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MODERN TRANSFORMATIONS OF CITY RIVERFRONT - COMPARISON OF THE RIVERFRONTS OF BELGRADE AND ZAGREB

Slobodan Bulatović

The University of Belgrade, Faculty of Architecture, Serbia
PhD Student, bulatovic-s@hotmail.com

Aleksandra Đukić

The University of Belgrade, Faculty of Architecture, Serbia
PhD., Full Professor, adjukic@afrodita.rcub.bg.ac.rs

ABSTRACT

City riverfronts are parts of urban areas that have become increasingly interesting in space reconstruction and revitalization in the last few decades. This situation has occurred due to several different factors. The most important factor is undoubtedly the value of the land along the river and the possibility of forming high-quality spatial landscapes. In these parts of the city, in urban centres worldwide, attempts are being made to organise the entire life of the city. This research seeks to examine changes in the examples of the city riverfronts of Belgrade and Zagreb. These two cities are attractive for research because they were formed on the banks of the same river and have similar spatial-geographical characteristics. To research the mentioned changes in the paper, the spatial planning and urban documentation will be analyzed, focusing on the transformations of the riverfront of the two mentioned cities. It is important to emphasise that this paper seeks to examine the transformations in the last twenty years, i.e. in the 21st century. This research tries to summarise all the changes made to the city riverfronts and their effects on the spatial configuration of Belgrade and Zagreb. It also seeks to answer whether such space transformations are favourable or not, or what impact do they have on changing the broader image of the city. Based on the results, proposals and guidelines for future transformations of urban riverfronts will be given at the end of the paper.

Keywords: *Urban riverfronts; modern transformations; planning documentation; urban landscapes; Belgrade and Zagreb*

1. INTRODUCTION

The development of cities from the appearance of the first urban settlements until this day is conditioned by the close distance from water courses. For the population, the proximity of watercourses represented the possibility of supplying residential buildings with water, using that water to irrigate agricultural areas, and various other activities (Živaković-Kerže, 2008). This undoubtedly had a significant influence throughout history on the planning policies of the development of cities because the position of water courses and the terrain configuration dictated the further development of urban areas. Furthermore, the improvement of infrastructure systems intended for water supply and the problems caused by floods influenced the relocation of urban settlements to a certain distance from the river banks. As a result, the riverfront area received a different type of use and was used as an open public space or as an area for food production, and very often as an area for transporting various goods and services. As stated above, it can be concluded that water surfaces next to them have always represented very significant elements of urban space (Khalifa et al., 2021). On the one hand, citizens and many city administrations worldwide perceived these spaces and still perceive them today as public. By contrast, due to the value of the land along the river courses, as well as the significant progress in the field of infrastructural development, the owners of private capital, as well as a large number of actors in planning, consider these areas extremely important for further urban and economic development.

Differences in the relationship of the population, but also of the actors in the planning processes towards the areas along water courses, are visible all over the world. Therefore, these differences can be seen by comparing the planning policies of cities developed on the same river course and with similar spatial and geographical characteristics. The aim of this work is precisely through a comparative analysis of planning documents to investigate how cities such as Zagreb and Belgrade treat river banks. In other words, this paper attempts to research the differences between the two mentioned cities, that is, their planning processes during the past two decades. Even more, it is essential to emphasise that the "Belgrade on the Water" project is crucial for this research. At the same time, the Zagreb coast is analyzed following the conclusions given in the spatial and urban plan. The results try to figure out the changes that took place during the mentioned period on the cities' riverfront and how these changes affected their spatial configuration. Most importantly, based on the observed results, we attempt to answer whether these changes are good, that is, what impact do they have on the broader picture of the mentioned cities and their urban development. The conclusions of the work, in addition to a critical review of the research results, will contain specific recommendations and guidelines for the future transformations of river banks.

2. BACKGROUND RESEARCH

City shores, as mentioned, have always been important for human settlements. As such, they were used in various ways. Today, in the period of increase in the number of inhabitants in the city, the riverfront areas are becoming more critical in the urban structure (Attia et al., 2018). Many cities use these areas as open public spaces intended for a large number of residents belonging to different demographic categories. In recent decades, many European and North American cities have been turning more and more city riverfronts into open public spaces in an effort to bring city life down to the riverfront (Mann, 1988). This approach to spatial planning is undoubtedly based on scientific works. In his work Urban Open Spaces (1987), Mark Francis includes the city's riverfront that is not intended for living in the category of open public spaces. In this way, the city's shores become available to everyone with the possibility of using them for various events, resulting in a better connection of citizens with the space and better relations in the social community. In addition, in this way, city shores become part of the network of open public spaces in the urban structure, allowing for further adequate city development near these spaces. The German city of Frankfurt is one of the cities where the purpose of the city's riverfront was changed for a better quality of life and connections between people. Namely, in this city, before and during the Covid pandemic, the use of part of the city's riverfront was repurposed, and access to traffic was prohibited from promoting green mobility and improving the quality of life (Pandit et al., 2021). All of the above indicates that cities around the world use their riverfronts to preserve green areas, as well as improve the quality of life, and of course also provide the population with the opportunity to complete their free time or perform recreational activities not far from their place of residence (Fainstein, 2010). Generally speaking, when it comes to urban development along rivers, specific criteria must be met to endanger the city's overall development and the social community. This primarily refers to examining the planned project's direct and indirect impacts on the area's ecological aspect. It is crucial to examine the various risks this project may cause to other parts of the city. This undoubtedly refers to possible natural disasters such as floods or the occurrence of landslides due to water retention (Follmann, 2015).

Nevertheless, the use of city shores in the manner described in the previous paragraph is perfect both for the urban structure and for the inhabitants, many cities in the planning process still decide on a different way of coasting. As previously mentioned in the paper, the number of city inhabitants has been increasing rapidly in recent years, and city authorities are facing the problems of urban space expansion and renewal. In this regard, many cities along rivers, lakes and other bodies of water have decided to develop new settlements precisely in the riverfront zones. With regards to this, large cities take advantage of the inherited infrastructure, such as city ports, etc., and reconstruct it to develop an entirely new city centre in those areas. One such city is Hamburg. Namely, in this city, the location of the old city port was used to create a new centre with business and residential facilities for thousands of people (Krüger, 2009). This project called HafenCity has completely changed and even improved the city of Hamburg in terms of quality of life and broadened the job market, as well as quality open public spaces.

However, there are many examples of cities that were guided by the same or similar principles in the planning process to improve their river banks and turn them into new residential and business settlements. On the other hand, this did not proceed according to the intended concept. For example, at the beginning of the third millennium, the city of Edinburgh tried to regenerate the former port of Granton with the help of the

Waterfront Edinburgh project. Still, that project failed at a certain point (Kallin, 2021). What was shown through the idea of actors in planning the new waterfront in Edinburgh is that despite the potential that a particular area has, too much desire for quick financial success can lead to the project's failure.

Riverfront zones in cities, therefore, from historical settlements to the present day, have a crucial role. In recent years, even decades, the regeneration and reconstruction of these spaces in cities have been trying to raise the residents' quality of life. Of course, this can result in the development of new public spaces and residential areas. In these processes, planning documents have the most significant importance, that is, the actors who participate in creating these documents. In the capitals of the Republic of Serbia and the Republic of Croatia, Belgrade and Zagreb, in the last two decades, a large number of plans and proposals were made that explicitly dealt with the city's riverfronts. Those plans treated the banks of the Sava River in different ways and the existing built-up areas in the riverfront zones. Due to the significant similarities between the two mentioned cities in terms of spatial planning and spatial-geographical characteristics, it is exciting to compare the application of planning documents adopted in the last two decades. Through these comparisons, one can undoubtedly conclude how certain planning decisions affect the spatial configuration and the broader picture of the city, but also the quality of life of the citizens.

In connection with what was aforesaid, this paper aims to point out the importance of the city's riverfront in terms of the inhabitants' quality of life and the urban structure. Based on the results obtained through a comparative analysis of the planning documents of Belgrade and Zagreb, an attempt is made to find an answer as to whether the city's riverfronts are the new drivers of urban regeneration or whether they are spaces that should be intended for recreation and rest for citizens. As mentioned in the introductory part of the paper, the concluding part of the research will contain recommendations and guidelines for future planning and development of riverfront areas in large cities.

3. METHODOLOGY AND MATERIALS

High-quality and effective spatial planning can undoubtedly be considered crucial in ensuring the progress of urban areas in which efforts are made to ensure a high-quality standard of living and sustainable urban development (Baffoe et al., 2022). This is because planning a specific area should improve the quality of life, which implies respect for the citizens' needs and improves spatial and social aspects that lead to better socio-economic development.

Considering the mentioned importance of the planning documentation, this paper, through the method of comparative analysis of this type of documentation of Belgrade and Zagreb, tries to investigate and compare the changes in the spatial configuration of the mentioned cities, which are the result of the adopted planning documents. Through the mentioned method, answers can be obtained adequately to the questions of how actors in the planning process treat transformations of city amenities and what contribution this process has in terms of the socio-economic aspects of the city. The two mentioned cities were chosen for this research for several reasons. Namely, these cities have certain similarities. Belgrade and Zagreb are the capitals of the countries in which they are located, and they were also developed on the banks of the same Sava river. Also, their similarities are reflected in the fact that, in the period of their most excellent development, both cities belonged to the same country, Yugoslavia. In this respect, they were developed according to the same urban principles. Indeed, based on this fact, these cities still have very similar urban planning systems today.

The spatial and urban plans of the above-mentioned cities are going to be analyzed in this paper. Also, plans that include smaller, isolated parts of these two cities will be included, but whose planning solutions are directly focused on the city's riverfronts. As already mentioned in the introductory piece of the paper, the plans created in the previous twenty years will be analyzed. Accordingly, the following plans will be analyzed for the area of the city of Belgrade:

- Changes and additions regional spatial plan of the administrative area of the city of Belgrade, adopted in 2011 and created to review the planning solutions defined in the primary document Regional spatial plan of the city's administrative area of Belgrade, adopted in 2004.
- Spatial plan of the area of special purpose for the development of part of the coast of the city of Belgrade – the area of the banks of the Sava River for the "Belgrade on the Water" project was made following the decision made by the Government of the Republic of Serbia at the session held in June 2014.

- The General Plan of Belgrade 2021 was adopted in 2003. This planning document was initially valid until 2021. Still, in the period after 2003, changes and additions were made to the basic plan, and in 2016, the General Urban Plan of Belgrade was adopted based on this document.

The plans that are important for this research and that relate to the development of the city of Zagreb are:

- Zagreb 2000+ New urban strategy: The general urban plan of Zagreb is a planning document adopted in 2000 and was based on several other plans and concepts from the 20th century. In 2016, amendments to this planning document were adopted.
- The urban development plan of Jankomir-Prisavišće, was adopted in 2008 to define the essential purpose and way of using the space defined by the plan.
- The document Amendments to the General Urban Plan of the City of Zagreb in 2017, which was adopted in 2017, was created based on the General Urban Plan of the City of Zagreb adopted in 2007.

4. RESULTS

Spatial planning in order to create a high-quality and interactive urban structure is the first step toward contributing to the spatial transformation and improvement of the socio-economic conditions of the place (Assche et al., 2020). That is why the documents created in the planning process are of utmost importance in researching and evaluating planning practices and their solutions. These documents are certainly one of the primary means for comparing the situation during and after the implementation of ideas and ideas of actors in the planning process. In this part of the work, a comparative analysis of the planning documents of the cities of Belgrade and Zagreb will be performed. In addition, those documents that treat the riverfront transformation in the mentioned cities will be analyzed.

4.1. The riverfronts of the cities Belgrade and Zagreb

Many cities treat city shorelines in different ways. In the 21st century, great amount of attention is being paid to the potential of the city's riverfronts, and precisely because of this, these areas are characterised as the most significant in the planning processes. Such a case is also noticeable in the two capital cities of the Balkan states, the Republic of Serbia and the Republic of Croatia. Belgrade as the capital of the Republic of Serbia and Zagreb as the capital of the Republic of Croatia are urban areas whose built-up areas are increasing yearly. For this reason, city authorities and various private investors strive to find new areas in the central parts of cities or their immediate vicinity, which can become new places to revitalise urban space. In these cities, in recent decades, increasing attention has been focused on the city's riverfronts, which were intended for certain activities or represented undeveloped accessible areas during the earlier periods of the city's history.

These two cities were fascinating because they belonged to the same state thirty years ago. Accordingly, they mostly had the same or similar principles in the planning process, conditioned by legislation and similar planning schools. This certainly impacted today's planning practice and decision-making aimed at the arrangement of urban space. Of course, the similarities of the riverfronts of these cities are also visible in the fact that they were formed on the same river Sava and had similar relief characteristics.

However, these two cities have specific differences in planning solutions related to riverfront development. Namely, in the third millennium in Belgrade, the realisation of an urban megaproject called "Belgrade Waterfront" was started, which greatly influenced the planning boom in the city itself and the country, at least when it comes to legal regulations (Grubbauer et al., 2018). On the other hand, Zagreb's city has strived to adequately arrange the riverfront through various urban competitions and plans for many years and decades. Still, there was great cohesion between the ideas that the riverfront should become a new residential area or that it should remain an open public area mainly intended for sports activities (Matković et al., 2012). Figure 1 shows the area where the development of ‘’Belgrade Waterfront’’ megaproject was planned and started, while Figure 2 shows the area of the Zagreb waterfront.

Figure 1: Belgrade Waterfront location (Source: Bing, 2015)

Figure 2: Zagreb Waterfront (Source: www.crorivers.com)

4.2. Comparative analysis of planning documents of Belgrade and Zagreb

As already mentioned in the paper, in the XXI century, actors in the planning process paid much attention to the coasts of Belgrade and Zagreb for twenty years. In this regard, in many planning documents, it is possible to find proposals, guidelines, ideas and visions for the arrangement and construction of the coastlines mentioned above. In this work, documents will be singled out in which the city's coastline is defined concretely, i.e. documents that determine the future use of these areas.

Belgrade

The city of Belgrade, i.e. the city authorities and many participants in the planning process in recent years, have initiated arranging the Sava coast and forming an entirely new residential and business settlement. This settlement, named "Belgrade Waterfront", should in the future represent an entirely new centre of the city with clearly expressed characteristics of socio-economic development. That project, of course, received a lot of negative and positive criticism over time, but despite that, it is being implemented to a large extent. In addition to the mentioned part of the coast, the city of Belgrade has many more landscaped features on the riverfronts, but this project is one of those that has a massive impact on the broader picture of the city.

Table 1: Planning documentation for the Belgrade riverfront

Planning documentation	*Year*
The general plan of Belgrade 2021	*2003*
Changes and additions regional spatial plan of the administrative area of the city of Belgrade	*2011*
Spatial plan of the area of special purpose for the development of part of the coast of the city of Belgrade - area the banks of the Sava River for the "Belgrade on the Water" project	*2014*

The city of Belgrade, as mentioned, has a very long coastline that is very diversely arranged. Sports and recreational facilities, green areas, economic activities, etc., are represented on Belgrade's shores. However, in this research, the focus is on that part of the Belgrade coast, which is trying to be given a completely new image and role in the city's further development. That part of the Belgrade coast became the subject of numerous types of research. It is a part of the coast on the right bank of the Sava where the project "Belgrade on the Water" is implemented. Table 1 lists three planning documents based on which a conclusion can be drawn as to how this part of the coast was treated. More precisely, based on these plans, it is possible to determine what this coast looked like before the project implementation and what results are expected after the performance of the planning documentation. Accordingly, it is possible to assume what impact the new imagined part of the city will have on the broader picture of the city and the socio-economic aspect.

In the Regional Plan of the Administrative Area of the City of Belgrade from 2011, the part of the observed coastline characterised as the area of the Sava Amphitheatre is defined as an area that must be adapted to the urban contents that should be built in that zone, but in such a way that the entire coast is opened for unhindered access to water. This plan envisages the formation of new complex business and commercial zones in Belgrade's mentioned area. The spatial plan of the area of the particular purpose for the development of the part of the waterfront of the city of Belgrade - the area along the Sava River for the project "Belgrade on the water" from 2014 fully defines the site where the modern transformation of the riverfront is planned. In the same planning document, green public areas, as well as cultural and historical heritage that exist in a defined area, are singled out. The plan emphasises the importance of existing green public areas in terms of air quality and temperature regulation and as spaces intended for citizens' meetings, communication, enjoyment, socialising and recreational activities. During the preparation of the planning document, many different cultural and historical heritage objects were listed. Certain buildings on the site date from the end of the 19th century, while a large number of them were inherited from the 20th century. It could be said, therefore, that this area was affluent in public areas and heritage objects before the transformation, according to the data from the plan.

On the other hand, the main goals of this plan are the affirmation of the tourism of the city of Belgrade and based on the arrangement of the coasts, the formation of integral ambient units based on cultural and historical heritage, and the improvement of the tourist offer in the function of tourism by creating areas for shopping, and the construction of residential and business facilities with the aim making an offer of a more significant number of residential and business spaces. The General Plan of Belgrade 2021 from 2003 also supports the idea of modern transformation of the coast with the aim of its rehabilitation and activation. This plan also characterises the coastal area being transformed as one of the locations for constructing cultural facilities of the highest national importance.

Based on the above plans, it is evident that the city authorities of the city of Belgrade and actors in the planning process have recognized part of the Belgrade coast as an area that can become a new tourist and economic centre of the city. Without a doubt, it can be said that this kind of transformation of the space, in which multi-storey buildings and shopping centres will dominate, has a direct impact on the broader picture of the city. An increase in the number of users of this area may lead to an overload of the city's infrastructure systems. Indeed, the concentration of new multi-storey buildings will undoubtedly reflect the complete urban image of the city of Belgrade.

Zagreb

In contrast to the Belgrade riverfront in the city of Zagreb, the city authorities have repeatedly tried to organise the riverfront during the last few decades. In connection with this, various tenders were announced, and planning documents were drawn up. However, Zagreb's coastline remained mainly intended for sports and recreational activities without significant changes in the construction of new residential and business facilities or activating the city's tourist offer in the coastal zone.

Table 2: Planning documentation for the Zagreb riverfront

Plans	*Year*
Zagreb 2000+ New urban strategy, Proposal of the new General Urban Planning of the city plan of Zagreb	*2000*
Urban development plan of Jankomir-Prisavišće	*2008*
Amendments to the General Urban Plan of the City of Zagreb in 2017	*2017*

Developing the Zagreb riverfront has always been an exciting challenge for planners and city authorities. For a whole century, the actors in the Zagreb planning process have been trying to find an adequate solution and model according to which they would arrange the city's riverfront so that it becomes the new driving centre of Zagreb's development. As in the case of the analysis of the transformation of the coast of Belgrade, three essential documents have been singled out in this part of the work, through which the vision of the future development of the Sava coast can be seen most adequately. Indeed, it is critical to emphasise that many documents and initiatives treat this part of the urban structure in specific ways. Table 2 shows the three

analyzed planning documents on the basis of which conclusions are drawn about the development of the Zagreb waterfront.

As early as the beginning of the third millennium, the city of Zagreb tried to solve the undefined status of the Sava coast in a way to determine its clear purpose in further urban development. In the spatial planning document from 2000, the area of the city's coastline is defined as a "skipped" area in the planning process with exceptional potential. In this document, the area along the Sava River is mainly characterised as an area intended to develop infrastructure systems to improve the city's water supply, sewerage, and traffic network and as a sports and recreational area. Although there is a great desire of the city authorities for complete development of this area, there are no concrete solutions, also, in the Jankomir-Prisavišće urban development document from 2008. In addition to numerous concrete solutions and projects, there are no concrete solutions for transforming the Sava coast. To the greatest extent, the development of new public facilities in the immediate surroundings and the preservation of green areas to further promote the greenery of the city of Zagreb are sought. The amendments and additions to the General Urban Plan of the City of Zagreb from 2017 clearly define the visions for the further development of the City of Zagreb and, thus, the banks of the Sava River as part of the urban area. This plan proposes preserving wide undeveloped spaces between the built structures of the settlement. Also, it strives to develop and improve the cultural and tourist offer and promote sports and recreational activities while preserving the green areas along the Sava River.

Based on the above, a clear difference can be seen regarding the treatment of city shores in the planning documents of Belgrade and Zagreb. However, it is essential to emphasise that these two cities, although they are the largest cities in the states, differ in terms of population and built-up near river banks. Indeed, there is a noticeable difference in terms of the relationship to the riverbanks, i.e. their use. While the city of Belgrade in the 21st century is trying to move the city and tourist life to the coast, the city of Zagreb, on the other hand, is trying to preserve the rich green spaces along the river and improve them, thus making it a detractor of development in another way. Nevertheless, it is essential to emphasise that during the last time, the idea of transforming the city's shores was present in Zagreb, and still is exactly the way it is happening in Belgrade.

5. DISCUSSION AND CONCLUSIONS

City riverfront s are parts of the urban structure that ennoble cities and make the city space much more diverse. Richard Marshall, in his book Waterfronts in Post-Industrial Cities (2004), states that urban riverfronts are extremely important in cities because they improve anaemia in their immediate environment and the entire city. It is crucial to emphasise that throughout the riverfront's history, significant changes have taken place. Thus these spaces in many cities have become places for people to gather and connect, from being a pure business zone. Furthermore, it is undoubtedly vital to emphasise that these areas have become important economic and development hubs of cities. As mentioned in the paper, many cities in recent decades have decided to develop new settlements in these areas to initiate a major reconstruction of the city and, at the same time, provide housing for new city residents. All of this directly affects the city's image's breadth and the urban structure's quality.

This paper shows that planning documents play an extremely significant, if not the most important, role in developing a project from idea to realisation. Based on these documents, it is possible to evaluate the needs for the completion of a specific idea, that is, a project, and it is possible to determine how that project affected the entire city. Cities of Belgrade and Zagreb, due to their history, population, and importance as administrative centres must adapt their urban structure to the needs of the wider population. Precisely because of this, the actors in the planning process in both cities, through concrete examples of the transformation of city shores, clearly convey the idea of exploiting the area's tourist potential. It is clear that tourism represents one of the essential tools in development, and it must undoubtedly be included in the plans of the mentioned cities. However, as seen in the paper, in terms of coastal planning, there is a big difference between the two analyzed cities. Belgrade is undoubtedly striving to transform its riverfront in a way that has been very popular in recent decades all over the world, as seen in the already mentioned city of Hamburg. Namely, through the "Belgrade on the Water" project, the tourist offer in this city is completely changing, as well as the broader picture of the city, and all of the above have a significant impact on the socio-economic aspects of this city. On the other hand, in the city of Zagreb, the planners are trying to preserve the green area and sports activities along the Sava river, thus aligning themselves with the cities that want to promote the banks as open public spaces to everyone. Nevertheless, following the trends in European and world cities, building new settlements along the river and creating a unique cultural and touristic city offer is being promoted from time to time in Zagreb.

Following what was stated in the paper, the basic conclusion is that the modern transformations of the city coasts are precisely those in which the purpose of the city coast, as well as its appearance, is completely changed. In this transformation, without a doubt, the overall image of the city also changes, and thus also many other spatial and social aspects. This change can be a ban on the use of traffic in a specific area and the use of the coast for open public spaces. Still, in the 21st century, it is a pervasive case that cities around the world tend to reconstruct the coastal area to build new housing - business premises and make the coast a development centre of the city in this way. For such transformations to take place with as much benefit as possible for all users of the space and as minor damage as possible to the cityscape, it is necessary:

- Involve citizens in decision-making processes and, through public insights, clearly determine their needs and desires from a specific space;
- Conduct analyses and studies to determine how the transformation of the city coast will affect the city and its functioning;
- During the transformation process, it is mandatory to try to preserve the spatial potentials in the form of green areas as much as possible, as well as the cultural and historical riches of the area.

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IMPACTS OF COURTYARD ENVELOPE DESIGN AS AN IMPORTANT ARCHITECTURAL PARAMETER FOR ENERGY SAVINGS

Dusan Randjelovic

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
Ph.D., Teaching and Research Assistant, dusan.randjelovic@gaf.ni.ac.rs

Miomir Vasov

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
Ph.D., Associate Professor, miomir.vasov@gaf.ni.ac.rs

Dragana Dimitrijevic Jovanovic

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
Ph.D. student, Junior Researcher, dragana.dimitrijevic@masfak.ni.ac.rs

Danka Kostadinović

Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia
Ph.D. student, dankak@vin.bg.ac.rs

Aleksandra Ćurčić

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
Ph.D. student, ajkiro94@gmail.com

ABSTRACT

When designing facilities with lower energy consumption, the most crucial parameter is the correct choice of location. The terrain configuration has a distinct influence on the organization of the urban plan and the building design. It largely determines the microclimate, especially the temperature level, direction, and wind speed. The subject of this paper is the analysis of courtyard configuration as a dominant parameter in architectural design and energy savings. The courtyard is an open area that is tied to a specific building. It is usually surrounded by walls, other buildings, or a fence. The courtyard's dimensions significantly affect the project's development and the location's microclimatic characteristics. The courtyard's proportions and configuration directly affect the building's shape, so it is essential to consider the advantages and disadvantages of different influential parameters adequately. The influence of solar radiation on heat gains is evident, while it also increases the energy demand of buildings with different shapes and proportions of yards. Through an overview of various architectural aspects, the paper provides guidelines that can be useful to designers and spatial planners to form and select adequate courtyards for the buildings.

Keywords: courtyard configuration, architectural design, energy savings, urban planning;

1. INTRODUCTION

Increased urbanization in larger cities has influenced the design of buildings with an increased need for mechanical ventilation. Along with ensuring higher air quality and thermal comfort for the tenants, there was an increasing energy consumption. Global warming and climate change consequently lead to significantly higher energy consumption to provide thermal comfort in buildings, directly affecting the environment.

As a result, there has been a general movement toward finding effective design strategies to reduce buildings' energy demands and encourage further awareness of energy-conscious design. Designing a passive solar

building can reduce additional heating costs in buildings without compromising user comfort. Besides the impacts on the energy performance of integrating passive energy strategies [1], such as Trombe wall [2], double skin facade [3], green roof [4], and chimney effect [5]), the implementation of the courtyard and atriums can contribute to energy savings in buildings. In addition to climatic features [6–8], orientation [9–12], shape [13–16], and the ratio between the surface of the outer envelope of the building and its volume, the inner courtyard or atrium could also affect the final energy consumption in buildings [17]. They are integrated into the construction so that they could be considered a unique space, the so-called "atrium room". The geometry of the courtyard can play a significant role in the final energy consumption of the building [18].

By improving the urban landscape architects aim to solve global challenges. Some ways to achieve these goals are reflected in preserving heritage-inspired planning and design. At the same time, we should strive to develop cities of the future following modern approaches to urbanization patterns, architecture and design. This paper points out the benefits of designing buildings with an internal courtyard and the impact of good courtyard design. The paper concludes that adequate application of the courtyard could contribute to sustainable energy-efficient development of future cities.

2. COURTYARD AND ATRIUMS THROUGHOUT HISTORY

The original courtyards originated around the great Indus River region from 6500-6000 BC and evolved in response to the climatic and cultural conditions of the context. During the medieval period, the courtyards acted as an open space within the fortress to enjoy nature but remained protected from enemy forces. Although they varied in size, the houses of the time had a typical plan with a square courtyard in the center and rooms surrounding it. The smaller dwellings consisted of one courtyard along the northern wall, while the larger ones had several courtyards. The courtyard size is determined proportionally to the surrounding walls per the local climatic conditions.

The courtyard is an open area connected to a particular structure, often bounded by walls, other buildings, or a fence. The history of the courtyard can be traced back to 3000 BC in the archaeological remains of a courtyard house in Ur, Mesopotamia (Figure 1). In the Roman Empire, courtyards had basins to catch rainwater. Early medieval Christian churches often used atriums or courtyards as covered, open spaces at the front of the building. The courtyard served not only to achieve natural ventilation but also as a space for the socialization of the building's residents. Its purpose was different during the historical development: socializing, walking, cooking, looking after animals, etc. Although in ancient times, the primary idea was to ensure better social connection within the central premises, in the nineteenth century, the application of metal and glass enabled the further development of these systems so that from the middle of the twentieth century, the concept of the atrium experienced a revival and significantly improved the economy and the environment.

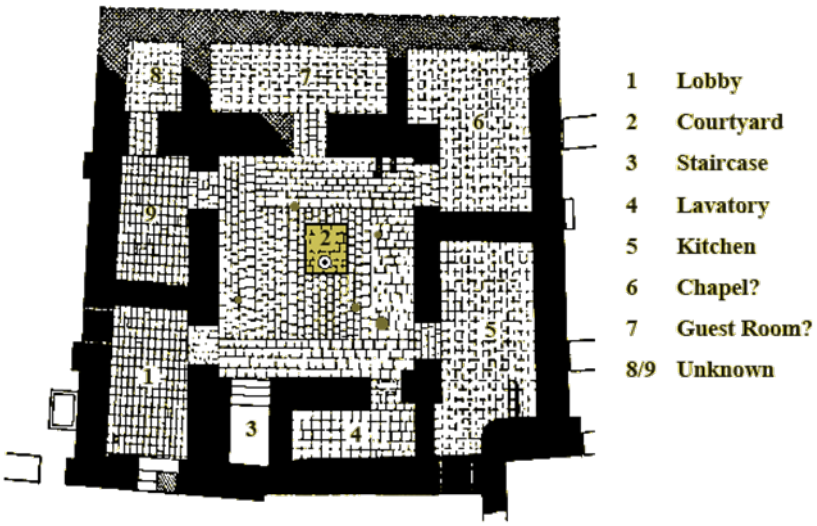

FIGURE 1: House in Ur, Mesopotamia [19]

The incorporation of the courtyard into building design in the modern era began during the Industrial Revolution with the availability of plate glass and slender structural elements of iron and steel. However, modern atriums appeared in the late 1950s and early 1960s. The new atrium originates from the temperate

climates of high latitude regions, providing an environmentally controlled room, natural sunlight, and warmth during winter. The ecological benefits of the atrium and courtyard design were reconsidered in response to the energy crisis. However, when designing these types of constructions, special attention should be paid to analyzing climatic conditions. Nowadays, many hotels, houses, country houses, and public spaces carefully recreate courtyards [20]. Land costs are increasing with the current urbanization rate and residential architecture development, so implementing internal courtyards in buildings is becoming very expensive [21].

2.1. Basic forms of the atrium

Despite its various advantages, the approach to courtyard housing typology is often neglected. Houses with a courtyard belong to particular types of individual family buildings. Unlike atriums which are enclosed spaces or spaces for "public use", courtyards are not covered with a roof, and these spaces may or may not be enclosed. Courtyards can be designed in several ways, but their configurations should always be a reasonable response to climate goals and a pleasant living environment. Typical configurations of this architectural element can be surrounded by walls or partially enclosed. The design is mainly based on climatic conditions and architectural experiments to ensure the expected level of thermal comfort in the building. There are four different forms of the atrium, and each has a unique environmental advantage chosen according to its ambient condition, expected ventilation, and daylighting. In moderate climatic conditions, it is recommended to design the atrium next to the building as a glazed facade, enabling more significant solar gains in winter. For hot and humid climates, centralized and linear atriums minimize temperature fluctuations during warm and temperate seasons (Figure 2).

a) central b) semi-closed c) glued d) linear

FIGURE 2: Forms of the atrium (From left to right: central; semi-closed; attached; linear)

3. OVERVIEW OF THE MAIN INFLUENCING FACTORS WHEN DESIGNING BUILDINGS WITH AN INTERNAL COURTYARD

3.1. Climatic characteristics and orientation of buildings

Climatic conditions have a dominant influence on the design of buildings with courtyards. Thermal characteristics of a building with a square courtyard, which is surrounded by buildings on all four sides, in different climatic conditions, differ depending on the climate, and have a different impact on cooling, heating, and total annual energy consumption. Generally, buildings with an open interior courtyard show better energy performance in hot-dry and hot-humid areas.[7]. In warm, humid climates, it is desirable to orient the longer axis of the courtyard along the northeast-southwest direction to achieve good performance. Furthermore, buildings with internal courtyards are best oriented along the north-south axis in moderately cold climates. In a warm, dry climate, buildings are best oriented between the northeast-southwest and north-south directions to ensure efficient performance in both seasons [6]. Using the modeling method, Muhaisen [6] performed an analysis of the influence of the geometric shape of the courtyard, as well as the effects produced on the inside of the analyzed rectangular shape for four different locations as characteristic representatives of regions with warm, humid, warm dry, moderate and cold climates. The study indicates the influence of climatic conditions on the proposed geometric characteristics and height of the yard to achieve a justified annual performance of the investigated locations. The results showed that the shading conditions of the inner side of the courtyard depend significantly on the proportions of the shape, geographical location, and available climatic conditions. Almhafdy, Ibrahim, Ahmad, and Yahyaocene [8] performed an analysis of the microclimate characteristics of a U-shaped courtyard in a General Hospital in Malaysia. It was confirmed that the change in the yard's configuration and its orientation affect the microclimate inside the yard.

The orientation of the building significantly affects its relationship to the natural environment, sun, wind, weather, thermal inertia, thermal insulation, topography, landscape, and views. Decisions made during spatial planning have an impact on the energy characteristics of the building throughout its life cycle [9]. The optimal

orientation of the building is one of the essential factors that create the conditions for the rational use of energy in the urban planning stage[10]. Regardless of the orientation, smaller houses and houses of higher quality performance are more efficient and better than those whose square footage exceeds 250m^2 or houses designed for the basic level of energy efficiency compliance[10]. The best position for symmetrical houses is when they are exposed to all directions.

In contrast, for houses with an elongated base, the longitudinal side of the house should be oriented towards the south [11]. The analysis of sunlit surfaces facilitates the determination of temperatures inside the building. Graphically determining the sunlit area is helpful for visualization and precise measurement [12]. East and west orientation are favorable in summer, while winter is much less sunny. The building should be opened to the south to have as much heat gains as possible through the windows - a direct solar energy gain. A south-facing free wall can have large glazed areas that provide solar gains. Living areas should be oriented toward the south, and bedrooms and utility rooms should be oriented toward the north. Rooms often used should have the most significant solar energy gains, made possible by large glass surfaces. On the contrary, less used rooms (cold, unheated rooms) with little need for daylight can be oriented on the opposite side.

3.2. The influence of the shape of the building and courtyard on energy consumption

The influence of the shape of the building on the total energy consumption in buildings primarily depends on three factors: relative compactness, window-to-wall ratio, and solar heat gain coefficient of the glazing.[14–16]. Optimizing the geometry of office buildings and glazing can reduce energy consumption and achieve savings regardless of the climate zone in which the building is located [22]. An object whose shape creates less airflow resistance and friction will cool or heat less. Florides and others [11] indicate that annual heating needs an increase in the elongated shape compared to the square-shaped base. That increase ranges between 8.2 and 26.7%, depending on the type of construction. In thermally insulated buildings that have a different form factor, the rates of thermal energy savings range between 1% to 7%, while in the case where buildings have the same form factor, the rate of thermal energy savings is from 34% to 36% compared to buildings without thermal insulation. Considering that these measures relate to the saving of thermal energy, it is pretty evident that they can significantly affect the financial picture of the entire facility [23].

The energy characteristics of buildings with a yard depend on many variables. The type of building with a courtyard has proven to be relevant in all climates. The energy performance of buildings with a courtyard compared to buildings with an atrium showed that buildings with a courtyard are a more energy-efficient option as part of low-rise buildings, while buildings with an atrium record better results in buildings with a higher height, i.e., in multi-story buildings [24]. In general, shallow rooms have the best energy performance for all window orientations and sizes in warm and temperate climates, while deep rooms perform best in cold climates. Regarding the shape of the base, in warm and temperate climates, the best energy performance is recorded for shallow rooms with medium-sized windows, deep rooms with large windows for north-facing rooms with large windows, and all rooms with small windows oriented to the south. In cold climates, the best performance occurs in shallow rooms with small windows and deep rooms with medium-sized windows for south-facing rooms with large windows.[22].

Internal courtyards act as microclimate modifiers that improve the perception of environmental comfort. Using courtyards in buildings can reduce the need for adjacent cooling spaces by more than 10%[25]. Due to the significant exposure of the external walls, houses with a courtyard are more suitable for warmer climates. These buildings are primarily single-story buildings, although it is possible to design multi-story solutions in some cases. Energy-efficient solutions for such buildings imply the orientation of the living rooms towards the south, while the sleeping rooms are designed towards the east side. This construction system represents one of the most energy-efficient construction methods. With two-story courtyards, the walls of the second floor receive more radiation than the walls of a single-story courtyard of the same size would receive.

On the other hand, the load from solar radiation on the lower floor surfaces is far less than on the surfaces of the one-story courtyard. Forms with a minor aspect ratio of the base in the selected geometric range receive minimal radiation [26]. Total energy consumption in narrow, elongated, or rectangular atriums with a large length ratio to width is significantly higher than in square atriums[27].

4. BASIC BENEFITS OF DESIGNING BUILDINGS WITH AN INTERNAL COURTYARD

Atriums and courtyards are similar structures found in residential and commercial spaces. Despite their many differences, they have in common that they provide space for relaxation and privacy while at the same time enabling natural ventilation and daylighting. Depending on their shape and orientation and applied glazing, atriums and courtyards contribute to reduced building energy needs. Throughout history, these constructions have been most often used in landscape architecture. The benefits of using this type of construction are reflected in the excellent use of ventilation and lighting as ways in which courtyards contribute to the sustainable, energy-efficient development of buildings. These spaces contribute to aesthetics, exposing adjacent interior spaces to daylight and maximizing direct solar energy. Also, they provide air circulation, increased socialization, and interaction between building residents.

Traditionally used as a central space between apartments, there has been a paradigm shift in the approach and design of the courtyard. Serving as a focal point and a protective barrier against harsh climates, courtyards are seen as a way of life. From influencing the indoor environment to creating a peaceful corner in a busy lifestyle, yards offer many benefits to enrich our lives. The yard as a passive solar system was developed mainly in response to climatic requirements. Poor or inappropriate design can create challenges in controlling the yard's temperature, glare, and energy consumption. Energy-efficient courtyard design involves looking at the shape of the building and its associated courtyard, ventilation, and courtyard performance in terms of daylight factor to improve the building's energy efficiency performance[28].

4.1. The courtyard illuminates the surrounding rooms

The sun's position varies with latitude, which significantly impacts the created conditions [6]. External static shading should be adapted to the characteristics of the location and should be designed depending on the location, which would be controlled according to seasonal conditions [12]. The courtyard, positioned under the open sky, allows the rooms surrounding it to be exposed to more daylight. Even long, narrow houses with fewer openings can be well lit with the help of a courtyard that saves large amounts of energy and creates a pleasant atmosphere in the house. The yard's proportions and geometry significantly influence the yard's shading, which depends on the position of the sun in the sky and the geometry of the yard [18].

By introducing natural lighting to the interior, interior courtyards and atriums provide a more pleasant working environment by connecting to natural daylight and the outside environment. Protection from the sun on the south side of the building can be achieved by trees planted along the facade in the form of a horizontal shelter. Shading east and west-facing windows can be achieved with vertical barriers such as trees. Deciduous trees in the winter, when the leaves fall, allow the sun's rays to penetrate the interior of the building unhindered through the branches, and in the summer, it provides a strong shadow.

4.2. The yard provides ventilation

Natural ventilation in buildings plays a crucial role in ensuring the optimal quality of internal air circulation in the building and maintaining an acceptable level of thermal comfort without using mechanical systems such as heating, ventilation, and air conditioning. One of the most critical roles of the inner courtyard is the supply of fresh air and the removal of stale air from the building premises. By providing natural and cross ventilation, courtyards increase oxygen supply and provide the maximum cooling effect. While they draw in the fresh air and expel hot air in the summer, solar radiation protects against cold winds in the winter. In addition to helping to exchange heated air from adjacent spaces from the building, it enables connecting the space with the outside space. The courtyard can use ventilation for heating by bringing fresh air in and exhausting stale air with less air exchange ventilation. In case of intense solar radiation, in addition to the yard's design, it is necessary to install a solar chimney or a double facade in the facade of the building. The use of additional mechanical ventilation is most often used in urban areas to extract cleaner and cooler air from the upper atmosphere using an inverted solar chimney.

Atriums offer natural light, and if they are covered, they require some form of ventilation in the spring and summer because the glass retains heat. In contrast, during the fall and winter, the trapped heat enables energy savings for heating. This way, there is optimal energy consumption and summer comfort in extreme climatic conditions. An atrium with the exact geometric dimensions in different climates and glazing conditions is more energy efficient with increasing building height. At the same time, in the summer months, it is more advisable to use an open courtyard in low-height buildings.

4.3. The courtyard connects the interior and exterior and, at the same time, offers privacy and security

Although there are less pronounced differences between the modern atrium and the courtyard, their purpose is essentially the same. Both aim to improve the quality of life of those who live or work in the building or home. They offer a semi-covered or private space where one can enjoy the outdoors. The natural light entering the space provides space for growing a garden or various other plants in full sun. Courtyards are open spaces that contain indoor elements, such as places for cooking or sitting, while atriums bring a small amount of the outdoors into the indoor space. The courtyard provides physical separation of space within the house, providing residents with an open space available throughout the day. This space is private, secure, and easily accessible without the distraction of household chores. Establishing a connection with the natural environment allows residents to relax in a more private garden with fresh air and a clear mind. This way, the stress level is reduced, the immune system is strengthened, and it can be used as a meeting place for people.

4.4. Radiation control of the outer surface of the envelope

Shape parameters that affect the thermal balance of building surfaces with an internal courtyard under the influence of solar radiation are geometric (proportions, size, and orientation) and physical (reflection from the object's surfaces). The first category affects the initial radiation load on the object's surface, while the second affects the final load from solar radiation [29]. Solar heat gains through glazing represent one of the most dominant building envelope parameters that affect their energy efficiency [30]. The geometric shape of the yard has a minimal influence on the sun exposure of the inner surfaces of the yard in the winter period. In contrast, in the summer period, this influence is more significant [18]; by reducing the depth of the yard, the penetration of the sun's rays increases. The optimal height of buildings with an internal courtyard and enabling the best performance of the building in summer and winter, is a height of three floors in hot-humid areas, two floors in warm-dry and temperate areas, and one floor in cold climates [6].

The tendency is that buildings with a shallow inner courtyard are built in moderate and cold climates due to the sun's low position in the sky. By increasing the depth of the inner courtyard by adding a parapet to the top of the building walls, the load from solar radiation progressively decreases as the height of the parapet increases [26]. Deep-form patios of any geometry are generally recommended to achieve maximum internal shading in summer. On the contrary, in winter, the shallow form of the yard would allow the sun to shine on the most significant part of the yard [18]. A building with a deep courtyard significantly influences the sun exposure of the interior surfaces in the summer, which results in a low energy need for cooling. At the same time, in the winter, minimal heat loss is ensured, reducing the need for heating. Several methods can be used to improve the control of heat gains from solar radiation in the summer, such as light colors or shading devices. In this way, the absorption of solar radiation is reduced, and at the same time, the thermal characteristics of the outer envelope of buildings are improved. The courtyards shaded from the buildings contribute to a reduction in cooling needs by an average of about 4%, while in winter, the need for heating increases by an average of about 12% [31].

Controlling the thermal performance of the inner courtyard concerning solar radiation can be achieved naturally by controlling the radiation of the outer surface of the envelope. This type of solar radiation control is achieved by manipulating the geometric and physical parameters of the form [29]. Energy-saving measures such as thermal insulation, double-glazed windows, Persian blinds, and sealing strips can reduce energy needs for cooling as much as a well-designed yard. At the same time, a properly designed courtyard reduces the building's energy needs for heating [21,32].

5. CONCLUDING REMARKS OF DESIGNING BUILDINGS WITH AN INTERNAL COURTYARD

This research aimed to identify an energy-efficient, integrated use of the courtyard to improve the energy performance of buildings in terms of seasonal and climatic factors. The results of this research showed that the use of passive characteristics of the courtyard affects reduced energy consumption and improved lighting and ventilation, but also the control of the radiation of the building envelope. Architects and planners, as well as policymakers, may profit from the mentioned guidelines.

The importance of the courtyard is reflected in its practical implementation through the aesthetic aspect. In urban environments, courtyards can provide many benefits, such as security for adults and children and connecting the interior with the exterior. A contemporary approach to courtyard design requires multiple functions, adaptable recreational spaces for residents to network, and flexibility to exchange and change use

according to community requirements. Integrated use of courtyards and atriums can save energy in different climates. The integrated use of the passive features of the courtyard and atrium affects energy consumption. It is recommended to carry out further studies on the impacts on the energy performance of integrating other passive energy strategies (e.g., Trombe wall, double skin facade, green roof, chimney effect) on the buildings with the courtyard. Although the courtyard is only one of many strategies for ensuring better energy efficiency of buildings with increased thermal comfort, its adequate application contributes to sustainable energy-efficient development and could lead to the development of the cities of the future.

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CASSINIAN DIRECTORIAL CURVES AS A PATTERN FOR URBAN DESIGN

Maja Petrović

University of Belgrade – The Faculty of Transport and Traffic Engineering, Serbia
PhD., Associate Professor, majapet@sf.bg.ac.rs

Aleksandar Trifunović

University of Belgrade – The Faculty of Transport and Traffic Engineering, Serbia
PhD., Assistant Professor, a.trifunovic@sf.bg.ac.rs

Dragan Lazarević

University of Belgrade – The Faculty of Transport and Traffic Engineering, Serbia
PhD., Assistant Professor, d.lazarevic@sf.bg.ac.rs

ABSTRACT

The urban planning of cities or city blocks is, in essence, tightly connected to geometric grid patterns. Cities of the future, thanks to modern technology, are increasingly based around complex geometrical forms. Fractals, radio-concentric networks, regular and irregular polygons, fingerprint patterns, Voronoi diagrams, are just some of the modelling structures, i.e. generators, used when defining a modern urban design. Geometric cities (GC) generated using new geometric forms are the topic of this paper. The geometric patterns we created are based on the use of Cassinian directorial curves (CDCs). A CDC is the geometric locus of points with a constant product of distances to directorial lines. These curves, besides having the property of incorporating a constant geometric mean, are generated using regular polygons (the edges of the polygon are the directorial lines), and thus belong to the group of curves with a perfect radio-concentric network. CDCs will represent new city blocks, while the traffic infrastructure will be connected to the directorial lines.

Keywords: *urban planning; street pattern; city block; geometric form; regular polygon, directorial line; Cassinian curve*

1. INTRODUCTION

Cities are the base elements of the development of society and they're a basic structure in migrational demographic processes. Throughout centuries, many cities have changed their cultural, religious and social characteristics, changed their governors, flourished or, on the other hand, decayed and disappeared. The development of cities has always been tied to civilizational progress. Modern cities, thanks to economic development and contemporary technics and technology, are growing according to the principle of geometrically organized bases (streets, roads, squares and/or parks) with spatial structures (buildings) in-between them. Furthermore, the bases of cities (top-view) are becoming increasingly similar to more complex mathematical/geometrical 2D elements. The principle of the regular expansion of cities is based on the adopted geometrical concept as well, although the fact that "a modern city is not only expanding, but also growing in height" (Ristić and Lješević, 2011) should also be noted. Functional city planning is the first base principle of sustainable urban mobility planning.

1.1. Geometric grid patterns from ancient times to today

The urban planning of cities or city blocks is, in essence, tightly connected to geometric grid patterns. Rectilinear networks, radio-concentric networks, regular and irregular polygons, fractals, fingerprint patterns, Voronoi and Delaunay diagrams, are just some of the modelling structures i.e. generators used when defining a modern urban design. "The only clear mathematical analogy between architectural styles is the presence or absence of patterns" - said Salingaros (1999).

All over the world, rectilinear networks are very common and these networks are characterized by road sections crossing at right angles. We will present just a few examples of this network which has been in use as early as in an old Hippodamian urban structure in the antique Egyptian city of Kahun (pyramid of Sesostris); the American cities of Chicago in 1848, New-York with Manhattan, Sacramento and also the Asian city of Ho Chi Minh in Vietnam (Josselin et al. 2016). Hippodamian or rectilinear (also called Manhattan) networks are made of rectangular polygons, while radio-concentric networks show a center location and a series of radial and circular links (Arc de Triomphe and Place de la Nation, Paris, France; Brøndby Haveby, Denmark; Suncity in Arizona, USA; Rotonda West, United States; Jumeirah Islands, Dubai, United Arab Emirates; Al Falah Housing Project, Abu Dhabi, United Arab Emirates). This pattern traces back to ancient times and continues even to this day (ArchDaily, 2020). The Plaza Del Ejecutivo in Mexico City (Mexico), like many squares with regular geometric plans, is located in the center of radially arranged sixteen streets and it is inspired by the radiating streets found in Palmanova, Italy, from 1593 (ArchDaily, 2022). Furthermore, Piazza Carlo Maria Carafa in Grammichele (Sicily, Italy), build in 1693., represents the connection of regular polygons with a radial network. The streets parting from the sides of the hexagon-shaped square also cross six other squares located in the surroundings of the central square (ArchDaily, 2022).

The use of irregular polygons and polyhedra in urbanistic and spatial planning is noticeable when Voronoi and Delaunay diagrams are used (Nowak, 2015; Ai et al. 2019; Zuo et al. 2020). Voronoi diagrams are a method of spatial data interpolation into polygons around each point in such a way, that each location from the area surrounding a given point is closer to it than to any other point (Pokojski and Pokojska, 2018).

A fractal form fills space by replicating its form at increasingly finer scales (Jahanmiri and Parker, 2022). Within their research, authors Jahanmiri and Parker (2022; see Fig. 5) present a historical bibliometric analysis of literature on fractals in urban planning based on the count of publications per year. There has been an increasing amount of research about the application of fractal geometry in urban pattern design (Batty and Longley, 1994; Salingaros, 2005; Marshall, 2005; Jevrić et al. 2014; Frankhauser, 2015; Boeing, 2018).

Low walls throughout the island of Bavljenac (Croatia) give the appearance of a fingerprint's tiny ridges. Even the oval shape of Bavljenac, which was recently nominated to become an UNESCO world heritage cultural site, adds to the finger comparison (InterestingEngineering, 2017). The viral image of a fingerprint-shaped German village was of a 3D graphic created by an artist called Jacob Eisinger for the February 2015 cover of Modus Magazine (TheQuintWorld, 2021).

Sustainable urban mobility, traffic planning, reduction of pollution and noise are just a few of the reasons to create new geometric forms of cities. Geometric cities (GC) generated using new geometric forms are the topic of this paper. The geometric patterns we created are based on the use of Cassinian directorial curves (CDCs).

2. NEW GEOMETRIC FORMS

Cassinian focal curves (CFCs) represent geometric loci of points with a constant product of distances to n fixed points - foci ($R_1 \cdot R_2 \cdot \ldots \cdot R_n = S^n$, where R_i are Euclidean distances from a point of the locus to the focal point). Based on a previously known premise: "From a geometric point of view, in a plane, a line is dual to a point and vice versa" (Petrović et al. 2021), we have defined Cassinian directorial curves. A CDC is a geometric locus of points with a constant product of distances to directorial lines.

2.1. Cassinian directorial curve definition

We can define a Weberian n-directorial curve, where the number of directorial lines is n ($n \geq 1$). The following equation represents a planar curve as a locus of points with a constant sum of distances to n fixed straight lines (Petrović, 2016)

- $r_1 \cdot r_2 \cdot \ldots \cdot r_n = S^n, \quad S > S_0$ *(Eq. 1)*

where r_i are Euclidean distances from the point of the locus $T(x,y)$ to the directorial lines d_i ($i=1..n$). The smallest value of the parameter $S = 0$ for which the locus (Eq. 1) is a nonempty set represents the Fermat set of points (Petrović, 2016).

Beginning with two lines which are geometrically dual to two foci, then an equilateral triangle, a square and a regular pentagon, the sides of which coincide with directorial lines d_i ($i=2..5$), in Figure 1 we present the form variation of directorial curves for appropriate values of parameter $S > 0$. These curves, besides having the property of incorporating a constant geometric mean, are generated using regular polygons (the edges of the polygon are the directorial lines) for four different values of parameter S, see Fig. 1 c-e.

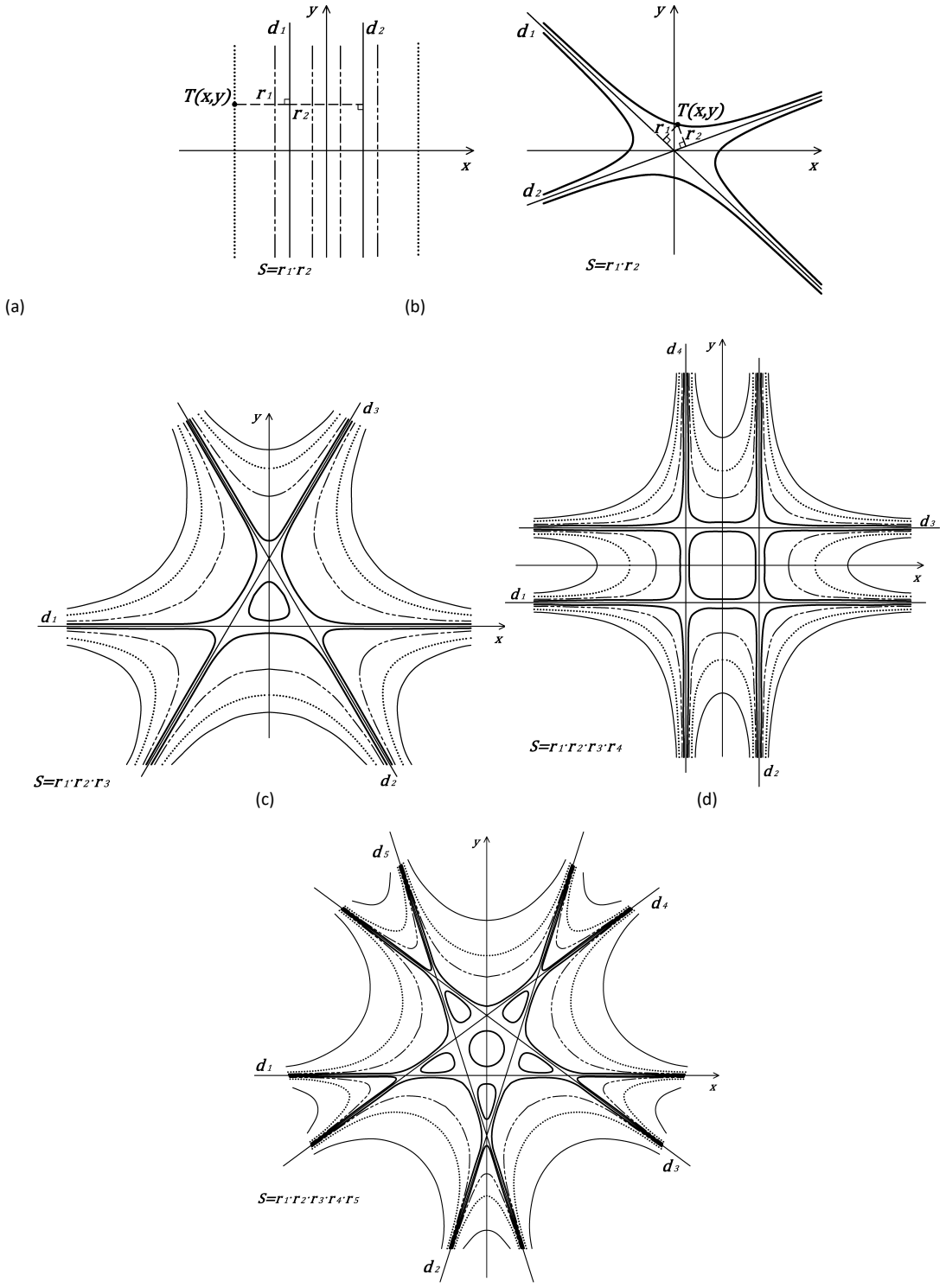


Figure 1: Cassinian directorial curves with: (a) two directorial lines, $d_1 \parallel d_2$; (b) two directorial lines, $d_1 \cap d_2$; (c) three directorial lines; (d) four directorial lines and (e) five directorial lines

2.2. Geometric pattern: Cassinian directorial curve with eight directorial lines

For the beginning geometrical pattern of a new urban design, we have chosen a regular octagon. More exactly, we have generated Cassinian curves such that their starting directrices coincide with the sides of a regular octagon (Fig. 2, black polygon line). The number of directrices was chosen to be eight, knowing that Vitruvius had, for his ideal city, chosen this very polygon (eight-part windrose). Vitruvian city was an octagonal radial-concentric city. Vitruvius describes how to trace the direction of the eight winds astronomically and relates the tracing of the street network of the city to the form of the windrose (Lagopoulos, 2009).

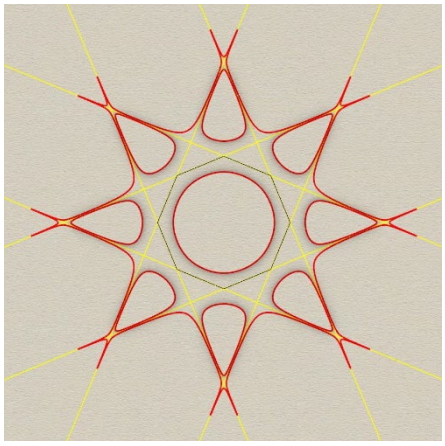
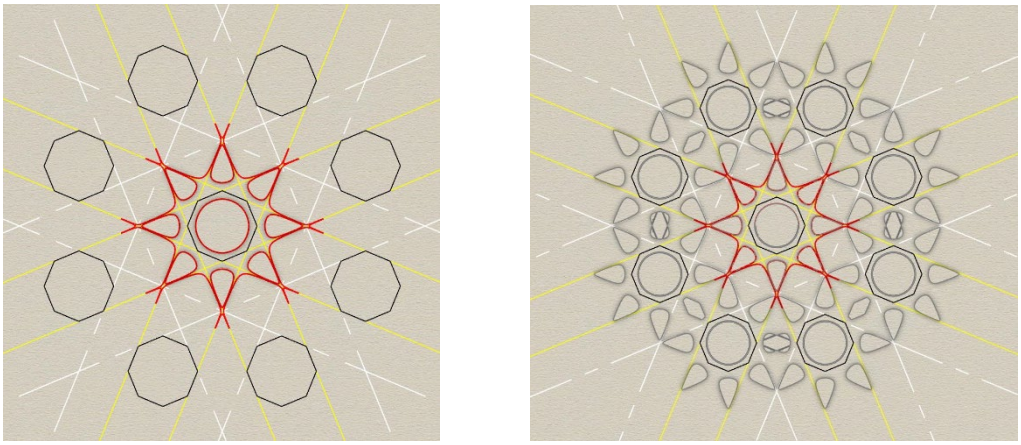


Figure 2: Geometric pattern - Cassinian directorial curve (red line) with eight directorial lines (yellow lines)

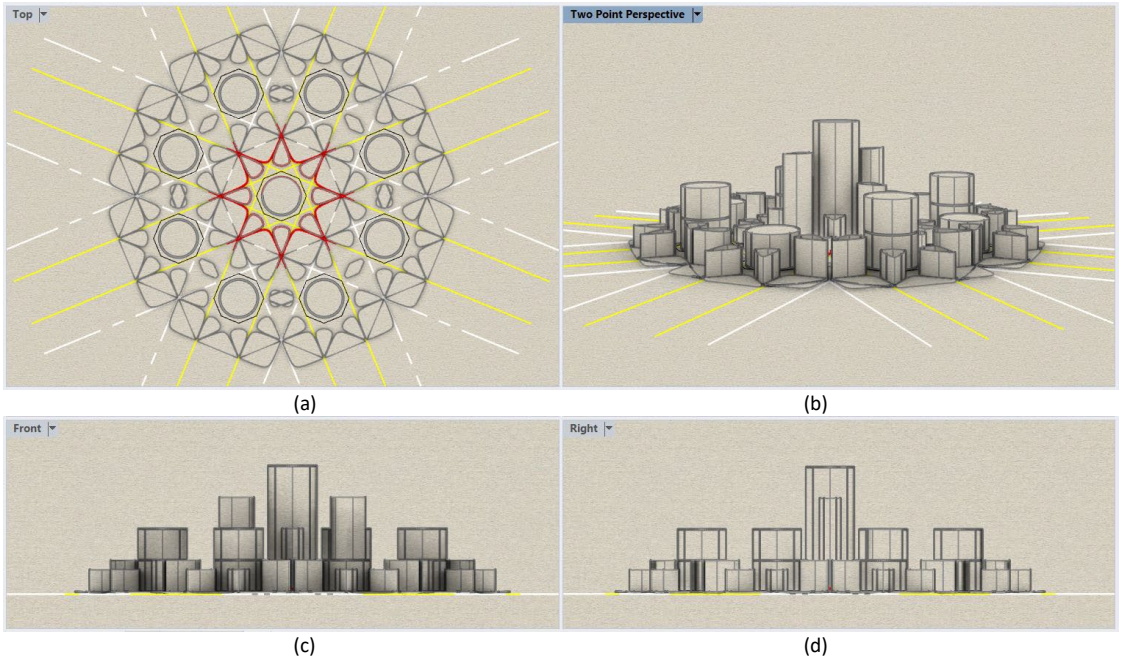
2.3. Cassinian town - Example of new geometric city

Radially repeating the starting geometrical CDC with eight directorial lines pattern, (Fig. 3a) we have formed new multiplied CDCs (Fig. 3b). These CDCs represent new city blocks (Fig. 3b, red and grey lines), while traffic infrastructure will be connected to the directorial lines (Fig. 3b, yellow and white lines).



(a) (b)

Figure 3: Multiplication: (a) polygons i.e. directorial lines and (b) CDCs



(a) (b)

(c) (d)

Figure 4: Cassinian town (a) top; (b) perspective;(c) front and (d) right view

The main directions of traffic to the main city core of the Cassinian town (Fig. 4, red line) are the directorial lines of the starting polygon which generates the CDC (Fig. 4, yellow lines) while the secondary streets of this city are defined based on its radial expansion (Fig. 4, white lines).

Modern traffic challenges encountered by cities around the world are a consequence of the accelerated growth of urban areas for which the current methods of planning and regulating traffic are not adequate.

2.4. CDCs – lines with the same level of traffic noise?

Let us note that Cassinian ovals i.e. two-focal curves ($R_1 \cdot R_2 = S^2$) are used when defining radar and solar systems (Karatas et al. 2018; Karatas, 2013). There is increasing attention regarding the Cassini coverage model with larger numbers of transmitters and receivers (Li et al. 2021). Radar sensor networks have great use potential in many applications, such as border surveillance and traffic monitoring (Gong et al 2013). With the aforementioned notes in mind, if the transmitters and receivers in multistatic radar/solar networks are represented as not focal points, but directorial lines, could the newly-formed CDCs be used in the same way as CFCs?

Besides the previously noted application, Cassini ovals, i.e. CFCs, have appeared in various other scientific applications, including acoustics, biosciences and nuclear physics (Karatas, 2013), so we expect that CDCs could also find use in these areas.

The use of CDCs in acoustics gives us the possibility of asking the following question: if the directorial lines, i.e. the roads, of the new Cassinian town represent transmitters of noise, does every city block, i.e. CDC, receive the same amount, in decibels, of noise? Are CDCs truly - lines with the same level of traffic noise?

3. CONCLUSION AND FUTURE WORK

Because of the large variety of forms (varying of form can be done by changing the starting parameter *S*, as well as by changing the positions or the number of directrices) of 2D elements/patterns generated in this way, their usage in urban and architectural design is possible. Only CDCs generated using regular polygons were presented in this paper, so CDCs generated using an irregular orientation of directrices will be an area of our further research. Furthermore, we will analyze the connection of CDCs with multistatic radar/solar networks, wherein the transmitters and receivers would be represented as directorial lines, rather than focal points. Based on the previously mentioned, CDCs represent an inexhaustible source for generating new geometric patterns. Using geometric forms defined in this way for the structures of cities enables simpler planning and construction of supporting infrastructure such as streets and sidewalks, as well as more efficiently utilizing available land, which would contribute to the reduction of pollution, noise and other negative consequences of traffic.

ACKNOWLEDGEMENTS

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THE CONVERSION OF OFFICE BUILDINGS INTO HOTELS IN THE HISTORIC DISTRICTS IN BELGRADE: LEGISLATIVE BENEFITS

Damjana Nedeljković

University of Belgrade – Faculty of Architecture, Serbia
M. Arch., Teaching Assistant, damjana@arh.bg.ac.rs

Tatjana Jurenić

University of Belgrade – Faculty of Architecture, Serbia
PhD., Assistant Professor, tanja@arh.bg.ac.rs

ABSTRACT

Conversion, as a type of building adaptation, is becoming an increasingly common kind of architectural practice in many cities. Various aspects of this topic are the subject of numerous analyses and research interests, mostly, focused on drivers and obstacles of the conversion process.

Although the conversion is still not sufficiently present in modern construction practice in Belgrade, several office building conversions to luxury hotels were completed on the territory of the central historic districts. Also, many vacant heritage buildings were noticed. Considering the above mentioned, the Serbian standards for classifying hotels into categories are analyzed, to examine the difference between the procedures for conversion of heritage buildings and non-heritage buildings into hotels, in terms of application of the standards. Although the status of heritage buildings, in many cases, can be an obstacle in the process of building conversion, this paper presents the legislative benefits of converting heritage office buildings into hotels.

Keywords: conversion; heritage; historic office buildings; hotels; standards

1. INTRODUCTION

The increase in the percentage of office buildings out of use is a problem that a large number of contemporary cities are facing in the last few decades. There are several ways to solve the problem of buildings out of use, and one of them is the adaptation of such buildings for other uses (Remoy, 2010). Reusing buildings represents a special form of renovation with possible specific problems faced by the participants (Langston, Wong, Hui & Shen, 2008). The success of the conversion process is determined by numerous factors related to the interests of investors, the market, the characteristics of the building itself, the location, and the current legislative framework of the city where the building is located (Wilkinson, Remoy & Langston, 2011). Changing the class of a building, by the categorization of buildings according to their purpose, requires adapting the building to valid standards for the new purpose (Langston et al, 2008). To encourage the conversion of buildings as one of the types of architectural interventions for the regeneration of the existing built stock, it is necessary to foresee the regeneration of the architectural heritage by regulation (Olivadese, Remoy, Berizzi & Hobma, 2017). The legislative framework can, to a great extent, influence the financial justification of conversion (Remoy & Van der Voordt, 2014), which is often a decisive factor for starting the conversion process, since a large number of conversions are initiated by the potential financial interest of the investor. The focus of the research of this paper is the influence of the legislative framework on the processes of conversion of the buildings out of use.

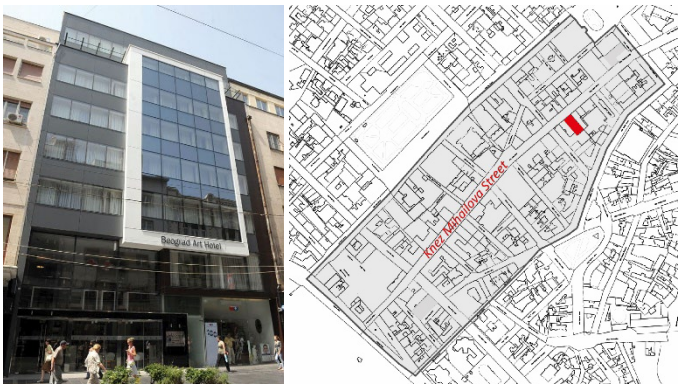
In the cities like London and Toronto, the conversion of office buildings into residential buildings is one of the strategies for revitalizing the central parts of the cities (Heath, 2001), while in Amsterdam, in this way, to a certain extent, the problem of lack of housing stock was solved (Remoy & Van der Voordt, 2007). Considering the statistical analysis that dealt with the market of office buildings in Belgrade, a decrease in the percentage of office buildings out of use concerning the total number of office buildings was observed. This result was

influenced by several factors: on the one hand, a certain number of vacant office buildings were revitalized (adapted for another or the same use, by current standards) or demolished, and, on the other, a large number of new office buildings were built (CBRE, 2021).

