were landscaped with open grassy areas, hedges, play and exercise facilities, each having its own distinctive character.

Green corridors. Green spaces between Kronsberg's neighbourhoods were designed as park corridors, linking the residential area to the woodland and tying it with the countryside (Figure 2b). They are designed for diverse use and distinctively landscaped, to stand in contrast to the surrounding countryside. The spots where green corridors extend to the hilltop woodland are landscaped with viewpoint hills and trees, thus creating areas for play and exercise.

Street trees and vegetation. In the urban planning concept of Kronsberg, the streets are designed as avenues, with a variety of tree species in each neighbourhood. The appealing green streetscape enhances the aesthetics of these POSs. The grass verges of the street accommodate elements for infiltration and management of stormwater runoff. The area between the structures and street space is landscaped by front gardens, which are diversified in order to enhance housing quality.

Neighbourhood parks. The two parks are centrally positioned in each neighbourhood, and framed by eight urban blocks (Figure 2a). In the master plan, neighbourhood parks are designated as public spaces for recreation, since they are located in close proximity to homes. Aside from spaces for various activities involving play and leisure, they also feature quiet, secluded areas for relaxation. The streets surrounding the parks are integrated into the overall design as gathering spots for socializing and relaxation. Therefore, the two parks play a key role in shaping the identity of the neighbourhoods.

Shared Courtyards and Private Gardens. Each residential building was complemented by open space, developed under strict design and ecological standards set by the municipality. As a result, the inner courtyards of the residential complexes were shaped as shared spaces with unique design. The distinct character depends on the integration of local topography, use of diverse plantings and stormwater infiltration areas, and tracing the network of internal paths. Although public access is enabled from the surrounding streets, it does not interfere with the courtyards' function - most courtyards maintain a secluded atmosphere, providing a safe space for children to play. Additionally, the vast majority of homes feature a private outdoor space: ground-floor apartments typically include terraces and rented gardens in the inner courtyards, while upper-floor apartments offer balconies, loggias, or rooftop terraces.

Green playgrounds. Children's playgrounds are located adjacent to the green belt, and foster strong connections between the community and the surrounding countryside. Water features and recreational amenities are provided in the Feldbuschwende playground near the play house in the north, and Weinkampswende playground on the solar storage tank in the south. Both playgrounds are very popular with children.

Water management. The main goals of water management in Kronsberg include creating a semi-natural drainage system, ensuring the supply of ground-water and improving flood protection (una.city). Urban

planning for the district introduced a 'close-to-nature' drainage system, thereby offering a sustainable alternative to the traditional drainage method. The aim of the 'close to nature' rainwater system is to preserve the quality of run-off stormwater along Kronsberg hill as much as possible after development (Stadtwässerung Hannover, 2002).

Sustainable urban drainage systems. Technical elements for stormwater management that were implemented involve (Stadtwässerung Hannover, 2002): gully-and-trench system, sluiced channels, retention areas, rainwater reservoirs and outfall ditches. They are integrated into streets and planted areas for long-term living with water. Their position in Kronsberg district is illustrated in Figure 3.



Figure 3. Stormwater management concept in Kronsberg settlement with the disposition of technical elements and water features
Source: Stadtwässerung Hannover (2002)

Stormwater is channelled into green-planted gullies (bioswales) and retained there for cleansing and slow release into the ground (Figure 4a). Through a layer of humus, polluted water filters into a trench filled with gravel, and drains away for deep ground storage. Excess water is gradually directed, with much delay, through a sluiced shaft into a regulated channel (Figure 4c), from where it flows to retention areas and surrounding greenery. Numerous water surfaces in the gullies encourage evaporation, positively influence the climate and reduce the formation of dust.

Retention areas in residential open space play a vital role in flood prevention as occasional catchments, by gradually channelling heavy rainfall into drainage ditches. These retention areas involve bioswales (Figure 4b) and ponds (Figure 4d). They are designed like parks and span up to 35 meters in width. Retention areas serve to hold rainwater from the main roads, taking the outfall from the sluice network. Compared to the conventional rainwater drainage, the outfall is significantly decreased.



(a) Bioswale in street area



(b) Bioswale in residential POS



(c) Stormwater channel



(d) Retention area - pond in residential POS

Figure 4. Elements for stormwater management in Kronsberg settlement, Hannover
Sources: (a) https://enviropaul.wordpress.com/wp-content/uploads/2018/01/img_5197.jpg; (b) https://una.city/nbs/hannover/water-management-hanover-kronsberg; (c) Stadtwässerung Hannover (2002); (d) https://sdg21.eu/galerien/fotogalerie-2000-kronsberg

Aside from small retention areas in residential blocks, two large-scale natural retention areas are provided at the foot of the hill, west of the main roads Oheriedentrift and Kattenbrookstrift and tram-tracks (Figure 3). Furthermore, the newly constructed elementary school features a retention reservoir designed to collect rainwater while promoting biodiversity. The structure also has a green roof, which is extensively planted for slower run-off of stormwater. The rainwater collected is used either as industrial water for toilet flushing, or in the school garden. In cases of extreme rainfall in Kronsberg district, surplus water is channeled into these large-scale retention areas and green corridors on the edges of the development. Large retention elements are designed for ten-year maximum rainfall.

Green roofs. Total area of planted roofs in the settlement amounts to 29%. Aside from school roof, green roofs are also implemented on residential buildings and some underground garages. In line with nature conservation law, owners were obliged to plant gently-sloping roofs in certain parts of the neighbourhood, including 32 rowhouses designed as Passive Houses.

Streams. The stream along Rohgraben street is the only watercourse draining this area, located just outside of the Kronsberg district. It was initially an open ditch shaped like a regular channel. The stream was renaturalised with the development of the settlement, in order to accommodate controlled and delayed release of stormwater.

Large urban parks or forests. The concept for open areas within the settlement was complimented with open spaces outside the developed area (Figure 2b). Large-scale recreational spaces frequently used nowadays include the grassland area to the east of the site, two viewpoint hills, a woodland strip and Parc Agricole located to the south of Kronsberg (Landeshauptstadt Hannover, 2013). It is interesting that viewpoint hills were formed by using the material excavated during construction, as part of soil management program. Parc Agricole features a walled garden with limestone, extensive meadows and an orchard. These large urban parks

are popular not only among Kronsberg residents but also with citizens across Hannover, who use them for activities like cycling, walking, flying kites, or just for enjoying the appealing views.

4. DISCUSSION AND CONCLUSION

This research discussed the implementation of NbS in POSs within multi-family residential areas, based on a case study of Kronsberg neighbourhood in Hannover, Germany. As a response to the challenges of rapid urbanization, urban development concept employed in this case was oriented towards creating a resilient ecological urban landscape, with NbS perceived as its fundamental element. The case study demonstrated a variety of NbS types that were implemented based on the specific challenges they aimed to address. Moreover, it was observed that NbS elements were applied at two levels: at the building-oriented level and the micro-level of the area, involving common spaces for clustered buildings and neighbourhood spaces. The example of Kronsberg neighbourhood also reveals that a single NbS intervention can provide multiple benefits, address several challenges simultaneously, and fulfil multiple functions in residential areas.

Creating a model city district with an exemplary urban design, ecological and social qualities required an integrative and participative planning approach. Collaboration of all city departments has streamlined the process of planning and construction, while extended citizen participation fostered a harmonious dialogue between residents and municipality. Main beneficiaries of the Kronsberg eco-development project involve both the local government/municipality, and the local community. As a successful example of environmentally responsible planning, Kronsberg district is strongly embraced by its residents.

The development strictly adhered to planning regulations, thereby ensuring the extensive implementation of NbS. The formal monitoring system for Kronsberg project was established to assess the development's impacts and achievements, with evaluation reports provided regularly. Concerning green areas and habitat, an increase in green space is accomplished (una.city). Regarding water management and blue areas, the environmental impacts include increased protection against flooding and improved stormwater management (una.city). At the time, the water management concept for a development of this scale was pioneering. As a result, the experts were overly cautious, and today the stormwater infiltrates so effectively that some areas, which were intended to feature visible water for urban design reasons, are almost always dry (Landeshauptstadt Hannover, 2013).

The Kronsberg project is showcased as one of the world's hundred most innovative infrastructure projects (una.city). It was awarded the 'Climate Star 2002' prize by the European Climate Alliance for the exemplary energy and environment concept (www.hannonver.de). As a benchmark eco-development, Kronsberg has great potential for scaling up in residential developments across Europe

The study's findings provide important insights into the planning of new POSs that enhance urban resilience. In conclusion, incorporating NbS into the design of POS within multi-family residential areas is considered crucial for creating multifunctional, appealing, healthy and socially engaging environments, that simultaneously restore natural systems, foster biodiversity and mitigate climate impacts.

ACKNOWLEDGEMENTS

This research was supported by the Science Fund of the Republic of Serbia, #GRANT No 7572, Reclaiming Public Open Space in Residential Areas: Shifting Planning Paradigms and Design Perspectives for a Resilient Urban Future - RePOS.

For further reading on Nature-based Solutions in residential public open spaces, please visit the RePOS project website https://www.repos-project.rs/pdf/overview-of-innovative-solutions_scs-mfs-ms-ds-and-nbs.pdf

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AFFORDANCES OF PUBLIC SPACES IN THE LESNÁ HOUSING ESTATE: THE ROLE OF SPATIAL ORGANIZATION IN CHILDREN'S ACTIVITIES

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ABSTRACT

Panel housing estates represent a key segment of urban planning in post-socialist countries. This study focuses on the Lesná housing estate in Brno, one of the most positively rated estates in the Czech Republic, known for its spacious public areas, diverse green spaces, and good connectivity to the city. The research examines how residents use public spaces, with special attention to children's activities. The research is based on the concept of affordance, analyzing the opportunities that spaces provide to users depending on their abilities, needs, and perception. The research focuses on the following questions: what affordances public spaces in Lesná offer to children, how physical characteristics influence children's activities, the role of parental supervision, and the key interaction points within the estate.

Findings indicate that, although panel housing estates are often perceived as monotonous and uniform, their public spaces can play a crucial role in fostering local communities and social activities. Lesná stands out for its successful integration of natural and urban elements, contributing to the residents' quality of life. This study provides both theoretical and practical insights into how public spaces are adapted to the needs of different user groups, with a special focus on children.

Keywords: *Panel housing estates, public spaces, affordance, urban planning, children's activities, Lesná*

1. GENERAL INFORMATION

Panel housing estates represent a key segment of urban planning in post-socialist countries. They were built in response to the mass demand for housing, particularly in the second half of the 20th century, when urbanization accelerated significantly. These estates were often designed with an emphasis on functionality and cost-effectiveness, while aesthetic and social aspects were sometimes neglected. However, although panel housing estates are often perceived as areas of low urban value, certain locations, such as the Lesná estate in Brno, demonstrate how a well-conceived urban concept can contribute to the quality of life for residents (Šimáček, 2015)

The Lesná estate is one of the most positively rated panel housing estates in Brno and the Czech Republic (Andráško, 2013). Its design is characterized by spacious public areas, diverse green spaces, and relatively good connectivity to the city. Public spaces play a crucial role in the daily lives of residents, as they facilitate interaction, leisure, and social activities. However, the way public spaces are used and perceived often depends on social, cultural, and demographic factors (Musil, 1995)

This study focuses on the public spaces of the Lesná estate, with special attention to how they are used by children. Children are among the most active users of public spaces, as they shape their environment through play, exploration, and interaction (Kyttä, 2002).

This research applies the concept of affordance, which refers to the possibilities that a given space offers its users, depending on their abilities, needs, and perception (Gibson, 1986).

Although panel housing estates are often criticized for their monotony and uniformity, research suggests that public spaces within these estates can play a crucial role in fostering local communities and enabling social activities. It is particularly important to understand how different groups of residents utilize these spaces, with children being one of the most significant user groups, as their play and activities largely depend on the spatial characteristics of the environment.

The key research question of this study is: How do children use the public spaces of the Lesná housing estate, and what affordances do these spaces provide for them?

To address this question, the study focuses on the following aspects:

1. What affordances do the public spaces of the Lesná estate offer to children?
2. How do the physical characteristics of these spaces influence children's activities?
3. How do parental rules and supervision shape children's use of public spaces?
4. What are the key interaction points within the public spaces of the Lesná estate?

These questions are essential for gaining a deeper understanding of how public spaces in panel housing estates are adapted to children's needs and identifying the key factors influencing their use. The study of public spaces in panel housing estates holds theoretical, practical, and social significance.

- Theoretical significance lies in the application of the concept of affordance to the public spaces of the Lesná estate. Traditionally used in psychology and design (Norman, 2013), affordance theory can provide valuable insights into how public spaces are used in everyday urban life.
- Practical significance is reflected in the potential recommendations for improving public spaces in panel housing estates. Understanding children's affordances can help urban planners and designers create safer, more functional, and more engaging environments for children's play and social interactions (Chaudhury, 2019)
- Social significance relates to challenging the stereotypes surrounding panel housing estates. While these estates are often perceived as monotonous and unappealing, research demonstrates that certain locations, such as Lesná, possess significant social potential (Andráško, 2013). This study contributes to the discussion on how such spaces can be improved and how they are actually used by residents, particularly children.

2. PUBLIC SPACES: FUNCTION, SIGNIFICANCE, AND CHALLENGES

There are various ways to define and approach the topic of public spaces (Pospěch 2013, Mitchell 1995, Holubec 2016, Goheen 1998). Although the core ideas among these authors do not differ significantly, this only highlights the importance and frequent study of this research area. A similar dilemma regarding the definition of public space arises in the context of residential housing estates, as discussed by several authors in the Czech Republic (Musil 1985, Andráško 2013, Špaček 2012, Lehečka 2015). Due to the broad scope of both concepts, it is challenging to establish a single definition or term that precisely describes public spaces within residential housing estates. It is important to emphasize that public spaces and housing estates have become a significant topic in Czech society in recent years and are often at the center of public debates. Experts from various disciplines, including social anthropology, geography, sociology, urban planning, and architecture, contribute to these discussions. Unsurprisingly, public spaces within housing estates are also subject to these debates. One

of the key questions frequently raised is: "How should they be designed and used?" Perspectives on this issue vary, ranging from complete neglect and criticism of housing estates—sometimes even proposing their removal—to constructive solutions and conceptual approaches to their improvement.

Additionally, the works of (Mulíček, 2015) and research by (Lehečka, 2015) indicate that residents of housing estates exhibit specific behavioral patterns. For this reason, linking the concept of affordance with public spaces in these estates can provide new insights and enable a deeper understanding of their functionality.

Public spaces represent one of the fundamental elements of urban life, as they facilitate not only physical activities and movement through the city but also social interactions, cultural events, and the formation of a shared community identity. Although they are often perceived as "neutral spaces" accessible to all, public spaces are, in reality, dynamic places where various functions, interests, and social groups intersect (Goheen, 1998). Their usage evolves over time and depends on historical, political, and economic factors that shape the urban environment.

The Lesná housing estate, as part of Brno's urban fabric, provides an interesting example of how public spaces can be used and perceived within panel housing estates. Unlike many similar estates that have faced spatial degradation, Lesná has maintained a relatively high quality of public areas, contributing to its positive perception among residents. To better understand the role of public spaces in this specific context, it is essential to analyze their functions, significance, and the challenges they face in contemporary urban environments.

2.1. Functions of Public Spaces

Public spaces serve multiple functions that extend beyond their basic physical use. Their true value lies in their ability to foster interaction, facilitate the exchange of ideas, and enhance the quality of life (Mitchell, 1995). The functions of public spaces are generally categorized into social, ecological, political, and cultural dimensions.

Social Function: Spaces for Interaction and Community Identity. Public spaces play a crucial role in forming social bonds and strengthening the sense of community. They are not merely transitional zones between residential blocks or places we pass through on our way to work—they are spaces where people gather, communicate, and build social networks.

In the Lesná housing estate, public spaces are particularly significant as they enable various forms of interaction. Children use playgrounds and green areas for play, parents observe them from benches, elderly residents spend time in parks, while pedestrians utilize walkways for recreation. These spaces facilitate spontaneous encounters, contributing to social cohesion and strengthening interpersonal relationships within the neighborhood.

Moreover, public spaces can hold symbolic importance in shaping the identity of a community. For example, the Lesná estate is known for Čertova rokle, a natural area that is not only part of the landscape but also a recognizable symbol of the neighborhood. Generations of children have grown up playing and exploring this space, making it an integral part of the collective memory of its residents.

Ecological Function: Greenery and Quality of Life. In addition to their social significance, public spaces also serve an important ecological function, influencing air quality, noise levels, and the urban microclimate (Šimáček, 2015). In panel housing estates, the presence of green spaces can significantly improve living conditions, particularly in cities with high levels of pollution.

The Lesná estate stands out from many other panel housing estates due to its high percentage of green areas, which not only enhance the aesthetic appeal of the neighborhood but also provide space for recreation, relaxation, and psychological well-being.

Green spaces such as parks, tree-lined avenues, and forested sections of the estate:

- Reduce temperatures during summer months, making outdoor spaces more comfortable.
- Improve air quality by absorbing harmful gases and producing oxygen.
- Reduce stress and promote physical activity by offering space for walking, jogging, and play.

However, despite the abundance of green areas, their functionality depends on continuous maintenance. Without proper care, even the most beautiful parks can become unattractive and neglected, ultimately losing their intended function.

Political Function: Spaces of Power and Social Change. Public spaces are not merely neutral places—they often reflect power relations and societal changes. Musil emphasizes that public spaces serve as arenas for civic rights struggles, hosting protests, debates, and various forms of social expression (Musil, 1985)

In post-socialist societies, including the Czech Republic, the transformation of public spaces after 1989 has demonstrated how their political and social roles have evolved (Ferenčuhová, 2013). Many spaces that were previously used for socialist demonstrations have been repurposed for new forms of public life, including shopping centers, cultural events, and sports activities.

In the case of Lesná, public spaces are not politically active in the traditional sense, but they still play a role in civic participation. For example, spaces such as school courtyards, sports fields, and local parks often serve as informal gathering places, venues for discussions, and planning sites for local initiatives.

3. SPATIAL AND SOCIAL ASPECTS OF THE LESNÁ HOUSING ESTATE

Lesná is located on a south-facing slope in the northeastern part of Brno, approximately three kilometers in a straight line from the city center. Most of the estate was built on what was once a greenfield site, while a portion of the area had previously been used as a military training ground. The estate was designed in close proximity to the Soběšice Forests, which were intended as a recreational zone, and is further surrounded by wooded valleys and ravines. Due to this geographical setting, Lesná offers its residents expansive panoramic views of the city while simultaneously ensuring optimal natural lighting for residential units (Semrád, 2019).

One of the most significant natural features of the estate is Čertova rokle (Devil's Ravine), which divides the originally built sections of Lesná into two segments and further integrates the natural environment with the urban landscape. This natural element is a unique asset of the estate and is difficult to replicate in other residential zones. In the Czech Republic, it is rare to find an example of such a harmonious integration of the natural environment into the structure of a housing estate. Over the past decade, Lesná has expanded with the construction of the Majdalenky residential complex in the northern part of the estate. This complex consists of four large buildings with apartments of various sizes and price categories, further enriching the housing options in the area.

The Lesná housing estate is considered one of the most successful urban planning projects in the Czech Republic and possibly in the broader Central European region. Additionally, it enjoys a certain level of public recognition in the Czech Republic and is frequently featured in various media, including non-academic publications. One of the reasons for its popularity lies in the fact that it belongs to the first generation of panel housing estates, developed during a period when architects had greater freedom to experiment and introduce innovative designs in urban planning.

The spatial organization of Lesná is clearly visible on the map (Figure 1). The central natural element of the estate, Čertova rokle (Devil's Ravine), divides the originally built part of Lesná into two sections. Additionally, the main thoroughfare (Okružní and Seifertova streets) separates the inner and outer parts of the estate, while in the north, it forms a boundary between the old part of the estate and the new Majdalenky residential complex. During the planning phase, urban designers intentionally structured the road network to prevent transit traffic through residential zones, thereby contributing to a quieter living environment with reduced noise levels (Kilnarová, 2017).

This road layout further minimized the negative impact of traffic barriers on the spatial organization of the estate (Divina, 2010). The layout of buildings was based on the specific terrain characteristics, which gently slopes towards the south. Čertova rokle runs through the central part of the estate, forming the backbone of park and recreational zones. It was planned that this area, surrounded by forests and valleys, would accommodate approximately 6,000 residential units designed for around 20,000 residents, covering an area of more than 100 hectares.