The subject of the research is vacant office buildings located on the territory of historic districts in Belgrade. Analyzing these locations, it was noticed that a certain number of these buildings located within the central historic districts have been converted into hotels of high categories. Given that, these buildings are heritage buildings, the paper examines the influence of the status of a heritage building on the possibilities in the conversion process. The research presented in this paper is based on the analysis of parts of the document named "Pravilnik o standardima za kategorizaciju ugostiteljskih objekata za smeštaj" from 2016, which refers to the standard for hotel categorization. Since the status of a heritage building in the previous research is, mostly, considered an obstacle in the conversion process, the research presented in this paper aims to highlight the importance of the flexibility of valid standards for the successful revitalization of vacant protected buildings.

2. THE CONVERSION OF OFFICE BUILDINGS INTO HOTELS IN THE HISTORIC DISTRICT OF BELGRADE

Considering the annual statistical reports and numerous construction sites where the construction of new and renovation of existing office buildings is underway, it can be concluded that the demand for office space in Belgrade still exceeds the market supply (CBRE research, 2021). However, it is the fact that it can see many vacant office buildings in good locations. The conversion of vacant office buildings, which are located on the territory of a historic district in Belgrade, into hotels, can be interpreted as one of the ways of implementing the aims of a document called *Strategije razvoja turizma Grada Beograda*, which, among other things, refer to the increase of accommodation capacity (Grad Beograd, 2019).



(a) (b)

Figure 1: Belgrade Art Hotel, (a) Image, and (b) Disposition of the hotel building in the district "Područje Knez Mihailove ulice"

(a) (b)

Figure 2: Hotel Center No 1, (a) Image, and (b) Disposition of the hotel building in the district "Istorijsko jezgro Beograda"

(a) (b)

Figure 3: Courtyard by Marriot Belgrade City Center (a) Image, and (b) Disposition of the hotel building in the district "Istorijsko jezgro Beograda"

(a) (b)

Figure 4: Hotel Zepter, (a) Image and (b) Disposition of the hotel building in the district "Terazije"

Photos 1-4 represent examples of hotels that are the results of conversion-protected former office buildings out of use. All hotels are located in the inner-city center and are high-category hotels (four stars).

3. COMPARATIVE ANALYSIS OF THE STANDARDS FOR CLASSIFYING HOTELS INTO CATEGORIES: NON-HERITAGE AND HERITAGE BUILDINGS

The required conditions, the fulfillment of which is influenced by the spatial characteristics of the building and location are presented in Table 1 (Pravilnik o standardima za kategorizaciju ugostiteljskih objekata za smeštaj, 2016), since the aim is to consider the potential advantages of conversion of heritage office buildings into hotels, which relate to architectural-urban planning parameters and construction technologies, and, therefore, have an impact on the financial justification of the whole conversion procedure. The conditions related to the type and quality of available services and room equipment (number and type of furniture, decorative elements, devices in accommodation units, lobby, restaurant, etc.) required for the hotel to receive a certain category were not considered.

Table 1: The standards for classifying hotels into categories: heritage and non-heritage buildings

	Non-heritage buildings	*Heritage buildings*
The standards for classifying hotels into categories	*The external appearance of the building and horticultural arrangement:* *- arrangement of existing green areas and footpaths;* *- external appearance: the use of materials of different quality levels, which achieve a standard, first-class, and exclusive appearance;*	*The external appearance of the building and horticultural arrangement:* *- arrangement of existing green areas and footpaths;* *- external appearance: the use of materials of different quality levels, which achieve a standard,*

	Parking and garage: *-the ratio of the number of parking places next to the hotel and the number of accommodation units;* *-parking service;*	*Parking and garages:* *it does not apply to the inner-city core and heritage buildings;*
	Entrances: *- the main guest entrance is separated from the staff entrance;* *- covered main guest entrance or entrance with windbreak;* *- covered vehicle access in front of the main guest entrance;* *- the possibility of access by tourist buses to the main guest entrance;* *- the separate baggage entrance;*	*Entrances:* *it does not apply to the inner-city core and heritage buildings;*
	Elevator: *- The guest elevator for different number of floors depending on hotel category;* *- The additional guest elevator;* *- The service elevator and the freight elevator for more than 3 floors;* *- The food elevator for more than 3 floors;*	*Elevator:* *it does not apply to the inner-city core and heritage buildings;*
	Food services area: *restaurant - obligatory for hotels that offer main lunch and/or dinner;* *for bed and breakfast hotels - breakfast room;*	*Food services area:* *restaurant - obligatory for hotels that offer main lunch and/or dinner;* *for bed and breakfast hotels - breakfast room;*
	Accommodation unit *(including the surface of all rooms in an accommodation unit):* *- At least 80% of the total number of rooms has a minimum surface area for a certain category (20% of the room may have a surface for one category below).*	*Accommodation unit* *(including the surface of all rooms in an accommodation unit):* *In the case of the hotels in heritage buildings, there may be deviations concerning the minimum surface area of an accommodation unit;*
	Air conditioning: *- Air conditioners with the possibility of individual adjustment (the ratio of the number of accommodation units with air conditioners depends on the hotel category);*	*Air conditioning:* *in heritage buildings where it is not possible to install air conditioners with individual adjustment, there is a fan in an accommodation unit;*
	Bathrooms: *at least 30% of accommodation units have to be equipped with a separate toilet; surface area of 80% of bathrooms >5m2;*	*Bathrooms:* *at least 30% of accommodation units have to be equipped with a separate toilet; surface area of 80% of bathrooms >5m2;*
	Additional contents: *Swimming pool, national restaurant, garden, terrace, meeting room, club, boutiques, library, bank, post office, spa,…*	*Additional contents:* *Swimming pool, national restaurant, garden, terrace, meeting room, club, boutiques, library, bank, post office, spa,…*

3.1. Discussion

Based on the conducted analysis, it can be determined that the following groups of conditions, the fulfillment of which is required for the hotel to receive a certain category, are invariably, regardless of the status of the heritage building: the external appearance of the building and horticultural arrangement, food service area, bathrooms and additional contents. The group of conditions related to the food service area has the greatest influence on the classification of the converted building, because if it is not possible to implement a kitchen block whose structure is clearly defined (Pravilnik o uslovima i načinu obavljanja ugostiteljske delatnosti, načinu pružanja ugostiteljskih usluga, razvrstavanju ugostiteljskih objekata I minimalno tehničkim uslovima za uređenje I opremanje ugostiteljskih objekata, 2012;2016) in the existing structure, only breakfast can be served in the hotel, which means that the hotel's service is limited to “bed and breakfast”.

The focus of the research is on groups of conditions whose provisions are variable when it comes to hotels within protected buildings: parking and garages, entrance, elevator, accommodation units, and air conditioning, within the accommodation unit. The importance of the flexibility of provisions within each group will be discussed.

3.1.1 Parking and garage

The provisions of this group refer to the number of parking spaces next to the hotel in relation to the number of accommodation units and, optionally, the number of garage spaces at a distance of up to 300m

from the hotel or next to the hotel (1:5). The higher the potential category of the hotel, the greater the required number of parking spaces and varies from a ratio of 1:5 (one parking space for every five accommodation units) required for a two-star hotel to a ratio of 1:1 for a five-star hotel (Pravilnik o standardima, 2016).

When it comes to heritage buildings, it was stated that the obligation to have parking spaces and garages does not apply to buildings located in the inner city core or within the framework of natural assets or historic districts and their protected surroundings. Also, it was stated that there may be deviations when it comes to the relationship between the number of existing parking spaces and the number of accommodation units prescribed by the standard (Pravilnik o standardima, 2016). Considering the fact that one of the basic ways of potentially achieving a financial profit of the reused building (which is directly related to the financial justification of the whole conversion procedure, since the costs of reusing are considered in relation to the planned financial profit realized during the period of exploitation of the converted building) is the provision of accommodation services, the number of possible accommodation units in the building and the high category of the facility are of great importance. According to the provisions of this group of conditions, the hotel category and the number of accommodation units are closely related to the number of possible parking spaces. The aforementioned flexibility in the provisions relating to heritage buildings allows for a higher category of building and a larger number of accommodation units, with a smaller number of parking spaces.

3.1.2 Entrances

The provisions related to the entrances include a separate main entrance for guests from the entrance for goods and staff, a covered main entrance for guests or an entrance with a windbreak, covered access for vehicles in front of the main entrance, and, optionally, the possibility of access for tourist buses to the main entrance of the facility and a separate luggage entrance (Pravilnik o standardima, 2016).

In cases where, due to the architectural characteristics of the existing buildings, on the one hand, and the impossibility of major changes due to the status of the heritage building, on the other hand, it is not possible, for example, to achieve a sufficient number of entrances, permitted deviations for protected buildings enable a higher category of hotels.

3.1.3 Elevator

The provisions of this group determine the necessity of a guest elevator concerning the number of levels, a food elevator for more than three levels, and, optionally, an additional guest elevator, a staff elevator, or a freight elevator for more than three levels. According to the regulations, it is necessary that the facility, which has four or more levels, has an elevator, to receive the category of three stars, which is a middle-category hotel. To obtain higher categories of four or five stars, an elevator is necessary even for three-story buildings (Pravilnik o standardima, 2016).

The implementation of an elevator shaft in the existing structure is a large-scale and demanding intervention that represents a major change that may not be possible in terms of the degree of protection of the building and permitted interventions. Given that, on the one hand, a larger number of potential buildings for conversion has higher floors and, on the other hand, higher categories are aimed for cost-effectiveness conversions, allowed deviations are important.

3.1.4 Accommodation unit

The provisions of this group refer to the minimum area of accommodation units for each category and the equipment of accommodation units (which is not the subject of this analysis). The minimum square surface is given for single, double, and family rooms and apartments. In a higher category hotel (four stars), the accommodation unit must have a minimum area of 16m² to be classified as a single room, 20m² to be classified as a double room and 24m² to be classified as a family room or suite (Pravilnik o standardima, 2016).

Given that a large number of subject potential buildings for conversion date from earlier periods when, in construction practice, smaller spans were more often applied, these square surfaces of accommodation units cannot be realized in a certain number of these buildings due to the existing grid. Allowed deviations for buildings under protection allow a higher category of hotels and buildings with accommodation units of slightly smaller square surfaces.

3.1.5 Air conditioning

The air conditioning of the accommodation unit is part of the provisions related to the equipment of the accommodation unit and is the subject of this analysis, given the fact that the existence of air conditioning in the accommodation units can affect the appearance of the facade of the building, which in the case of heritage buildings, mostly, is not subject of change. The deviations are allowed for heritage buildings in terms of applying some other method of air conditioning (Pravilnik o standardima, 2016), since the issue of room air conditioning directly affects the comfort of users.

4. CONCLUSION

The vacant office buildings represent, more or less, a part of the urban fabric of a large number of world cities. By reusing these buildings into temporary or permanent housing facilities, following the development goals and tendencies of each city, unused buildings are repurposed, and the offer of the housing stock is expanded.

An analysis of the inner-city core of Belgrade, on the territory of several historic districts, revealed a certain number of high-category hotel facilities (four stars) that were created by reusing vacant office buildings. Given the fact that they are the part of protected areas, it is clear that the observed buildings themselves are protected.

The paper presents a part of the research into the process of conversion of these buildings, which refers to the legislative benefits observed during the analysis of certain valid Standards related to the ways of classifying hotels into categories, which are a consequence of the status of the heritage building. Allowed deviations in the provisions of this Standard encourage the conversion of protected buildings out of use, enabling a high category of hotels that operate in buildings whose spatial characteristics and location characteristics, to some extent, deviate from the prescribed ones. On the one hand, it can be concluded that a hotel in a reused heritage building can, with less fulfilled conditions, get a high category and, therefore, a higher price for the services provided, which is significant from the aspect of potential financial profit during the period of exploitation of the converted building. On the other hand, as a consequence of the permitted deviations, certain expensive and technically demanding interventions were avoided, which reduced the investment required for the conversion of such a building. Many of these interventions could not be carried out, first of all, due to the degree of protection of the building, so if these interventions were insisted on, the conversion of the existing building would be questionable. Finally, it can be concluded that the shown deviations affect the reduction of the costs of realizing the conversion and, at the same time, contribute to a higher potential profit in the exploitation period, which can achieve a higher degree of financial justification of the whole procedure and, to a greater extent, ensure the economic interests of the potential investor.

In addition to the presented legislative benefits in the conversion process, which are a consequence of the status of a heritage building, the fact is that this status is often considered an obstacle, primarily due to the long-time procedures for obtaining the necessary documentation (which, in the case of heritage buildings, is extended in compared to non-heritage buildings) which delay the start of works, so in the future, it is necessary to improve the efficiency of those procedures. Further research is focused on creating a multi-criteria decision-making model, which will include parameters from different areas that affect the financial justification of the conversion process, to understand the conversion potential of each building out of use at an early stage.

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3D CADASTRAL DATA IN THE PROCESS OF URBAN PLANNING

Nenad Višnjevac

Faculty of Civil Engineering, University of Belgrade, Serbia
PhD., Assistant Professor, nvisnjevac@grf.bg.ac.rs

Mladen Šoškić

Faculty of Civil Engineering, University of Belgrade, Serbia
PhD., Assistant Professor, mladens@grf.bg.ac.rs

Rajica MIhajlović

Faculty of Civil Engineering, University of Belgrade, Serbia
PhD., Associate Professor, rajica@grf.bg.ac.rs

ABSTRACT

Cadastral data are very important in the process of urban planning. Moreover, cadastral data present a spatial base for urban planning decisions. Over the last few decades, research on 3D cadastres have been performed raising worldwide awareness of the need for 3D cadastral systems. This was driven by the development of new technologies for the acquisition, storage, maintenance, and visualization of 3D data as well as by complex situations in urban areas that cannot be unequivocally registered in 2D based cadastral systems. This paper examines the 3D cadastral data and emphasizes the differences between traditional cadastral data and 3D cadastral data. An overview of 3D cadastral systems was provided, the basic description of 3D cadastre data, and examples of the real situations that traditional cadastral systems cannot handle and unequivocally register. The paper further presents what would be clear benefits for urban planning once the 3D cadastre system is implemented. It is emphasized how important is 3D geometry and data on ownership for underground constructions and utility networks. Conclusions were provided and what needs to be fulfilled to effectively use 3D cadastral data in the process of urban planning.

Keywords: 3D cadastre, urban planning; land administration; modelling

1. INTRODUCTION

During the last century, modern cities become highly populated urban areas with property units located above and below the ground. There are also complex 3D situations when two or more properties overlap each other. This has resulted in many obstacles for traditional 2D cadastral systems because these 3D situations and objects are registered and represented in 2D cadastral maps and projected into the horizontal plane. All of these restrict the registration and presentation of urban property units. In other words, 2D cadastral plans can become ambiguous, and certain complex structures cannot be represented in an unequivocal way (Višnjevac et al, 2019; Petronijević et al, 2021).

The development of modern technologies (3D Geoinformation systems, 3D visualization, Building Information Models, etc.), has initiated significant research on 3D cadastres (Van Oosterom, 2013; Van Oosterom et al, 2018) and that opened the space to solve difficulties with registering and representing complex 3D situations and objects.

3D Cadastre as a new concept is still in the development stage. The type of 3D Cadastre system, its basic definition, and implementation highly depend on the legal system of a county, previous cadastral system, and economic and technical potential. It is important to emphasize that cadastral data contain legal data. In the context of 3D Cadastre, it is a legal space and not necessarily physical object boundaries (Višnjevac et al, 2018).

On the other hand, cadastral data represent the basis for urban planning and urban plans define a new parcel structure so there are strong ties between cadastral data and urban planning. 3D cadastral data will bring more

quality to the urban planning process. By solving difficulties that the current cadastral has urban planning process will gain a better and more clear basis.

The rest of this paper is organized as follows: Section 2 describes the role of cadastral data in the process of urban planning. Section 3 contains the description of the current state, ie. traditional cadastral systems, and examples of the real situations that traditional cadastral systems cannot handle and unequivocally register. Section 4 presents an overview of 3D cadastral systems and the basic description of 3D cadastre data and emphasizes the differences between traditional cadastral data and 3D cadastral data. At the end of the paper, the conclusion and discussion were provided.

2. CADASTRAL DATA IN THE PROCESS OF URBAN PLANNING

A cadastral system containing cadastral data represents the basis for urban planning. It is inconceivable to start making an urban plan without the proper cadastral data. There are two aspects that the importance of cadastral data for urban planning can be observed.

First, in order to obtain relevant and up-to-date data on land, the cadastral maps and other cadastral data must be analyzed. Besides the parcel boundaries and buildings, the cadastral system contains other information about the land. Most cadastral systems in the world contain data about property rights of the parcels and buildings, values of land and buildings, the way of use, fertility, etc. The modern approach to the cadastral system tends to make it as multipurpose as possible. Because of that, the content of the cadastral systems can be the data in the fields of ecology, meteorology, even sociology, and so on. So, besides geometry data, which is crucial for urban planning, the cadastral system contains other data that can be important for designing urban plans.

Second, the implementation of urban plans inevitably leads to a new parcel structure with new parcels and parcel boundaries. In order to create new parcels and make them official, in accordance with the existing legislation, the coordination between the plan implementation and cadastral records must be obtained.

Besides that, the coordination with the cadastral system provides that the whole process of urban planning goes efficiently. There are many formal phases in the process which can be time-consuming and even sometimes may appear like insoluble obstacles. In most countries, the cadastral system is designed in a way that it serves as support to urban planning in terms of dealing with formal phases of the process.

The importance of cadastral data for urban planning can be seen when analyzing the examples of unsuccessful plan implementation in countries that have problems with outdatedness of cadastral data (Šoškić et al, 2022). In those cases, data recorded in the cadastre can significantly deviate from factual data on the ground. The main question is: would the experts who made the urban plan make it differently if they had the updated data? Unfortunately, the answer is found at the end of the process of implementation of an urban plan. That leads to the inapplicability of urban plans in practice and collapses the whole system.

After this being said, it is obvious that the role of the cadastre in urban planning is indispensable, and that there is no successful urban planning without a good and up-to-date cadastral system that can, not only provide quality data but also to support the whole process of urban planning.

3. CURRENT STATE – TRADITIONAL CADASTRAL SYSTEMS

Traditional cadastral systems contain 2D cadastral maps with land parcels as a base. Land parcel ID is the main identificatory. Additionally, to the cadastral map, there is a cadastral database that contains all other information on properties. In recent decades, many countries digitalized the cadastral maps and integrated them with the cadastral database. However, usually only 2D geometry data are presented.

It means that traditional cadastral systems have a number of difficulties to register and visualize complex 3D situations that are very common in densely populated urban areas. Depending on different criteria, 3D situations can be classified in several ways, but they can also be divided into components such as terrain, buildings, building units, underground constructions, constructions over or under several land parcels, etc. The following paragraphs contain a description of how these components are registered in the case of the cadastral system in the Republic of Serbia. The description is also valid for many countries that have similar cadastral system.

Terrain is not presented on the cadastral maps, there is only a representation of properties in 2D space. When comes to heights, the cadastral database contains only heights of geodetic points. It means that it is very hard

to get an idea of the terrain based only on cadastral maps and other content of the cadastre database. The utility cadastre contains height data on devices, shafts, branching points, etc. However, this cannot be considered as an adequate representation of the terrain.

Buildings are registered in the cadastral database and visualized on the cadastral map. Cadastral maps present buildings as 2D polygons inside a land parcel. They also include descriptions showing the number of floors, which is the only piece of information in the vertical dimension. Figure 1 shows examples of buildings on the digital cadastral map. The cadastral database does not contain any additional information on building height. This information can be found only in project plans.

Figure 1: Buildings on the digital cadastral map

Building units are not presented on the cadastral maps and it is not possible to have an insight into building units' data by looking at the cadastral map. The cadastral database contains descriptive data such as area, usage type, id, etc. There is no additional information that will provide spatial characteristics of a building unit.

Underground structures can be divided into two types: underground structures that are an integral part of another building (basement, garage, etc.) and underground structures that represent stand-alone objects (underground shelters, special underground garages, underground railway stations, etc.). Underground structures that represent parts of a building are presented in the same way as other building units. Stand-alone underground structures are connected to the land parcels where the main entrance is located. It means that the entrance is presented as building (2D polygon) on the cadastral map. Underground structure itself is registered in the cadastral database as a building unit (without geometry). Figure 2 shows an example of an underground pedestrian passage with four entrances. Only main entrance was registered as building on the cadastral map.

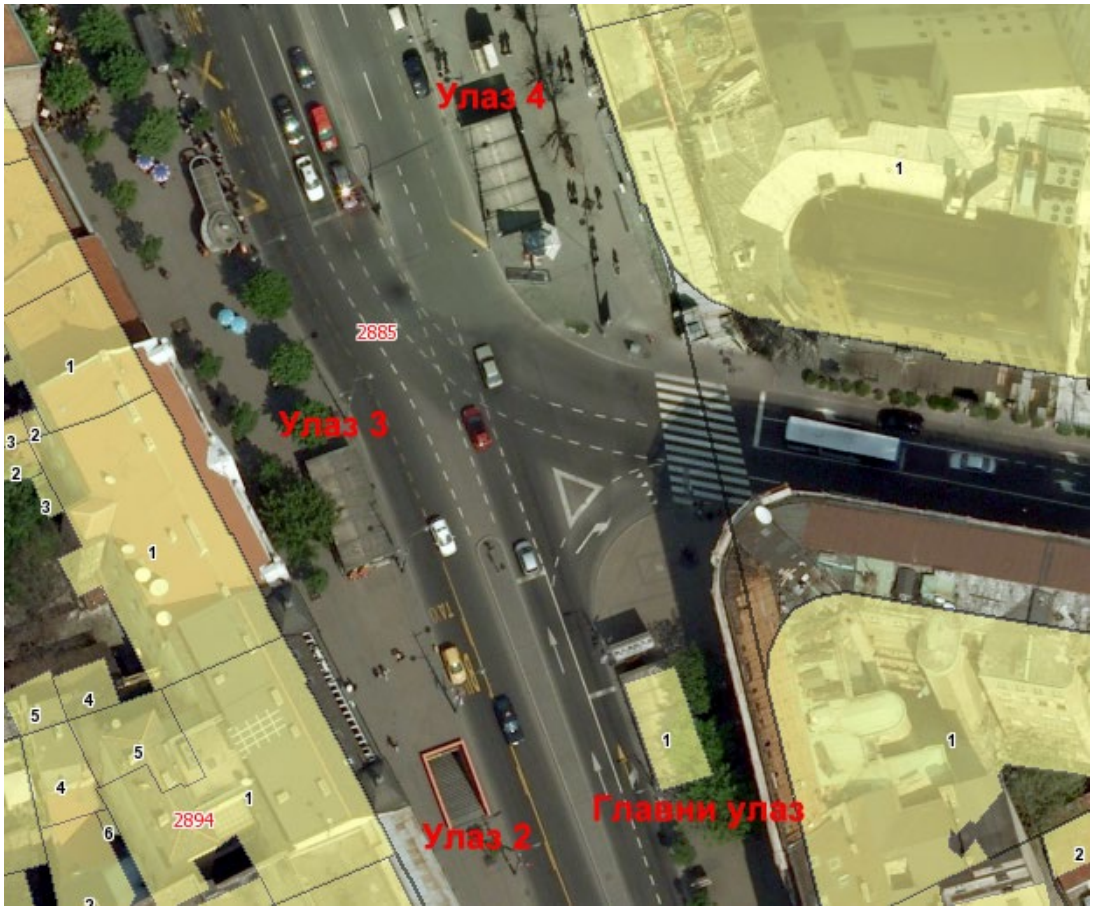


Figure 2: Underground pedestrian passage

Tunnels are specific type of stand-alone underground structures. In many cases they go under several land parcels. Since registering such cases is very hard in the current 2D based cadastral they are usually registered without geometry or not registered at all. Figure 3 shows an example of tunnel (interpreted by red dashed line) which is not registered in the cadastre system.

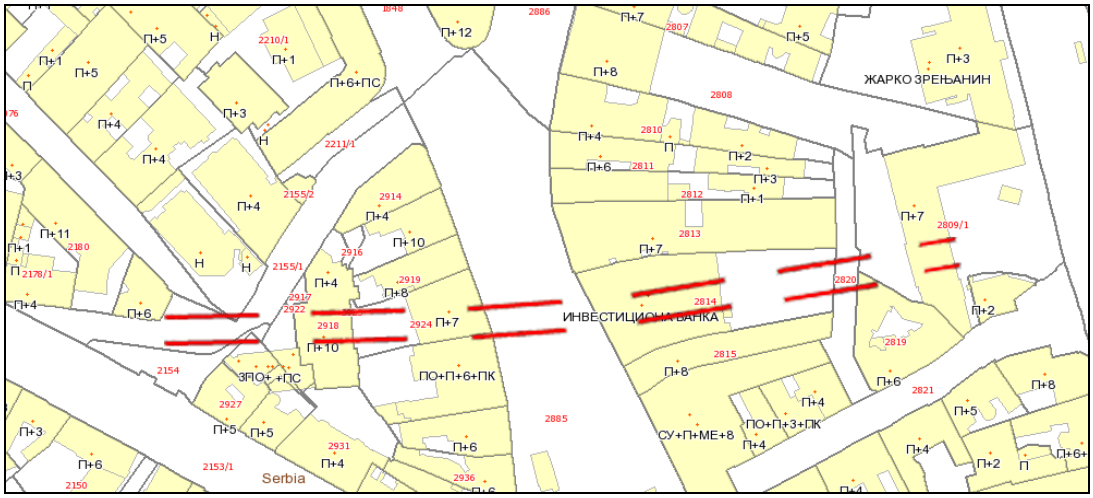


Figure 3: Location of Terazije tunnel in Belgrade

Similar situations are when comes to structures that go over several land parcels (bridges, overpasses, etc.). In many cases they are not registered and it is not possible to get information about them by looking at the cadastral map.

All these examples show that the current cadastral systems have difficulties to unequivocally register and visualize all complex 3D situations. This comes from the fact that the basic spatial unit is a 2D land parcel and

that it is necessary to project and visualize all elements of a complex 3D situation on a 2D surface. This situation has contributed to the fact that many specific structures are not registered in cadastral system.

4. 3D CADASTRE

The basic requirement that a 3D cadastre should meet is to enable overcoming the difficulties that current cadastre systems have when registering and visualizing complex 3D situations and objects. In other words, 3D cadastre systems should enable the registration and representation of rights through 3D entities.

It is very important that the future 3D cadastre be as simple as possible in order to ensure that the system is up-to-date as easily as possible. Up-to-date data in the real estate cadastre is key to the existence of the system itself because it is a public register of real estate and rights to it. A complex system with an overly detailed data model can lead to the fact that in practice it is very difficult to fulfil all the requirements of the system, or that the process requires too many economic resources. If this is the case, it will certainly lead to not updated data and more difficult management of the cadastre system itself.

For the development and implementation of 3D cadastre, it is necessary to pay attention to the additional requirements, such as the integration of the real estate and the utility estate cadastre. It also includes use of different sources for collecting 3D data. Additionally, the 3D cadastre should be implemented in a way that cadastre data can be easily and frequently used by professionals in different fields.

3D cadastre can be developed as a 2D system with 3D tags, a hybrid model, or as a full 3D cadastral registration system (Stoter and Salzmann, 2003). A 2D system with 3D tags is a basic, starting approach and no information on the 3D situation is integrated into the cadastral registration. When comes to a hybrid model, the approach is based on keeping the registration and visualisation in 2D space, but also registering 3D situations as 3D objects including establishing a connection between 2D parcels and 3D objects (see Figure 4). Full 3D cadastral registration system represents the introduction of a completely new concept of registering rights in 3D space, where the entire space is divided into 3D parcels (volumes) that are defined as parts of 3D space. When comes to this approach it is possible to register 3D rights on parts of space that represent separate entities and are not tied to traditional 2D land parcel.

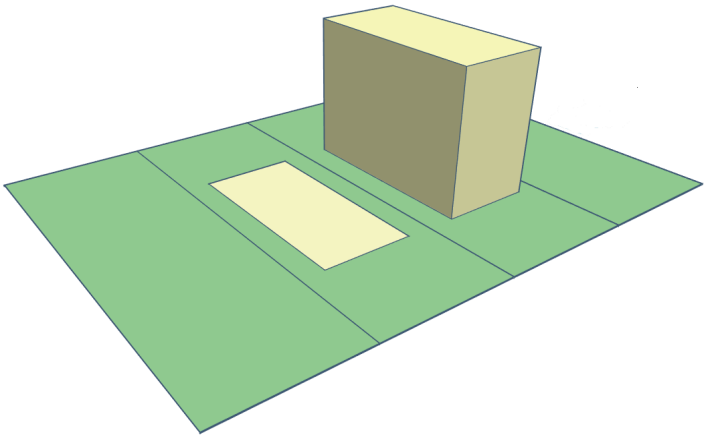


Figure 4: An example of hybrid 3D cadastre elements

By analysing all three approaches, it can be concluded that the hybrid model provides the simplest way to meet the needs and functionalities of a 3D cadastre system. This is based on the fact that by using a hybrid approach it is possible to overcome the difficulties that a 2D cadastre system has when registering 3D situations and at the same time partially use the current 2D cadastre data. This will make the costs and resources needed for establishing and maintaining a 3D cadastre system more acceptable.

4.1. 3D Cadastre Data

If we consider a hybrid model as an optimal solution it means that in addition to current cadastral data there is 3D geometry for complex objects and situations (overlapping properties, underground constructions, structures over or under several land parcels, etc.). 3D geometry can be presented in 2 ways, as a 3D solid body or a set of surfaces that form closed 3D body. Both approaches have advantages and disadvantages, however international standard for the land administration domain propose (LADM) proposes using MultiSurface

geometry to represent 3D objects. The study (Aien et al, 2013) provides discussion comparing multisurface geometry and solid geometry for 3D cadastre needs. Figure 5 shows an example of a set of surfaces (multisurface) that form a closed 3D body.

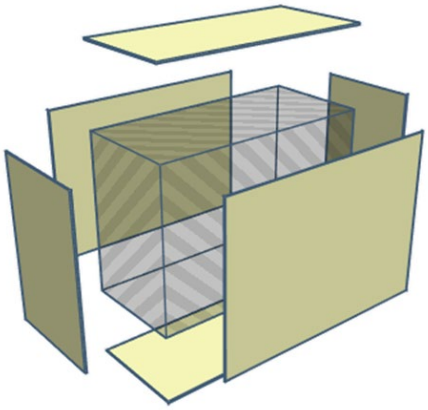
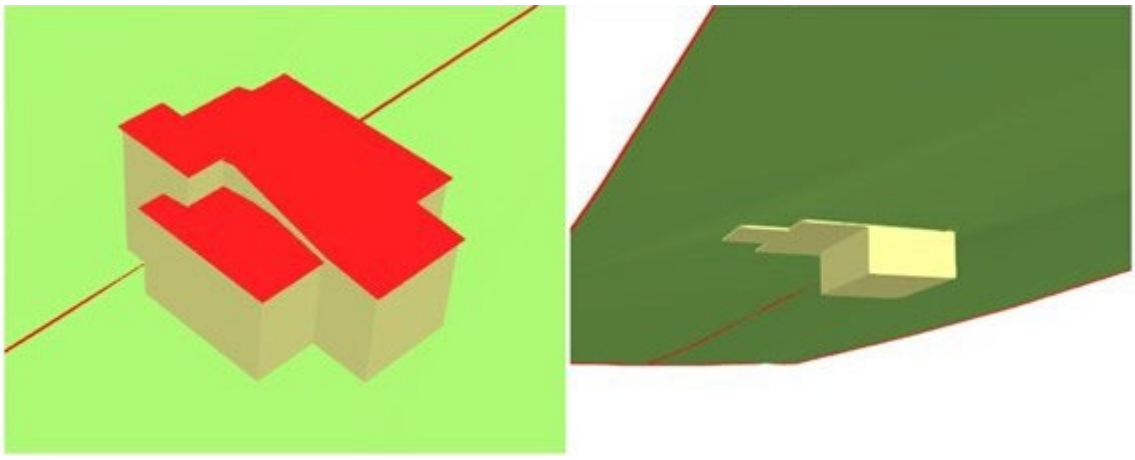


Figure 5: An example of a set of surfaces (multisurface) that form a closed 3D body

In the case of MultiSurface geometry it means that officially in the cadastre register, in addition to horizontal locations, heights of vertexes are stored (X, Y, H). The size of the minimum details on the external dimensions of the object that are measured and registered must be predefined by geodetic authorities.

Comparing to 3D city models which can provide 3D physical objects, 3D cadastral systems (such as LADM based ones) maintain legal data. When it comes to legal space, determined by a boundary, it shows where a right or a restriction ends and where the next right begins (Kaufmann and Steudler, 1998). It means that in the case of a 3D cadastre an object represented as a 3D object is recorded by its legal dimensions and presented as a set of surfaces that form a closed body. Legal boundaries are important, especially in cases when they are not the same as physical object boundaries or it is hard to detect them, such as underground constructions and utility networks. 3D geometry of legal space for such objects is necessary for unequivocal registration of ownership of such properties.



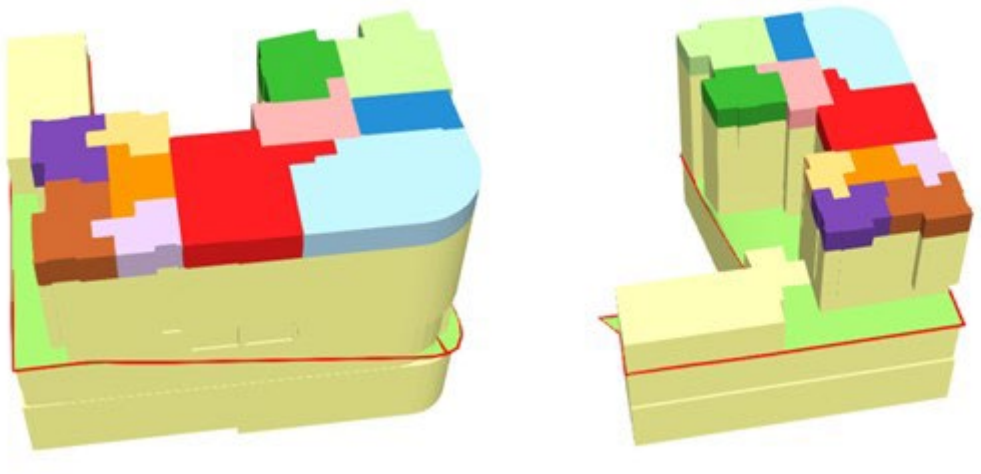


Figure 6: 3D cadastre objects (house with underground structure and building with building units)

5. DISCUSSION AND CONCLUSION

A 3D cadastre is a modern approach to cadastral systems and it enables solving difficulties that traditional cadastral systems face. It is about using modern technologies to improve cadastral systems and enable the acquisition, storing, and visualizing of 3D data (3D objects) that represent legal boundaries. Additionally, it provides the possibility to register, store and visualize complex 3D situations and properties (such as underground constructions or utility networks) by using 3D geometry and to unequivocally register and present where a right (for example ownership) ends and where the next right begins in such cases.

There is still a long way to go until a fully operational 3D cadastre system is developed. Besides new technologies (which are already more or less prepared and ready to support 3D cadastre needs) there is still work on developing data models, procedures and promoting the new 3D cadastre approach. Since 3D cadastre data are going to register legal boundaries there is also work on legislation and that part heavily depends on a country that wants to introduce the 3D cadastre concept. Additionally, since 3D cadastre systems are more complex (because of 3D geometry) than traditional cadastre systems it will require more economic resources to develop and maintain such systems. All this need to be fulfilled to develop a 3D cadastral system and to effectively use 3D cadastral data in the process of urban planning.

In this paper, we emphasized how important are cadastral data in the process of urban planning and that the role of cadastral data in urban planning is indispensable. Moreover, there is no successful urban planning without a good and up-to-date cadastral system. When comes to 3D cadastre and by the fact that this new approach will improve traditional cadastral systems it can be concluded that urban planning will benefit from developing 3D cadastre systems. Since difficulties and ambiguity of current cadastral systems will be solved, it will help and provide better data for urban planning. Additionally, data on underground structures and 3D data on utilities that are not currently available will provide a better basis for urban planning. In other words, professionals in urban planning will have a better picture of what is property situation over and under ground and a clear 3D geometry when properties overlap each other.

Compared to 3D city models, 3D cadastral data will provide legal boundaries data (not only physical object boundaries) which are very important for urban planning and additional focus will be on underground structures and integrating real estate data with utility data and data from other sourses (values of land and buildings, the way of use, fertility, etc). It means that a 3D cadastre will provide information about the 3D space, and depending on a 3D cadastre model it could include legal boundaries and physical object boundaries.

The implementation of a 3D cadastre system will provide a good basis for urban planners to think in 3D space and it will provide additional support to 3D urban plans. Traditional urban plans are 2D based, so with all modern technologies that support 3D cadastre there is also a space to improve and push forward 3D urban planning.

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IMPLEMENTATION OF LAND READJUSTMENT IN SERBIA – BASED ON EXPERIENCES IN THE CITY OF BOR

Rajica Mihajlović

Faculty of Civil Engineering, University of Belgrade, Serbia
PhD., Associate Professor, rajica@grf.bg.ac.rs

Mladen Šoškić

Faculty of Civil Engineering, University of Belgrade, Serbia
PhD., Assistant Professor, mladens@grf.bg.ac.rs

Nenad Višnjevac

Faculty of Civil Engineering, University of Belgrade, Serbia
PhD., Assistant Professor, nvisnjevac@grf.bg.ac.rs

ABSTRACT

The paper presents the process of implementing land readjustmentin the Republic of Serbia from the initial thinking, through the intensification of research and pilot projects to the first projects that are implemented in practice.

The work discussed the observed problems related to the selection of the area, the initiation of the procedure, legal regulations, the competences of the commission for land readjustment, the rights and obligations of the participants, the quality of urban plans and their implementation, the resolution of property legal relations, the correction of errors in the general plan and the detailed regulation plan, and final activities, with registration in the real estate cadastre of the new state.

The work is based on the acquired experiences of implementing land readjustment in the city of Bor in the Republic of Serbia.

Keywords: urban planning; land readjustment, urban plan, cadastral plot, building plot.

1. INTRODUCTION

Urban land readjustment (LR) is a mandatory, responsible and creative job for local self-government units in all countries of the world, including in the Republic of Serbia (RS). However, the current situation in the field of urban land management in the RS could be briefly described as insufficiently good for the following reasons:

- the inherited state of land ownership from the socialist era,
- the absence of applicable legal and by-law regulations in the existing conditions,
- the absence of prepared urban plans in urban areas,
- adopted plans are not consistently implemented or the conditions for their implementation have not been created,
- cadastre not being up-to-date and a large volume of unresolved property relations on land
- the existence of illegally built buildings, roads and infrastructure on a large scale,
- inadequate organization of urban entities, etc.

All of the listed characteristics require looking at the problem from all aspects, special mobility of all relevant entities and an adequate approach to finding solutions.

Land readjustment (LR) represents a certainly unused process of urban land development, which effectively reshapes plots that do not have a regular shape or access to a public road, and at the same time provides areas for public purposes in optimal shapes and areas. Although the LR, as seen in (Law on Planning and

Construction), was defined by law on the territory of Serbia before the Second World War and today it is not widely applied even if it is known that it is intensively applied in developed countries such as Germany, Japan, France, Israel, Holland, South Korea, Taiwan, etc (Larsson, 1997; Muñoz Gielen et al, 2019). Lately, efforts have been intensified for a more massive introduction of LR into legislation and practice in Serbia (Šoškić et al, 2022).

In the text that follows, the existing legal solutions are described and their application is discussed through a current example in the RS.

2. INITIATION OF THE PROCESS LAND READJUSTMENT IN THE REPUBLIC OF SERBIA

The first attempts to implement LR in the Republic of Serbia (RS) after the Second World War were launched in 2010 with the cooperation of the Ministry of Environment and Spatial Planning and the German Organization for International Cooperation GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit i AMBERO Consulatanig Beograd). when the joint project defined six pilot areas for the implementation of LR in Serbia (Niš, Užice, Despotovac, Kladovo, Majdanpek, and Novi Sad). Since at that time the legal regulations did not prescribe the procedure for LR, the project team implemented the process based on the advice of experts and experience in FR Germany. Simultaneously with the initiation of the pilot projects, the procedure of drafting a by-law was initiated, which would prescribe in a more detailed manner the process of implementing the LR in the RS, relying on the Law on Planning and Construction from 2009. In addition to those pilot projects, parallel researches were also launched with the aim of examining the possibility of applying LR in Serbia (Šoškić, 2016; Šoškić et al, 2016).

The initiated pilot projects and the drafting of the by-law were not completed until the end of the project and it can be said that they had only an educational character, within which problems were observed and the experiences of LR implementation in the world, and especially in FR Germany, were presented.

The city of Bor in the RS, respecting the possibility and obligation of the Law on Planning and Construction, was among the first local governments in Serbia to include in the General Regulation Plan of the urban settlement of Bor the possibility of arranging parts of the city through LR, and then in 2019, it contracted the implementation of the LR for three compacted areas in the city of Bor. The pioneering project is still going on and is coming to a successful end with all the difficulties.

2.1. Legislation related to the LR in the Republic of Serbia

Land readjustment was legally prescribed for the first time in the territory of today's RS by the Civil Code of the Kingdom of Yugoslavia in 1931, which included today's RS. The law was written in imitation of the legal solutions of the former Austro-Hungarian monarchy, but it was not applied to a significant extent until 1941, and it ceased to be valid in 1946.

After the Second World War, the implementation of the LR in the territories of the Republic of Serbia was prescribed by the Law on Planning and Construction only in 2009, which was then amended in 2014 and today represents the basic legal framework for the implementation of the UK, which in Articles 107 to 108v prescribes the following:

- LR is implemented in the area where a plan of general or a plan of detailed regulation has been adopted, which determine the areas for LR,
- LR represents the public interest for the Republic of Serbia and is implemented based on the decision of the municipality or city,
- All property-legal relations in the collective area are resolved through the LR.
- The LR procedure is carried out in an administrative procedure by the first-instance commission for the LR (Commission) established by the municipal or city assembly, while the second-instance commission for the LR is established by the Government of the RS.
- A note related to all immovable properties is entered in the real estate cadastre that the LR process has begun,
- All changes in the real estate cadastre are carried out with the notification, agreement and decision of the Commission while the implementation of the LR is ongoing,
- After the decision of the competent authority on LR, the authority responsible for urban planning issues a public call for registration and determination of the necessary data on immovable properties and their right holders for the implementation of LR,

- The application deadline is 30 days, during which the committee is obliged to conduct a public presentation and familiarize interested persons with the principles of LR and the principles of redistribution of construction land, on which the report is drawn up.
- The LR project is made in accordance with the rules of subdivision and pre-parcellation contained in the valid planning document and LR rules, with the existing and newly planned state clearly shown,
- Based on the measure of the land area, each owner is entitled to construction land in the area of the parcels that were included in the LR mass, less the share of the area that will be used for public purposes and determined by the Commission.
- Based on the yardstick of land value, each owner is entitled to one or more construction plots, the market value of which after the LR (post-LR value) corresponds to the smallest value of the construction land included in the LR mass (pre-LR value).
- In the event that there is a difference in the area between the allocated and the entered area, and after deducting part of the area for public purposes (according to the criteria of the entered area and the entered value of the land), that difference is compensated in money,
- After preparation, the LR project is submitted to the Commission, the authority of the local self-government unit responsible for urban planning and the Republic Geodetic Institute for confirmation,
- After entering into legal force, the LR project is submitted to the body of the local self-government unit responsible for property legal affairs, which, after the procedure has been carried out, issues a decision on LR, which can be appealed to the ministry responsible for urban planning within 15 days.
- A legally binding decision on LR, with proof of the fees paid in the LR procedure, is the basis for the registration of newly formed building (cadastral) plots in the real estate cadastre,
- The costs of the preparation of the LR procedure (drafting of the LR project, geodetic works, etc.) are borne by the local self-government unit,
- The Government of the RS prescribes in more detail the composition, scope and responsibility of the republican commission for LR, the procedure for implementing LR, the content of the decision on LR, the content, conditions and method of issuing a decision on LR, the procedure for developing and the content of the LR project, the method of assessing the value of land in the process of LR, costs and those liable for the payment of costs, as well as the request for exclusion from the collective mass, of all holders of real rights on the cadastral plot. According to these legal provisions, the corresponding by-law was not adopted by the Government of the RS, so LR is carried out only on the basis of legal provisions.

Surveying works in the LR are carried out on the basis of the Law on surveying and cadastre and the Law on the procedure of registration in the cadastre of immovable property in lines and corresponding by-laws.

The assessment of the value of real estate is also carried out on the basis of the valid legal regulations in the Republic of Serbia.

3. LAND READJUSTMENT IN THE CITY OF BOR

For the purpose of implementing the General Regulation Plan of the urban settlement of Bor ("Official journal of the Municipality of Bor", No. 1/18 and 3/18), in accordance with the provisions of the Law on Planning and Construction ("Official journal of the RS", No. 72/09, 81 /09, 64/2010, 24/2011, 121/2012, 42/2013, 50/2013, 98/2013, 132/2014 and 145/2014), Decisions on implementing LR in compacted areas within the scope of the General Regulation Plan of the urban settlement of Bor for:

1. The zone of family housing with larger gardens in spatial unit 6-Zone 1
2. Industrial zone along the state road Selište - Bor - Zaječar 1B-37 in spatial unit 5 - Zone 2
3. A mixed residential and commercial zone that stretches east and west of the state road IB-37 - Zone 3, all in the cadastral municipality of Bor 1.

The total orientation area of all three LR areas is 71,1485 ha.

3.1. Description of the implemented process of land readjustment in the city of Bor

After the contracting of the works, the city administration of the city of Bor and the executor of the works held meetings with the participants of the LR, where the principles and concept of parcellation were

presented and the objective of the LR was clearly stated. The LR participants accepted the implementation of the LR with pleasure, and then the implementation started.

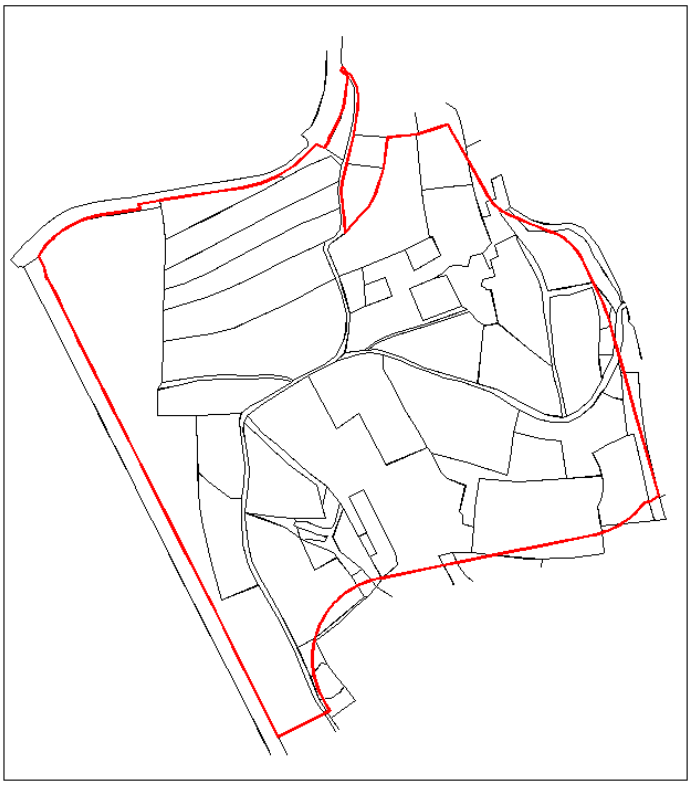
After downloading the data from the Republic Geodetic Institute, it was established that the registered rights on immovable property in the real estate cadastre (REC) were not up-to-date in relation to the factual situation. Namely, the LR commission, with the support of the contractor, invited each participant of LR to register their immovable properties in the LR area, identified all non-updated rights registered in the National Register of Land Registry and through the process of determining the factual situation, updated all entries in the National Register of Land Registry. During that time, the contractor carried out all previous works related to the creation of a topographical and cadastral-topographical plan on a scale of 1:1000 and a plan of infrastructure lines as geodetic bases for designing. The boundaries of the LR areas, which are marked on the ground with temporary markings, have been precisely determined. As part of these activities, an assessment of the market value of the land before LR was also carried out.

The Commission made the decision that the pre-parcellation project should be done on the basis of land area measurements, because it was seen that this is a more efficient and acceptable procedure for the participants of the LR.

The executor of the works, with the verification of the commission, prepared proposals for the distribution of land, which were then exposed to public inspection for a period of 30 days. The family housing zone was accepted by the participants of the LR after the presentation without objection, while for the other two locations the process was not completed until the writing of this paper was completed.

Figure 1 shows the old state of the cadastral parcels, while Figure 2 shows the newly accepted state of parcellation for Zone 1, which includes an area of 24.0476 hectares with 34 participants in the LR, of which the smallest property is 1306m^2 , and the largest property is 60893m^2 . The minimum area of a new construction plot defined by the general regulation plan (GRP) is 1000m^2 . Thus, appropriate construction plots were designed for all participants, and based on the defined traffic routes and land use defined by the GRP.

The following activities that need to be implemented are: acceptance of the LR project by the competent authority for urban planning of the city of Bor and the Republic Geodetic Institute, geodetic marking of the boundaries of new parcels on the ground, introduction of LR participants to the new property, adoption of legally binding decisions on the distribution of land, preparation of a geodetic study for implementation of changes in the real estate cadastre and finally registration of new plots in the real estate cadastre.



Picture 1 - Pre-combination state of land parcels

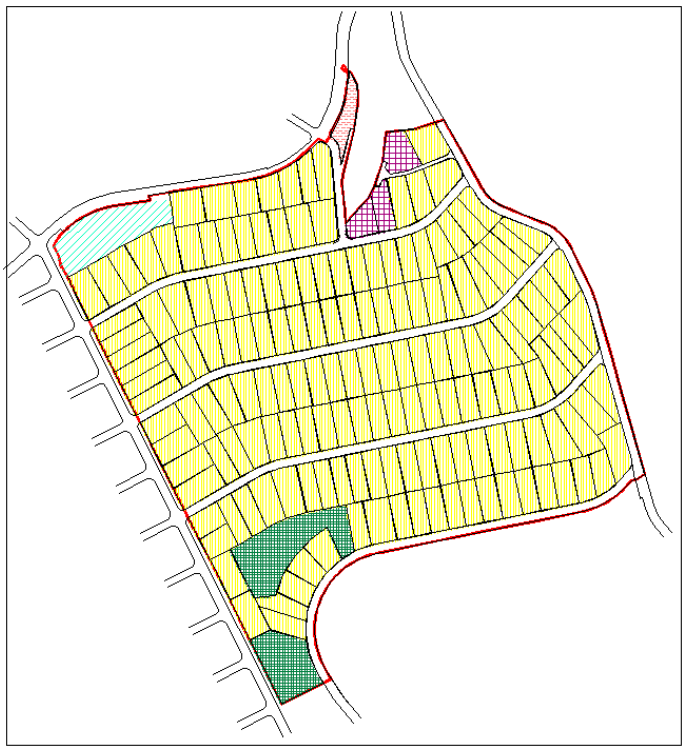


Figure 2 - The newly designed state of construction (cadastral) plots

3.2. Experiences gained and suggestions for solving problems

Selection of the LR message and definition of the purpose of the GRP space

The areas for the LR are defined by the GRP of the urban settlement of Bor and as such have been accepted for implementation. Considering the actual state of roads and streets and constructed facilities and the lack of experience in the implementation of LR borders in all zones, there are problems at the borders that need to be solved, starting with the analytical definition of traffic routes, the cutting of cadastral plots, built streets and buildings, erected fences, etc. The definition of the LR area in the Industrial Zone makes it impossible to implement the reduction coefficient for common areas in the entire area by reducing new areas, but must resort to payment in money according to the debt-credit principle, or the reduction coefficient calculated for two or three areas independently. The advice for urban planners could be that with great care the urban plan should determine the LR area so that LR could be realized.

Take care of the found built-up plots in the communal area

Within the communal areas, errors were discovered in defining the boundaries of previously formed and built construction plots up to 30 cm in size, as well as a number of buildings that were built without a construction permit, and then legalized without the formation of construction parcels. It was necessary to incorporate such plots of land into the new parcelization project with buildings, fences and actual surfaces, without or with minimal possibilities of changing the borders of the existing plots.

Analytical definition of roads and urban planning criteria for construction parcels

The analytical definition of roads was taken from the GRP and in Zone 1 only one shorter approach road with a turnpike at its end was designed because the existing situation dictated it. The projected roads caused a reduction coefficient for public areas of 12%, dictating the shape of the new plots. When designing the roads of the future LR areas, one should take into account the possibilities of optimal design of construction plots and harmonize the spacing of parallel roads with the optimal shape, surface and dimensions of new construction plots. In the residential area, there was a discussion from certain participants of the joint venture that the plots of 1000m ^{2} are large areas, so the largest number were designed with a minimum area in a rectangular-trapezoidal shape, it seems that the streets should have been closer to each other in order for the plots to have a more favorable shape. It would be ideal to prescribe that roads of minor character are designed together

with the subdivision project or to allow minor corrections of their position in the process of implementing the LR.

Structure of property and plots

Within the residential area, the largest area of land is in private ownership, while the city of Bor owned part of the land that was used for green and recreational areas, and the remaining part was allocated to new construction plots intended for the construction of family facilities. Certain parts of the parcels included in the LR did not have the conditions for shaping and forming construction plots, so it was proposed that such cases be resolved by exchanging the land of LR participants whose parts of the plots remain outside the LR areas, i.e. by correcting the borders of the parcels based on the geodetic study in accordance with the Law on Planning and construction.

Legal regulations

The legal and by-law regulations required for the LR have not been completed, so the works are carried out based on the provisions of the Law on Planning and Construction, professional rules and expert proposals.

The LR program

For the implementation of the LR, a LR program was previously drawn up, which defined activities divided into three phases. The program relied on the experiences of rural LR and the legally prescribed process of the LR, which due to inexperience and the absence of a more detailed sub-legal act, was not adequately reviewed, terminologically defined and adequately written. It is not even foreseen by the law, and it was done with very modest previous works and analyses. The program should be thought about when drafting the legal act related to the implementation of the LR.

Appraisal of land and buildings

The market value of the land assessment was carried out using a comparative method and aimed to satisfy the legal requirements that the LR participant does not receive land of less value than he contributed to the LR mass, while for the distribution and reduction coefficient, a method based on the surface area and not on the scale was used value, because it was estimated that the value measure would cause problems due to the insufficient coverage of this part by legal and by-law regulations and the very understanding of the participants of the LR of the value measure principle.

Fixing observed DRP errors

During the detailed elaboration of the LR project, certain errors of the GRP were discovered. On the northern side of the Residential Zone, a street with parking lots and a sidewalk was built, the position of which is not in accordance with the DRP, so part of the sidewalk and parking lot belonged to the Garđević plots. Within the LR area, there is a defined archaeological site in the north, which then conditioned the change of the border of the LR area during the implementation.

Formed construction plots on CP are not in accordance with the regulation line of the access road. This error caused the correction of the position of the access road by about 30 cm.

Determining the factual situation (DFS) and resolving property-legal relations

Unsettled property-legal relations were found in the collective area, such as estates not being implemented after the death of the owner, real rights not being determined but only the holders of individual plots, sales not being implemented and there being co-ownership relationships on the plots. In the DFS procedure, the Commission invited each participant of the LR to make a statement and gave instructions for the procedures for implementing the procedures for resolving property relations at the court, at the notary, in the real estate cadastre. This procedure lasted more than a year. After the final resolution of all cases, the preparation of the pre-parcellation project was started.

Settlement of small plots and parts of plots cut by the border of LR

By defining the boundary of the LR area that goes along the external roads and parcels, several cadastral parcels were divided into parts inside the LR and the rest outside the LR. Thus, areas were formed that do not have the conditions to be converted into a construction plot. Such cases were resolved by applying procedures

for correcting the borders of cadastral parcels by creating a geodetic study in accordance with the Law on Planning and Construction.

Elaborate of the cadastral survey

After the adoption of the LR project, it is planned to create a geodetic study of the cadastral survey and mark the new plots on the ground. The elaboration of the cadastral survey together with the legally binding decision is the basis for the registration of new plots in the real estate cadastre.

Distribution decisions

On the basis of the Project of the LR Geodetic Elaboration of the Survey, the competent authority for property and legal affairs of the city of Bor (local self-government unit) makes decisions on the redistribution of land from communalization.

Jurisdiction of the LR commission for land readjustment

The experience of this project shows that the law should prescribe to the commission for LR, among other things: competences related to the resolution of property-legal relations, verification of the correction of certain errors of the DRP or GRP of a smaller scale, evaluation of the exchange of land inside and outside the area for areas that do not have the conditions to grow into Graševin plots, corrections of plot boundaries, etc. The commission should even make decisions on the distribution of land from LR, analogous to the commission for rural land consolidation of.

Obligations of LR participants

The law should provide for the obligations of LR participants when it comes to permanent buildings and perennial plantings, fences and communal infrastructure, as well as facilities built without a construction permit, especially when solving property-legal relations and participating in the process of LR and urban development of Graševići land in accordance with urban plans. .

Obligations of other LR participants

There are no time periods for the realization of the activities of the RGA with all the activities that are their responsibility

Compliance of urban planning criteria and street network

CONCLUSION

Through the LR example presented in this paper, the effectiveness of the LR application can be seen, which simultaneously arranges urban land on a larger area with resolved property relations, which is necessary for the construction of buildings, streets and infrastructure. The implementation of the LR in Serbia is necessary in all cities and would represent one of the necessary conditions for the elimination of illegal building construction. On the other hand, the LR is able to solve the problems of unresolved property relations on land and the provision of land for public needs in areas where facilities have been illegally built. Case of cadastre not being up-to-date and solving property-legal relations are also overcome by the application of the LR. In order to implement the LR in the RS more massively and efficiently, the work related to legal solutions and the drafting of by-laws must be completed, taking into account all the perceived problems that still hinder its implementation.

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BENEFITS OF THE GREEN ROOFS APPLICATION ON AN URBAN SCALE

Marija Stamenković

University of Priština, Faculty of Technical Sciences, Kosovska Mitrovica, Serbia
PhD., Assistant Professor, marija.stamenkovic@pr.ac.rs

Milica Živković

University of Niš, Faculty of Civil Engineering and Architecture, Niš, Serbia
PhD., Assistant Professor, dia.milica@gmail.com

ABSTRACT

Urban areas, especially urban cores, face the problems of overpopulation and dense construction. In such conditions, open spaces and green areas are endangered and insufficient. The materialization of urban areas with predominantly impermeable surfaces causes not only the environmental issues, such as the effect of Urban Heat Island, deterioration of air quality, noise, increased flood risk, etc, but also the social problems occur. They are related to the lack of areas for recreation and social interaction, visual experience of a city, health issues, etc. The only way to improve and increase greenery in urban areas is to integrate it within buildings. The green roof concept is chosen over the vertical greening because of the creation of useful open spaces. Topic of the paper is the analysis of benefits that could be achieved when green roofs apply to a large extent – on an urban scale. Primarily, the urban levels were defined, and the examples of constructed green roof systems and projects were presented. The benefits of green roofs, which were classified as environmental, social and economic, that can be achieved on an urban scale were analysed. It was concluded that although the economic issue – high initial cost could be an obstacle to the green roof construction, numerous environmental and social benefits justified their application.

Keywords: green roofs; urban area; sustainability; benefits

1. INTRODUCTION

Uncontrolled urbanization is a great problem of modern society. It is a consequence of the fact that most of the world's population lives in cities, and by 2050. the share would be over 75% (Gómez-Baggethun & Barton, 2013). Due to the expansion of cities and increasing construction density, the nature within the built environment becomes often degraded, rare, marginalized, neglected and insufficient, while elements of nature are crucial for functioning of the urban areas – urban ecosystems. They provide many ecosystem services which are available to humans and directly affect health and quality of life (Gómez-Baggethun & Barton, 2013; Millennium Ecosystem Assessment, 2005). Since a city, as a socio-ecological system, depends on ecosystems and their components, it is necessary to sustain long-term conditions for life by providing and preserving nature within the built environment. On the other hand, urban areas, especially urban cores, are materialized with predominantly impermeable surfaces. The disruption of green infrastructure causes many problems, such as the effect of Urban Heat Island, increased flood risk, deterioration of air quality, noise, etc. In these circumstances, the increment of greenery in urban areas, to a certain extent, is achievable by planting trees along low-level roads, improving soil quality, and materializing roads, footpaths and parking spaces with permeable surfaces (Jim, 2013). However, the only way to significantly improve and increase green infrastructure is to integrate greenery within buildings.

Integrated greenery can be classified into vertical greening and green roofs. Vertical greening encompasses green walls (extensive systems) and green façades (intensive systems). Green roofs can be extensive, semi-intensive and intensive systems. Although vertical greening has a greater potential, regarding the façade area which indicates greater environmental benefits, the implementation of green roofs, particularly within the flat roof structures, is a good solution for increasing social benefits by the creation of useful open space.

The paper aims to point out the importance of green roofs for urban environments. For a better understanding of their role, the concept of green roofs is primarily determined, followed by the analysis of their structure and typology. Afterwards, the scales of an urban environments were defined based on selected criteria. This is significant when considering the improvement of green infrastructure in terms of jurisdiction and beneficiaries. Finally, the analysis of the benefits that could be achieved by their implementation on an urban scale was conducted in order to create sustainable urban environments.

2. GREEN ROOF AS A NATURAL ELEMENT OF URBAN AREA

In contrast to the previous understanding of green roofs limited to their decorativeness, the modern definition includes their utility. Green roofs are now defined as open spaces covered with functional greenery, separated from the soil by anthropogenic structures. Thus, the unplanned/spontaneous development of vegetation on a roof surface is not considered to be a green roof, but it is rather the consequence of damage due to inadequate maintenance. When it comes to application, a green roof can be a space for itself or a space designed within a building, as well as an urban space that is a part of the green infrastructure. In addition to the term “green roof”, other terms related to certain performances and regions where they are most often used have been established and defined: “brown roof”, “eco-roof” and “living roof” (Stamenković, 2019).

The basic elements of the green roof structure are substrate layer/growing medium and vegetation. The other elements were designed with the aim to accomplish the natural balance (Fig. 1). The role of the several meters thick weathering layer within the natural soil structure, is replaced by a few centimetres thick filter and drainage (and accumulation) layers in the green roof system. The protection layer is important to prevent the damage of waterproofing and roof construction. The last-mentioned layers mimic the source rock.

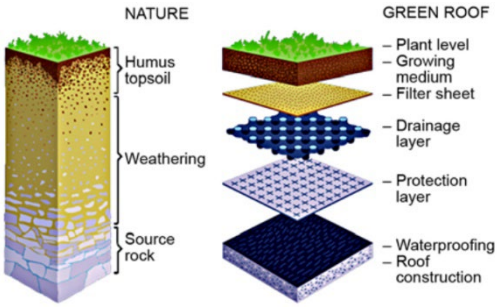

Figure 1: Structures of the nature soil and a green roof (Dimitrijević et al., 2016)

The typology of green roofs is based on the complexity of the structure and their function. Two basic types of green roof systems are extensive and intensive, while semi-intensive systems have also been defined as a transitional variant (Berardi et al., 2014).

Extensive systems support the development of lightweight low vegetation (e.g., sedum, grasses, and herbs) properties important for their application to existing buildings. It is significant for their application on an urban scale, because urban areas are already densely built. Extensive systems are cheaper, easier to implement and maintain, and can be applied on sloped roofs (optimally up to 45°). However, due to the limitation on low vegetation, extensive green roofs have lower ecological value than intensive ones. Although they cannot fully replace the function and importance of green spaces on the ground level and developed on the natural soil, extensive systems are certainly an integral part of the green infrastructure.

Intensive green roofs support the development of low, medium and high vegetation – predominantly perennial plants, woody plants, trees. Their role and function are close to natural soil, i.e., to natural elements of the green infrastructure. However, several impediments can limit their application, especially on an urban scale. The intensive systems are heavy, approximately from 300 kg/m2 to more than 1300 kg/m2 (Optigreen, n.d.) which is why they are almost exclusively applied on new buildings, previously designed to support the load. They could be also implemented on existing buildings by strengthening supporting structures, further increasing their already higher cost than extensive systems. Installation of intensive green roofs requires high expertise, and they also need to be maintained at a high level. These systems are applied on flat roofs, representing useful open spaces – park areas. Despite economic constraints, the implementation of intensive green roofs could be justified by the achievement of environmental and social benefits.

Semi-intensive green roofs, as a transitional variant between extensive and intensive systems, support the development of low and medium vegetation. They are applied due to the greater variety of plant species and potential in terms of design, in comparison to extensive green roofs.

3. SCALES OF AN URBAN ENVIRONMENT

In a physical context, the urban environment consists of the built environment and nature within it. Nature elements, such as biodiversity-rich parks, gardens, green roofs, ponds, streams, woods, hedgerows, meadows, restored brownfield sites, coastal sand-dunes, etc., are an integral part of the green infrastructure, on a local scale (European Commission, 2013). Green infrastructure is defined as a network of green spaces with natural functions and processes sustained, serving the interests of both people and nature (European Commission, 2013). Benefits provided by nature, such as clean air and water, flood protection, reduction of CO2 emissions, health and well-being are available to citizens, while at the same time, plant and animal species survive and develop in their natural habitats. Thus, it is essential for natural elements to exist, to be developed, protected and connected within urban areas.

Considering the topic of the paper and the potential of green roofs implementation, to improve green infrastructure, three scales of an urban environment on a local level were defined: (i) rooftop urban area, (ii) ground level green roof area, (iii) large green roof urban area.

The criteria based on which the scales were defined are size, position, intended use (for walkable roofs) and the complexity of applied green roof systems. The scales were ordered from less to more complex urban spaces. The size of an urban area is not strictly established, regarding building (roof) and ground scales, however, some of the other criteria clarify this order. When it comes to position, green roofs can be implemented at the roof level of buildings or ground level, when there are underground facilities, such as garages, basements, underground roads, etc. The intended use refers to the character of the space – private, semi-public and public, which is significant from the social aspect of sustainability. Predominant usage of extensive or intensive systems is directly related to the green roofs' performances, and therefore to the achievement of environmental and social benefits.

A rooftop of a building with implemented green roof, within urban design, is one, small-scale, urban ecosystem. The size is limited primarily by the roof area, technical facilities and available space. Since the position is above, and most commonly not connected to the ground, those areas are private and intended for a limited number of people – users of the building. Extensive green roof type is more used, particularly within existing buildings, while semi-intensive and intensive green roofs provide greater design potential for new buildings. The examples of urban design of rooftop areas are shown in figure 2.

Figure 2: Urban design of rooftop areas (b) Jackson, 2021; c) Setherton, n.d., d) Talbot, 2021)

Ground level green roof areas are limited by underground facilities. However, they are (and should be) integral parts of an urban design, and thus connected to other nature elements of the green infrastructure. In terms of intended use, these areas can be private, semi-public and public (Fig. 3). In general, these areas are intended for a larger number of people in comparison to rooftop urban areas. Contemporary design and construction of urban blocks include the implementation of green roofs at ground level, above the underground garages. All

green roof types are in use. Semi-intensive and particularly intensive systems are applied within new buildings due to the great additional load.

Figure 3: Ground level green roof areas: a) public, b) semi-public, c) private

Large urban areas with green roofs vary in size, from a large urban block to a part of the city (Fig. 4). All types of green roofs could be applied at both rooftop and ground levels, within new or existing buildings. These areas are intended for the largest number of people, in comparison to previously analysed scales of urban environment. Such areas would be significant parts of the green infrastructure primarily for environmental issues, regardless if the greenery is physically connected or not.

Figure 4: Large green roof urban area: a) urban block (Fortuna, 2013), b) part of the city – individual green roofs (Rooftop gardens, 2012), c) part of the city – continuous green roof (Mairs, 2015)

4. ANALYSIS OF THE POTENTIAL GREEN ROOF BENEFITS

Considering the state of the environment and the need for improvement, integrated greenery systems, particularly green roofs, are recognized as the only natural improvement measure, which also has a visual impact. On the basis of the components of sustainability, green roof benefits are classified as environmental, social and economic.

4.1. Environmental benefits

Environmental benefits are predominantly significant at the urban level. Mostly, they are related to the mitigation of the Urban Heat Island effect, the management of precipitation, the improvement of air quality, noise control, the usage of recycled and recyclable materials, and the increase of urban biodiversity.

Mitigation of the Urban Heat Island effect refers to the reduction of air temperature in city cores, which can be up to 7°C higher than in suburbs in summer months (Goode, 2006). The increase in temperature has a negative impact on the quality of air and water, creates pressure on the ecosystem and affects climate change. The ability of greenery to reduce air temperature is reflected in the process of evapotranspiration. Conducted study for The City of New York showed the air temperature reduction between city core and suburbs by 0.8 °C if green roofs would cover 50% of roof area (Fig. 4b) (Bianchini & Hewage, 2012).

The management of precipitation is another important role of green roofs. As natural filters, they affect the quantity and quality of water. Green roofs retain and retard the drainage of precipitation, especially during stormy weather, reducing the possibility of flooding. Extensive systems can retain 15% - 83% of water, while for the intensive systems the amount is 60% - 95% (Wang et al., 2017). In general, green roofs improve water quality because they mitigate acid rain by absorbing pollution.

Green roofs, as a clean and practical air purification technology, are the most suitable measure for solving the problem of increased pollution harmful to human health. Vegetation can reduce pollution directly and indirectly, i.e., by absorbing gases, retaining particles and decomposing organic compounds; and by modifying the microclimate (Rowe, 2011; Yang et al., 2008). The reduction of the rooftop temperature is achieved through shading and transpiration, which lead to a cooling effect of the roof surfaces. In this way, photochemical reactions that create pollution in the atmosphere (such as ozone) are reduced (Rowe, 2011). Green roofs also affect the reduction of CO2 concentration, which is significantly increased in urban cores. The authors of one study (Li et al., 2010) revealed that in sunny weather green roofs can reduce the concentration of CO2 in the immediate area by 2%.

Noise is another problem in urban areas that can be mitigated by the application of the green roof concept. Since conventional roofs have hard surfaces, the implementation of green roof systems would have a positive effect due to the vegetation and substrate layers. This was confirmed by the results of the research, which showed that sound transmission losses through the green roof were greater in comparison to the conventional roof by 10 dB – 20 dB (Connelly & Hodgson, 2013). The sound intensity is reduced due to the insulating properties of the green roof, as well as by absorbing the sound waves that are refracted above (Van Renterghem & Botteldooren, 2011).

The usage of recycled and recyclable materials in the green roof production (for anti-root membrane, drainage and accumulation layers, filter membrane, and some of the components of the substrate layer) contributes to environmental protection (Pérez et al., 2012).

The increase in urban biodiversity is significant to provide ecosystem services. Their vital flow is based on a certain minimum number of different types of organisms, and the value of biodiversity as such is infinite (Nurmi et al., 2013). Changes in biodiversity, especially in urban areas, have negative effects and can lead to the extinction of some types of organisms, which could disrupt the basic processes in the ecosystem. The only measure that ensures survival and increase in diversity of plant and animal species in densely built urban areas is the integrated greenery within buildings, particularly green roofs. Intensive systems provide greater diversity, but they cannot be applied to a large extent (due to previously analysed obstacles). On the other hand, extensive systems are important for the diversity of microorganisms, insects, other small animals, birds, etc. In general, the importance of green roofs in urban ecosystems is in creation of new connections in the habitat matrix.

4.2. Social benefits

Green roofs, when apply to a large extent, provide many social benefits on an urban scale, intended for a large number of people. They may be turned into recreation spaces and places for socializing between residents (walkable roofs). Also, they enhance the visual experience and improve the aesthetics of the city, and they contribute to the health of the residents.

By creating open recreation spaces, the physical activities of the residents and social contacts are improved. In the research that confirmed the impact of urban greenery on increasing physical activity, it was pointed out the necessity of its existence because 60% of the population is physically inactive, which is the main health risk [8]. Walkable green roofs, primarily intensive systems, have great potential to attract users due to their appearance.

The visual experience and the image of a city refer to the aesthetic component of buildings and the urban environment. Of all sustainable measures for building improvement, only integrated greenery systems within buildings have a visual effect, which is of vital importance for their wide usage. The urban environment can create an identity by the implementation of these systems within existing buildings if they apply to a large extent.

It is confirmed that green roofs can encourage physical activity and social interaction, and have a positive effect on the psychological well-being of residents. Research also shows that greenery has a beneficial effect on preventing the development of many diseases and ensures a longer lifespan (Zhou & Parves Rana, 2012). All of these facts favour the promotion and more intensive application of green systems.

4.3. Economic benefits

Economic benefits are related to the assessment of financial gains by applying green roofs. They can be achieved at the urban and the building levels. The benefits at the level of the urban environment are related to the advantages of green roof application as opposed to other measures used to reduce the costs of air and water purification, sound control, redesign of the sewage system, etc.

5. CONCLUSIONS

Green roofs as previously planned structures within new or existing buildings have a significant role in urban ecosystems. That is confirmed by the analysis of the benefits achieved by their application. Although green roofs cannot fully replace nature elements, they are designed for the functions they should fulfil. Bearing in mind overpopulation and densely built urban areas, the integrated greenery systems are the only measure by which the existing environmental conditions can be improved. By their application negative impacts on the environment are reduced, and also, positive effects are achieved.

Regarding the urban scale, the application of green roofs to a large extent provides primarily environmental and social benefits. While environmental benefits can be “measured”, social benefits are the least represented in up-to-now research, which is a consequence of qualitative indicators of their values. Economic benefits can be also achieved on an urban scale. The assessment of those benefits requires further analysis.

There is certainly potential for the application of the green roof concept in urban areas, particularly on existing buildings, but the successful realization is preceded by the establishment of mechanisms, primarily for the promotion of green roofs. The public, policy makers, building owners, etc. need to be involved from the local level. In that way, the initial high investments in the construction of green roofs would be overcome and justified.

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COMMON OPEN SPACES WITHIN MULTIFAMILY HOUSING AREAS: WHAT DID COVID-19 PANDEMIC TEACH US?

Branislava Stoiljković

Faculty of Civil Engineering and Architecture, Serbia
PhD., Assistant Professor, branislava.stoiljkovic@gaf.ni.ac.rs

Nataša Petković Grozdanović

Faculty of Civil Engineering and Architecture, Serbia
PhD., Assistant Professor, natasa.petkovic@gaf.ni.ac.rs

Vladana Petrović

Faculty of Civil Engineering and Architecture, Serbia
PhD., Assistant Teacher, vladana.petrovic@gaf.ni.ac.rs

ABSTRACT

Measures to prevent the spread of the virus, which were in force during the COVID-19 pandemic, generated new needs in the use of common open spaces in the areas of multifamily housing and a different attitude towards them. For this reason, the characteristics of these spaces must be re-evaluated, with special reference to those that, in unusual circumstances such as the need to maintain physical distance, recommendations regarding frequently touched surfaces, staying outdoors, etc., were perceived as disadvantages, or as advantages. The aim of this paper is to check the extent to which the application of recommendations for design and planning in pandemic conditions gives positive results in the time after the pandemic. The paper includes a description and analysis of organizational and functional characteristics of common open spaces in the areas of multifamily housing, from the perspective of recommendations for shared use of space in a pandemic. It concludes that the benefits of implementing some measures to prevent the spread of the virus would also be applicable in regular, non-pandemic conditions, without significantly increasing costs. In the end, some recommendations, and guidelines for designing and equipping this type of space were drawn.

Keywords: *multifamily housing areas; common open spaces; COVID-19 pandemic measures; design recommendations*

1. INTRODUCTION

The COVID-19 pandemic, with all the temporary and long-term changes in life and work habits that it imposed on us, additionally emphasized the existing inadequacies of the housing environment, and drew the attention of the professional public to certain problems. Since the residents of multi-family residential areas with limited access to common open spaces – as a physical framework for social interactions, and at that time the only connection with nature – were particularly affected by forced isolation, the inadequacy or absence of the surrounding garden spaces stand out as one of these problems. This paper aims to identify those design solutions that can help not only to reduce the risk of disease transmission, but also to permanently improve the quality of common open spaces, and to create a sustainable built environment.

It is common knowledge that relations between neighbours are a key indicator of the strength of the local social community. Neighbourhood relations were particularly important during the COVID-19 crisis, as they represented buffers against the negative impacts of the pandemic [15]. Additionally, the environment in which people live plays an important role in encouraging social contacts. In order to enable the establishment of neighbourhood interactions there is a need to provide adequate spaces for this type of activity. Moreover, the way in which the physical environment is designed may lead to better relationships among the residents. When

the quality of public spaces between buildings is high, optional activities (activities in which residents participate if there is a desire to do so and if time and place allow it) occur more frequently, and therefore the number of social activities is also increasing [7]; it thus implies that social activities are indirectly supported whenever they are given better conditions in public spaces. This is particularly important for more densely populated areas with predominant multifamily housing, since higher housing density impairs social interactions, reduces the degree of neighbourhood ties, and can lead to alienation among residents [9].

From the outbreak of COVID-19 until today, many measures have been implemented to curb the spread of the virus. In addition to recommendations for the responsible behaviour of people in the conditions of the pandemic [14], some researchers have begun to make suggestions regarding changes in the built environment [5, 11, 13]. The OECD has collected various local policy responses, including those related to the urban mobility, urban density and urban design, and made recommendations for rebuilding better cities that can be resilient in a post COVID-19 world [10]. These responses range from increasing the number of green spaces within walking distance for each resident, to growing food on shared green spaces as a direct source of fresh food supply, to creating an attractive residential surrounding for new housing. Some researchers argue that it is necessary to ensure that the built environment can prevent the spread of infectious diseases, particularly emphasizing the importance of housing flexibility and designing semi-private and collective spaces [4]. Others examine the emerging questions on the impact of COVID-19 on public space, in terms of position, design, dimensions, equipment and even the purpose itself, leaving the possibility for this crisis to change people's attitudes towards public spaces permanently and substantially [8]. Some authors suggest that housing design strategies should focus on larger and more liveable living spaces [1, 11] and that urban and architectural design measures that promote distancing also have secondary benefits [6].

2. RESEARCH METHODOLOGY

This paper aims to investigate whether the COVID-19 measures can be used to sustainably improve common open spaces within multifamily housing areas, i.e. whether the lessons learned during the COVID-19 pandemic will result in a reduction of future risks in urban areas and creating a more sustainable housing environment. The methodological framework has been based on empirical research and review of relevant literature. Using a systematic approach, the paper identifies potential solutions that can be applied in the residential surrounding in order to reduce the risk of disease spread, at the same time contributing to its permanent quality enhancement.

The methodology used in this research involved, first of all, a review of certain health measures, suggested by appropriate authorities in order to prevent the spread of the virus, which included a certain impact on the surrounding of residential buildings. After that, an analysis of the application of those measures was carried out, in terms of benefits in the fight against COVID-19, but also in terms of the extent and significance of the changes in the environment that would follow their implementation. Then follows a discussion and assessment of whether the benefits of design solutions (created by the application of these measures) are of a temporary or permanent nature and whether they contribute to improving the quality and sustainability of the residential environment. For easier understanding of the proposed design solutions and their contribution to sustainable development, examples of good practice were used as illustrations. The examples were selected so that their characteristics meet both the requirements for preventing the spread of infection and the intention to improve the quality of common spaces within the multifamily housing areas. In the conclusion, the findings of the research are summarized and guidelines for future research are given.

3. RECONSIDERING COMMON OPEN SPACES TO INTEGRATE MEASURES TO CONTROL THE SPREAD OF DISEASE

The virus that causes COVID-19 is transmitted most often through close contact with an infected person through respiratory droplets that are formed when an infected person talks, coughs or sneezes. Since aerosols are able to suspend in the air for up to several hours, transmission of the virus can also occur by staying in the same room with an infected person. Moreover, transmission can also occur when a person touches a surface or object with the virus on it and then touches their own mouth, nose or eyes. Bearing in mind the ways of viral transmission, the basic precautions to prevent the spread of the virus are: keeping a safe physical distance, wearing a protective mask, covering the mouth when coughing and sneezing, ventilating closed spaces, avoiding prolonged stays indoors and more frequent stays outside, avoiding contact with frequently touched objects, maintaining hand hygiene, etc.

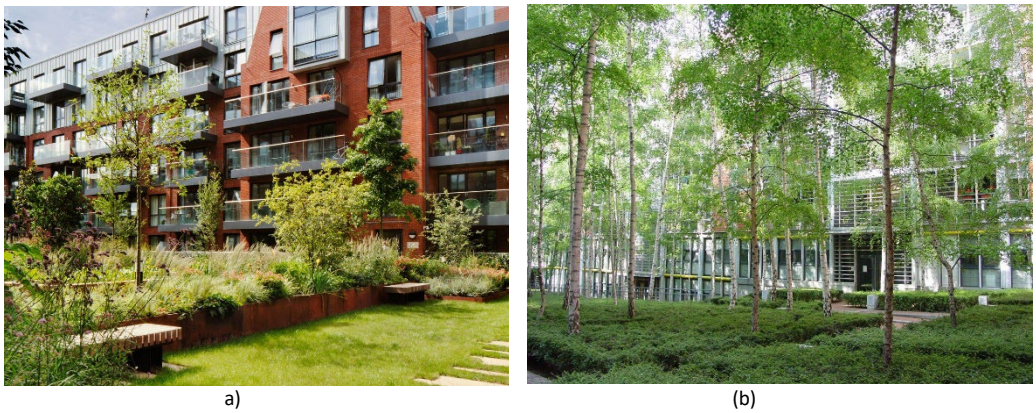
Some of these measures, such as social distance, hand hygiene, and the recommendation for longer stays outdoors, can result in new design solutions, i.e., can have a direct (temporary or permanent) impact on the appearance and furnishing of the residential surrounding. The need to maintain distance may require increased dimensions of spaces intended for joint use by residents (such as footpaths, spaces for outdoor gathering of residents, etc.) and placement of safety distance markers on benches. The need to maintain hand hygiene can affect the choice of materials for equipment and furnishing in common open spaces, as well as the distribution of public disinfectant containers or washing infrastructures. As one of the recommendations refers to avoiding staying in closed, stuffy and overcrowded rooms and spending more time in nature, planning common open spaces enriched with greenery and areas for outdoor activities is also one of the priorities. However, not all potential design solutions can be easily implemented, so it is necessary to consider whether such solutions offer other benefits, especially in terms of sustainability.

The design of shared open spaces greatly affects the intensity and quality of interactions between neighbours, and therefore can be an essential factor for improving public health [3]. Several components of the design of common open spaces were taken into consideration during the research: green areas, urban furniture, public equipment, pedestrian paths and common areas intended for socializing, and in relation to them an overview of measures and actions for sustainable design was given.

3.1. Green areas

The COVID-19 crisis particularly highlighted the importance of accessible green spaces, including common courtyards within multifamily housing areas, since the green spaces were perceived as an important refuge during the pandemic, where residents could gather while still respecting social distancing measures. It was even widely reported in the media that the green spaces have a protective function against the spread of the virus. During the period of restrictive measures caused by the COVID-19 pandemic, urban green spaces played an important role to relieve the consequences of the lockdown policy on people, especially from the perspective of social isolation and mental health [13]. People that live in greener neighbourhoods experienced a lesser degree of reduction in their physical activity level than those who lived in less green neighbourhoods. Additionally, some people were especially concerned about the lack of social distancing and overcrowding in urban green spaces. However, during crisis times, available and accessible green spaces in urban context should not be a luxury but a necessary component of our shared living environment.

Since a landscaped building surrounding has the potential to improve the physical, mental and social well-being of city dwellers, even under regular circumstances, the conclusion is that it is necessary to increase the presence and access to green spaces close to apartments. The stay in green spaces is important for reducing stress and increasing the level of happiness and also motivates to engage in physical activities [11]. Green areas have a positive effect on the number of individuals involved in social activities and promote community integration, so they have great social value, in addition to environmental benefits. Community gardens, which can also be grown in public open spaces surrounding apartment buildings, promote the socialization of residents, so from that perspective they are also desirable in a residential environment. Planning green open spaces accessible to all residents should be a priority for all future multi-family housing buildings. In addition to providing benefits in terms of protection against viruses, green spaces around apartment buildings improve public health in the long term and contribute to improving social and environmental sustainability. (Figures 1a, 1b)



a) (b)

Figure 1: Green areas surrounding multi-family apartment buildings: (a) Streatham Hill, London; (b) Rue de Meaux, Paris

3.2. Urban furniture

Urban furniture within common surrounding spaces contributes to increasing the quality and intensity of use of these spaces, encourages contacts between neighbors and, in general, makes staying in these spaces more pleasant. From the perspective of preventing the spread of infection, it is generally suggested for equipment used by a large number of people, such as equipment in public transport, entrances to buildings, stairwells, circulation areas, etc. (seats, handrails, fences) to use materials with a shorter residence time for viruses, as well as using easily washable surfaces. This also applies to urban furniture in shared open spaces. Some research evaluated the survival of the COVID-19 virus on different surfaces and reported that the virus can remain viable for up to three days on plastic and stainless steel, and up to four hours on copper. As the use of copper and its alloys (bronze, brass) would be expensive for this purpose (perhaps even questionable in terms of modern aesthetic understanding), this only underlines the importance of continually disinfecting and cleaning surfaces that are frequently touched. That brings us to the recommendation that urban furniture should have surfaces that are easily cleanable, i.e. that finishing doesn't have capture spaces, such as cracks and crevices, where contaminants can hide [2] (Figure 2a). The implementation of this solution is long-term and can generally contribute to public hygiene and health.

Moreover, it is necessary to rethink the design of urban furniture itself [11]. Simpler minimalist design for furniture could similarly reduce the accumulation of viruses on it (Figure 2a). The benefits that such solutions offer also include consuming fewer resources and requiring less maintenance, which is very useful in terms of sustainability. A more complex design, although certainly attractive and appealing, is unsuitable from the perspective of ease of maintenance (Figure 2b).

a) (b)

Figure 2: Urban furniture examples: (a) easily cleanable surfaces, simple minimalist design; (b) more complex design

3.3. Public equipment

The use of safety distance markers on benches ensures the necessary safe distance between residents in pandemic conditions and is therefore useful in reducing viral transmission. On the other hand, this measure has the effect of reducing the number of seats available to users. An increased number of benches in the conditions of a pandemic might contribute to a higher degree of use, but in the long term this measure would contribute to the excessive spending and the unnecessary occupation of space (which could be used for some other activities). As the use of safety markers is a temporary measure that does not bring additional benefits and is not applied in regular circumstances, providing additional seating is not a priority.

Similarly, providing with public disinfectant containers is a highly recommended measure during a pandemic, and is extremely useful for minimising the risk of transmission, as well as for public hygiene in general. Although from the perspective of enhancement of public health the use of sanitizing containers would be justified even after the suppression of the pandemic, there are no other relevant contributions to sustainability, and their use would mean increased consumption of disinfectants and the need for regular maintenance and refill. Therefore, the implementation of this measure is considered short-term. On the other hand, providing with public faucet within apartment building's surrounding would be of essential benefit, both in pandemic conditions and in the long term.

3.4. Pedestrian paths

Pedestrian paths within common open spaces serve for the movement of users (walking, jogging, cycling) and connecting different activities within the open space. The use of pedestrian paths leads to more or less encounters between the residents and can lead to good neighbour relations. It is common for them to be dimensioned for the unhindered passage of one or more people, depending on the number of potential users, but it is certainly not necessary to oversize them, especially if this is to the detriment of other features (greenery, seating and areas for socializing). Seen from the perspective of the health measures for the necessary physical distance that were current during the pandemic, planning wider footpaths would contribute to ensuring an adequate level of distance and therefore this measure would be useful for preventing the transmission of infectious diseases between people. On the other hand, paths dimensioned in this way, since they would not be overcrowded, could motivate residents to use them to a greater extent and for a longer period of time. Although primarily intended for merely walking, with increased widths they can be suitable places for spontaneous and intentional social interactions between residents, as well as for some other activities, such as joint activities with neighbours, children's play, physical activities, etc. (Figures 3a, 3b) The application of this measure would be permanent, and its benefits would be noticeable even in the period after the pandemic.

(a) (b)

Figure 3: Wider footpaths within common open areas stimulate multiple uses: (a) Parkstad, Rotterdam (preliminary design); (b) The Eastern Docklands, Amsterdam

3.5. Common areas intended for socializing

Social connections among neighbours are encouraged when they have the opportunity and adequate space to meet. Planning and designing common open areas intended for intensifying the social life of the residents could improve housing conditions and reduce the alienation of people in multifamily housing complexes. Since the characteristics of common spaces intended for socializing within multifamily residential areas are important for the quality of neighbor relations, one of the challenges facing architects is how to design common areas within which the residents can become closer and form a community. During the COVID-19 crisis, the challenge was even greater because it was necessary to simultaneously provide physical distance and create a suitable architectural framework for intensifying neighbour relations and strengthening the community. Throughout the lockdown the importance of adaptibility of common spaces was particularly emphasized [12] – there were frequent cases that residents, by adapting underused and unused spaces within common courtyards, voluntarily rearranged a certain place of common open space for such a purpose. This is because they needed to make a place for themselves where they could gather outside their apartments and by reusing and adapting some capacity of public areas they got a new sociable space.

It is obvious that the need for socialization among neighbours is equally important both during the pandemic and after it, so the recommendation that spaces for gathering and socializing of residents outdoors must be planned in the environment of buildings for multi-family housing could be considered permanently sustainable. In order to meet the demands and wishes of a wider number of users, it is desirable to form several smaller ambiences whose content and equipment should enable the performance of various activities (conversations, drinking coffee, table tennis, children play, residents' club meetings, sunbathing, joint hobby activities, joint winter stores preparation, parties) (Figures 4a, 4b). In cases of lack of space, modifiability and polyvalence of these ambiences would be desirable features, since they would contribute to meeting the needs and affinities of different groups of users in one place. The design and finishings for the furniture should be in accordance

with the previously stated recommendations. The application of this measure contributes to the enhancement of housing conditions both in the context of the pandemic and in general.

(a) (b)

Figure 4: Areas intended for residents' joint activities: (a) Skydebanegade, Copenhagen; (b) BIGyard, Berlin

Table 1 shows an overview of the health measures to protect against the transmission of the virus, current during the duration of the COVID-19 pandemic, the corresponding recommendations for the design of the surrounding of multi-family residential buildings, the duration of the recommendations and their contribution in terms of sustainability.

Table 1: Relationship health protection recommendations – residential surrounding recommendations, in the context of sustainable development

Design component	*Health protection recommendations*	*Residential surrounding recommendations*	*Temporal aspect of recommendation*	*Sustainability benefit*
Green areas	*Stay in the fresh air Sun exposure Care for physical and mental health*	*Common green spaces available to all residents (common gardens, green roofs, terraces with greenery, areas for urban gardening)*	*Long-term*	*Improved public health Promotion of neighbour socialization*
	Physical distance	*Increased surface area of greenery per user*	*Long-term*	*Improved environment*
Urban furniture	*Restrictions regarding frequently touched objects and surfaces*	*Urban furniture made of materials with a shorter residence time for viruses*	*Long-term*	*Economically unprofitable Aesthetically unacceptable*
		Urban furniture made of materials with easily cleanable surfaces	*Long-term*	*Economically acceptable Improved public health*
		Urban furniture with a simple minimalist design	*Long-term*	*Improved public health Improved aesthetic aspect Increased flexibility in use*
	Physical distance	*Increased number of seats*	*Temporary*	*Reduction of space for other activities*
Public equipment	*Physical distance*	*Safety distance markers*	*Temporary*	*Less available space*
	Regular hand hygiene	*Public disinfectant containers*	*Temporary*	*Increased consumption of disinfectants Need for regular maintenance*
		Public faucet	*Long-term*	*Improved public hygiene*
Pedestrian paths	*Outdoor physical activity*	*Pedestrian paths in the surroundings of residential buildings*	*Long-term*	*Improved public health*
	Physical distance	*Wider pedestrian paths*	*Long-term*	*Increased extent and duration of use Enabling other, complementary activities*
Areas intended for socializing	*Care against social and emotional isolation Mental health care*	*Common spaces intended for socialization available to all residents*	*Long-term*	*Strong local social community*
	Physical distance	*More space for residents to socialize Modifiability and polyvalence of uses*	*Long-term*	*Fulfilled a wide range of different requirements and needs*

4. CONCLUSIONS

The COVID-19 experience has revealed certain deficiencies in residential surrounding so the organization and equipment of them should be rethought and improved for better resilience through pandemics. One of the more significant effects of the COVID-19 pandemic refers to the rediscovery of common open spaces in multi-family residential areas, which had exceptional importance during the implementation of measures to combat the spread of the disease, as they contributed to connecting with nature and maintaining social ties despite physical distance. They offered a valuable opportunity for residents to be outdoors, helping them to fulfill their psychological and physiological needs through access to greenery and daylight, while reducing stress and anxiety during the lockdown. As man is a social being and can hardly tolerate social isolation, the surrounding garden spaces were places where, after the relaxation of the strictest restrictions on movement, neighborly relations could develop. On the other hand, the lack of outdoor common spaces is considered a major drawback, not only in pandemic conditions, but in general. In this sense, significant changes are needed in the design of the residential environment of multi-family housing, which will entail mandatory planning of shared gardens, green roofs, terraces, as functional open spaces with multiple benefits.

Planning shared green areas in the immediate vicinity of an apartment building has numerous benefits. To mention only a few of them, being in a natural environment has a positive effect on physical and mental health, and social contacts between neighbours are enhanced. As these benefits are significant both during the pandemic and after it, the suggestion to include these spaces in multi-family residential area design can be considered long-term and sustainable. The recommended surface area of greenery per resident should be reconsidered, since a larger green area enables a greater number of users at the same time, which can have favourable consequences for environmental and social sustainability. Although at first glance the recommendation that urban furniture be made from materials that can be easily sanitized, may seem justified only during the pandemic, it can also be applied after it, as it contributes to general hygiene and public health. Moreover, the recommendation that the design of urban furniture be simple and minimalistic is not only of an aesthetic nature, but also contributes to easier cleaning and maintenance, and in a broader sense to the improvement of public hygiene. The need to install safety distance markers and sanitizing containers is of a temporary nature and disappears with a relief of the pandemic. Common open spaces around apartment buildings should contain pedestrian paths and one or more spaces for residents to gather and socialize. In order to be able to maintain physical distance on footpaths in the conditions of a pandemic and to simultaneously perform various complementary activities in the time after the pandemic, it is advised to plan them wider than usual. Due to the need to maintain physical distance, joint activities of residents should be planned in several places within common garden, with different features, so that the wishes of a wide range of users can be fulfilled. Compliance with this recommendation can significantly improve the quality of the residential environment and housing in general, so it can be considered sustainable in the long term.

The measures described in this paper show different levels of contribution to risk reduction, and some of them include improving the quality of housing, so we can derive benefits for a sustainable housing environment from them. It is clear that health and sustainability are closely linked and that a sustainable housing environment can contribute to improving public health and this finding should be usefully incorporated into future planning.

What this paper did not deal with in detail, and it would certainly be useful, is the economic justification of the application of certain measures for the improvement of common open spaces in the environment of multi-family housing buildings, since sustainable systems can only be spoken of if all three aspects of sustainability are guaranteed. Furthermore, some future research can investigate whether COVID-19 could leverage specific design solutions for other segments of the housing environment, such as housing units or common spaces inside apartment buildings.

Post-pandemic efforts can be turned into an opportunity to improve the lives of city residents and stimulate innovation in the design of housing environments, and therefore shared open spaces. The post COVID-19 recovery has the potential to establish a ’new normal’ in housing, reducing the vulnerability of the built environment.

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TRANSFORMATION OF THE TRAITS RELATED TO SPACE, SHAPE AND DESIGN OF CHURCH BUILDINGS IN SERBIA IN THE MIDDLE AGES

Jovana Vukanić

University of Belgrade – Faculty of Architecture, Serbia
PhD., Student, jovanavukanic96@gmail.com

ABSTRACT

This paper analyzes the transformation of church buildings referring to space, shape, and design of various types of church architecture. The complex structures of sacral buildings erected in Serbia in the medieval period reflect both their refined architecture and their cultural and historical significance for the people. This research examines three schools of architecture, the Raska, the Byzantine and the Morava architectural styles, whose names derived from the historical period in which each style was predominant and their particular design of construction in the medieval Serbian ecclesiastical architecture. Transformation, combination and arrangement of the primary geometric bodies, cube, sphere, and cylinder, created an inner space that determined the exterior design of the constructions. The beauty of the Serbian sacral buildings was emphasized by the use of the solid geometric shapes and their numerous combinations. This further proves that architecture is based on the strong connection of three components, function, design, and form, the aspects that should be considered when judging a construction, regardless of one of them being predominant in a certain period of time. The problem researched in this paper, the analysis of the structural characteristics related to space, shape, and design, is examined by means of the historical and structures procedures. The goal of the paper is the creation of particular geometric models and the classification and systematization of the types of sacral buildings built in the medieval Serbia.

Keywords: Serbia, medieval ecclesiastical buildings, transformation, geometry, shape, design

1. INTRODUCTION

Serbian medieval architecture developed from early IX century up to the end of XVII century. This time span was marked by the structures built in various styles, which was conditioned by the position of the Serbian states in a particular period. The most significant architectural styles of the period are the following: the Pre-Romanesque architectural school, characteristic of the period before the rule of the Nemanjić dynasty and known for the monasteries and churches built in the Principality of Zeta, Zahumlje and Primorje dioceses from early IX century to the end of XI century; the Raška architectural school developing during the reign of the Nemanjić dynasty from the second half of XII century to the end of XIII century, known for the church buildings erected in the territory of the Raška state; the Byzantine architectural school thriving during the reign of King Milutin from the end of XIII century to the first half of XIV century; the Morava architectural school that was dominant from the second half of XIV century up to the first half of XV century. The period ranging from the middle of XV century to the end of XVII century was the period of the Ottoman rule. [6]

The church buildings of the period can be classified according to their similarities by type and time of construction. The Serbian medieval churches were built on the initiative of Stefan Nemanja (1168-1196), who launched the attack against Byzantium and founded the dynasty that ruled until the territory of Serbia was occupied by the Turks. One of the first churches and monasteries that Stefan Nemanja founded were the

church in the vicinity of Koršumlija and the monastery Đurđevi Stupovi near Novi Pazar. Both of these religious structures are single-nave temples with a rectangular basis and a circular dome over the pendentives. The variants of this architectural style are to be found in the construction of the church in Budimlje near Berane, the church Sveti Nikola in Studenica and the church of Sveti Petar and Pavle in Žiča. These churches are also single-nave churches with two or three traves and one apse, where the semicircular dome of the central trave can be replaced by a cupola. This type of construction was rather uncomplicated, which is the reason why it was practiced in the Balkans. It is evident in the design of the churches erected in Serbia, Bosnia, and Bulgaria in VI century and it remained a predominant design in the ecclesiastical architecture throughout XII and XIII centuries. Vestibules were built on either side of the church whereas the cupola was placed on the cubic pedestal. The architecture of the sacral buildings from XIII century followed the same design; however, the churches were of greater height and width, with the addition of several traves, which contributed to their graceful appearance. Master builders, who came from Dalmatia and were Slavic Catholics, were educated in those workshops characterized by tradition of the Romanesque style, which is visible in the most prominent examples of the ecclesiastical architecture of the period, such as Bogorodičina church in Studenica, monastery Žiča, monasteries Mileševa and Sopoćani. Also, one or more bell towers used to be erected by the church, as exemplified by the church near Kuršumlija, monasteries Žiča and Sopoćani. Visoki Dečani, dating from XIV century, was built in the same tradition, which was combined with a cross-in-square plan, two exterior side naves and one spacious narthex with three naves per three traves respectively. The ribbed vaulting with its semi-circular or interrupted arches is distinctive of the Gothic style, whereas the façade was done in the Romanesque style – coated in marble in two colors with the relief-decorated portals. Decorative portals and windows, such as those found in Studenica, Banjska and Dečani, were common features in the Romanesque cathedrals and churches in Italy and Dalmatia. The monastery Studenica boasts with the oldest and most beautiful decoration, masterfully created and enriched with intricate motives. The foundations established by the Serbian rulers changed in accordance with the expansion of their power over the Byzantine provinces. Therefore, King Milutin restored the church Bogorodica Ljeviška in Prizren in 1307 while his heirs and successors continued the tradition of building churches in Macedonia, Metohija, and Pećka Patrijaršija. [3]

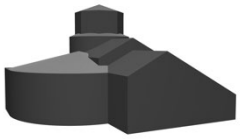
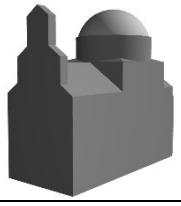
2. TYPOLOGICAL CLASSIFICATION

After the early period of the Byzantine architectural style, the sacral architecture was dominated by the central floor plan roofed by a cupola symbolizing the heavens. The churches were designed after the Greek cross or *crux immissa quadrata,* of the cross-in-square or cruciform form. The sacral architecture of the period was characterized by the similitude of the interior to the exterior and the persevering style throughout the whole period.

2.1. Sacral architecture of the Pre-Romanesque architectural style

The oldest monuments of the Serbian ecclesiastical architecture were built during the rule of the Nemanjić dynasty, in the territory of contemporary Montenegro, Herzegovina and Primorje (the Adriatic coast), from IX to XII century. The churches erected in this period were designed in various shapes, according to which they are classified as: single-nave churches with a rectangular base; churches with a tower on the west side or a vaulted dome and three-nave basilicas with a tower; central-floor plan, cruciform churches with a vaulted cupola, triconhos churches with a cupola, rotundas, and other complex structures. The building material was primarily split or hewn stone (ashlar), while stone or bricks were rarely used. The vaults were either semi-circular or cruciform, the cupolas were square on the exterior and circular on the interiror, built directly from the roof and not on a square base, which would become a common practice in the later periods. The square base was transformed into a circular one by means of trompes, while pillars or konches (niches) were used in the design of rotundas with the same purpose. The stone transoms were above the doors, the windows were arched and vaulted. This architectural style was later enriched with an addition of Romanesque portals. The façades were decorated with pilasters, and blind arcade friezes in certain cases [1]

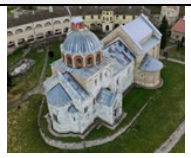
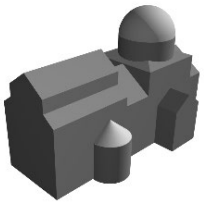
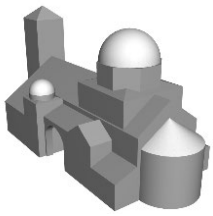
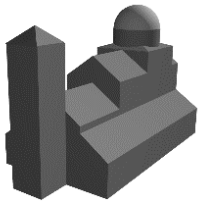
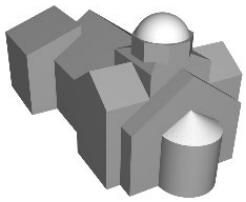
Table 1: Comparative analysis of the monasteries belonging to the Pre-Romanesque architectural style

Name of the church	*Photograph*	*Founder*	*Year of constructi*	*Type of base*	*Type of shape*	*Building techniques*	*Geometrized model*
Petrova church Novi Pazar		*Restored by Prince Časlav*	*X century*	*Single-nave church*	*Rotunda - Semi-circular dome*	*Hewn stone (ashlar)*	
Church of Saint Apostles Petar and Pavle, Bijelo Polje		*Prince Miroslav of Hum*	*Circa 1190*	*Single-nave church*	*Cross-in-square - Semi-circular dome*	*Hewn stone (ashlar)*	
Church of St. Luka, Kotor		*Marvo Kazafranka*	*1195*	*Single-nave church*	*Cross-in-square - Interrupted dome*	*Hewn stone (ashlar)*	

2.2. Sacral architecture of the Raška architectural school

Sacral buildings belonging to the Raška architectural school were erected during the rule of Stefan Nemanja and influenced by the Byzantine and Roman architecture. They were single-nave churches with a large middle apse, a narthex located at the west end of the nave and side choir transepts. The main dome was on the cubic pedestal, formed by side and diagonal walls above the arches supporting the cupola. The interior of the cupola was comprised of the free and leaning arches as well as the pendentives. The interior of these churches is exquisite, spacious, and well-lit. The absence of pillars contributes to it being wide and extensive. The paraklesis or choir chapels were added to the main nave, being lower than the main nave at first, but later reaching the same height as the nave, therefore becoming a transept as examplified by the monastery Banjska. Over time, the cupola was not as wide as the main nave, whereas the cubic pedestal got decreased with side areas united into one single space, giving the impression of a three-nave church when observed from the outside, despite its interior being that of a single-nave church. Paraklsesis were transformed into bell towers in some churches. The primary building material was stone, the interior was built mainly of split stone covered with plaster, while the exterior was occassionally covered in marble. Façades differ by the manner of construction and stone layers. Some façades were built of flat stone or marble, most frequently tuff or breccia. Roof wreaths and portals were decorated. The roof wreath enclosed a series of arcades with simple or double arches. The wreaths used motifs based on leaves, sculptures in the shape of girls' heads, mythical creatures, or animals. The windows had one opening with a small column or bifora. The windows on the apse were triforas, often located on the west side. The tympaniums were richly decorated with sculptures. The entrances were frequently built in the vestibules, allowing a direct exit or entrance from the naos itself. The main entrance, located on the west side, was most splendidly decorated. The portals had several collonetes in their corners and archvaults. [5][7]

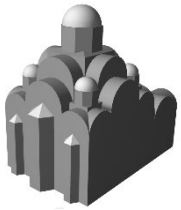
Table 2: Comparative analysis of the monasteries belonging to the Raška architectural style

Name of church	*Photograph*	*Founder*	*Year of construction*	*Type of base*	*Type of shape*	*Building techniques*	*Geometrized model*
Bogorodičina church, Studenica		*Stefan Nemanja*	*circa 1190*	*Single-nave church with the altar apse and one cupola*	*Cross-in-square*	*Brick Hewn tuff Marble*	
Monastery Žiča		*Stefan Prvovenčani*	*circa 1210*	*Single-nave church with the altar apse, two choir transepts and one cupola*	*Cross-in-square*	*Brick Stone Mortar*	
Monastery Sopoćani		*Stefan Uroš I*	*circa 1265*	*Single-nave church with the altar apse, one choir transept and one cupola*	*Cross-in-square*	*Stone Mortar*	
Monastery Banjska		*Stefan Uroš II Milutin*	*Between 1312 and 1316*	*Single-nave church with the altar apse, two choir transepts and one cupola*	*Cross-in-square*	*Hewn stone*	

2.3. Sacral architecture of the Byzantine architectural school

Sacral buildings belonging to the Byzantine architectural school are found in the territory of contemporary Macedonia, as well as in Serbia. They were built in the period ranging from IX century to the end of XIV century. This extensive time span influenced the variety in spatial concept, whereas the building material used, the architectural style and construction remained unaltered. The churches were primarily built as basillicas with or without the cupola, triconhos structures following the inscribed cross plan with one or five cupolas. They were square based, originally built without the narthex, containing only the naos and the altar apse. The proscomidia room and the diaconate were constructed as either separate rooms or as niches. Unlike the inside apses, the outside ones were rarely semi-circular, but rather three-sided or multi-sided and frequently ornamented with numerous niches. The four main vaults formed a cross, whose interception was a square pedestal, arched by a dome supported by pillars, pilasters, or consoles. Observed from the outside, large domes were octagonal or dodecagonal, while they were circular on the inside. The building material was hewn stone and bricks. The masons used stone, limestone, tuff or sandstone, well-baked bricks of different shapes, sometimes even the bricks remaining from demolished buildings. The ornaments on the outside walls were made of terracotta, in the shape of pots based on four-leaf flowers or in the shape of tiles. [4]

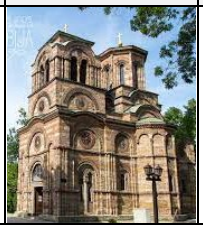
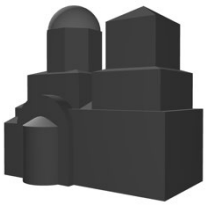
Table 3: Comparative analysis of the monasteries belonging to the Byzantine architectural style

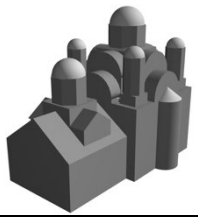
Name of church	*Photograph*	*Founder*	*Year of construction*	*Type of base*	*Type of shape*	*Building techniques*	*Geometrized model*
King's church, Studenica		*King Milutin*	*circa 1313*	*Single-nave church with the altar apse and one cupola*	*Constricted inscribed cross*	*Bricks, stone, mortar*	
Monastery Gračanica		*King Milutin*	*circa 1315*	*Single-nave church with the altar apse and five cupolas*	*Augmented inscribed cross*	*Hewn stone*	

2.4. Sacral architecture of the Morava architectural school

The Morava architectural school dominated the last years of the Serbian medieval state independence. The collapse of the Serbian rule in the southern regions transferred the centers of power to the north, to Kruševac, Smederevo and Belgrade. The monuments belonging to this particular architectural style are to be found in the territory of the Morava basin. Numerous characteristics of this style were inherited from the Byzantine architectural school, which means that the churches were built respecting the cross-in-square plan and using stone and bricks as the primary building material. However, there emerged certain new architectural elements related to the base shape and building techniques. The cross-in-square plan was exhibited as the constricted and as the augmented inscribed cross with one or five cupolas. The churches were commonly built without the narthex, which was added to the main building in the later period. The churches with the constricted inscribed cross plan had both the narthex and the naos, separated by a thick wall. The narthex had side biforas extending to the floor, whose lower parts were enclosed by parapets. The side conches, almost always pentagonal, and the side naves were of the same height, thus sharing the same roof wreath. The façades were built of the hewn rectangular sandstone, the combination of one row of sandstone with three rows of horizontally layered bricks. Some of the churches were built using the half-hewn stone, aimed for emplastration, covered in painted bricks, giving the impression that the church was built with these two materials. The façade was divided horizontally and vertically by means of the cordon of wreaths and semi-colonnettes. Semi-colonnettes were placed in the corners where the sides of the apses intersected and in other parts with shallow pilasters. The cordon wreaths divided the façade into three parts. The rosette was also an ornament on the façade, typical for this architectural style. [2]

Table 4: Comparative analysis of the monasteries belonging to the Morava architectural style

Name of church	*Photograph*	*Founder*	*Year of construction*	*Type of base*	*Type of shape*	*Building techniques*	*Geometrized model*
Lazarica church, Kruševac		*Prince Lazar*	*Circa 1375*	*Single-nave church with the altar apse, side conches and one cupola*	*Constricted inscribed cross - triconhos*	*Bricks Stone Mortar*	

Monastery Manasija		*Despot Stefan Lazarević*	*1406-1418*	*Single-nave church with the altar apse, side conches and five cupolas*	*Augmented inscribed cross - triconhos*	*Stone*	

3. CONCLUSION

After the fall of the Western Roman Empire in VI century, the Eastern Roman Empire or Byzantium continued to exist and flourish, evident in the extensive construction of sacral buildings in the Byzantine and early Christian architectural style characterized by the fusion of the basillican and central church space. The sacral buildings were predominantly central plan structures with the cupola and separated interior, ornamented with frescos, and mosaics. The exterior design was versatile, whereas the interior remained true to the original architectural style.

As regards the idea of having a certain effect or transferring a particular massage, the church is often observed as a complex fusion of shapes. The fusion of various geometrical bodies, such as rectangles and squares, cylinders and cubes, or other solid geometric shapes, creates a composition whose elements appear as a whole, and yet whose orign and primary shape could be recognized. Thus, cupolas, vaults, pillars, window openings, and walls represent separate parts of a structure, but it is their interrelationship that makes this structure a stable whole in both structural and aesthetic sense. Regarding architecture, the phenomenon of the predominant building shapes is very well known, which means that in a composition of curves and curved volumes, it is one simple rectangular shape that is first observed, and vice versa. Considering the churches that are square based, it is the cupola that is the most impressive element from the point of view of architecture. The aforementioned examples illustrate the proposition that the shapes are not experienced the way they really are, but the way they are seen and incorporated in the context, the relationship that significantly determines both the visual and psychological experience of a certain building. When examined in the process of its analysis, design and construction, an architectural structure can be observed through three projections, notwithstanding its complexity since it is always a special and unique composition. Each shape within an architectural compositon has its own characteristics that need not be congruent with the characteristics of other parts of the composition, but which are interconnected and interrelated. The harmonious interrelationship between the elements of sacral buildings is based on the use of proportion that defines the shapes of arches, vaults, and cupolas, as well as their position and connection with other elements of the structure. Besides its practical benefits, the application of proportion contributed significantly to the aesthetic of the ecclesiastical buildings.

The analysis of the mentioned examples, whose characteristics were shown in tables, defines the typology of the Serbian medieval monasteries built in the period of the rule of the Nemanjić dynasty from XII to XIII century. Transformation of various shapes of the Serbian churches is based on the adoption of the traditional accomplishments and their creative restructuring under the influence of dominant and changing factors. The Serbian medieval sacral architecture is a masterful combination of the Eastern and Western influences and its own regard for tradition.

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CITIZENS' PARTICIPATION DURING COVID-19 PANDEMIC: LESSONS FOR THE FUTURE

Marina Nenković-Riznić

Institute of Architecture and Urban&Spatial Planning of Serbia, Serbia
PhD., Senior Research Associate, marina@iaus.ac.rs

Sanja Simonović Alfirević

Institute of Architecture and Urban&Spatial Planning of Serbia, Serbia
PhD., Senior Research Associate, sania.simonovic@gmail.com

Mila Pucar

Institute of Architecture and Urban&Spatial Planning of Serbia, Full member of the Academy of Engineering Sciences of Serbia (AESS), Serbia, PhD., Principal Research Fellow, pucarmila@gmail.com

Borjan Brankov

Institute of Architecture and Urban&Spatial Planning of Serbia, Serbia
Research Assistant, borjan@iaus.ac.rs

ABSTRACT

Since the beginning of the Covid-19 crisis, the scientific community around the world has been trying to explain and study many newly formed issues, from health problems, but also to how the city can function in adaptation to changing environment with the importance of citizen participation. The focus of these issues is mainly on city areas that have been the biggest hotbeds of infection and have seen the biggest shift in the way these areas function on daily basis. This paper gives a brief overview of some research that primarily relates to the role of how pandemic motivated the change in participation methods and how we perceive meeting spaces in physical and online spheres. Part of the paper descibes the importance of citizen participation in emerging conditions along with chosen case study of the ConnectGREEN project's participation process during live and online workshops organized from 2019 to 2021, in which the authors of this paper participated.

Lessons learned through research and projects aim to help understand the impact of specific, often unforeseen situations, that can change existing patterns of urban planning and design, but also change and challenge the existing quality of life, show the need for proper community involvement, good governance, etc. The paper concludes that future cities will have a semi-online way of functioning, which in the post-pandemic period opens new possibilities in different public initiatives (some already started in various cities), and also creates specific conditions with advantages and disadvantages for participation in wider initiatives, but also in scientific and similar small projects.

Keywords: *Covid-19 pandemic, urban planning, online participation, virtual space*

INTRODUCTION

The multidimensional global crisis caused by the COVID-19 pandemic continues to unfold, combining health, economic and social crises with extensive published research that emphasizes that the poor population has had the hardest impact of the pandemic. The massive death toll is a global failure on many levels showing the problem of governments' capacity (and world major powers) for dealing with multiple challenges, and inadequate system of informing the citizens which led to problems such as misinformation, disobeying the strict health and social distancing measures, etc. (Sachs et al, 2022).

Cities as part of well-connected and dense urban areas were among the first to be exposed to the pandemic areas (Stier et al, 2020). Although the density of some cities has not appeared to be the only determining factor, partly reflecting strong policy responses, still many large cities performed worse than other regions (Hamidi et al, 2020). Good governing and proper response with enacted measures to contain the epidemic in the largest cities such as Tokyo, Seoul, and Sydney, have dramatically reduced the spread of the epidemic emphasizing a proactive approach (Ramuni, 2020). Cities that are characterized by inequality and a high concentration of urban poverty are more vulnerable than those with more equal economic distribution (with better resources, infrastructure, etc.) (Iacobucci, 2020).

As a response to the pandemic spreading cities and whole countries have transferred multiple businesses to the online and remote spheres, with still some of the essential service businesses (face-to-face interaction) in urban areas continued to function (OECD, 2020). High-speed internet coverage in urban areas allowed businesses and residents to replace in-person interactions with virtual ones (OECD, 2019). With higher rates of digitization, good internet quality, and coverage cities compensated for new limited available physical space.

In the conditions of the pandemic, participatory processes had to go through serious changes to maintain quality communication between interest groups. Through the various global experiences of different experts from 2020, it was determined that newly created conditions of physical distancing demanded wider use of online tools/platforms and focused work on smaller groups. By combining different communication channels, it was necessary to define a new methodology for future alternative participation. The new type of communication in addition to the obvious advantages, also imposes several obstacles, primarily of a technical-technological and psychological nature (Buehler et al., 2020).

On the example of workshops' participatory processes within the ConnectGREEN Interreg project, this paper reviews the new mechanisms of participation and possible directions for developing functional involvements of different users/stakeholders. Comparing the participation levels and satisfaction of the participants in multiple national workshops during the project period paper discusses the advantages and disadvantages of these new ways of participation

NEW WAYS OF PARTICIPATION

Focus on defining changed participation, with the appearance of the problems with the pandemic social distancing, is important for the perpetual engagement of stakeholders in planning and decision-making procedures. Changing the communication strategy demanded mostly the use of available online tools/platforms, with some newly created along the way. Methodological procedures for future alternative types of participation, which could easily be part of virtual participatory platforms, should follow the previously adopted Arnstein 'participation ladder' (Arnstein, 1969) with the clear steps needed for enabling full and adequate participation with information-using tools such as social networks, consultations (online surveys, questionnaires, focus groups, etc.), inclusion (video conferences, online voting, email communication), collaboration (distribution of documents via emails and other types of communications, or on online platforms, with conversation 1 on 1, tools such as for 3d mapping, virtual whiteboards, etc.), empowerment (support for the formation of a unique opinion, using means of virtual reality) (Mohankumar, et al. 2020).

Although the COVID-19 pandemic shifted participation largely to the online sphere, multiple authors in their papers emphasized that participation should not be exclusively realized in online spheres, but some parts should still be realized in live contact with experts. In the meantime, in the period of uncertainties caused by frequent quarantines and lockdowns or curfews, they, however, suggest adapting for the moment the engagement of participants in the completely online form (Mohankumar et.al 2020; Buehler et al, 2020; Pantic et al, 2021; Buheji et al, 2020; Thoeneick, 2021). Coming back from 2 years of the pandemic has reenacted some live parts of participation, but has also shown that online platforms constructed new meeting places that are solely in the virtual world. Although physical space has been returning to its former potential, the question is if, after the COVID-19 pandemic, the meeting places in the future will be partially shifted to the virtual sphere.

HOW HAS URBAN MEETING SPACE CHANGED DURING COVID-19 - VIRTUAL NETWORKING PLATFORMS

The paradigm of rapid urbanization globally, until COVID-19, was that urban centers offer better opportunities, jobs, quality of life, and access to better services and goods. With the start of the pandemic, the cities were perceived as dense clusters of people, where disease spreads quickly and efficiently, and with the pandemic and online working system, the need to live and function in cities has no longer been seen as a need

for various types of jobs. With the beginning of the pandemic, the urban lockdown opened the question of what a cosmopolitan city is and whether it is sustainable in the time of any epidemic, and whether is it then an attractive place to live (Martínez, 2021). It wasn't any more necessary to live in the city to be able to go to work. Because of that, the post-pandemic city will be faced with new planning and living challenges (Honey-Rosés et al, 2020).

With this pandemic virtual meeting spaces created new opportunities to introduce communication once again but with higher levels of health safety. These and other initiatives can become permanent changes in urban planning (Thompson, 2020). As the risk of future pandemics remains a real possibility the post-pandemic city cannot be the same as the city before 2020 and has to have better regard for public health, but also envision ways for people to meet and participate in the urban space and community (Thorpe, 2020). All these problems open many questions about the future and new paradigms of planning in cities.

Various platforms emerged in 2020 to become the backbone of the new virtual meeting places. This new type of connecting people and enabling participation led to multirole platforms which explored how people connect and how can online sphere mimic the physical space. Most notable platforms e.g., Zoom, Microsoft Teams, Google Meet, etc. emerged as video conference platforms with the standard audio-video-file-sharing concept, but some other platforms tried to create virtual spaces as more focus on social aspects with meeting and networking. Platforms such as Berlin-based Wonder enabled guests/users to "move" freely inside the platform and conversational space choosing their partners and shaping the events, groups, and joining discussions (Figure 1). This fosters interaction between participants and is a reaction to increased tech fatigue during the pandemic, driven by the data that more than 80% of respondents claimed that they do not fully pay attention to classic video conferences and feel drained. Authors of the platform stated the importance of the "social spaces as the core of our lives are filled with meaning because of shared experiences" and the goal of the platform concept was to build those spaces online (Takahashi, 2021). Because of a new understanding of virtual networking, upgraded virtual meeting spaces can motivate better participation and help to foster a wide range of experts and citizen participation in the future.

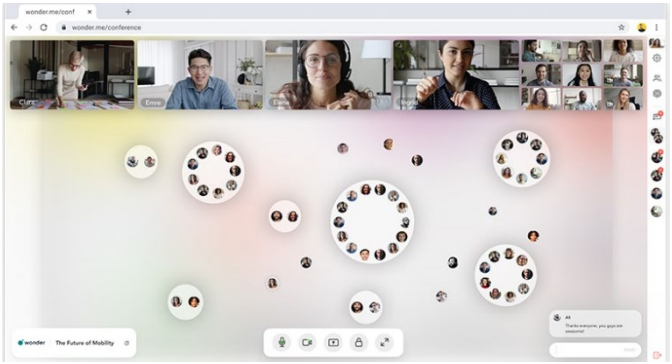

Figure 1: Wonder networking platform (circles are virtual chat/discussion groups)
SOURCE: https://meetings.skift.com/wp-content/uploads/2022/05/800x530px-inposts-canvas-no-areas.jpg

THE IMPORTANCE OF CITIZENS' INVOLVEMENT IN THE PARTICIPATION PROCESS DURING THE PANDEMIC

There is a continuous need for active public participation in the cities and especially in decision-making regarding urban and other topics. The ways how the participation processes were done naturally and spontaneously changed during COVID-19 following global tendencies and local policies. Standard decision-making through lectures, public workshops, round tables, open discussions, and debates with the physical presence of participants shifted abruptly to a new virtual space. This situation directly influenced the change of participatory tools and instruments used in the pre-pandemic era and opened new opportunities for different ways of active participation of experts and city residents in projects of wider community importance. Stakeholder consultations with the community were key to sustainable and inclusive growth and increased accountability in the pandemic and post-pandemic period. Two-way dialogue with communities and other stakeholders, essential for trust building, established through multiple channels with transparent, accurate, and consistent information helped address rumors and misconceptions which included regular feedback mechanisms for monitoring and course correction that reveal how knowledge, beliefs, and practices are changing (Bhattacharyya, 2020). The pandemic has helped to reaffirm the importance of community, especially in the virtual sphere and their participation has become an important component in emergencies. In Singapore,

the Ministry of Health regularly clarified misinformation and encouraged the public to follow accurate and reliable information from official channels and also be aware of the different kinds of knowledge and experiences that different communities and individuals can bring (Adenipekun, 2020).

A large number of local and regional governments are now coordinating and energizing these efforts not only as community action to survive in times of pandemic but as a tool for future improved participation processes and building post-pandemic cities. Organizations such as The International Observatory on Participatory Democracy (IOPD) and Eurocities network collected experiences of cooperation between civil society and local governments with more than 50 examples of good practices during the pandemic, together with initiatives for post-pandemic future cities (IOPD, 2020; EUROCITIES, 2020)

There are various initiatives such as Haute-Garonnes' French department which launched a consultation process for its citizens to decide how they want the post-COVID-19 society to look like, tackling issues not only related to public health but the organization of society as a whole, with nearly 2000 participants visiting this platform to consult or participate in this citizen dialogue. The "society after" the participants' outline is marked by 4 requirements: a more sustainable society, inclusive and united society, society of proximity, in all dimensions of our lives (work should no longer require hours in transport, etc.), society of simplicity (with focus on people, as opposed to that which is usually granted by economic drives or profitability) (Conseil départemental de la Haute-Garonne, 2022). In Bogotá, the city council, together with several civil society organizations, launched the Hackatón contest, where citizens shared data analysis proposals on how to improve the organization of public transport to serve those who need to use it and avoid contagion, with awarded group design of a web viewer for analyzing public transport trips, with which, based on the information from the Survey of Mobility 2019, defined routes for trips essential within the context of the pandemic, with additional web form in which people interested in the example route can program a service, to guarantee an adequate and safe occupation of the service (NUMO-New Urban Mobility Alliance, 2020). In Barcelona, the citizen participation platform Decidim.barcelona received numerous proposals from different groups, in fields such as sport, culture, education, and care. The platform is based on open source, and any citizen can see how it is built, reuse it or improve it, enter the participatory processes, add proposals, share ideas in the debates or make comments (Decidim.barcelona, 2022).

New examples of community engagement through digital and virtual methods in the context of COVID-19 included innovative community management systems while mobilizing local resources and volunteers. UNICEF recommended using UNICEF's 16 minimum standards for community engagement beside existing frameworks or standards for community engagement in participation processes to support planning, implementation, and monitoring encouraged to support high-quality implementation (UNICEF, 2020). Examples of using the standard and new models of participation varied from the country, city, and from a specific topic in a project that involved various communities, experts, and stakeholders.

ADAPTED MODELS OF PARTICIPATION IN CONNECTGREEN PROJECT

Different types of engagement in pandemic and post-pandemic conditions have also been established in Serbia, with all advantages and disadvantages that these new virtual or hybrid ways of participation promoted. International scientific projects that are carried out on the territory of the Republic of Serbia (INTERREG, HORIZON, etc.) necessarily imply the active participation of different stakeholders in the process of determining their views on various project topics. This informal and non-binding type of participation is carried out to determine the opinions and views of experts on a problem, through the actual method of participation in the field, with various educational workshops and round tables, however, with pandemic and strict social distancing measures, projects' activities have usually been continued with the migration of the complete communication on the virtual spheres.

The research paper shows the example of the project done by the Institute of Architecture and Urban&Spatial planning of Serbia - IAUS, in the period 2018-2021, as part of the international INTERREG project from the Danube transnational calls - ConnectGREEN (DTP 072-2.3) – 'Restoring and managing ecological corridors in mountains as the green infrastructure in the Danube basin'. This project demanded the constant involvement of stakeholders in all the implementation phases. Comparing the live and online experience in the workshops, as well as the evaluation forms filled by the participants in three national workshops for the ConnectGREEN project paper presents three different and evolved participation situations: 1) live participation (workshop in 2019) 2) online participation at the beginning of the pandemic (in 2020), 3) online participation after more they a year of the pandemic (in 2021).

In the first year of project implementation, public participation was held offline, with the 1st national workshop being held live in Belgrade in 2019., with the active participation of thirty-six representatives (Table 1) of the relevant stakeholders in Serbia, including the representatives of four ministries of the Republic of Serbia, NGOs, public enterprises, and academic institutions. On three different points (tables) mediators from IAUS were discussing with the groups of ten people different topics, with stakeholders and experts discussing proposed methodologies via world-café participation model and round table discussions, as well as through direct communication with the project leader and team members.

From 2020 project team reorganized the participation procedures, strictly following the Arnstein 'participation ladder' but adapted for functioning in the online sphere. The 2nd national workshop was held via Zoom platform in April 2020. The transition from offline to the online sphere was done during the most intensive part of the pandemic, with the information distributed via e-mail, the project`s web page, as well as newsletters. Somehow expected participants from previous workshops were semi-interested in this new system of workshops and communication (Table 1). Unfortunately, this lack of interest was also motivated by the lack of technical knowledge in working with new technology, as well as a sense of discomfort with communication through online platforms in the type of conference calls (via Zoom platform). Although Zoom was still new to most of the participants, they were not oversaturated with other similar seminars in that period. Compared to the first workshop, they were not as much interested in joining the call. It can be seen that, considering the depressive state during the first months of COVID-19, the satisfaction of the participants in this workshop was high with the remark on the length of the all-day online workshop.

The 3rd workshop was held online in 2021, with a lower number of participants, probably showing some amount of a "burn-off" with these online activities in the previous period. However, the experts and stakeholders who participated have shown that are more prepared to the new online circumstances, with better use of online tools. Participants showed satisfaction with this workshop and had a better response to the presentations, discussions, and duration of the workshop (Table 1).

Parallel with 2 online pandemic workshops project has held online education methods of engagement, as another type of public participation. Team members gave lectures online for the students of the Faculty of Architecture of the University of Belgrade, and in the master's studies and at the Metropolitan University, Faculty of Applied Ecology – FUTURA. Compared to the expert and stakeholders' workshops, online lectures did not contribute to a decrease in student engagement, and also encouraged them to take a more agile approach in interactive discussions of the observed issue.

Table 1: Evaluation of three national workshops held during 2019-2021 for the ConnectGREEN project

No. of workshops	No. of participants	Workshop completely fulfilled the expectations	Presentations were interesting and informative	Discussions were adequately moderated and informative	Appropriate duration of the workshop
1	31	77%	68%	78%	100%
2	23	83%	74%	87%	91%
3	14	93%	79%	79%	100%

Source: Report of ConnectGREEN project part D 2.3.2 – Events attended at the national, international, and EU level to present, disseminate and promote project outputs (Annex 5-Rating of the First National Workshop by the stakeholders, Annex 5-Rating of the Second National Workshop by the stakeholders, Annex 5-Rating of the Third National Workshop by the stakeholders)

These workshops and online education lectures have shown the advantages of new online approaches such as a better overview of the presentations for the participants, the opportunity to attend the workshops from different locations in Serbia, the possibility of a bigger number of participants compared to conventional limitations of physical space, or smaller focused groups, duration of the workshops not being constrained to the working hours of venues, participants can share their data/examples online with others during the discussions, health compromised individuals can easily be part of the workshops, reduced cost of organizing workshops, can organize potentially more frequent workshops at no additional cost, etc. Also, these types of online events have disadvantages such as a lower number of participants due to oversaturation with these types of events, problems with technical illiteracy regarding the online platforms, semi-interest in changing the way participation is done, semi-attention as participants are multitasking while attending the workshops, lack of motivation to be involved (fewer benefits of networking in the online sphere), etc. These remarks have

shown that the future participation models should always be improved to adjust to the needs of the participants and also the organizers.

CONCLUSION

COVID-19 has affected the quality of life of almost every urban resident around the world. This paper tried to show the reshaped relationship of citizens' participation in the city, community, and local and state government and how it reflected on the quality of life. The lessons learned during the pandemic and the adoption and implementation of ambitious sustainable development policies can help prevent future global shocks, including new pandemics, while continuously promoting resilience not only in the city systems but also in the community's resilience.

It can be concluded that it is important to strengthen multilateralism in all key dimensions: political, cultural, institutional, and financial. It is also necessary to involve the civil and private sector, local self-government, parliament, the academic community, and youth in these processes more than before. Managing participatory spaces requires sensitivity and the ability to recognize and use the different types of knowledge and experience that different communities and individuals bring. Given the many limitations, it can be said that the pandemic highlighted existing problems and opened up new dilemmas and questions. All the long-term consequences of this pandemic and how it will transform cities in the future have not yet been seen, but the urban areas are already experiencing some more permanent transformations regarding work, leisure, and allocation of working space (virtual, etc.).

There is a significant impact of this pandemic on urban economies, including the informal sector, which will have direct consequences on finance, inequality, and increased poverty, especially in cities, and strengthen already pronounced social and economic inequalities. This state also represents an opportunity to rethink the capacity and how we manage governance structures, public service provision, data use, and citizen and community self-management. COVID-19 has forced us to rethink urban living and rethink how we perceive and govern the cities. We should seize the opportunity to reimagine a more vibrant, and engaging city in which participation leads to less vulnerable cities in the future.

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PERI-URBAN AGRICULTURE AND LAND USE CHANGE UNDER GLOBAL CHALLENGES FOR FOOD SECURITY: URBAN PLANNING PERSPECTIVE

Jelena Živanović Miljković

Institute of Architecture and Urban & Spatial Planning of Serbia, Serbia
PhD., Research Fellow, jelena@iaus.ac.rs

ABSTRACT

Policies addressing food security issues are becoming an increasingly important agenda globe wide. The preservation of agricultural land and contribution of urban agriculture to food security is widely recognized as a need. The main treat to agricultural land use change (ALUC) is due to urban sprawl and land take, and the first under attack is the land in peri-urban areas. The current growth of ALUC is contrary to the principles of sustainability. The prevention of agricultural land loss and permanent land use change, i.e., land take is seen as the necessity and there is no dilemma on that issue ("no net land take").

Agricultural land within functional urban area (FUA) of Novi Sad face with strong land use change pressures. Starting from the broadly adopted theses that spatial and urban planning affect ALUC, the author analyses the experiences in urban planning practice regarding ALUC within part of Novi Sad FUA and analyses the effects of regulatory land policy instruments. The purpose of this approach is to contribute with such perspective to very modest domestic research practice on those issues. As a result, the extension of ALUC, which inevitably has implications on peri-urban agriculture in the context of food security, is perceived. With the reference to some international experiences on related issues, the author draws a parallel and concludes that binding legal framework providing protection of urban agriculture through land use planning practice is a key for the protection of agricultural land, especially high quality land within peri-urban area of Novi Sad.

Keywords: agricultural land; urban planning; land use change; peri-urban agriculture, food security

INTRODUCTION

The phenomenon of agricultural land use change (ALUC) due to urbanization processes, that mainly occur in form of urban sprawl in Europe, is on the focus of a numerous research. It specifically describes the scattered development of settlements in the peri-urban area (Wandl, Magoni, 2017) and it is related to the physical pattern of low-density unplanned expansion of large urban areas, mainly into the surrounding agricultural areas (EEA, 2016). Impacts of urban sprawl are often quantified by monitoring of land take (Tardieu et al., 2021), that is the loss of agricultural, forest and other semi-natural and natural land to urban and other artificial land development (EEA, 2006). Still, land take does not always coincide with urban sprawl, since it can occur outside of urban or peri-urban areas, but the role of land use planning in reduction of land take is fully recognized (Colsaet et al. 2018: 349).

The concept of providing food security through the protection of agricultural land and especially high-quality peri-urban land has been promoted only recently (e.g. Verburg et al., 2013; Horst et al., 2017; Zróbek-Rózanska, Zielinska-Szczepkowska, 2019). Gardi et al. (2015) proposed a methodology to quantify the impact of land take on food security at the European level and demonstrated that land take could be an important threat to food security in a long term perspective(e.g.100 years). In EU, it is recommended to stop the process of land take of agricultural land and other natural areas by 2050 ("no net land take") (EC, 2011). In the other hand, that goal is expected to be achieved globally by 2030 in accordance with Sustainable Development Goals (SDG), as well as substantial increase in food security to achieve zero hunger and promote sustainable agriculture (UN, 2015).