Around the central park area, there are 18 rectangular residential buildings, positioned in alignment with the natural slope of the terrain. The main road forms a ring around the estate, while internal streets mostly end in cul-de-sacs, further enhancing the tranquility and safety within the estate. The central part of Lesná houses

most of the public and communal amenities, creating a functional space that meets the everyday needs of residents (Skřivánková, 2017).

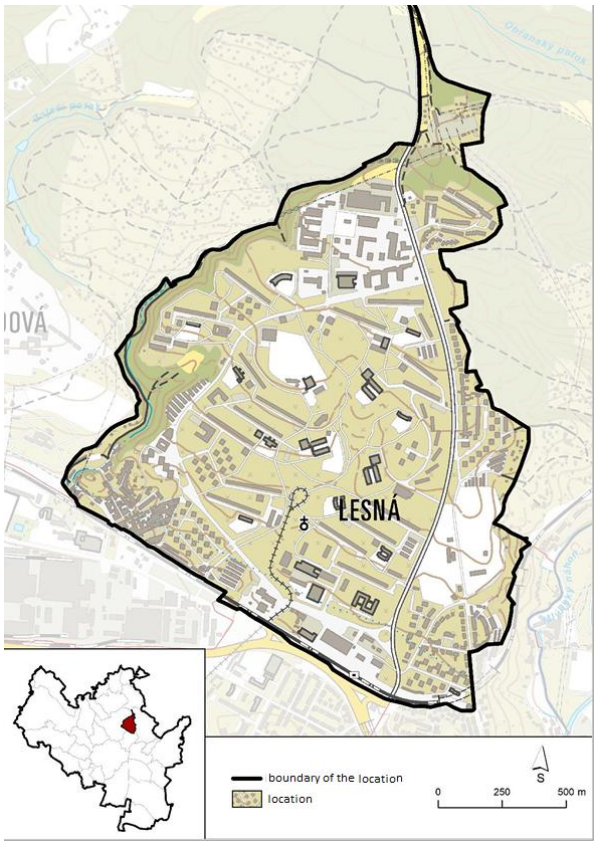


Figure 1: Područje stambenog naselja Lesná i njegova lokacija u okviru grada Brna (Kaplan, 2019)

According to Semrád, the organization of the Lesná housing estate was structured into five districts, with key service centers located around the main zones—Lučina, Polana, Obzor, Dukát, and Halasovo náměstí. It was planned that each of these districts, at maximum occupancy, would accommodate between 4,000 and 5,000 residents (Semrád, 2019).

Each district had a central space with shops, service facilities, a restaurant, and a small hall for social gatherings, as well as two preschools, a daycare center, and an elementary school with a sports field.

The fundamental concept behind this design was to create residential units that provide a pleasant, safe, and hygienic living environment, with ample green spaces, essential services within close proximity, and dedicated areas for recreation and cultural activities.

The main goal of this urban planning approach was to ensure residents have easy and quick access to all necessary amenities. Services intended for the entire housing estate were concentrated near the central park. A sports complex with a stadium and swimming pool was located in the northern part of Lesná, while in the southern part, the busiest area of the estate, a commercial and cultural center was established, offering various services, including a polyclinic. Later, the TJ Tesla Brno sports hall was constructed in this area (Divina, 2010).

Public Spaces in Lesná

From a spatial perspective, the Lesná housing estate is characterized by three main categories of public spaces (Kaplan, 2019):

- Green areas and natural landscapes – including parks and natural surroundings within the estate.
- Pedestrian zones and squares – spaces designed for interaction and community gatherings.
- Playgrounds and sports areas – playgrounds and sports fields, particularly important for children and youth.

The playgrounds in Lesná are strategically distributed to be easily accessible to all residents, ensuring continuous usage. The playground equipment is adapted to different age groups, with seesaws, swings, and sandpits for younger children, while older children use climbing structures and obstacle courses for physical activities.

In addition to spaces designed for children, pedestrian zones and squares represent a significant segment of public spaces, serving as central hubs for social activities within the neighborhood. According to the author, these spaces serve multiple functions—they are not just transitional areas but meeting points and places for interaction among residents. Their design encourages people to spend time outdoors, utilizing benches, green areas, and urban furniture placed throughout these zones.

One of the key challenges that Lesná faces is the increasing dominance of automobiles, which has become more pronounced with the growing number of privately owned vehicles. Although the estate has a relatively well-organized parking system, a conflict exists between drivers' needs and public space users, as an increasing number of residents utilize public areas for parking, reducing the availability of spaces for pedestrians and recreation.

Furthermore, the ongoing maintenance of public spaces remains a critical issue. Even well-designed spaces can lose their functionality without regular investment in their upkeep. Certain areas of the estate are experiencing aging urban furniture and infrastructure problems, yet Lesná still maintains a relatively high standard of public space quality compared to other panel housing estates in the region.

Lesná serves as an example of a panel housing estate with well-planned public spaces that remain functional and actively used. Its integration with the natural environment, the separation of pedestrian and traffic zones, and the presence of distinctive locations such as Čertova rokle contribute to maintaining its status as a high-quality residential area for its inhabitants.

4. AFFORDANCE AND PUBLIC SPACES IN THE LESNÁ HOUSING ESTATE

The analysis of public spaces in the Lesná housing estate cannot be fully understood without relying on the concept of affordance, which helps explain how specific physical characteristics of space shape user behavior. Urban space affordance is defined as the potential that an environment provides to its users, depending on their abilities, needs, and interaction with the space. In this context, an analysis of Lesná reveals that public spaces offer various types of affordances, with the most significant elements being the natural landscape, planned urban infrastructure, and the flexibility of space usage.

Lesná represents a unique example of a panel housing estate where the interaction between natural and urban elements shapes the use of public space. Unlike many other housing estates built during the socialist period, which were characterized by strictly planned green areas without clear integration with the natural landscape, Lesná stands out for its preservation of natural elements, which have become an integral part of residents' daily lives (Šimáček, 2015). These natural elements provide rich affordances for children's play, recreation, and social interactions, while the planned urban segments of the estate support structured activities within playgrounds, sports fields, and pedestrian zones.

4.1 Natural affordance and its role in the public spaces of Lesná

One of the key aspects of affordance analysis in Lesná is the role of natural surfaces and their impact on user behavior. Natural affordances represent the possibilities that children and adults recognize in the natural environment and utilize for various activities. The Lesná housing estate contains a large number of green areas, but Čertova rokle stands out as a natural zone that plays a crucial role in shaping affordances for children and young people.

Čertova rokle is a space that enables a variety of activities, allowing children to engage with natural elements in ways that are not strictly predefined. In this space, children develop different activities, including climbing, hiding, running, and interacting with natural materials such as branches, stones, and soil. This spatial flexibility makes it particularly valuable, as it allows children to creatively use their environment while developing motor and social skills.

According to Šimáček, natural spaces within urban settlements serve a dual function—ecological and social. On one hand, they contribute to the preservation of the natural landscape, and on the other, they allow residents to use the space in various ways. In the case of Lesná, Čertova rokle has proven to be a key segment of public

space, facilitating spontaneous and informal activities without the strict limitations typical of planned urban areas. Its usage varies seasonally—during summer, it is used for exploration and physical activities, while in winter, it transforms into a space for sledding and winter games (Šimáček, 2015). This adaptability further enhances its value in residents' daily lives, ensuring continuous use throughout the year.

Regarding vertical elements in public spaces, housing estates are generally characterized by a certain monotony in their structure. Among the objects that enable vertical movement, common ones include trees, climbing frames with various types of ladders, walls, and stairs. These elements are often used by children to reach higher points from which they can observe other participants in activities such as hide and seek, or to access alternative descent routes, such as slides or climbing poles. Regardless of age, children frequently use these objects to test their physical strength and coordination, particularly tree branches and playground structures. These elements are most commonly found in children's playgrounds or their immediate surroundings.

The Lesná housing estate is characterized by a ravine with steep slopes covered with various types of vegetation, while trees are distributed throughout the entire estate. However, not every tree provides a climbing affordance. Children most often choose trees with low, sturdy branches and dense canopies, which provide greater safety when climbing (Figure 2). Attempts to climb tall shrubs have also been recorded, indicating a wide range of objects that children use for vertical movement. The reasons for climbing can vary—from gaining a better overview of the surroundings and seeking privacy to exploring tree characteristics or testing their own physical abilities.



Figure 2: Tree affordance as an object enabling vertical movement (Kaplan, 2019)

On the other hand, one of the most prominent examples of natural affordance relates to protection from adverse weather conditions. During the summer months, it has been observed that adult users of the space prefer to stay in the shade of trees, avoiding direct exposure to sunlight and high temperatures on open surfaces. Benches exposed to the sun were less favored compared to shaded areas provided by tree canopies.

In contrast, children showed greater resilience to high temperatures and continued playing on playgrounds regardless of the intensity of solar radiation. Parents, however, were more likely to use shaded areas, adapting their behavior to the natural conditions of the space (Figure 3).

These behavioral patterns highlight the importance of natural affordance in the planning and use of public spaces. Vegetation not only enhances the aesthetic and ecological quality of the neighborhood but also allows for greater flexibility in its utilization, creating varied microclimatic conditions that cater to the needs of different user groups.



Figure 3: Shade as protection from strong sunlight (Kaplan, 2019)

4.2 Planning and use of public spaces in the Lesná housing estate

In addition to natural elements, the Lesná housing estate also features purpose-built spaces that enable organized activities and the controlled use of public spaces. These spaces include playgrounds, sports fields, squares, and pedestrian zones, all designed to meet the needs of different user groups.

Lesná is characterized by a large number of playgrounds, each of which possesses a unique element, provides a specific affordance, or stands out due to its location, which directly affects its level of use. Interestingly, the playgrounds in Lesná lack a clearly recognizable common design element that would allow for visual identification. In many urban environments, such spaces are often defined by distinctive color schemes, uniform playground equipment, or consistent urban furniture design, whereas in Lesná, such a standardized approach is not present.

One of the key factors influencing the structure of playground users is their basic division into children's playgrounds and sports fields. While younger children predominantly use children's playgrounds, older age groups, if they visit these spaces at all, tend to prefer sports fields. This usage pattern is particularly noticeable at the playground in Čertova rokle, which integrates both children's and sports zones, allowing users to engage in various activities according to their interests.

Some playgrounds feature more complex climbing structures, made of ropes or metal ladders. These structures require a certain level of physical ability and coordination, and in some cases, the assistance of another person to ensure children's safety while using them. It has been observed that younger children tend to choose elements that match their height, often managing to climb up but requiring help to descend.

A specific exception to this age-based division is a playground with a large and tall climbing frame, where children can reach a height of approximately two meters above the ground (Figure 4). Younger children use this structure less frequently, either due to physical limitations or restrictions imposed by parents. At the same time, for older children, these climbing frames can be too small, making movement within the structure more difficult. However, observations have shown that a significant number of preadolescent children were physically capable and independent enough to use them without additional assistance.



Figure 4: Climbing frame at the children's playground on Blažkova Street (Kaplan, 2019)

Swings are one of the significant elements of children's playgrounds, with their functionality varying depending on the design. As previously mentioned, certain types of swings are constructed in a way that makes independent movement difficult, regardless of the user's age (Figure 4). In such cases, children use their body weight and movements to intensify the swinging motion and maintain momentum.



Figure 5: Older child on the swing (Kaplan, 2019)

The public space of the Lesná housing estate does not contain a large number of movable objects, and the possibility of interacting with them largely depends on the physical characteristics of the individual. Therefore, Lesná does not have many items that can be freely picked up and moved. These primarily include benches, trash cans, or containers. These objects are distributed throughout the estate, but there are exceptions—specific objects added to the space that are located in only one place or playgrounds with freely accessible toys.

One such example is the children's playground near the Jaroslav Kvapil Art School, where toys are available to all visitors (Figure 5). Any child who comes can use them for play. Such objects, including plastic shovels and various toy cars, provide a wide range of affordances and encourage creative interaction with the space.



Figure 6: Children's playground with freely accessible toys (Kaplan, 2019)

Unlike organized activities, which are pre-planned and institutionalized, unorganized activities in Lesná are spontaneous and depend on the current needs and interests of users. These activities are often not tied to predetermined locations and can take place in various areas of the estate, allowing spaces to acquire multiple functions depending on the users who occupy them.

Unorganized activities are not limited to children—adults also use public spaces for walking, spontaneous gatherings, recreational sports, and spending time outdoors. According to Šimáček (2015), parks and green areas in the estate are frequently used for informal activities such as cycling, jogging, and relaxation, with seasonal changes influencing how these spaces are utilized. During the summer months, residents use green areas for picnics and socializing, while in winter, certain slopes and grassy areas transform into spaces for sledding and winter games.

5. CONCLUSION AND RECOMMENDATIONS

Research on public spaces in the Lesná housing estate has confirmed that they are essential for the quality of life of residents, particularly children, young people, and the elderly. The analysis showed that the use of these spaces depends on their physical characteristics, seasonal changes, as well as social norms and rules that influence how users interact with their environment. In this context, the natural elements of the estate, such as Čertova rokle, are of invaluable importance as they provide opportunities for informal, spontaneous play and physical activity, while planned urban spaces, such as playgrounds, sports fields, and squares, enable organized activities and social interactions.

One of the key insights of this study is the significance of affordance in urban environments—the way in which spatial elements enable certain activities depending on the needs of users. It has been observed that children particularly utilize natural affordances for play and exploration, while adults tend to value spaces that provide comfort, shelter, and safety. This diversity in perception and use of public spaces indicates the need for their adaptation to different resident groups.

However, even though the Lesná housing estate represents a positive example of the integration of natural and urban elements, certain challenges could threaten the long-term functionality of public spaces. Among the main identified issues are the need for continuous infrastructure maintenance, insufficiently defined rules for the use of certain public spaces, and the growing presence of automobiles in pedestrian zones, which can negatively impact the quality of life for residents and the availability of spaces for recreation.

To preserve and further improve public spaces in Lesná, several strategic measures are recommended:

1. **Preservation and improvement of natural elements** – natural areas, such as Čertova rokle, should be protected from urbanization and degradation, while additional investments in ecological initiatives could contribute to the improvement of environmental quality and biodiversity.
2. **Maintenance and modernization of urban infrastructure** – regular upgrading of playgrounds, sports fields, and urban furniture is essential for the long-term sustainability of the estate and the quality of

life of its residents. Special emphasis should be placed on inclusive design to ensure that public spaces are accessible to all generations.

3. **Regulation of traffic in public spaces** – the increasing presence of automobiles in pedestrian zones presents a challenge that requires better planning and the implementation of traffic restriction policies in key public spaces, particularly near playgrounds and parks.
4. **Encouraging community participation** – involving local residents in the decision-making process regarding urban development can contribute to better preservation and use of public spaces. Organized initiatives, workshops, and public discussions could help raise awareness of the importance of these spaces and their maintenance.
5. **Flexible use of space** – increasing the number of temporary and movable elements in public spaces could contribute to the dynamism of the estate and encourage creative interaction with the environment.

From the perspective of physical affordance, children use public spaces to satisfy their need for movement, interaction with the environment, and creative engagement. Housing estates offer a wide range of affordances that support these activities, with a clear differentiation in how various spatial elements influence user behavior. In terms of creativity, the affordance of movable objects and materials stands out as crucial, as it allows children to engage in different forms of creative activity. However, the number of movable objects in the Lesná housing estate is limited, and they mostly appear spontaneously and for short periods. This temporary nature may be due to certain restrictions related to their long-term placement in public spaces, which could be associated with concerns from residents and local authorities regarding possible theft or vandalism. As a result, objects that are temporarily present in public spaces are usually of low material value and already used. This phenomenon suggests that movable objects in the public spaces of Lesná have an informal character and that their temporary functionality depends on the current needs of users and the community's tolerance of their presence.

Children's interaction with public space often depends on the availability of simple yet temporarily present elements in the environment. Certain materials, such as gravel or snow, represent specific affordances whose use changes depending on seasonal conditions. Their availability is limited, but at the same time, they open possibilities for spontaneous play and creative interaction with space. A similar principle applies to movable objects, which appear in urban spaces for a certain period and, during that time, become central elements of activities. Their temporary presence can significantly influence patterns of space usage, creating new opportunities for play, exploration, and social interaction.

These examples point to a potential strategy for improving public spaces, which would involve the occasional placement of objects that have lost their primary function but could serve as temporary attractions. Such a practice could contribute to increasing the dynamism of space and enriching the daily activities of its users.

Additionally, certain seasonal factors, such as snow and ice, can temporarily transform the affordances of a space, enabling new activities that would otherwise not be possible. These processes illustrate how even short-term changes in the physical environment can have a significant impact on behavior and user interaction with space. The implementation of temporary and economically sustainable affordances could help redefine the perception of housing estates, particularly in relation to the stereotypical image of their monotonous and static character. Initiatives for such changes do not necessarily have to come only from local authorities but also from various social groups, organizations, or individuals, which would further encourage community participation in shaping public space.

One of the key affordances of this space relates to providing shelter and privacy, making the ravine a place most frequently used by older children for various forms of social interaction. This part of the estate is recognized as an informal gathering space where activities such as socializing, listening to music, and using mobile devices take place, while in some cases, the consumption of psychoactive substances has also been observed. In addition, Čertova rokle has a significant educational and recreational function, as it is frequently used for organized activities by local preschools, schools, and other educational and recreational organizations. Its natural features encourage children's creativity and the development of imaginative play, particularly in the form of role-playing games that spontaneously emerge in this specific environment. The topographical characteristics of the ravine further contribute to its role in public space, enabling various dynamic activities. Steep slopes are often used for running downhill, climbing, and sledding, while during the winter months,

certain areas transform into natural slippery surfaces, further enriching the range of possibilities for using this space.

The affordance characteristics that public spaces in the Lesná housing estate provide for children largely depend on their physical development. Many objects in the space may be classified as graspable or movable for adults or older children, while for younger children, these same objects represent static and non-interactive elements. However, the affordance of objects does not necessarily have to be linked only to their mobility. Fixed elements, such as tall structures or vertical obstacles, may be inaccessible to younger children due to the lack of climbing supports. In contrast, due to their physical characteristics, younger children may take advantage of spatial opportunities that are unavailable to adults or older children—passing through narrow openings, crawling under objects, or climbing on thinner tree branches that would not support the weight of older users.

These differences in affordances directly influence children's territoriality within public space. Younger children, due to the need for supervision, spend most of their free time near their parents and within clearly defined spatial zones. Older children, although moving within a broader area, exhibit less dynamic movement patterns, indicating different ways of using public spaces depending on age and physical abilities.

Based on the analysis, it can be concluded that the Lesná housing estate represents an example of a functional and well-designed urban space that enables various types of activities and meets the needs of a wide range of users. Its successful integration of the natural landscape and urban elements contributes to a high quality of life. However, certain challenges, such as infrastructure maintenance and traffic regulation, require continuous attention and adaptation to the modern needs of residents. The implementation of the recommended measures could further improve the quality of public spaces and make them even more adaptable to different user groups, ensuring the long-term development of Lesná as a well-planned and functional urban space.

ACKNOWLEDGEMENTS

This research was supported by the Science Fund of the Republic of Serbia, GRANT No. 7572, Project Reclaiming Public Open in Residential Areas: Shifting Planning Paradigms and Design Perspectives for a Resilient Urban Future - RePOS.

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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ICUP2025
5th international conference on urban planning

AN OVERVIEW OF THE STRATEGIC AND PLANNING FRAMEWORK OF THE CITY OF LESKOVAC IN SERBIA FOR THE (RE)DEVELOPING OF PUBLIC OPEN SPACES IN RESIDENTIAL NEIGHBOURHOODS

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ABSTRACT

During the Socialist period, the City of Leskovac faced rapid urban development thanks to its textile industry production. In this period, caused by rapid urbanisation, some of the housing estates were built in order to provide homes for the working population. These housing estates were characterised by generous open spaces with large surfaces of greenery. During the 1990s, like many other cities in Serbia, Leskovac experienced economic decline, which led to numerous problems in the urban structure of the city. In the Post-Socialist – transition period, many informal settlements were built on the city territory. Changes in housing policy on the national level affected the multi-family housing estates across the country and led to their neglect and degradation – both the built structures and open spaces - which were in public ownership. By analysing the current strategic and planning framework of the City of Leskovac, this paper aims to determine the treatment of POS within these documents and to highlight the causal relationship with their existing state. Even though POS in residential neighbourhoods are recognised as an important factor for future urban development, they are treated indirectly within strategic and planning documents, which is causing their further neglect and loss. This research highlights the need for the improvement of POS integration within strategic and planning documents in the cities, in order to contribute to their development and enhance the quality of life in residential neighbourhoods both inherited and newly developed housing estates.