In order to meet global demands for food security, urban planners and municipalities in numerous European countries developed tools to protect urban and peri-urban agriculture within the metropolitan areas by some forms of controlled urbanization and zoning (e.g. Jansma et al., 2022; Olsson et al., 2016). It has to be stressed that urban agriculture is usually considered as micro- to small-scale agriculture practiced on non-agricultural land within the build-up city and oriented to short supply chains, while peri-urban agriculture is small- to large-scale, which is performed by professional farmers on agricultural land, often with the zoning status and distributed by a wider range of channels (Opitz, 2016). However, although researchers insist on differences between (intra-) urban and peri-urban agriculture, these are not separated from each other by rigid borders.

Traditional planning instruments, as zoning regulations, urban growth boundaries and green belts, as well as other tools for land use control (development fees, infrastructure financing, financial incentives etc.) represent the main planning instruments for urban agriculture preservation (Zasada, 2011; La Rosa et al., 2014). Policy makers must combine regulatory protection with positive reinforcement of farming activity to support the agricultural land use (Eagle et al., 2015), although land use planning occasionally failed to encourage farmers to continue their agricultural activities near urban areas and resulted in the abandonment of agricultural activities (Darly, Torre, 2013).

The planning perspectives to peri-urban agriculture issues have very modest research practice in Serbia. Starting from the fact that agricultural land within peri-urban areas is under huge land take pressure, the author presents the example of ALUC process within part of Novi Sad peri-urban area. In the same time, that area belongs to functional urban area (FUA) of Novi Sad. Urban and peri-urban agriculture have very important role in the economy of Novi Sad FUA, primary because of the fertile agricultural land, plenty of water, accessibility and vicinity to large urban markets of Novi Sad and Belgrade (Figure 1). Relying on recent research (Živanović Miljković et al., 2022a) of which is a part, this paper shows case study on peri-urban agriculture and ALUC in lenses of urban planning practice, as urban and peri-urban agriculture and farmers are facing strong land take pressures throughout the FUA. By analysing primary sources (urban planning documentation and urban strategies), the extension of ALUC, which inevitably has implications on peri-urban agriculture in the context of food security, is perceived. The main objective of this review is to identify the effects of ALUC on peri-urban agriculture in the context of urban land use planning and land policy. This perspective resulted with some recommendations for future planning practice concerning agricultural land, especially regarding the upcoming new planning cycle, that will occur after new Spatial Plan of the Republic of Serbia (SPRS) adoption.

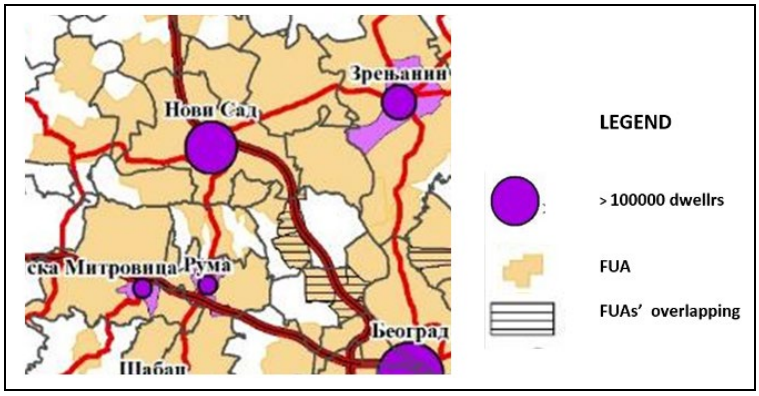

Figure 1: Novi Sad FUA position in the nearest environment
(Source: adapted from SPRS Draft, 2021)

REGULATORY LAND POLICY CONTEXT ON AGRICULTURAL LAND USE CHANGE IN SERBIA – A BRIEF PREVIEW

The protection of agricultural land as a basic natural resource for food production, along with controlling ALUC, is a priority in Serbia, as declared through national strategic documents. According to the Law on agricultural land (2009), it is forbidden to use arable agricultural land up to the fifth cadastral class for non-agricultural purposes, except in cases where the public interest is determined by law and with compensation for the land use change (LAL, 2009). Still, the practice of spatial and urban planning is faced with permanent spatial conflict related to agricultural land, because agricultural land is very attractive for investors. The previous Spatial plans of the Republic of Serbia (SPRS) (1996, 2010) promoted the mandatory protection of

agricultural land and the preservation of its quality and natural fertility for food production. Going further in protection of agricultural land than previous ones, the draft of the newest SPRS (2021) encourages the use of existing construction funds for new developments instead of greenfield investments. Also, it recognizes that urban plans may contribute to the excessive expansion of urban settlements by unrealistic consideration of future needs for construction land (SPRS, 2021). However, in previous planning cicle, within the planning determinants that have significantly affected the spatial development of municipalities and cities, the use and protection of agricultural land is most often marginalized (Ibid.).

In the local planning context of Serbia, the instrument of land use change in plans can enable land take and ALUC (Živanović Miljković et al., 2022a; Živanović Miljković et al., 2022b). Recent quantitative research on spatial and urban land use plans and policies at the local level (Živanović Miljković, Čolić, 2020; Živanović Miljković et al., 2022a; Živanović Miljković et al., 2022b) indicated long-term tendencies of ALUC, which is mostly for other- ie. non-public - purposes (e.g. housing, industrial, commercial).

3. THE CASE STUDY ANALYSES ON PERI-URBAN AGRICULTURE IN NOVI SAD F U A

Novi Sad FUA covers an area of 1892 km^2 , larger than administrative area of the City of Novi Sad. According to 2018 data on land cover (CLMS, 2022), agricultural land accounted for 1,377 km^2, with 73% of total area, respectively. Arable land dominates, with share 88% of total agricultural land (Figure 2). Based on Corine Land cover data, in the period 2000-2018, ALUC is occurred on 34 ha.

Peri-urban agriculture of Novi Sad FUA is very specific. Here is presented the example of Futog settlement, due to its specificity of the production of Futog cabbage, vegetable with appellations of origin, a special kind of geographical indication. According to WIPO (2022), a geographical indication is a sign used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin. Acknowledging that the land is substantial for the long-term success of the products with geographical indications, that fact encourage producers to adopt long-term strategies for land protection (Calboli, 2017) since that products are always related for certain area only.

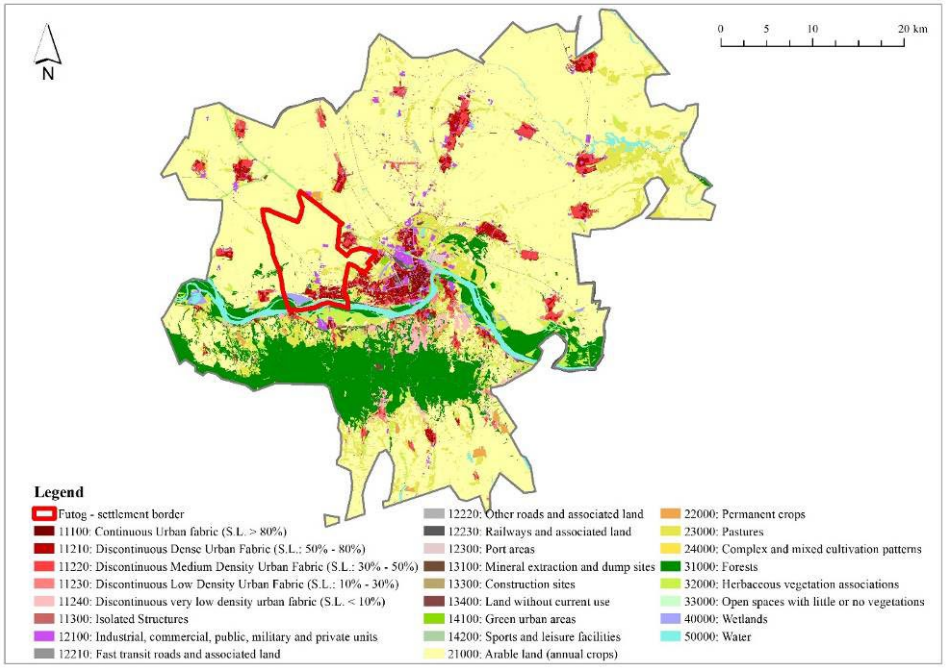

Figure 2. Land cover for Novi Sad FUA (2018)
(Source: Živanović Miljković et al., 2022a)

3.1. Land use planning issues

Plan of the General Regulation for the Futog Settlement (PGR, 2015) and its subsequent amendments (Ammendments, 2017-2021) are in implementation in the period 2015-2022 (Figure 3). The basic concept of spatial development within the settlement creates the conditions for arranging two main land use: Futog "atar",the area of rural settlement with primarily function of agricultural production, and Building zone.

Agriculture is considered as a primary activity, and, therefore, "atar" land use includes about 87% of total area covered by PGR (Table 1). At the entrance directions to the settlement and within the individual housing plots, working zones are placed. For the purpose of communal equipping, it is planned to expand the building land over „atar", within the area planned for the business on entrance directions to the settlement. Also, the area between Futog and Novi Sad, which is not designated for the construction, has been taken over by illegal building for housing purposes for a long time. That is in collision with the earlier conception according to which the area between the city and the closest settlements should have been preserved as agricultural land (Spatial plan of the City of Novi Sad, 2012).

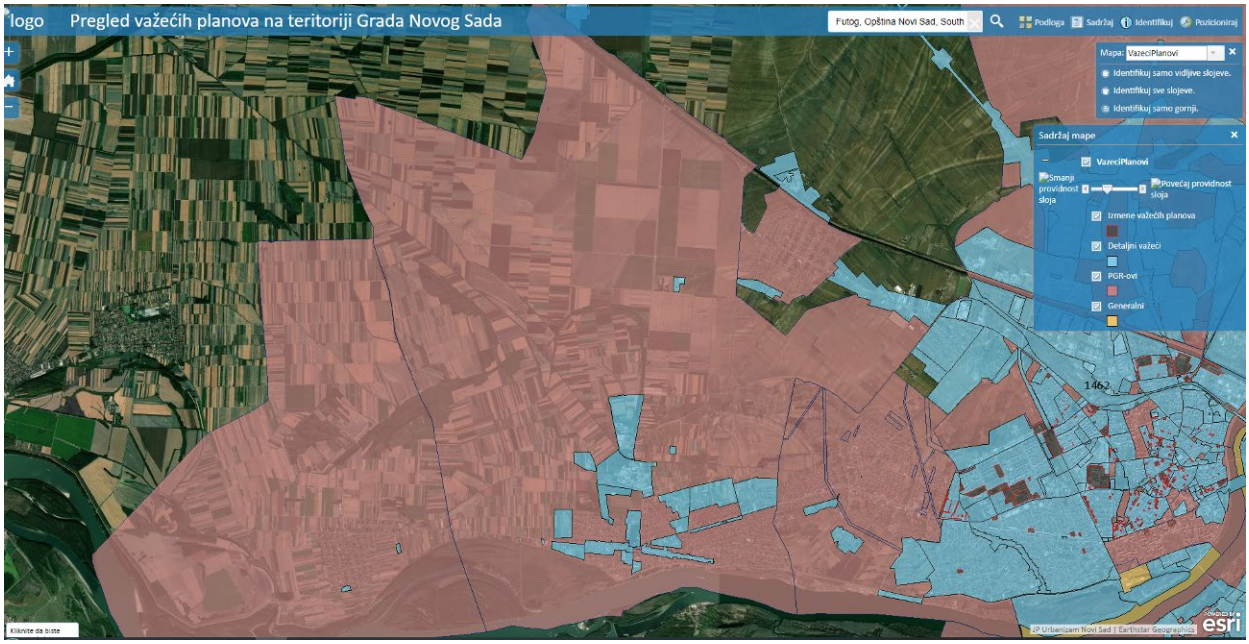

Figure 3: Coverage by plans for Futog settlement
(Source: https://vgis.nsurbanizam.rs/gis/planovi/)

Table 1: A comparative land use balance for Futog in the period 2015-2021

Land use	Area (ha)	%
PGR	8280.85	100
-Building zone	1087.62	13.13
Public land use	463.37	42.67
Other land use	624.25	57.33
Futog „atar"	7183.23	86.87

(Source: author's elaboration based on PGR, 2015, Amendments on PGR 2017-2021)

3.2. The effects of regulatory land policy instruments on peri-urban agriculture

Strategy for the Development of Agriculture and Rural Development of the City of Novi Sad for the period 2018-2022 (SDARD NS) promotes multifunctional agriculture and responsible resource management, maintenance of different production systems and types of agricultural holdings within urban agriculture.

However, local level, i.e. urban plans promote ALUC and new land take (Živanović Miljković et al., 2022a), even if that implies land use change of land designated for production with geographical indications within "atar" (e.g. Amendments , 2015). Also, an initiative for additional expansion of construction land in Futog was submitted again in 2021 (Amendments, 2021), with planned land take more than 15 ha of 'atar', where commercial facilities – non- public purposes, thus. In the covered area, currently there is no built traffic infrastructure except agricultural roads. It's about, therefore, new land take of high quality agricultural land belonging to "atar", including land registered for appeal of origin for cabbage production.

Consequently, with ALUC into construction land, farmers in Futog are faced with increase in property tax. The market value of construction land is 125 times higher than the price of agricultural land (Decision on the construction land development program for 2021). As a result of public investment in infrastructure capitalization of construction land's increased value (SIUDS, 2019).

4. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE PLANNING PRACTICE

The results of this review stand by an international consensus on the required, and sometimes mandatory protection of agricultural land from permanent loss due land use change, and its rational use, because that are very important issues from the aspect of food security. Searching for and balancing realistic needs with development and investment interests remain major task and challenge for planers.

The example of peri-urban agriculture in Futog specificity indicate necessity of scientific and expert-based solutions for conflict between the profit-oriented ALUC (e.g. for commercial, industrial, housing purposes) and the preservation of agricultural land for unique production with geographical indications. Special attention had to be drawn due to attachment of products with geographical indications to the land on certain area only.

Taking into account ALUC issues within study area, some principal recommendations for land use planning practice, especially within the forthcoming new planning cycle, have been identified as follows:

- *To identify areas with high quality agricultural land* (protected agricultural areas) and include them into planning documents as areas with constraints in terms of new ALUC.
- *To allocate resource in order to better protect agricultural land.* All new ALUC should be directed to the land of marginal importance for agriculture. Greenfields should be avoided.
- *To stop ALUC for economic and socio-cultural* needs (private interests), except for national interests of high priority (public interests). Any potential new ALUC should be evaluated from the perspective of food security issues as a public interest.

5.ACKNOWLEDGEMENTS

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MAKING CITIES MORE RESILIENT THROUGH URBAN DESIGN: CASE OF RECREATIONAL COMPLEX IN "BLOCK 44", NEW BELGRADE

Jelena Živković

University of Belgrade Faculty of Architecture, Serbia
PhD., Associate Professor, jelena.zivkovic@arh.bg.ac.rs

Ana Nikezić

University of Belgrade Faculty of Architecture, Serbia
PhD., Associate Professor, ana.nikezic@arh.bg.ac.rs

Marija Cvetković

University of Belgrade Faculty of Architecture, Serbia
PhD., Assistant, marija.cvetkovic@arh.bg.ac.rs

ABSTRACT

Throughout history, cities have faced risks but have also demonstrated their resilience to different kinds of disturbances and changes. Today, the scale and the unpredictability of urban risks are increasing due to the complexity of city systems and the uncertainty associated with many hazards, including climate change. The need to make cities more resilient affects how we plan, design, and build our cities. Urban design is a discipline that links architecture, landscape, and urban planning to provide meaningful, safe, functional, and pleasant places for people. As such, it is recognized as an essential tool for adapting cities to climate change and responding to other risks and disturbances.

This paper explores how urban design can be used to improve the recreational quality of abandoned urban spaces while, at the same time, helping to make cities more resilient. The case of a planned but only partially built and abandoned recreational complex in New Belgrade is chosen as a context and a starting point of the study, being an example of the absence of resilience thinking in urban development. The study uses research by design method (in the context of an urban design studio) to identify new urban design models through which links between cultural landscape, urban recreation, and climate change adaptation can be established and analyzed. The results indicate that, although all identified urban design models enable the introduction of measures to adapt to climate change, the level of their contribution varies concerning spatial scales as well as different dimensions of urban resilience.

Keywords: *urban design; resilient cities; climate change; urban recreation; cultural landscape*

1. INTRODUCTION

Contemporary cities face variety of challenges that threat both their built, natural and socio-economic structure and the quality of life of people and other living beings. Growing complexity of the city systems on one side, as well as the uncertainty associated with many natural and man-made hazards on the other, increase the scale and the unpredictability of urban risks (Meerow and Newell, 2019; Živković, 2020).

But, although throughout history cities faced variety of risks, they also demonstrated resilience to disturbances and changes. It has been shown that the capacity to overcome challenges is related not only to cultures and societies but also to how we plan, design, and build our cities (Mumford, 1961). In that sense, urban design has been recognized as an essential tool for adapting cities to climate change and responding to other risks and

disturbances, while at the same time aiming to provide safe, meaningful, functional, and pleasant places for people (Handley & Carter, 2006; Živković & Đorđević 2016)

Therefore, exploring paths towards more resilient cities become one of the main topics in urban planning and design research and practice. The literature review points out to several lines of the research that focus on different issues (Meerow et al. 2016; Pickett et al. 2013; Eraydin and Taşan-Kok, 2013). While one line of the research explores problems of existing urban structures in relation to specific challenges, such as climate change and natural disasters, there have also been attempts to develop models for planning resilient cities (Meerow and Newell, 2019) and designing more resilient urban forms (Lak et al. 2020)

Despite the main research focus, in general, it has been recognised that introducing specific spatial measures to combat challenges is necessary, but not enough. Cities and their components operate not as isolated entities but as systems and therefore "silo thinking" should be replaced by "systems thinking" that recognise importance of links between spaces, times and scales. The debate is still open in relation to why and how to link urban design and systems thinking in order to contribute to urban resilience.

The paper aims to contribute to this debate by exploring different paths to urban resilience through urban design. The research goal is to reveal possible links between urban design process and issues of resilience. It does so based on case study of planning and development of the recreational complex in Block 44 in New Belgrade.

First part of the paper introduces the concept of urban resilience and relates urban design as process and product to issues of urban resilience. In that sense, it provides theoretical framework through which urban resilience is further analysed and discussed in the case study of development of recreational complex in New Belgrade, Serbia.

The second part of the paper first introduces the context, planning and development goals for the researched area. In this way, it set the scene for the case of non-resilient urban project of Aqua Park as well as for further exploration of potential paths to more resilient urban recreational complexes. The research is based on the results from applying the research by design methodological approach in "Ecological urban design" studio at Master of Architecture programme of the University of Belgrade - Faculty of Architecture.

2. CONCEPT OF URBAN RESILIENCE

2.1. Concept of urban resilience

Contemporary cities are more densely populated and more interconnected than ever before. But at the same time they face variety of challenges, where urbanisation, climate change, refugee crises, disease pandemics, are among the most prominent ones. These challenges and risks are unprecedented in scale, scope, and complexity, and place serious pressure on local institutions to adapt (Meerow and Newel 2016). This situation requires new models of governance that mitigate risk and respond to evolving challenges (ARUP, 2014), and requires designing more resilient urban forms (Vaništa Lazarević et al. 2018, Lak et al 2020). It is assumed that "*Business-as-usual models of reactive planning and siloed decision-making will not generate the fundamental strength and flexibility essential for us to thrive in the face of the acute shocks and chronic stresses of the 21st century*" (Resilient cities network, 2022).

In order to help cities to effectively adjust and sustain their key functions, academics and policymakers are recognising the concept of "urban resilience" as an important organizing principle (Meerow and Newel 2019). Urban resilience confronts environmental, socioeconomic, and political uncertainty and risk, and acts as a "boundary object" that have significance and emerging attention across many disciplines (Konstantinos , 2022)

Different conceptualisations of urban resilience exist in academic literature and practice. According to Meerow, Newell, and Stults (2016) "*Urban resilience refers to the ability of an urban system-and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales-to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity*." Another useful general definition is provided by Urban resilience network (2022) suggesting that "*Urban resilience is the capacity of a city's systems, businesses, institutions, communities, and individuals to survive, adapt, and grow, no matter what chronic stresses and acute shocks they experience.*"

These definitions illustrate that at the very heart of the concept lays the idea of cities conceptualised as (set of) systems and a necessity of systems thinking in order to built and govern resilient cities. As opposed to silos view, systems thinking is, as defined by Arnold and Wade (2015) "*a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviours, and devising modifications to them in order to produce desired effects*." From this perspective, it is assumed that the future can't be predicted, but that "*it can be envisioned and brought lovingly into being*" (Meadows 2007). In that sense, systems can't be controlled, but they can be designed and redesigned.

This means that achieving urban resilience demands that cities look holistically at their capacities and their risks, and that besides introducing only specific measures to combat or adapt to urban challenges, integrating the systems thinking and design thinking may be necessary for development of more resilient urban structures.

2.2. Urban design as a tool for developing resilient cities

Urban design is a process and a product of designing man-made environment by creating connections between people and places, nature and urban fabric, urban movement and urban form (Živković and Nikezić. 2021). It is concerned with settlements of all sizes, including villages and rural settings. Urban design deals with different elements of urban form and operates at different scales. Two broad traditions of urban design- "visual artistic" and "social usage" tradition - recently blended into "making places" approach to urban design that simultaneously refers to urban space as an aesthetic entity and as a behavioural setting. Besides that, contemporary environmental and urban challenges additionally put forward ecological dimensions of urban form, and support flourishing of variety of ecological approaches to urbanism that affirm holistic and systems view on the city (Živković et al. 2019).

During the design process, designers make decisions on how to relate program and form in order to produce spatial interventions that have meanings and values for people and nature. Their actions build upon knowledge base that helps them define the purpose and guide decisions in different phases of the design process. Specific social, cultural, economic and environmental characteristics and relations of the site need to be recognized, so that urban designer can establish a knowledge base and a framework for the design, and make decisions on how to incorporate specific elements into a project (Djukanovic et al. 2021). Urban design connects knowledge to action through a systematic process that is related to specific context. For Palazzo and Stainer (2011) the design process has four key steps: (1) Defining the problem; (2) Developing a rationale for spatial intervention; (3) Summarizing development opportunities and constraints; (4) Conceptualizing and evaluating design options. It is in this context that integrating resilience issues into design process might be explored.

Examining the relationships between urban design and urban resilience is not a new. Anne Whiston Spirn (2014) nicely pointed out that "*Humans' survival as a species depends upon adapting ourselves and our…settlements in new, life-sustaining ways, shaping contexts that acknowledge connections to air, earth, water, life, and to each other, and that help us feel and understand these connections, landscapes that are functional, sustainable, meaningful, and artful*". Urban design theory constantly explores and discusses how links between nature and culture are established, supported or endangered through urban planning and design. While some authors focus on the effects of human activities on nature, others point out to our vulnerability and need to overcome the need for absolute control over the urban form, by embracing the inevitability of risks and changes and integrating them into design process and products. For example, in addition to authenticity, hybridity and connectivity, as already recognised principles that support sustainable development, Nan Elin (2006) suggest the principles of vulnerability and porosity as key principles of integral urbanism. These principles are important because they embrace limits of human knowledge, and suggest the need to adapt to changes that can't always be predicted. In that sense, they are directly linked to the concept of resilience.

Recently, several scientific (Lak et al. 2020, Vanista Lazarevic et al.2018, Pickett, et al. 2013) and practical (Resilient cities 2021, ARUP 2014) approaches have been developed linking urban design with resilience. What they have in common is a need for a) applying measures to mitigate or adapt to challenges, b) embrace uncertainties, risks and vulnerabilities, through development of flexible, adaptable, multifunctional and nature-based urban structures, and c) to apply systemic view on the problem as basis for resilience thinking. It is in this context that case studies of developing Recreational complex in Blok 44 in New Belgrade will be further explored and discussed.

3. CASE STUDY: RECREATIONAL COMPLEX IN NEW BELGRADE

3.1. Context for development of the Recreational complex in Block 44, New Belgrade

New Belgrade is a municipality of the City of Belgrade, capital of Serbia. It was built after WW2 (1948 -) in a previously uninhabited, wetland area on the left bank of the Sava. The new municipality was planned, designed and built as socialist modern city. It has all characteristics of the “functional city" model and layout based on concept of super blocks.

(a) (b) (c)

Figure 1 – Location of a) New Belgrade, b) Sava Blocks and c) Block 44 in urban structure of Belgrade

Block 44 belongs to Sava Blocks, the area located in parallel to the Sava River that consists of several super blocks (45,44,70 and 70a). The urban plan from 1965 conceptualised Block 44 as the administrative, commercial, cultural and recreational and center of the entire area of Sava Blocks. Besides that, General plan from 1972 opened up the possibility for new public recreational riverfront - SAVA Quay to be developed in the area between Sava superblocks in south-east part of New Belgrade

Until 80’, except for "Novi Beograd" health centre, none of the planned facilities were built in Block 44. Following changes in General plan, during 80’ and 90’s, a commercial zone was formed along Jurija Gagarina Street, with a market (1982) and shopping centre Piramida (1994), bordering the central pedestrian promenade “Lazaro Kardenas” that links all Sava Blocks. The function of the middle area of the Block 44 was converted to collective housing, and a new housing area was built in 1982.

But the area, covering 7 ha, between new housing neighbourhood and Sava Quay, planned as a recreational complex, stood inactive for decades. According to General Plan of Belgrade (1985, 2003, and 2016) it was planned as a regional public multifunctional recreation complex for sport and leisure. Although there were several design competitions and attempts to activate it, it was during the post-socialist transition at the beginning of 21st century that substantial changes of the area occurred.

(a) (b) (c)

Figure 2 – a) Concept plan for Sava Blocks (1965) and Block 44 in b) Master Plan of Belgrade for 2021, and c) Master Plan of Belgrade for 2041 (draft)

3.2. Project for Aqua-park in Block 44 - example of non-resilient development

a) History, design, realisation and current state of Aqua-park project

Although planned as public and multifunctional recreational complex, in reality the location was envisioned as commercial and profitable investment, and this economy-driven approach will actually determine its destiny. The initial idea to build an Aqua park in Block 44 dates back to the end of the last

century, but was realised at the beginning of the new millennium. The construction of the sports and entertainment water complex in New Belgrade began in October 2005, and the work was planned to be completed within a year.

The project was designed as a unified complex on 50 000m2, with 11 swimming pools and 21 slides . The investors wanted to attract visitors with the highest "kamikaze" water slide in Europe, but also with lazy river 405m and unique "family slides"132 meters long.

Figure 3 – Location, model and layout of Aqua Park project in Blok 44. Biro 59 (https://biro59.rs/info/138?r=all&l=sr)

However, during time, only half of the originally planned structures were completed, and several million euros were spent on the project. The original investors quickly gave up. Since then, several investors have changed. The construction started on several occasions, but the investors successively withdrew from the project. In 2010, the city of Belgrade tried to reclaim this land under its ownership and planned to diversify recreational offer by adding a bowling alley, an ice rink, and outdoor courts for team sports to the original project, but this never happened. Finally, only about 3/4 of the basic construction works remained from it (concrete pools, wall and gate) (Figure 4). The area was left completely abandoned. In 2019, the restart of work on the project was announced.

Figure 4 – Location of recreational complex in: 2001 (before construction), 2008 (under construction), 2022 (current state)

b) Discussion on Aqua Park project's resilience: dimensions and levels

The project of Aqua Park can be read as an example of silo-thinking in urban planning and design. Although planned to be public recreational complex, in reality the location was allocated for the development of the private-owned and managed recreational complex. This decision induced the *formal and functional closure*, and thus affected the relationship of the project and its environmental and social context.

Besides that, any aqua-park is by definition an introvert complex, which in this case also influenced the applied general design strategy of a large enclosed structure. These kinds of structures are *not flexible or adaptable* to changes and do not allow for incremental or piecemeal growth. In the case of Aqua Park, they were left abandoned after financing of the project stopped, producing *functionally, economically, and socially* non-active space and *physical barrier* between housing area and Sava River.

3.3. Exploring pathways to resilience of Recreational complex in Block 44

a) "Ecological urban design studio"- task and pedagogical concept

Potential pathways towards more resilient development of Recreational complex in Block 44 was explored in the context of "Ecological urban design" studio at UBFA Master of Architecture programme during 2020/2021 and 2021/22 and included 32 students projects. Using inherited situation of abandoned Aqua park as a starting point, they investigated *how urban design can be used to improve the recreational quality of derelict urban spaces while, at the same time, helping to make cities more climate resilient*.

The „Ecological Urban Design Studio"(EUD) is conceptualised and designed to enable students to acquire complex and deep awareness, knowledge, skills to design place based ecological urban design project. The work in the studio is based on the premise that the ecological urbanism draws from ecology to inspire urbanism that is more socially inclusive and sensitive to the environment, and that seeks for new ethics and aesthetics of the urban (Mostafavi and Doherty, 2010). Pedagogical process combines research, design and reflection phases that weave together to help students produce design project at different spatial scales, and gain wider knowledge on how can urban design and environmental issues be integrated (Živković & Nikezić 2021).

b) Results

This study uses research by design method (Nikezić et al. 2021) to identify new urban design approaches as models through which links between cultural landscape, urban recreation, and climate change adaptation can be established and analysed. Analysis of the students' urban design projects, reveal that *there are different potential pathways* to developing resilient recreational complexes. Based on their primary focus and conceptual grounding, all analysed urban design projects can be grouped around five general design approaches, namely:

FORM based approach- that aims at developing aesthetically pleasing and meaningful place
FUNCTION based approach- that uses provision of variety recreation activities for diverse public as a starting point for design
COMMUNITY based approach- that relates existing social system, local assets and neighbourhood needs to project, and develops design solutions aiming to improve overall quality of life
NATURE based approach- that looks at the nature as metaphor, mentor, process and system to develop spatial interventions that emphasize human place in nature.
LANDSCAPE based approach- that emphasize wider understanding of place as produced through time by natural and cultural processes, and integrates this view into urban design intervention.

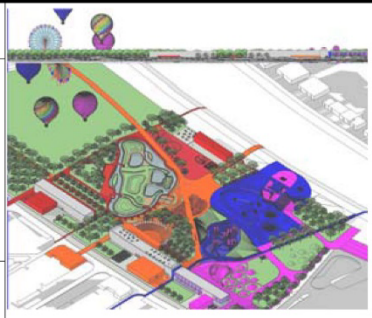
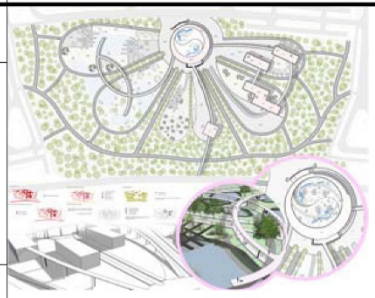
Table 1 presents the representative projects for all five design approaches through their concept and design characteristics of Recreational complex structure and elements and reveals sequences of relations between Landscape, Program (recreation), Form, Community, Nature and Climate adaptation measures established during the design process. It further comments issues related to RESILIENCE, such as a) Climate adaptation measures, b) Flexibility of structures, and c) presence of systems thinking as reflected in design project.

c) Discussion on urban design paths to resilience

The results indicate that, although all identified urban design approaches (models) enable the introduction of measures to adapt to climate change, the level of their contribution varies concerning, flexibility of structure (that enables different aspects resilience), and level of integration into wider systems. Differences between identified design approaches are based on different focus and priority values as starting points for project development, that affect how the links to resilience issues are established at different points in design process.

This reveals that some approaches allow for better integration of resilience thinking into urban design process. While traditional Program and Form based approaches allow for implementation of resilience oriented climate adaptation measures and flexible design structures, more general Nature, Landscape and Community-based approaches support systemic thinking that, at the very beginning anchor urban design actions to social and environmental systems. In this way, throughout design process designers ought to develop program and design solutions having in mind links between people and nature in different spaces, times and scales.

Table 1: Urban design approaches for resilient cities

	RECREATIONAL COMLEX Structure and elements	DESIGN PROCESS	CLIMATE ADAPTATION measures	FLEXIBILITY of structure	SYSTEMS thinking
PROGRAM based approach **CONCEPT** *"Play 44"- the idea* is to create a playful environment that attract neighbours and visitors offering variety of activities Student: Milica Jokić		P → C → F → CAM+N → L	Existing abandoned pools provide for "place for water" and help adapt to flood and drought risks. New structures and trees help in adapting to overheating.	Project can be delivered through phases and offer some flexible structures. Different areas need different levels of investment and enable economic resilience	Project is designed as a system of play, that is functionally related to surrounding areas. Relations to natural systems are relatively weak.
FORM based approach **CONCEPT** *"Flower 44"* – metaphor of natural form is used as organising principle for structuring variety of activity areas. Student: Nikolina Đogo		F → N → P+C → CAM → L	Climate adaptation measures are integrated in project following established formal and functional requirements and mainly relate to water management.	Project is designed as a clear and strong form that lacks flexibility. Adaptability of structures exist at local level.	Except for protecting existing and introducing new green areas in order to improve quality of space, systems thinking was not leading the project.
NATURE based approach **CONCEPT** "*Garden 44* " – aims to create place where people re-create and enjoy, nurture and learn from nature in all its diversity. Student: Neda Stamenković		N → P+C → CAM → F+L	Climate adaptation measures relate to: overheat, flood and drought. Resilience of existing structures is improved through re-use in line with local needs.	Recycling of existing structures and development on new ones can be realised through phases. Modular elements were used to provide for dominance of nature and flexibility of project .	The project is conceptualised as "situation of garden" that relates human and natural systems. This idea led new interventions to improve relations through spaces and scales.
COMMUNITY based approach **CONCEPT** *"WE -thorugh - Block"* – aims to link neighbours and spaces of Block by creating structure that can grow and adapt through time. Student: Dunja Putić		C → P+N → F+CAM → L	Climate adaptation measures relate to: overheat, flood and drought, by re-using existing pools and designing new places for water and greenery.	Flexibility of the structures is high since the principle of "increments" and "growth" were leading the project. it uses movable structures that can adapt to changing needs.	The project was conceptualised having in mind existing social and natural systems that were supposed to benefit from new spatial interventions.
LANDSCAPE based approach **CONCEPT** *"Enchanted Forest"* – aims to attract people by creating diverse, nature-like landscape that offers variety of activities Student: Aleksandra Koković		L → N+C → P+CAM → F	Climate adaptation measures relate to: overheat , flood and drought. New landscape is formed by integrating existing pools and structures	Project is structured so that it can be realised through different phases and uses adaptable design solutions	Project is envisioned as part of green urban infrastructure, and part of both natural and social systems.
P-program, **F**-form, **N**-nature, **C**-community, **L** – landscape, **CAM**-climate adaptation measures					

4. CONCLUSION

The research aimed to increase knowledge on how to best integrate resilience thinking in urban design process in order to contribute to development of more resilient cities. The paper presented concept of resilience in relation to urban development and design, and based on the theoretical framework analysed the case of developing recreational complex in Blok 44 in New Belgrade, both as an example of non-resilience and resilience thinking.

The project of Aqua Park can be read as an example of silo-thinking where its introvert design strategy lead to absence of all aspects and levels of projects resilience. Absence of social relevance and functional and formal adaptability, flexibility and elasticity, led to abundance and neglect of the partially built project, that today function as a barrier in wider urban context. On the other hand, the analysis of students' urban design projects revealed that there are different potential pathways to developing resilient recreational complexes. But it also revealed that these design approaches differ in relation to how well they support application of resilience thinking and measures. These differences are related to different focus and priority values as starting points for project development, that affect how the links to resilience issues are established during the design process, and how they contribute to different aspects of urban resilience at different spatial scales. This all means that in order to better integrate issues of resilience into urban design process, the introduction of specific spatial measures, incremental development and flexibility of form, should be complemented with systems view on the design project as a part of the wider natural, social, spatial and temporal context.

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RETHINKING THE PRIVATE OPEN SPACE OF GROUND FLOOR UNITS IN MULTI-FAMILY HOUSING DEVELOPMENTS IN THE CITY OF NIS, SERBIA

Nataša Petković Grozdanović

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Assistant Professor, natasa.petkovic@gaf.ni.ac.rs

Branislava Stoiljković

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Assistant Professor, branislava.stoiljkovic@gaf.ni.ac.rs

Hristina Krstić

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Assistant Professor, hristina.krstic@gaf.ni.ac.rs

ABSTRACT

The provision of private open space is one of the basic factor of residential quality. With the global spread of COVID-19 pandemic in the world, and stay-at home attitude, private open space showed to be essential for daily-life quality and residents' wellbeing, since it downsizes the negative aspect of social distancing, remote working/learning and situations like lockdown or quarantine.

Gardens are seen as the private open area with the highest degree of spatial comfort, and urban planners and architect worldwide strive to develop models that will provide multifamily housing with private gardens. While in the west and northern Europe the significant amount of multifamily housing developments are conceptualized in a way to provide garden-like-apartments on the ground floor level (by joining a part of the surrounding terrain to the unit area, in order to form larger and landscaped private open space) local urban and architectural practice do not recognize potential of the proximity to the terrain when designing ground floor apartments. Quite contrary, in domestic circumstances focused is to overcome the negative aspect of ground floor living, by setting back the unit from the near-terrain environment. The absence or reduction of ground floor private open space isolates the apartment unit from the surroundings. What's the reason for such distinguish perspectives? Do the cultural differences play the key role or is it up to the legislative framework? These are some of the questions to be answered in the paper.

Keywords: ground floor apartments, garden-like apartments, multifamily housing, private open space, private gardens

1. INTRODUCTION

One of the vital advantages of family housing is the existence of a private yard, which is commonly the main reason why people prefer house over an apartment unit. Nevertheless, in order to create sustainable housing in urban areas (due to the limited spatial resources) new developments are more and more oriented towards multi-family residential models. As these models are increasingly developed "in height", there is almost a complete absence of the relationship between the apartment and the surrounding terrain – the only certain connection is present in terms of enabling access to the residential unit (Stoiljkovic et al, 2015).

In order to partially compensate this lack of multi-family housing, contemporary developments of this type include the provision of private open space (in a form of balconies, loggias, roof terraces and etc.) which ensure apartments with access to the natural environment and provide an alternative to the yard. Although it is impossible to provide apartments with a private open space that will have all of the advantages that the yard of a family house has (especially from the aspect of size) with adequate design and landscaping it is possible to

create a high-quality alternative (Levit and Levit, 2010; Stoiljkovic et al, 2015). Since only the ground floor level has direct connection to the terrain, special attention is devoted to the development of private open space of the units situated on this level. Due to the proximity of the natural environment, there is a possibility of developing a garden-like apartments – with a kind of private yard, by adding a part of the land to the residential unit at the expense of the surrounding terrain. Such approach do not only ensure an open space of larger dimensions, but also the access to the exterior landscaped ground, with lush greenery and in the proximity of facilities in common courtyard. This way, housing quality of the units situated on the ground floor level (usually considered lower than on the upper floors) significantly improves.

Although there are no restrictions of the application of garden-like ground floor private open space, the most effective ones have proven to be in low-rise housing schemes (up to 4 or 5 floors) in suburban settings (Levit and Levit, 2010; Milanovic & Vasilevska, 2018). When it comes to the issue of density, even a high-density values are appropriate. However regarding the occupancy rates, low to medium occupancy results in a higher percentage of green open space, on which expense a private garden of the ground floor units can be organized. Open blocks, surrounded with significant amount of green open areas and closed or semi-closed blocks are favourable settings for development of the garden-like private open space. Regarding the street scape, traffic lines and parking areas should be drawn from the buildings with green walkways, in order to create adequate ambient in which private open space can be interpolated.

This paper deals with the garden-like private open space of the ground floor units, with an emphasis on design, legal and cultural issues and ownership status.

2. ADVANTAGES OF PRIVATE GARDENS

In physical sense the private garden should act as a functional outdoor extension of living space. However, in broader sense, a garden is not just a unit's addition. A garden is a place to be, a place for productive work, a place to retreat, a place to care for growing things, to exert creativity, as well as a place that develops over time, that one can own and control (Fransis, 1990). In order to design quality garden-like private open space of the ground floor apartment's researches and experience from the urban planning and architectural practice show that the successful solutions are those with balance in several aspects.

The positive effects of having access to the garden and views of nature from the home are reflected in the improvement of physical and mental health and wellbeing (Gros and Lane, 2007). Green and landscaped surrounding prevents noise and air pollution and provide healthier living environment in which residents can rest, work, play or engage in recreation (Palme et al, 2020). In childhood the garden functions as an escape through the provision of additional space, while adults value the seclusion and distraction from reality that absorption in the garden offers (Coolen and Meesters, 2012). A chance to spend some time outdoors in natural setting helps to reduce stress and daily life struggles. Engagement in gardening leads to the greater level of satisfaction (Kaplan, 1973).

In current pandemic situation implementation of a garden-like private open space on the ground floor level represents adequate respond to the health concerns and shift in daily life routines. More frequent and longer staying at home is made easier through the possibility to reside in alternative, outdoor space (Capolongo et al, 2020; Megahed and Ghone, 2020; Zarabi et al, 2020). Although private open space of the units primarily serve to supplement the housing function, these spaces can greatly contribute to the socialization of the tenants. They helps to overcome isolation and alienation, caused by social distancing, and ensure social interaction in the naturally open air, on the necessary physical distance, either with household visitors or with the neighbours from the immediate surroundings.

Garden, which forms part of the unit's environment, is not only a site for interaction (with nature or with people) and the psychological processes associated with this, but also for expression of personal needs and individuality (Anthony, 1997). Contribution of nature have a large effects on residents' relationship with the place of living (Bernadini and Irvin, 2007). Findings show that home garden plays an important role in defining and expressing self-identity and enables residents to express their personality (Freeman et al, 2012).

Adding a part of the terrain to the ground floor apartment, in addition to positive effects on the lives of tenants, has a positive effect on the overall quality of a residential environment. In situations when there isn't defined model for the maintaining of common open areas in multi-family housing, which reflects in the neglecting of such spaces (such as in Serbia) private gardens on the ground floor can make a great contribution to the environmental quality. By adding a part of the surrounding land to the apartment on the ground floor,

the care for the green area is passed to the residents of that unit. This way the plot is enriched with landscaped greenery, which contributes to the overall layout of the site.

As an extension of living space, a kind of 'outdoor room', private gardens can promote security of the area. Their position allows easier visual surveillance of the surrounding area, which reflects in higher security. However, the issue of privacy and safety of the units need to be fulfilled.

3. GUIDELINES TO DESIGN GARDEN-LIKE PRIVATE OPEN SPACE OF THE GROUND FLOOR APARTMENTS

By adding a part of the terrain to the unit located on ground floor, a larger and landscaped private open space can be created, which promotes housing quality and unit's ambient. In order for private gardens to be a useful extension of the interior space, design of 'broad' connection between living room and the open space is required, which makes them functionally linked and creates the whole. Design of the garden-like private open space provides greater opportunities for outdoor activities, especially for elderly, household with small children and people with disabilities – as they are generally more accessible. For families with small children they extend the lifestyle choices available in the apartment by facilitating activities such as outdoor playing, hobbies, gardening and even home business. When it comes to the size of garden-like private open space the minimum with is 3m, optimal 5m (without the additional green tampon) and the area of 15m² is required.

Regarding their position, these spaces should be oriented toward the more natural setting, preferable internal semi-public or public space, with small as possible vistas on the roads and transport, in order to reduce the pollution, filling of overcrowding and public exposition (Milanovic and Vasilevska, 2018). When this is not the case, private open spaces of the ground floor units can be designed as enclosed gardens. Even in such concepts, their use value can remarkably be increased, as opposed to the loggias or balconies of the upper floor units in multi-family housing developments.

Although proximity of the common land multiplies the value of garden-like open spaces, their organization needs to satisfy certain criteria of privacy and safety. Privacy refers to the ability of these spaces to host households' activities outside, without exposing them to the non-household members. Therefore, spatial resources of unit', which surround the terrain, should be dually utilized. Beside as an apartment functional extension it should form a kind of buffer zone, to provide a higher degree of intimacy and security. It should enable isolation and undisturbed simultaneous stay of all household members and perform of different activities without unnecessary exposure. The best solutions ensures the balance of the need for privacy with the surveillance. Well-designed private open space of the ground floor units obtain adequate comfort regarding user privacy, with the control of visual connections to the surroundings and interaction with neighbours, but without blocking the vistas to the environment. This is achieved by forming a buffer layer of low or medium greenery, in a width of 1 to 1.5m (ADGLV, 2021). Accentuated by greenery, private gardens of the ground floor units are physically and visually separated and isolated from views and noise from the surrounding area (Milanovic and Vasilevska, 2018).

According to their position, garden-like private open spaces of the ground floor units can be divided in two main categories.

Private open space facing the inner courtyard. In the cases where immediate connection to the surrounding land is enabled, the greatest potential of the ground floor units' outdoor space is used when they are situated on the same level as the terrain. In settings where units are facing the inner courtyard, the surrounding area has a semi-public, in some cases even semi-private character. Such circumstances greatly contribute to the visual connection and the openness of garden-style open space to the environment.

In such setting, it is not necessary to form any significant physical barriers. It is possible to design only a green buffer zone, which has a role to ensure the necessary spatial distance of common areas from the space which belongs to the housing unit. Greenery can be landscaped as lawn, flower or shrub bushes or even small trees. If fencing is applied, the physical structure is low to medium height, often transparent (Figure 1).

Figure 1: Possible solutions for spatial organization of garden-like private open space facing the inner courtyard

***Private open space facing the street*.** Although the greatest potential of the surrounding terrain is used in cases where gardens of the residential unit are constructed at the level of the terrain, in cases when units are facing the street this setting can greatly violate necessary level of privacy and security.

The problem can be overcome by applying certain design measures. Denivelation of a ground floor level, by lifting the unit above the street view level, can compensate this problem. It should be raised up to no more than 1.2m in relation to the terrain (Figure 2, example a) and screened with green buffer zone (with the width between 1 and 1.5m). Also partial or complete fencing of private open space can be applied (Figure 2, example b).

a) denivelation of the ground floor level

b) partial or complete fencing of private open areas

Figure 2: Possible solutions for spatial organization of garden-like private open space facing the street

4. DEVELOPMENT OF THE GARDEN-LIKE PRIVATE OPEN SPACES FOR THE GROUND FLOOR APARTMENTS IN LOCAL CONTEXT

Although contemporary international practice show an increasing tendency towards the development of garden-style apartments on the ground floor level, in Serbia there is a completely opposite trend. The spatial potential of the available land surrounding the apartment unit is unutilized. Linking the unit with the terrain is not considered at all. In local circumstances the proximity to the terrain is seen as disadvantage. In the majority of multi-family housing developments private open spaces of the ground floor apartments are gone under reduction or even total absence.

In local practice apartments situated on the ground floor level are characterized as low-quality and undesirable for many households. Quite contrary to western countries, where precisely due to the “possession of the own piece of land and access to the nature” ground floor apartments are of a higher value (compared to the same apartments on upper floors).

Figure 3: Reduction of ground floor private open space in domestic practice – new residential developments in the city of Nis, Serbia

4.1 Obstacles in designing garden-like private open spaces

In local context safety and privacy requirements of the ground floor apartments are often unfulfilled. Mentality and cultural habits can be related to such outcomes. However, the main reason for such distinguish approaches could be found in planning regulation, economic and cultural differences. In the continuation of the paper a brief overview of local circumstances that affect the development of garden-style apartments will be presented.

Design issues. The planning regulation and domestic urban and architectural practice significantly contribute to the low environmental values of the ground floor units and associated private open space.

Observed from the currently applicable regulation for multi-family housing construction, there is no clear definition regarding the treatment of free, unbuilt land on the plot. In current urban planning documents, the formal treatment has given to the parking and common outdoor area. The parking is normatively defined, and can be developed as enclosed garages or in a form of parking lots. Besides parking, the minimum 10% of total plot area is defined for common use. Percent of green, unpaved areas are not defined as mandatory in local regulation. As a result, in the majority of recent multi-family housing developments, total absence of green areas is recorded. Organized common areas are usually only the paved walkways that surrounds the building and the wider parts on the position of entrances. Such spatial arrangement caused that ground floor units do not have any green barrier with a common ground, which reflects in a very low ambient quality, with no access to the natural environment.

Ambient value is also reduced by the treatment of the streetscape. Regardless the scale of a development, the way a street looks and feels – its proportions, views of house fronts, play of light and shade – all effect the value of a street. In current local urban planning practice street profiles are constructed as very narrow and without any green areas.

In such circumstances, development of garden-like private open spaces on the expense of the surrounding terrain do not gain the ground floor units any additional value.

Ownership status. A significant barrier in applying western concept of garden-style apartment is the ownership status of the free, unbuilt land on the plot. The undeveloped land around the building is owned by all of the tenants from the building. From a legal point of view, residents from the ground floor apartments could claim the right to use the common land as unit's spatial extension only if approved by all of the tenants. The ownership could be obtained only in cases when this area is calculated in the total floor. This situation reflects on the increase of occupancy rate and decrease the gross building area, which discourage investors to develop such kind of multifamily concepts.

There were few situations when investors sold the part of the unbuilt land. Namely, in the local practice the parking space is sold separately from the unit for which is planed (both parking space in the garage or on the land). This, not legal, neither illegal situation regarding parking could be transfer on the treatment of private gardens in multifamily housing developments. This way the ownership of the garden itself would be separate from the unit ownership.

4.2. Rare cases of garden-like private open spaces in the city of Nis, Serbia

Regardless the obstacles that affect development of garden-like private open space of ground floor units, modest efforts are made in order to change the common perspective. Some newly developed multi-family housing blocks and few cases of recent ground floor apartment's reconstruction show that there is an evident need for such multi-family housing concept.

In the case of *Immoreal multi-family housing complex*, ground floor units facing open inner courtyard, gain the larger private open areas (10-15m²) bordered by split-level, massive concrete planters, planted with various greenery. The ground floor is elevated 80cm from the terrain. Private garden-like open space has direct connection with the common ground through the private staircase. In all of the cases a presence of physical barrier between private outdoor space and common area is recorded.

Figure 4: Garden-like private open spaces in the housing block Immoreal, Duvaniste, Nis, Serbia

In the case of *Zeleznicka kolonija multifamily housing block*, some of the ground floor units have gone under recent reconstruction (Figure 3). Initially, buildings were constructed with a larger balcony on the ground floor, 1.2m elevated from the terrain. Undergoing reconstruction, in some units, residents made alteration of the balcony by opening them more toward green surroundings. Direct connection to the surrounding terrain is made through the addition of private staircase, which connects the unit's balcony with the surrounding green area. In some cases a part of the terrain is added, forming an outdoor extension – a kind of private garden. In areas where private outdoor spaces are facing the parking, residents landscaped the terrain in the proximity of the units, creating more comfortable environment. In all of the reconstructed, garden-like units, a presence of the physical barriers between private outdoor space and common area is recorded.

Figure 4: Alteration of the ground floor private open spaces in the housing block of Zeleznicka kolonija, Palilula, Nis, Serbia

5. CONCLUSION

Due to the necessary sustainability in urban planning and tendency toward compact cities, family housing is more frequently replaced with modern multi-family housing models. One of the transitional multi-family concept implies the implementation of garden-like open space for the units situated on the ground floor level. Such residential concept gain positive aspects of both housing models – provision of private garden, in the liveable neighbourhood, in the vicinity of the common facilities. In developed countries, garden-style apartments are seen as one with the highest comfort and they are on high demand.

Opposite to the contemporary western practice, in newly national and local multi-family housing developments, garden-like apartments on the ground floor have received no attention. A significant barrier in applying such concept is the applicable regulation for the urban planning and construction of multi-family housing, as well as undefined ownership status of the potential gardens. However, it seems that the main reason lies in the poor urban planning and architectural practice. New residential developments are situated in the setting with poor urban organization, with no street scape layering and often accompanied by the absence of common and green areas on the plot – which results in severe and monotonous ambient. The basis of such conclusion is linked with the few recorded garden-style outdoor space of the ground floor units. In all of the cases where this concept is applied, buildings are situated in more natural environment, with peaceful and safe ambient. Consequently, the residents showed tendency toward opening the units and connecting them to the immediate surroundings.

In local context, when it comes to the design of private open areas of the ground floor units, the analysed cases showed social and cultural influence on the spatial organization. The garden-like private open spaces should be design 1) above terrain level, 2) with adequate ambient comfort and 3) with fencing – physical barrier that would provide higher degree of user privacy, control of the intensity of interaction with neighbours and appropriate level of security.

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SMART PLANNING TECHNIQUES TO COMBAT THE URBAN HEAT ISLAND

Varshini Renikunta

Master's in urban and Regional Planning
USF, Tampa, FL. renikuntavarshini@gmail.com

ABSTRACT

Global climate change, which is primarily brought on by greenhouse gas emissions and has regional repercussions, is one of the main issues facing urban planning and architecture. Within the next 50 years, this change is predicted to modify the temperature, precipitation regimes, storm frequency, sea-level rise, and other factors that will have an impact on metropolitan areas by altering the current climate environment.

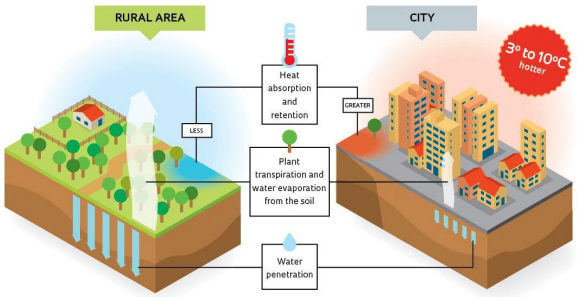
Numerous cities have implemented measures to reduce urban heat islands. Indian cities must also adapt to these shifting climatic conditions, particularly by putting in place urban cool zones and mitigating urban heat island effects. Understanding the changes in thermal comfort brought on by urbanization will aid in urban planning and help the urban habitat. The study focuses on comprehending and applying methods in the Indian city of Hyderabad. The goal of the study is to quantify and assess how future climate change will affect the urban heat island effect, regional weather patterns, and urban climate. implementing measures to reduce urban heat islands. Greater Hyderabad recently experienced a spectacular surge in temperature, which intensified the urban heat island and caused microclimatic differences. This study must be carried out. These microclimatic differences in the research area are caused by a number of urbanization- and development-related factors. In light of the nature and effects of urban microclimates, it was deemed important to delve deeply into understanding urban microclimate complexity.

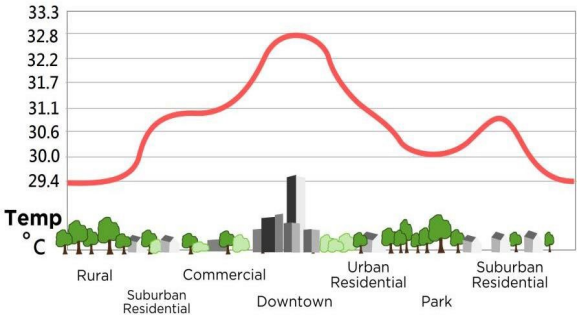
Keywords: *Climate change; Urban heat Island; Urbanisation.*

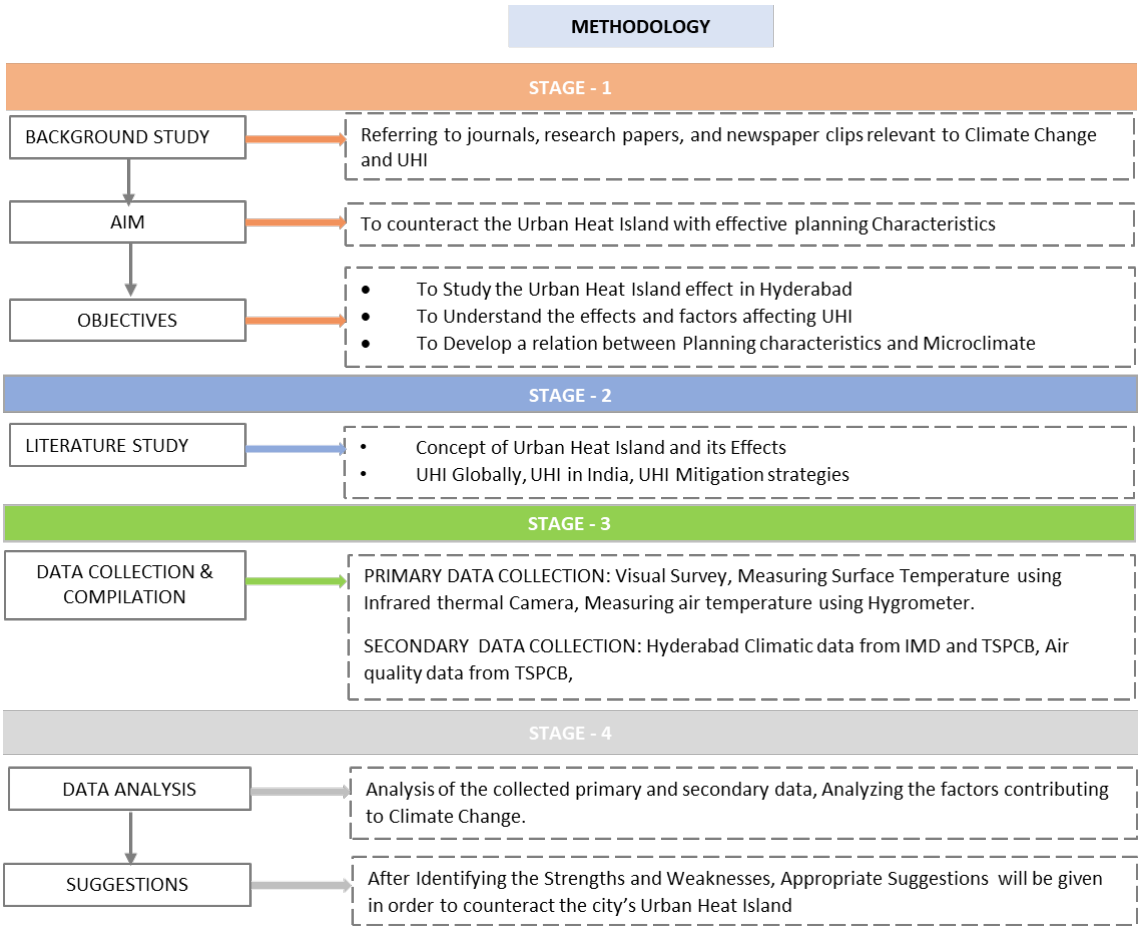
RESEARCH NOTION

Urban Heat Island Effect Definition and Concept

The term "heat island" refers to urban areas that are hotter than surrounding rural areas. Heat islands can have an impact on communities by increasing peak energy demand in the summer, air conditioning costs, air pollution, and greenhouse gas emissions, heat-related illness and mortality, and water quality.







LITERATURE STUDY

Basic Characteristics of Surface and Atmospheric Urban Heat Islands (UHIs)

Table 1: Features and their Composition W.R.T Surface and Atmospheric UHI's.

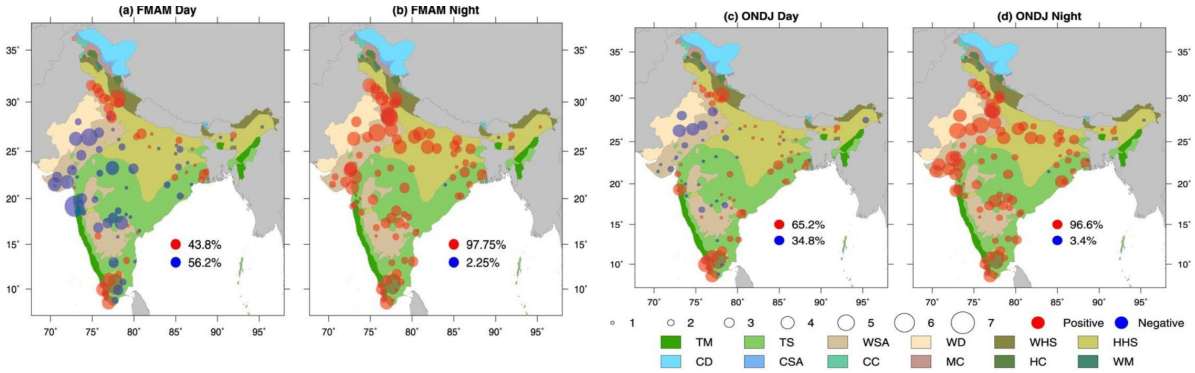
FEATURE	Surface UHI	Atmospheric UHI
Temporal Development	Present at all times of the day and night. Most intense during the day in summer	May be small or non-existent during the day. Most intense at night or predawn and in the winter
Peak Intensity	More spatial and temporal variation: Day: 18 to 27F (10 to 15°C), Night: 9 to 18F	Less variation Day: 18 to 27F (10 to 15°C), Night: 12.6 to 21.6F
Typical Identification Method	Indirect measurement: Remote sensing	Direct measurement: Fixed weather stations and Mobile traverses.
Typical Depiction	Thermal Image	Isotherm Map

Reference : (The United States Environmental Protection Agency)

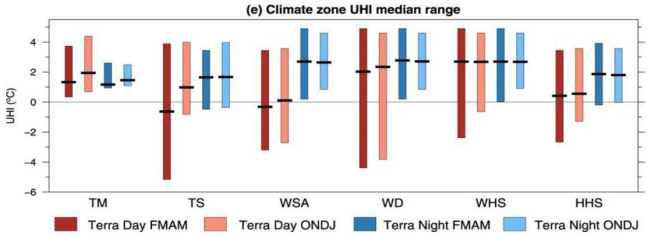
Types of Urban Heat Island

- Surface Heat Island: Higher Surface Temperatures in Urban Areas when Compared to Rural Areas, Illustrated with Thermal Maps.
- Atmospheric Heat Island: Warmer air in Urban areas when compared to Rural, Illustrated with Isotherm maps or graphs.

Urban Heat Island in India



Tropical Monsoon (TM), Tropical Savannah (TS), Warm Semi-Arid (WSA)Warm Desert (WD), Warm Humid Subtropical (WHS), Hot Humid Subtropical (HHS), Cold Desert (CD), Cold Semi-arid (CSA), Cool Continental (CC), Mediterranean Continental (MC), Humid Continental (HC) and Warm Mediterranean (WM).



Source : (TERI, 2017)

Causes of Urban Heat Island

According to Steuben and Schneider, paved over surfaces like highways and parking lots can collect solar energy and release heat into the atmosphere. More heat is absorbed by buildings with dark roofs. Urban sprawl and a reduction in green space.

Currently, urban regions are home to 50% of the world's population. That proportion is anticipated to increase to 70% by 2050. Increases in urban temperature are anticipated to go hand in hand with population growth, placing more residents at the peril of the harmful health impacts of intense heat. Exhaustion, heatstroke and worse are examples of these medical conditions.

Young children, elderly people, outdoor workers, and low-income groups are more at risk for heat-related issues. In fact, the USA alone saw approximately 8,000 heat-related fatalities between 1979 and 2010. The number of these fatalities surged in 2006, the second-hottest year on record in the USA. Those numbers will increase as urban populations increase and temperatures rise.

BARCELONA: A HEAT ISLAND IN THE CITY

One city that is particularly affected by the urban island effect is Barcelona. Barcelona's temperatures are predicted to rise by up to 3.2 degrees Celsius during the next 30 years, similar to many other cities in southern Europe. From 2050 onward, the city is anticipated to experience up to 20 more "hot" days a year in addition to the increase in urban temperature. A day that is hot is one where the temperature exceeds 30 degrees Celsius. The city will be severely impacted by this.

While the sea cools many of the city's coastal districts during the day, at night the sea has the opposite effect, raising temperatures in the coastal neighborhoods.

(Appleton)

Urban Heat Island (HYDERABAD)

City Profile

10.2 Million

Tropical wet and Dry

Pop Density- 10477/sqkm

Max Temp- 42C,

Min Temp- 10C

Avg Rainfall – 828.5mm

Hyderabad: Walls of glass, islands of heat

- Excessive use of glass in buildings leads to increased use of air conditioners that release green house gases.
- "This has an adverse impact on the weather pattern locally and heats up the area further" an expert warned.

Source: Times of India, Oct 26, 2015

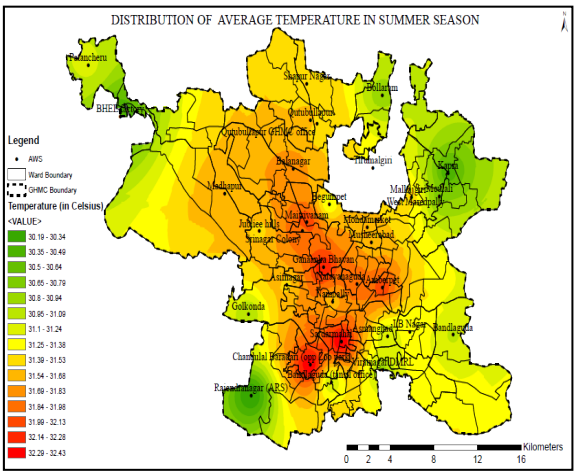
Urban Microclimate Analysis

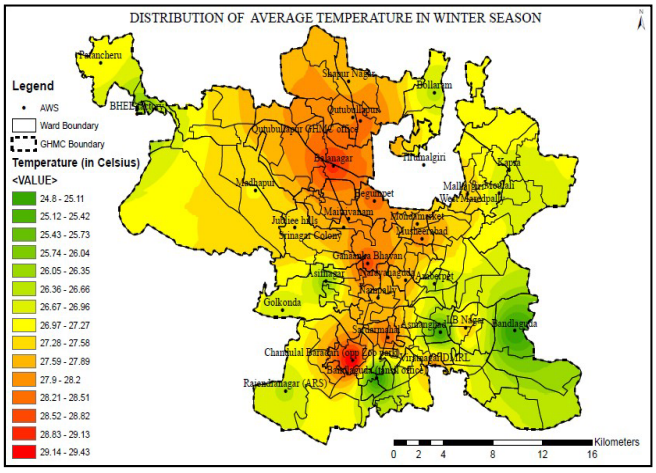
The parameters which are taken into consideration for climate Study of Hyderabad are

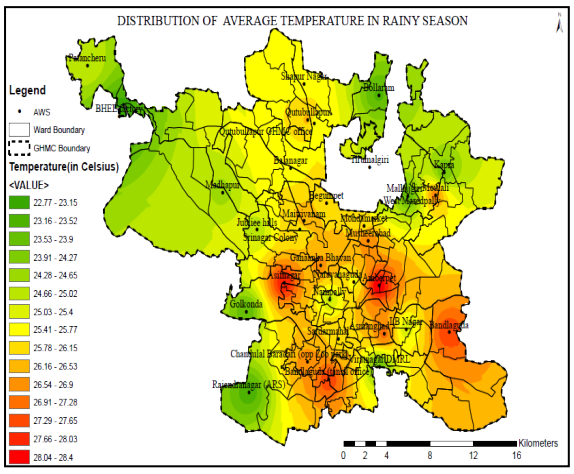
- Temperature
- Humidity

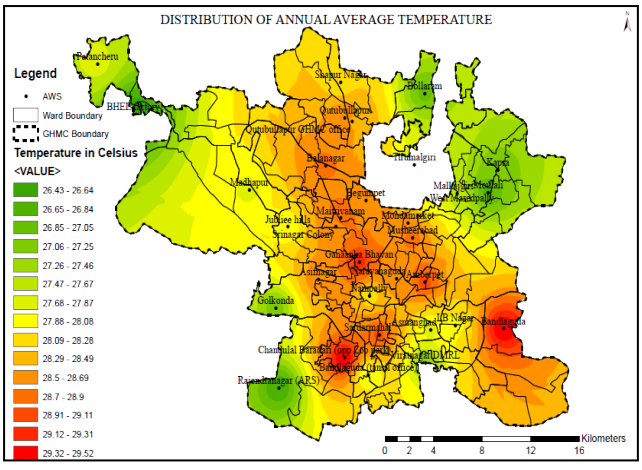
An attempt is made here to bring out seasonal and spatial patterns of microclimatic variables. The spatial analysis is done for the summer, rainy, and winter season for year 2018 using ARC GIS 10.1

Temperature Analysis









Inferences

•For the year 2018, the maximum temperature is associated with central parts of Hyderabad namely Maitrivanam, Narayanaguda, Sardarmahal, and Gananka Bhavan.