Keywords: *Public Open Spaces (POS), Multi-family Housing Estates, Redevelopment of POS, Planning and Strategic Framework, City of Leskovac*

1. INTRODUCTION

The City of Leskovac is situated in the southeastern part of Serbia and is one of the country's 29 cities. It encompasses an administrative territory that includes 144 settlements. According to the 2022 Census data, the city's population is 123,950, with 58,338 residents living in the urban area (Statistical Office, 2023). Leskovac covers a total area of 1,025 km², of which 449 km² is designated as urban territory (City of Leskovac, 2022). The population density in the urban area is 130 inhabitants per km². Leskovac represents the administrative seat of the Jablanica district, one of the nine districts in the Southern and Eastern Serbia region, which is recognised as

the least developed region of the country. Together with the Pčinja district, Jablanica forms a distinct spatial unit. The Draft of the Spatial Plan of the Republic of Serbia for the period between 2021 and 2035 designates Leskovac as an urban area of integration centres, as it has a population exceeding 100,000. It is identified as a centre for economic growth, highlighting potential development in high-tech industries, services, and regional institutions to help mitigate further population migrations (Draft of the Spatial Plan, 2021).

Leskovac was the centre of the textile industry during the socialist period, a time when several housing estates were developed within the city. In the post-socialist or transition period, informal settlements emerged, and in the last decade, numerous new construction projects have taken place. The Large Housing Estates (LHEs) built during the socialist period are characterized by extensive Public Open Spaces (POS) that include generous green areas, such as the Dubočica housing estate. Unfortunately, over time, many of these areas have been neglected, and some have even been completely devastated, as seen in the Radničko housing estate. Due to unresolved ownership issues, there have been no interventions or regeneration projects aimed at improving the POS in these LHEs. In contrast, for the estates built more recently, the demand for parking has led to a significant reduction in green areas, especially in those located in the city centre, like the Housing estate near the Faculty of Technology. For the new construction projects, open spaces are primarily privately owned, often in poor condition, and their main use has become parking, as exemplified by the Housing estate on the site of the former printing house.

This paper aims to analyse the relevant strategic and planning framework concerning public open spaces (POS) in housing estates in the city of Leskovac, focusing on the post-socialist period. The investigation seeks to determine two main aspects: 1) the treatment of POS in inherited Large Housing Estates (LHEs) and 2) the treatment of POS in regulations pertaining to new types of housing developments, assessed at the residential area (neighbourhood) level. This will establish the cause-and-effect relationship between legal and urban planning principles and the existing urban form.

In the first part of the research, the current strategic and planning framework of the City of Leskovac will be analysed to understand how POS is addressed in residential neighbourhoods – both inherited and newly developed. Based on the obtained data, the second part will discuss the connection between strategic, planning, and regulatory principles and the current state of POS. The research will focus particularly on four representative multi-family housing estates in Leskovac: the Dubočica housing estate, the Radničko housing estate, the Housing estate near the Faculty of Technology, and the Housing estate on the site of the former Printing House (RePOS project, 2024).

2. STRATEGIC FRAMEWORK

Regarding the strategic framework for the case of the City of Leskovac, three adopted documents relevant to the POS treatment will be analysed:

- Development Plan of the City of Leskovac for the period 2023 – 2029
- Strategy for the development of the urban area of the city of Leskovac for the period 2024-2034
- The Local Waste Management Plan of the City of Leskovac 2021-2030

These documents, which have been adopted for an extended period represent a crucial strategic framework for the urban development of the City of Leskovac. They outline objectives, measures, and specific actions to be taken in order to improve sustainable development. While these plans apply to the entire administrative territory of the City of Leskovac, some sections focus on public open spaces or green areas in general not specifically only in the residential neighbourhoods.

2.1. Development Plan of the City of Leskovac for the period 2023 – 2029

By analysing the Development Plan of the City of Leskovac for the period 2023 – 2029 (Official Gazette of the City of Leskovac, no. 43/2022), it can be observed that this document doesn't consider the future development of housing in urban areas, nor the POS in residential neighbourhoods. Within development direction III, which deals with Environmental protection, a few priority goals are related to the POS and green areas in general on the city territory. These goals are towards achieving sustainable development and protecting the environment and they are referring to the improvement of green areas, which represent important segments of the POS. Other development directions focus on economic growth and improvement of social well-being. Priority Goals and measures within the Development Plan of the City of Leskovac for the

period 2023 – 2029 related to the treatment of POS, as well as the measures or their implementation are presented in Table 1.

Table 1: Priority Goals and measures within the Development Plan of the City of Leskovac for the period 2023 – 2029 related to the treatment of POS (Source: Official Gazette of the City of Leskovac, no. 43/2022)

Development direction - ENVIRONMENTAL PROTECTION			
Priority goal		***Measure***	
1.2.	*Reduce the impact of climate change and the level of biodiversity vulnerability*	*1.2.5.*	*Measures to improve biodiversity*
1.5.	*Ensuring zero environmental pollution, preserving and restoring ecosystems and biodiversity*	*1.5.4.*	*Establishing a unified information system for environmental management*
1.6.	*Preserving the potential of adaptation and mitigation measures, determined at the national level, by 2030 by increasing resilience to climate change in priority sectors and establishing a response*	*1.6.4.*	*Measures to create green and blue infrastructure*

One of the Measures of the Priority Goal 1.2. *Reduce the impact of climate change and the level of biodiversity vulnerability* - Measure 1.2.5. for biodiversity improvement, suggests increasing the area of landscaped public green spaces in the city of Leskovac. Currently, the greenery of the city of Leskovac is divided into two categories: public and protective green areas. Public green spaces include parks, squares, and public green areas in neighbourhoods like Dubočica. Greenery also exists as a compatible purpose within other primary uses, among others, within multi-family housing. According to the Plan, the total area of green spaces in the City of Leskovac relative to the population is 7.6 m²/inh, and when including green areas for other purposes, the level of greening is 26.7 m²/inh. The recommended value is 30-50 m² per inhabitant, and so measure 1.2.5. suggests increasing green areas.

Within the Priority Goal 1.5. *Ensuring zero environmental pollution, preserving and restoring ecosystems and biodiversity,* Measure 1.5.4. *Establishing a unified information system for environmental management recommends* the formation of a cadastre of green areas. This cadastre would form an information basis for planning and monitoring the implementation of the construction and arrangement of green areas and accompanying facilities. This measure also suggests mapping the existing green areas and their condition, monitoring and management of their maintenance to significantly reduce work on the field by using mobile systems and different tools for digital and spatial mapping.

Measure 1.6.4. *Measures to create green and blue infrastructure*, within the Priority Goal 1.6. *Preserving the potential of adaptation and mitigation measures, determined at the national level, by 2030 by increasing resilience to climate change in priority sectors and establishing a response,* also indirectly considers POS, especially green areas. This measure includes guidelines for defining green and blue infrastructure as well as nature-based infrastructure for the preparation of planning documents, with ecosystem management measures to increase resilience and reduce the vulnerability of people and the environment to climate change (EbA approach).

2.2. Strategy for the development of the urban area of the city of Leskovac for the period 2024-2034

Analysed Strategy for the development of the urban area of the city of Leskovac for the period 2024-2034 (Official Gazette of the City of Leskovac, no.17/2024), discusses POS and provides different measures for their improvement. As public spaces, within the Strategy public block areas are recognised and they are presented as areas that are formed inside residential and commercial blocks and are most common within the city centre. They are also present in the wider city zone within the multi-family housing estates such are Dubočica and Radničko housing estates. In the part of the analysis of the current state of public spaces, Strategy states that there is a usurpation of green areas in the Radničko housing estate for parking purposes. Within the SWOT analyses, one of the weaknesses, the insufficient level of greening of public green areas is recognised. Regarding the greenery, it states that on the entire city territory, the level of greenery is 1.25%, if counting only urban areas then it is 2%, and if greenery within other purposes is taken into account the value is 4.5%. The average planned level of greenery in urban territories in Serbia is 10-15%.

Within the Strategy, four goals are determined and for each goal special objectives are proposed. A set of measures is also determined to accomplish the special objectives. In order to monitor and evaluate the implementation process of the measures, indicators are defined. Goals 1 and 2 consider POS within their

specific objectives and measures (see Table 2). Within Goal 1, measures are focused on the sustainable development of urban areas of the city of Leskovac, and indicator or monitoring their implementation is regarding counting newly constructed or renovated open public spaces in urban areas. Goal 2 is oriented toward sustainable development, climate change adaptation and mitigation and protection of environmental resources. Measures within this Goal are mainly regarding green areas and their improvement, and improvement of POS by using some of the innovative solutions such are Nature-based Solutions and Ecosystem-based Adaptation.

Table 2: Special goals, measures and indicators within the Strategy for the development of the urban area of the city of Leskovac for the period 2024-2034related to the treatment of POS (Source: Official Gazette of the City of Leskovac, no.17/2024)

THEMATIC OBJECTIVES, SPECIFIC OBJECTIVES AND MEASURES				
Special objectives		***Measure***		***Indicator***
GOAL 1: Strengthening urban identity and urban renewal by encouraging sustainable and integral development				
1.1.	*Improved and uniform quality of arrangement and accessibility of the urban area*	*1.1.2.*	*Urban regeneration of parts of settlements exposed to devastation processes, including the consequences of climate change (heat islands, etc.)*	*Newly created or renovated open public spaces in urban areas*
		1.1.3.	*Promotion, development, preservation and connection of public spaces (areas and facilities) in accordance with the concept of accessibility and increasing accessibility to public service facilities and services*	
GOAL 2: Promoting the transition to clean and fair energy, green and blue investments, climate change adaptation and mitigation, risk prevention and management, and sustainable urban mobility				
2.4.	*Adapting to climate change and preventing disaster risks, strengthening resilience to climate change, taking into account an ecosystem-based approach*	*2.4.5.*	*Green infrastructure built or improved for climate change adaptation*	*Green infrastructure built or improved for climate change adaptation*
2.5.	*Ensuring equal access to sanitation and water supply and promoting sustainable water management*	*2.5.5.*	*New or improved systems for protection against stormwater flooding, including rainwater harvesting systems*	*Newly built or reinforced flood protection*
2.7.	*Strengthening the protection and preservation of nature, biodiversity and green infrastructure and reducing all forms of pollution*	*2.7.1.*	*Systemic protection of green (plants) and blue infrastructure (water)*	*Population that has access to new or improved green infrastructure*
		2.7.3.	*Reclaimed land for green spaces, housing, economic or other purposes*	
2.8.	*Encouraging sustainable multimodal urban mobility*	*2.8.2.*	*Providing infrastructure for pedestrians (pedestrian paths) and bicycle traffic*	*Annual number of users of cycling infrastructure*

In the second part of the Strategy, various strategic projects are proposed. Two of the projects are regarding the improvement of greenery in POS: 1) Green infrastructure - increasing the share of green areas and networking into a single system, creating a green cadastre; 2) Mapping green areas, heat islands - Green infrastructure. There are no projects related specifically to the POS in multi-family housing estates.

2.3. Local waste management plan for the territory of the city of Leskovac for the period 2021-2030.

Within the Local waste management plan for the territory of the city of Leskovac for the period 2021-2030 (Official Gazette of the City of Leskovac, no. 13/2022), POS within the multi-family housing estates are not considered directly. Public spaces and green areas in general for the entire city territory are analysed. In the first part of the Plan, different types of waste are determined, and among others, *Green municipal waste*. It represents waste that is generated periodically during the maintenance of yards and POS. In the plan, the lack of urban furniture and other means of collecting waste from public areas is recognised as a problem for waste management. The local waste management plan details measures for urban environment protection, including the implementation of composting processes and the management of biodegradable waste in public areas,

which can indirectly influence the upkeep of green areas and POS in general. This directly affects the attractiveness and quality of the POS and improves life quality.

One of the specific goals for the period until 2030 is the introduction of a composting process for the processing of the "wet" component of municipal waste - "green" waste from public areas. This includes building compost facilities to manage green waste from public spaces and developing a system to treat daily communal waste, including organic waste from urban areas. This infrastructure aims to support the maintenance and sustainability of green spaces within multi-family housing zones by reducing organic waste and improving waste management. One of the proposed actions is the development of a process for disposing of dry daily municipal waste fraction from POS.

3. PLANNING FRAMEWORK

Regarding the planning framework for the case of the City of Leskovac, planning documents on „two levels“ which are relevant to the POS treatment will be analysed:

- General urban plans
- General regulation plans

Since available Detailed regulation plans are considering mainly locations where single-family housing is dominant and they are not considering POS in housing estates – multi-family housing, they are not analysed within this research. Also, for the territory of the City of Leskovac, there are 19 adopted General regulation plans, and 7 of them are further analysed regarding their treatment of POS.

3.1. General urban plans

The previous *General Urban Plan for the City of Leskovac* was adopted in 2013 (Official Gazette of the City of Leskovac no. 4/13) and pertains to the period from 2010 to 2022. Although the plan does not directly recognise POS, it specifies that existing sports and recreational areas, as well as children’s playgrounds within residential estates, must be preserved, and repurposing these spaces is not permitted. For housing in the central zone, the plan mandates that at least 20% of the total area must be designated as open spaces. In zones designated for multi-family housing, it is obligatory to arrange open areas and provide parking spaces on the property. The plan aims to address the disorganisation within the inner sections of housing blocks, the shortage of parking spaces, and the inadequate green areas. Additionally, it stipulates that greenery within multi-family housing must cover at least 10% of the total area, with a maximum building occupancy of 70%.

The current *General Urban Plan for the City of Leskovac* was adopted in 2022 (Official Gazette of the City of Leskovac No. 35/2022). This plan recognises block or district parks—designated green spaces within residential areas—covering approximately 13 hectares within the planned territory. The plan stipulates that in multi-family housing developments, greenery must constitute at least 20% of the total area in the broader city zone and 10% in the central zone. For new developments and urban renewal projects, it is essential to allocate space for passive recreation, children's playgrounds, and lawns for playing and relaxing.

The plan acknowledges the public block areas that currently function as parks or POS for residents living in multi-family residential buildings. To address issues such as the disorganised internal layouts of existing housing blocks, a shortage of parking spaces, and inadequate green areas, the plan includes specific regulations for site arrangement and housing development. New developments must meet the following criteria:

- an adequate number of garages and parking spaces;
- access roads;
- pedestrian pathways;
- designated waste disposal areas;
- minimum open spaces necessary for organising the lives of inhabitants.

Additionally, normative for arrangement of open spaces are defined for each public purpose, particularly concerning educational needs.

3.2. General regulation plans

The City of Leskovac currently has 19 General Regulation Plans that encompass both the urban area and surrounding settlements within its administrative territory. Public Open Spaces (POS) in areas with multi-family

housing are included in several of these plans. The plans identify common block areas as "*free areas around multi-family residential buildings which represent common block areas where vehicular and pedestrian communications, open parking lots, as well as existing substations, sports fields, green areas and the like, are defined*". Several different types of POS are specified within these General Regulation Plans, particularly in Plans: 1 (Official Gazette of the city of Leskovac no. 33/19); 2 (Official Gazette of the city of Leskovac no. 31/15); 6 (Official Gazette of the city of Leskovac no. 31/15); and Plan 12 (Official Gazette of the city of Leskovac no. 26/15):

- public block areas – all open areas out of housing and communal buildings;
- public greenery – all green areas within public block areas (the General regulation plan defines that for landscaping public greenery, it is obligatory to first adopt the plan);
- green areas-spatial-landscape objects.

In the section outlining the planned purposes for future developments, various types of public greenery and other green spaces are specified. This includes green areas within multi-family housing and around public buildings such as kindergartens, administrative offices, and churches (as shown in Plans 1 (Official Gazette of the city of Leskovac no. 33/19), 2 (Official Gazette of the city of Leskovac no. 31/15), and 6 (Official Gazette of the city of Leskovac no. 31/15). Within these plans the zoning for these areas is defined as mandatory, with three suggested zones:

- First Zone: This area is located adjacent to the building and serves as a buffer zone between the building and traffic areas, including both vehicular and pedestrian traffic. It also establishes a compositional connection with the surrounding environment;
- Second Zone: This zone is designed for gathering and recreation, catering to individuals and groups of all ages. It includes plateaus and constitutes a significant surface of the open spaces;
- Third Zone: This area pertains to the newly planned multi-family housing. It is intended for active recreation and includes play areas while being situated at a safe distance from the residential building. Additionally, it should be separated from the housing units by green spaces.

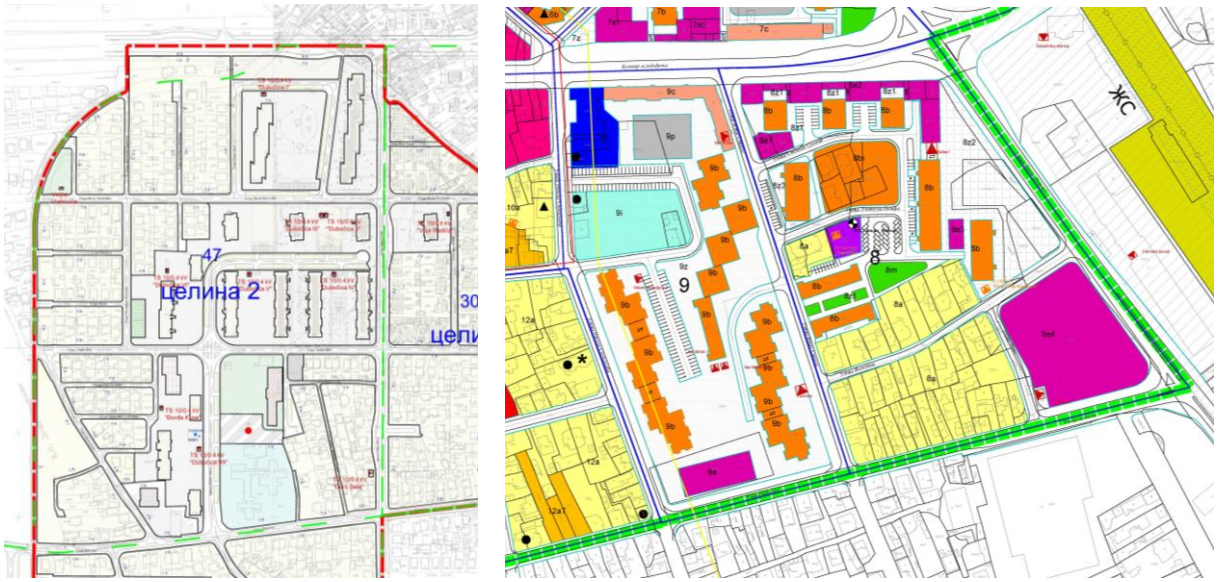
These plans specify that existing housing must include a minimum of 10% green areas of the total surface area, with these spaces primarily serving the residents. For new developments, it is recommended that green areas make up 10-15% of the total surface. This should include mandatory spaces for passive recreation, children's playgrounds, and various types of greenery.

To determine the appropriate area for open spaces within planned multi-family buildings, the General Regulation Plans recommend planning based on the number of inhabitants. The minimum standard that should be met is approximately 1 to 1.3 m^2 per inhabitant of the block, while the optimal standard is between 2 and 3 m^2 per inhabitant. Within this space:

- The space designated for passive recreation should cover an area of approximately 0.5 to 1 m^2 per inhabitant of the block. This area must include a surrounding green space and should be located 10 to 15 meters away from children's playgrounds, sports facilities, and economic zones, ensuring it is isolated by dense greenery;
- Children's play areas should account for about 0.8 m^2 per inhabitant of the block and should be situated within the green area, approximately 10 meters away from the buildings;
- For small sports fields and areas dedicated to active recreation, the recommended space is about 0.7 m^2 per inhabitant of the block.

The General Regulation Plans encompass four analysed housing estates (RePOS, 2024): *Dubočica* (General Regulation Plan 6, Official Gazette of the city of Leskovac no. 31/15), the *Housing estate near the Faculty of Technology*, and the *Housing estate on the site of a former printing house* (General Regulation Plan 1, Official Gazette of the city of Leskovac no. 33/19). The *Radničko housing estate* is addressed in General Regulation Plans 4 (Official Gazette of the city of Leskovac no. 11/14) and 10 (Official Gazette of the city of Leskovac no. 09/12). General Regulation Plan 3 (Official Gazette of the city of Leskovac no. 07/14) focuses on the central zone "North," predominantly featuring single-family housing, but it also includes areas designated for educational purposes. This plan states that the POS for educational institutions should be allocated based on a norm of 15 m^2 per child. In cases where existing structures do not allow for expansion, the POS must be retained entirely - no construction or reduction of POS is permitted. This is very significant since many cities are facing infill construction in existing patterns.

In the case of the Dubočica housing estate (Figure 1a) and the Housing estate near the Faculty of Technology (Figure 1b), POS are marked as public block areas without any differentiation of surfaces – there is no division of greenery, pedestrian areas, vehicle areas nor parking. In General Regulation Plan 4, a deprived area was considered, but however, it only stipulates that urban projects are mandatory for the arrangement of POS. General Regulation Plan 10 only specifies that for both existing and newly planned multi-family buildings, green areas must constitute 10% of the total surface area. Unfortunately, the POS in these housing estates is in poor condition, and the plan does not propose any solutions for urban regeneration or development. In the case of the Radničko housing estate (Figure 2a) and the Housing estate on the site of a former printing house (Figure 2b), there is no differentiation between the built area and POS they are all marked as multi-family housing. This represents a huge obstacle to the future POS development and redevelopment because the plan does not consider it as two different purposes and there are no specific rules for their future arrangement.



(a) Dubočica Housing estate- General Regulation Plan 6 (b)Housing estate near the Faculty of Technology- General Regulation plan 1

Figure 1: POS in Dubočica housing estate and Housing estate near the Faculty of Technology

(Source: a) Official Gazette of the city of Leskovac no. 31/15; b) Official Gazette of the city of Leskovac no. 33/19)



(a) Part of the Radničko Housing estate - General Regulation Plan 10 (b)Housing estate on the site of a former printing house - General Regulation Plan 1

Figure 2: POS in Radničko housing estate and Housing estate on the site of a former printing house

(Source: a) Official Gazette of the city of Leskovac no. 09/12; b) Official Gazette of the city of Leskovac no. 33/19)

4. DISCUSSION

By analysing the current strategic and planning framework of the City of Leskovac regarding the redevelopment of POS in residential neighbourhoods, we can determine that there is no strict basis for the development and improvement of POS quality. These areas are in poor condition, which is the consequence of poor or inadequate management and maintenance. Open spaces in the residential neighbourhoods from the socialist and post-socialist periods are in public ownership (Dubočica, Radničko housing estate and Housing estate near the Faculty of Technology), while in new developments it is in private ownership (Housing estate on the site of a former printing house). Their ownership status is also one of the obstacles to their redevelopment

because in the case of the public ownership for the management and maintenance public utility companies are in charge and often caused by administrative procedures this process is inadequate (Figure 3a). In the case of private ownership, investors are not shaping POS according to the projects which have led to their poor condition and use for parking (Figure 3b).



(a) Radničko Housing estate (b)Housing estate on the site of a former printing house

Figure 3: The current state of POS in multi-family housing estates in Leskovac
(Source: a and b) Photos taken by Authors)

Within the analysed strategic documents, there are general suggestions to improve POS on the city territory and these areas are recognised as important factors for future sustainable development. It is especially considered within the goals and measures dealing with biodiversity, climate adaptation and “green” development. As the most important aspect, green areas are highlighted and most of the measures are regarding their improvement (Development plan). Within the section regarding the quality of urban areas in the Strategy, there are measures regarding regeneration and connection between POS and the indicator for monitoring refers to the newly created or renovated open public spaces in urban areas. However, these objectives and measures are too general and they do not refer only to the POS in residential neighbourhoods, but to all POS on the city territory. Also, POS are not included as a priority area of intervention within the strategic documents. This is especially pronounced within strategic projects that are proposed because they are related only to green areas and their improvement in light of climate change adaptation. This is also a problem that POS in residential areas are facing and it could help their improvement, but it is not the only problem.

In the case of planning documents, the previous General urban plan defined the percentage of mandatory surface for open spaces and does not allow the repurposing of existing green areas and children's playgrounds. It considers POS very general without concise guidelines for future development and redevelopment. The current General urban plan determines public block areas that currently function as parks or open spaces (POS), and also recognises disorganised internal layouts of existing housing blocks as a problem for urban development. Despite recognizing this problem, the plan does not provide solutions for overcoming it. The plan gives only guidelines for future developments of housing areas.

General regulation plans that are adopted for the entire urban territory of the City of Leskovac, recognise common block areas as "free areas around multi-family residential buildings”. Within these plans, three different types of POS are established. These types are very generally defined and they do not separate common block areas in inherited housing estates and new developments. Even in the graphic maps of the plan, pedestrian paths, vehicle access, parking, children's playgrounds, green areas, and areas adjacent to the buildings are all marked with the same hatch. This is one of the major setbacks for future redevelopment of existing POS since the guidelines are given in general for the entire common block area. The positive fact is that there are no other purposes predicted within them, which can reduce the risk of new developments between existing buildings. In the case of some estates (Radničko and Housing estate on the site of a former printing house), entire blocks are marked as multi-family housing, where guidelines for arrangement regarding POS only determine the minimal surface of green areas. This provides the possibility for “infill construction” on the existing open spaces since they are marked as multi-family housing, which is happening in other cities. Detailed guidelines or rules regarding POS arrangement and construction, and its obligatory elements are not incorporated in general regulation plans. In the case of a few plans, zoning of green areas was introduced based on the number of inhabitants and it is referred to the new developments. But analysing new

development – Housing estate on the site of a former printing house, we can see that this was not implemented and that large open spaces are used only for unplanned parking.

Although the strategic and planning frameworks consider public open space (POS), they remain too general and focus more on managing green areas to improve the environment and enhance the adaptation process. The issues related to POS in LHEs are merely acknowledged within the analysis, yet no specific guidelines, solutions, or strategic projects are proposed later on. Even when identifying purposes related to POS in plans, without clear distinctions between surfaces or at least different rules for their arrangement, their redevelopment and future development cannot be effective. Furthermore, unclear and complex administration regarding their management and maintenance has led to neglect and degradation, as evidenced in the field. Another issue is the lack of monitoring for the implementation of the planned guidelines, resulting in the newly developed POS being in very poor condition and not utilised as intended. POS represent a crucial element for sustainable urban development and play a key role in improving the quality of life in residential neighbourhoods. This is why their redevelopment in existing multi-family residential neighbourhoods and development in new housing estates is vital and must be considered within strategic and planning documents at both national and local levels.

5. CONCLUSION

Leskovac, one of the larger cities in Serbia and the administrative centre of the Jablanica district, experienced significant development during the Communist era, resulting in the construction of several housing estates. These estates are notable for their extensive public open spaces (POS), although the current condition of these areas is unsatisfactory. Strategic and planning framework for the City of Leskovac in certain measure considers POS, but it doesn't provide solutions for their redevelopment. The Development Plan of the City of Leskovac for the period 2023 – 2029, highlights the categorization of green spaces into public and protective areas, acknowledging their significance for enhancing the quality of life in urban settings. However, despite the implementation of measures to improve biodiversity and expand green spaces, the total area of greenery available per capita remains below the recommended standards. This indicates a need for additional efforts in this area. One of the suggested measures is the use of digital solutions – especially the establishment of a green cadastre. The Strategy for the development of the urban area of the city of Leskovac for the period 2024-2034, recognises the importance of green infrastructure, particularly in residential blocks, where there are plans to integrate these elements into a cohesive system. However, the strategy often addresses POS improvements indirectly.

Planning documents also do not specifically address POS but do provide general guidelines for areas within multi-family housing zones. It includes considerations for POS in the central zone and areas with large housing estates. Various types of POS are identified, and the plan sets forth rules for their layout, including minimum surface area requirements for different zones. Additionally, some of the plans delineate the zoning of POS in both existing and new multi-family housing developments. The requirement to define urban projects for the arrangement of open spaces serves as a mechanism to control construction, regeneration and the organization of POS effectively, both in new and inherited residential neighbourhoods.

In conclusion, within the strategic and planning framework of the City of Leskovac, the significance of POS in urban development is acknowledged, but in too general way. However, there is a need for a more coordinated and comprehensive approach to meet contemporary urban planning standards and improve these spaces. While the existing strategic and legal frameworks are a positive step toward sustainable development, further efforts are required to redevelop POS in inherited residential neighbourhoods, as well as in new developments since they are crucial elements in enhancing the quality of life for residents.

ACKNOWLEDGEMENTS

This research was supported by the Science Fund of the Republic of Serbia, #GRANT No 7572, Reclaiming Public Open in Residential Areas: Shifting Planning Paradigms and Design Perspectives for a Resilient Urban Future – RePOS and by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, under the Agreement on Financing the Scientific Research Work of Teaching Staff at the Faculty of Civil Engineering and Architecture, University of Niš - Registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

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QUANTITATIVE STUDY OF SPATIAL RELATIONSHIPS IN EXISTING SCHOOL GROUNDS IN THE CITY OF NIŠ

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ABSTRACT

This study examines the spatial relationships within existing school grounds in the city of Niš through a quantitative approach. The research aims to analyze various aspects of space utilization, including the proportion of built areas, green areas, open spaces, and sports facilities within school grounds. The methodology encompasses spatial data analysis for 20 elementary schools in Niš, employing quantitative methods such as correlation and descriptive statistics. The results reveal significant differences in spatial distribution across schools, with particular emphasis on the relationship between the number of sports facilities and the extent of green areas. The findings provide insights into the current organization of school grounds and may serve as a foundation for proposals to enhance their functionality and aesthetic value in urban areas.

Keywords: *school grounds, school building, space, green area*

1. INTRODUCTION

School grounds in urban areas play a key role in the educational and social life of communities. Beyond their educational functions, school grounds often serve as spaces for recreation, social interaction, and the development of physical skills, giving them multifaceted importance in pupils' daily lives. These environments contribute to fostering social connections, promoting mental health, and enhancing overall community cohesion. In this context, the spatial design of school grounds becomes crucial in shaping healthy and functional living environments. However, many school complexes in urban areas, such as those in Serbia, have not been adequately analyzed in terms of their spatial potential and the distribution of various functional zones.

The spatial characteristics of school grounds can vary significantly depending on numerous factors, including the size of the school, the age of the facilities, the architectural and urban features of the city, and the social and educational priorities of local authorities. For instance, the number and types of sports facilities, built-up areas, and the amount of green areas can differ greatly, directly impacting pupils' physical activity and the quality of their education. Schools with well-designed grounds not only support educational goals but also provide essential opportunities for pupils to engage with nature, reduce stress, and develop creative thinking skills through outdoor learning environments.

Through a quantitative analysis of spatial relationships, this research in Niš aims to contribute to a better understanding of how these variables function in real-world conditions within urban schools. It emphasizes the need for an integrated

approach that considers ecological, pedagogical, and recreational aspects of design. Such an approach can help create spaces that are more inclusive, sustainable, and adaptable to the evolving needs of urban communities.

The study focuses on the quantitative analysis of spatial relationships within the school grounds of elementary schools in Niš. The research is based on an analysis of 20 school grounds in Niš, employing quantitative methods such as descriptive statistics and correlations between relevant variables. These methods enable the identification of patterns that highlight disparities in resource allocation and usage, paving the way for targeted interventions to improve spatial equity among schools. Through this analysis, the study contributes to an understanding of the spatial patterns shaping school grounds and provides a basis for improving their design in the future.

The objective of this research is to analyze the distribution of different types of spaces (buildings, sports facilities, greenery, plazas/paths) within the school grounds of elementary schools in Niš and to explore their interrelations. By employing quantitative methods such as descriptive statistics and correlation analysis, the study aims to identify the key spatial characteristics that influence the functionality and efficiency of these complexes. Special emphasis is placed on examining the relationship between the number of sports facilities, the extent of green areas, and the total area of the school grounds, with the goal of identifying patterns that can serve as guidelines for improving the design of school grounds in urban areas. Furthermore, the research seeks to identify the key factors shaping the functionality of these spaces, as well as correlations between the size of the school complex and its usability for pupils.

This study not only provides a quantitative analysis of existing school grounds but also contributes to the understanding of the importance of optimizing spatial resources in the context of urban education. By highlighting the critical role of school grounds as multifunctional spaces, the research underscores their potential to serve as hubs of activity that benefit not only pupils but the broader community. Based on the findings, recommendations can be made for future planning and revitalization of school complexes to enhance the quality of the educational environment and the overall well-being of pupils. Additionally, the results may serve as guidelines for urban planners, educational institutions, and decision-makers when planning and revitalizing school complexes in Serbia and similar urban settings.

2. LITERATURE REVIEW

School spaces, including school grounds and their surroundings, have long been recognized as critical elements of the educational experience. While numerous studies have explored various aspects of school spaces, the majority focus on psychological, social, or pedagogical dimensions, leaving quantitative research on the spatial and functional relationships of school grounds relatively underexplored. This literature review examines key studies addressing the organization of school grounds, their impact on educational activities, and methods for conducting quantitative analyses of spatial relationships.

Understanding the connection between space and education is often based on theories emphasizing the importance of the physical environment for pupils' cognitive, social, and physical development. High-quality school spaces are known to enhance pupils' concentration and engagement, while poorly organized spaces can negatively affect performance. According to some studies, the quality of school grounds and green areas has a direct impact on pupils' mental health and physical activity (Bell et al., 2008; Fjørtoft, 2004; Jansson et al., 2012; Kopeva et al., 2017). Green spaces and open areas for play allow pupils to relax and socialize, positively influencing their learning abilities (Dyment et al., 2009; Thaiutsa et al., 2008; Zhou and Wang, 2011; Wolch et al., 2014).

The functional design of school grounds encompasses various aspects, such as the size and layout of green areas, the number and types of sports facilities, and the degree of accessibility and safety (Jansson et al., 2018; Haar, 2002; Anđelković et al., 1997; Auf-Franić, 2004). Research suggests that an increased number of sports facilities and well-organized spaces for play and recreation contribute to higher levels of physical activity and improved social interaction among pupils. For example, Dudek (2008) highlights that schools with well-organized outdoor spaces equipped with adequate sports facilities demonstrate better academic performance, as pupils return to classrooms more relaxed and ready to learn.

Although numerous qualitative studies analyze school spaces, quantitative studies on the spatial and functional relationships of school grounds are rarer. One of the few quantitative studies on school grounds was conducted by a group of researchers in Australia. This research was carried out in three phases, combining qualitative and quantitative data collection. The findings provide insights into more effective teaching practices and illustrate how outdoor learning could be integrated into English language instruction and other subjects (Neville, 2023). Such studies demonstrate that quantitative methods can significantly enhance the understanding of the efficiency of school space organization and its impact on pupils' physical activity and academic performance (Malone et al., 2003).

Through a comparative analysis of selected case studies in Croatia, researchers presented three examples of the interaction between elementary school outdoor spaces and urban public spaces. This interaction is seen as a viable future trend in school design and urban planning, aiming to reconnect education with its origins in nature and public urban areas, especially considering the reduction of accessible community areas (Krajnović et al., 2023).

Urbanization and city expansion create specific challenges in the design of school grounds. In cities like Niš, where space is often limited, schools face difficulties in optimizing spatial distribution. Research shows that urban schools often have smaller school grounds and limited access to green areas, which may restrict opportunities for physical activities and social interactions among pupils (Tanic et al., 2018). Nevertheless, even in such conditions, studies indicate that proper space organization can positively influence the increased use of outdoor spaces and encourage physical activity.

The issue of child safety in school grounds has also gained attention. In recent years, there has been growing demand for strategies that reconcile the seemingly conflicting goals of opening schools to the community while ensuring crime prevention. To address this, the active application of Crime Prevention Through Environmental Design (CPTED) theory has gained traction. Natural surveillance plays a crucial role in CPTED, with proposals to enhance crime prevention efforts through layout and floor plan studies, alongside traditional elementary school planning models focused primarily on function and design. A recent study evaluated natural surveillance in 46 elementary schools from two perspectives — the view of the school grounds from outside and the view of the exterior from within buildings — to identify factors contributing to school safety (Fujii et al., 2023).

The literature review demonstrates that researching schoolyard spaces is highly relevant for improving educational systems and pupils' physical health. Quantitative studies, such as this one, contribute to understanding the relationships between different types of spaces within schools and their interconnections. The analysis of school grounds in urban areas like Niš can provide significant insights into current challenges in school ground design and help identify optimal solutions for future planning and revitalization of these spaces.

3. MATERIALS AND METHODS

The objective of this research is to investigate the spatial relationships within the school grounds of existing school grounds in Niš through quantitative analysis. Special attention is given to analyzing factors such as the areas occupied by buildings, open spaces (plazas and pathways), green areas, the number and types of sports facilities, and the total area of the school grounds. Quantitative methods will be employed to examine the relationships between these variables and the functionality of open spaces in elementary schools, with the aim of providing guidelines for improving the design of school grounds.

3.1 Type of Research

The research is quantitative in nature, as it utilizes numerical data to analyze the spatial relationships and functionality of school grounds. Data on areas, the number of sports facilities, and other relevant characteristics will be processed using statistical methods that allow for the identification of correlations among variables and their interconnections.

3.2 Sample Selection

The research sample includes all elementary schools in the urban area of Niš that have clearly defined school grounds. Based on available data, 20 school grounds were selected. Data were collected from relevant institutions (local government, educational institutions) that provided information on areas, the number of sports facilities, the extent of green areas, and other key characteristics of the school grounds.

Table 1: Elementary schools in the city area of Niš - general data

	№	Elementary school	Street	Year of construction	Year of upgrade	Development (class coverage)	Number of shifts
EXISTING FUND OF ELEMENTARY SCHOOLS IN	01	**"Vožd Karađorđe"**	**Voždova 29**	**1889**	**1937**	**I - VIII**	**2**
	02	**"Radoje Domanović"**	**Generala Milojka Lešjanina 49 a**	**1932**	**1960** **1978**	**I - VIII**	**2**
	03	**"Kralj Petar I"**	**Vojvode Putnika 1**	**1933**	**----**	**I - VIII**	**2**
	04	**"Učitelj Tasa"**	**Rajićeva 24**	**1935**	**----**	**I - VIII**	**2**

	05	**"Njegoš"**	**Ratka Pavlovića 60**	**1955**	**1973**	**I - VIII**	**2**
	06	**"Ratko Vukićević"**	**Ratka Vukićevića 5**	**1958**	**1968**	**I - VIII**	**2**
	07	**"Čegar"**	**Školska bb**	**1959**	**1971**	**I - VIII**	**2**
	08	**"Vuk Karadžić"**	**Beogradska 2**	**1960**	**----**	**I - VIII**	**2**
	09	**"Car Konstantin"**	**Velikotrnavska 4**	**1962**	**1976**	**I - VIII**	**2**
	10	**"Dositej Obradović"**	**Kraljevića Marka 13 a**	**1962**	**etapno**	**I - VIII**	**1**
	11	**"Branko Miljković"**	**Ljubomira Nikolića 3**	**1965**	**1972**	**I - VIII**	**2**
	12	**"Ćele Kula"**	**Radnih brigada 28**	**1966**	**1975, 1976**	**I - VIII**	**1**
	13	**"Bubanjski heroji"**	**Bubanjski heroji 1**	**1972**	**----**	**I - VIII**	**2**
	14	**"Stefan Nemanja"**	**Kosovke devojke bb**	**1973**	**----**	**I – VIII**	**2**
	15	**"Ivo Andrić"**	**Branka Bjegovića bb**	**1974**	**----**	**I – VIII**	**2**
	16	**"Kole Rašić"**	**Vase Čarapića 8**	**1977**	**etapno**	**I – VIII**	**2**
	17	**"Sveti Sava"**	**Garsije Lorke bb**	**1980**	**etapno**	**I – VIII**	**2**
	18	**"Sreten Mladenović"**	**Šabačka 20**	**1982**	**1989, 1998**	**I – VIII**	**1**
	19	**"Dušan Radović"**	**Đerdapska 45**	**1987**	**2004**	**I – VIII**	**2**
	20	**"Miroslav Antić"**	**Knjaževačka 156**	**1983**	**2006**	**I - VIII**	**2**

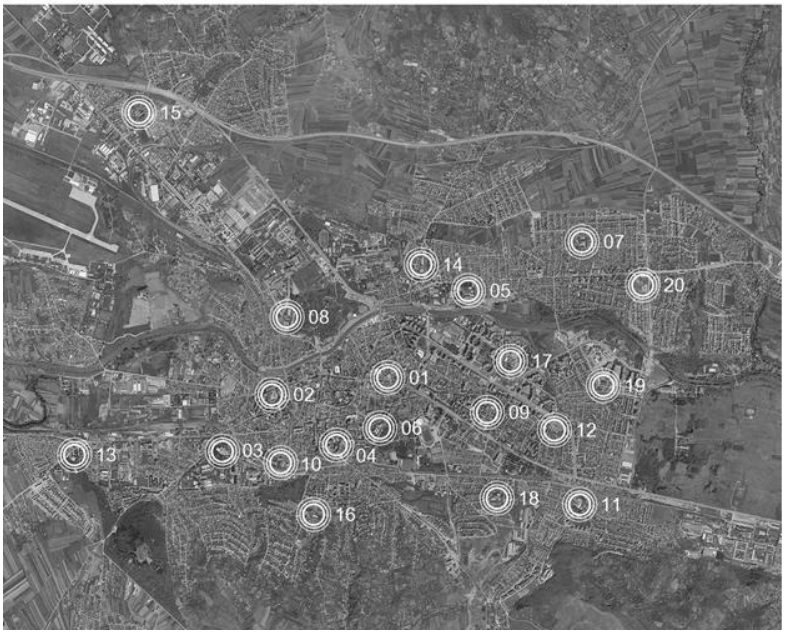


Figure 1: Elementary schools in the city area of Niš

3.3 Data Collection

Data were collected from secondary sources, including school ground plans and official data on schools and their facilities. Additionally, field surveys were conducted to verify data on areas, the number of sports facilities, and green areas. The field surveys included direct measurements and mapping of school grounds using precision instruments, as well as a visual assessment of the condition of existing structures and infrastructure. This comprehensive approach ensured the accuracy and reliability of the collected data, providing a strong foundation for the subsequent analysis and allowing for a detailed understanding of spatial relationships.