•The variation in summer average temperature in Greater Hyderabad is to the tune of 2.24°C.

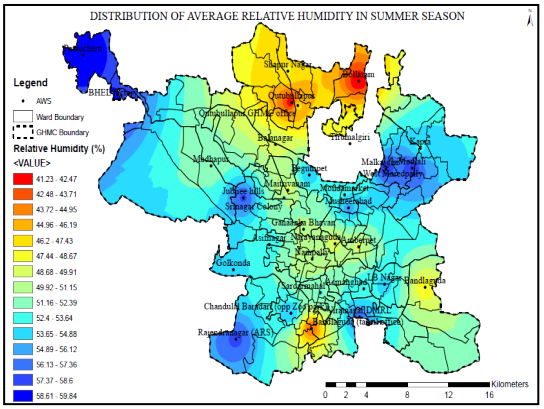
•The variation in average temperature during the rainy season is about 5.63 °C within the study area which is quite considerable.

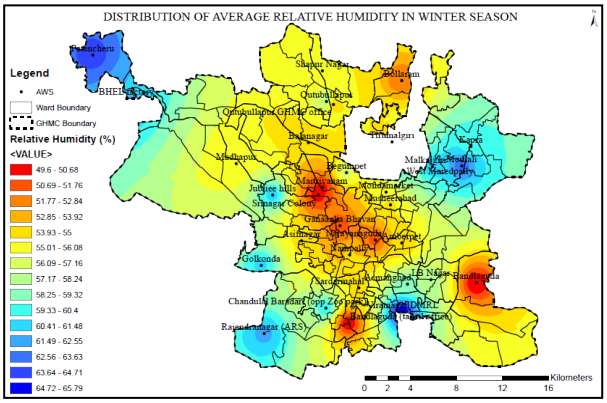
•The intra-urban variations in the average winter temperature is 4.63°C.

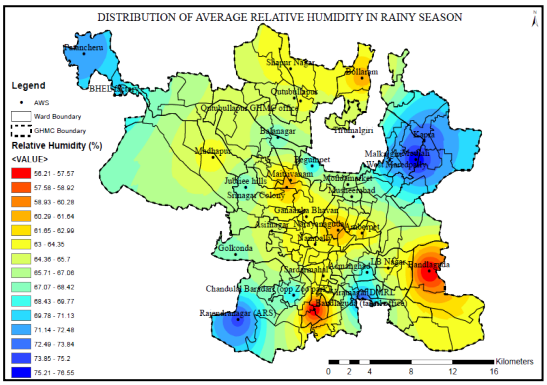
•The intra-urban variations in the average annual temperature for the year 2018 is 4.63°C.

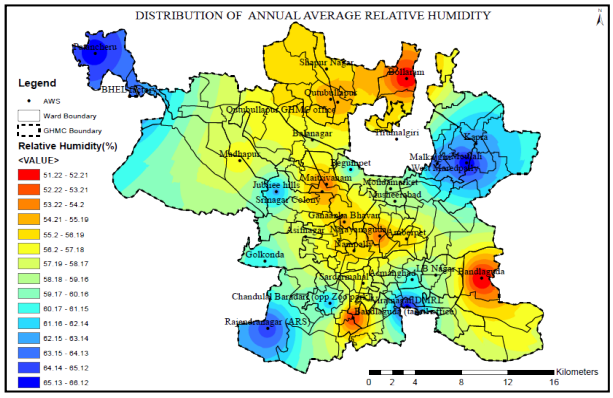
•The general spatial pattern of temperature distribution shows that the warm central core area is surrounded by relatively cool or low-temperature areas.

Relative Humidity Analysis





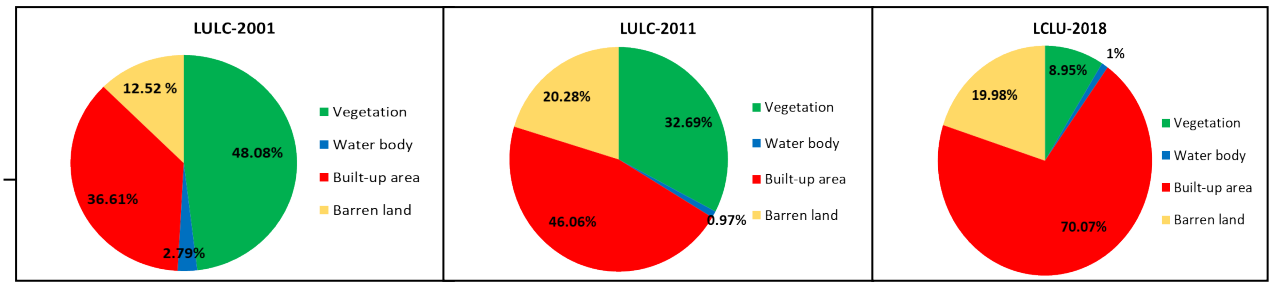




Inference

- Relative humidity is inversely proportional to the air temperature.
- The spatial distribution of relative humidity as emerged, has not shown any particular spatial pattern.
- The peripheral areas are recorded with high relative humidity when compared to the central part of Greater Hyderabad.
- The variation in relative humidity in the study are could be due to variations in land use or due to presence or absence of vegetation and water bodies.

Assessing the land use land cover changes across GHMC(Greater Hyderabad Municipal Corporation)due to the process of urbanization

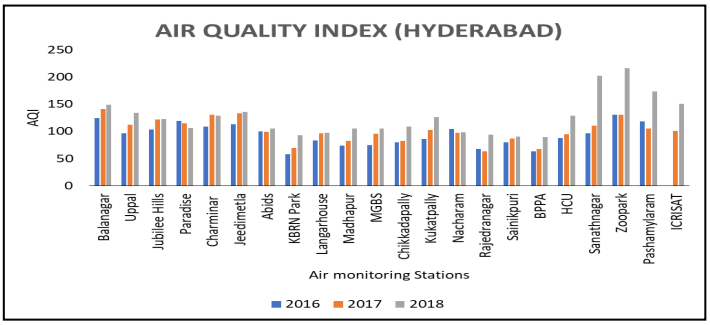


Due to the seasonal change, the area under the water body and vegetation was observed to be decreased in April for all three respective years. It was also observed that the area under the non-built-up category increased.

When considering the temporal pattern of LULC, the percentage area under considering the temporal pattern of LULC, the percentage area under vegetation, water bodies, and non-built up was observed to decrease from 2001 to 2018.

Air Quality Index of Hyderabad

The Air Quality Index of Hyderabad is declining for the past 3 years from satisfactory to moderate. The Average Air Quality is 215 which is unhealthy.



KEY ISSUES

The Urban heat island effect in Hyderabad city is driven by a number of key factors:

- A high percentage of solid surfaces e.g. asphalt and concrete: These surfaces absorb, trap, and re-radiate heat. They also prevent rainwater soaking

in reducing water available for plants, which in turn reduces evaporative cooling.

- Decrease in Vegetation cover: Reduces shading and cooling through evaporation from plants through leaves.
- Urban development pressure: creates denser urban environments that trap heat and removal of green areas reducing cooling.
- Construction materials that hold heat and have low reflectivity: e.g. bricks, bitumen, and

concrete- these materials absorb, trap, and re-radiate heat.

- Dense urban arrangements: absorbs and traps heat
- Air pollution: that creates a local 'greenhouse' effect trapping heat.

Recommendations

Strategy 1

Integration of UHIE reduction and responses into existing operations, policies, and programs

1. Telanganaana ku Haritha Haram

Telangana Ku Haritha Haaram, a flagship program of the Telangana Government envisages increasing the present 24% tree cover in the State to 33% of the total geographical area of the State.

Establishment: On 3 July 2015, 230 Crore seedlings are proposed to be planted in the State during the next three years.

2. Cool Roof Program

The program started in May 2019 to achieve a target of 0.1sqkm by 2020. By the end of 2030, its target is to achieve 100.3 sqkms in GHMC area. Depending on the setting, cool roofs can help keep indoor temperatures lower by 2 to 5°C (3.6 - 9°F) as compared to traditional roofs.

Cool Roof Materials

Usage of Cool Roof Materials like Coated cool roofs, Membrance cool roofs, Tiled cool roofs, Mod roofs, and Green Roofs which help maintain the building temperature.

Strategy 2

Strengthen and build Green Infrastructure

"Green Infrastructure (GI) is the network of designed and natural vegetation found in our cities and towns, including public parks, recreation areas, remnant vegetation, residential gardens, street trees, community gardens, as well as innovative and emerging new urban greening technologies such as rain gardens, green roofs, and green walls".

Green infrastructure practices can reduce local temperatures and shade building surfaces:

- Less energy is required to cool and heat the buildings

- Emissions from power plants are decreased.
- Cost savings can be realized over time.

The selection of Green infrastructure should be based on two features of street canyons.

1. Height and width
2. Orientation

Strategy 3

To facilitate reflective materials (cool buildings ,pavements and paths)

To provide cool pavements

- Cool pavements refer to a range of established and emerging materials.
- These pavement technologies tend to store less heat and may have

lower surface temperatures compared with conventional products.

- Conventional pavements in the **Hyderabad** are impervious concrete and asphalt, which can reach peak summertime surface temperatures of **48–67°C.**

Cessation

One of the most pressing issues confronting urban planning and architecture is global climate change, which is primarily caused by greenhouse gas emissions and has regional ramifications. Temperature, precipitation regimes, storm frequency, sea-level rise, and other factors that will have an impact on metropolitan areas are predicted to change as a result of global climate change. The effect of change has been noticeable in Hyderabad in recent years, and this study demonstrates the clear need for implementing strategies to combat the heat island. The strategies recommended are doable; the first two are already Telangana state programs that can be improved; the second discusses strengthening green infrastructure, which I believe is not a bygone concept; this strategy both helps the heat island and the city's scenic experience. The final Strategy intends to shift the use of heat-absorbing materials such as asphalt and concrete.

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THE IMPACT OF DESIGNING ON THE CHARACTER OF THE CITY: THE CASE OF THE NEW PARK IN PIROT

Mirko Stanimirovic

University of Nis, Faculty of Civil Engineering and Architecture, Serbia
PhD, Assistant Professor, wireframe22@gmail.com

Jasmina Tamburic

University of Nis, Faculty of Civil Engineering and Architecture, Serbia
PhD, Assistant Professor, jasmina.tamburic@gaf.ni.ac.rs

Olivera Nikolić

University of Nis, Faculty of Civil Engineering and Architecture, Serbia
Assistant, olivera.nikolic@gaf.ni.ac.rs

Nemanja Randjelovic

University of Nis, Faculty of Civil Engineering and Architecture, Serbia
Student, nemanjarandjelovic@gmail.com

ABSTRACT

The character of the city is realized through the action of several actors, who are involved in the construction of new buildings, the design of architectural and urban projects, the preservation of heritage and the implementation of various social activities. Planning the development of the city, in terms of architecture and urban planning, has been studied in science and profession as very important. In the case of the new park in Pirot, which is under construction, we analysed in what ways the design affects the character of the city and its development. Based on the research conclusions, we proposed improvement models. In the synthesis of the research, it was shown how responsible the designer's task is and the consequences of the application of the design in the case of the park in Pirot were pointed out.

Keywords: architecture, design, urban planning; character of the city, park

1. INTRODUCTION

Urban design includes architecture, landscapes and roads that transform individual identity into a new thing - an urban environment (Toskovic, 2000). The ambient whole is recognized as the pleasantness of the space, if it is composed of successfully integrated elements. It can be said that the great danger is the replacement of aesthetic criteria in urban design. In the event that the urban designer only adopts the purpose under the influence of the market, it is a method in which the outcome will be evaluated as a failure. Hence, urban design is the art of building cities, a method by which man creates his built environment, which satisfies his needs and represents his values (Moughtin, 2003). That is why we believe that studying the process of urban design, projecting and creativity in general answers the question of how a space should be designed. Indeed, many papers have been written on the subject. According to available services (Academia, Science Direct, Google Scholar, Web of Science etc.), urban design is a topic in over 2 billion titles, of which in the last 5 years there are from 1000 to 500,000 works. Although much attention has been paid to the process of urban design in science, the construction of city parks has not always been successfully implemented. We believe that the reasons for this are twofold. The shaping of cities is not entirely in the hands of designers and many designers have obeyed the conditions of investors, not really taking into account the character of the city. Therefore, we believe that the justification of this work lies in the social, professional and scientific evaluation of current spatial interventions in the city of Pirot, which within the theme of contemporary urban design and architecture has only begun with several works (Stanimirovic et al. 2016, 2020). We believe that the

presentation and analysis of the phenomenon of urban design in Pirot contributes to the documentation of the current situation, with the aim of starting a professional discourse that would further lead to the improvement of architectural and urban science, thereby improving the process of urban design, which is one of the participants in the formation of the city's character.

2. OUTDOOR SWIMMING POOL COMPLEX IN PIROT

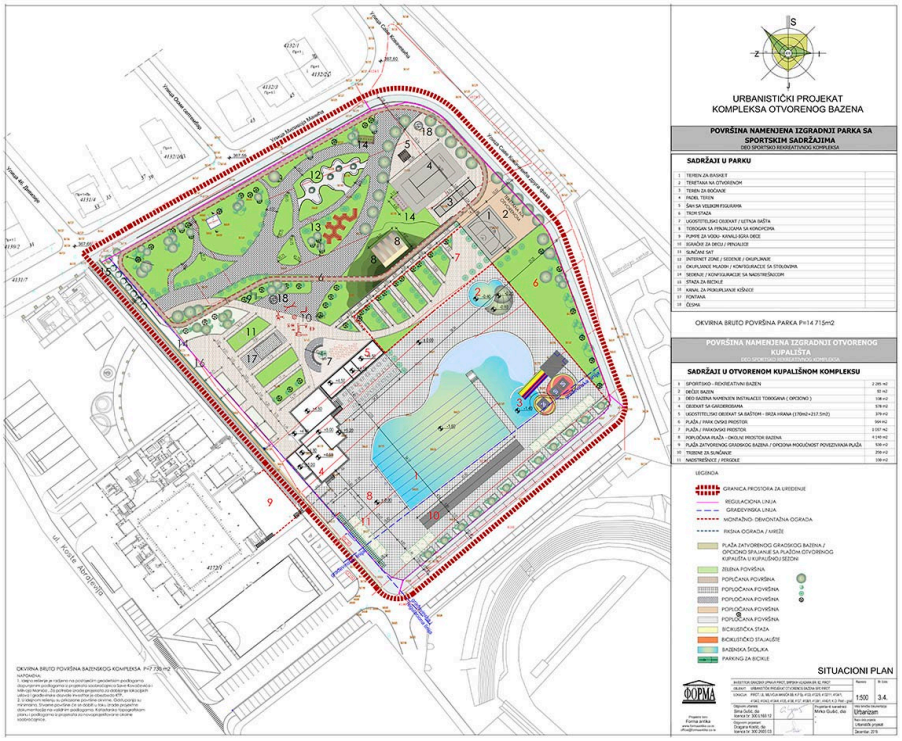

Figure 1: UP (Source: https://www.plusonline.rs/idejno-resenje-za-otvoreni-bazen-u-pirotu/)

After consulting the sports and general public, the city administration of Pirot concluded that this city lacks an outdoor swimming pool and sports and recreational facilities. On the basis of the General Regulation Plan "Pirot Center" from 2019, a program task was completed for the development of an Urbanistic project for the Urbanistic-architectural development of the location of the outdoor pool complex in Pirot. The location was chosen according to the future use of the water purification and heating system of the Closed Pool, which was built in 2015. According to the Urban Planning Project, which was processed by "Forma Antika" from Niš, in 2019, the conditions for the arrangement and construction of the open pool project were defined, respecting the principles of green construction and recycling. On an area of 2.13 ha, within the location that is equipped with communication infrastructure, as well as water supply, sewerage, electricity and telecommunication installations, the conditions for the construction of facilities with the aim of increasing economic development and improving the quality of citizens, which are determined by the spatial plan of the Municipality of Pirot, have been defined. The solution concept was created with the goal of creating a sports and recreation complex rich in green areas, pedestrian-vehicle and pedestrian communications. Respecting the basic requirements of investors, the space for this purpose is divided into two basic units. The first unit represents the space intended for the construction of an open swimming pool complex with accompanying facilities. The second is intended for the construction of sports and recreational facilities and a park with a square. Within these units, contents for children's play, recreation and gathering of youth and people of all ages have been designed. On the basis of this project, the complete project-technical documentation was completed and the construction permit was issued in 2019. The projects were signed by the architects Mirko Gušić (chief designer) and Dragana Kostić (responsible designer) within the company "Forma antika". At the beginning of 2020, on the basis of a tender, the company SIB invest from Niš was chosen as the contractor, which should finish construction by the end of 2022 (https://www.plusonline.rs/pirot-dobija-otvoreni-olimpijski-bazen; https://www.plusonline.rs/idejno-resenje-za-otvoreni-bazen-u-pirotu/; 14.11.2019. taken 2022 09 20).

3. ANALYSIS

The location on which the sports and recreational complex is being built does not belong to immovable cultural assets in the territory of the City of Pirot, for which the Institute for the Protection of Cultural Monuments Nis is responsible. Also, there is no record in the registers of the Institute for Nature Protection and the International Union for the Protection of Nature, which would classify this area as some kind of protected landscape of exceptional characteristics. However, the area that is of great importance for the citizens themselves, and which is located in the immediate neighborhood, is the Quay on Nišava. It was built in 1923-1933 in the form of river bed regulation, in order to avoid floods. The row of linden trees was installed on both sides in the sixties. At the beginning of the 21st century, the promenade on the Quay was paved with cobblestones, which were moved from Nikola Pašića Street during its reconstruction. Today, the pier represents the pride of all the citizens of Pirot and an oasis in the center of the city. It is about 1.5 km long and represents a recreational zone. The urban project of the new outdoor pool complex is available on the website of the city of Pirot (https://www.pirot.rs/downloads/Izgradnja/bazen/000-UP-BazenPirot.pdf, downloaded 2022 09 16) and it is based on previously adopted projects roads, which we could not find in the System for electronic submission of requests (https://ceop.apr.gov.rs). According to this project, the outdoor pool complex is clearly divided into pool and park zones. The pool area is surrounded by a fence, while the park is open to traffic and the indoor pool area. In fact, the new park is a continuation of the adrenaline park located in front of the indoor swimming pool facility. It can be said that a park unit has been formed, because the paths continue in the same way, within a clearly defined circle as the idea of the drawing. The meeting of the park and the swimming pool takes place in the central area, where a cafe with a summer garden and a facility with changing rooms and toilets are imagined. These buildings have solar panels, which will provide hot water in the showers, which we think is well planned. However, we cannot say that the form of the mentioned objects was consciously modeled, according to the formation of a certain ambience in the space. In fact, what is missing from this concept is an architectural composition, which can be seen in the arrangement of functions, which become three-dimensional objects by raising the walls from the base drawing. A similar manner was used in the drawing of the aforementioned circle and other paths, which Le Corbisier pointed out through misconceptions about the plans (Le Corbusier, 1986). In addition to design problems, the park has a safety problem. Namely, there is a trim path around the park, resting directly on the sidewalk. No obstacles prevent small children from running out of the park into the street. The next problem is the insufficiently architecturally articulated northern part of the park. There is a very awkward intersection in that part, which further complicates this situation. We are of the opinion that this part should be reworked both in the park part and in the road part. In the end, communication with the quay was not considered at all, probably because of the planned parking spaces.

Let's approach the evaluation of solutions using five design principles, which were created as a set of recommendations, looking at architectural design as a comprehensive thinking, ethical, creative process. The five design principles are: unity of space, ambientization, contextualization, evolution of ideas and professional ethics. Within the framework of the first principle (A), we observe whether the spaces of the park and the surroundings are interwoven in such a way that they improve the quality of life. The principle of ambientization (B) in this case refers to the achieved public or private purpose of the space. Within the framework of contextualization (C), we observe the interaction of architecture with the place, the creative interpretation of heritage, the application of archetypal forms, the enrichment of architectural thought and the modernization of experiences. Within the evolution of ideas (D) we observe the creative processing of an inherited model. And finally, within the fifth principle (E), we condemn the literal taking of ideas from practice. We conducted the scoring according to the following principle. Within each principle, we graded each case slightly with 0 or 1, depending on whether it is at least slightly in line with the recommendation.

Table 1: Design principles

Case	*A*	*B*	*C*	*D*	*E*	*SUM*
New outdoor swimming pool complex	1	1	0	0	0	2

In the part of the park there are courts for basketball, bocce, paddle tennis and chess with large figures; trim track, toboggan with climbers, climbers for children, sundial, Internet zone, channels for children to play with water, bike path, area for gathering of young people, water fountain and fountain. In this part, the authors planned about 20 tall trees, green and paved areas. In the pool area, the sports and recreational pool of an irregular shape (160 cm deep) extends to 2285 m2, with a beach (surrounding area) of 4140 m2. In addition to

the stands for sunbathing and canopies, two beaches on the green surface are planned. There is also a smaller children's pool (92m2), as well as a slide with its associated pool area.

The topics of recreation and parks have been addressed in modern science (Juutinen et al., 2022; Fontán-Vela et al. 2021; Komossa et al. 2020, 2021; Fagerholm et al. 2021; Aly, 2022; Mueller, 2019; Enserink, 2022 ; Kang and Liu, 2022; Pinto et al. 2022; Wysling and Purves, 2022 etc.) and the decision to build an open pool complex is welcomed. Citizens' lives will certainly gain a new quality, and the activities of the Sports Center will be aimed at young people and their healthy development. He is aware that the level of equipment is related to finances and we think that this small town has taken a big step in its development. However, in this case, we cannot rate the architectural composition of the entire complex as exceptional. We also believe that the investor created an overly large program, probably out of the desire to meet the citizens as much as possible. What we believe can be improved is the traffic around the complex and the procedure for the future implementation of similar public purpose projects.

Observing the traffic around the complex, we first notice that the new amenities lack parking spaces. A culvert was made in the part of the closed pool and the parking lot was realized as an open one. This means that nearby residents also park in that parking lot, not exclusively pool visitors. The same problem has been deepened in the new complex, and a couple of situations have been added that should not be allowed for security reasons. The number of parking spaces is designed according to the presented norms that refer to built catering facilities, not according to the planned load of all visitors. The exact calculation is not shown in the urban planning project, which normally does not include the surrounding streets. However, 40 spaces for parallel parking (near the stadium) and 22 spaces for administrative parking (toward the quay) are planned in the surrounding streets. At the same time, safe access to the complex (pedestrian crossings, etc.) and parking for disabled people were not taken into account. A broader insight into the surrounding traffic actually leads us to the conclusion that vehicle access was not taken into account at all. So, for example, visitors from other cities will have difficulty getting to the location, both because of the unfavorable surrounding infrastructure and because of the insufficient number of parking spaces. Parking for buses has not been treated at all, and what is most dangerous - access to the stadium has been completely neglected. In fact, the planned way of using the complex will make it impossible for the surrounding sports facilities to function. This brings us to a bigger problem than architectural design, which is traffic. According to the result of the conducted evaluation within the design principles, the success of the design is 34%, and in the part of the most important principles, it did not receive a positive evaluation. In the case of traffic, we expect an even bigger problem.

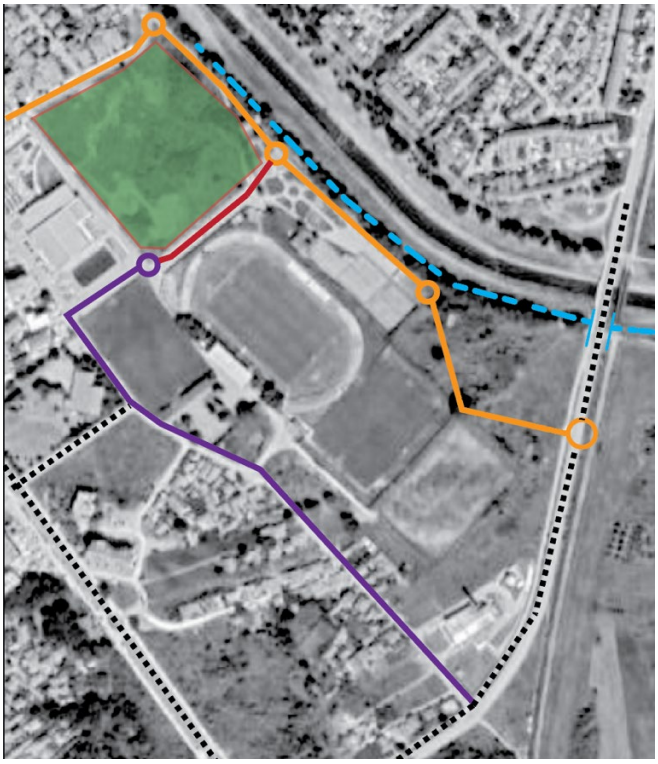

Figure 2: Access to the park (Source: Archive of author)

Figure 3: UP (Source: Archive of author)

If we set the goal of car and organized access to the complex, then we will look at the situation even more broadly. The road profile that could bear a greater load is only suitable for the bypass around Pirot. This road, popularly called the "ring", is located near the east exit from the highway. The cleanest solution would be to open a new roundabout at the level of the stadium, which would put the entire stretch from the pool to the ring in a more efficient function of use. The stadium would receive adequate attention, and thus the situation of illegally built buildings would be cleared up. For the needs of the traffic solution, we hired a traffic engineer, Nikola Aleksić from Pirot, with whom we visited the City of Pirot on April 1, 2021. proposed 6 development scenarios according to the following principles:

1. Safety,
2. Improvement of roads and communications,
3. Increasing parking capacity and
4. Enabling further development.

Suggestions for improving the current and projected state are the result of our analysis:

1. Access the location in question,
2. Connections of new content and the subject area,
3. Pedestrian and bicycle communications and
4. Future parking needs.

On this occasion, we will present the 6th scenario. It differs from the other variants in the part of the space located between the Quay and the new complex. We are of the opinion that the building that was placed on the ramparts of the Quay, in the 20th century, does not belong to the sports and recreational environment. As its former function is closed (training of children in traffic), its position and location largely usurp the functioning of the quay and the park. The facilities dedicated to tennis are also in the same problem. They abut directly on the stadium, thus stopping its future development. We propose to relocate those functions in the extension of the planned recreation zone, according to the bypass of the city. The introduction of a road parallel to the rampart clearly requires the construction of a smaller roundabout at the northern intersection, which should be repeated towards the parking lot located on the south side of the complex. As the safety of children is the most important thing, we suggest that the park be fenced off from the roads with a 1.2 m high hedge and a minimum buffer zone. It would also be ideal to relocate the transformer station, which certainly does not belong to the new idea of the complex, but represents the inherited condition. In addition to the reorganization of the parking, which can be of the closed type in the area next to the stadium, it is necessary to change the profile of the street that is accessed from the north, also next to the Quay. The locations of the buildings along the street require direct access to private parking spaces. That's why we brought the street closer to the houses, creating space towards the rampart, quite the opposite of the current solution. The significant area of this street from the ramparts to the mentioned buildings (their regulation lines) can contain on each side a pedestrian path of 3m (with a tree line), parallel parking of 2.5m (toll zone in the future) separated from pedestrians by unevenness or steps, a traffic lane of 3m. In addition to this communication towards the park, towards the rampart, a green belt (2-5 m) and two bicycle lanes of 1 m each can be realized in phases. The separation of cyclists from traffic lanes is justified by the safety of all road users. We can continue the cycling and walking route, which would start from the "Love Bridge" towards the swimming pool, which is located on the other side of the ring. If such a continuation is carried out under the railway and road, the safety of all pedestrians and cyclists (who, according to the current solution, cross the street and the railway bridge) would be raised to a much higher level. Our opinion is that communication next to the ramparts opens up further possibilities for development (new park, new facilities, revitalization of tennis courts, etc.) and we should consider changing the plan and its implementation.

4. CONCLUSION

From the analysis of the solution of the new complex and the discussions, which are conducted with the aim of its improvement, it follows that the responsibility of the designer in the architecture and urbanism of public areas is great. Experts' advice is often not accepted in our environment, for various reasons. We are of the opinion that it is expensive for our small country to allow the construction of insufficiently thought-out projects. The consequences of solutions that are unidirectionally directed towards specific functions can be enormous. The first mechanism, which we propose in the situation of construction in public space, is a public, anonymous architectural competition, which will lead to a greater choice of better solutions. The second proposal concerns architectural education, which should be improved according to current problems. Real situations should be presented to students and their perception of the city should be improved through a stay at the construction site. In this way, we believe that the development of the image of the city can be constantly improved, towards a better quality of life for citizens and an increase in income from tourism.

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EXPLORING THE INFLUENCES OF URBAN FORM ON SOCIAL SUSTAINABILITY ASPECTS

CASE STUDY OF: HARAT QASRA & FALAJ ASH SHURAH- OMAN

Khalsa khalifa al Salmi

Sultan Qaboos University, Sultanate of Oman
Master Degree, Architectural Engineer, khalsa.alsalmi@gmail.com

Sallam Islam

Sultan Qaboos University, Sultanate of Oman
PhD., Assistant Professor, Isallam@squ.edu.om

Naima Benkari

Sultan Qaboos University, Sultanate of Oman
PhD., Assistant Professor, nbenkari@squ.edu.om

ABSTRACT

In the last decade, the rapid growth of cities and exacerbated social problems have led to a great deal of inquiry on the extent to which the physical forms of cities can contribute to achieving a just and sustainable future. As can be seen in Oman's vision 2040 plan, which aims to achieve a more sustainable Omani lifestyle, this aim is becoming more and more persistent.

The main objective of this study is to examine the relationship between social sustainability and urban form aspects within a neighbourhood scale. A multi-method approach was applied to achieve the research aim, including quantitative and qualitative methods. Two different neighbourhoods (traditional & modern) were selected to be studied. Several data collection methods were used, including questionnaires, semi-structured interviews, and site observation. Moreover, the relationships between urban form and social sustainability were investigated using static analysis and validated with interviews and site observations.

The findings of this study reveal that most of the urban form aspects are significantly correlated with some of the social sustainability aspects. However, the relationships vary from one aspect to another. Also, many other factors including, socio-economic factors, can considerably influence social sustainability. Furthermore, according to the research findings, guidelines and policies are developed and proposed to achieve more socially sustainable neighbourhoods in Oman.

Keywords: *Neighbourhood; traditional; modern; Omani; SPSS; correlation*

1. INTRODUCTION

There has been much debate about shaping urban development to achieve greater sustainability. Many claims have been made for the greater sustainability of compact cities, although these have been particularly controversial concerning the urban communities' social functioning and acceptability (Jenks, Williams & Burton, 1996).

Urban forms cannot be sustainable if they are not acceptable to people as places to live, work, and interact, or if their communities are unstable and dysfunctional. Recognition of this has become a significant feature of current Omani urban and planning policy and strategies as appeared in Oman National Spatial Strategy ONSS and Oman Vision 2040 (Ahmed, 2020; Al-Jebouri et al., 2017).

the compact urban form versus urban sprawl debate of the 1990s and early 2000s has relied on assertion and assumption about the social impacts of different urban forms, with limited reference to systematic contemporary empirical evidence (Bramley et al., 2009). Moreover, the density, shape, and configuration of urban spaces have been proven to influence the social relationships between the residents of any inhabited compounds (Soltani et al., 2020).

However, the urban development process in Oman has faced several challenges, including authorities' lack of coordination and the foremost planning authorities no coordination between different levels of stakeholders. Researches and studies relating to urbanism are still rare, especially in Oman. Moreover, most studies concentrate on the capital city due to the availability of references. There is a weak connection between researchers' results with decision-makers and planners. As a result, other decisions should be considered, including a comprehensive planning system (Benkari, 2017). Usually, the neighborhood is the most important place where people interact and socialize. The neighborhood's urban form and physical features affect the social connection of locals (Ahmed, 2020).

This study investigates social sustainability indicators and how they affect urban forms of residential Omani settlements. Moreover, it explores the mutual effect of urban form and people's behaviour and satisfaction. This approach gives more answers and possible solutions for reforming and redesigning our trendy neighbourhoods and cities.

2. LITERATURE REVIEW

2.1. Sustainable development

The sustainable development concept prevailed alongside the raised awareness regarding ecological destruction and the regress of social interest in the 1980s due to the spread out of poverty deficiency and urban negligence, which dominated most of the world's parts (Dempsey et al., 2011).

In recent years, sustainable development has influenced urban planning and housing layout. Moreover, urban form directly impacts ecosystems and habitats through land use (Karuppannan & Sivam, 2011). Due to the emergence of sustainable development concepts worldwide, the discussion was not limited to environmental issues but improved to include social and economic dimensions. (Karuppannan & Sivam, 2011). However, even social aspects have been increasingly accepted regarding sustainability, but there is still no clear definition (Dempsey et al., 2011).

Without a doubt, sustainable development is not an easy or fixed process to be applied directly; however, it is a progress of modifying with resources' exploitation and the future and current needs intuitional change.

2.2. Social sustainability Definition:

As the economic and environmental aspects dominated sustainable development in the past, social issues' importance has increased in recent years (Mcguinn, 2020). However, the social sustainability definition is still unclear by particular criteria or assessment (Mcguinn, 2020; Yung, Chan & Xu, 2014). Littig & Grießler (2005) explain that the difficulties in convincing the concept of social sustainability are due to the lack of an apparent distinction between the normative, analytical and political criteria; thus, people may prioritize one over the other.

Most researchers and authors try to explain the definition of social sustainability. There is no general agreement on the meaning of social sustainability because it depends on the type of study perspectives and study-specific criteria, so the researcher should indicate adequate objectives and disciplines for his study area (Mcguinn, 2020; Yung, Chan and Xu, 2014; Dempsey et al., 2011; Colantonio, 2009). As a result, there is no general agreement on a set of criteria regarding the social sustainability concept (Bramley et al., 2006).

Despite the variations of the concept meaning, there is a standard agreement that "the socially sustainable neighbourhood that supports the well-being of its individual and community at all" (Omar, 2018) It includes integration of the physical environment design with society's development and functions in which it lives. That should be consolidated by the availability of required infrastructures and features that help residents improve their social, cultural, and participation. To conclude, in this study, a definition of Bramley & Power (2009) is considered:

"Social sustainability is identified as: "the continuing ability of a city to function as a long-term, viable setting for human interaction, communication, and cultural development."

2.3. Social sustainability aspects from Literature:

Most scholars tried to define the social sustainability concept by listing principles instead of providing a conceptual sentence. There are several researchers on social sustainability topics worldwide, including traditional and modern neighbourhoods. However, a lack of consensus can be evident in many definitions, and aspects found in the last literature (Omar, 2018).

A chronological list of social sustainability aspects used by researchers in their studies is presented in Table 2.2. This table clarifies a fragmented approach toward social sustainability in literature. That can be illustrated by the normative nature of social sustainability aspects and the situation specificity of the case studies (Shari & Murayama, 2013). Moreover, it shows the significant importance of basic needs and equity in terms of social sustainability as fundamental pillars. These criteria are considered necessary for the social and psychological remains of beings and societies (Colantonio, 2009).

Table 1: Aspects of social sustainability from different literature

Aspect	*Author*
Livelihood, Equity, Capability to withstand external pressures, and Safety nets	*(Chambers R & Conway G, 1992)*
Equity, Democracy, Human rights, social homogeneity, Equitable income distribution, Employment, Equitable access to resources and Social services	*(Sachs, 1999)*
Interactions in the community/ social networks, Community participation, Pride and sense of place, Community stability and security	*(Bramley et al., 2009)*
Social interactions, Participation, Community stability, Pride and sense of place, Social equity and Safety and security	*(Dempsey et al., 2011)*
social equity (Transportation, Job availability, Open spaces, and Access to service), Sustainability of community (Safety, Social interaction, Sense of belonging, and Residential stability)	*(Ali, Al-Betawi & Al-Qudah, 2019)*
Density, Mobility, Integration, Choice and Diversity, Mixed-use, Safety, Security, Environmental Quality, Social Capital, Accessibility	*(Ahmed, 2020)*

2.4. A framework for the measurement of social sustainability:

After a comprehensive literature review, this research focuses on six aspects of social sustainability. These variables are selected due to many criteria based on pragmatic consideration (Arab, 2011). Moreover, the required data availability and how easily these indicators can be implemented and explained are considered. Likewise, the local context of the selected case studies plays a significant role in defining suitable themes and aspects to be addressed in this study. All these indicators should be considered to achieve the aim of this research. In the following sections, they are discussed in more detail and how they affect social sustainability. The six aspects of social sustainability are:

1. Social interaction
2. Residential stability
3. Sense of belonging (community & place)
4. Access to services
5. Open and public spaces
6. Safety

2.6. Urban Form Definition:

There are various explanations from different references of urban form; however, there is no specific definition (Arab, 2011; Jenks & Dempsey, 2007). That is due to the nature of urban form study, which depends on the geographic scale and the analysis goal. Its aspects vary from very localized areas with building façades and materials features to a bigger-scale urban layout and spatial arrangement (Arab, 2011). While Clifton et al. (2008) argue it can be classified into five groups economic structure, landscape, transportation layout, urban, and community design (Clifton et al., 2008). All these classifications effectively provide a framework for the argumentation of literature regarding sustainable urban form.

Urban form, as explained by Jenks et al. (2008), is a city's physical and non-physical aspects. It includes physical (tangible) and non-physical elements (density). Moreover, Tsai divides urban forms into three categories diversity, density, and spatial structure pattern (Tsai, 2005).

In this manner, the nearer definition of urban form in this study is taken from the UK government authority, which is summarized as (Williams, 2014):

"*Urban form is the physical characteristics that make up built-up areas, including settlement's shape, size, density, and configuration. It can be considered at different scales: from regional to the urban, neighbourhood, 'block' and street*".

2.7. Urban form indicators from literature:

It is significant to be familiar with its prominent aspects to understand the relationship between urban form and social sustainability. Regarding Conzen, land uses, street and blocks pattern and building structures are the most significant aspects of urban form (Conzen, 1960).

Another paper was to study the effects of urban patterns on some features of social sustainability for two neighbourhoods (traditional neighbourhood& modern) in Jordan (Ali, Al-Betawi & Al-Qudah, 2019). Five leading urban form indicators were applied: Density (number of houses per land-use area), Land-use distribution, Building height, house typology, and Accessibility (street connection & integration). In another research, a group of characteristics of urban form with their indicators was evaluated as shown below (Shirazi, 2020):

Table 2: Characteristics of urban form with their indicators.

Characteristic of urban form		indicators
Density	-	Gross population density, Average (built-up area), density, Land use spilled up, Average land consumption per person
Accessibility	-	Service accessibility, Public Transport accessibility
Density distribution/ dispersion	-	Density profile
	-	Density gradient, Population by distance to the center of gravity (CBD)
Shape	-	Dispersion Index
Transportation network	-	Mode share, Average trip length, Road network, density, Congestion index, Walkability index
Mixed-use land composition	-	Land use spilt up, the ratio of residential to non-residential use, Ration of built to an open area

Source: (Shirazi, 2020)

2.8. A framework for the measurement of urban form:

After a comprehensive literature review, this research focuses on four aspects of urban form. These variables are selected due to many pragmatic considerations (Burton, 2002). Additionally, the required data availability and how easily these indicators can be implemented and explained are considered (Arab, 2011). Likewise, the local context of the selected case studies plays a significant role in defining suitable themes and aspects to be addressed in this study (Ali, Al-Betawi & Al-Qudah, 2019). All these aspects should be considered to achieve the aim of this research. They are discussed in more detail and how they affect urban form in the following sections. The four principles of urban form are:

- Density
- Housing types and building characteristics
- Accessibility
- Layout

3. RESEARCH METHODOLOGY

The overall methodology emerged from similar thesis research conducted in Aleppo, which has a comparable cultural, social, and urban form (Arab, 2011). This research methodology is qualitative, but a quantitative method is also included to measure both urban form and social sustainability.

3.1. Data Collection Methods

There are four main parts of data collection methods are applied as follows:

- Literature review: It is obvious during the literature review that it is not easy to identify the relation between urban form and social sustainability. Most of the research and literature are general and vague while discussing this topic (Arab, 2011).
- Physical site visit for each neighbourhood (Harat Qasra & Harat Falaj Ash shurah): A site visit is conducted to gather most of the data required to measure each neighbourhood's urban form aspects. A site survey can give the researcher accurate and factual data regarding urban form aspects.
- A questionnaire: A pilot study was conducted before questionnaire distribution for ten residents. This stage helped to recognize the questions' clarity, length, and appropriateness of the covered aspects. This study used a snowball sampling technique to distribute the questionnaire (Abubakar, Etikan & Alkassim, 2015). One hundred fourteen (114) questionnaires were received from each neighbourhood; 67 responded to questionnaires from Harat Falaj Ash shurah, and 47 from Harat Qasra.
- Semi-structured interview: The main aim of conducting the interview is to gain a comprehensive picture of how residents interact with their built environment and what it means. As a result, semi-structured with a face-to-face technique were employed in this study for two neighbourhoods. A total of five semi-structured interviews were conducted for each neighbourhood. The selection of interviewees pended on some criteria including different types of household groups and to cover the gaps in the questionnaire.

3.2. Average evaluation of indicators

The average of each aspect of social sustainability is calculated according to all indicators. Using excel software, each indicator (question) is given an estimated weight (from 1 to 5) similar to the Likert scale according to its influence on the total value of the aspect (Benkari &Sallam, 2021; Arab, 2011).

3.3. Correlations

Correlation is the most significant part of data analysis because it helps identify the relationship between urban form and social sustainability. It is usually employed to illustrate the relationship between variables and indicate their strength and direction (Bryman & Carmer, 2005). A Spearman's Rank Order correlation (rho) coefficient is employed for categorical or ordinal data (Bryman, 2016), thus, it is employed in this study. Statistical Package for Social Science (SPSS) was primarily used to analyze data reported from questionnaires and semi-structured interviews.

(a) (b)

Figure 1: Site Visit Images (a) Harat Falaj Ash shurah, and (b) Harat Qasra

4. INDICATORS AND MEASURES

It is essential to translate the theoretical information on urban form and social sustainability into measurable aspects and indicators to measure the relationship between urban form and social sustainability (Bryman, 2016). The selected aspects and indicators were taken from different studies, papers, and sources. Moreover, relevant, applicable, and appropriate indicators were considered for this study. The coming sections outline the selected aspects with their indicators and the tool used to measure each one.

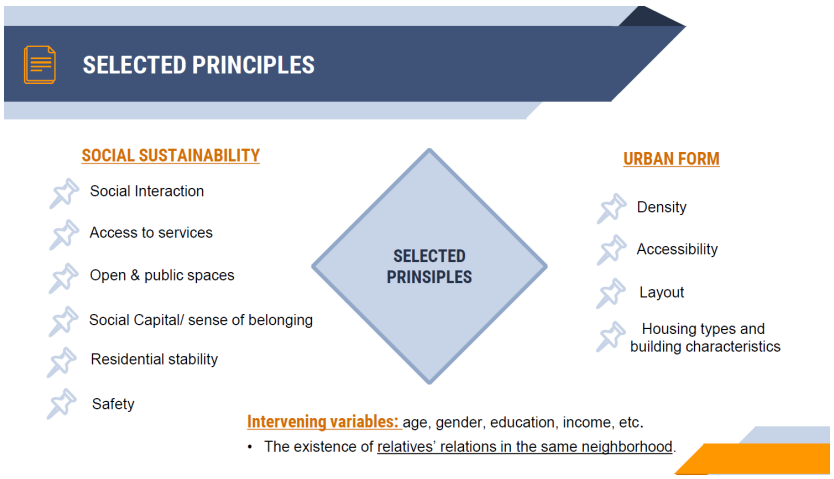

Figure 2: The selected Aspects of urban form & social sustainability

4.1. Aspects of measuring urban form

According to the research's case study, a set of urban form aspects with indicators were identified to measure each neighbourhood's urban form level. The following table summarizes all aspects and indicators with indicates their references.

Table 3: Selected Aspects & Indicators of urban form.

Aspect	*indicators*	*Equation*	*References*
Built-up Density	• *Built area/total area*	*Built area/ total area*	*(Bramley &Power, 2009)*
Housing types & Building characteristics	• *Houses Building types*	*PW= AVG Σ (W/H) ×100*	*(Ali, Al-Betawi & Al-Qudah, 2019) (Wan Nurul Mardiah, 2012)(Jenks et al., 2008)*
Accessibility	• *Main street path number of intersections/ length of the path*	*Ac= (Σ (i)/Lxy) ×100, where (Σi) is the sum of all intersections*	*(Benkari & Sallam, 2021) (Ali, Al-Betawi & Al-Qudah, 2019)(Jenks et al., 2008)*
Layout	• *Average urban block size*	*Average urban block size (Total area of blocks/ total number of blocks)*	*(Jenks et al., 2008)(Wan Nurul Mardiah, 2012)(Arab, 2011)*

4.2 Aspects of measuring Social Sustainability

Besides aspects of urban form, and according to the research's case study, a set of social sustainability aspects with their indicators were identified to measure each neighbourhood's social sustainability level. The following table summarizes all aspects and indicators with indicates their references. Moreover, the interfering variable is considered in this measurement, such as age, gender, employment status, household composition, etc.

Table 4: Selected Aspects & Indicators of social sustainability.

Aspect	*indicators*	*References*
Social Interaction	• *Talking/interacting with neighbors* • *Knowing neighbors* • *Helping neighbors* • *Having relatives or friends*	*(Ali, Al-Betawi & Al-Qudah, 2019)(Arab, 2011)(Omar, 2018)*
Residential Stability	• *Year of residency* • *Plan to change house (whether inside or outside neighborhood)*	*(Ali, Al-Betawi & Al-Qudah, 2019)(Omar, 2018)*
Sense of belonging	• *Well-being/ satisfaction* • *Belonging* • *Participation* • *Attending a social gathering*	*(Ahmed, 2020)(Ali, Al-Betawi & Al-Qudah, 2019)(Omar, 2018)(Arab, 2011)*

Safety	• *Feeling safe in the neighborhood* • *Safe for children* • *Safe neighborhood*	*(Ahmed, 2020)(Ali, Al-Betawi & Al-Qudah, 2019)(Omar, 2018)(Arab, 2011)*
Open & Public spaces	• *Using public spaces* • *Public spaces availability* • *Time to reach park/open spaces* • *Satisfy with the public spaces*	*(Ali, Al-Betawi & Al-Qudah, 2019)(Jaffar, Harun & Abdullah, 2019)(Hemani, Das & Chowdhury, 2017)*
Access to services	• *Services are within a short distance* • *All people can reach it (Equity).* • *Frequency using facilities.*	*(Ahmed, 2020)(Ali, Al-Betawi & Al-Qudah, 2019)(Arab, 2011)(Jaffar, Harun & Abdullah, 2019)*

Table 5: Indicators of intervening variables.

Variable measuring	*indicators*	*Source*
Social characteristics of the respondent	• *Age* • *Gender* • *Educational level*	*Questionnaire*
Socio-economic Characteristics of respondent	• *Employment Status*	*Questionnaire*
Household characteristic	• *Household composition*	*Questionnaire*
Relatives & Friends	• *Having relatives or friends*	*Questionnaire*

5. CASE STUDIES METHODS

In this study, two neighbourhoods are selected as case studies for this research. They are chosen to be compared and evaluated in term of urban form, and community reform; Harat Qasra, which reflect a traditional neighbourhood, and a trendy neighbourhood is Harat Falaj Ash shurah. There are many reasons for choosing these two neighbourhoods. Firstly, all of them are located in Al Rustaq city, the administrative Centre of the southern Al Batinah region. Also, one of them reflects the traditional Hara of Al Rustaq, while the other is a contemporary type of settlement. Moreover, I attempt to select neighbourhoods that differ in date of construction, urban location, and inhabitant structures (wealth, social class, etc.).

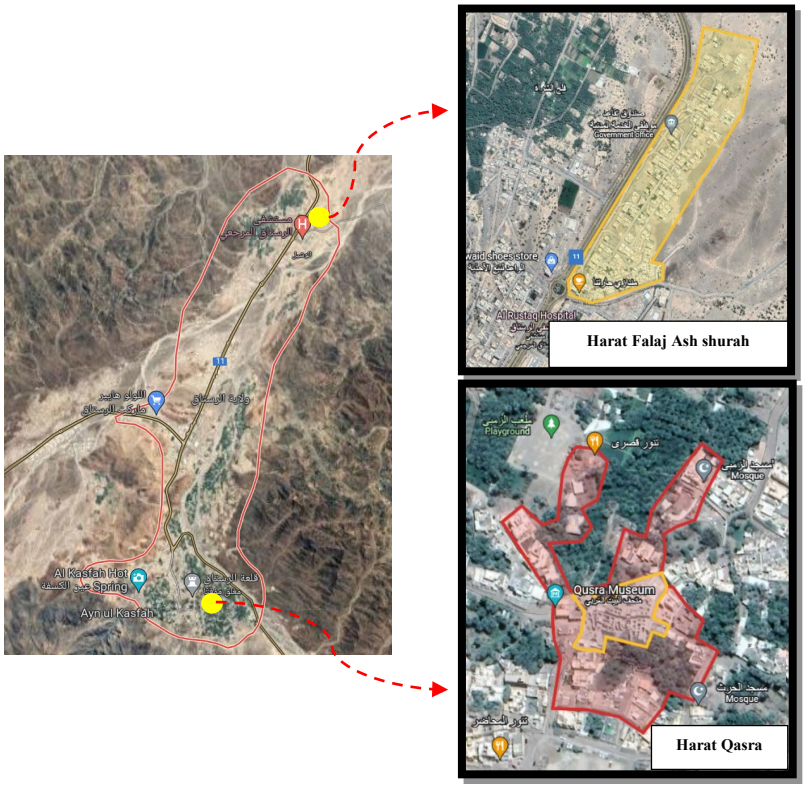

Figure 3: Harat location within Al Rustaq, source: Google earth

6. URBAN FORM AND SOCIAL SUSTAINABILITY

The final comparison chart between the two case studies regarding social sustainability elements is summarized below. It is evident from the chart that, Qasra case study had received a higher level of social sustainability in all aspects except access to services. That is due to the inequity of using communal spaces for both genders, as Harat Falaj Ashurah has more communal spaces, which are available for both genders.

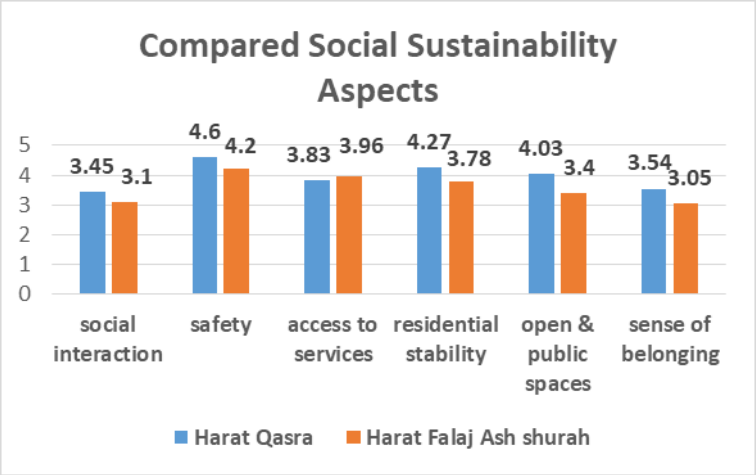

Figure 4: Summarized and compared social sustainability aspects between two case studies.

The final comparison chart between the two case studies in urban form is summarized below. It appears that Qasra case study has achieved a better level in all urban form aspects.

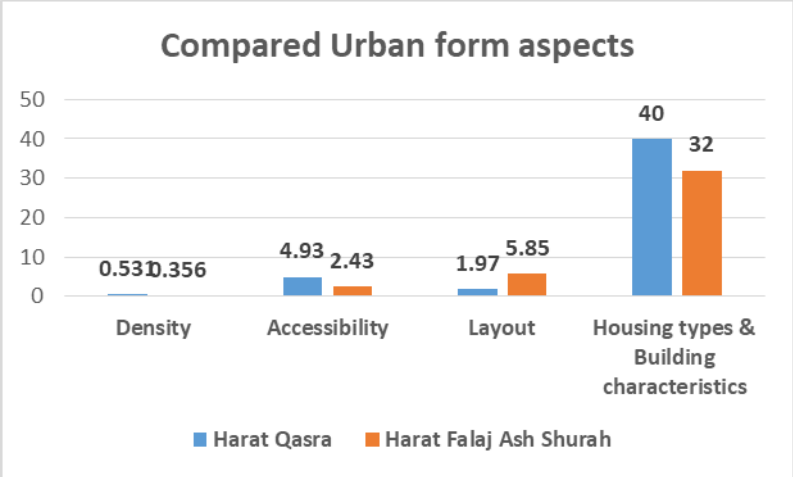

Figure 5: Summarized compared urban form aspects between two case studies. Source: Author

It is evident from the above chart that, Qasra case study had received a better level of urban form in all aspects. Moreover, it is noticeable that the layout level in Qasra is lower than Falaj Ash shurah. That is because the layout is better as the average urban block size is low.

7. RESULTS AND DISCUSSION

According to the correlation evaluation, the Table below summarizes all the relationship types between social sustainability and urban form. Each aspect of urban form's effect on social sustainability is mentioned below.

Table 6: Summarized table of relationship types between social sustainability & urban form aspects.

Social sustainability & urban form aspects	Social interaction	Residential stability	Sense of belonging	Access to services	Open & Public spaces	Safety
Built-up density						
Accessibility						
Layout						
Housing types &,						

	Strong positive		Strong negative
	Medium positive		Medium negative
	Weak positive		Weak negative

7.1. The influence of density on social sustainability

The findings reveal several relationships between built-up density and some aspects of social sustainability. Building density influences social interaction, residential stability, sense of place attachment, access to services, and open & public spaces. A positive association is founded between built-up density with three aspects (social interaction, residential stability, and open & public spaces).

As built-up density increases, social interaction between residents and residential stability increases. The questionnaire found that social interaction and residential stability are significant in higher built-form density neighbourhoods than in lower-density ones. Furthermore, residents' use and satisfaction with open & public spaces increase positively with built-form density. As was validated by respondents of the questionnaire and interviews, residents living in denser urban areas show better use and content regarding communal spaces.

In contrast, urban density represents a negative correlation with access to services. It was evident as in higher built-up density, access to services revealed a lower level than in denser neighbourhoods. According to questionnaire respondents, access to services was more difficult in high urban density areas than in lower ones. That is because they are not allowed for both genders to use.

Although the correlation indicated a negative relationship between building density and place belonging, the questionnaire's responses show a reverse relationship. Residents with higher built-up density represented a better place and community attachment. A possible illustration could be that this relationship is valid up to a certain level of urban density. The sense of place belonging might decrease if the density is too high or too low.

7.2. The influence of housing types & Building characteristics on social sustainability

From the previous findings, housing types and building characteristics represented various associations with many dimensions of social sustainability. It was founded on a positive association between three aspects (social interaction, residential stability, and open & public spaces).

As the average height per average width increases, social interaction between residents increases because people can meet each other frequently. In addition, as people know more, residential stability will enhance because residents feel safe and satisfied. If the H/W ratio increases, areas within the neighbourhood are exploited, especially for green and shared spaces that will improve the quality of open and public spaces.

However, as H/W increases, access to services for especially both gender will affect. That is because women cannot feel privacy due to the overlocked buildings. Moreover, the sense of place belonging can be affected as residents are dissatisfied with building design and lack privacy.

7.3. The influence of Accessibility on social sustainability

Regarding the influence of accessibility, as street intersections and integrations increase, it allows people to interact more and increase meeting choices with neighbours. It supports social interaction between residents. As a result, locals satisfy with their neighbourhood and would increase residential length. That is because of people's satisfaction with urban planning and services available within their neighbourhood.

Whilst correlation evaluated a negative relationship between accessibility and a sense of belonging, interviewees did not support this finding, as they feel more attached to their neighbourhood while accessibility increases. Moreover, street integration and intersections are negatively associated with the ability of both genders to access common spaces and facilities. That is because of traditional Omani culture; women are not preferred to integrate within the highly integrated areas.

7.4. The influence of Layout on social sustainability

According to correlation analyses, the urban layout influences many social sustainability aspects. Urban layout in terms of the average urban block size significantly affects social interaction. As buildings' size reduces, people can socialize and meet frequently. Moreover, the arrangement of residential buildings and the quality of distance between them played a considerable role in providing residents with opportunities to meet or talk together. Moreover, this influences residents' length period, as they are not satisfied with social interaction with their neighbours.

Adequate urban planning and design have affected residents' satisfaction. A small Average urban block size allows more extensive areas to be exploited as open, green and public spaces for residents and children to play. Furthermore, it allows more accessible access to facilities and services. As urban block size decreases, more functions can be built within a walkable distance, increasing access to services. It can enhance people's contentment regarding the neighbourhood and improve their sense of place attachment.

Based on the research findings, the criteria of urban form in Omani urban settlements are formulated for each urban form aspect as follows:

1. Density:
   - As the built-up density of the neighbourhood (Built area/ total neighbourhood areas) increases, a higher social interaction between residents will be achieved. This finding is valid to a certain level; if the built-up density is too high, access to services and a sense of belonging will decrease again.

2. Accessibility:
   - If the accessibility of the neighbourhood (using the formula below) is more than four, the social interaction level is better.
   - Ac=(Σ (i)/Lxy)×100, where (Σi) is the sum of all intersections, while (Lxy) is the shortest path in (m) between variables (x) and (y) (Benkari & Sallam, 2021).

3. Housing types & building characteristics :
   - Is measured using the formula below, and as its value is close to 67 or less, social interaction becomes good.
   - PW= AVG Σ (W/H) ×100; its values should be ≤ 67 according to international norms (Benkari &Sallam, 2021)

4. Layout:
   - As the Average urban block size (%) decreases (closer to 1), social interaction level increases.

8. CONCLUSION & MAIN FINDINGS

The study of neighborhoods' urban form is a critical object and influence people's life. It is not a rigid and physical place but dynamic and exposed to change in time. Urban forms are influenced by what is planned and integrated within their structure. Through the detailed investigation and study of urban forms, designers and planners learn how to design areas better and what should be included. Urban forms study is a significant objective to achieving holistic urban management.

According to the above results and findings, we benefit from traditional residential settlements' urban layouts to achieve more socially sustainable new neighborhoods; the following recommendations for urban developers, planners and designers.

- • Provide neighborhood with social services and communal spaces such as a mosque, local shop, community centre, clinic, children's play area, and green space. This would offer residents basic needs and support for social interaction and people communication.

- • Provide safety for paths, public & open spaces, bicycles and playgrounds for children.
- • Integrate open and green areas within neighborhoods, including parks.
- • Improve accessibility by providing pedestrian paths, and green areas for shade and water features to improve environmental quality.
- • Adequate distance between buildings supports social interaction and saves privacy at the same time.
- • Provide communal spaces that allow people to practice traditional and social ceremonies, religious events, and activities for both genders (such as sablah and, mosques).

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THE FEASIBILITY OF IMPLEMENTING THE COMPLETE STREET PLAN TO IMPROVE SUSTAINABLE URBAN TRANSPORTATION

CASE STUDY: '< TEHRAN METROPOLIS'

Mazhar Ahmadi

Kharazmi University of Tehran, Iran
PhD., Geography and Urban Planning, Ahmadi.mazhar90@gmail.com

Kajal Rashidpour

Polytechnic University of Milan, Italy
Master's student, Building and Architectural Engineering, Kajal.rashidpour@gmail.com

Fereshteh Dehghan

University of Mazandaran, Iran
Master, Urban Planning, Fereshte.7171@gmail.com

Navid Enayati Shabkolaei

University of Mazandaran, Iran
Bachelor, Urban Planning Engineering, navidenayati96@gmail.com

ABSTRACT (STYLE OF THE PARAGRAPH: '<ABSTRACT'; 10PT, BOLD, ITALIC)

As a major urban center in Asia, '< Tehran' has always had problems with sustainable urban transportation. In this context, the street's capacities have not been fully utilized. In particular, since urban transportation management is still dominated by car-centric visions. A complete street can be presented as an alternative to previous approaches, which are inefficient. It is important to design and implement Complete streets in order to make sure all users can access and travel safely. In light of this, the present research aims to identify the most suitable option in the 6th district of the '< Tehran metropolis' for the construction of a complete street. A complete street was defined in this study according to four main criteria and 31 sub-criteria. The options (ten streets) were evaluated using the AHP-TOPSIS model and experts' opinions. The data collection method was documentary-field (deep observation and questionnaire). The weights assigned to walking, cycling, public transportation, and private cars were 0.56, 0.26, 0.12, and 0.05, respectively. Based on the results of the model '< Keshavarz street', with a score of 0.8 (CL), had the best design and implementation capacities for a complete street. Through this street, people can return to urban life, improve their health, reduce their use of private cars, and reduce pollution, which are the most important goals of a complete street.

Keywords: *complete street; sustainable transportation; walking; cycling; '< Tehran metropolis'*

INTRODUCTION

It is very clear that the street should not be used only for transportation. Streets, as one of the most significant elements that shape the city, are a cultural and social symbol and establish spatial communication and connection of urban activities. However, today's cities, especially metropolises like Tehran, use the streets differently from what they were designed for, namely, as places to gather and to live and it has become a channel for cars, especially personal cars, a place where pedestrians are forgotten and do not receive their least right, namely safe and secure sidewalks. As a response to these problems, the complete street concept

has been proposed for some time as a new paradigm in street planning and design (Hui et al., 2018; Jordan & Ivey, 2021). A complete street is a street that is accessible to everyone. Our goal when designing complete Street was to provide safe, comfortable access for all users of the street, including pedestrians, cyclists, drivers, and public transportation users of all ages and abilities to move comfortably and without worry next to each other (Winters, 2015؛ Jacobs, 1961؛ Seskin et al, 2014). In fact, the complete Streets movement was created to counter the car-centric paradigm, while recognizing the importance of alternative transportation options (Kingsland et al., 2011; Schlossberg et al, 2013). In Complete Street, people's needs are connected with the place of transportation planning, design, construction, operation, and maintenance (Atherton et al., 2016). The results of a recent study in America show that people in walking communities are more sociable and reliable than those in less walkable neighborhoods. In addition, it has been reported that these people are often happier and healthier (Slotterback & Zerger, 2013; LaPlante & McCann, 2011; Gregg & Hess, 2019). Finally, complete streets will not only benefit street users, but will also contribute to the improvement of the region's social, environmental, economic, and general conditions (Atherton et al., 2016; Kingsland et al., 2017). Complete streets are defined and designed differently depending on their classification (for example, arterial streets), and each class has different purposes and functions in the road network.

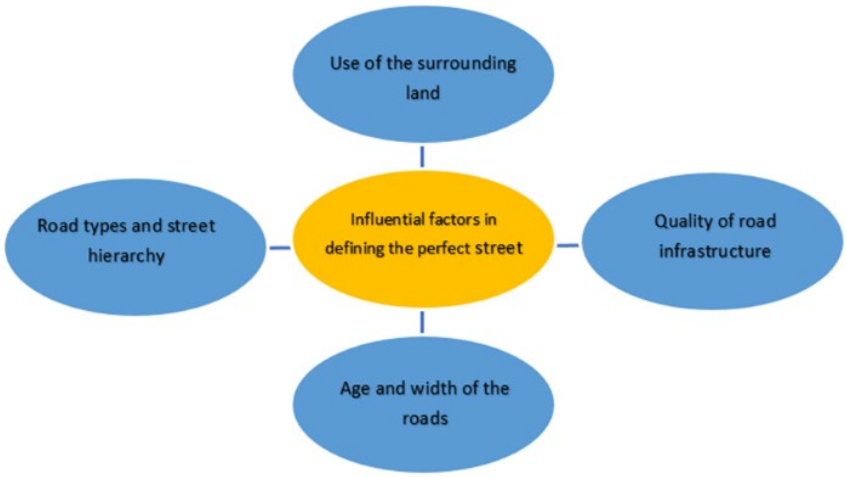

Figure 1: Influential factors in defining the perfect street (Adapted from Winters, 2015)

A complete street policy, the diagram shows a new and forward-looking approach (Simpson, 2011). complete streets are available in a wide variety of configurations but complete streets are based on designing for the needs of all users, increasing safety, facilitating pedestrian movement, respecting the environment and society, and creating public spaces, Easy movement for cyclists and disabled people, integrated public open spaces, improving quality of life, increasing vitality in the urban space, reducing car use, promoting the use of cars, promoting the use of public transportation, coordination between urban management and city departments (Gregg & Hess, 2018; Nutter et al, 200; Vasilev et al., 2022). Based on the explanations presented in connection with the complete Streets movement, the objective of this study is to determine the most important criteria for creating a complete Street in Tehran. In addition to the 8.6 million people in Tehran, gate trips bring the floating population to more than 10 million people each day. As the country's and the Middle East's largest metropolis, the transportation system there faces many serious problems with this growing population. Due to the increase in car ownership over the last decade and the general improvement of citizens' well-being, the travel rate has reached about 1.5 trips per person, so Tehran city's road network operates at 15 million trips per day. This number of trips is the source of many other problems in Tehran (Khaksari &, Saffarzadeh, 2014). With regard to the aforementioned discussions in the context of the current problems of transportation planning in Tehran and the lack of response from the current infrastructure and traffic density exceeding the availability of infrastructure and transportation facilities in the city of Tehran, as well as the emergence of the aforementioned issues and problems, it seems necessary to pay attention to new approaches such as the complete street. Despite having 3% of the area of Tehran city, District 6 had 251384 people in 2015, and its gross population density was 107 people per hectare (Mohammadpour et al., 2014). In Tehran, this is one of the busiest and most popular areas. Choosing region 6 as a study sample is due to its geographical and spatial centrality, as well as its position in urban development so far. However, this area is strategically important in urban plans because of its functional activities and the presence of extra-regional activities due to its spatial centrality (Soleimani Meranjani et al., 2021). As a result of its spatial centrality and attractive travel centers,

this area experiences an increase in traffic, much of which is made up of private cars going beyond the capabilities of the local transportation system. In light of these factors, there is a need for the region to upgrade and enhance the capacity of its roads, taking into account people of all abilities and ages, as well as motorized and non-motorized modes of transportation. According to the presented materials, the current research seeks to answer the question that according to the principles and characteristics of complete Street, which street in the 6th district of Tehran would be the most suitable for implementing such a program and plan?

Figure 2: The location of the sixth district in Tehran

RESEARCH METHOD

The purpose and method of the present study are descriptive-analytical. Interviews and in-depth observations were used to collect data. The complete street is defined as having four users, including pedestrians, cyclists, public transportation passengers, and private cars, respectively. For each function, the following criteria are determined by users' characteristics. As an example, to increase pedestrian safety, it is necessary to create observer eyes on the streets by mixing uses and to consider ramps for disabled people throughout walking paths. In the process of hierarchical analysis, sub-criteria related to the specific needs of users are considered. Table number 1 shows the main functions (criteria) and sub-criteria related to each function.

Table 1: The criteria and sub-criteria of the complete street according to the thinkers of this field

Criteria	*Sub-criteria*	*Researcher*
Walking	*Special pedestrian path* *Sanctuary Islands*	*Litman (2013)*
	Special route for the blind and visually impaired *Observer-safe crossings (mixed use)* *Climatic comfort and green landscaping*	*Nutter et al (2009)*
	Disabled people's preference for the route *The walking area has clear and unbroken paths* *Easy access to the walking area from the parking lot* *Cleanliness of the path and appropriate urban furniture*	*Los Angeles department of city planning, 2014* *A Local government commission,2015*
	Pause spaces and public life	*Adams et al (2009)*
	Pedestrian safety facilities	*Winters (2015)*

		Tustin(2022)
	Human scale	*City of Johannesburg complete street design guideline (2006)* *Jensen et al (2017)*
Riding Bike	*Special path for cyclists*	*Rawlings et al (2013)* *Mirzahossein et al(2022)*
	Clear and unobstructed paths *Parking lot climate comfort for bicycles*	*City of Johannesburg complete street design guideline (2006)*
	Suitable radius for circulation	*Litman (2013)*
	Bicycle parking (short-term and long-term) *Building entrance with adequate parking* *Bicycle carrier in public transportation*	*Los Angeles department of city planning (2014)* *Sousa & Rosales, 2010*
	Proper connection to other transportation networks	*Nutter et al (2009)*
	Safety facilities for cyclists	*Winters (2015)*
Public Transportation	*Special public transport route*	*Litman (2013)*
	Convenient and accessible stations *Appropriate turning lines*	*Los Angeles department of city planning (2014)*
	Clear and unobstructed paths	*Adams et al(2009)*
	Connection to nearby destinations *Reliable road facilities*	*Nutter et al (2009)* *Carlson et al (2017)*
Personal Car	*Special car track* *Suitable circulation lines*	*Los Angeles department of city planning (2014)*
	Marginal parking lot *Appropriate speed design*	*Nutter et al (2009)*

Edited by the authors based on theoretical studies, 2018

According to this study, out of 4 main criteria, including walking (12 sub-criteria), cycling (9 sub-criteria), public transport (6 sub-criteria), and private cars (4 sub-criteria), 31 sub-criteria were used to evaluate and locate complete Street in Tehran's Six District. The criteria and sub-criteria were developed into a questionnaire, which was answered by 30 experts and specialists selected purposefully. Expert Choice software used hierarchical analysis to weigh the criteria, and TOPSIS Solver software used the TOPSIS multi-criteria model for selecting the best option. As examples of streets in the area, Fatemi Streets, Keshavarz Blvd., Inghelab, North Kargar, Asadabadi, Taleghani, Felestin, Hijab, Karim Khan Zand, and Vesal Streets were examined, taking into account their uses and functions (commercial, recreational, educational, residential, and...).

RESULTS AND DISCUSSION

As a result of hierarchical analysis and weighting of criteria and sub-criteria (Table 4), walking, cycling, public transport, and private cars all have weights of 0.56, 0.26, 12.0, and 0.05. According to these data, walking is one of the most important features of a complete street, while private cars are the least important. It can be seen that each sub-criteria has been weighted separately. According to the walking criteria, the special routes for pedestrians and for blind and partially sighted people, respectively, have the highest weights of 0.21 and 0.134, and the indicators of pedestrian safety facilities and human scale, respectively, have the least importance scores with weights of 0.039 and 0.033. In the criteria of cycling, public transport, and private cars, according to the indicators of the design of a special path for cyclists (0.275), creating a special path for public transport (0.266) and special car route (0.391) have the highest scores.

Table 2: Pairwise comparison of criteria and sub-criteria

Criteria	*Criteria and sub-criteria comparison*			
	Sub-criteria	*Importance factor*	*Sub-criteria*	*Importance factor*
	1. Special pedestrian path	*0.210*	*7. Safe and visible crossings with observer eyes (mixing of uses)*	*0.072*
	2. Special route for the blind and visually impaired	*0.134*	*8. Climate comfort and green landscaping*	*0.046*

Walking 0.56	*3. Disabled people's preference for the route*	*0.118*	*9. Suitable urban furniture and cleanliness of the path*	*0.043*
	4. The walking area has clear and unbroken paths	*0.113*	*10. Sanctuary Islands*	*0.041*
	5. Pause spaces and public life	*0.078*	*11. Pedestrian safety facilities*	*0.039*
	6. Easy access to the walking area from the parking lot	*0.075*	*12. Human scale*	*0.033*
Riding Bike 0.26	*13. Special path for cyclists*	*0.275*	*18. Parking lot climate comfort for bicycles*	*0.070*
	14. Clear and unobstructed paths	*0.174*	*19. Proper connection to other transportation networks*	*0.062*
	15. Suitable radius for circulation	*0.139*	*20. Safety facilities for cyclists*	*0.061*
	16. Bicycle parking (short-term and long-term)	*0.108*	*21. Bicycle carrier in public transportation*	*0.036*
	17. Building entrance with adequate parking	*0.074*		
Public Transportation 0.12	*22. Special public transport route*	*0.266*	*25. Appropriate turning lines*	*0.087*
	23. Convenient and accessible stations	*0.260*	*26. Connection to nearby destinations*	*0.083*
	24. Clear and unobstructed paths	*0.260*	*27. Reliable road facilities*	*0.045*
Personal Car 0.05	*28. Special car track*	*0.391*	*30. Suitable circulation lines*	*0.158*
	29. Marginal parking lot	*0.305*	*31. Appropriate speed design*	*0.146*

Source: Research findings, 2020

A decision matrix is formed based on the points assigned by experts and specialists to each option for each sub-criteria based on the weights assigned to each sub-criteria in the TOPSIS solver software. Afterward, two normalized and weighted matrices are constructed, the amount of positive and negative ideals is calculated, and finally, by calculating the distance between each option and the positive ideal and the negative ideal, options are prioritized, and the final option is presented. As shown in Table 5, Keshavarz Boulevard was ranked higher than all other options.

Table 3: Ranking options based on the TOPSIS technique

Options	*The normalized value of the distance of options from the positive ideal*	*The normalized value of the distance of options from the negative ideal*	*Relative close index*	*Rank*
Keshavarz Blvd	*0.030577418*	*0.244506895*	*0.802677102*	*1*
Inghelab	*0.074754182*	*0.190299752*	*0.564273578*	*2*
Fatemi	*0.110206207*	*0.112654172*	*0.34211095*	*3*
Karim Khan Zand	*0.10036532*	*0.125477833*	*0.388747442*	*4*
Taleghani	*0.09120451*	*0.111490419*	*0.383424897*	*5*
North Kargar	*0.111355805*	*0.060003749*	*0.215143751*	*6*
Hijab	*0.411664825*	*0.050744198*	*0.1812003*	*7*
Vesal	*0.118451275*	*0.039629257*	*0.145442282*	*8*
Asadabadi	*0.121241622*	*0.040328283*	*0.144723092*	*9*
Felestin	*0.125193194*	*0.024865442*	*0.091766865*	*10*

Source: Research findings, 2020

Based on the comparison of the 10 selected streets, Keshavarz Boulevard has the smallest positive ideal distance and the largest negative ideal distance, making it the most suitable street to plan and implement the complete street plan. Considering the length of the table, different stages of the model have been done for the studied options and streets based on their importance with regard to all the criteria and sub-criteria. In Table 6, Keshavarz Boulevard ranks highest in all main criteria except for public transportation. A score of about 27% was given to the features related to public transportation due to Inghelab Street's central location in Tehran and the existence of special bus lines (BRT). Therefore, Felestin Street ranked last in the complete Street Plan according to the criteria of public transportation (3.5%), walking (4.3%), and private cars (1.5%). Asadabadi and Wesal streets also scored the lowest with 5.4% importance coefficients.

Table 4: The importance coefficient of the options compared to the criteria

Options (street)	*Criteria's importance coefficient*			
	Walking(%)	*Riding Bike(%)*	*Public Transportation(%)*	*Personal Car(%)*
Keshavarz Blvd	*21.9*	*24.5*	*14*	*21.2*
Inghelab	*15.9*	*8.4*	*26.4*	*14.2*
Fatemi	*13.3*	*5.5*	*8.9*	*8.3*
Karim Khan Zand	*12.2*	*19.2*	*11.1*	*11*
Taleghani	*8.2*	*13.5*	*11.3*	*8*
North Karegar	*7.3*	*6.8*	*8.6*	*8.3*
Hijab	*6.2*	*5.6*	*4.7*	*12.5*
Wesal	*5.5*	*5.4*	*5.1*	*5.3*
Asadabadi	*5.3*	*5.4*	*6.4*	*6.2*
Felestin	*4.3*	*5.6*	*3.5*	*5.1*
Total	*100*	*100*	*100*	*100*

Source: Research findings, 2020

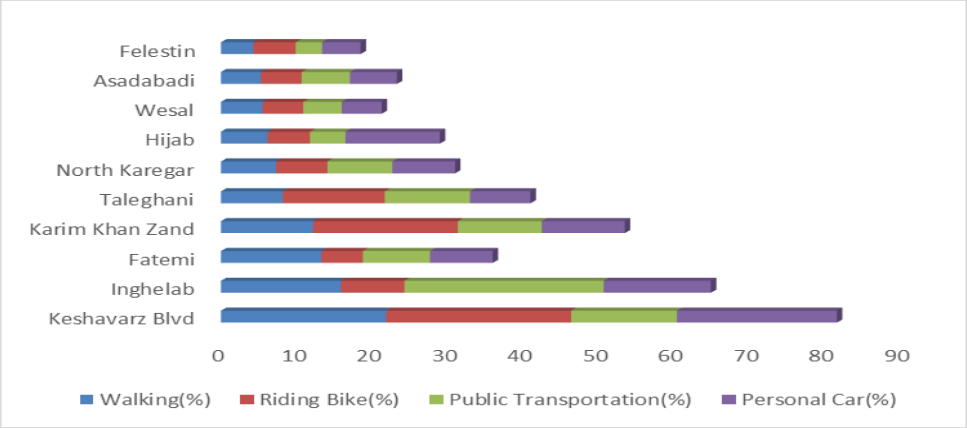

Figure3: The importance coefficient of the options compared to the criteria

CONCLUSION

Tehran's central area needs a complete street plan, considering that every day more space is available for private cars without the necessary environmental standards. Nevertheless, a complete street should be able to consider various dimensions and be planned with an all-around and flexible perspective. The first step to designing a complete street is to be flexible, and no one principle can be 100% fixed. It will be difficult to implement the complete street without considering the flexibility of the plan and the participation of residents. We used the context and background of information obtained from theoretical studies to select the most appropriate street in District 6 of Tehran Municipality for the implementation of the complete Street Project. Finally, the research concludes that Keshavarz Boulevard is the most appropriate and suitable option for implementing complete Street; In fact, Keshavarz Boulevard can become a completely safe, comfortable, healthy, accessible for all users and special groups, a popular destination for users, appealing, dynamic, human-centered, a flexible and collaborative program and plan, beautiful, with a low speed of vehicular traffic, in which different modes of transportation (walking, biking, public transportation, and cars) can be used and complete Street has achieved its most important objectives, such as restoring urban life and human-centered planning, increasing the health of citizens, reducing the use of private cars, and reducing the environmental pollution. By reducing travel time and increasing the use of public transportation, a special route for public transportation helps improve traffic. By physically changing the street and designing the appropriate speed, we can reduce the speed of private cars, reduce the lines of passenger cars to only two passing lanes, improve pedestrian safety, and increase pedestrian use of the street as an urban space. By reducing private car use along Keshavarz Boulevard and the microclimate of the boulevard on this street, greenhouse gas emissions will be reduced. It has created pleasant and comfortable spaces for stopping and resting in the pedestrian area by creating inviting and attractive spaces for pedestrians, improving the physical quality of the boulevard; and creating furniture areas, which have increased social interactions and maximized space usage. This makes this street a popular place for people to visit. Flexibility and vitality will be added to the street as the pedestrian area and marginal park path, which have previously served as a space for pedestrians and mobile users during off-peak traffic hours, become a space for urban activities. By establishing special traffic routes for the blind and other special groups, the isolation of these groups can be reduced and their independence increased. In

the end, Keshavarz Street is presented below, in accordance with complete Street's principles and criteria, which provides reasons for upgrading it.

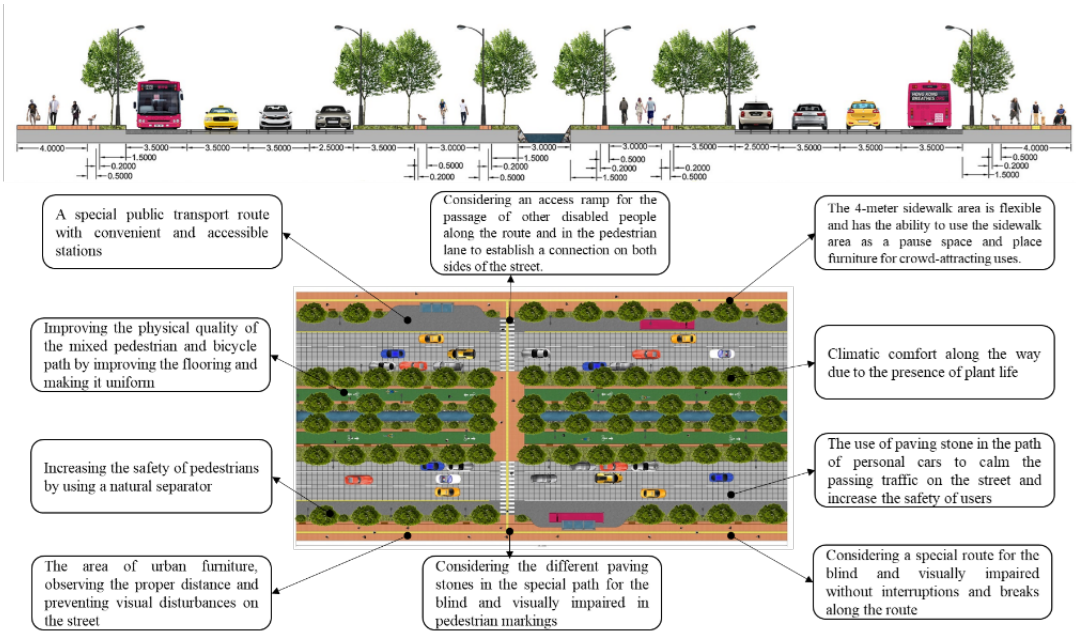

Figure4: The proposed plan of Keshavarz Boulevard as a complete street

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THE ENERGY TRANSITION OF THE CITY OF NIŠ WITH REFERENCE TO THE POTENTIAL OF RENEWABLE ENERGY SOURCES

Mihailo Mitković

Faculty of Civil Engineering and Architecture, University of Niš
Assistant, PhD student, mihailo.mitkovicgaf@gmail.com.

Milena Dinić Branković

Faculty of Civil Engineering and Architecture, University of Niš
Associate Professor, PhD, milena.dinic@gaf.ni.ac.rs.

Milica Igić

Faculty of Civil Engineering and Architecture, University of Niš
Assistant, PhD student, milica.igic989@gmail.com.

Jelena Đekić

Faculty of Civil Engineering and Architecture, University of Niš
Assistant, PhD student, jelena_djuric@ymail.com.

Milica Ljubenović

Faculty of Civil Engineering and Architecture, University of Niš
Assistant, PhD, milica.stj@gmail.com.

ABSTRACT

Electric energy security is crucial, but the high cost and limited availability of fossil fuels, as well as the need to minimize greenhouse gas emissions, have made renewable resources desirable in energy-based economies across the world. The potential for renewable energy resources is enormous because they can, in theory, exponentially exceed the world's energy demand. As a result, these types of resources will comprise a significant portion of the future global energy portfolio, with many countries currently focusing on expanding their renewable energy resource pools. This paper aims to look at the dilemma of a potential sustainable energy transition in the city of Niš. Such an analysis gives us insight into the identification of global and national contexts and provides us with an opportunity to understand the impact of energy development on cities. Energy is essentially a problem of sustainable development, multisectoral and multidirectional, covering many areas. From this complex phenomenon arise the issues of energy in urban areas as well as the need to look at the analysis of energy consumption in the building sector of the city of Nis.

Keywords: electric energy security; energy transition; renewable energy resources; energy consumption; urban energy

1. INTRODUCTION

Energy is crucial for every nation's economy and industry, as well as any attempt to improve its citizens' standard of living. In today's world, energy is not only an essential component of the production function, but it is also seen as a strategic commodity that plays a role in moulding both the global economy and politics [1]. Due to the increasing focus on the environment, as well as on the security of their energy supplies, countries around the world are facing major problems that force them to change their energy mix. In the last 10 years, the use of renewable energy has grown faster, thanks to the better institutional frameworks and economic policy measures. The growth of the renewable energy sector is considered as a solution to the world's energy demands that should also help towards the realization of sustainability [2]. To the contrary, renewable energies are derived from non-exhaustible or replenishable [2] natural processes (such as sunshine

or wind), making them ecologically beneficial sources of energy [3]. On the other side, encouraging the development of the renewable energy sector helps boost jobs and the economy in general [4]. Following the crisis caused by the COVID-19 pandemic, the world's renewable energy capacity has increased by more than 314 (GW) in 2021 [5]. However, the market growth reflected in the additions of renewable power capacity was 11%, but this growth was still just a third of the yearly additions needed to reach the world's key targets of net zero carbon emissions [5].

2. COMPLEX URBAN ENERGY SYSTEM

The city and its energy functions form a complex system. According to Keirstead [6], there are three types of physical representation of urban energy systems, as shown in (Fig. 1,2,3). The first is the thermodynamic model. This takes into account the flows of energy and materials that enter the city and are transformed in it to produce work and, inevitably, waste (Fig. 1). These energy transformation processes are regulated by the first two principles of thermodynamics. The first principle states that during the transformation of a closed system, energy is conserved, whereby the internal energy of the system is exchanged with the external environment in the form of heat and work. According to the second principle, entropy (disorder) increases during the transformation of a thermodynamic system. The second type of model is based on the analogy of the functioning of the city with the metabolic activity of living organisms (Fig. 2). According to this vision, the city takes the resources that circulate throughout its territory towards the distribution networks to make use of them before discarding the waste. The analysis of urban metabolism, therefore, boils down to the identification of material flows entering and leaving the city, those stored there, and all the transformations these flows undergo within the urban system [7].

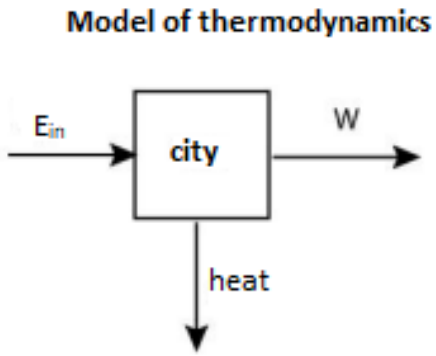

Figure 1: Model of thermodynamics [6]

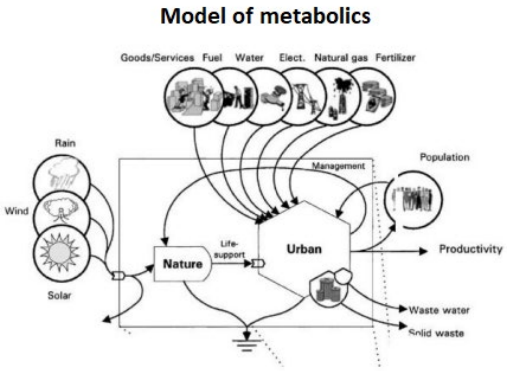

Figure 2: Model of metabolic [9]

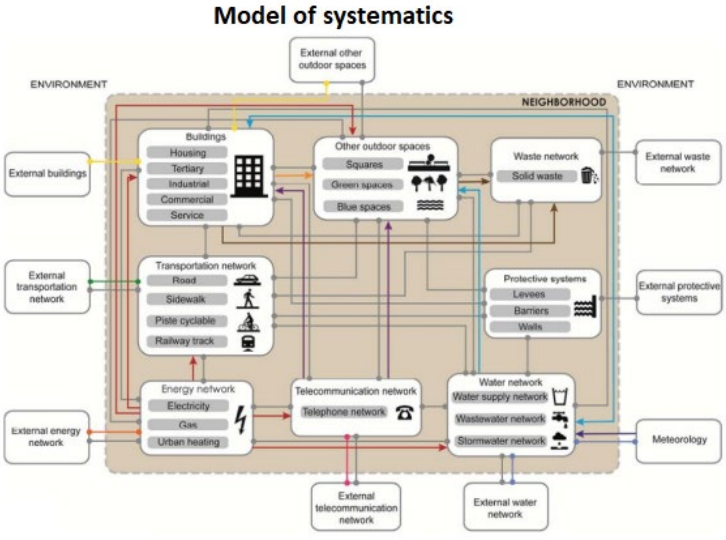

Figure 3: Model of systematics [10]

The third mode of representation consists of considering the city and its energy system as a complex system, that is to say, made up of a large number of components linked together in multiple ways, more or less directly. Each of these visions highlights important characteristics of urban energy systems (Fig. 3).

In addition to the energy functioning of the city, the interactions between its physical reality (location, urban forms, materiality, etc.) and energy flows, the impact of its inhabitants on energy systems should not be overlooked. Indeed, a wide variety of actors participate in the energy behaviour of the urban environment: consumer users, decision-makers, industrialists, network managers, etc. Therefore, "The needs and choices (for example, comfort), the users, and the varied behaviours of these are both the source and the result of the complexity and specificity of energy systems and their reconfigurations [8].

2.1. Urban project in the service of energy

The contribution of local authorities to the energy transition can take several forms: getting involved in the production or distribution of energy, integrating energy issues into development strategies or even setting up a panel of incentive schemes to raise awareness and mobilize local actors [8]. It seems that local authorities are mobilizing more, trying to regain control over the management of energy networks, promoting the dense and polycentric city, building eco-districts that want to be exemplary in terms of energy and encouraging local actors and their citizens to be more energy-efficient behaviours. However, the urban project is a widespread mode of action that makes it possible to organize the transformation of a part of the city in a coordinated way. This is as it appears to us as an opportunity to be seized to implement the energy transition in the city. However, urban projects are increasingly complex processes, due to the growing number of global and local issues to which they must respond and the multiplication of actors participating in the conduct of the action. Energy is thus an additional factor of complexity in urban projects.

3. ANALYSIS OF TOTAL ENERGY CONSUMPTION IN THE BUILDING SECTOR IN THE CITY OF NIŠ IN 2010.

This research explores energy consumption by subsectors and kinds of energy sources in the city of Niš for the year 2010. Table 1 illustrate the amount of energy consumed by source type. The energy analysis that was done on the total amount of energy consumed in the construction sector of the city of Niš, illustrates that the most dominant form of energy is consumed electricity with 63.75%, followed by thermal energy delivered form the district heating system with 16.70%, followed by heat produced by burning firewood 16.02%, then heat obtained by burning heating oil 2.16%, coal with 1.89%, and finally heat energy obtained from gas with 0.86% [11].

Table 1: Total energy consumed in the building sector by type of energy source in 2010.

Energetic	*Total surface area [m2]*	*Total spent quantity energy sources*	*Total spent energy in facilities [kWh]*	*Specific consumption Energy [kWh/m^2]*	*The percentage of energy used [%]*
Natural Gas	*102.471,40*	*1.352.488[m^3]*	*12.524.038,66*	*192,06*	*1,39*
Fuel oil	*264.137,00*	*1.668,66[m^3]*	*30.378.096,60*	*115,01*	*2,15*
Firewood	*1.927.390,00*	*122.666,62[m^3]*	*206.079.932,96*	*106,92*	*14,57*
Coal	*230.218,00*	*5.325,29 [t]*	*26.626.463,40*	*115,66*	*1,88*
Central remote heating	*2.135.107,00*	*/*	*234.615.203,00*	*109,88*	*16,58*
Electricity	*8.794.096,00*	*/*	*897.354.458,22*	*102,04*	*63,43*
Total	***8.795.916,00***	*/*	***1.407.578.192,84***	***160,87***	***100***

Regarding the structure of energy consumed in the building sector in Niš, depending on the sub-sector for 2010. It illustrates that the most energy was consumed in the sub-sector of building of collective and individual housing 85.27%, than in the sub-sector of buildings of commercial and service activities 10.69% and finally in the sub-sector of public buildings owned by the city with 4.04% [11].

The costs associated with using power in this manner are enormous. Thus, it is essential that the city's energy policy is predicated on the introduction of activities and measures that will result in an improvement of this condition. As we can see form the presented analyses, the electricity of consumption is the most dominant in the building sector, while other non-alternative sources also participate with a large percentage as a primary energy source. This kind of energy illustration is certainly unsustainable in the long run. Therefore, the mandatory use of renewable energy sources, the application of energy efficiency norms and standards, are inevitably imposed on Serbia due to the increase in energy consumption, which will be more and more difficult to meet with the limited capacity of traditional fossil fuel sources, as well as due to the damage caused to the environment.

4. ANALYSIS OF RENEWABLE ENERGY SOURCES IN THE TERRITORY OF THE CITY OF NIŠ

It is generally known that Serbia has large regional disparities on the one hand, while on the other hand renewable energy sources are concentrated in smaller developed areas of the country. One of the challenges that Serbia is facing is the inadequate use of renewable energy sources. Similarly, the territory of the City of Niš is rich in resources such as: a sufficient amount of sun, biomass, thermal energy, but also suitable locations for small hydropower plants. Hence, in this part of Serbia, there are renewable energy sources whose energy potential is at a high level, while, unfortunately, its utilization is at an unenviable level [12].

In the area of the City of Niš, there is no usage strategy, there is no predetermined objective with a specified proportion of meeting energy demands from renewable energy sources within a specified time frame. From an energy perspective, solar energy represents a resource that is always accessible for use and may be used to replace a considerable number of traditional energy sources. The reasons for the limitation of these kinds of energy sources are technological education and economic issues. Data on the average daily total solar radiation per month, data on the average temperatures during respective periods are important for the utilization of solar energy. These data include the number of sunny hours, the times when solar energy can be used, the inflow of energy per square meter, the average daily inflow for the sunniest month of the year, and the overall average daily inflow.

When it comes to solar energy facts on the territory of Niš are: The energy of global solar radiation per square meter of horizontal surface in January is between. 1.50-1.60 kWh/m^2; The energy of global solar radiation on the horizontal surface in July is 6.40-6.50 kWh/m^2; The average daily inflow at the annual level of radiation energy to the horizontal surface is 4.00 4.20 kWh/m^2; The average daily inflow, on an annual level, of the energy of global solar radiation on a surface with a slope of 30 degrees and an orientation towards the south is 4.60 - 4.80 [kWh/m^2] [13]. So, it appears that the potential for solar energy production in this region is high enough to warrant further exploration. Unfortunately, solar systems are exclusively utilized on individual residential buildings. Otherwise, data on the precise number of installed solar systems in the municipality are still unavailable, although (PV) systems are utilized to generate electricity that is used to power public lighting. In the area of the City of Niš, however, solar panels have not found widespread use. The populace's weak economic, purchasing power, is the primary cause for their non-use since it is essential to invest a bit more money for their installation.

When it comes to wind energy facts on the territory of Niš are: Average annual wind power at a height of 100 [m] is from 100-200 [W/m^2]; Average annual wind energy at a height of 100 [m] is from 900-1800 [kWh/m^2]; Average wind energy in January at a height of 100 [m] is from 75-150 [kWh/m^2]; The average wind energy in July at a height of 100[m] is 75-150[kWh/m^2] [13]. Based on the data presented, it can be concluded that the territory of the City of Niš is not suitable for the construction of wind generators.

Increased interest in using renewable energy sources (RES) has lead to a rise in the popularity of biomass energy (bio-energy) in recent years [14]. In a more sustainable and energy-efficient future, bio-energy may play a significant role. Numerous factors are at play, including those that are contributing to the surge in attention paid to bio-energy [15]:

(1) helping to alleviate poverty in developing nations;

(2) providing constant energy without the need for costly conversion devices;

(3) providing energy in all the forms required (including liquid and gaseous fuels, heat, and electricity);

(4) it is carbon dioxide (CO_2)-neutral and can even act as carbon sinks, and

(5) it helps to restore unproductive and degraded lands, increasing biodiversity, soil fertility and water retention.

Considering the global trends in the energy sector and the fact that Serbia has large biomass energy resources (estimated at around 2.7 million ten), it is clear that growth of this sector might offer the essential energy sources in the long run [16]. As a country with large areas of arable land and land under forest, Serbia has a great potential for biomass production, its amount is 2.4-2.6 Mtoe per year, which represents about 63% of the total RES potential [17].

The total quantity of agricultural land on the territory of the city of Niš is 36,996 hectares, of which 86.3% is privately held, 58% is arable land, 5.3% is orchards, 10.60% is vineyards, 5.10% is meadows, and 20.40% is pastures. The primary comparative advantage of Niš is its land fund. The territory is filled with a variety of land types, as well as uncontaminated territory. There are 20.000 hectares of arable land, and on ploughed fields, there are burnt straw with an energy value of 16MWh/ha. By utilizing this straw for heating in the Niš district, 320 GWh of energy may be saved annually. Annually, it is anticipated that the entire thermal value of firewood in the area of the City of Niš is 110GWh.

In the region of Niš, there are 20.000 hectares of woods, primarily of beech, oak, and other deciduous trees. At the yearly level, one-quarter is meant for cutting, which equates to 36 000 m^3 of firewood and 4000 m^3 of wood for building. The overall calorific value of firewood is estimated to be 110 GWh/year. Approximately 450 m^3 of wood waste is crated throughout the building process, with a heat value of 500 MWh as fuel. Figure 4 illustrates the estimated energy value of biomass on the territory of Nis, on an annual basis.

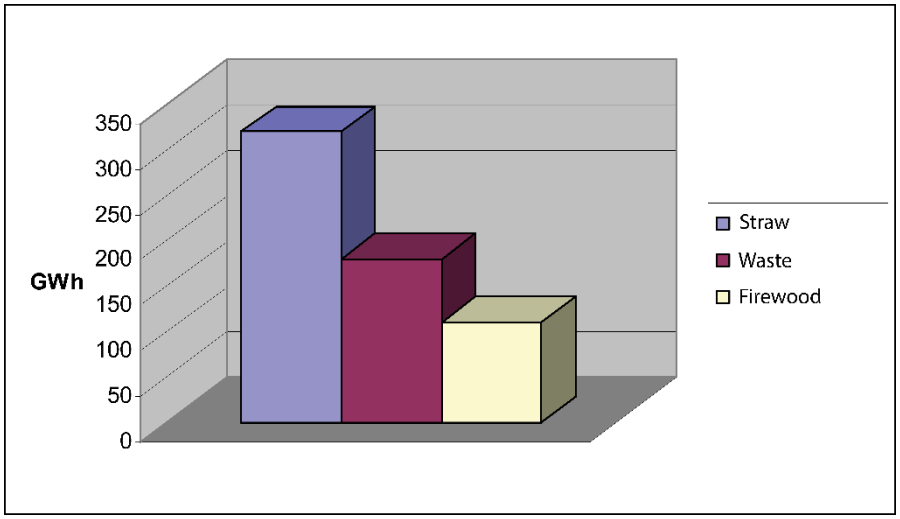

Figure 3: Estimated energy value of renewable energy resources (biomass) in the territory of Nis, on an annual basis [12]

This leads us to the conclusion that the distribution of biomass and its potential in the Niš region is suitable, and that detailed analyses are required to determine its profitability. Based on the studied data, regarding the area and structure of agricultural and forest land, as well as the type and quantity of plant production, it can be said that in the territory of Niš, there is still no significant production of plant raw material base for biofuel production. Nor can it be claimed that there is sufficient potential for it. On the other hand, it is necessary to determine the potential of landfill gas, but also to foresee the use of biogas obtained from wastewater during the construction of a water treatment plan.

According to their potential, geothermal phenomena in Serbia, particularly in Niš, might be of enormous significance, primarily for thermal energy generation but also for other cascade solutions. Due to low fluid temperatures and higher investment costs for wells at deeper depths, Serbia is able to contribute less to the production of power [18].

Prior study has demonstrated that the subsurface of Niš and Niš Spa are rich in geothermal water with high temperatures but is required to continue testing the water in order to use it correctly, for purposes of maximizing its usage and obtaining energy. In 1983, the Belgrade Faculty of Mining and Geology was primarily responsible for the investigation of the geothermal well on Niš Spa. On that occasion, the following properties

of the Niš Spa water were determined: temperature 35,5 degrees Celsius, pressure 8bar, the surface area of the water reservoir 65km2, and lake depth 350-800m. In addition to the Niš Spa, three more hydro-geothermal energy sources are recognized in the region of Niš, the values of which are also included in Table 2. Although the area of Niš is rich in hydro-geothermal energy sources, their utilization is still insufficient, and it is imperative that not only the local population but also the highest levels of government does not take immediate action to enable the use of this renewable energy source. Previous explorations of the Niš and Niš Spa subsurface have shown the presence of exceptionally significant volumes of high-temperature geothermal waters. Further examination into the water's potential for use in energy generation is needed.

Table 2: Locations of geothermal springs on the territory of Nis

Place geothermal sources	*Hot water temperature [℃]*	*The capacity of the source [l/s]*	*Distance from the city [km]*
Niš Spa	*35-40*	*100*	*11*
Topilo Spa	*30*	*10*	*20*
Miljkovac	*36*	*50*	*15*
Ostrovica	*22*	*10*	*25*

When it comes to small hydropower plants facts on the territory of Niš are: On the river Nišava in the Sićevo canyon, there are two mini-hydroelectric plants: "Sveta Petka" hydroelectric power plant, which began operations in 1908, and "Sićevo" hydroelectric power plant, which began operations in 1931. There are possibilities for the development of 8 small hydropower plants in the researched area.

5. CONCLUSION

The existing scenario in Niš in terms of heating expenditures for the ordinary family is not sustainable, but it may be maintained by ideas for increasing the use of renewable energy sources. If all of the examined resources were to be put into operation, there would be an improvement not only in energy efficiency, but also in economic profitability, employment, environment and hence regional growth. Such initiatives would make Niš a more energy-efficient city. As a means of supporting the maintenance of some rural communities and networking with cities in order to primarily enable their survival and success, the government must encourage the perception of local potentials. The concept of local energy cultivation can encourage a strong and developed sense of preservation of local identity and culture among the population. This would have a convenient effect on the region's urban-rural image in a number of ways. The wealth of renewable potential of the Nišava district should be one of the modes of this process, where it is justified.

It is especially crucial to note that the current situation in Serbia's smaller cities regarding renewable resource consumption does not correspond to the potential. These untapped potentials will be more important for urban planning and balanced development, particularly in Serbia's EU accession. Recognizing these potentials at the Nišava district level can have many implications for rural development and the alleviation disparate of in the city in the long run. At the same time, it should especially take into account different forms of use of renewable energy sources in terms of (heating of building and cooling, drying processes, development of different clusters, energy efficiency, and reduction of pollution). A very good example of possible measures at the level of local institutions to help make decisions at the local level regarding the use of renewable energy sources can be found in the examples of good practices in the EU.

Last, but not least, when it comes to ambition from the perspective of energy management and planning, the paper recognizes and elaborates on three proposals from the literature that are repeated as the basis of energy planning and processes in cities, namely: model of thermodynamics, model of metabolics, and model of systematics within the complex urban energy system. Then, through the analysis of total energy consumed in the building sector by type of energy source in 2010. It was seen in which direction energy is consumed. In parallel with that, the potential of renewable energy sources in the territory of the City of Niš was perceived. So, the findings presented should be seen as steps toward a faster transition to renewable energy sources, with an emphasis on managing the city in a sustainable way.

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DATA COLLECTION OF ARCHITECTURAL INFORMATION ABOUT TRIPOLI OF LEBANON THROUGH EUROPEAN TRAVELERS BETWEEN 1500 AND 1914

Antoine Dib

DICAM, Università degli studi di Bologna, Italy
PhD., Visiting Scholar, antoine.dib@hotmail.com

ABSTRACT

In the era of big data analytics and other prominent technologies, the urban planning and cultural decisions are based on "data collected from citizens, devices and traditional sources". Traditional sources are diverse and can referred to historical documents, archive, travelers' accounts, social and daily routine and much more. The data collection of historical information is crucial to take urban and architectural decisions after devasting events such as earthquakes, floods, wars, etc that can destroy entire cities; or for regenerating the cultural aspect of a city. The main objective of this paper is to fill one nostalgic gap in the cultural heritage of Tripoli of Lebanon and to present for the first time a description of the city as seen by foreign travelers. The data for this research were collected from the memories, books and reports written by dozens of European travelers that passed by this city between the 15th and the 19th century. Being a small town on the Mediterranean, Tripoli was not the main destination for any of them which makes the information written about it rare and the main difficulty was to find people that passed by and wrote about it. The importance of this research lays in the fact that it is based on published sources written by ancient travelers that are truthful and, with these established forgotten facts, it can be a significant reference for decision makers and stakeholders in their future urban and architectural decisions.

Keywords: *Cultural heritage, European travelers, Tripoli of Lebanon, Historical sources, Planning decisions*

INTRODUCTION

"No society can flourish without culture and no development can be sustainable without it". Indeed, cultural knowledge includes bunch of information that can help the society to discover its own forgotten identity, in its tangible and intangible aspects. Historical documents are essential in the construction of the self-identity and of the rediscovery of its authentic culture, most of the time hidden under a crust of oblivion, contrasted narrations, conflicts and misleading political and social agendas. Through times, historical documents were a push for the future, to grow, to continue the development, to explore new horizons in many contexts, and the field of architectural design and urban planning is not an exception. In many countries, especially in the Levant area, the written history at the last five centuries was limited by a political and military stand view, without addressing the urban fabric and social life of a country or city. Documents that dealt with everyday life are conserved in some religious and governmental archives, private collections, archive of museums and libraries (mainly occidental) etc, and many of them are not discovered or not fully unveiled and not all of them are known or studied yet. Fortunately, nowadays many libraries and museums offer free digital copy of their published documents online, mainly books and photographs, where there is the possibility to dig in the past and find a social and cultural description written by some unknown or forgotten writers about a place or another. Sometimes, the valuable information that can help researchers and scholars in enhancing, or completing, their researches may be found in unexpected documents. From here raise up the idea of this research, to dig in ancient books and maps and find a description of the city of Tripoli, in Lebanon, looking that the documents that describe it in ancient centuries, specially the last five ones, are few if not rare. Two types of documents have been found, Arabic documents that described the political and military situation, or religious conversations, and some architectural and botanical features of the city written by Arabic religious scholars and travelers like Al Burini (1599), Ramadan Al 'Outaifi (1634), Al Mahasini (1639), Al Nabulsi (1700) and others (Ibn

Mahasen & Al Bakhit, 1981). These documents are known among Lebanese scholars and are studied and published more than once. The second type of documents are written by European, and many of them are not known among researchers concerned about Tripoli. Hence, the aim of this research is to present an inventory of European travelers, scientists, artists, politicians, etc, that visited Tripoli between 1500 CE and 1914 CE, and report their impression or scientific view about Tripoli, mainly about its structures, monuments, facilities and streets, as they were written in their diaries. The objective of this data collection is to build a solid historical knowledge of the past of Tripoli in terms of urbanism and architecture that can help future decision makers and stakeholders in taking decisions and give it back its old splendor and authenticity, instead of imitating other cities or doing improvised interventions.

TRAVELERS THAT VISITED TRIPOLI BETWEEN 1500 AND 1914 CE

Until now, there is no evidence that sources written by local Lebanese under the rule of Ottoman about social and cultural life, or local architecture exist; or if they exist, they are not published or well know. Maybe because they considered their environment a normal thing not worthy or not special to be described, and/or it was not an anormal event to be memorized. However, outsiders; and outsiders are not else than travelers, tended to describe the sites of foreign countries, as the bloggers and influencers of nowadays do on their social-media. Travelling was always a natural human activity, and many travelers wrote down their memories describing the new countries that they visited and the wanders they saw in the place. Some cities were more attractive than others, for their commercial activities, geographical location, religious importance or political relations, so as consequences they attracted more travelers and more related documents are conserved. For example, despite that Tripoli was the third biggest city in the Levant after Damascus and Aleppo, the city was not a main attraction site for almost all of them, but only a city of passage.

The current research is the collection of the descriptions and opinions of only 24 travelers between 1502 and 1914 CE; first, the lack of space in this article does not allow to expand the research more than that; second, from the long list of travelers that passed by the orient, and they are more than verified 230 travelers before 1860, few of them passed by Tripoli or kept a description of the city. For example, in the memories of Mrs Carla Serena published in 1884, she had not the opportunity to visit Tripoli even though she visited Beirut and Beit Eddin in Lebanon, (Serena, 1884), Mariti who was in historical mission to Lebanon in 1756 di not pass by Tripoli also (Mariti, 1787); In 1727, Sir de la Motraye did not pass by Lebanon (La Motraye, 1727) , same as Pietro della Valle in 1650 (Della Valle, 1650) and many more. Moreover, many traveling books in that epoch were written by non-travelers based on the accounts of other travelers like the work of Olfert Dapper in 1677 where he described Tripoli as a very beautiful city, with amazing baths and abundant gardens and markets as he had lived there for weeks (Dapper, 1677).

In the following pages, a description of Tripoli as was written by those travelers is presented in its original language or translated from other languages like French, Italian, Dutch and German; these phrases are written between “”. The symbol […] means sentences not written in this research because have no importance from architectural point of view. This data collection starts with the traveler Ludovico di Varthema and ends with max Van Berchem.

In 1502, Ludovico di Varthema, an Italian traveler, passed by Tripoli and mentioned that it is a city under the reign of the great Sultan, populated by Muslims and it abounds any type of goods (Raconis, 1888).

In 1533, after encountering a big tempest between Dimiat in Egypt and Tripoli in Lebanon, Greffin Affagart, a French nobleman wrote his impressions about Tripoli, where many Venetians lived there “we went down to earth, we were received humanely by the Venetian merchants […] Tripoli is a very good city and well marketed and located near the sea […] situated at most beautiful country and more fertile than one would wish” (Affagart & Chavanon, 1902).

In 1556, Andre Thevet, a French Franciscan priest and explorer, visited the city and was amazed most of all by its baths, he said: “In Tripoli, a city of great pleasure and delegation, there is a great abundance of silk, which is made in this place. The gardens there are beautiful, for the great copiousness of the orange trees, apricots, and several other trees which are seen there. I also do not want to obviate the wines of the said place, both excellent and nothing more. […] But really what I find beautiful and of very good grace in Tripoli, and by all other towns and villages of Turkey, are the large and spacious baths, most of them of marble, both the bottom and the top, made in vault, where Turq, Mores and Christians can freely go bathing.” (Thevet, 1554).

In 1587, the Knight Ivan Zuallart, mayer of the city Ath en Haynnaut, visited the orient and described Tripoli as follows: **"**At the end of this plain and towards the mountain, is the great and commercial city of Tripoli. […] All sorts of Levantine merchandise arrives in this city, coming from Persia, Medem Mesopotamia and the East Inia, even groceries and fragrant drugs from Felix Arabia (yemen) […] The public places, which we call markets, and the bazaars, are all vaulted like our churches. […] As for the buidlings and houses, they are flat above, as are almost all those in the Orient, without having pointed roof, there you can walk, sit and lie down and each having a small wall down, that you can stepover and go from roof to the other without putting foot in the street." He described more about Tripoli but the limited space in this article forced the author to put the most representative (Zuallart, 1576)

In 1588, the knight Jacques de Villamont, who wrote one of the most famous traveling books in his time, said about Tripoli: "As for the beauty of the port, it lies on a long point of planure, then advances strongly into the sea, having at its extremity a square tower, which defends the entrance, half a quarter of a league from which there are another similar tower joining the customs of the port which is built of square form and covered in the Turkish style with other warehouses where the goods are stored" (Villamont, 1611).

In 1599, Girolamo Dandini, an Italian Jesuit went to Mount-Lebanon in a visit for the Maronite society and he passed few nights in Tripoli, he said: "The port of Tripoli is fortified with five beautiful towers lined up on the shore…I saw camels laden with ashes that are taken froma certain grass which they burn in tehse quarters. They collect it in ditches where it hardens and it provides Venice and almost all of Europe with a large quantity of material to make fine glasses. I also took pleasure in contemplating a green countryside… so full of mulberries and sweet-smelling orange trees… this town abounds in amny things…its main traffic is silk, ashes, spun cotton, grapes, soap, tallow canfles which are there beautiful and well made". What he noticed the most in Tripoli iae the fortress and the terraced roofs of the houses, that seemed to him a typical of the Levant since the time of David. He addes a little description of the sepulchres of high class people that are more magnificent respecting to the normal people, "where one sees an arch supported on four pillars; but that is nothing compared to the magnificence of ours… they have neither art nor industry" (Dandini, 1694)

In 1615, when he left Constantinople, Baron Henry de Beauveau, an ambassador of the Duc of Lorraine in Rome, mentioned that his road was directed to Tripoli and then he described the cities that he saw on his trip, but this fact emphasis the importance of the city at that time respecting to other ones. He said: "It is enclosed neither by walls nor by pits, although there are gates; because the houses attached to each other serve as walls, and are separated only at the place of the doors. The streets are narrow there, and the houses are made in flat shapes. There are many beautiful and ancient churches turned by the Turks into mosques where they still remain the Christian bells" (Beauveau, 1619).

In 1624, during the spring, the theolog Domenico Magri passed a half day in Tripoli and described the city and its fields with poetic words, he said: "it lies beneath the slopes of Lebanon, towards which an eminent fortress rises, from which a very thin olive grove can be admired from which a very large quantity of exquisite oil is extracted. The city is a mile and a half away from the sea, where you can see a very comfortable port guarded by seven towers garnished with a good number of cannons. Among those towers there is one called tower of Love, for having been made by a Venetian found with a Muslim woman, a capital crime. However, he was commuted to a penalty, having been sentenced to build this tower at his own expense. The convenience of the port makes the city very abundant […] the countryside is very grateful to the eye; it stretches from the City to the sea, painted by the brush of Spring, verdant all over with lush citrus trees, palms, and mulberry. Stroll through this vast plain sown with gardens the river […] which originating from Lebanon flows for that very fertile plain, which looks like an earthly paradise". (Magri Maltese, 1664)

In 1655, Monsieur Balthasar de Monconys stayed five days in Tripoli in and he could not enjoy a lot because of the unstopped rain, but from what he wrote, he said: "Tripoli is located at the foot of the rock which forms the beginning of Mount Lebanon, and is within reach of an arquebus from the sea, along which there are many palm trees which border it, and some 3 or 4 towers which defend it. The city is rather small and melancholy, with strong water, which makes fountains by all the houses, which are all terraced. […] I saw a stone cut in foliage, which is said to be a talisman against scorpions […]. There is nothing to see other than the remarkable castle which is a work of the francs and in the old way, with many towers" (Monconys, 1666).

In 1697, even the traveler Henry Maundrell, an academic at oxford University, stayed over eight days in Tripoli, he did not describe any particular monument or structure of the city apart the aqueduct. He mentioned the six towers on the sea side, the traditions of visiting people and a convent near Tripoli. He said: "it passes through

this valley a very beautiful aqueduct, which goes from one mountain to another and which carries a quantity of water sufficient for the necessities of the city. It is called the Prince's Bridge where it is supposed to have been built by Godfrey de Bouillon" (Maundrell, 1697).

In 1714, Cornelis le Brun, a Dutch artist and traveler, passed by Tripoli and wrote: "I also found it pleasant and located at the foot of a mountain. You can see around a number of gardens full of mulberry trees, so there is a lot of silk. There are a number of pleasant views here, both of the city and outside, because there is a lot of water flowing through it, which comes from the mountains of Lebanon. [...] It has very little depth in several places. [...] the city itself is not of great consequence, but nevertheless the houses are built of cut stone, and most are quite large and remarkable. The main districts are well populated, but there are others where there are no buildings. The bazaar or rue de Marchands is in fairly good condition (Le Brun, 1714).

In 1740, an English traveler called Richard Pococke visited the orient and described Tripoli as follow: **"**the river of Tripoli runs through a most delightful narrow valley from the east. There is a convent of Dervishes on the side of the hill over the river, about half a mile out of the town; it is one of the most beautiful situations I ever beheld, being adorned with several waterworks, supplied by an aqueduct that runs through it. On this aqueduct the water runs from the foot of mount Lebanon […] it crosses the valley and river, on an aqueduct of four arches, which is one hundred and thirty paces long: The aqueduct: is seven feet eight inches broad, and serves for a bridge; the two middle arches, which are Gothic, have been probably rebuilt, but the others are fine arches, of a more antic date. The bridge is said to be built, or rather repaired by Godfrey of Bouillon, though it is more probable that it was done by Baldwin king of Jerusalem, 'and upon that account it might have been called the Prince's bridge, for I observed a cross cut on the stones: From these arches the water runs on the south side of the vale by the Dervishes convent. The trade of Tripoli consists chiefly in exporting raw silk to Europe, and the cotton and silk manufactures of Damascus to the different parts of the Levant; they have also a manufacture of soap made with the oil of olives, for which they were formerly more famous than Joppa, though' now the latter has rather the preference" (Pococke, 1745).

In 1799, a British Francis Spilsbury visited the Near East and wrote his memoirs and illustrated them, about Tripoli, he said: **"**Its situation is highly picturesque and romantic; the time-honored summit of Lebanon, towering in sublime grandeur, at its back, while the mountain of Santa Crux presents itself on the left, the town appearing at a distance between the hills. […] On each side of the road are gardens, which for ages have been the scene of stolen amours […] It is scarcely possible to venture among these Elysian shades without encountering strong temptations from the fair beings who haunt them, but, should the helpless lovers be discovered, the frail female would unrelentingly be consigned to the pitiless ocean, and the adventurous swain would also become the victim of Turkish vengeance. The town of Tripoli is fortified at the upper part, by an ancient castle of Gothic architecture, and according to the Turkish fashion, is surrounded by walls with towers at intervening distances. An aqueduct with capacious reservoirs, furnishes water for the public baths, and other ordinary purposes, while a small river, running through the town, turns a number of mills, and plentifully irrigates the gardens of the inhabitants. Over this bridge is a little stone bridge. The baths of Tripoli are extremely neat and commodious" (Spilsbury, 1823).

In 1821, son of a banker Englishmen, John Carne travelled to the East, and published his memoirs with illustration done by W.H. Bartlett, W. Purser and T. Allom who travelled in 1830's to that places. About Tripoli, he said: **"**Tripoli is the prettiest city in Syria, the houses are of stone, well-built and conveniently distributed inside. It is surrounded and adorned with beautiful gardens, which not only mingle with the houses of the city, but extend over the whole plain to the sea. […] Tripoli, richer in gardens and woods that Beirut, more sheltered and healthier than Sidon and Acre, seems to unite all the advantages of convenience, picturesqueness and fertility, to induce the foreigner who seeks health or pleasure, to make it his residence, in reference to any part of Syria. The site of the convent of the Dervishes, on the edge of the Kadeesha, among lemon and olive trees, is charming; it is a retreat from a world of worries, temptations and pleasures, to a world of charming, silent and lonely beauty. Every path on the banks of the Kadeesha is dear to the meditative man, in its windings through the valley one finds seclusion, shade, pastoral life and calm, where thoughts are gently stirred by the murmur of the waters and the Shepard's flute." He mentioned also the towers, the terraces of the houses, the production of soap, silk and sponge (Carne, 1836).

In 1834, the French poet Alphonse de Lamartine stayed few days in Tripoli. A part the elegant description of the hostility of his hosts and the beauty of their house, he said that Tripoli is a lovely town (Lamartine, 1855).

In 1838 and 1839**,** Edouard Blondel lived in the Levant, he was amazed by the perfumes of the trees around Tripoli, he said: “we breathed the fragrant air of orange and lemon orchards in flowers. These trees that cover the entire countryside around the city of Tripoli, reach the greatness and size of our apple trees and our pear trees in Europe. At the time of flowering, the breeze carries its scent several leagues out to the sea. […] Its stone houses, without outward appearance, are not lacking in elegance within. There are several mosques and a Latin convent of the Holy Land. The channels for the flow of water share the middle of the cobbled streets, narrow, and which describe a thousand zigzags. Busy bazaars announce that it must transact important business there. Few towns in Syria can boast of having such pleasant walks as Tripoli; […] Halfway up a mountain, a short distance from the fortress, a delightful esplanade, shaded and adorned with waterfalls, fountains, ponds, introduces us to the Dervishes. From there we kiss a delightful view of the city of Tripoli, its orange tree gardens, El Mina and over all the country comprised between this city and the sea, which merges on the horizon with the clouds” (Blondel, 1840).

In 1840, the French novelist Gustav Flaubert visited the Levant, Lebanon and Tripoli included, about the latest he said: **“**Suddenly we see Tripoli, a white city, stretched in long in the plain”; (Flaubert, 1974). He was more concerned on describing the people of Tripoli, and a part a general description of its color and the green promenade between the main city and the port, he did not mention anything related to its architecture

In 1860, Ernest Louet was in an expedition for the Levant and he wrote about Tripoli: **“**we see before us the magnificent plain of Tripoli: an immense garden where the fertility of the earth maintains an eternal spring. On all sides there are orange and lemon trees, olive trees, mulberies, splendid forest of greenery where one meets all shades of foliage; the city appears far like a white handkerchief carried by the wind in a retreat from this magnificent landscape; the sea frames everything with its immense bluish horizon. This is one of those paintings where creation appears in its entirety and it is impossible to forget. […] In the morning, we walked through the streets and bazaars of Tripoli, a more curious and better built city. than Beirut. The streets are narrow, but clean and fairly regular; the alignment of the constructions is not an empty word. Order reigns in the bazaars: they are divided by nature of products; it is a covered area, where the stalls have a certain coquetry; we gladly stop at the bazaar of the silk, an industry in which Muslims are superior to the Maronites: the silk belts of Tripoli have a reputation in the Orient; carpets to high wool are also an industry of the country, we manufactures in the countryside and it is here that they are sell. In fact of monuments, it is necessary to quote only the mosques and the khans, a kind of very solidly built and very conveniently arranged barracks: they are large square buildings, with interior galleries around a large courtyard, the center of which is occupied by a fountain and a large basin where one water the animals. cavalry squadrons would be perfectly settled in these khans; but while waiting for a garrison to occupy them, traders turned them into commodity stores. […] It is from there (the fortress of Saint Gilles) that you have to admire the city with its white terraces, its domes, its minarets and the delightful gardens that surround it” (Louet, 1862).

In 1869, the French Vicomte, Florimond de Basterot visited Lebanon and Galilee and Rome, he described in Tripoli how the people came to greet the patriarch who was with him on the same boat: “As we approach the anchorage of Tripoli we see the dark greenery of the pine woods, which border the coast, further white city well placed on a hill and dominated by the huge mansion of the Counts of Saint-Gilles. […] Tripoli was at the time of the Crusades one of the main cities of the East. His library was famous and contained, it is said, one hundred thousand volumes (Basterot, 1869)

In 1870, the British Army officer and archaeologist Sir Charles William Wilson was in Lebanon and he visited Tripoli: “With dense olive orchards on the right towards the sea, and fig and mulberry gardens on the left, we ride along the level macadamized road, the white roofs, domes, and minarets of Tripoli gradually rising in the foreground, until our horses' hoofs clatter on the pavement at Bab et Tibbaneh, and we enter this peculiarly Oriental city. It seems a strange and sudden transition to glance from the ancient khans, Muslim tombs, vaulted streets, and crowding throngs of Bedawin and Nusairiyeh cameleers to the brilliantly painted and gilded cars of the Tripoli tramway, which here has its eastern terminus. It is the East and the West in conjunction, the Syria of the past and the Syria of the future. […] On both sides of the river, the city of Tripoli is built. The roaring Kadisha, called by the Muslims Abu Ali, runs through the city, crossed by two stone bridges, besides the new bridge of a tramway farther down the stream. On the right bank, the houses on the hill are chiefly rough structures of the Maronite *fellahin*; those below, between the river and the Bab et Tibbaneh, being Muslim. The Christian quarter is on the left side of the river, and stretching far to the southern Blacksmith's Gate is the populous Muslim quarter. […] the different trades of the city, as in Damascus, occupy separate streets. From a fine fountain five miles south-east of the city, the water of the Zghorta river is brought in an aqueduct, which

crosses the Kadisha a mile from the city on the Kunatir el Brins, or Prince's Arches, a structure dating back to Raymond of Toulouse, Count of Tripoli. The distributing reservoir is a small room below the castle, whose floor is punctured with holes a few inches in diameter, through which the water flows in earthen pipes to all parts of the city. Every house, mosque, and khan has its *sabil* and *birkeh*, in which the water runs constantly day and night, giving a cheerful aspect to the houses, refreshing in summer, but chilling and clamp in the winter. The houses are built of the yellow porous sandstone from the reefs along the seashore, and there are few dry houses in the city. The ground floors are often green with damp and mold, and the entire population, with the exception of the poorer classes, sleep on the second floor. The city is well paved, and many of the streets are arched over, so that, as in Sidon and intramural Beirut, they have the appearance of vaulted tunnels. Over the door of the Hammam el Jedid is a curious stone chain. The keystone of the arch, two arch stones midway down the arch, the huge links of the chain, and a massive stone tassel has ring in the middle, are all carved from one block of stone. Not a few quaint Saracenic arches and doorways can be seen in various parts of the city. Among the objects of interest is the well-preserved castle of Raymond of Toulouse […] Before its conversion into a prison, access could be obtained to the charming view from the top of its walls. On the east you look down into the river gorge, with its roaring waters, the Mullawiyeh Convent, and the orange groves, with snowy Lebanon in the background piercing the clouds. On the west, the verdant plain, the blue sea in the distance, its shore broken by the Mina, or marine city, the northern beach, while the snow-white roofs, walls, domes, and minarets of the city form the foreground at your feet. From a residence of several years in Tripoli, I can testify to the ever-changing beauty of its scenery, the lusciousness of its fruits, as well as the courtesy and hospitality of the better portion of its people. Passing beyond the castle, and descending rapidly into the gorge of the river, you walk for a few minutes among trees and flowers and murmuring waters to the convent of the Mullawiyeh dervishes, who perform their sacred dances every Friday afternoon, at certain seasons of the year […] This charming spot is a' favorite resort of the Tripolitans, and in the month of April, when the orange and lemon groves below and around are in full bloom, and the air filled with the delicious fragrance, this quiet retreat is a place one never wearies of visiting. Between the mouth of the Kadisha, on the northern shore, and El Mina, are several fine towers of cut stone, standing like sentinels along the shore. They are called Burj Ras en Neba, Burj es Seb'a (Lion's Tower), Burj et Takiyeh (Traveller's Rest), Burj el Mugharibeh (Algerines), and Burj esh Sheikh Affan. These are evidently mediaeval structures, and were built on foundations made up of ancient granite columns and fragments of Greek and Roman edifices. They are now being rapidly razed, to supply stone for more modern structures" (Sir Wilson, 1881).

In 1884, Victor Guérin, the French explorer and author of the book: '*La Terre Sainte. Liban, Phénicie, Palestine occidentale et méridionale, Pétra, Sinaï, Egypte'*, said about Tripoli: "Here we go renders from Al Mina by a fine road, where a line of trams has been established for some years. This road is bordered by fertile gardens well-watered and planted with pomegranate trees, fig trees, orange trees lemon trees, apricot trees, and especially mulberry and olive trees, in the middle of which rise intervals of elegant palm trees. Sugar cane also grows there. The city of Tripoli is better built and somewhat better maintained than many other Muslim cities. Its streets are generally lined with sidewalks; many fountains, either public, either private, provide ample water for all the needs of the inhabitants; they are fed, not by the Nahr Kadisha, which crosses the city and which one passes over two bridges, but by a branch canal of Ain-Zgharta. Several bazaars, some covered by simple mats, others by canvases, others finally forming long vaulted stone galleries, with manholes to light them from distance in distance, are abundantly provided not only with the principal necessities to life, but also a host of luxuries, including elegant silks and rich brocades. Various fairly large khans serve as depots for goods. At the entrance to one of these establishments, one notices a beautiful stone chain skillfully shaped in a same and single block cut with art. Some mosques are said to have succeeded old churches Christians. Outside and to the south of Tripoli, rises on an isolated hill, which is the mons Pellegrinus or the Mont Pèlerin from the time of the Crusades, the old castle of Raymond de Toulouse; built with stones of medium size, but regular, it offers an imposing appearance by its gigantic mass and the height of its powerful walls, flanked by slightly pronounced projections. Transformed a few years ago into a prison, it commands the smiling and fertile valley of the Kadisha to the east, in which we see, in the middle of a grove of orange and lemon trees, the Takkiyeh of the dervishes turners or Maoulaouieh. It is in this convent that every Friday, during the summer season, these species of Muslim monks perform their sacred dances" (Guerin, 1884).

In 1892, Miss Louise Marquette, a French lady, had not the chance to visit Tripoli but saw it from the sea, she said: "We are in front of Tripoli (from Syria), but we don't have the time to get down there. We can only look with our telescopes this famous city in antiquity and which was of great importance under the Crusades. That's when Raymond de St-Gilles, Count of Toulouse, he built a castle on Mount Pellegrinus which still partly

survives. On the right, the port of El-Mina; on the left, leaning on the mountain, the city proper. Descriptions that we have read of them make us regret not being able to walk the narrow streets, sunken doors, with balconies in moucharabis, to the resonant cobblestones, on which one seems to hear the resonance of not barded knights of iron." (Marquette, 1892)

In 1895, the Swiss historian Max van Berchem and his friend Edmond Fatio spent two days in Tripoli devoted to Arabic inscriptions, they said: **"**we were able to make only a superficial examination of its monuments, the study of which would require a much longer time. […] The day after our trip, we noted the Italian character of the streets and monuments of Tripoli, and we sought the cause of it is the influence that the rich cities of Italy exerted, during the crusades, on the maritime cities from Syria" (Van Berchem & Fatio, 1914).

In 1909, a German archeologist called Hermann Thiersch wrote his book about minarets and he said about the one of the main mosque in Tripoli: **"**The minaret of the Great Mosque of Tripoli on the Syrian coast has very old massive character. The small top, the way in which the arched windows are set in place, make it closely related to Tunisian forms. The specifically Syrian floor plans, on the other hand, have a preference for the transverse rectangle, they never possess the depth development and the column richness of Riwaks characteristic of Egypt" (Thiersch, 1909).

CONCLUSION

In this research, the narration of 24 travelers from several European countries about the architecture of Tripoli of Lebanon, between 1500 and 1914 were presented. The importance of this data collection is to create a solid historical reference, especially in terms of architectural aspects, for future architects and changemakers who will do intervention in the old core of Tripoli or develop new area of the city. This research closes a gap in the historical knowledge of the city which is one of the pillars of the architectural conservation and renovation.

Many of the mentioned travelers agreed, without being in direct connection between each other or living at the same time, that Tripoli was the prettiest city in all Syria. While others emphasized on the beauty and cleanliness of its streets, many were amazed by its gardens and not few liked its baths. From reading the above-mentioned descriptions, some general aspects of the city of Tripoli can be concluded: 1) It was full of gardens, around the houses and outside the city, mainly planted with orange, citrons, mulberry, palm and sugar cane. 2) The convent of the Dervishes, known actually as Al Takiyya Al Mawlawiya, was kind of 'paradise'. 3) All its houses were coated by white. 4) The skyline was dominated by the minarets and the fortress. 5) It has narrow streets, paved, very clean and many of them were roofed or covered. 6) Its houses were big and water reached them abundantly. 7) All houses, specially before 1860 were not roofed but terraced, they were connected between each other, planted with plants and used during summer season. 8) Its baths were very big, clean and attractive. 9) It had gates but not any defensive wall, external houses were attached one to the other and took the role of the wall. 10) From the part of the sea, the city was protected by six defensive rectangular towers, many of them were not equipped with canons or soldiers. 11) It was a mercantile city, used to produce mainly soaps and silks, and to export herbs and ash to make fine glass.

The importance of this research is not only to collect old facts, but to inspire future generations from the old ones. Because nowadays, in order to limit the warming global effects, changemakers, and everyone can be a changemaker, are finding alternative ways of living inspired by traditional and indigenous pre-industrial practices. Indigenous Knowledge includes understanding how to cope and adapt to environmental variability and trends. Which means that the application of the practices of native people, in the context of modern architecture and urbanism, can help somehow in reducing the negative effects of the present economy. For example, replanting mulberry and citrons around Tripoli will not be a bad idea, or widening the main street that connect the city with Al Mina and planting it with local trees will give rebirth of this Elysian fields praised by a lot of travelers; coating all stone buildings, specifically key monuments, by white clay as it used to be the trend will limit the effects of corrosion and humidity in these structures; painting the houses of the American Quarter with white color instead of colorful and strong colors inspired by Latin American experience will reflect the authentic identity of the city; demolishing the abusive shelters in the center that dwarfed the minarets will regenerate the old skyline aspect of the city; transforming some terraced roofs into coffee shops covered with trees and plants for example and connect them above the streets could be a new concept for the city and its inhabitants; regenerating the area around the Dervishes Convent and the river as a public garden dedicated as well for religious and cultural events will give the city another positive aspect, constructing stone bridges above the river could be a good point specially that stone is returning now as favorite material looking its longevity and environmental effects, especially for low span bridges. Paying more attention to the remaining public

bathhouses in Tripoli and transform them into true tourist spots. It is possible to let the Tripolitans “proud of their fine scenery, their gardens and sparkling waters, their fruits and flowers, their sea and mountain landscape” again as they were in the 19th century as noticed Sir Wilson (Sir Wilson, 1881). It is always important to be aware of the importance of the cultural heritage and to learn from the past, and remind ourselves that new is not always better, and as François de Sales said: "Let's be what we are”.

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IMPLEMENTATION OF SMART TOOLS IN BELGRADE'S TRANSPORTATION SYSTEM: LESSONS FROM COPENHAGEN AND MADRID

Aleksandar Kovacevic

University of Belgrade – Faculty of Political Sciences
MA, PhD Student, Research assistant, aleksandar.kovacevic@fpn.bg.ac.rs

ABSTRACT

Big cities confront several transportation issues, including traffic congestion, air pollution, public transportation, and so on. The most important aspect of any smart city initiative should be smart transportation systems. This system provides people with high-quality, environmentally friendly transportation based on their needs. As a result, the subjects covered in this study are diverse, including transportation models, information technology integration in transportation reform, and the development of environmentally friendly transportation modes. The goal of this research is to examine how digital technologies are used in the transportation systems of Copenhagen and Madrid. The research question for the study is: can digital technology use in transport assist Belgrade in resolving its transportation issues? At the outset of this research, we will provide smart transportation concepts from the cities of Copenhagen and Madrid as a starting point for smart transportation development. These cities' experiences could serve as a model for smart transportation systems. We'll look at a variety of strategy documents and plans that outline the current state of transportation, projected applications of ICT in transportation, and several transportation models that focus on environmental protection and reducing the use of fossil fuels and air pollution. This data should help Belgrade become a smart city in terms of transportation. Belgrade has started to deploy smart mobility solutions, but there is still a lot to learn from other cities that are forerunners in this field. We shall devise the ideal scenario for Belgrade that is best for its people.

Keywords: *digital tools, smart city, smart transport, eco-friendly model of transport, smart mobility*

1. INTRODUCTION

Large cities face a number of difficulties nowadays. The impact of digitization on urban life and its pervasiveness are the biggest problems. So, in this essay, we will talk about the idea of the smart city and its many facets, notably in the area of transportation. Smart mobility, smart urban mobility, sustainable urban mobility, intelligent transportation system, and more terms are used to describe it. According to the most widely used meaning of these phrases, they stand for a crucial element of any smart city endeavour that offers a high-quality, environmentally friendly transportation system based on the demands of the local populace. Social scientists are extremely interested in this specific topic for a number of reasons, including the requirements of these individuals. The broad use of digital and smart instruments in transportation is another feature that sets all smart transport efforts apart. Therefore, the primary goal of this essay is to investigate how Copenhagen and Madrid's transportation systems employ smart digital technology. The research question is: Can digital technologies used in transport assist Belgrade in resolving transportation issues?