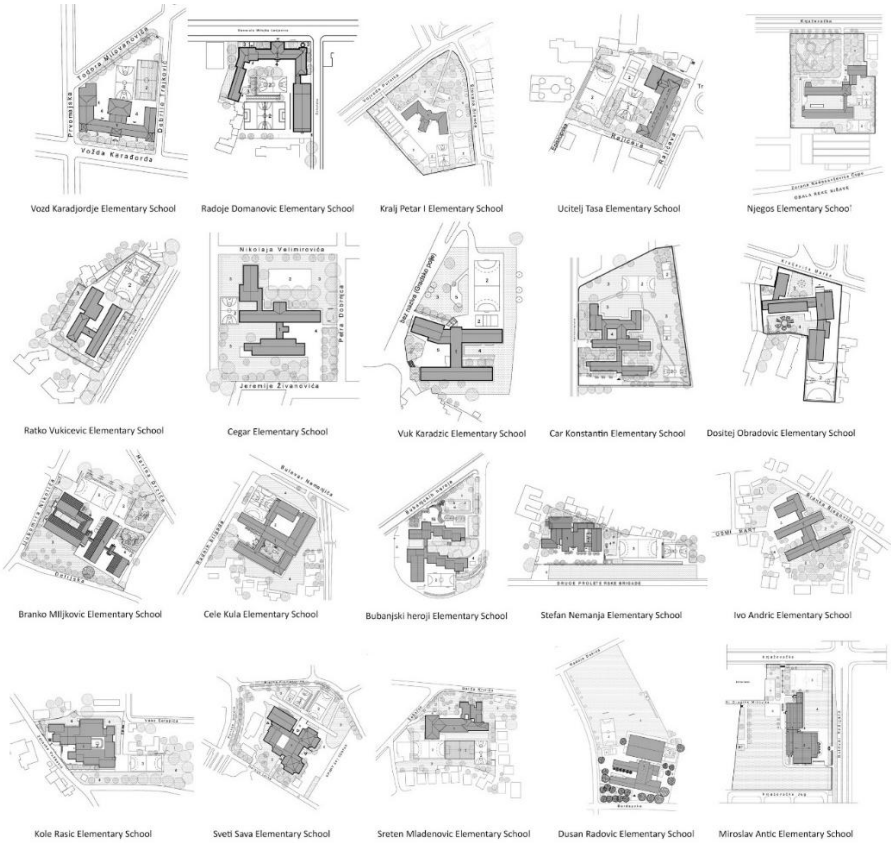


Figure 2: School grounds in the city area of Niš

For the purposes of the analysis, the following variables were defined:

- Built-up area (m²): The total area occupied by the school building within the school grounds.
- Open spaces (m²): Areas including plazas, pathways, and other non-built spaces. The schoolyard cannot be used as a reference variable because it cannot be fully identified as an organized spatial unit within the school grounds (except in the elementary schools "Branko Miljković" and "Bubanjski heroji") (Table 2).
- Greenery area (m²): The total area covered with grass, trees, and other plant materials. Although not clearly defined as a unit in the majority of the analyzed school grounds, school gardens are included in the "greenery area" variable.
- Number of sports facilities: The number of sports structures such as football fields, basketball courts, volleyball courts, etc.
- Total area of the school grounds (m²): The total area occupied by the school grounds, including buildings, open spaces, sports facilities, and green areas.

Table 2: Content of open areas in school grounds

	ELEMENTARY SCHOOL	Summer classrooms	Schoolyard	Sports fields	School garden	Green areas	Economic yard
EXISTING FUND OF ELEMENTARY SCHOOLS IN THE CITY AREA OF NIŠ	"Vožd Karađorđe"	□	◘	◘	□	◘	□
	"Radoje Domanović"	□	◘	◘	□	◘	◘
	"Kralj Petar I"	□	◘	◘	□	■	◘
	"Učitelj Tasa"	□	◘	◘	□	◘	□
	"Njegoš"	□	◘	◘	□	■	◘
	"Ratko Vukićević"	□	◘	◘	□	◘	◘
	"Čegar"	□	◘	◘	□	■	□
	"Vuk Karadžić"	□	◘	◘	□	■	□
	"Car Konstantin"	□	◘	◘	□	■	◘
	"Dositej Obradović"	□	◘	◘	□	◘	□
	"Branko Miljković"	□	■	◘	□	■	◘
	"Ćele Kula"	□	◘	◘	□	◘	◘
	"Bubanjski heroji"	□	■	◘	□	■	◘
	"Stefan Nemanja"	□	◘	◘	□	■	□

"Ivo Andrić"	□	◘	□	□	■	◘
"Kole Rašić"	□	◘	◘	□	◘	◘
"Sveti Sava"	□	◘	◘	□	■	◘
"Sreten Mladenović "	□	◘	◘	□	■	◘
"Dušan Radović"	□	◘	◘	□	■	◘
"Miroslav Antić"	□	◘	◘	□	■	◘

■ REPRESENTED ◘ PARTIALLY REPRESENTED □ NOT REPRESENTED

3.4 Statistical Methods

The following statistical methods were used for data analysis:

- Descriptive statistics were employed to present the basic characteristics of the data, such as mean values, standard deviation, and data distribution for each variable.
- Correlation analysis was applied to examine relationships between different variables, such as the correlation between the area of green areas and the number of sports facilities, or the relationship between the total area of the school grounds and the built-up area.
- Regression analysis was utilized to determine how individual variables affect the overall functionality of school spaces, considering various factors influencing the design of school grounds.

Table 3: Characteristic Parameters of Elementary Schools in the Urban Area of Niš

	ELEMENTARY SCHOOL	**Built-up area (m^2)**	**Open spaces (m^2)**	**Greenery area (m^2)**	**Number of sports facilities (kom – m^2)**	**Existing Area of the School Grounds (m^2)**	**Required Area of the School Grounds (25 m^2/pupil)**
EXISTING FUND OF ELEMENTARY SCHOOLS IN THE CITY AREA OF NIŠ	"Vožd Karađorđe"	1700	1543	580	2 – (1470m2)	5293	9725
	"Radoje Domanović"	2167	1622	1020	3 – (1980m2)	6789	12450
	"Kralj Petar I"	1763	2858	6980	4 – (2310m2)	13911	11825
	"Učitelj Tasa"	1142	671	2100	4 – (2630m2)	6543	11950
	"Njegoš"	2222	2861	9475	3 – (1720m2)	16278	7875
	"Ratko Vukićević"	1445	2273	1423	2 – (1340m2)	6481	11325
	"Čegar"	3194	1993	5279	3 – (1230m2)	11696	10525
	"Vuk Karadžić"	1668	2604	5069	2 – (1500m2)	10841	5925
	"Car Konstantin"	3452	2815	10574	4 – (1980m2)	18821	10325
	"Dositej Obradović"	1629	1238	870	1 – (690m2)	4427	8175
	"Branko Miljković"	3082	3161	4177	2 – (1760m2)	12180	15700
	"Ćele Kula"	2922	1794	3031	1 – (860m2)	8607	9050
	"Bubanjski heroji"	1464	2513	4432	1 – (610m2)	9019	11700
	"Stefan Nemanja"	1873	2523	813	2 – (1430m2)	6639	13950
	"Ivo Andrić"	2104	4876	3198	0	7157	12900
	"Kole Rašić"	2003	2015	2487	1 – (734m2)	7239	10100
	"Sveti Sava"	4732	6835	5263	3 – (2420m2)	19250	12950
	"Sreten Mladenović "	1739	1834	3657	3 – (1995m2)	9225	5150
	"Dušan Radović"	4442	5556	5183	6 – (8460m2)	23641	16425
	"Miroslav Antić"	6131	6307	15673	5 – (4480m2)	32591	15375

Correlation coefficients (r) range from -1 to 1:

- Positive values indicate that as one variable increases, the other also increases (e.g., larger building areas are associated with larger total school grounds areas, r = 0.89).
- Negative values indicate an inversely proportional relationship.
- A value close to 0 represents weak or no correlation.

p-values indicate the significance of the correlation:

- $p < 0.001$: Indicates very high reliability of the results; the probability of error is less than 0.1%.
- $p < 0.01$: Still high reliability, but slightly lower than the previous threshold.
- $p < 0.05$: The threshold of statistical significance; indicates a potential relationship but with a higher chance of error.

Example: The correlation between green area and the total area of the school grounds is very strong ($r = 0.88$) and statistically significant ($p < 0.001$).

Through quantitative analysis, the study aims to identify key factors affecting the functionality of school grounds in Niš. Additionally, the relationships between the size of the schoolyards, the number of sports facilities, the presence of green areas, and the overall quality of space were examined. The results will provide a foundation for further research as well as recommendations for improving the design and functionality of school grounds in urban areas.

3.5 Regulatory Framework

The Regulation on Amendments to the Regulation on Detailed Conditions for the Establishment, Commencement of Work, and Operation of Elementary Schools ("Official Gazette of the RS - Education Gazette," No. 16/2020) defines the required size and structure of the school grounds.

The required land area for an elementary school is determined based on the capacity of the building, i.e., the number of pupils in the school. The total required area for an elementary school is 25 m² per pupil. In densely built-up areas and inherited structures, the land area can be smaller if green and other recreational areas are available nearby for pupil use, but it should generally not be less than 18 m² per pupil. The land area must not be smaller than 0.30 hectares for remote classes of the first cycle of elementary school.

In inherited urban structures where school facilities with all the necessary amenities for single-shift operation already exist and where parcel expansion is not feasible, the existing land area is considered acceptable.

School land includes:

- Land occupied by the building;
- Schoolyard;
- Sports facilities;
- Green areas and school gardens;
- Pedestrian and vehicular access, service yards, and parking lots.

Land occupied by the building is determined by the gross developed construction area of the ground floor, depending on the number of floors and the total gross developed area of the building.

The schoolyard is intended for pupils' rest and recreation. Its size ranges from 3–5 m² per pupil, depending on the size of the school land and the use of all open areas within the schoolyard. For optimally sized school facilities (24, 32, and 40 classes), schoolyards must be divided (if possible, with separate entrances): one schoolyard for first-cycle pupils and another for second-cycle pupils. This also applies to smaller school facilities (8 and 16 classes), where feasible.

Schoolyards are located adjacent to the school building, directly connected to the entrances, separated by sidewalks and protective greenery to avoid disrupting classes. The schoolyard includes trees for shade and benches for seating.

The sports facilities are primarily used for physical and health education classes, pupil recreation, and, as needed, by other users in the school's vicinity outside school hours.

For optimally sized school facilities, the sports facilities include separate courts for handball (40 m x 20 m), basketball (28 m x 15 m), and volleyball (18 m x 9 m), running tracks (2–4 lanes) 60 m in length and 1.25 m wide, areas for shot put, long jump, high jump, and a grass field (30 m x 15 m), all designed in accordance with standards for sports facilities.

Green areas and school gardens must account for at least 25% of the total school land. They consist of grassed areas and protective greenery (shrubs and trees) to shield from noise, wind, and sunlight. This area includes pedestrian paths connecting various facilities (school gardens, outdoor classrooms, playgrounds, etc.).

4. RESULTS

An overview of the existing state of school grounds in Niš reveals a very limited range of amenities in outdoor spaces. In addition to the school building, the school grounds in Niš consist of access pathways, partially recognizable elements of the schoolyard, open areas for physical education, unpaved areas, or greenery zones that are insufficiently designed in terms of ambiance. The existing range of outdoor amenities can partially meet the needs of school-aged

children for play, sports, refreshment, and relaxation. However, due to the relatively low functional and purposeful diversity of the outdoor amenities, there are evident shortcomings in the form of organized spatial units intended for various pedagogical and social activities (Tanic et al., 2020).

All elementary schools show noticeable deficiencies, including the absence of summer classrooms, school gardens, clearly defined and well-designed schoolyard areas (for younger and older pupil groups), and a lack of ambient spaces designed for gatherings and diverse pupil activities, such as amphitheater-like plazas and other facilities in natural surroundings.

The results of descriptive and correlation analyses provide a comprehensive insight into the structures and spatial characteristics of the school grounds. Detailed interpretations of each segment are presented below, along with explanations of statistical indicators, including r-values and p-values.

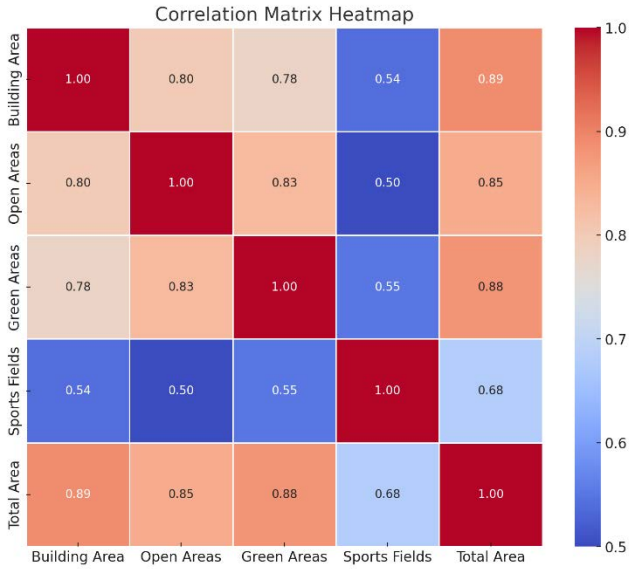


Figure 4: Correlation Matrix – r-values

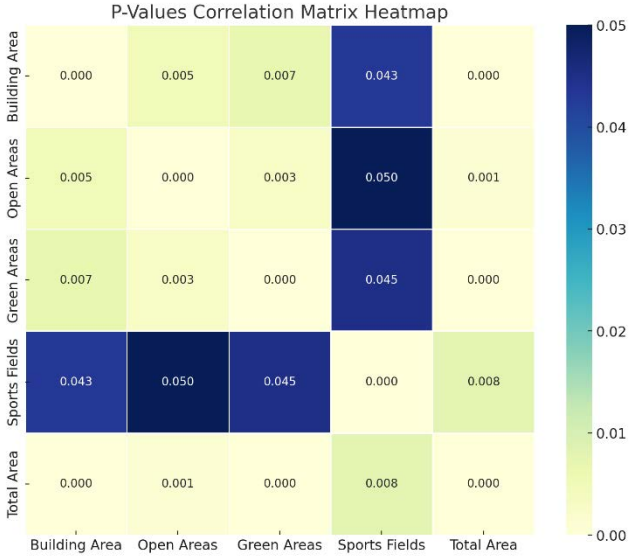


Figure 5: Correlation Matrix – p-values

4.1 Built-up Area

The majority of schools have an average built-up area of 2,543.7 m², with extremes ranging from 1,142 m² (smallest school) to 6,131 m² (largest school). This variability reflects significant differences in school capacities, likely linked to the number of pupils and the specific purposes of the facilities.

The high standard deviation (1,298.4 m²) indicates considerable heterogeneity in school infrastructure.

Correlation with the total area of the school grounds: A strong positive correlation ($r = 0.89$, $p < 0.001$) implies an almost linear relationship. The r-value close to 1 suggests that larger buildings are typically part of larger school grounds, while the p-value confirms that this relationship is not random.

Regression analysis reveals that the built-up area is a significant predictor of the total area of the school grounds ($\beta = 0.89$, $p < 0.001$).

4.2 Open Spaces – Plazas/Pathways

The average area of open spaces, including plazas and pathways, is 2,894.6 m², with variations ranging from 671 m² to 6,835 m².

Correlation with the built-up area: A moderately strong correlation ($r = 0.80$, $p < 0.01$) indicates a significant relationship between the size of the buildings and the size of open spaces. Although the r-value is not exceptionally high, it clearly highlights the connection between these aspects, supported by the statistically significant p-value.

Open spaces such as access pathways, parking plazas, and recreational plazas substantially contribute to the total area of the school grounds ($\beta = 0.78$, $p < 0.01$).

4.3 Greenery Area

Green areas are present in varying proportions across the analyzed school grounds. While their presence in most complexes is relatively satisfactory, they often lack clearly defined features tailored for specific pedagogical activities. Notably, Kralj Petar I Elementary School stands out for maintaining a high level of natural attractiveness and favorable microclimatic conditions in its well-developed access zone (Tanic et al., 2018).

Green areas contribute to creating a healthy and pleasant environment, while the lack of greenery can negatively impact the quality of the living space.

Out of the 20 school grounds analyzed, 14 schools meet the condition that green areas constitute at least 25% of the total area. The school with the highest percentage of green areas is Njegoš Elementary School (58.21%), where greenery covers more than half of the complex. Other schools with significant greenery percentages include Car Konstantin (56.18%), Kralj Petar I (50.18%), and Bubanjski heroji (49.14%). These schools exhibit well-developed green areas that enhance the aesthetic and ecological quality of their spaces.

Six schools have less than 25% greenery in their school grounds, with Vožd Karađorđe Elementary School having the lowest percentage (10.96%), where only about one-tenth of the complex is covered with greenery. Other schools with low greenery percentages include Stefan Nemanja (12.25%), Radoje Domanović (15.02%), and Dositej Obradović (19.65%). These schools could consider expanding their green areas to meet the minimum threshold and improve their complexes.

Overall compliance: Most schools (70%) meet the greenery requirement, which is a positive indicator. However, the remaining 30% highlights room for improvement. Schools with insufficient greenery could utilize available spaces to plant trees, shrubs, or grass, contributing to both functional and aesthetic enhancements.

Average area: The greenery area is the most variable category, with an average of 4,564.2 m², ranging from 580 m² to 15,673 m².

Correlation with total area: A very strong positive correlation ($r = 0.88$, $p < 0.001$) indicates a direct relationship between greenery area and the total size of the complex. The p-value confirms the statistical reliability of this relationship.

Regression analysis: The greenery area has a significant regression coefficient ($\beta = 0.85$, $p < 0.001$).

4.4 Sports Facilities

Sports facilities, to varying extents, are present in every school grounds. However, numerous organizational irregularities have been observed. These include the size and features of the sports fields, in some cases their location within the complex, as well as the absence of grass fields and protective greenery buffers. Additionally, in several instances (Radoje Domanović, Čegar, Car Konstantin, Branko Miljković, Bubanjski heroji, Kole Rašić, Sreten Mladenović, and Miroslav Antić), the sports facilities have improper orientation.

In cases where built sports surfaces are lacking, recent years have seen the introduction of so-called "balloon" gymnasiums. While this approach, particularly in local conditions, provides a financially simpler solution to the lack of

sports amenities, the spatial detachment of the gymnasium from the elementary school building and the aesthetic aspects of such interventions remain questionable.

Average number: The average number of sports facilities is 2.6, ranging from 0 to 6.

Correlation with built-up area: A correlation ($r = 0.54$, $p < 0.05$) indicates a weaker but significant relationship. This suggests that larger schools tend to provide more sports facilities, though this is not a universal rule.

Correlation with greenery area: A similar correlation ($r = 0.55$, $p < 0.05$) confirms the connection between green areas and the number of sports facilities. The p-value supports the statistical significance of this relationship.