2. METHODS

This research is theoretical and belongs to the field of political sciences and the narrowly scientific fields of public administration, local self-government, and public policy. Because of the specific area of our research interest, we can say that this research is multidisciplinary and includes knowledge from different areas beyond

the mentioned scientific field. These different areas are: urban planning, digitalization and artificial intelligence, traffic engineering, economy, law, etc. In this research, we present the most significant scientific literature in this field using a multidisciplinary approach, but our crucial aim is to explain the implementation of these tools according to citizens' needs. In this research, we will use most of the basic scientific methods such as: literature review (analysing smart city projects, articles, and documents), case study, and comparative method. This paper starts with the concept of smart cities and different concepts of smart transportation systems and their implementation in Copenhagen and Madrid. After, we will discuss the possible solution in Belgrade, as one of the youngest smart cities in Europe.

3. SMART CITY CONCEPT

During the times of crisis at the beginning of the 1970s, cities as local governments gained prominence, and it became obvious that rising social issues should be solved locally. Therefore, cities have become important developers of new policies and public practise in the creation of new entrepreneurial institutions, tools, and work techniques (Djordjevic, 2012, p. 173). As important developers of public policies at the local level, cities need to change their role. Some authors highlight the human dimension of the cities. For decades, many urban planners excluded the people from urban planning, and a common feature of almost all cities is that the "people who still use city space in great numbers have been increasingly poorly treated" (Gehl, 2010, p. 3). Urban planners called "modernists" rejected the city and city space and focused on the individual buildings. This ideology became dominant in the 1960s and continued to affect many urban areas in the last five decades (Gehl, 2010, p. 4). It took a lot of time before urban planners understood the importance of human dimensions in urban planning. At the beginning of the new millennium, the majority of the world population became urban rather than rural. The cities' growth is rapid, and human dimensions become the necessary new planning dimensions. That led to four key objectives such as "lively," "safe," "sustainable," and "healthy city" (Gehl, 2010, p. 6). It is hard to find a clear definition of this concept. First, the meaning we give to the world "smart" gives rise to different phrases such as "intelligent city," "knowledge city," "wired city," and "digital city." The second issue is the difficulty in understanding the phrase "smart" (Cocchia, 2014, p. 18). Giffinger et al. (2007, p. 11) identify the six key characteristics of smart cities, such as a smart economy, smart people, smart transportation, a smart environment, and smart living. Dameri (2013, p. 2549) defines "smart city" as "a well-defined geographical area in which high technologies, such as ICT, logistics, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, and intelligent development."

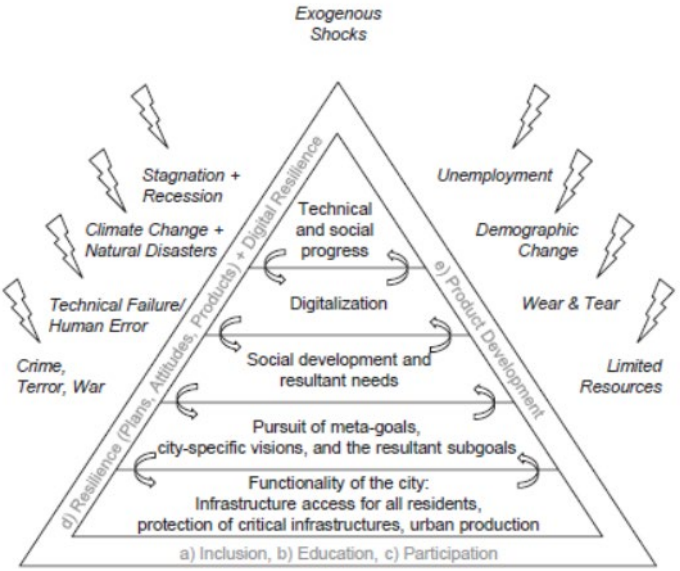

Figure 1: Challenges facing cities. Source: (Etezadzadeh, 2016: 43)

The smart city concept is well connected with the Fourth Industrial Revolution, called the Digital Revolution. It encompasses the use of mobile Internet, low-cost sensors, artificial intelligence, and machine learning (Schwab, 2016, p. 11–12). There are many megatrends that follow the Digital Revolution, but one of the most important is the emergence of the Internet of Things. Haller et al. (2009, p. 15) defined IoT as "a world where physical objects are seamlessly integrated into the information network, and where the physical objects can

become active participants in business processes." People gained smart tools for everyday communication as a result of digitalization, and their entire lives migrated to the internet. But how does digitalization change cities? In Figure 1, you can find the many challenges facing cities as the consequence of digitalization. First of all, cities need infrastructure that is effective and efficient. So, the different fields such as energy, transportation, the security sector, health care, education, etc., will probably undergo radical changes. These changes include the use of data collection points installed in the cities for the purpose of measuring the traffic volume on the streets, the capacities of bus stops, the collection of environmental data from streetlamps, and the fullness of waste containers (Etezadzadeh, 2016, p. 43). These sensors provide the mass of information that needs to be transformed into informative data. Received data could be utilised in different areas, such as optimising water pipe pressure control, bus fleet deployment, the allocation of police patrol cars, and also to promote or enable entrepreneurship, etc. (Etezadzadeh, 2016, p. 44). After collecting and processing the data from different smart sensors, the question about using this data arises. It is precisely the question of how to use this data in relation to the efficient and effective functioning of cities. Digitization thus enables cities to become more transparent, secure, and functional, but at the same time more vulnerable to possible sabotage (Etezadzadeh, 2016, p. 45). So, it is very important to keep track of who has access to this information to prevent it from being used wrongly.

4. SMART TRANSPORTATION SYSTEMS

One of the most important questions at the beginning of our research is: What are the components of the smart city concept? Earlier, we gave some definition of this concept, but we didn't say anything about the crucial characteristic of smart cities. Giffinger et al. (2007, p. 11) found the six key characteristics of smart cities: smart economy, smart people, smart transportation, and smart living. So, now we can claim that the development of smart transportation systems could be one of the important aspects of every smart city project. Various authors said that a smart transportation system lies within the four pillars. The first pillar is shared mobility, which includes carsharing, carpooling, e-hailing, and demand-responsive transportation. The second pillar includes the use of different sensors in cars such as lane assist, automated cruise control, blind spot sensors, etc. that can prevent traffic collisions and increase traffic security. third pillar is electric transportation, which includes the use of electric and hybrid cars (Audouin & Finger, 2019, p. 4). The last pillar is integrated mobility, which entails the merging of two or more separate public or private transportation services for travel purposes. Integrated mobility spawned the idea of mobility as a service, which is described as "a digitally supported distribution model bundling several transport options together and enabling the user to plan their trips, select the transport option that best suits their need, and finally book and pay for it via an app" (Audouin & Finger, 2019, p. 5).

A smart transportation system demands a multidisciplinary approach. As a new concept, there are lots of scientific debates about this concept. Also, it is hard to find the best definition of this phrase, so we need to collect research data from various authors. Garau et al. (2016, p. 36) have noticed a lack of a clear definition of this concept in the literature. Papa and Lauwers (2015, 543) describe this concept as a "buzz phrase in the planning and transport fields in the last decade." There are two stages in the evolution of smart mobility. The first phase is techno-centric smart mobility. This approach has spread since 2000, and it has focused mainly on the technological aspect and provides a vision of smart mobility that can maximise its efficiency through the widespread use of ICT (Papa and Lauwers, 2015, p. 545). The second phase is a consumer-centered aspect of smart mobility characterised by a strong emphasis on the human side. This phase has spread since the second half of the 2000s, and according to it, the human component (Papa and Lauwers, 2015, p. 546). The technology is user-oriented. Its needs are explored over and over again, and user feedback is used to improve digital tools. This definition means that smart urban mobility brings a revolution to previous modes of mobility. Therefore, the emphasis is on the accessibility, efficiency, attractivity, and sustainability of this concept. Smart urban mobility outlives the limitations of traditional transportation systems and brings the alternative modes of transport mentioned earlier in the text. Garau et al. (2015, p. 614–615) talk about six variables: [1] public transport; [2] cycle lanes; [3] bike-sharing; [4] car sharing; [5] private mobility support systems; and [6] a public transport support system. Based on these variables, he created the specific indicators and determinate units listed in Figure 2. The first four variables identify the relation between two units per specific indicator, while the last two use the binary system [yes/no].

The smart mobility concept is directly related to the sustainable urban mobility concept. The European Commission recommends to the member states the adoption and implementation of a Sustainable Urban

Mobility Plan. This plan is a strategic document designed to satisfy the mobility needs of people and business in cities and their surroundings for a better quality of life. SUMP is based on the following principles: [1] Plan for sustainable mobility in the "functional urban area"[1]; [2] Cooperate across institutional boundaries; [3] Involve citizens and stakeholders; [4] Assess current and future performance; [5] define a long-term vision and a clear implementation plan; [6] develop all transport modes in an integrated manner; [7] arrange for monitoring and evaluation; and [8] assure quality (Rupprecht Consult, 2019, p. 9). There is a significant difference between traditional transport (TTP) and sustainable urban mobility planning (SUMP). First of all, while the TTP focuses on traffic, the SUMP focuses on people. Over traffic flow capacity and speed, the SUMP prioritised accessibility and quality of life, including social equality, health and environmental equality, and economic viability. TTP only covers the administrative areas, but SUMP tried to cover a functional urban area based on travel-to-work flows. While TTP demands dominant traffic engineers, the SUMP demands interdisciplinary planning teams. That is well connected with the involvement of stakeholders and citizens in SUMP using a transparent and participatory approach and systematic evaluation of impact to facilitate learning and improvement (Rupprecht Consult, 2019, p. 10).

Variables	*Indicators*	*Specific Indicators*		*Unit*
Public transport	I_{PT}	I_{BND}	Bus network density	km/100km^2
		I_{DPT}	Demand for public transport	passengers per year/inhabitants
		I_{TLC}	Traffic lights centralized	n°/total
Cycle lanes	I_{CL}	I_{CLD}	Cycle lanes density	km/km^2
		I_{CLI}	Cycle lanes for ten thousand inhabitants	km/10.000 inhabitants
Bike sharing	I_{BS}	I_{BSD}	Bicycle station density	n°/km^2
		I_{BPI}	Bicycle per thousand inhabitants	n°/1.000 inhabitants
Car sharing	I_{CS}	I_{CI}	Car for ten thousand inhabitants	n°/10.000 inhabitants
		I_{SI}	Station for ten thousand inhabitants	n°/10.000 inhabitants
Private mobility support system	I_{PMSS}	I_{VMS}	Variable message sign	yes=1,00; no=0,00
		I_{STA}	SMS service for traffic alerts	yes=1,00; no=0,00
		I_{EPPS}	Electronic payment park systems	yes=1,00; no=0,00
		I_{AMD}	Applications for mobile devices	yes=1,00; no=0,00
Public transport support system	I_{PTSS}	I_{EBSS}	Electronic bus stop signs	yes=1,00; no=0,00
		I_{ETPS}	Electronic ticket payment system	yes=1,00; no=0,00
		I_{RSWT}	Information on routes, schedules and waiting times	yes=1,00; no=0,00
		I_{TPC}	Travel planner for the route calculation	yes=1,00; no=0,00
		I_{TTO}	Travel tickets online	yes=1,00; no=0,00

Figure 2: Variables and indicators to evaluate smart mobility Source: (Garau et al, 2015, p. 615)

5. SMART TRANSPORATATION SOLUTION IN COPENHAGEN AND MADRID

This research paper is focused on a case study of Copenhagen and Madrid. These cities are benchmarking by implementing smart solutions in transport and could serve as models for Belgrade's transportation reform. We focus on three different areas in this study: [1] the transportation model; [2] the role of ICT in transportation reform; and [3] different transport modes and projects in transportation reform.

At the beginning, we need to note the status of these cities on the globe. The Smart City Index for 2021 ranked Copenhagen at 7th place, which put it in the first group with the highest Human Development Index (HDI) quartile. Madrid took the 34th place and belongs to the second group in the second HDI quartile (IMD World Competitiveness Center, 2022, p. 9). The Global Liveability Index for 2022 places Copenhagen second, but it also shows some issues in Madrid's liveability because the city is part of a group of the biggest movers down in the last 12 months, placing it 43rd (The Economic Intelligence Unit, 2022). The reasons for these changes could lie in actual pandemic situations.

5.1. The transportation models of Copenhagen and Madrid

The transportation model includes the total share of different modes of transport. In this part, we will examine current trends in observed cities with an accent on planned reforms. The overall share of different modes of transport in Copenhagen is: walking (21%); cycling (28%); public transport (21%); and private cars

1 Functional urban areas are small urban units belonging to the LAU2 category. "It could identify urban cores and use travel-to-work flows to identify hinterlands with highly integrated labour markets with the cores" (OECD, 2013, p. 2);

(30%) (The City of Copenhagen, 2020, p. 3). The city authorities of Copenhagen developed a comprehensive strategy from 2011 to 2025 called Copenhagen, a Cyclist City. To achieve a neutral level of air pollution, Copenhagen has also developed a green mobility package. This package includes [1] urban development: the city is developed and designed in a way that makes green means of transport the first choice; [2] green means of transport: the green transport systems are extended; [3] transport system: the road network is adapted to smooth traffic flow; [4] incentive: the green means of transport are made more attractive by better information and incentives for choosing them; and [5] innovation: the development of transport technology and new concepts makes green growth possible (The City of Copenhagen, 2013, p. 6). In each area, several activities need to be done to achieve better results from the strategy. Thus, in the area of urban development, the adoption of a city plan is envisaged, which implies that the share of transport is made up of a minimum of one third by bicycle, a minimum of one third by public transport, and a maximum of one third by car (The City of Copenhagen, 2013, p. 9).

In 2022, the city of Madrid will adopt the urban mobility strategy called the Madrid 360 Sustainable Mobility Plan. This plan continues the Madrid 360 Environmental Sustainability Strategy with the aim to transform Madrid into a city that is more sustainable from the environmental and mobility points of view, as well as from a social, territorial, and economic standpoint. This Plan combines a traditional policy of the promotion of sustainable mobility (walking, cycling, and public transport) with more innovative strategies based on intermodality and new technologies (Plan de Movilidad Sostenible Madrid 360, p. 15). The city developed a good distribution model based on mobility motivation. They use different travel purpose travel to work, travel by leisure, shopping, studying, health care. By crossing the data from the table, we get the total share of each type of transport in Madrid: walking (34,3%); cycling (0,4%); public transport (35,8%); and private vehicles (29,5%) (Plan de Movilidad Sostenible Madrid 360, 2022, p. 55). Also, this data is comparable with the distribution model by territory. They merge walking and cycling in one category, and the other two categories stay the same. The total amount is about the same, but if we look at the Almendra, there is a big difference. Almendra is the urban core of Madrid and could be defined as a functional urban area. The total amount of active modes of transport (walking and cycling) in this area is 53%; public transport has a 34% share, and private vehicles are below average with 13% of the share (Plan de Movilidad Sostenible Madrid 360, 2022, p. 48). As a result, the Madrid's critical strategic goal is to reduce the number of private vehicles while increasing the number of eco-friendly modes of transportation. From a practical standpoint, we cannot expect Madrid to become a cyclist city in the future, but we can hope that they will find the best scenario for increasing the number of people using this mode of transportation. Environmental Sustainability Strategy quotes two scenarios, one for 2030 and another for 2050, that are divided into two groups: sustainable and extended. Both groups and scenarios talk about the importance of decreasing the share of private vehicles in transport. We will discuss the scenarios for 2030. More realistic is a sustainable scenario with 30% of nonmotorized (walking and cycling) modes of transport in total, 40% of public transport, and 30% of private vehicles. The extended scenario talks about an almost impossible decrease in the total share of private transport at an optimistic 9% (Roadmap to Climate Neutrality by 2050, 2020, p. 27). The crucial aim of this strategy is to become a climate-neutral capital by 2050.

5.2. The role of ICT in transportation reform

The importance of ICT in transportation reform is a second topic. In this topic, we will discuss smart transportation solutions in observed cities. We start with Copenhagen and its development of central units that monitor 360 traffic lights and prioritise buses and bikes, enabling them to move freely (The City of Copenhagen, 2013, p. 19). Also, Copenhagen participates in the EU C-Mobile Initiative to regulate traffic flow. This app provides users with information about the velocity they need to ride a bike or drive to go through the green at the next traffic light. This application gives warnings about the construction zones on our route or slippery roads. The most important feature of this application is its security because the application is hands-free and provides information visually or via audio signals. This project aims to develop safer, more efficient, more sustainable, and economically viable transport in Europe with the minimum environmental impact. This project involves defining a C-ITS (Cooperative Intelligent Transport System) infrastructure that supports various technologies such as mobile internet and wireless internet access in vehicles (802.11p standard) and that allows a large number of citizens to use the advantages of these services (Ferrandez, 2018, p. 1). This project implies cost-benefit analyses. Specifically, we can distinguish the four packages within this project and relate to them the different groups of costs. These packages are: [1] urban efficiency that includes rest time management, motorway parking availability, and urban parking availability; [2] infrastructure for vehicle safety

that includes road work warning, road hazard warning (incl. traffic jams), emergency vehicle warning, and signal violation warning; [3] traffic efficiency that includes green priority, green light optimal speed advisory (GLOSA), dynamic eco-driving, cooperative traffic lights for pedestrians, Flexible infrastructure (HOV, peak-hour lanes), in-vehicle signage (e.g., dynamic speed limit), mode and trip time advice (e.g., by incentives), and probe vehicle data and [4] vehicle-to-vehicle safety that includes emergency brake light, cooperative (adaptive) cruise control (Urban ACC), slow or stationary vehicle warning, motorcycle approaching indication (including other VRUs), and blind spot detection and warning (VRUs) (Mitsakis, 2017, p. Considering the costs and benefits of this system, we can conclude that the short-term costs are high when building infrastructure, but that the extended-term benefits outweigh the costs, and it is more efficient to switch to an intelligent transportation system through the introduction of smart solutions.

The City of Madrid also implemented the intelligent system that maintained the traffic lights. For the creators of the local public policies in Madrid, the traffic regulation at road intersections and for pedestrians has vital importance. In cooperation with the IMESAPI, Madrid developed the system that provides the regulation of the traffic lights, speed control, regulation of the pedestrian crossings, visualisation of the system, etc. Also, they provide services such as traffic management centres, the control of traffic management, and the control of parking in restricted areas such as: public transport stops, bus lanes, intersections, video detection, licence plate recognition, traffic light detection of crossing in red, radars, Automatic Incidence Detection (DAI) systems for tunnels, etc. (imesAPI, 2022). Madrid participated in the C-Roads platform as a joint initiative of EU Member States and road operators for testing and implementing the C-ITS service. This pilot in Madrid called Calle 30 Road will be implemented in two phases called Day 1 and Day 1.5. In the first phase, there will be slow vehicles and traffic ahead warnings, road work warnings, weather conditions, emergency brake lights, speed limits, etc. In the second phase, there is a plan to ensure traffic information and smart routing. These services will be implemented by using hybrid communications technologies (mobile and ITS-G5) with autonomous vehicles that analyse the integration of C-ITS services (C-Roads Spain, 2022).

5.3. Different transport modes and projects in transport reform

The third important factor is the development of various modes of transportation and initiatives in transportation reform. In January 1995, Copenhagen established the first large-scale bike-sharing system in Europe, called Bycyklen. This initiative included 1,000 specially designed bicycles that were placed all around the city at the designated city bike rack [eight at the beginning]. The Bycyklen has continued to operate with more than 2,000 bicycles and 110 city bike racks. This system belongs to the second generation of bike-sharing known as the coin-deposit system. The main components of this system are [1] different bicycles, usually by colour and unique design; [2] designated docking stations in which bikes can be locked, borrowed, and returned; and [3] a small deposit to unlock the bikes (Shaheen et al., 2010, p. 160). This system had significant issues during 2013. The city launched a new CityBike programme in October 2014, developed by using the Internet of Things that included using electric-assisted bikes that have a GPS tracker and tablet computer embedded on the handlebar [Behrendt, 2016, p. 159]. The crucial design study is the Copenhagen wheel for an IoT version of e-bikes called Copenhagen Wheel (Outram, 2009, p. 4). Another important project in Copenhagen is a cycle superhighway called "Commuter Way," where commuters have the highest priority. The first MaaS application in Copenhagen was Car2Go, established in 2014. The second application, Drive Now, appeared a year later. In 2019, both applications merged into Share Now, supported by the EU. Over 500 vehicles from various manufacturers, including Mercedes-Benz, BMW, Mini, Fiat 500, Smart, and electric vehicles, are available via Share Now. Value-seeking, convenience, lifestyle, and sustainability are four motivating patterns identified, while environmental consideration is observed only as a benefit (Schaefers, 2013, p. 73–75).

The city of Madrid established the bike-sharing system called BiciMAD. This system starts operating in 2014. During the first two years, they put 168 into operations. Nowadays, there are 2,964 bicycles, 6,315 anchors, and 264 stations (BiciMAD, 2022). Madrid developed strategies to increase the number of bikes in transportation because the total amount of cycling in the transportation model is low. Also, in Madrid there are the lot of MaaS platforms such as well-known ShareNow since 2015 with a fleet of 950 vehicles, of which 300 have four seats. Madrid has one of the most extensive carsharing platforms in Europe. There are also Free2Move, Wible, Zity, GoTo Global, and Ubequo, in addition to Share Now (Madrid Destino Cultura Turismo, 2022). All of these services have available mobile application. The city has also created the Smart Mobility application, which covers all services that are present in Madrid.

6. SMART TRANSPORT SOLUTIONS IN BELGRADE

Finally, we can discuss how smart transportation solutions will be implemented in Belgrade. In December 2020, Belgrade accepted the SUMP. Belgrade's data varies from that of the other cities in the sample because the city's transportation model contains 49.93 percent public transportation, 24.32 percent passenger cars, 24.25 percent pedestrians, and only 0.75 percent bicycles (Transport Model of Belgrade, 2015). Belgrade has a high proportion of public transportation in total transportation, which is positive. As a result, the development of Belgrade's plan as a bicycle city is now unattainable since it requires a change in the habits of Belgrade's residents. This is a similar situation to what we have in Madrid. However, in recent years, Belgrade's streets have seen an increase in the number of bicycles, particularly in the city's recreational areas. Since the Second World War, Belgrade has not developed a systematic bicycle policy. When authorities anticipated the expansion of this mode of transportation in recreational regions in the 1980s, one attempt was undertaken. The location of Belgrade in a region with a moderate continental climate is advantageous for the growth of this method of transportation. Thus, Belgrade's growth plan envisions a 30 percent overall share of bicycles and walking and the building of 100 kilometres of new cycling pathways (Sustainable Urban Mobility Plan, 2020, p. 57). This plan considers three potential scenarios: the worst-case scenario, which is to do nothing and consequently see a decline in the number of eco-friendly modes of transportation overall; the second, which is to take action in order to stop the spiral of growth and put it into reverse; and the third, which is to see significant increases in eco-friendly modes of transportation over the ensuing years while putting a strong emphasis on changing citizens' habits and behaviours. The City of Belgrade has opted for the third scenario, which implies a complete reform of the transport system with an emphasis on increasing the share of bicycles, walking, a stable share of public transport, and reducing the share of private motorised vehicles in total transport (Sustainable Urban Mobility Plan, 2020: p. 131–133). The Sustainable Mobility Plan gives a vision of the city of Belgrade as an adaptable, sustainable, quality, rational, efficient, and tolerant city. Therefore, the plan assumes an increase in walking (25%), cycling (4%), maintaining a high proportion of public transport (48%), reducing private cars in transport (20%), etc. (Sustainable Urban Mobility Plan, 2020: 137–138).

The City of Belgrade is in the initial phase of implementing smart solutions. The implementation of the park and ride system is one of the peculiarities. The Sava Centre, an international convention, cultural, and economic centre with a variety of multifunctional events, is in close proximity to the park and ride facility. The city centre and other areas of Belgrade are easily accessible to passengers using public transportation. Owners of personalised Belgrade city cards who also own cars are eligible for free use of this facility; however, they must register on the parking service website. Other users can pay for this service via SMS. The disadvantage of this system is that there is no possibility of combining public transport and parking for users who do not own a personalised Belgrade card. A possible solution is the introduction of a smart urban card that can be used for driving, bike rentals, entering museums, etc. Since 2019, Belgrade has included seven electric vehicles called Vrabac in the public transport system in the central pedestrian zone, one of which is adapted for disabled persons. At the end of last year, we started with the creation of the first public bike sharing system. It is planned to build 150 public bike racks and 100 km of bicycle paths (Danas Online, 2021). Belgrade started a park and bike programme that allows riders to pick up a bicycle for use at regular parking prices. This programme is available in six garages and parking lots of the public parking service and means that the user can take a bicycle with a regular parking ticket and return it to the garage after use. It is also crucial to emphasise the development of the so-called "smart traffic lights," a system for adaptive control of traffic lights. Siemens Mobility and the City of Belgrade worked together on this project. In three years, it is intended to build more than 300 intelligent traffic lights. This objective is delayed by the coronavirus pandemic hence the project's completion is not anticipated until 2024. Through sensors, this system gathers information on precisely what is occurring in real time and adjusts to meet the needs of the moment. Accordingly, if there are more automobiles, the green lights will stay on for a longer period of time while the pedestrian traffic lights will remain red until the first pedestrian approaches and activates the traffic signal. This system also favours using public transportation (Srbija Danas, 2021). The inhabitants of Belgrade were outraged by the smart traffic light system. Traffic congestion are brought on by improper use of this mechanism. Citizens' lack of knowledge of the system is one of the main causes of these issues. People frequently touch the pedestrian crossing button, but the green light does not turn on. Then, right when they expect it to, it turns on for automobiles. Additionally, it occasionally happens that drivers do not come close enough to the stop lane for the smart system to recognise the presence of the car. Belgrade should make significant investments in training its citizens to use these sophisticated tools.

The new city administration got off to a fresh start with adjustments to transportation. The mayor suggested outlawing single-occupant car operation during rush hour. Traffic experts think that while this plan may not necessarily be bad, more needs to be done to address other infrastructure issues, such as relocating cars off of the streets and into massive parking structures or charging for vehicle entry into the city centre. The mayor's first plan to reduce air pollution is still a good one, but it is useless to discuss it without good public transportation (Miljuš, 2022). In 2015, the business Car4Use started the first car-sharing programme in Belgrade. At 19 locations throughout the city, they provide 30 Fiat 500s and 30 Fiat Pandas to residents. Although this concept initially received a lot of media coverage, the general public was not very enthusiastic about this form of transportation (Balkan Green Energy News, 2020). Car: Go is a ride-sharing programme available in Belgrade. This Uber-like service for Serbia first launched in 2015 with the express purpose of modernising the Serbian transportation industry. Additionally, a group of people established the association "Car: Go" in 2019 to offer smart mobility in a smart city. Eventually, there will be friction with the taxi business. In order to oppose unfair competition, leaders of the taxi business insisted on a tight licencing process and a cap on the number of taxi licences that might be issued (Kovačević, 2021: 270–271). There are projects in Belgrade to change the city's transportation system with a focus on smart mobility, but the city and its residents still have a lot of work to do to put these innovative ideas into practise. Therefore, the creation of smart transportation in Belgrade necessitates intelligent decision-making with a focus on community involvement.

7. CONSLUSION

A smart city initiative is spreading across the globe. Therefore, the use of smart tools in cities has become unavoidable. The citizens' needs are the most important factor in creating cities, so we shape cities, and cities also shape us. Observed cities in our research are facing almost the same issues, but urban tradition, political regime, and political culture shape their response to actual megatrends. Cities need infrastructure and finance to implement smart solutions. However, cities need smart people and good governance to implement this solution. The observed city should serve as a benchmark for Belgrade. Their good plans and obstacles should help Belgrade find the best scenario for the implementation of smart tools. Belgrade could become a smart city if we decide to be smarter and use our resources in accordance with citizens' needs. Therefore, the academic community needs to cooperate in finding the best solution for our citizens. We need to involve the different stakeholders and citizens and put policies in place to fulfil the citizens' expectations and needs. Belgrade could not become a cyclist city like Copenhagen, but we need to do more to increase the use of bicycles, especially in residential zones. Our advantage is that we have a high proportion of public transportation, but our disadvantage is that we also have a high proportion of private cars transporting one or two passengers. Belgrade must improve its transportation by adopting cars that run on acceptable fuels. Also, we need to encourage people to use carsharing, especially electrical vehicles. If our citizens accept our proposal, maybe we can become the green capital in the nearest future. So, the implementation of the digital tools should help Belgrade solve a lot of problems in transport, and today’s city is not possible without smart tools, smart governance, and smart people.

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GREEN INFRASTRUCTURE - FUNCTIONAL URBAN AREAS, IN A LANDSCAPE CONTEXT

Luka Bajić

Faculty of Agriculture, University of Novi Sad, Serbia
PhD student, luka.bajic@polj.uns.ac.rs

Dragana Čavlović

Faculty of Forestry, University of Belgrade, Serbia
PhD., Research Associate, dragana.cavlovic@sfb.bg.ac.rs

Nevena Vasiljević

Faculty of Forestry, University of Belgrade, Serbia
PhD., Associate Professor, nevena.vasiljevic@sfb.bg.ac.rs

ABSTRACT

The research includes the concept of green infrastructure, as a new planning approach to green networks in urban areas. The paper is based on an approach where, for a given scale, the land use definition is simplified and gives an insight into a certain value of ecosystem services for an urban region. The result is a preliminary land use map, with the goal of further development of the green infrastructure network. Assessment and valuation of ecosystem services regarding land use is a theoretical basis for this research. The database is Copernicus/Urban Atlas, which provides a unique typology of land cover/land use for urban regions in Serbia, as well as in Europe. The applied typology corresponds to theoretical approaches to the classification of the green area in cities, urban-rural fringe areas, and larger vegetation units as parts of the existing landscapes. The ten classes are derived concerning land use and ecosystem services, from "grey" to "green" infrastructure. Additionally, the database precisely defines all other areas (except green areas) and classifies them according to their use, which also enables the evaluation of all other elements following the principles of green infrastructure. In further research, it is possible to define areas that can change their use according to standards and city development needs. This paper explains a fast, widely applicable, and integrated approach to the typology of urban spaces, which enables the assessment of the capacities for the future development of cities.

Keywords: *urban planning; green infrastructure, grey infrastructure, ecosystem services, Urban Atlas, typology of urban spaces*

INTRODUCTION

According to data, over 60% of the land that is expected to become urbanized by 2030 has not been built yet (Jennings et al. 2017). On the other hand, the city form needs to be re-examined in the context of changes in natural processes and the global challenge - climate change. As per projections, European cities will become hotspots for multiple risks of increasing temperatures and extreme heat, floods and droughts. Warming beyond 2°C global warming levels (GWL) is projected to result in widespread impacts on infrastructure, businesses, increased risks for energy supply and transport infrastructure, increases in air conditioning needs and high water demand (VI IPCC report, Bednar-Friedl, 2022). As a response to these assessments, spatial and urban planning in Serbia generally accept development that includes the planning of stable ecological networks, i.e. the modern concept of Green Infrastructure (GI) (Vasiljević, 2012). In addition to the existing natural units and the urban-rural fringe areas, where greater exploitation and tourism are possible, they also include the planning of different types of protective belts, production forests, and large park areas that meet the standards according to size and availability. Visions of development according to the concept of GI imply a system or network of urban green areas connected with elements of urban-rural fringe areas, which would increase the functions of that system. However, rare natural entities in urban areas are

often protected by law as natural assets, which include some restrictive measures for their use. Also, mentioned natural areas are often threatened themselves, and under constant pressure from both informal and formal urbanization.

The loss of the traditional mosaic of urban landscapes is a process that is also recognized in Serbia, therefore as a consequence the problem of this type of landscape, according to the Spatial Plan of the Republic of Serbia (2010 – 2020), is considered to be the disappearance of the specific character of urban and rural landscapes. Also, due to the expansion of peri-urban areas, the conversion of agricultural land is evident, mainly by building and using space that does not respect regional and local specificities. The aim of this paper is to cross-section the conditions and a relationship between the basic land uses - urban, arable, and close to nature/forest, all within the framework of the modern landscape approach to the planning of ecological networks i.e., the concept of GI. The research assumes that there are strong demarcations between dominant uses on a regional scale for urban centers and that in the process of general homogenization of space, data from Copernicus platform (LU/LC) can be utilized for quick and successful definition of the proportion of “green-grey” uses for planning GI for urban functional areas.

With the development of the theory of Green Corridors, urban forestry, and urban green systems, *multifunctionality* became widely accepted as one of the main principles of GI planning (Little, 1990; Ahern, 1999; Beatley, 2000; Konijnendijk, 2003, 2006). Each of these authors suggests that the capability of a multifunctional approach to landscape planning should be integrative at many different scales enabling the delivery of what Konijnendijk et al. (2006) suggest are green elements that fulfil many functions of physical infrastructure. Matthews and Selman (2006) also theorize the benefits of multi-functionality, stating that it has helped to move away from single-purpose spaces to provide a wider range of benefits to a wider target population. The author himself, Davies with colleagues (2006), who proposed a theoretical approach of looking at GI elements through the Grey-green continuum (G-G-C), proposes as the basic spatial elements of GI a wide range of types of "green" and "blue" spaces such as nature reserves, agricultural land, forests, parks, green corridors, gardens, cemeteries, abandoned lands, wetlands and all types of watercourses. Named authors further noted that the main functions of GI should be used to define the concept. In their work, they note that the semantic nature of the term "green" can be viewed along the G-G-C, where the functions of GI cannot be strictly defined due to its interaction with different regional entities, so they propose scaled categories from grey to green, which is the theoretical basis method of this research.

METHOD

Study sites for this research are 14 Functional Urban Areas (FUAs) in Serbia (Figure 1), for which Land Use/Land Cover (LU/LC) data are available in Copernicus’ database Urban Atlas for the year 2018. The FUAs are described as the combination of the city with its commuting zone (Dijkstra et al., 2019). The named database is chosen because the classification is uniform throughout the entire Europe, and the data are freely available, therefore the developed methodology could be widely applied. Initial Urban Atlas Land LU/LC classification is derived from CORINE Land Cover and is composed of 27 classes, of which 26 are present within the research areas. All the classes were further reclassified following the methodology suggested by Bajić et al. (2022), to meet the G-G-C concept of Davies et al. (2006), as presented in Table 1. Furthermore, obtained classes were grouped into 4 categories: Grey, Neutral, Potential green and Green Infrastructure, and the relationship between them was tested with Pearson correlation, using the Past 4.11 software.

RESULTS

Formatting the database, to reach the target values, has its inductive flow in terms of consolidating the image of the urban landscape to emphasize the assumption of demarcation, or could be said dominant land uses. The methodical procedure of preliminary categorization is adapted to the assumption of a non-mosaic urban landscape with unconnected green areas. In this sense, although the data may not be identical to official censuses and records of the classic land survey approach, the methodological approach allows the interpretation of spatial data, where in terms of the scenario character of this research, general conclusions can be drawn deductively on the set topic.

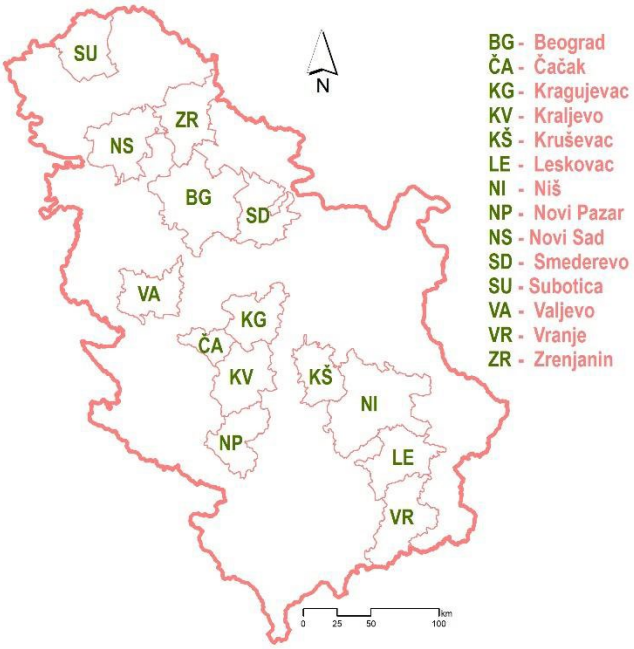

Figure 1: Study sites- Functional Urban Areas

Table 1: Reclassification of LU/LC classes according to the G-G-C concept.

LAND USE	*VALUE*
Continuous urban fabric (S.L. : > 80%)	*I*
Fast transit roads and associated land	*I*
Mineral extraction and dump sites	*I*
Construction sites	*II*
Airports	*II*
Discontinuous dense urban fabric (S.L. : 50% - 80%)	*II*
Industrial, commercial, public, military and private units	*II*
Other roads and associated land	*II*
Port areas	*II*
Railways and associated land	*II*
Discontinuous medium density urban fabric (S.L. : 30% - 50%)	*III*
Discontinuous low density urban fabric (S.L. : 10% - 30%)	*IV*
Discontinuous very low density urban fabric (S.L. : < 10%)	*IV*
Isolated structures	*IV*
Arable land (annual crops)	*V*
Complex and mixed cultivation patterns	*VI*
Land without current use	*VI*
Open spaces with little or no vegetation (beaches, dunes, bare rocks, glaciers)	*VII*
Pastures	*VII*
Sports and leisure facilities	*VII*
Herbaceous vegetation associations (natural grassland, moors...)	*VIII*
Permanent crops (vineyards, fruit trees, olive groves)	*VIII*
Green urban areas	*IX*
Forests	*X*
Wetlands	*X*
Water	*BLUE*

Graphic representation of the results of reclassified LU/LC classes in the context of G-G-C can be seen in Figure 2a. After analyzing the percentage of coverage by G-G-C category, we decided that the first result that should be presented is the *size* of urban cores/built areas in a relation to the whole, urban landscape, that we named *Grey* (Table 2). FUAs of Belgrade, Čačak, and Valjevo, with more than 10% of built-up areas within their boundaries, prominently stand out. They are followed by the FUAs of Novi Sad and Smederevo, with approximate values of around 9%, while the other 9 out of a total of 14 analyzed FUAs have a share of built-up areas of up to 7.5% (Table 2). Concerning the other extreme that we are examining, which is the share of green surface areas in urban units, which refer to the nature or close to nature areas, formal and non-formal urban green areas, and forest land (category *Green Infrastructure*), the distribution is more or less uniform. As many as 6 of the 14 analyzed FUAs have a percentage of surface coverage within these types of land use of more than 40%. Kraljevo (64.98%) and Vranje (59.36%) have extremely high percentages. Other FUAs, according to the category that defines the existing structure of the system of green areas at the level of an urban landscape, can be divided into those that we consider being developed urban centers (Belgrade, Novi Sad, Čačak - values cc 10 %) and the cities in the agricultural area (Subotica - 2.28 % and Zrenjanin - 3.89 %) (Figure 2b).

The two categories that proved to be relevant for the general picture of the analyzed FUAs are those that are located between the mentioned extremes. The difference between them is that the category covering the grade 5 (marked as *Neutral*), includes exclusively intensively used land for agriculture, which is a homogeneous element of the landscape. On the other hand, the category we called *Potential green* (Table 2) includes extensive and intensive production and non-production areas, which are often within smaller plots, so in this analysis, they are representatives of the landscape mosaic, i.e., the urban-rural fringe areas and potential elements of connecting existing green units (category *Green Infrastructure*). Within this category - *Potential green*, the city of Novi Pazar has an extremely high value - of 39.37% (Figure 2b), and the city of Čačak has an extremely low value of 5.72%. All other cities are in the value range of 10 to 20% within the boundaries of FUA.

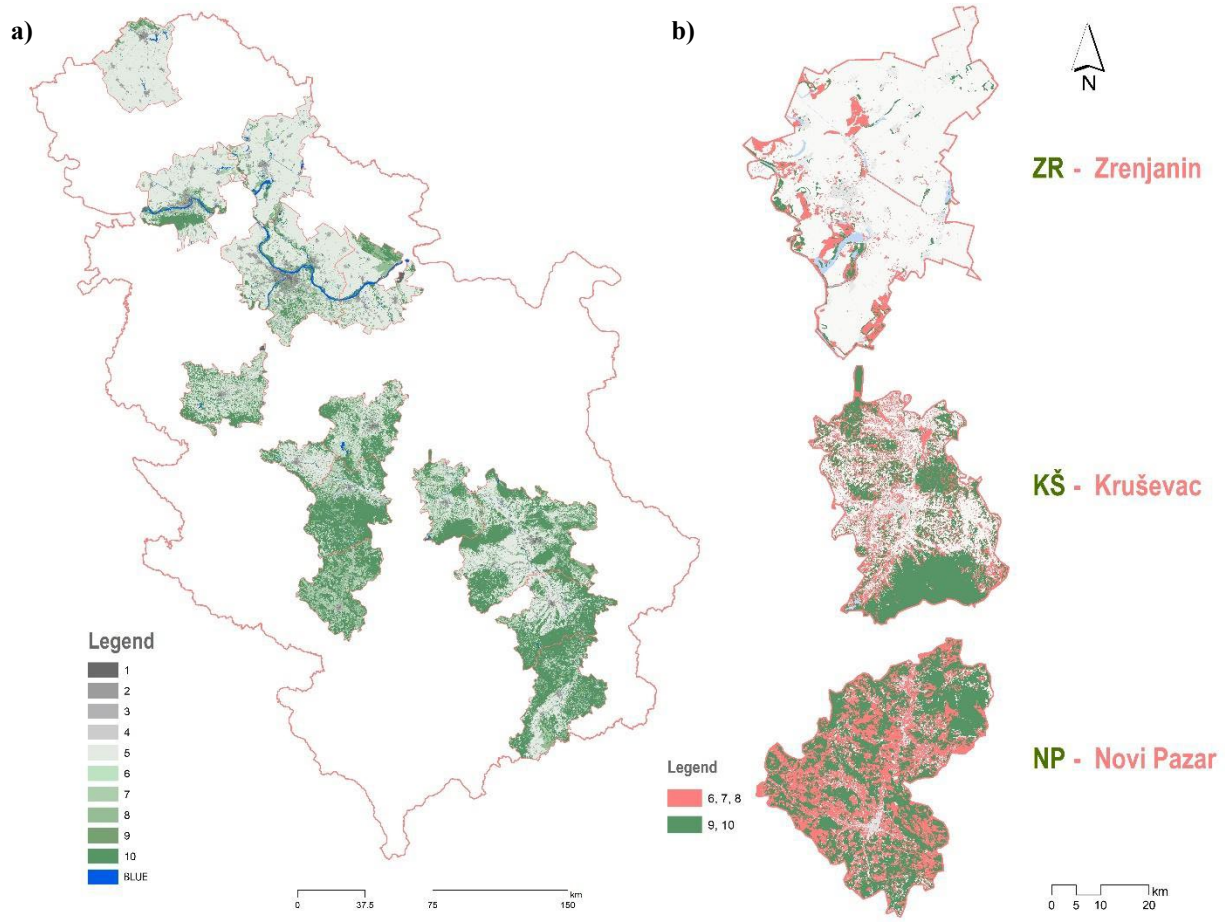

Figure 2: G-G-C plan for: a) Analyzed FUAs in Serbia, b) FUAs of Zrenjanin, Kruševac and Novi Pazar

The analyzed FUAs show a much greater variability of the percentage within the *Neutral* category than in the *Potential green*, which points us out to the diversity of natural entities, within which the analyzed FUAs were created and developed. Extremely high values in the *Neutral* category belong to FUAs in lowland areas with intensive agricultural production, therefore the value for the FUAs of Zrenjanin is 82.34% and for Subotica is 86.33%, while the values are slightly lower for the FUAs of Novi Sad - 65.79% and Smederevo - 66.37%. The principle is clear- all larger urban centers have a larger share of intensive production areas (cc 20-35%), counting the cities with a typical agricultural hinterland in the northern part of Serbia - the province of Vojvodina. As a contrast, FUA of Novi Pazar has, without a doubt, the lowest value within this category, with only 4.67% (Figure 2b).

Table 2: Percentage of coverage by G-G-C category, per FUA (%)

Table	*G-G-C*	*Beograd*	*Čačak*	*Kragujevac*	*Kraljevo*	*Kruševac*	*Leskovac*	*Niš*	*Novi Pazar*	*Novi Sad*	*Smederevo*	*Subotica*	*Valjevo*	*Vranje*	*Zrenjanin*
Grey	*1-4*	*14.82*	*12.99*	*7.31*	*6.04*	*7.12*	*6.74*	*6.46*	*5.07*	*9.71*	*8.92*	*7.44*	*10.39*	*5.04*	*5.41*
Neutral	*5*	*59.19*	*52.83*	*34.43*	*12.95*	*30.99*	*28.87*	*36.31*	*4.67*	*65.79*	*66.37*	*86.33*	*37.45*	*20.36*	*82.34*
Potential green	*6-8*	*14.61*	*5.72*	*18.11*	*16.03*	*22.02*	*10.75*	*14.97*	*39.37*	*11.26*	*12.04*	*3.96*	*19.16*	*15.24*	*8.36*
Green Infrastructure	*9-10*	*11.38*	*28.45*	*40.15*	*64.98*	*39.87*	*53.65*	*42.27*	*50.89*	*13.24*	*12.67*	*2.28*	*33.01*	*59.36*	*3.89*

Strong, negative, statistically significant correlation was found between the *Neutral* and *Green Infrastructure* categories (-0.95), and also between *Neutral* and *Potential Green* categories (-0.72). The only positive correlation was found between *Potential Green* and *Green Infrastructure* categories (0.5), although at the very limit of statistical significance (p=0.058). All other relationships are neither strong (coefficient of correlation is <0.5) nor statistically significant (p>0.05).

The first correlation tells us that, regardless of the values in the *Grey* and *Potential green* categories, a high value for the *Neutral* category is associated with a low value for the *Green Infrastructure* category and vice versa. In other words, according to the presented results, high level of homogenization of urban areas (in the case of Serbia it is intensive production) is accompanied by a reduced share of areas close to nature. The next correlation concerning the presented results is the connection between the categories *Neutral* and *Potential green*, which complements the previous correlation.

It can be concluded that the optimal values for the categories *Neutral* and *Potential green* should be in the ratio of 30%: 20%, within the urban-rural fringe areas, and the city area in general to achieve a certain level of production and development of the city, but also to preserve the areas that would be the carriers of the GI of the city. If we assume that the ideal relationship between all the categories is 10%: 30%: 20%: 40% (*Grey, Neutral, Potential green* and *Green Infrastructure* respectively), which must be taken conditionally for many reasons, it can serve well as a basic test, or the basis, for further analysis in the relation to different types of landscape. In this research, FUA of Kruševac has the ratio closest to the proposed (Table 2, Figure 2b). Likewise, it can serve as an evaluation criterion, primarily for the availability and connectivity of green areas in the categories *Potential green* and *Green Infrastructure* towards the formation of a network of GI in the urban landscape.

DISCUSSION

Lowenthal (1997), at the end of the last century, believes that the nature of the urban-rural fringe areas is a "rural remnant" because there was a fundamental disconnection between the structure of the landscape and the processes that shaped that landscape. The idea of sustainability can be interpreted in two ways (Antrop, 2006). First, the idea may refer to the preservation of certain types of landscapes or values, and second, the idea could refer to sustainability as the main principle of future planning. In this case, the concept refers to potential landscapes that have to improve sustainability, especially in the planning and management of marginal zones, which is the aim of this research.

The effects of climate change on biodiversity make the concept of Ecological Networks particularly relevant (Schweiger, 2014). The role of habitat connectivity because of climate change remains to be clarified. Today, the prevailing opinion is that facing increasingly extreme weather conditions, habitat connectivity is a prerequisite for maintaining biodiversity (CBD, 2003; Opdam and Vascher 2004; Ssymank et al. 2006). Identifying, promoting, and preserving a strategically planned GI network has become a priority for the planning and decision-making process in sectors such as conservation, resource (land) efficiency, agriculture, forestry, and urban development (Liquete et al. 2015). The same authors propose a methodology that can be used to identify and map GI elements at the landscape level based on the concepts of ecological connectivity, ecosystem multifunctionality, and maximizing benefits for both humans and nature conservation and protection. However, to reach this level of analysis, it is necessary to determine the existing state and structure of land use on the landscape scale and provide a preliminary model of GI.

The theoretical and practical basis of the quantitative approach is, as stated, the principle/concept of the G-G-C according to the author Davis and colleagues 2006. The concept in question provides a generalized diversification of space according to the GI concept, regardless of whether we look at space through GI functions or the theory of Ecosystem services. Although there is no criterion basis for why one use deserves a better rating in terms of providing nature and ecosystem services, the concept includes the first and basic principle of the GI concept, which is the comprehensive application of the concept to different uses and in this sense the nuances and connection of potential elements of the GI network into one system. Perhaps incomprehensible within the G-G-C, there is also the basic principle of the GI concept, which is multi-functionality, applied to the urban landscape, regardless of whether it is the surface of the polluter or the surface of the city park. In this sense, although multi-functionality is the quantitative carrier of the concept, it must still be articulated theoretically and practically through evaluation criteria, certainly the connectivity of elements.

It is considered that each Case Study according to the GI concept tends to use and apply its principles toward the desired state, while the obtained general conclusions do not contribute to a better theoretical structuring of the concept. However, the proposed analyses do not directly include the existing theoretical patterns (they even partially verify them through an application) but return to the basic assumptions of regional planning. The general approach can be considered an innovation, which is that regardless of the richness of the existing natural units, in their

protection it is necessary to think about the development of planning solutions, which will preserve those values, considering the forecasts of urbanization, by using other potential locations. The work certainly implies a principally adaptive approach to landscape design, and practically realizes the possibility of further examination of different development scenarios.

CONCLUSION

Green infrastructure, as a landscape approach to urban environments, usually looks at the relationships in the network of greenery on a larger scale as something that is in the city and something that belongs to the periphery, the outer zone of the city. Priority is given in this paper to the edge zone of the city and the analysis does not take into account the existing potential of natural areas, which by themselves cannot forever have the carrying capacity of the future network, especially in collision with urbanization. In this regard, the separated elements must have a certain level of multi-functionality, which is partly ensured by looking at one version of the network of each administrative unit, and a comparative analysis defined more precisely the possibility of GI planning for urban areas on the territory of the Republic of Serbia. This research concludes that high level of homogenization of urban areas (in the case of Serbia it is intensive production) is accompanied by a reduced share of areas close to nature. If the ideal relationship between *Grey, Neutral, Potential green* and *Green Infrastructure* is 10%: 30%: 20%: 40% (respectively), which must be taken conditionally, the analysis described in this paper can serve well as a "rapid test", further as an evaluation criterion for the availability and connectivity of green areas in the categories *Potential green* and *Green Infrastructure* towards the formation of a network of GI in a urban landscape.

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OUTDOOR THERMAL COMFORT AS AN INDICATOR OF THE "BELGRADE GREEN CITY" CONCEPT - ADVANTAGES AND APPLICATIONS

Milica Lukić

Faculty of Geography, University of Belgrade, Serbia
MSc, Researcher Associate, micalukic92@yahoo.com

Ana Lukić

Roads of Serbia Public Enterprise, Serbia
MSc, IT engineer - database administrator, analukic48@gmail.com

ABSTRACT

The main goal of this research is to present outdoor thermal comfort (OTC) as one of the criteria and instruments for creating a more efficient urban planning policy, with the aim of mitigating the effects of climate change. Also, the idea is that the application of various indices that determine OTC can contribute to the improvement of the urban planning methodology. Belgrade's vision is to become a "green city", and one of the dominant features of green cities is that the bioclimatic conditions of the urban environment are favorable for people's life and work. This aspiration was formally confirmed in 2018 when Belgrade became part of the large international project "EBRD Green Cities", but also with the adoption of the "Green City Action Plan of Belgrade" in 2021. However, while there is a clear aspiration, achieving this goal will be very challenging. First, due to climate change, Serbia's climate is characterized by a warming trend since 1980, which is confirmed by many scientists. In recent years, summer anomalies, extreme weather conditions, and intense heat-waves are becoming more frequent, which results in increasingly unfavorable OTC. On the other hand, construction in Belgrade has significantly intensified (in the period 2016-2020 the number of annually built apartments increased by 70%), while the central city area is markedly deficient in greenery, and public green areas cover only 2.83% of the total territory. OTC, that can help us in understanding these problems, but also in solving them, is not yet recognized in domestic urban planning practice.

Keywords: outdoor thermal comfort, indicator, Belgrade Green City, urban planning

1. INTRODUCTION

Due to rapid, uncontrolled and unplanned urbanization that has affected many parts of the world, there has been a dramatic transformation of the morphological structure of cities (Brilhante and Klaas, 2018; Cetin, 2019). Unbridled urbanization has eradicated green cover in many cities and intensified the vulnerability to climate change (Sharmin and Steemers, 2018). Growing urbanization poses a threat to people, but also to biodiversity and vulnerable terrestrial ecosystems (Marselle et al., 2020).

During the last 30 years, as a result of the numerous economic, political, and social turmoils that shook the Republic of Serbia, similar transformations in the biggest urban areas took place in our country as well. The landscape of Belgrade has completely changed in recent decades, and in the same period, the impact of climate change on the city microclimate becomes increasingly pronounced. Extreme weather conditions such as extreme temperatures, longer and more intense heat-waves (Lukić and Milovanović, 2020; Lukić et al., 2021; Pecelj et al., 2021), and more pronounced urban heat islands enhanced by urbanization, call into question the quality of life in the Serbian capital. A higher heat load results in more health risks in the general population but also results in higher consumption of energy resources (Cetin, 2019). All of this puts an additional burden on the economic and social stability of underdeveloped countries such as Serbia.

After the 2000s, climate change issues were placed at the center of the discussion on sustainable development and urban sustainability (Brilhante and Klaas, 2018). It is clear that we cannot talk about sustainable urban development if we do not deal with the issue of how climate change affects the daily life of citizens. If citizens do not feel comfortable or their health is threatened when they are in the outdoor environment, then we can say that there is a direct impact on the human population. The purpose of each modern, democratic and conscientious community should be to create a space that will be tailored to all residents, a high-performance city that will be able to meet the needs of citizens. A city with a preserved environment rich in biodiversity and greenery, a city that provides support for the improvement of public health, wellbeing and safety (Lukić et al., 2021). All of this ultimately leads to high standards of life quality, which is impossible to expect if sufficient attention is not paid to outdoor thermal comfort which influences permeate a number of sectors of social life.

In order to better understand what thermal comfort represents, we will provide a definition by the ASHRAE Standard 55 (2020), where thermal comfort is the "*condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation*". Thermal comfort (whether outdoor or indoor) can have a more or less pronounced impact on the work performance of employees, the health of the general population, quality of life, living conditions, etc. (Lukić et al., 2021; Pecelj et al., 2021).

During the stay in the outdoor environment, the human body is exposed to various influences, and some of the most significant are microclimatic conditions. Outdoor thermal comfort (OTC) is not only affected by climatic parameters, but also is directly and indirectly affected by anthropogenic factors such as intensive urbanization, high population density, industry, large infrastructure corridors and commercial zones, lack of public and other green areas, air pollution (aerosols, GHG), etc. According to Tsoka et al. (2017) the progressive modification of the morphological characteristics of urban areas, i.e. the expansion of zones dominated by artificial materials such as glass, steel and concrete at the expense of natural materials and surfaces, leads to the accumulation of a large amount of heat energy. All these factors together contribute to the formation of what we call the "urban heat island" (UHI), and the air temperature of the urban area is almost always higher than that recorded in the surrounding semi-urban and rural areas (Gunawardena et al., 2017).

The main goal of this research is to present outdoor thermal comfort as one of the instruments for creating sustainable urban planning policy, as well as a tool for achieving the Belgrade green city concept. Microclimatic characteristics and OTC should be taken into account more in urban planning, which is currently not the case in the urban practice of Belgrade. The perception of city development must change from planning to meet the needs of investors and the construction sector to meeting the needs of the general population.

2. URBAN DEVELOPMENT OF BELGRADE IN THE PAST DECADE - GENERAL CHARACTERISTICS

The urban development of the Serbian capital in past years can be simply described as an example of intensive urbanization. Conversion of green areas into residential, commercial and mixed city center zones and increasingly dense construction both in new and existing parts of the city. As the number of active construction sites has never been higher, Belgrade rightly bears the epithet of the largest construction site in Europe (Mitić-Radulović et al., 2022). Construction in Belgrade has significantly intensified in recent years: 30% of all construction works performed in Serbia in 2020 were performed in Belgrade, from 2016 to 2020, the number of apartments built per year increased by 70%, the annual value of construction work performed increased by 105%, and the number of square meters of high-rise buildings built per year increased by as much as 350% (Mitić-Radulović et al., 2022a, 2022b). On the other hand, green areas cover 12.38% of Belgrade and are characterized by unfavorable territorial redistribution. The largest green areas are city forests, which are located outside the city and cover 9.55% of the total territory. The central city area is markedly deficient in greenery, and public green areas cover only 2.83% (Mitić-Radulović et al., 2022a, 2022b).

3. THE INTERRELATIONSHIP BETWEEN URBAN GREENERY AND THERMAL COMFORT AND THEIR IMPORTANCE IN URBAN PLANNING

3.1. Why is greenery so important for the urban development and where is the link with OTC?

Urban greenery includes a wide range of shapes and formations from urban forests, parks, street trees, verges, public gardens, fringes of transport corridors, green roofs and facades (Gunawardena et al., 2017).

Urban greenery and various types of green infrastructure can improve the urban microclimate: lower summer temperatures up to 3-4°C, mitigate climatic extremes, mitigate excessive insolation and strong winds, regulate

air humidity, etc (Filipović and Đurđić, 2008). Abdollahzadeh and Bilori in their research (2021) came to the result that greenery and trees especially can increase specific humidity up to 0.56g/kg and improve the thermal comfort of the surrounding area. In addition, the average mean radiant temperature will decrease between 1.32°C and 1.49°C by using dense and sparse tree-planting options. Furthermore, greenery provides diverse ecosystem services to the urban environment including reduced surface runoff, flood relief, and sustainable drainage (Gunawardena et al., 2017). Trees, green roofs, and lawns reduce the amount of particulate pollution and retain dust particles (Stošić-Mihajlović et al., 2017). It also reduces CO_2 and other GHGs emissions (Lalošević et al., 2018), which means that it not only helps fight climate change, but also improves air quality.

Apart from this, urban green areas also have a pronounced health function. There are more and more studies that show that greenery in the city reduces depression and anxiety, which became very evident in the context of the Covid 19 pandemic, and being in the park began to be officially used for health purposes: for the treatment of diabetes, high blood pressure, ADHD- a, depression, etc. (Angel et al., 2021). Marselle et al. (2020) have found a lower rate of antidepressant prescriptions for people living within 100 m of higher density of street trees.

3.2. Is the OTC really that important for urban planning and how can it be explained in the easiest way?

In domestic urban planning practice, OTC is not considered to a sufficient extent, which is confirmed by the situation on the ground. All the pressure is concentrated on the maximum number of square meters that will be built, and how people feel in that environment is left aside. Urban planning is becoming more and more challenging. The accumulated problems of polluted environment, climate change, degraded urban biodiversit, etc., are becoming bigger and more difficult to control and solve. Every year we witness extreme weather conditions, temperature records, and severe heat waves that especially affect urban areas. However, completely unjustifiably, in Serbian urban planning practice, the issue of microclimate is discussed only declaratively, and more serious research into thermal comfort is absent. Given that the city is a “living organism” and that its physiognomy is constantly changing due to urbanization, it is highly likely that the microclimate and OTC of Belgrade will change over time and become even more unfavorable.

How important thermal comfort can be in urban planning is perhaps the easiest to explain with an example of "health care facilities zones", i.e. parts of the city where hospitals, maternity wards, clinical centers, etc., are located. Obradović-Arsić (2014) in her book entitled "*Medical-geographical factors in planning and protection of space*" dealt with this very topic. She states that the planning of such urban zones requires the functional integration of both climatic and urban aspects in order to regulate extreme values of meteorological parameters. If it is not approached in an adequate way, unfavorable OTC can significantly burden the recovery of users of health institutions (Obradović-Arsić, 2014). It is not rare that in Belgrade, patients of the largest health facilities complain about inadequate living conditions, especially in the summer period, during heat waves. All this is additionally influeced by the lack of green areas in the immediate surroundings. The same author further states that OTC is an equally important indicator in the planning of school zones, kindergartens, sports centers and playgrounds, residential, industrial and work zones, etc.

4. OTC, URBAN MICROCLIMATE AND BELGRADE GREEN CITY

4.1. Green City Action Plan of Belgrade (GCAP)

In light of climate change and other global threats, it is necessary to find an adequate response that will minimize the negative impacts, establish the sustainability of urban environments, preserve nature and improve the living conditions in cities (Lukić, Burazerović, 2020). One of the urban planning models that offer mechanisms for solving the mentioned problems is the concept of “*Green cities*”. The green city concept is one of the latest potential solutions to the problems caused by dispersed urban development, as well as an instrument for creating more sustainable, greener, and more livable urban areas (Brilhante and Klaas, 2018).

Encouraged by this, the European Bank for Reconstruction and Development (EBRD) launched a new international project “*EBRD Green Cities*”, and in 2016 it presented the “*Green Cities Program Methodology”*. The “*EBRD Green Cities*” project provides cities with the tools necessary to make substantial, positive improvements in their environmental performance and to establish important, globally adaptable solutions to increasingly prevalent environmental challenges. The program presents the definition of green cities, and part of the definition coincides with the topic of this paper, which we can conclude based on the following: ...*green city is a city that shows high environmental performance in relation to established criteria in terms of mitigating*

and adapting to risks arising from climate change... (Green Cities Programme Methodology, 2016). Today, this project covers more than 40 cities of the world, among which is Belgrade.

Belgrade has recognized the advantages and opportunities offered by the concept of "green cities", and thanks to this, it became part of this project in August 2018. Three years later, in June 2021, the "*Green City Action Plan for the City of Belgrade (GCAP)"* was adopted by the Assembly of the City of Belgrade. It is this document that confirms all the problems of inadequate urban development that Belgrade has been experiencing in recent decades. The key problems that have been singled out connected to this topic are:

- Uncontrolled urban growth in many cases happens at the expense of green areas.
- The park and recreation zone network requires improvements. The few large recreation zones that exist are not enough for many residents for daily use.
- A range of climate hazards was identified including, heat-waves, extreme weather, and flooding present the highest risks to Belgrade.
- The population has a low adaptive capacity and high sensitivity to climate (in particular the elderly, infants and children, people with mobility impairments, chronic illnesses, etc.).

The adoption of this plan, as well as the clear identification of existing problems and the definition of activities that could lead to a solution, represents an important step forward. What the next period will show is how much the City of Belgrade is really ready to tackle the above-mentioned problems and whether we have the necessary knowledge and capacities.

In the next chapter, we will present examples of how OTC can help and support the implementation of this project.

4.2. How OTC can support establishing Belgrade Green City and sustainable urban planning?

It is unjustified and irrational to expect that the expansion of cities will stop so easily, and the current trend is that the population of the largest metropolises is increasing year after year. UN estimates are that by 2050, 66% of the world's population will live in cities. While we await the results of the new Population Census of the Republic of Serbia, which will be held in October 2022, according to existing estimates, around 25% of the total population lives just in Belgrade (Statistical Office of the RS, 2022). At the same time, the increase in mean, minimum, and maximum temperature values, which leads to further changes in environmental conditions, is a new reality to which we must adapt. Practically every year, we have more and more citizens who live in a relatively small space, who consume more and more energy and create more and more pressure on the environment. Also local authorities in Belgrade just declaratively promote urban greening and sustainable development, and a significant discrepancy between policies and practice is obvious, as stated by Mitić-Radulović and Lalović (2021).

When we talk about the discrepancy between the policies and practices of Belgrade's urban development, it is interesting to point out that Belgrade has been unsuccessfully applying for the European Green Capital Award (EGCA) for several years now (Pantić and Milijić, 2021), while at the same time many call it the largest construction site in Europe (Mitić-Radulović et al., 2022a,b). Part of the process of adapting and responding to this new conditions in which we live is a change in the paradigm of urban planning.

What do the results of previous research on OTC and the urban microclimate in Belgrade show? Pecelj et al. (2021) presented general temporal bioclimatic conditions in Belgrade for the period 1976 to 2018. During the period of 43 years covered by this research, it registered a positive trend and the increase in the value of each index bioclimatic, increase in subjective thermal stress and thermal discomfort in Belgrade. This confirms the findings of other authors who found that average temperatures have recorded a constant increase since the 1980s. According to Unkašević et al. (2005) the average summer temperature at Belgrade increases at the rate of 0.1316◦C/year. Except during the summer period, the rise in temperatures is also recorded in other parts of the year. For instance, in Belgrade, the average spring temperature has a positive trend of 1.32◦C/100years, while the minimum spring temperature has a positive trend of 1.92◦C/100years. The average autumn temperature has a positive trend of 0.74◦C/100years. Further, the minimum winter temperature in Belgrade has a positive trend of 2.97◦C/100years (Đorđević, 2008). Lukić and others (2021) dealt with the evaluation of OTC in Belgrade during different seasons in the period 1999-2018. They have used UTCI (Universal Thermal Climate Index) to assess outdoor thermal comfort. Findings show the presence of a growing trend in seasonal UTCI anomalies, especially during summer and spring. In addition, there is a notable increase

in the number of days above the defined UTCI thresholds for each season. Average annual UTCIs values also show a positive, rising trend, ranging from 0.50◦C to 1.33◦C. A significant occurrence of thermal heat stress was registered especially during summer which makes this part of the year bioclimatically the most unfavorable.

What tools can we use to get applicable OTC data and how to apply them? Part of urban planners, spatial planners, and policymakers who act and think in a progressive manner is engaged in the development of new urban development strategies that combine urban planning, land use, and urban climate. In our country, as we have already stated, the approach to urban climate and outdoor thermal comfort air is very superficial, and it is mostly dealt with by a small number of people who come from narrow scientific and academic circles. The profession remains rather rigid and insufficiently motivated to engage in rethinking the existing way of city planning. Nevertheless, under the influence of global and local pressures, as well as the awareness of the group of experts and decision-makers, the GCAP of Belgrade was recently adopted, as well as a set of other plans and strategies dealing with the sustainable development of Serbian capital. As we could already conclude, the green city concept does not only mean the introduction of green infrastructure but the formation of a city resistant to climate change, a city that successfully fights existing environmental and social problems, and a city that supports public health. However, the link between land use and OTC is still missing (generally).

Prevention is the best solution, which means that with adequate planning and bioclimatic design of urban districts, the occurrence of UHI and unfavorable OTC can be prevented in advance. Tapias and Schmitt (2014) emphasize that the integration of microclimate data into the creation of new urban forms using outdoor thermal comfort as an indicator is a way to establish resilient and sustainable neighborhoods. So what to do with already built urban zones? Is it possible to influence the improvement of thermal comfort in such areas as well? Nikolopoulou et al. (2001) state that it is possible to regulate thermal comfort even in cases of already built urban fabrics. As an example, they highlight the shading of entire streets using trees, with the advantage of cooling through evapotranspiration through leaves, but also other types of vegetation that can be applied. Emmanuel and Loconsole (2015) conducted a survey in the Glasgow area which showed that an increase in greenspace of 20% above the current level could eliminate between a third and a half of the city's expected UHI effect in 2050.