Regression analysis: The number of sports facilities has a smaller but statistically significant effect on the total area of the school grounds ($\beta = 0.45$, $p < 0.05$).

4.5 Existing Area of School Grounds

The data reveal significant variations between the existing and required areas of school grounds. In some cases, the existing areas significantly exceed the required ones, while in others, there are severe spatial deficiencies.

The average existing area of school grounds is 11,831.4 m², while the average required area is 11,170.0 m². This indicates an average surplus of 661.4 m², which is relatively modest compared to the overall values but conceals significant variations among individual schools.

Largest surplus: 17,216 m² (existing area 32,591 m² vs. required 15,375 m²).

Largest deficit: -7,311 m² (existing area 4,427 m² vs. required 8,175 m²).

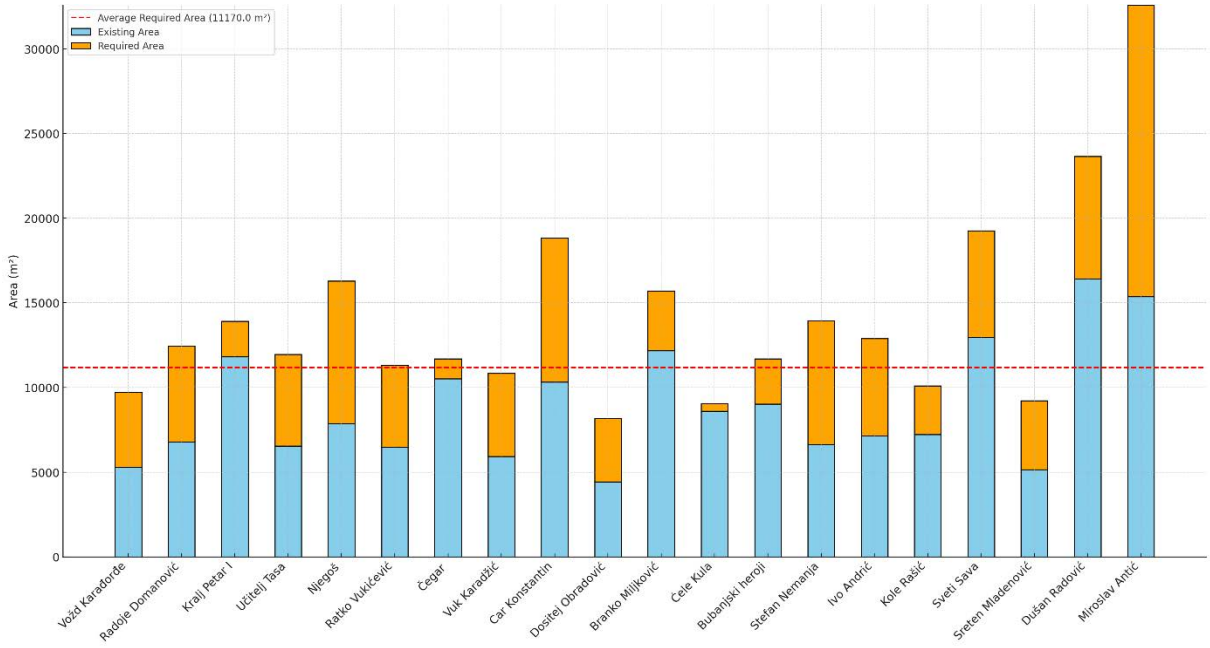


Figure 6: Comparative Analysis of Existing and Required Areas of School Grounds

The relative ratio (existing/required area) has an average value of 1.09, meaning that the existing areas are, on average, 9% larger than required.

However, a significant number of schools have a ratio below 1 (space deficit), with a minimum value of 0.48 (nearly half the required space).

For schools with a surplus, the maximum ratio is 2.12, meaning the space is more than double the required size.

Space Distribution Insights:

- 25% of schools have a significant space deficit, with differences ranging from -4,535 m² or lower.
- 75% of schools have a neutral or positive space balance, but in some cases, the surplus exceeds optimal values.

Out of 20 elementary schools:

- 10 schools have a total surplus of 72,065 m².

- 10 schools have a total deficit of 58,837 m².

This balance suggests a potential for resource redistribution, although significant external factors (location, school type) may complicate such efforts.

Schools with Relative Ratio < 1:

- These schools lack sufficient space for optimal functioning. This is evident in 10 schools, with the lowest ratio being 0.48 (a school with only half the required space).

Schools with Relative Ratio > 1:

- These schools represent resources that could be better utilized, as some have significantly more space than required (up to 2.12 times the needed area).

Extremes in Data:

- Largest surplus: A school with an existing area of 32,591 m² and a required area of 15,375 m² has a surplus of 17,216 m².
- Largest deficit: A school with an existing area of 4,427 m² and a required area of 8,175 m² has a deficit of -7,311 m², representing a serious issue.

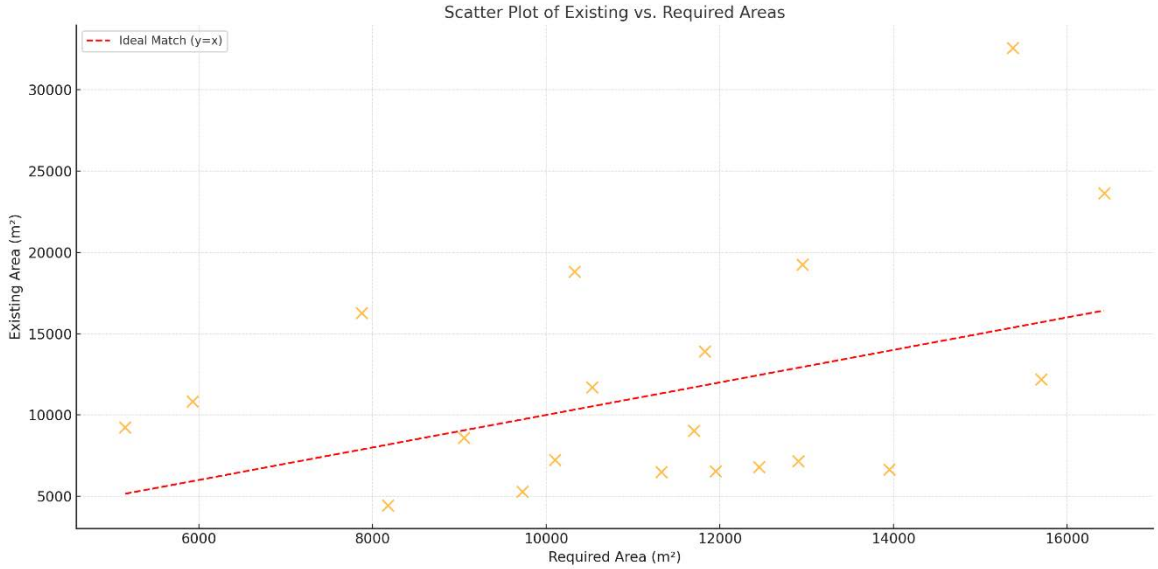


Figure 7: Scatter Plot for the Relationship Between Existing and Required Areas of School Grounds

- The red line ("ideal match") indicates cases where the existing area equals the required area.
- Schools below the line have a space deficit, while those above the line have a surplus.
- A cluster of schools with a significant surplus of space is observed in the upper-right corner.

Correlation with Built-up Area and Greenery: Strong positive correlations ($r = 0.89$ and $r = 0.88$, respectively, $p < 0.001$ for both) indicate that the total area depends on these key factors. Statistically significant p-values further confirm the reliability of the results.

The combined regression model suggests that the built-up area, open spaces, and green areas are the main predictors of the total area ($R^2 = 0.92$, $p < 0.001$).

In terms of space distribution, the analysis highlights the need for a balance between built-up and open spaces to achieve optimal functionality.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Findings

The results reveal significant correlations among the analyzed variables. Larger school grounds provide better conditions for various activities due to the integration of open spaces, green areas, and sports facilities. Regression analysis further confirms that the built-up area, open spaces, and green areas are key predictors of the total size of the school grounds.

Built-up area and open spaces: A strong correlation ($r = 0.80$, $p < 0.01$) and significance in regression indicate that larger buildings are typically surrounded by proportionate open spaces, suggesting thoughtful spatial planning.

Built-up area and greenery: A strong correlation ($r = 0.78$, $p < 0.01$) implies that larger schools often integrate green areas into their design, promoting sustainability and well-being.

Greenery and total area: A very strong correlation ($r = 0.88$, $p < 0.001$) highlights the importance of green areas as a key contributor to the overall size of the complex.

5.2. Inequalities and Functional Implications

Significant differences among schools in terms of available space highlight unequal conditions for pupils. This disparity can lead to variations in the quality of the educational experience.

Sports facilities and built-up area: A weaker correlation ($r = 0.54$, $p < 0.05$) suggests variability in priorities when constructing sports facilities, which can impact the standards of physical education. Additional investment in this area is required.

Greenery and sports facilities: A moderate correlation ($r = 0.55$, $p < 0.05$) indicates that not all green areas are utilized for sports activities, presenting an opportunity for better integration.

Although the number of sports facilities has weaker correlations with other elements, their presence is crucial for promoting physical activity among pupils. Schools with fewer facilities may face challenges in meeting curricular and extracurricular needs.

5.3. Analysis of Dimensions and Distribution

The detailed analysis reveals important differences in the dimensions and distribution of school grounds, with significant implications for their functionality. Larger school grounds offer better-integrated spaces, while smaller complexes show limitations in available resources.

Balancing disparities: To equalize conditions, measures should be taken to reduce disparities among schools, particularly in areas with minimal green areas and a lack of sports facilities.

Efficient resource use: Better balancing of available spaces between schools is necessary to ensure efficient use of resources. Excess space in some schools may result from poor planning or changes in pupil population. Such spaces could be repurposed for community needs.

5.4. Recommendations

Expansion: Priority should be given to expanding school complexes with space deficits to ensure adequate conditions for pupils.

Investment in sports facilities: The moderate to weak correlation of sports facilities with other elements implies a need for additional investment in this area.

Optimization strategies: A strategy should be developed to optimize existing school grounds, utilizing surplus space for additional facilities such as sports fields, parks, or pupil workshops.

Future studies: Further research should investigate the causes of excessive or insufficient areas, including demographic changes and specific functional requirements of schools.

ACKNOWLEDGMENTS

This research was funded by Ministry of Science, Technological Development and Innovation of the Republic of Serbia (grant number 451-03-65/202403/200095; University of Niš, Faculty of Civil Engineering and Architecture).

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REVITALIZATION OF THE TECHNICAL SCHOOL COMPLEX IN NIŠ - CASE STUDY OF THE NEW BUILDING FOR THE ACADEMY OF APPLIED TECHNICAL AND PRESCHOOL STUDIES

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ABSTRACT

The Academy of Applied Technical and Preschool Studies, together with the technical secondary schools "12. februar" and "Neimar" in Niš, forms a cohesive architectural ensemble shaped like the Cyrillic letter "P." This formation was finalized after the Second World War. The architectural and spatial unit, dating from the early Modern period constitutes a complex of technical schools characterized by a pronounced linear form oriented in the northeast-southwest direction. At the same time, the complex serves as the "left wing" of a broader urban-architectural entity, a kind of campus that includes the buildings of several technical faculties and high schools. In the northwestern part of the existing complex, the construction of a newly designed school building for the needs of the Academy is planned. Its positioning will create a kind of atrium within the complex itself. This paper presents the urban-architectural conceptual design of the new Academy building, highlighting it as one of the key elements in the revitalization of the entire ambient space, with particular emphasis on the remodeling of the ground floor in its immediate surroundings.

Keywords: *facility complex; urban and architectural design; revitalization; education; form; shape; structure*

1. INTRODUCTION

The multiple significance of the existing school complex, composed of the aforementioned technical vocational schools, is recognized on several levels. At the most fundamental level, it holds cultural and historical importance for the entire Niš region and its surroundings. Due to the urgent post-World War II need for construction, mechanical, and electrical technicians, one of the first and largest vocational schools in the country was established in this part of Yugoslavia, enrolling over 3,000 students (GTS Neimar, 2025). A particularly important contribution to this cultural and historical value is the involvement of Aleksandar

Medvedev, one of the most renowned Russian émigré architects of the period between two World Wars, whose work significantly shaped the architectural identity of educational institutions in the region. He designed many school buildings at the time—most notably the "12. februar" secondary vocational school, which remains part of this architectural ensemble (Petrović, 2021). Today, the street that houses all of the mentioned schools and technical faculties in Niš bears his name.

The next level of importance is urban-architectural, or spatial-environmental. This includes the strategic location of the school complex near some of the most significant protected cultural monuments in the city, its direct connection to technical faculties, and its traffic accessibility to the central urban core of Niš. In addition, the educational significance of the complex is undoubtedly its most enduring contribution. Over the course of nearly a century, thousands of skilled workers, technicians, and engineers from various technical fields—including architecture, construction, mechanical engineering, etc.—have been educated within its institutions, contributing to the technical and industrial development of the region.

The current task within this historically and culturally rich complex is the design and implementation of a new facility, one that will meet modern demands and capacities while contributing to the further revitalization and enhancement of the entire ambient environment.

2. URBAN PLANNING AND ARCHITECTURAL DESIGN CONCEPT

2.1. Ground plan – current state

From a macro perspective, the location of the school complex where the new Academy building is planned is situated in the northwestern part of A. Medvedev Street. To the west, it has access to 12. Februar Boulevard; to the south, it is near the "Fortress" memorial complex; to the north lies the "Crveni Krst" concentration camp memorial site; while to the east, the remainder of a larger urban-architectural entity is formed, consisting of technical faculties and the secondary school of electrical engineering. Via the 12. Februar Boulevard, the location is directly connected to the city center by road (Figure 1(a)).



Figure 1: (a) Ground plan – macro level, (b) Ground plan - micro level

From a micro perspective, the newly designed Academy building is planned to be positioned opposite the existing Academy building, in the southwestern part of the shared courtyard. It is to be located on the site currently occupied by a series of single-story garages with an elongated linear footprint (Figure 1(b)). It is important to note that the entire shared courtyard between the school buildings was reconstructed approximately ten years ago, including the installation of outdoor furniture and the landscaping of both ground-level and tall greenery. As a result, the courtyard area is currently in satisfactory condition.

However, the part of the site that remains significantly degraded or completely neglected includes the garages and the space behind them, located in the southwestern corner of the plot, which extends to the neighboring buildings. The area designated for parking near the vehicular and pedestrian entrance to the plot is particularly undeveloped. All the above indicates that this part of the school complex, in addition to being dilapidated and visually unattractive, also represents a safety concern for the hundreds of people who enter the complex or pass by it every day.

2.2. Ground plan - newly designed state

As already mentioned, the new building of the Academy is planned in the place where the garage facilities in a row are currently located. The newly designed building also has an emphasized linear dimension at the base and a low floor height, as well as the surrounding buildings within the complex. The characteristics of the revitalization of the space by "inserting" the newly planned building and its impact on the entire complex are reflected in the following:

- With its setting, it does not threaten the existing buildings within the complex, but on the contrary, following the height of the neighboring buildings, it completes the ambient whole,
- It obscures the views towards spontaneously and unplanned buildings on the neighboring plots on the west side,
- The existing half-atrium acquires the dimensions of a real atrium between four school buildings with a central and peripheral gathering area,
- Better views on the west side of the inner courtyard.

In the immediate vicinity of the new Academy building, the revitalization of the parking space on the south and west side of the plot is also planned. On the southern side, the expansion of the existing green area with a new parking space is planned, followed by tall vegetation to protect that area as much as possible from excessive southwest sunlight. On the west side behind the new Academy building, a two-row parking space with accompanying greenery is also planned. In addition, within the newly designed facility at the level of the underground garage, a certain number of garage parking spaces are planned to additionally relieve the problem of parking for the needs of all facilities within the school complex (Figure 2).

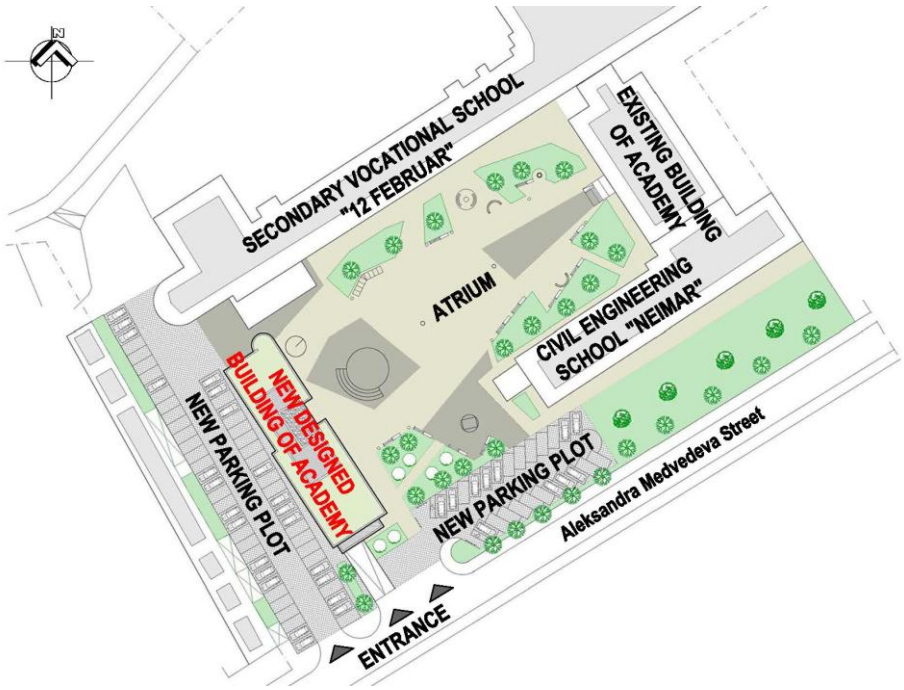


Figure 2: Situation - newly designed state

3. ARCHITECTURAL DESIGN OF THE NEW ACADEMY BUILDING

3.1. Functional organization of the interior space

Given that the basic dimension of the newly designed building has an elongated (longitudinal) shape tilted in relation to its width, which arose primarily from the conditions on the ground in order to be implemented as adequately as possible in the existing complex of buildings, and so that it would not take away a large area from the common inner courtyard, the staircase is placed centrally in the space of the building, which achieved the most optimal use of space with the minimum areas required for communications (Figure 3).

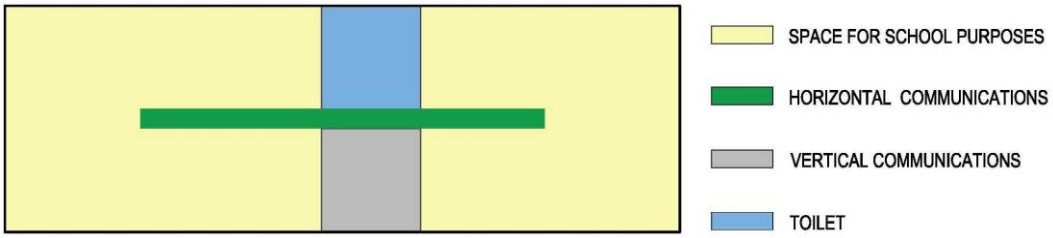


Figure 3: Schematic view of the functional organization

As shown in the Figure 3, across from the vertical communications (stairs and elevator) and in the central area, there are toilets throughout all floors, while horizontal communications are provided in the central corridors, which also leaves the most optimal spatial capacity for meeting school, i.e. classroom needs with accompanying contents.

On the ground floor level, the central entrance hall represents a spatial element that on the one hand connects and on the other hand separates the interior space of the floor into two zones. On the south side, a two-level amphitheater with about a hundred seats is planned, while on the north side, in addition to the mentioned communications and toilets, a cafe-bar is planned that would serve all users of the entire school complex. The covered facade part of the glass canvas with sliding glass panels at the cafe-bar should, in addition to the complete transparency of the premises, allow a direct connection at the ground floor level with the atrium during warm days, thereby "negating" the border between interior and exterior (Figure 4).

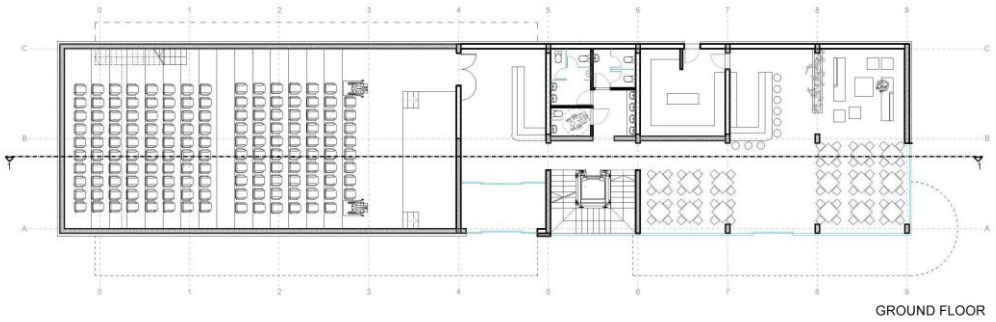


Figure 4: Ground floor plan

On the first and second floors, classrooms were designed that would be optionally partitioned off from each other depending on specific teaching needs. Since the structure consists of a modular system of columns and beams, these movable partitions would be located near vertical columns (columns) that would be opened or closed as needed, in order to obtain one larger or several smaller spaces. In terms of the connection between the hallway and the classroom, it is planned that the classrooms will be partitioned off with soundproof glass panels in order to achieve the visual effect of a larger and more comfortable space for work, and thus the central corridor would be maximally illuminated by natural light. An open common terrace is planned on the south side above the amphitheater (Figure 5).

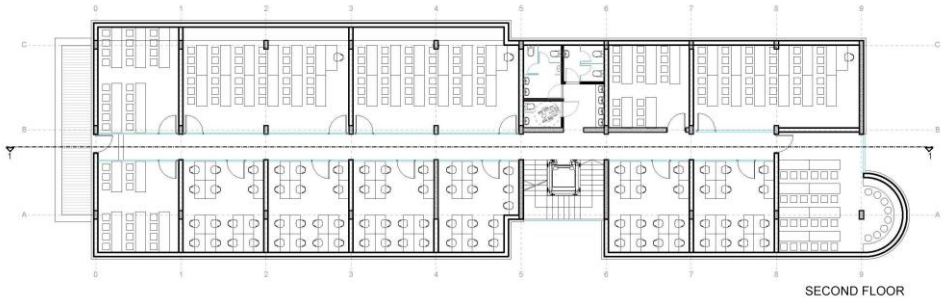


Figure 5: Second floor plan

On the third recessed floor, an open shared terrace is planned for the entire area, most of it with a final layer - a flat green roof of an extensive type. It is partially covered with concrete brisoles for better shading.

3.2. Structural design of the building

The structural system of the new Academy building is based on a modular skeletal frame with a 5x5 meter grid, combined with reinforced concrete walls. A reinforced concrete core is positioned in the vertical circulation zone. One of the key architectural features of the newly designed building is the prominent volume of the southern section housing the amphitheater, which partially covers the descending ramp leading to the underground garage. The slope of the ramp follows the same 15% gradient as the corresponding section of the amphitheater (Figure 6).

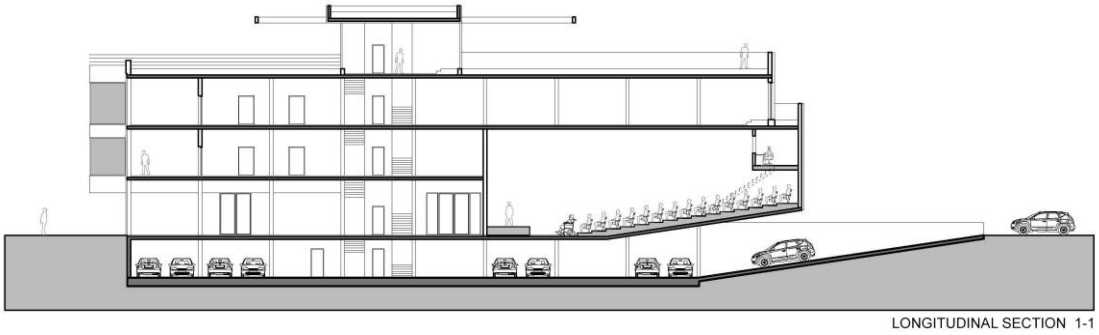


Figure 6: Longitudinal section

3.3. Architectural articulation and visual identity of the new Academy building

The architectural form of the newly designed "inserted" building within the existing complex is a longitudinal cubic volume with raised cantilever masses at the level of the first and second floors. The dynamism of the building's form is further emphasized by the protruding cube of the amphitheater lined with LED screens, above the entrance to the underground garage (Figure 7).



Figure 7: (a) 3D model – southwest view, (b) South façade

Glass "horizontal strips" were applied to the facades of the classrooms, characteristic of International Style buildings, i.e. Early and Late Industrial Modern buildings, the period when the existing buildings of the subject complex were designed and built (Keković, 2008). Large glass areas were planned also for the reason of accepting more sunlight, especially on the eastern facade in the afternoon, as well as for wide views towards the open atrium and the rest of the complex (Figure 8).

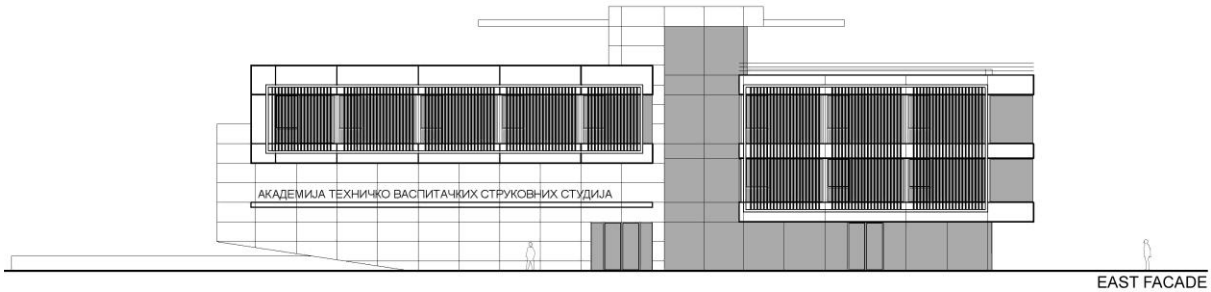


Figure 8: East facade

Additional secondary architectural exoression consists of movable facade brisoleis positioned on the east and west facades, which rotate in relation to the sunlight. In addition, they contribute to the visual identity of the object in space (Figure 9).



Figure 9: 3D model – east view

A characteristic detail of the new building is the rounded part of the northern facade, also as a tribute to the neighboring building of the "12 February" school, which was designed by Aleksandar Medvedev, a great Niš Modernist, after whom the street where the entire complex of technical schools and faculties is located is named (Figure 10).



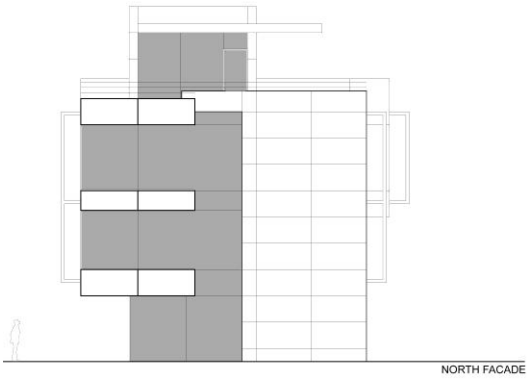


Figure 10: (a) 3D model –northeast view, (b) North facade

4. JUSTIFICATION OF URBAN PLANNING AND SPATIAL INTEGRATION

The project of the new building of the Academy of Applied Technical and Preschool Studies represents an urbanistically justified intervention, which clearly responds to the needs of the existing urban structure and the future development of the complex of technical schools and faculties. The urban framework of the location, with its location along Aleksandra Medvedeva Street and close proximity to the central city core, technical faculties, as well as important cultural and historical monuments such as the Fortress and the Red Cross camp, ensures a high value of the location in the city fabric. The building was designed in such a way that it clearly responds to the requirements of integration with the existing buildings of the complex, which completes the spatial composition and realizes a functional unit with an internal atrium as a central meeting point (Figure 11).

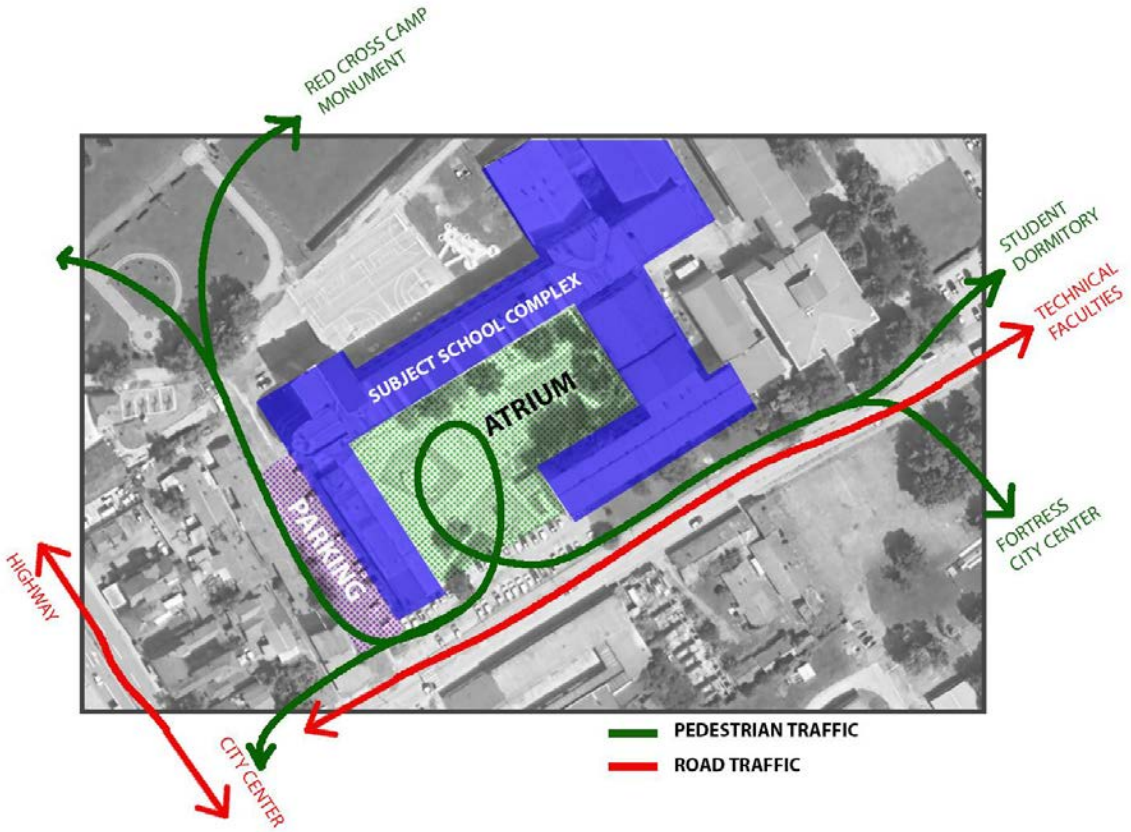


Figure 11: newly formed atrium as a central meeting point

The impact of the new building on the immediate environment is reflected in the formation of a clear atrium space, which achieves better visual communication between the buildings of the complex, as well as a better ambient atmosphere for the users of the space. In addition, the installation of the object solves the existing problems of degraded garage space, pedestrian safety and visual disturbance of the space. By integrating the green area and parking space around the building, the microclimatic conditions and accessibility of the complex are significantly improved, at the same time alleviating the problem of parking through the design of an underground garage.

The traffic and infrastructural justification are reflected in the clearly defined connection of the location with city roads, which enables direct accessibility of the building from the central parts of the city. The organization of parking areas and the formation of new traffic solutions significantly reduce traffic conflicts and improve the safety of users. Pedestrian connections are planned in order to enable efficient and pleasant movement within the complex, as well as connection with the surrounding city amenities.

The ecological aspect of the project is emphasized through the application of sustainable solutions such as a green roof, protective tall greenery and environmentally friendly materials. These solutions contribute to mitigating the negative impact of urban heat islands and have a positive effect on the local microclimate. The ecological sustainability of the building further strengthens its importance within the urban planning of the city.

Finally, the visual integration of the object into the urban context is achieved through respect and reinterpretation of the modernist tradition of Niš, especially using clear horizontal lines, large glass surfaces and movable brisoleis, which achieves continuity in the visual identity of the city. In this way, the new building becomes a recognizable urban benchmark, simultaneously respecting and improving the existing architectural and urban heritage of the complex.

5. CONCLUSION

We are witnessing big, sudden and frequent changes on a global planetary level in all segments of the social community. Urban-architectural interventions may represent the most visible direct changes in the space

in which we live. These changes can be positive or negative, but they are certainly inevitable. There are increasingly rare cases where architects have the opportunity to design in an "empty space" without a built-in surrounding, i.e. inherited structure. Today's construction very often implies adaptation, superstructure, extension, reconstruction or revitalization of a building, that is, a complex of buildings or larger spatial built units. Therefore, every intervention in the public space must be viewed multi-layered, multidisciplinary and above all contextually, so as not to make big mistakes that can lead to multi-year or permanent consequences in cultural-historical, aesthetic, socio-psychological, economic and any other aspect.

The presented conceptual urban-architectural solution of the new Academy building in Nis represents a kind of Brownfield investment of a devastated part of a larger complex important for the city and the entire Nis region. The goal is that with the implementation of this project, this area will become attractive, modern, aesthetically and visually pleasing while preserving the existing ambient values, so that in the future there could be an initiative for the redevelopment of the entire surrounding area from the subject school complex to the boulevard on the west side, that is, to the camp monument on the north side, as well as from the boulevard 12 February all the way to the Fortress and the current bus station in the south. With the existing tobacco industry complex and the revitalization of the former machinery industry complex, Niš would finally get the entrance from the north into the city it deserves.

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URBAN PLANNING IN NIŠ, SERBIA: CURRENT TRENDS AND STRATEGIES

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ABSTRACT

Over the recent years, Niš, Serbia, has witnessed a significant trend in the revision of urban planning documents, focusing on enhancing the urban environment, mixed-use areas, and greenery. This shift aims to modernize planning frameworks and improve residents' quality of life. A key aspect of these changes is the emphasis on developing green spaces and open areas for relaxation and social interaction, aligning with global urban sustainability trends. These efforts not only address environmental concerns but also foster a sense of community within urban areas.

In addition to expanding public spaces, there is a growing focus on the development of mixed-use zones. These zones are designed to promote compactness, high density, and the integration of residential, commercial, public and recreational spaces, aiming to create vibrant, walkable neighborhoods that enhance urban life quality. The goal is to reduce urban sprawl while stimulating economic growth and improving the overall livability of the city.

However, these amendments have sparked a range of public reactions, particularly from politically motivated groups and conservative urban planners, who raise concerns about the impact on the city's traditional character and its future development. This paper provides a comprehensive review of the recent amendments, examines their potential consequences, and evaluates how these changes could shape the urban future of Niš.

Keywords: *urban planning; greenery; mixed-use areas*

1. INTRODUCTION

Urban planning is a fundamental discipline for fostering sustainable, resilient, and inclusive urban environments, in accordance with sustainable development goals (Jensen, 2022). It addresses the multifaceted challenges of urbanization while aligning spatial development with the evolving needs of society.

In recent years, the city of Niš, Serbia, has undertaken significant revisions to its urban planning frameworks to modernize its approach to public spaces, greenery, and mixed-use zones. These initiatives reflect a broader

global trend emphasizing compact urban forms, high-density development, and multifunctional land use to promote sustainability and improve urban quality of life.

Central to these efforts are amendments to the General Urban Plan and several General Regulation Plans (GRPs), covering key districts such as Medijana, Crveni Krst (Phase 1), Pantelej (Phases 1 and 2), and Palilula (Phases 1 and 2). These revisions aim to harmonize local urban planning practices with contemporary principles of sustainable development while addressing practical challenges that have emerged during the implementation of earlier planning documents.

Empirical observations and stakeholder feedback have highlighted deficiencies in prior urban planning approaches, which have resulted in suboptimal spatial outcomes, such as inefficient land use, insufficient greenery, and poorly integrated urban functions. These shortcomings have not only been identified by professionals but have also become a source of public dissatisfaction, necessitating a comprehensive reassessment of existing plans. The amendments introduced aim to address immediate issues, mitigate negative consequences, and establish a foundation for long-term urban development.

Key changes include the elimination of the floor count parameter in favor of building height, the introduction of ecological index, an increase in the minimum required percentage of greenery with updated calculation methods, and the designation of new city centers as mixed-use zones. These changes underscore a strategic shift toward creating vibrant, walkable neighborhoods that integrate residential, commercial, public, and recreational functions. Such approaches align with the principles of sustainable neighbourhood planning outlined in international urban planning literature, emphasizing compact, integrated urban forms that reduce travel distances and foster social inclusion (UN-Habitat, 2015)

This paper examines the motivations, implementation processes, and implications of these planning amendments. It provides a critical analysis of their potential impact on Niš's urban development, addressing challenges such as public opposition, policy limitations, and the need to preserve the city's cultural and historical identity. By contextualizing these reforms within global urban planning paradigms, the study seeks to contribute to the discourse on sustainable urban development and offer insights for application in similar urban contexts.

2. METHODOLOGY

This study adopts a qualitative approach to examine recent amendments to urban planning documents in Niš, Serbia, focusing on their implications for sustainable urban development, public spaces, and mixed-use zones. The methodology is based on a detailed analysis of official documents and secondary sources, providing insights into the motivations, processes, and anticipated outcomes of these amendments.

Data collection and analysis was conducted through three key methods: document analysis, literature review, and public feedback analysis.

- **Document Analysis:** The primary data source includes official urban planning documents, such as the revised General Urban Plan (GUP) and General Regulation Plans (GRPs) for Medijana, Crveni Krst (Phase 1), Pantelej (Phases 1 and 2), and Palilula (Phases 1 and 2). These documents were systematically analyzed to identify significant amendments, including changes to urban planning parameters, and adjustments to greenery requirements.
- **Literature Review:** A comprehensive review of relevant academic literature, policy reports, and case studies was undertaken to contextualize the amendments within broader global and regional urban planning trends. The review provided comparative insights and established a theoretical framework for interpreting the findings.
- **Public Feedback Analysis:** Public responses to the amendments were assessed by examining publicly available materials, including local media reports, public consultation documents, and online discussions. This analysis sought to capture the perspectives of various stakeholder groups and evaluate public sentiment regarding the changes.

The study acknowledges several limitations. The reliance on secondary data sources for public feedback may not fully capture the diversity of opinions or reflect the nuanced perspectives of all stakeholders. Additionally, the analysis is constrained to the immediate and short-term implications of the amendments, as their long-term effects remain to be explored in future research.

3. URBAN PLANNING PARAMETERS AND CONSTRUCTION RULES

Numerous problems in implementation necessitated amendments to the urban plans in Niš. These issues largely pertained to urban planning parameters and building regulations. The manner in which the urban planning parame ters were defined was not in alignment with the intent of Article 31 of the Planning and Construction Law. Additionally, the rigid application of such building regulations led to negative spatial effects. The goal of the amendments was to mitigate these negative effects through adjustments to urban planning parameters and building regulations.

3.1. Plot Coverage Index, Floor Area Ratio, Maximum Allowable Building Height, and Number of Floors

The Planning and Construction Law of the Republic of Serbia, in Article 31, specifies that construction rules must define essential urban planning parameters, including the maximum allowable plot coverage index, floor area ratio, building height, and the number of floors. In the case of Niš, urban planning documents historically utilized all four parameters concurrently. While this might appear to provide a comprehensive regulatory framework, in practice, it resulted in excessive rigidity and inefficiencies in urban development. This approach conflicted with the strategic intent of Article 31, which advocates for adaptable and context-sensitive planning practices.

The simultaneous application of these parameters created redundancies and conflicts, limiting design flexibility and often complicating the realization of projects. For instance, the requirement to adhere to both a maximum number of floors and a maximum building height imposed unnecessary constraints, as one of these parameters could effectively control vertical dimensions. Similarly, the strict combination of plot coverage index and floor area ratio restricted creative architectural and urban design solutions while discouraging the efficient use of land resources.

These challenges were particularly evident in the implementation of the General Urban Plan (GUP) of Niš, which sought to define detailed construction rules for all land uses. While the GUP is legally defined as a strategic document focused on general urban planning solutions and predominant land uses within construction areas, its overly prescriptive nature limited flexibility during the elaboration of Detailed Regulation Plans (DRPs). This rigidity not only impeded the practical application of urban plans but also constrained the ability to adapt to evolving urban needs and stakeholder interests.

In response to these issues, amendments to the urban planning documents in Niš introduced a more flexible regulatory framework. The number of floors was removed as a parameter, based on the rationale that the remaining three—plot coverage index, floor area ratio, and building height—are sufficient to define the scope of construction and align with the strategic goals of urban development. The floor area ratio, a parameter that determines the maximum gross above-ground building area on a plot, was preserved as a critical regulatory tool. It plays a pivotal role in managing building capacities and ensuring adequate infrastructure planning, particularly in urban contexts where spatial efficiency is essential.

Similarly, the plot coverage index and building height were retained to regulate the physical dimensions of structures. The plot coverage index, which governs the proportion of the plot that can be occupied by a building, ensures that sufficient space is allocated for open and green areas, thereby supporting broader urban sustainability goals. Building height, on the other hand, serves to maintain a harmonious urban skyline while providing clarity for architectural design.

By removing the floor count parameter, the amendments introduced greater design flexibility and allowed architects and developers to explore innovative approaches to building volumes and spatial arrangements. This change facilitated economically efficient solutions while increasing the potential for open and green spaces on plots. For example, under the revised framework, developers can opt for lower coverage ratios while maximizing floor area within the permitted height limits, thus creating more space for public amenities and greenery.

The revised regulatory framework represents a significant advancement in the urban planning practices of Niš. It balances the need for regulatory control with the flexibility required to adapt to diverse urban contexts and stakeholder demands. Moreover, it aligns with contemporary urban planning principles, emphasizing the integration of functionality, sustainability, and aesthetic considerations in the built environment. These adjustments not only mitigate the negative spatial effects of previous rigid regulations but also provide a foundation for more dynamic and sustainable urban development in Niš.

3.2. Greenery percentage

The integration of greenery into urban environments is a critical component of sustainable urban planning, addressing issues such as urban heat islands, air quality, and biodiversity. Research has shown that open and green spaces improve community well-being by fostering social interaction (Saiedlue S. et.al. 2016).

However, in previous urban planning documents in Niš, the building regulations mandated a minimum greenery percentage of just 10%, calculated exclusively from greenery in direct contact with the ground. This narrow definition excluded various forms of greenery, such as tall greenery, greenery above underground levels, rooftop greenery, and other innovative green solutions.

This limited approach had several detrimental consequences. By not recognizing or incentivizing the use of alternative forms of greenery, such as green roofs or greenery on elevated structures, the regulations inadvertently discouraged sustainable and creative landscaping solutions. In practice, investors on private plots often opted to meet the bare minimum requirements, avoiding the planting of trees or incorporating greenery into areas above underground structures. This lack of incentive not only reduced the aesthetic and environmental quality of urban plots but also failed to contribute meaningfully to broader urban sustainability goals.

In response to these shortcomings, amendments to the urban planning documents significantly increased the minimum required greenery percentage on building plots from 10% to 25%. More importantly, the calculation method was revised to encompass a broader spectrum of greenery types. While maintaining the requirement for a minimum of 10% greenery in direct contact with the ground, the revised framework introduced the following enhancements:

- **Inclusion of All Forms of Greenery**: The calculation now accounts for greenery above underground levels, rooftop greenery, and tall greenery, encouraging diverse landscaping solutions.
- **Tree-Based Calculation**: Each tree is assigned a value of 5m² of greenery, providing a quantifiable incentive for tree planting.
- **Housing-Unit-Based Requirement**: Some plans mandate the provision of one tree per housing unit on the building plot. If on-site planting is not feasible, developers can meet this requirement by financially contributing to the greening of public spaces.
- **Green Roofs and Elevated Greenery**: Greenery above underground levels or on rooftops is calculated as 50% of its actual area, acknowledging its environmental and aesthetic contributions.

These adjustments reflect a significant paradigm shift in urban planning practices in Niš. By expanding the definition of greenery and offering flexible compliance options, the amended regulations aim to enhance the overall greenery footprint of the city. This approach not only addresses the deficiencies of earlier regulations but also aligns with contemporary urban planning principles that emphasize ecological sustainability, climate resilience, and urban livability.

The revised greenery percentage requirements have several far-reaching implications. First, they incentivize the integration of greenery into architectural designs, fostering innovation in the use of green roofs and vertical greenery systems. Second, they enhance the microclimatic conditions of urban areas, mitigating heat island effects and improving air quality. Third, by encouraging tree planting, the amendments contribute to increasing urban biodiversity and providing natural habitats within the city. Finally, the option for developers to contribute to public greening initiatives creates a mechanism for balancing private development with public environmental benefits.

The increased greenery percentage and revised calculation methods represent a proactive step toward sustainable urban development. These changes not only improve the aesthetic and ecological quality of urban areas in Niš but also set a benchmark for other cities aiming to integrate greenery into their urban fabric more effectively.

3.3. Ecological index

The integration of sustainability principles into urban planning has become a pressing necessity, particularly in cities like Niš, which are navigating the challenges of urbanization while striving to maintain ecological balance. The introduction of the ecological index as an urban planning parameter in several detailed regulation plans represents a significant advancement in aligning urban development with environmental

preservation. In the period 2020-2024 this parameter has been applied in four detailed regulation plans for mixed-use zones in Niš, demonstrating a growing commitment to sustainable urban development.

The introduction of the ecological index as an urban planning parameter is based on research conducted by CEUS and the recommendations derived from it (Mitić-Radulović et al., 2022).

The ecological index is a composite parameter designed to ensure that building plots contribute to the ecological health of the urban environment. It quantifies the proportion of a plot's area dedicated to ecological functions, such as green spaces, permeable surfaces, and vegetation, including green roofs and walls. By assigning specific weights to different ecological features, the index encourages developers to integrate sustainable practices into their projects. The primary goals of the ecological index include:

- Enhancing biodiversity and habitat creation.
- Mitigating urban heat island effects.
- Improving stormwater management through permeable and vegetated surfaces.
- Promoting aesthetically pleasing and ecologically functional urban spaces.

The ecological index has been systematically incorporated into the planning and regulation of several mixed-use zones in Niš. Key aspects of its implementation include:

- **Calculation Methodology:** The ecological index is calculated as the ratio of the total area of ecological functional spaces to the total plot area. Different forms of greenery and ecological surfaces are assigned specific weight factors based on their environmental contribution.
- **Minimum Requirements:** Detailed regulation plans mandate a minimum ecological index value that developers must meet to obtain building permits. For example, in some detailed regulation plans, the required minimal ecological index varies from 0.30 to 0.40, depending on the zone.
- **Integration into Urban Design:** By incorporating the ecological index into planning regulations, the detailed plans incentivize the integration of ecological features into architectural and landscape designs. This approach encourages the use of innovative solutions such as vertical gardens, urban forests, and rain gardens, which enhance the ecological and aesthetic quality of urban spaces.

The introduction of the ecological index may have a transformative impact on urban planning in Niš. It addresses several deficiencies in previous planning practices, such as the lack of incentives for alternative forms of greenery, including tall vegetation, rooftop gardens, and greenery above underground levels. By mandating a broader inclusion of ecological features, the index fosters the creation of greener and more livable urban environments.

Furthermore, the ecological index aligns with global best practices, such as Berlin's Biotope Area Factor and Singapore's greenery strategies, while adapting these concepts to the specific context of Niš. Its implementation should not only enhance the environmental quality of mixed-use zones but also contribute to the broader goals of sustainable urban development, including biodiversity preservation, climate adaptation, and improved urban aesthetics.

In DRPs in Niš Ecological Index (EI) of a plot is defined as ratio of the sum of the areas (P) of individual ecological functional spaces on the plot (T1, T2,...) multiplied by their corresponding weighting factors (TF1, TF2,...) to the total area of the plot.

The value of the ecological index is calculated using the formula:

$$EI=T1\times F1+T2\times F2+T3\times F3+T4\times F4+T5\times F5+T6\times F6+T7\times F7+T8\times F8+T9\times F9+T10\times F10+T11\times F11+T12\times F12+T13\times F13$$

where EI is the value of the ecological index, T is the area or number of plantings by type, as defined in the table above, and F is the weight factor for the corresponding surface or planting.

Table 1: Types of surfaces and plantings included in the calculation of the ecological index and their weighting factors. (source DRP of mixed-use zone in area between Mokranjčeva, Zetska streets and SRC Čair, based on CEUS research)

	Type of surface or planting	**Weight factor**
	T1 - Surfaces with impermeable coverings (asphalt, concrete, etc.)	F1 – 0.0
	T2 - Surfaces with partially permeable coverings (paving stones, etc.)	F2 – 0.2

	T3 - Semi-porous surfaces (grid pavers, decking, etc.)	F3 – 0.4
	T4 - Green areas on underground structures and green roofs with soil substrate of lesser depth – up to 40 cm	F4 – 0.5
	T5 - Green areas on underground structures and green roofs with soil substrate of medium depth – from 40 cm to 100 cm	F5 – 0.7
	T6 - Green areas on underground structures and green roofs with a deep soil substrate – over 100 cm	F6 – 0.9
	T7 - Green areas in direct contact with the ground	F7 – 1.0
	T8 - Planters on terraces	F8 – 0.7
	T9 - Green facades	F9 – 0.5
	T10 - Water surfaces	F10 – 0.5
	T11 - Rain gardens and bioretention areas	F11 – 1.5
	T12 - Trees with a crown diameter up to 3m	F12 – 5.0m2
	T13 - Trees with a crown diameter over 3m	F13 – 10.0m2

While the ecological index has proven effective in driving sustainable practices, its implementation is not without challenges. Accurate calculation and monitoring require reliable data and effective enforcement mechanisms. Additionally, greater public awareness and cooperation between municipal authorities, developers, and residents are essential for maximizing its impact. Future regulation plans in Niš could benefit from refining the index further, incorporating additional ecological parameters, and expanding its application to other urban areas.

The adoption of new urban planning parameters in Niš has addressed deficiencies in previous frameworks that often led to inefficient land use and spatial imbalance. The replacement of the "floor count" parameter with "building height" and the introduction of the ecological index are key innovations. These changes are consistent with global trends advocating for flexibility in urban regulations to better respond to evolving urban needs. For instance, mixed-use high-rise buildings, as discussed in professional literature, demonstrate the potential of adaptable planning frameworks to foster sustainable and multifunctional urban environments (Generalova E., Generalov V. 2019).

4. MIXED-USE ZONES

Urban planning in Niš has adopted the principles of mixed-use development to address urban challenges such as land-use inefficiency, urban sprawl, and insufficient public infrastructure. The introduction of mixed-use zones in new Detailed Regulation Plans (DRPs) represents a paradigm shift in urban planning, aiming to create vibrant, sustainable, and inclusive urban environments.

4.1. Definition and Objectives of Mixed-Use Zones

Mixed-use zones are areas where various functions—residential, commercial, public, and recreational—are integrated both physically and functionally. The concept prioritizes compact urban development and proximity between living, working, and public spaces, reducing travel distances and promoting community cohesion.

In Niš, the purpose of mixed-use zones includes:

- **Efficient Land Use**: Maximizing the utility of limited urban land resources by combining different functions.
- **Improved Accessibility**: Reducing travel time between residential areas, workplaces, and services.
- **Social Inclusion**: Fostering spatial and social inclusivity by offering affordable housing and diverse services.
- **Quality Public Spaces**: Ensuring the design and integration of green areas, pedestrian connections, and accessible shared spaces.

4.2. Application in DRPs in Niš

The changes in GUP, some GRPs and new DRPs for mixed-use zones in Niš, developed between 2020 and 2024, reflect these principles. The third amendments and supplements to the General Urban Plan (GUP) introduced changes that respect the continuity of the planning framework established by the Basic Plan as a strategic document, while laying the foundation for the creation of mixed-use zones, potential locations for high-rise developments, and addressing the need for public-purpose locations. These amendments to the GUP defined potential mixed-use zones that needed further analysis to demonstrate their suitability for implementation through studies and amendments to General Regulation Plans (GRPs), followed by detailed development through Detailed Regulation Plans (DRPs) (Fig. 1).

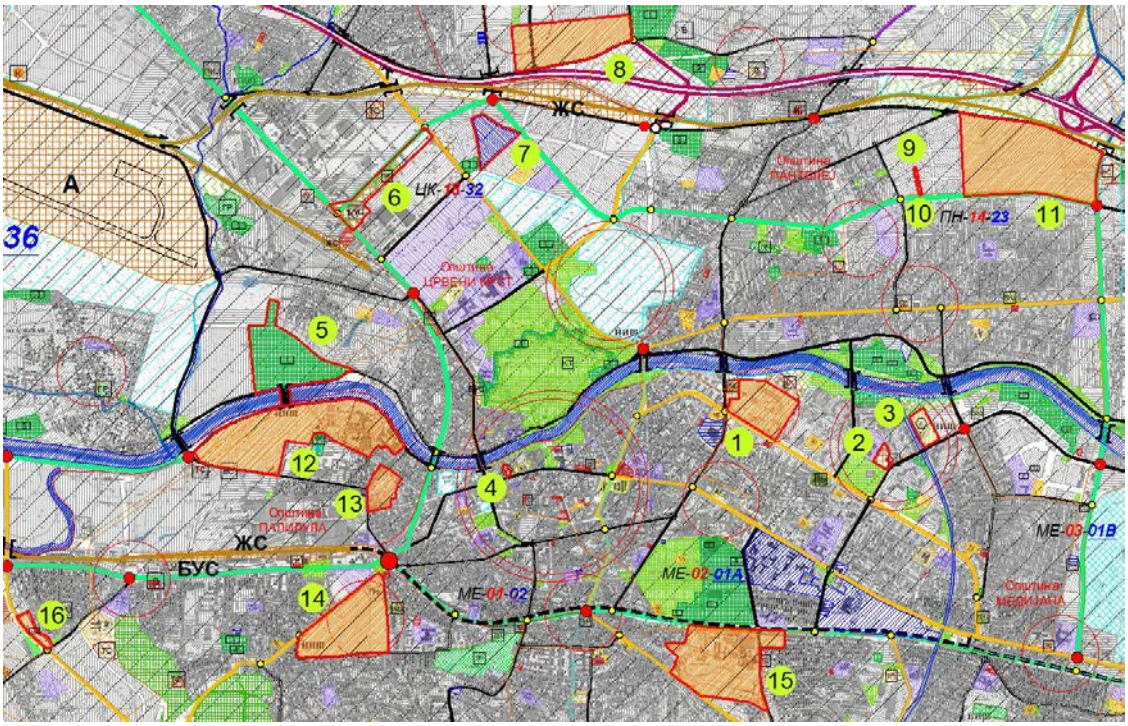


Figure 1: General Urban Plan Niš – The third amendments and supplements

Four locations identified as suitable for the development of new city centers as mixed-use zones have been elaborated through the following DRPs:

- Detailed regulation plan for the mixed-use zone in the area between Mokranjčeva, Zetska Streets, and SRC Čair.
- Detailed regulation plan for the mixed-use zone in the area between Vojvode Putnika, Zmaja od Noćaja and Stevana Sremca Streets.
- Detailed regulation plan for the mixed-use zone in the area of the Nišava River ans The Old Vulkan site in the Municipality of Palilula.
- Detailed regulation plan for the mixed-use zone in the area north of Boulevard St. Pantelejmon.

The DRPs mandate mixed-use both across the zone and within individual buildings, enabling diverse functions within single developments (e.g., retail and public facilities on the ground floor, offices above, and residential units on upper floors). The objective was to structure vertical functions in a manner that mandates developers to finance public facilities as compensation for the increased building heights and floor area ratios permitted in

these zones. To support this framework, economic analyses were conducted to quantify the financial obligations of developers, requiring them to invest in public facilities and infrastructure. This mechanism ensures that public-purpose developments are implemented concurrently with the construction of commercial and residential spaces, minimizing the financial burden on the city. This approach is particularly significant given the limited economic capacity of the city in previous periods, which resulted in the realization of very few public facilities and a substantial deficit in public amenities.

4.3. Planning Principles

The adoption of mixed-use development in Niš emphasizes sustainable urban growth by integrating ecological, social, and economic objectives to create livable and resilient urban environments. Central to this approach is the principle of dynamic zoning, which allows for the integration of residential, commercial, and public functions within cohesive neighborhoods. This flexibility supports diverse land uses, ensures long-term adaptability to evolving urban needs, and fosters vibrant, interconnected communities.

Financial sustainability is another key principle in the development of mixed-use zones. Mechanisms such as developer obligations to finance public facilities and infrastructure reduce the financial burden on the city while ensuring the realization of essential public amenities. This approach balances economic viability with inclusivity, facilitating access to housing, services, and public infrastructure for a wide range of socioeconomic groups. These planning principles align mixed-use zones with sustainable development goals, contributing to efficient and inclusive urban growth.

4.4. Benefits and Challenges

The development of mixed-use zones in Niš offers numerous benefits, particularly in promoting walkable neighborhoods and enhancing urban functionality. By integrating residential, commercial, and public uses within the same area, these zones minimize the need for long commutes, reducing transportation costs and lowering carbon emissions. The close proximity of living, working, and leisure spaces encourages walkability, public transportation, and environmentally sustainable urban forms.

Mixed-use zones also foster vibrant urban environments by supporting social interaction, cultural exchange, and economic activity. Diverse housing and service options cater to a wide demographic range, promoting inclusivity and enhancing the quality of urban life. Public spaces, green infrastructure, and innovative urban design further contribute to the aesthetic and functional value of these neighborhoods, creating shared spaces that enhance community well-being.

However, implementing mixed-use zones presents several challenges. Ensuring regulatory compliance requires robust monitoring and enforcement mechanisms, particularly in dynamic and evolving urban contexts. Coordinating infrastructure development to provide adequate utilities, transportation, and public facilities demands careful planning and significant investment. Phased implementation may be necessary to address resource constraints effectively.

Financing public services and infrastructure within mixed-use zones also requires innovative approaches, such as developer contributions and public-private partnerships. Maintaining affordability while achieving economic viability remains a critical challenge, necessitating a careful balance between accessibility and sustainability. Addressing these challenges is essential to the successful realization of mixed-use zones in Niš, ensuring they fulfill their potential as models of sustainable urban development.

5. CONCLUSIONS

The urban planning reforms undertaken in Niš over recent years represent a progressive and strategic shift toward sustainable, inclusive, and resilient urban development. Through amendments to key planning documents, including the General Urban Plan and several Detailed Regulation Plans, the city has demonstrated a commitment to addressing long-standing challenges while aligning with global urban planning trends.

The introduction of innovative parameters such as the ecological index and increased greenery requirements has reinforced the integration of sustainability principles into urban planning. These measures not only address environmental concerns but also enhance urban aesthetics, biodiversity, and climate resilience. Similarly, the development of mixed-use zones has set the stage for more vibrant, walkable neighborhoods that optimize land use, reduce urban sprawl, and foster community cohesion.

However, these advancements are not without challenges. Effective implementation requires robust regulatory frameworks, adequate infrastructure investments, and mechanisms to balance economic viability with accessibility. Public engagement and collaboration between stakeholders, including municipal authorities, developers, and residents, are crucial to overcoming these hurdles.

To further enhance the impact of these reforms, the following recommendations are proposed:

- **Strengthen Monitoring and Enforcement Mechanisms**: Develop tools and protocols to ensure compliance with urban planning regulations, particularly in the application of the ecological index and greenery requirements. Implement digital platforms for real-time monitoring of development projects.
- **Promote Stakeholder Engagement**: Facilitate regular consultations with community members, developers, and urban planners to ensure inclusive and transparent decision-making processes. Increase public awareness campaigns to highlight the benefits of sustainable urban development.
- **Invest in Infrastructure and Public Facilities**: Allocate resources for upgrading transportation, utilities, and public services in mixed-use zones. Encourage public-private partnerships to fund the development of high-quality public spaces and amenities.
- **Refine and Expand the Ecological Index**: Incorporate additional parameters, such as energy efficiency and renewable energy use, to broaden its scope. Expand the application of the ecological index to other urban areas beyond mixed-use zones.
- **Foster Innovation in Urban Design**: Encourage the adoption of cutting-edge design solutions, such as green roofs, rain gardens, and vertical greenery, to enhance the functionality and aesthetics of urban spaces. Provide incentives for developers to experiment with sustainable architectural practices.
- **Ensure Affordability and Inclusivity**: Develop financial plans and incentives to maintain affordability for all socioeconomic groups within mixed-use zones. Support initiatives aimed at increasing the availability of affordable housing and public amenities.

By addressing these recommendations, Niš can continue its trajectory as a model for sustainable urban development in Serbia and the broader region. The lessons learned from these initiatives can serve as valuable references for other cities facing similar challenges, contributing to a global discourse on urban resilience and sustainability.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under the Agreement on the Implementation and Financing of Scientific Research Work of the NIO in 2025 - Registration number: 451-03-136/2025-03/ 200095 dated 04/02/2025.

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