Of course, it is not enough to raise greenery by itself but to first perform analyzes and assessments of locations that have the most unfavorable OTC and the most pronounced UHI. For that, we need continuous micrometeorological measurements at different locations, as well as the use of modern technologies and software. This is where GIS and various software intended for bioclimatic research such as ENVI-Met stand out. ENVI-Met is one of the most widely recognized software for urban climate modelling. This software allows the investigation of the effects of urban planning and architecture on outdoor microclimate through various simulations (Madeco Alves et al., 2022). This methodology has been applied in different cities worldwide and has produced quality and applicable results: Valladolid (Spain) study by Madeco Alves et al. in 2022; Nanjing (China) study by Rui et al. in 2019; Cairo (Egypt) study by Fahmy and Sharples in 2009; Netherlands study by Taleghani et al. in 2015; Sao Paolo (Brazil) study by Carfan et al. in 2012; Hanover (Germany) study by Forouzandeh in 2021, Sydney (Australia) study by Abdollahzadeh and Bilori in 2021, Xi'an (Northwest China) study by Huang et al. in 2016, etc. In the case of the city of Belgrade, this model was applied by Lalošević et al. in 2015 when they investigated the role of green roofs in urban heat island mitigation (4 locations - parts of the territories of the municipalities of New Belgrade, Vračar, Stari grad, and Zemun). Another example is the use of GIS tools - Cetin in 2019 have created thermal perception maps of Bursa city (Turkey) by using ArcView GIS^{TM} 10 and meteorological data (average wind speed, temperature and relative humidity values). In addition to these, there are other different software designed for bioclimatic research, the application of which is very common in scientific research, such as RayMan and Bioklima software. All this includes the use of various thermophysiological and bioclimatic indices, among which PET (Physiological Equivalent Temperature) and UTCI are the most commonly used (Universal Thermal Climate Index) (Abdollahzadeh and Bilori, 2021; Lukić, 2019; Lukić and Milovanović, 2020; Lukić et al., 2021; Pecelj et al., 2021; Tapias and Schmitt, 2014; Huang et al., 2016; Zhang et al., 2020).

5. CONCLUSION

The main aim of this article is to present OTC as one of the instruments for improving urban planning policy in Serbia, with a focus on mitigating the effects of climate change. Belgrade was chosen for the case study, as the largest urban area in Serbia, with the largest number of inhabitants and the highest population density, far above the national average. Also, the most pronounced urban heat island has been identified in

Belgrade so far, as well as a significant difference in the temperature of the central and semi-urban parts of the city. In addition to climate change, UHI has additionally intensified by high concentrations of polluting particles and aerosols, which often puts Belgrade at the very top of the world's most polluted cities. On top of all that, in recent decades, Belgrade has been facing rapid, often uncontrolled and unplanned urbanization. As we mentioned, the pressure from investors, capitalism and the construction business is tremendous: 30% of all construction works performed in Serbia in 2020 were performed in Belgrade, from 2016 to 2020, the number of apartments built per year increased by 70%, the annual value of construction work performed increased by 105%, and the number of square meters of high-rise buildings built per year increased by as much as 350%.

At the same time, citizens' dissatisfaction is growing. Polluted environment, lack of public green areas, and harmful projects that violate the public interest are becoming the new realities. City authorities only declaratively deal with sustainable development, while in practice hardly anything is achieved.

New hope was brought by the adoption of the Green City Action Plan of Belgradeas well as other documents covered by the "green regulation". Considering the accumulated problems, it is clear that the existing urban planning practice must be revised and improved with new methods that will allow a better understanding of the circumstances in which we are now. In order to achieve the set goals - the realization of the Belgrade green city concept and and eventually winning European Green Capital Award, the perception of the role and interaction of greenery, thermal comfort and urban microclimate on the quality of life must change.

OTC can help us in many ways to understand more easily and better how climate change affects the urban microclimate, and how it influences the general population. Indicators used to assess thermal comfort, such as various bioclimatic and thermophysiological indices, can help us to more efficiently locate UHIs, and to understand their impact on the mental and physical health of citizens. Various software tools used in bioclimatic research can be used in initial research when creating urban planning documentation. Thermal perception maps can be part of the regular graphic attachments that we meet in urban plans. All of this together can help us plan more adequately and sustainably the spatial layout of green areas, work and business zones, zones where health care and education facilities are located, sports and recreational zones, etc. In this way, one day we will really be able to say that Belgrade has become a green city.

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TRANSIT ORIENTED DEVELOPMENT (TOD) AND INTELLIGENT RAILWAY SAFETY SOLUTIONS - POSSIBILITIES AND BENEFITS OF IMPLEMENTATION

Ljiljana Vasilevska

Faculty of Civil Engineering and Architecture Univeristy of Niš, Serbia
PhD., Full Professor, ljiljana.vasilevska@gaf.ni.ac.rs

Ivana Bogdanović Protić

Faculty of Civil Engineering and Architecture Univeristy of Niš, Serbia
PhD., Associate Professor, ivana.bogdanovic@gaf.ni.ac.rs

Magdalena Slavković

Faculty of Civil Engineering and Architecture Univeristy of Niš, Serbia
MSc, Teaching Assistant, magdalena.vasilevska@gaf.ni.ac.rs

ABSTRACT

Transit Oriented Development (TOD) is one of the current urban planning concepts and strategy of urban development that maximizes the amount of residential, business and recreation space within walking distance of public transport, promoting compact urban fabric, mix-use and public transport. In that sence, TOD typically includes a central transit stop such as train or light rail station as a focal point of physical and functional development of the community. Since technical solutions are very significant for the efficiency of the organization of railway, as well as the quality of urban life, the application of new technologies is imposed as an imperative. Future trends in transportation will enable a range of applications such as traffic flow analysis, smart traffic management, violation detection, driverless vehicles, etc. Advantech offers a range of onboard train solutions with sensing, diagnostics, and wireless capabilities. They provide full scalability and future-proof, rolling stock, wayside, signal, power, obstacle detection, and data collection capabilities. Apart from the analysis of the basic features of TOD and the overview of the future transportation trends, the focus of this paper is on the intelligent railway safety solutions and exploration of the possibilities and benefits of their implementation within a broader urban planning approach such as TOD.

Keywords: *Transit Oriented Development (TOD); future transportation trends; intelligent railway safety solution; implementation; benefits*

1. INTRODUCTION

Improving quality of life in the cities, reducing their ecological footprint and adapting them to climate change, are three fundamental challenges that need to be urgently addressed (UN 2010). In the wider discussion about possible solutions, several urban development concepts were introduced in the last few decades. All of them are based on the paradigm of sustainable urban development, while the differences arise from the research focus of a certain concepts. However, they are often difficult to determine due to overlapping, the breadth of concept definitions, multiple ways of describing, or from a wide range of interested stakeholders who promote them. Some of the concepts, such us *Nature-based Solution*, *Ecosystem-based Adaptation*, *Urban Green Infrastructure* or *Ecosystem Services*, are ecologically-oriented and focused on the integration of nature and natural processes in built-up areas, addressing the societal challenges through the protection, sustainable management and restoration of both natural and modified ecosystems. Other concepts are the reflection of the *Neo-traditional Planning*, which is trying to achieve a balance in a diversity of both functions and residents in space. They are focused on sustainable urban growth and urban patterns based on principles such us mixed-use, compact physical structure and increasing density, traditional neighborhood structure, connectivity, walkability and/or green transportation. The best known concepts among them are

New Urbanism, *Compact City* and *Transit Oriented development* (TOD). These concepts have gained importance not only within academic debates, but also because of their clear link to the urban context and active involvement in policy-making and urban planning. Despite the differences, the concepts are closely interrelated, partly overlapping and partly complementing each other. They share many features, starting with the promotion of public transport and built-up areas based on the principles of mix-use, compactness and walkability. Accordingly, as one of the current urban concepts and urban development strategy, *Transit Oriented Development* (commonly known as TOD) is based on: 1) public transit use; 2) maximizing the amount of residential, business and recreation space within walking distance of the train or light rail station, or bus station as the focal community and development point; 3) promoting a compact urban fabric; 4) mixed-use and diversity; and 5) walkable, pedestrian-oriented community.

Since technical solutions are very significant for the efficiency of the organization of high quality rail systems, which is on of the key TOD feature, the application of new technologies is imposed as an imperative. Apart from the analysis of the basic features of TOD and the overview of the future transportation trends, the focus of this paper is on the intelligent railway safety solutions and exploration of the possibilities and benefits of their implementation within a broader urban planning approach such as TOD.

2. METHODOLOGY

In analysing the key TOD features, comonents and principles, as well as in exploring the possibilities and benefits of intelligent railway safety solutions, the methodological framework is based on an analytical approach which relies on description, analysis and comparative analysis.

3. TRANSIT ORIENTED DEVELOPMENT (TOD) - FRAMING THE CONTEXT

Rooted in the planning ideas of Peter Calthorpe (1993), Transit Oriented Development (TOD) has developed into a concept and strategy ''that consists in promoting urban development that is compact, mixed-use, pedestrian- and bicycle-friendly, and closely integrated with mass transit by clustering jobs, housing, services, and amenities around public transport stations'' (Salat and Gerald, 2017). Based on the experiences in North America, and the achievements of successful cases such as, for instance, Rosslyn-Ballston corridor in Arlington, the TOD focuses on creating urban development patterns based on a public transit as a primary mode of transport at regional and city level (Fig 1a), and walking and cycling as a primary modes of transport at a local level (Fig 1b). Therefore, as a rule, TOD features a central mass rapid transit stop such as train, light rail or bus station(s) as a focal development point for the development of a vibrant, diverse, walkable local livable community (Fig. 1b). Local scale TOD is achieved by concentrating urban densities, urban functions and activities within a 5-10 minute walking distance from mass rapid transit station (Fig 1b).

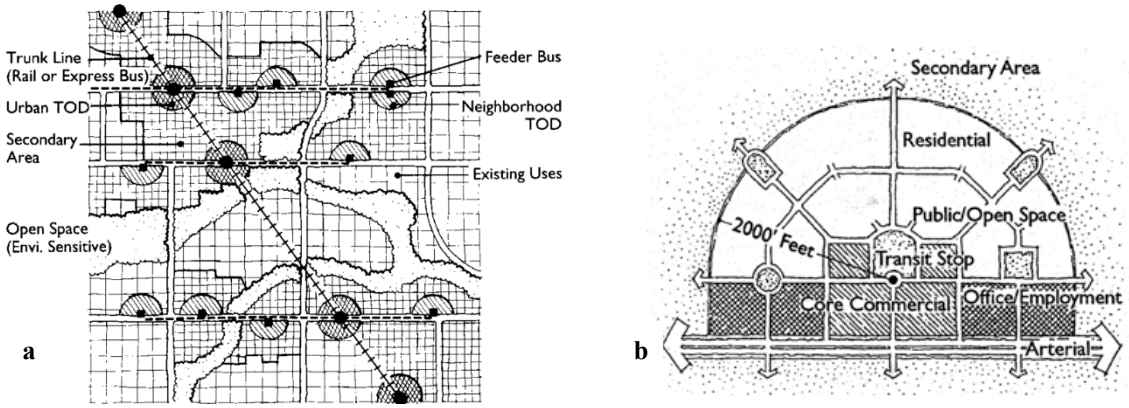

Figure 1. TOD urban model. a) TOD model at regional and metropolitan scale. b) TOD model at local scale - TOD zone. Source: Calthorpe, P. 1993.

According the *Transit Oriented Development Institute*, typical TODs components are the following: 1) walkable design with pedestrian as the highest priority; 2) train station as prominent feature of town center; 3) public square fronting train station; 4) a regional node containing a mixture of uses in close proximity (office, residential, retail, civic); 5) high density, walkable district within 10-minute walk circle surrounding train station; 6) collector support transit systems including streetcar, light rail, and buses, etc.; 7) designed to include the easy use of bicycles and scooters as daily support transport; 8) large ride-in bicycle parking areas within station; 9) bikeshare rental system and bikeway network integrated into stations; 10) reduced and managed

parking inside 10-minute walk circle around town center/train station; and 11) specialized retail at stations serving commuters and locals.

The TOD terminology is rarely used in Europe, even though its use has been intrinsic to most planning practice in European cities. Often associated with the Nort America and US, where rapidly sweeping, TOD has been applied at a city scale in cities around the world including, for instance, Curitiba, Stockholm, Copenhagen, Hong Kong SAR, Tokyo, Singapore, Vancouver, Vienna, etc (Fig. 2). The main reason for this is that attempts to alleviate increasing traffic congestion (a problem faced by most metropolitan areas as well as smaller cities) by constructing more highways, almost always lead to more sprawl and, often, more congestion. Transit proved to be a more sustainable solution because the following (Newman and Kenworthy, 1999): 1) transit investment has double the economic benefit to a city than does highway investment; 2) transit can enable a city to use market forces to increase densities near stations, where most services are located, thus creating more efficient subcenters and minimizing sprawl; 3) transit enables a city to be more corridor-oriented, making it easier to provide infrastructure; and 4) transit enhances the overall economic efficiency of a city; denser cities with less car use and more transit use spend a lower proportion of their gross regional product or wealth on passenger transportation. And this is precisely what TOD is geared towards. A hierarchy of TODs, based on a network of trunk and arterial transit lines, along with development restrictions in environmentally sensitive zones, can create a regional pattern for guiding development (Fig 1a, Fig. 2).

Figure 2. TOD best practice example. a) Marine Gataway Complex, Vancouver. b) Seestadt Aspern, Vienna.
The City of Vancouver's largest transit-oriented development, Marine Gateway complex, is adjoins the Sky-train station of the same name. It is a mixed-use development that anchors South Vancouver's neighbourhood town centre and serves as a vibrant, safe and complete community. The City of Vienna has an existing and new array of TOD developments including the new Seestadt Aspern—one of Europe's largest urban redevelopments.The Seestadt embodies TOD, because relies on residential density, public transit, decreased energy consumption, and varied mobility schemes from walking and cycling to extensive pedestrian-oriented spines and organized open space.
Source: a) https://marinegateway.com/about-marine-gateway/; b) https://vienna-solutions.com/portfolio/lake-city-aspern/#

In practice, TOD primarily occurs when regional or local governments encourage it through land use planning, zoning laws, and changes to building codes. The following benefits of TOD applying have been recognized (Salat and Gerald, 2017; Gerald et al., 2021): 1) agglomeration effects shaped by the higher densities and the concentration of jobs within relatively small areas boost a city's competitiveness (for instance, increases economic productivity by 5 to 10%); 2) concentration of jobs creates vibrant communities with high-quality public spaces and shorter commuting distances, making cities more livable; 3) compact urban development and high-quality public transit also mutually reinforce each other - mass transit can support the large passenger flows that come with high density development, while the concentration of jobs and housing around stations helps make public transport financially viable; 4) by concentrating jobs, services, and housing within the catchment area of transit stations, TOD makes public transport a more attractive and efficient option, while reducing dependence on private cars and promoting shorter commutes (this type of living arrangement can reduce driving by up to 85%); as a result, TOD typically translates into higher productivity and a smaller carbon footprint; and 5) proximity to mass transit improves access to TOD neighborhoods, boosting their attractiveness and increasing real estate value. On the other hand, TOD can drive up property prices and accelerate gentrification, which is one of the key arguments of TOD opponents. In addition, they argue that residents around the world prefer areas with lower population densities, and that any policy that encourages compact development will lead to a significant reduction in utilities and thus an increase in social welfare costs. TODs proponents argue that these problems can be solved with an inclusive TOD approach that includes allocating a significant portion of new development to affordable housing, improving access to job opportunities and services for residents at all income levels. It is considered that cities can capture a part of

these increases in value and use it to finance *additional transit improvements*, affordable housing, and other initiatives that promote sustainable inclusive growth. However, TOD principles cannot be applied uniformly across an entire city or transit network, since densities of jobs and people vary widely across the urban space. In fact, experience has shown that only about 15% of transit stations and their surrounding area can support very high density development (Salat and Gerald, 2017).

4. TOD AND INTELLIGENT RAILWAY SAFETY SOLUTIONS

Since innovative operation and information technology solutions are very important for the efficiency of the railway organization, as well as for the quality of urban life, the application of new technologies for the successful implementation of a wider concept such as TOD is imposed as an imperativ. Future trends in transportation will enable a range of applications such as: traffic flow analysis, smart traffic management, violation detection, driverless vehicles, etc. The emergence and development of artificial intelligence (AI), the Internet of things (IoT) and big data have provided the rail sector with an opportunity to forward into the future trains and railways in the aspects of: 1) AI behavior analysis; 2) train diagnosis, 3) cybersecurity, and 4) safety. AI offers a range of onboard train solutions with sensing, diagnostics and wireless capabilities, providing full scalability and future-proof, rolling stock, wayside, signal, power, obstacle detection, and data collection capabilities.

For the purposes of this paper, we will refer only to some possibilities of applying AI railway safety solutions. They are considered through two elements of the railway: 1) the railway station, 2) the railway system.

4.1. Railway stations

Passanger activity represent an increasing business at global level - wheter on short or long distance, regional, mass transit or high speed, the transport of passangers by rail is an activity with possitive expectation (UIC, 2017). Among all the necessary aspects needed to develop passanger transport (technology, marketing, financing, etc), the most important common point for companies, customers and society are railway stations. They are the key element in passanger transport for different kind of customers (commuters, travelers, passing-by) and their only gatawey to railway sistem. But, other than their strategic value for railway system, at the same time, they are also an essential element in regional and urban development and planning, especialy in the context of TOD.

Smart infrastructure	Smart mobility	Internet of Things (IoT)	Information and communication technology infrastructure
Adding value through improved feature, for instance better design or use of new technology	Using new technology to facilitate the flow of information and people in real time and space, usong smart information and communication infrastructure	Interconnection via the Internet of computing device embedded in everyday objects, enabling them to receive, use and send data and thus inrease their functionality	All the devices, networks, protocols and procedures that are employed in the telecoms or information technology fields to faster interaction among different stakeholders

Table 1. Key aspect os smart railway system and railway stations: Role of new technology. Source: Smart Station in Smart Cities, UIC, 2017.

Stations are multidimensional hubs and interfaces between different modes of transportation and places that have constantly adapted to growing development. But they are also an architectural benchmark, while their functionality and equipment influence not only passenger activities and transport convenience, but also the creation of vibrant, vital TOD zones. Therefore, one of the key TOD development policy aspect is: 1) improving and diversifying the functionality of station(s); 2) improving opportunities for centres which attract on a daily basis a large volume of users (not only for travel purpose); and 3) strengthening the relathionship between railway system and TOD community. In line with this, improved accessibility of information, sustainable railway station programs, security and the long-term development of station aimed at promoting stations (UIC, 2017), become also a significant TOD activities. Transformation of railway stations into *smart railway stations* through *smart infrastructure* and *smart mobility* that rely on new technologies - digitization and implementation of AI systems and applications, are an important part of those activities (Table 1).

Several factors contribute to making at pleasant time spent in station: cleanliness, lighting, sound an smell, friendliness of staff and *feeling of safety*. They can be improved by applying smart solutions that rely on new technologies and digitalization (Fig.3).

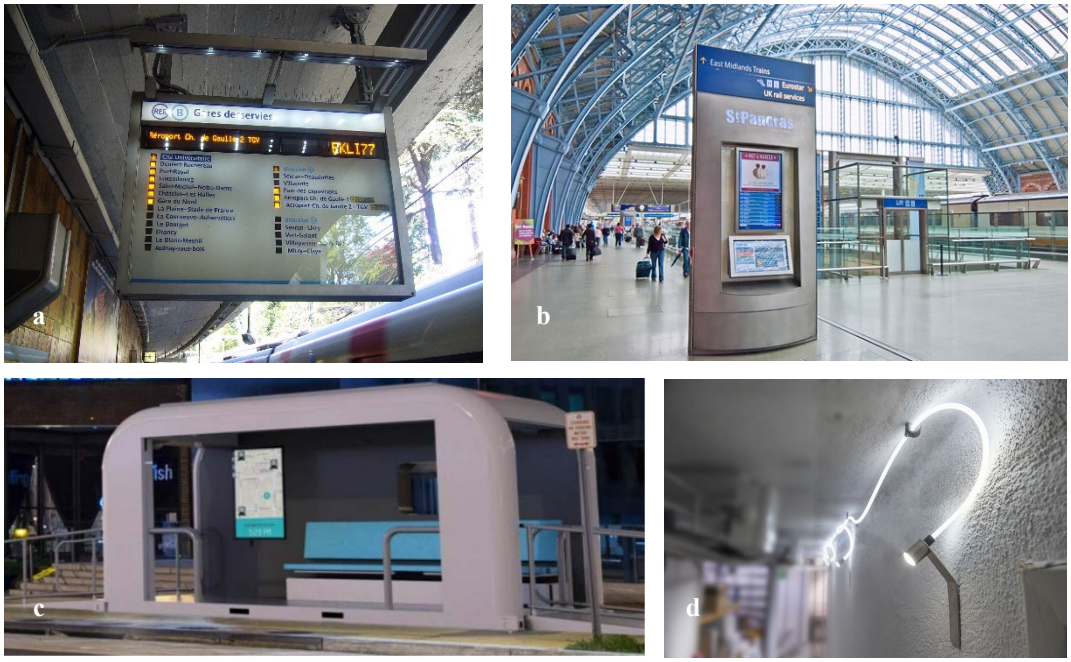

Figure 3. Smart railway stations safety solutions

a) *Passanger information display system.* Integrated passenger information systems provide either schedule-based information through a journey planner application or schedule-based information in combination with real-time information. Example - LED display above the square lights indicating the terminus and train service, 2nd generation termini indicator on the RER line B in Paris metro and 250 bus routes.

b) *Interactive terminal - touch screen kiosks for self-service.* They are an invaluable resource for passengers arriving at the station and also contribute to a real-time sense of safety. This type of terminal should be visible and easily accessible.

c) *Smart interactive equipment*. Smart hub ''Matilda'' (by SAGEAutomation) is a portable, connected transit hub that is equipped with the latest smart technologies that offer everyone the equal opportunity of autonomous transportation. Using a mix of smart innovations, the hub improves comfort on and around public transport which encourages ridership. It provides the following services: connecting tram timetables, booking an Uber, locating the nearest bike rental station or scheduling an autonomous shuttle ride. It is more than a shelter that provides safety and comfort during transit, it is a connection to smart mobility. The hub is designed so that it can be moved within a few hours, runs on solar or battery power and is completely self-contained. As well as being well lit for safety, this hub will also let know when the train is approaching via configurable coloured lighting cues.

d) *Fibre optic lightining*. Railway station sometimes lack light, which can negatively affects people's perception of safety and security. For instance, this type of lighting uses sensors on the roof of the building to transfer light throughout the building.

Sorce: a) https://www.wikiwand.com/en/Passenger_information_system#Media/File:SIEL_-_RER_B_-_Direction.JPG; b) Tony Page/travelsignposts.com; c) https://www.sageautomation.com/matilda; d) http://www.mtt-inl.com/product/echy-optical-fiber-system/

4.2. Railway system

Intelligent systems are highly automated systems. As a result of global technological changes and digitalization, automated systems will be able to offer extended functionality and a higher level of automation, thereby responding to the growing demand for the implementation of various railway developments. For the purposes of this article, we will briefly comment on only a few AI railway safety solutions and benefits of their application (Fig. 4).

- **Increasing safety of the passangers through implementation of AI driver and passenger behavior analysis**

Although today the operation of the train is almost semi-automatic, the importance of the drivers does not degrade. As the drivers work alone, in case of being unfocused or any acute medical condition, their activity can be monitored and analyzed with an AI system for onboard surveillance applications. For instance, if the driver falls to the ground for more than five seconds, the alarm will go off to alert the driver and the control

center to evaluate whether to start the emergency procedures. In the same way, the attack behavior of passengers can also be detected by the AI vision to ensure a safe ride.

- **Increasing convenience of the passengers through implementation of AI system for the seat occupancy detection**

Fueled by intelligence from AI-driven systems and applications, railway operations are becoming safer and smarter while improving passenger comfort. Integrated with advanced software and cameras, the AI system can detect passengers sitting down or leaving their seats, providing real-time status data. For the convenience of the passengers, the occupancy of each traincar would be displayed in graphics on the electronic boards on the transit station platform. More than that, the occupancy status can even be checked on mobile devices, which enhances and changes the scope of transportation. Information and booking through a smartphone app is controlled by the passengers and requires dynamic real-time routing and dynamic calculation of trip time. This on-demand bus transport is tem-poral and spatial flexible without a fixedtime-table and is suitable for times or areaswith less demand

- **Increasing driving safety through implementation of onboard diagnosis and predictive maintenance**

The driving safety can be improved with a implentation of variety of sensors such as sound sensors and the development of IoT which enable the predictive maintenance which is able to detect possible upcoming malfunctions or maintenance. To obtain data from different sensors via various protocols, gateways are required. As they integrate data and transmit it to the central management system, the location and the type of problem can be quickly identified.

- **Increasing railway cybersecurity through implementation of system to set up a firewall in the trains**

Digitalization of railways brings many advantages, but also increases its exposure to the Internet environment and threats of cyber-attacks, which is happening today to railways and related systems around the world. In order to prevent the breakdown of trains, installing firewall systems in trains to protect systems such as central control unit can be helpful. A firewall can segment the OT network from the IT network and filter unknown packets.

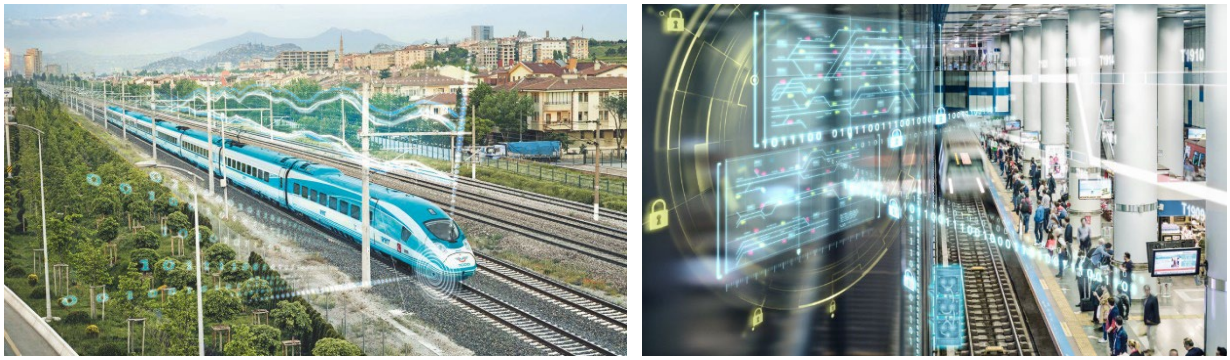

Figure 4. Intelligent railway system safety solutions
Source: https://www.mobility.siemens.com/global/en/portfolio/rail/services/digital-services/smart-security.html

5. CONCLUSION

The city of tomorrow is a city where all citizens manage to travel from home to work, to school or to shopping or leisure destinations faster, safer and more reliable. This requires a smart, integrated transport system that includes all modes and the integration of land use. Through implementation of smart transit hubs, or TODs, the key stakeholder - rail owners can offset capital costs of construction and secure long-term revenues to offset operating costs once in service. At the same time, they can achieve important sustainability goals and smart city initiatives. In that sense, TOD hubs have the potential to be a great catalyst for adopting new development strategies that will make cities more liveable.

Intelligent transport systems will have to provide a holistic solution for all transportation means. AI and smart systems are transforming our societies, and AI must also be used in the railway system, in view of the exponentially growing complexity of such infrastructural networks. Networking and communication-based operation will also have an increasingly important role in railway systems. A large amount of data generated by the network-based operation will be automatically transformed into information allowing the basic forms of automatic operationin the railway system. As a result, the use of AI can lead to increased transportation

efficiency, sustainability, security and safety. Implementation of smart railway solutions and AI systems, enables the railway station(s) can became a cornerstone of innovation, extra value (within and around them), as well as driver for creating a vibrant TODs community.

In addition, the real-time information provided by the integrated passanger information system is an improvement over timetable-only information. By providing real-time information to passengers, they are able to manage their journey more safely, including taking any necessary steps in the event of delays. This helps to encourage greater use of public transport, which is not only an TOD and urban planning goal, but also a political goal for many countries.

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SMART PARK SOLUTIONS AND POSSIBILITIES FOR THEIR APPLICATION IN THE CITY OF NIŠ

Ivana Bogdanović Protić

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Associate Professor, ivana.bogdanovic@gaf.ni.ac.rs

Ljiljana Vasilevska

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Full Professor, ljiljana.vasilevska@gaf.ni.ac.rs

Milica Ljubenović

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Teaching assistant, milica.stj@gmail.com

ABSTRACT

Urban parks are vital spatial and functional elements of the urban environment, which provide citizens with multiple benefits for their quality of life. Despite this, they often face problems, such as inadequate equipment and maintenance, a low level of security, and non-compliance with the modern users' needs. With numerous problems of cities, such as increasing pollution, climate change, construction volume growth, and lack of green areas, the importance of parks is becoming more prominent, as well as the need for their improvement. In recent years, the concept of smart parks has proven to be an effective model for improving and reshaping urban parks into a smart environment. This paper aims to investigate the smart park concept and explore the possibilities for implementation of smart park solutions in the city of Niš. For this purpose, the theoretical part of the paper discusses foreign good practice examples of smart urban park solutions. The application of smart parks in the city of Niš is investigated and recommended through various solutions: smart urban furniture, smart pavements, smart waste bins, smart irrigation, etc. This research is very important in terms of improving urban parks in the city of Niš, as their reshaping into smart parks would be significant while the city is facing multiple environmental problems, and it is also important in terms of creating a smart urban environment. The results of the research may be significant for the affirmation and promotion of the implementation of smart urban park solutions in domestic urban theory and practice, both in existing urban parks and in the newly planned ones.

Keywords: smart urban park; smart environment; smart urban furniture and amenities; implementation; benefits

1. INTRODUCTION

Nowadays, more than 60% of the world population live in cities and this number is expected to increase to 70% by 2050. Population growth and increased urbanization raise a variety of technical, social, economic, and organizational problems that tend to endanger the economic and environmental sustainability of cities (Neirroti, 2014). Today, cities are already facing serious problems, such as overpopulation, pollution, climate change, excessive energy consumption, increased volume of construction works, lack of green spaces, and devastation of public open spaces, all of which have negative implications for citizens' quality of life. In the current conditions, there is an increase in sedentary activities and the excessive use of digital devices, which lead to a series of health problems, indicating the overwhelming importance of urban recreation and spending time in urban open spaces, in the green, i.e., in city parks. In response to the said problems, a number of smart solutions have been applied in the last decades in various fields related to cities. Smart urban parks (hereinafter SUPs) are one of the fields of application. This research investigates the key characteristics of the SUP concept and explores the potential for its implementation in the case of the city of Niš. In the first part of the paper, the

concept of SUPs is discussed through examination of issues related to well-being. In this part of the research, the benefits of SUP application are also considered. In order to more comprehensively understand the SUP concept, this paper discusses examples of good practice in cities where various smart elements of SUPs are realized. Despite the rich international practice of implementing various smart solutions in urban parks, in the case of the city of Niš, their application is extremely modest. In this context, in the last part of the paper, the focus is on researching the possibility of applying smart solutions in a park in Niš for the purpose of reshaping, sustainability, and improvement of the quality of life. The research was conducted in the Čair district, which is located in the wider central city zone. Čair park was chosen both because it is one of the biggest parks in Niš, with many people gravitating towards it, and because of its accessibility, various urban recreational activities, and the potential for creating top-quality ambient values. The paper concludes with identifying key smart park solutions that are suitable for the selected park in Niš. The results of this research may be important for promoting the application of SUP practices in domestic urban practice in both the existing and the newly planned urban parks.

2. SMART URBAN PARKS – CONCEPT AND BENEFITS

Urban parks are vital and unique spatial and functional elements of the city fabric. Their importance is manifested through multiple aspects (Bogdanović Protić, 2022). Today, urban parks are facing serious challenges, such as not meeting user needs, inequitable access, obsolescence, antisocial behavior, low level of security, inadequate maintenance, neglected greenery, lack of resources for capital improvements and maintenance, etc. In addition, current developments in economy, technology, society, climate, demographics, and other areas are pushing cities and communities towards 'smartness' and smart cities (Radwan and Morsy, 2018). Smart cities use information and communication technologies (ICT) to enhance their liveability, workability, and sustainability (Smart Cities Council). The application of ICT can be seen in different segments of the urban fabric. One of the important fields of action that has been highlighted in the last decade is the implementation of smart solutions in urban parks to tackle the aforementioned challenges and to reshape them into smart urban parks in order to improve them and to create a smart environment.

SUP is a new concept that flows from the exponential growth in smart technologies (Truch and Sutanto, 2018). SUPs are parks that use environmental, digital, and materials technology to achieve a series of values: equitable access, community fit, enhanced health, safety, resilience, water and energy efficiency, and effective operations and maintenance (Loukaitou-Sideris et all, 2018). Smart solutions that are applied are aimed at reshaping parks into attractive public open spaces that encourage more utilization by citizens and contribute to their well-being. SUPs are equitably located and easily accessible by the community and various social groups close to population centers, they are connected to communities via transportation modes, and they provide walkways and other design features to accommodate users of different ages and abilities. Citizens feel comfortable in them and their services, amenities, and programs are aligned with the users' needs. SUPs facilitate healthy activities, encourage increased physical activity, and contribute to overall community well-being. Furthermore, the application of various smart solutions, primarily smart lighting sensitive to the movement of people, contributes to the adequate lighting of park units and the feeling of safety. SUPs are resilient to changes in climate, population, and land use, and the reuse of water for their irrigation significantly contributes to saving water. Combining smart technologies and outdoor recreational and social activities, the information about the number of visitors in SUPs, duration of their stay, and their location is provided daily to help plan a schedule for health activities and social events (M Abdelhamid, 2019). Additionally, the application of solar panels is significant for energy gains, relying on smaller capacity panels as a part of urban equipment, and especially for the development of solar parks. Finally, smart solutions used in SUPs enable efficient operations and maintenance practices and avoid the creation of neglected spaces, thus helping to reduce costs, improve safety, and encourage park visits and use.

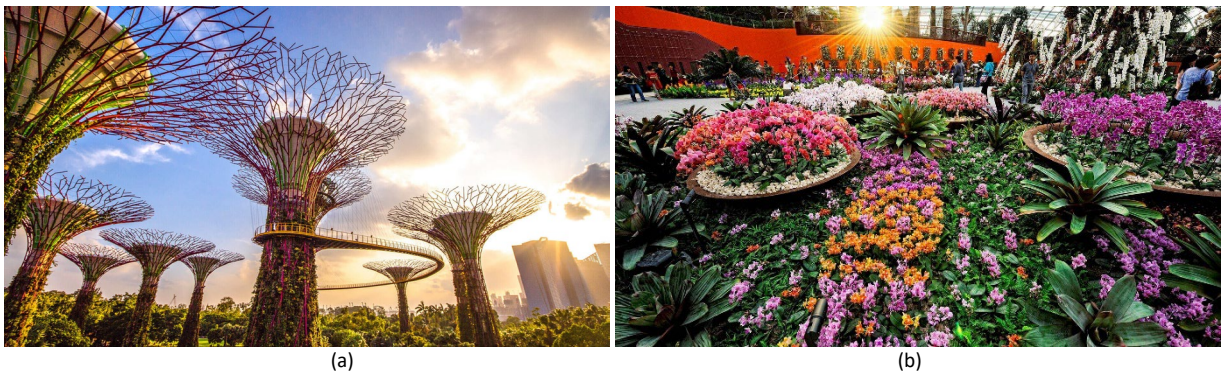
SUPs are based on the central control of the power supply of network devices and on the analysis of received data. For this purpose, a number of smart solutions can be used, such as the following (Hook, 2022): (1) Wi-Fi and other networks; (2) smart benches; (3) smart shelters, strawberry trees, technological tree; (4) smart playgrounds; (5) solar waste bins; (6) smart water fountains; (7) energy generating exercise equipment; (8) IoT bike stations and solar bike shelters; (9) smart lighting (solar and wind) and solar lighting (motion activated sensors); (10) energy generating pavements; (11) smart microclimate sensors; (12) smart CCTV cameras; (13) smart irrigation; (14) automatic lawn mowers; (15) smart dashboard; (16) sensors for visitor monitoring; (17) electric vehicle charging stations; (18) autonomous vehicles; (19) online interactive park mapping; and (20) augmented reality (AR). This paper focuses on smart solutions 1-16, and some of the lesser-known ones will be

explained in more detail. Energy generated pavements are special tiles equipped with a wireless API that transmits real-time movement data analytics, while directly producing power when and where it is needed (https://materialdistrict.com). Energy generating exercise equipment functions so that when it is used, it generates power that can be used for charging devices via USB. They also store energy and power interactive lighting on site (https://www.tgogc.com/green-energy). Microclimate sensors are designed for all types of environmental monitoring, including air quality monitoring, wind direction, wind speed, temperature, and humidity (https://www.womaster.eu). Smart playgrounds are equipped with various activities packed into a compact design and size, so they require less space and surfacing material than typical playgrounds, and they are intended for all age groups. Solar powered waste compactors are smart devices that recognize a waste bin's fill-level in real-time and trigger an automatic compaction of the waste (https://en.wikipedia.org/wiki). Smart trees by Strawberry provide free mobile device charging via a range of already built-in connectors and introduce the Internet of Things to outdoor public spaces. They create new social hubs and meeting points and can work 24/7 in all weather conditions (https://strawberrye.com). In addition to providing proper park lighting, solar lights are especially important because they also provide a sense of security and they produce the maximum possible illumination while drawing the least amount of power, thus reducing energy costs and providing cleaner energy (https://selsled.com). Smart water fountains are hydration stations that have both drinking and bottle filling functions and contribute to increased access to drinking water and greater water consumption (http://heart.huttcity.govt.nz). The technological tree is the ideal solar-powered solution that resembles greenery. It is perfectly integrated with the soul of the park, providing users with shelters and favorable outdoor comfort during summer (https://www.luminexence.com).

3.0 BEST PRACTICE EXAMPLES

3.1 Gardens by the Bay's in Singapore

Gardens by the Bay are a rich fusion of nature, technology, and environmental management (https://www.gardensbythebay.com.sg). There are eleven supertrees in the Gardens (Figure 1a) and some have photovoltaic cells on their canopies to harvest solar energy for their lighting. Others are integrated with the Conservatories and serve as air exhaust receptacles. The Gardens have an intelligent environmental infrastructure, allowing the existence of endangered species in the Flowerdome – two glass biomes (Figure 1b). Namely, with the help of smart solutions, a suitable climate is created in the glass biomes for the cultivation of plant species that are otherwise not characteristic of Singapore, some of which are of high conservation value (Gardens by the Bay, 2012). They also provide both leisure and education to the users. In the Gardens, there are sensors and stations for monitoring environmental parameters important for vegetation growth, as well as those for plant monitoring and irrigation, which have also been installed in the park. The central dashboard displays data related to plant monitoring and irrigation, lake management, and visitor management. They use automatic vehicles that spray fertilizers and insecticides, which reduces the physical work of people and the costs.



(a) (b)

Figure 1. Gardens by the bay: (a) Supertrees; (b) Flowerdome
Source: https://www.gardensbythebay.com.sg

The sensors also monitor pollutants in the lake, which can destroy the ecosystem. The application of smart lighting, lighting management, and cleaning of the park is particularly important. With the help of sensors, passers-by are detected and the bulbs are automatically turned on, while problems in operation are also detected and the replacement process is accelerated. By applying interactive lighting, entertainment with 'organic' lighting in playful harmony with the garden's greenery, water, and other natural scenery was created (Ying, 2013). Smart waste bins have also been installed, and they are significant for regular garbage collection.

An electrical vacuum sweeper is utilized, which performs a cleanliness check and automatically detects the need for cleaning. Throughout the park, sensors are installed for the monitoring of visitors on the dashboard by security officers, with the aim of recording real-time crowd density and pointing out potential problems. Facial recognition is used for effective and faster detection of missing persons. There are also sensors for displaying free spaces in the parking lot as part of the Integrated Parking Management System in order to direct drivers to free parking spaces as soon as possible and thus avoid crowds.

3.2 Queen Elizabeth Olympic Park

In the Queen Elizabeth Olympic Park, three interactive maps have been placed in order to transform it into a smart environment and a more sustainable place through visualizing different data feeds around the park (https://www.queenelizabetholympicpark.co.uk/). The first one is the Living Map (Fig. 2a), which contributes to greater accessibility of the park and easier discovery of the activities represented. It is compatible with all mobile devices that aim to help 'connect' people to the park. Through a multi-interactive map, users can see different paths in the park, for instance paths with the least crowd for access to certain areas during organized events, such as safe lit-up routes around the area at night. The second mapping technology is a virtual reality park model, which allows users to explore the park in virtual reality. The third is the Safety Map (Fig. 2b), which is particularly important. It contains users' comments along different routes and in different areas of the park, thanks to which safety-related problems are pointed out in real time and the park is constantly being improved.

(a) (b)

Figure 2. Smart maps in Queen Elizabeth Olympic Park: (a) Living map; (b) Safety map
Sources: (a) https://www.queenelizabetholympicpark.co.uk; (b) https://saferspaceslldcmap.commonplace.is/comments

In addition to maps, various sensors have been installed throughout the park to help harness data and use them to further improve the park and the manner the users are experiencing microclimate sensors, air quality sensors, and bat sensors for bat protection, which positively impacts the users. These sensors provide real-time information via the park Wi-Fi network. It is free for all visitors throughout the park, ensuring that the park is managed in the best possible way and providing a wide range of services to the users. A digital system was also introduced in the park, which examines trends such as bicycle use, the popularity of bus stops, and the flow of people across the park, and it will help to make the area more accessible, user-friendly, and sustainable. The transformation of existing CCTV cameras into smart devices is particularly significant for tracking the movement of people and objects around the area, which helps the park management make important decisions about how the space is used, improved, and developed (Samuels, 2022).

3.3 Smart parks in Barcelona

Barcelona is one of the most famous cities for the application of smart technologies, containing a series of innovations in different segments, one of them located in Poblenou Central Park. The irrigation in this park is based on sensor technology and it allows remote control of the irrigation system to facilitate the management of the water network (https://www.libelium.com/libeliumworld). Moisture sensors are installed in the park to measure humidity and water flow, and based on this collected information, the need for irrigation of certain parts of the park is determined in real time during the day. The collected information can be visualized in a platform that focuses on and provides information on the conditions in each zone in real time (Fig. 3a). The new irrigation management system allows an automatic control of the electronic valves that close or open the water flow. In addition to irrigation control, the importance of this system is the detection of incidents. This is a big contribution to water saving in Barcelona. The next innovation is the photovoltaic pavement (Fig. 3b), which is a part of the Barcelona city's strategy to become carbon neutral by 2050. In a small park in the Glòries area of

the city, non-slip Photovoltaic panels were installed in an area of 50 m^2. They can generate enough electricity to power three households. Intensification of the application of smart pavements can be of great importance for the supply of electricity to entire residential blocks (https://platiosolar.com/ez-egy-hir-2/?lang=hu).

(a) (b)

Figure 3. Smart parks in Barcelona: (a) Poblenou central park; (b) Park in the Glòries
Sources: (a) https://www.libelium.com/libeliumworld/success-stories/saving-water-with-smart-irrigation-system-in-barcelona/
(b) https://platiosolar.com/ez-egy-hir-2/?lang=hu

4.0 POSSIBILITIES OF APPLICATION OF SMART URBAN PARKS IN ČAIR PARK IN THE CITY OF NIŠ, SERBIA

4.1. Urban brief

The city of Niš is the third largest city in Serbia, which is facing growing issues, such as increased densely built-up areas (especially in the central city area, but also in other city areas), a high degree of pollution, and other environmental issues, climate change, lack of green spaces, poverty, and low-quality public open spaces, all of which have a profoundly unfavorable effect on the quality of life. According to the General Urban Plan of Niš 2021-2025, the existing park greenery consists of 15 parks, 3 squares, the old quay and the park in Niška Banja. The largest city parks are Bubanj memorial park, the park in the fortress, and Čair park (Figure 4).

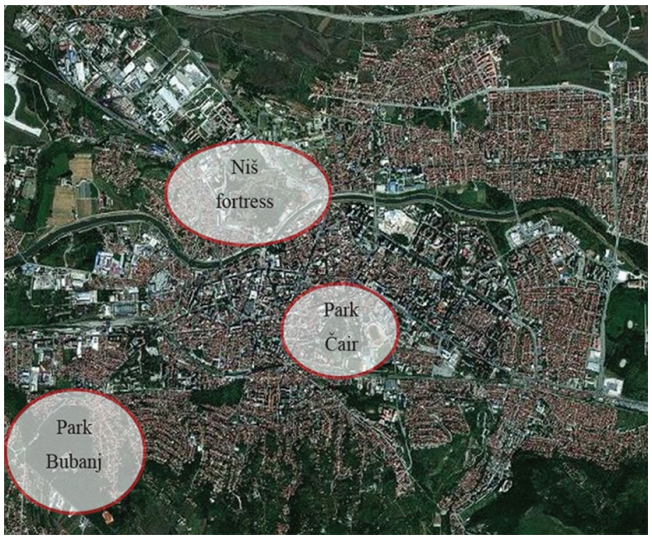


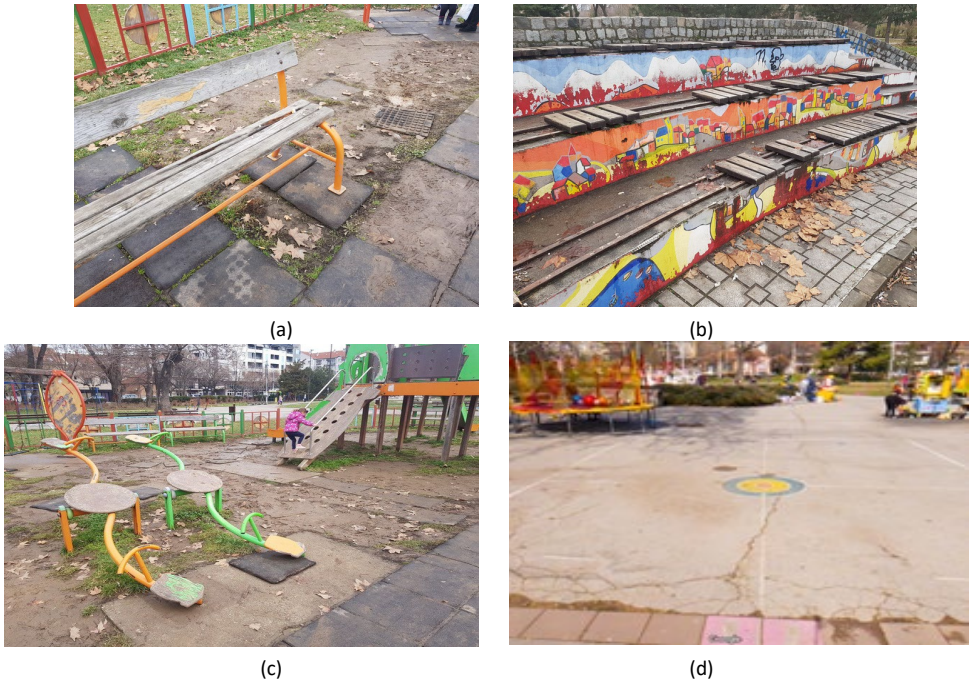
Figure 4. Spatial distribution of the largest parks in the City of Niš

Figure 5. Map of Čair park: (a) sports field; (b) playground; (c) children's cultural center; (d) bicycle tracks; (e) seating area; (f) amphitheater; (g) outdoor gym; (h) dog park; (i) café; (i) café; (j) ice rink; (k) stadium; (l) sports arena; (m) water park
Source: https://a3.geosrbija.rs/

Despite the expansion of smart technologies in cities around the world, their implementation in Serbia is much smaller than in other countries. Despite the fact that the "smart cities" project was one of the agreements signed in 2019 in Beijing with the company Huawei, and the city of Niš was chosen as the first city for pilot projects (Matović, 2019), the application of smart technologies in Niš is very limited, especially in the case of public open spaces and parks. Therefore, the question of how to implement smart solutions in urban parks in the city of Niš and transform them into smart parks is entirely justified.

4.2. Study area

The research platform for examining the possibility of implementation of SUP solutions in the city of Niš is Čair park (Figure 5). It is located in the central city zone, on an area of 16.4 ha within the municipality of Medijana. Park accessibility is good, both by public transport, by passenger cars, for which there is an organized parking lot, and by foot. Within the park, users are provided with several paths for walking and running, an outdoor gym, several seating areas, an amphitheater for gathering, a playground for children, tracks for cycling and rollerblading, open sports fields, a cafeteria, a dog park, and a dominant green area (Figure 5). The park also includes the following sports and recreational facilities: the water park complex (indoor and outdoor pool), a fitness center, a sports arena, a stadium, and an ice rink, as well as a children's cultural center. Apart from irregular partial interventions, there is no comprehensive continuous park maintenance system, which is the reason for various functional, hygienic, aesthetic, and maintenance problems.



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

Figure 6. Čair park – current state: (a) bench; (b) amphitheater; (c) playground; (d) pavement
Sources: (a, b, c) https://niskainicijativa.rs/za-ciju-bese-ono-decu/; (d) https://www.google.com/maps

Urban equipment is outdated and damaged due to poor maintenance and physical damage caused by vandalism. This primarily refers to the benches for sitting (Figure 6a) and the amphitheater (Figure 6b). Accumulation of garbage inside the benches (most of them have holes due to physical damage), in the space around the benches, as well as in entire seating areas is a big problem, which is due to users' negligence and irregular park cleaning. Urban equipment for children is insufficient, and most of it is damaged and unsafe for use. In terms of functionality, safety, and hygiene, the playground in the central part of the park is particularly at risk (Figure 6c). Furthermore, the outdoor comfort of the seating area is poor during the summer months, because most benches are placed far from the trees that could provide them with the necessary shade. In addition, the pedestrian paths are outdated – the cast concrete paths are damaged, with a considerable number of cracks (Figure 6d), which makes them unsafe for walking and especially for sports activities. The green spaces are not regularly maintained, which lowers the hygienic and aesthetic comfort of the park. During the spring and summer, in the afternoons, there is often a large number of visitors to the park, which leads to crowding due to a variety of simultaneous recreational activities, especially around the training ground, which disrupts walking and passive recreation. The security of the park is low, manifesting in (1) insufficient lighting, especially on peripheral paths, (2) the presence of completely dark sub-units in the southern and southwestern parts, (3) the absence of monitoring, and (4) antisocial behavior/vandalism. Regarding the application of smart solutions, thus far, one solar tree and several smart benches have been placed in the park, which is insufficient for a park of this size.

4.3 Possibilities for SUP solutions implementation – results and discussion

The analysis of the urban-architectural structure of Čair park indicates that, despite the significant urban changes and the introduction of additional urban content in the park, there are numerous problems that negatively affect the quality of life and that the space has enough physical capacity for the application of new content, including different types of SUPs. The reason for creating a SUP is to create a modern instrument in order to overcome the identified problems and modernizing this park of considerable urban importance, to provide a wider range of activities for different categories of users, and to reshape it into a desirable and sustainable place for all citizens.

Figure 7. Possibilities for SUP solutions implementation in Čair park: (1) map; (2) smart bench 1; (3) smart bench 2; (4) smart shelter; (5) technological tree; (6) smart playground; (7) solar waste bin; (8) smart water fountain; (9) energy generating exercise equipment; (10) IoT bike station; (11) smart irrigation; (12) energy generated pavement
Sources: (1) https://a3.geosrbija.rs/; (2) https://newcities.org/global-urban-innovators-alumni-strawberry-energy/strawberry-smart-bench-features/; (3) https://www.trendhunter.com/trends/smart-bench; (4) https://strawberrye.com/smartBench.html; (5) https://www.luminexence.com/lotus-collection/; (6) https://togetherweplay.playlsi.com/2016/05/13/case-study-smart-playground-design/; (7) https://www.ecubelabs.com/solar-powered-trash-compactor/; (8) http://heart.huttcity.govt.nz/health-leisure/more-hydration-stations-make-water-the-easy-choice-for-lower-hutt-community/; (9) https://www.getsurrey.co.uk/whats-on/whats-on-news/10-surrey-parks-see-outdoor-23625944; (10) https://classpass.com/studios/houston-bcycle-hcc-central; (11) https://www.hydropoint.com/what-is-smart-irrigation/; (12) https://platiosolar.com/

The previous discussion raises some of the possibilities for reshaping Čair park into a smart park. For that purpose, the following smart parks solutions are recommended: (2,3) smart benches instead of seating areas along the paths (Figure 7-2,7-3); (4) smart shelters throughout the park (Figure 7-4); (5) technological tree (Figure 7-5) in place of the current canopies; (6) smart playground in the central part of the park (Figure 7-6); (7) solar bins throughout the park (Figure 7-7), especially at the intersection of dominant paths with higher frequency of visitors; (8) smart water fountain (Figure 7-8); (9) energy generating exercise equipment within

the existing outdoor gym (Figure 7-9); (10) IoT bike stations and solar bike shelter (if possible, in several locations), in the eastern part, opposite the arena (Figure 7-10); (11) smart irrigation (Figure 7-11); (12) energy generating pavement on the most frequented paths (Figure 7-12); (13) Wi-Fi; (14) solar lighting (ground and vertical) in parts of the park; (15) smart microclimate sensors in the southern part of the park; (16) automatic lawn mowers; (17) smart dashboard in the northeastern part of the park (and smart mobile applications); (18) sensors for visitors' monitoring; (19) solar panels – converting one part of the park into a solar park (in southwestern part of the park, owing to insolation conditions); and (20) smart CCV cameras.

The assumption is that the application of the suggested SUP tools in Čair park can contribute to its improvement and, in a broad sense, to well-being in the following ways: improving the existing urban furniture; improving greenery; saving water for irrigation; attracting a larger number of visitors; creating a favorable microclimate and outdoor comfort in summer; enabling a wider range of activities for children and youth; providing a better schedule of health and social activities; and reducing crowdedness. Additionally, smart parks solutions could offer the following benefits: improved provision of information about the park events and activities to citizens, residents, and future users; improved accessibility by bicycle; increased Wi-Fi availability; improved supply of electricity; improved supply of drinking water; increased biodiversity so as to reduce antisocial behavior; enhanced visual aesthetic values and attractiveness and beautification of the wider park environment; enhanced visual identity; and improved overall aesthetics of the space.

5. CONCLUSION

This paper briefly explained the concept and benefits of smart urban parks. The conducted research revealed that the introduced smart urban parks are a current and innovative trend for reshaping urban parks into sustainable and improved areas that are vital for citizens' well-being. In addition to the functional improvement of the parks, the importance of SUPs is recognized through a series of environmental, social, economic, and visual-aesthetic benefits that provide users with a space for a pleasant and safe stay and recreation. Based on the analyzed examples of best practice, it is concluded that the range of application of smart parks solutions is expanding in line with the ongoing rapid digital transformation of cities. The enormous Gardens by the Bay project confirms that the comprehensive implementation of a wide range of smart parks solutions can improve the quality of life by enhancing greenery and flora in the city and create an extremely favorable health and smart environment. The Queen Elizabeth Olympic Park demonstrates the importance of collecting various data trough sensors, which is of great importance both because of live 3D maps and because it makes the area more accessible, user-friendly, safe, and sustainable. Sensors in Poblenou Central Park in Barcelona enable real-time monitoring of vegetation and matching of irrigation with the real needs, which improves the quality of greenery while simultaneously saving water. Smart pavement in the park in the Glòries is currently a pilot project aimed at generating electricity for a couple of buildings, and it is expected to be applied to wider areas so that they may become self-sufficient in terms of electricity supply.

The conducted research showed that the application of various smart park solutions is possible in Čair park to reshape it into a smart urban park in theory. The research showed that this park has great possibilities for transformation into a smart park, primarily owing to adequate spatial opportunities for the introduction of various smart solutions, which would significantly contribute to citizens' well-being. For the wider application of SUPs at the city level, a more detailed examination is necessary, both for existing parks and for the newly planned ones. Considering the identified benefits of SUPs, in the case of new construction of urban parks it would be desirable to designate locations for a SUP as part of the Master Plan of Niš, and concrete guidelines should be elaborated through detailed regulation plans.

Regardless of the identified potential for the introduction of SUPs in the city of Niš, the implementation of most of them is very limited in the current social, economic, and institutional conditions for several reasons. Namely, the introduction of smart technologies in the organization of life in Serbian cities is much slower than in developed countries. One of the reasons is generally insufficient awareness of SUP benefits from the local government and the citizens. The application of the SUP concept requires large investments, both for installing sensors, equipping parks with smart urban equipment, and training workers to monitor the applied smart solutions, perform maintenance and repairs, and replace sensors and urban equipment. In addition, it is also necessary to adapt to the rapid progress of smart solutions, which must be adapted to the context, requiring continuous monitoring of the efficiency of the applications and their update.

Considering the identified institutional and financial problems and the problem of moderate smart solutions application in Niš, it can be concluded that, in order to apply the SUP concept in the city of Niš, it is necessary

to educate local authorities on the importance and benefits of SUPs for creating a smart and healthier environment, improvement of parks, and promotion of park use for urban recreation or exercise. When considering the possibility of implementing the SUP concept through the city development strategy, it is especially important to allocate funds for its implementation. The introduction of SUPs in the planning documents, which would provide for certain types of solutions in future urban parks, is also important. However, it is imperative to cooperate with the countries where SUPs already exist and to apply for financial aid for smart park solution installation. Smart parks are the future of cities striving for a smart and improved environment, and intensive application of smart solutions should be one of the key goals that the city of Niš pursues in the near future.

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URBAN RENEWAL AND CONSTRUCTION OF SHOPPING CENTERS AS A MECHANISM FOR THE INTEGRATION OF THE POPULATION IN DIVIDED CITIES ON THE EXAMPLE OF KOSOVSKA MITROVICA

Jelena Božović

Faculty of Technical Sciences, Department of Architecture,
University of Pristina, Kosovska Mitrovica, Serbia
Teaching assistant, MA Jelena.bozovic1@pr.ac.rs

ABSTRACT

The aim of this paper is to examine the impact of urban renewal and the construction of shopping centers in the coastal part of the Ibar River in Kosovska Mitrovica, as a mechanism for the integration of different ethnic communities living in these areas. Due to political reasons in the period after the war in 1999, the city of Kosovska Mitrovica has developed into two separate cities, south and north of the Ibar, and now faces division on national, ethnic, religious, and cultural lines. The assumption is that the urban renewal of the coastal part and the positioning of shopping centers have improved the quality of the urban environment and the intensity of space use in relation to the social and cultural values of the space. The general scientific method applied in this work is analytical-synthetic, while the basic method used is the case study method, which enables critical research and description of the researched phenomenon of behavior and social interaction of different ethnic groups in the appropriate spatial and temporal context. The method of grounded theory, as one of the methods of qualitative approach, will include constant comparison and theoretical comparison of research material, and is especially applicable in the research of actors and their activities. The paper contains a case study of urban transformation in Kosovska Mitrovica and epitomize the importance of urban renewal that contributed to the construction of accessible spaces that promote the social integration of the population in a divided city. The results of the research provide an answer to the question of whether and to what extent urban renewal and the construction of shopping centers in the years after the war in Kosovska Mitrovica influenced the interaction of different ethnic groups, as a mechanism of their integration.

Keywords: Kosovska Mitrovica, planning, urban renewal, shopping centers, integration

1. INTRODUCTION

Historical social ties on the territory of Kosovo and Metohija for political reasons in the period after the 1999 war weakened, and the city of Kosovska Mitrovica developed into two separate (parallel) cities, south and north of the Ibar, becoming part of a group of politically and ethnically divided cities, such as Sarajevo and Mostar in the region of old Yugoslavia, Jerusalem in Israel and Nicosia in Cyprus and others. In accordance with the arrangements of the Brussels Agreement signed in 2013 after local elections in Kosovo* same year, two municipalities and two settlements were formed: North Mitrovica with a Serbian majority population and South Mitrovica with an Albanian majority. The Ibar River is the natural geographical border of the two cities. The city develops rapidly, but as two separate administrative, educational, and cultural centers. The spatial divisions of the post-war urban development of Kosovska Mitrovica are discussed in their symbolic, ethno-demographic and institutional dimensions. The city still experiences extreme divisions related not only to nationality, ethnicity, religion and/or culture, but also in physical terms.

The aim of this work is to examine the impact of urban renewal and the construction of shopping centers in the coastal part of the Ibar River in Kosovska Mitrovica, as a mechanism for the integration of different ethnic communities living in these areas and reveals:

- Does the urban renewal of the river Ibar coast shore by the positioning and design of shopping centers contribute to the improvement of the quality of the urban environment and the intensity of use of the space with reference to the social and symbolic values of this space,
- How residents of divided cities communicate in common public spaces and why daily visits to shopping centers are important,
- How does the use of these spaces affect inter-ethnic relations,
- Can shopping centers be considered tools that contribute to conflict transformation efforts in the contexts of divided cities?

The research was conducted by combining several basic methods and techniques that are used in the field of architecture and urban planning, as well as related areas of social sciences, primarily sociology and urban psychology. The general scientific method applied in this work is analytical-synthetic, while the basic method used is the case study method, which enables critical research and description of the researched phenomenon of behavior and social interaction of different ethnic groups in the appropriate spatial and temporal context. The method of grounded theory, as one of the methods of qualitative approach, will include constant comparison and theoretical comparison of research material, and is especially applicable in the research of actors and their activities. The paper contains a case study of urban transformation in Kosovska Mitrovica and boils down to the importance of urban renewal that contributed to the construction of accessible spaces that promote the social integration of the population in a divided city. Observation is the main tool for implementing qualitative methodology in the field and includes a variety of activities ranging from meeting people in shopping malls, to getting to know people and learning routines for using strict temporal sampling to record actions and interactions. Observation is further defined as the systematic recording and recording of events, behaviors, and interactions in a social environment. Using the method of logical argumentation and analysis, answers were given to the question of whether and to what extent urban renewal and the construction of shopping centers on the banks of the Ibar in Kosovska Mitrovica partially integrated the divided population.

2. PLANNING IN DIVIDED CITIES

Divided cities are a common phenomenon in the modern world. Each individual case is influenced by a specific, inherent series of influencing factors and consists of as many different forms of manifestation of division. A search for the term ``divided city'' reveals the work of many scientists who use the same term but have very different research perspectives, and thus different approaches in identifying and categorizing this phenomenon appear.

In cities around the world, inequalities are reflected in the division into wealthy and depressed districts. Urban studies tend to offer a dual explanation for these divisions. On the one hand, there are moderately divided cities: multicultural, more or less peaceful cities. Here, divisions mainly occur due to production processes, class, race, and gender relations, increasing inequality between rich and poor, and urban segregation. On the other hand, there are cities that are "extremely divided" - disputed cities, where division occurs over less negotiable aspects such as nationality, ethnicity, religion and sovereignty of physical space.

When dealing with divided cities, the planning profession becomes deficient to deal with the intense situations caused by conflicts over the sovereignty of physical space. To overcome the narrow framework of planning of physical usage of the space, the approach must be carefully conceptualized. Considering that planning has the power to change the spatial, economic, social, and political dimensions of urban space, the question appears, which of these dimensions can be used to intensify or reduce competition for space in divided cities? Contemporary urban planners and theorists Scott A. Bollens and Oren Yiftachel who deal with planning in polarized cities propose a group of ethnic dimensions that are used in planning processes to exercise control or repression therein:

- The territorial dimension is the most powerful tool used to control and distribute ethnic groups spatially via the usage of zoning policies. Problems of land ownership, drawing of jurisdictional boundaries, displacements etc. are also important tools for control;
- The procedural dimension can be used to include or exclude different sections of society from access to decision-making processes;

- The economic dimension is used to allocate urban services and spending. The negative and positive externalities of urbanisation are distributed by planning processes causing situations like deprivation or dependence of certain areas;
- The cultural dimension where group identity is maintained or threatened through cultural institutions, education and religious expression (Bollens, 2002).

According to these scholars, planning must include the above conditions in order to achieve an effective planning process in divided cities. Building on Benvenisti's (Benvenisiti, 1986), Bollens proposes four modes of urban planning: natural, partisan, equity, and resolver strategy. (Table 1.).

Table 1. Models of urban policy strategies (adapted from Benvenisti, M. 1986; Bollens, S. 2007.)

Urban Planning Mode	Strategies
Neutral Strategy ***Tactic:*** **Address urban symptoms of ethnic conflict at individual level**	• **Employs technical criteria in allocating urban resources and services** • **Distances itself from issues of ethnic identity, power inequalities and political exclusion**
Partisan Strategy ***Tactic:*** **Maintain/Increase Disparities**	• **Furthers an empowered ethnic group's values/authority and rejects the claims of disenfranchised group** • **Strategies seek to entrench and expand territorial claims or enforce exclusionary control of access**
Equity Strategy ***Tactic:*** **Address urban symptoms of ethnic conflict at ethnic group level**	• **Gives primacy to ethnic affiliation in order to decrease inter-group inequalities** • **Allocation of urban services and spending is based on group identity**
Resolver Strategy ***Tactic:*** **Address root causes/ sovereignty issues**	• **To connect urban issues to root causes of urban polarization** • **Impacts and authority of government policy is challenged**

Gizen Caner and Fulin Bölen in the work *`Urban planning approaches in divided cities'* investigated the approaches of many theoreticians about planning in divided cities (Caner, & Bolen, 2016). How does the role of planning affect the mitigation or aggravation of urban divisions in society, analyzing four cities: Berlin, Beirut, Belfast, and Jerusalem. They concluded that except for Berlin, all other cities continue to experience extreme divisions related to nationality, ethnicity and religion, culture as well as physical division. They believe that the current interventions in the cities concerned solve the problems arising from the division. In these cities as actual approaches the planning methods of urban renewal and reconstruction of broadline / contact areas has proven tangible through diversified spectra of projects aiming for commercialization of city, primarily shopping areas due to the impact they have on the wider city physical and social context and use. Urban renewal is the broadest term that include all types of urban regeneration processes which includes urban recycling, reconstruction, interpolation, rehabilitation (Vanista-Lazarevic et al, 2018). On one hand, urban renewal and the construction of shopping centers as closed public city spaces proved to be: a concern for social and functional integration and a response to the social and spatial segregation of the city and, on the other hand, a means of marketing localities and places that are consumed by all ethnic groups.

3. ROLE AND SIGNIFICANCE OF SHOPPING CENTERS

The role of public squares as a place where mutual relations and social interactions occur and developed has disappeared in a functional but not symbolic sense, so it is crucial to recognize how they were compensated in a time when the needs of the population became even more complex. Many authors who deal with the problem of the city consider shopping centers as large trading houses where, in addition to shopping, the needs for communication and entertainment can be met (Petrovic, 2009).

The emergence of shopping centers is primarily linked to the development of the automobile industry and the advent of ``sales box'' facilities on the outskirts of cities, primarily in American cities, until the transformation and development of those facilities into multifunctional spaces for recreation and spending the free time of consumers, due to numerous influential factors. The built and formed fabric of the city environment is transformed by the construction of the shopping center, and the influence of the shopping center changes in relation to the positioning in certain urban areas and the physical, functional, social, and symbolic characteristics of the object. Shopping centers greatly influence the quality of the immediate urban environment, as well as changes in consumer habits and ways of using space. The influence of the space of consumption in the creation of the city's vitality, the revival of the historical role of socialization in commercial spaces, the creation of a new symbolism of the city, as well as the revitalization of certain city areas was

noticed. In some cases, shopping centers develop into generators of urban development in some parts of the city, creating new forms and transforming existing structures. The shopping center is a representative of modern consumer spaces and is seen as a place of interaction between the environment and actors and between actors (Đukić & Cvetković, 2017). As a result, shopping centers has become new centers of social life - a place of socialization, spectacle trade, information exchange, etc. First, these are places that are the product of a particular society and quite adapted to modern consumers. These are fully equipped spaces, in which unified specialized stores, hypermarkets, various services, activities, entertainment, cultural and other contents that allow relaxation, leisure and socialization of users. All this is offered in a unique location, in a specially created architectural unit, where unique conditions prevail, from the interior design to the air conditioning of the entire space. Shopping centers are also characterized by communications, where all the offered contents are connected and accessible through public spaces, which are carefully planned. Mandatory content of these constructs are spacious and free parking lots, often easily accessible, next to traffic roads, thus achieving the condition of maximum openness and accessibility. and spatial connectivity.

Locating shopping centers in the built-up urban fabric has an undeniable impact on the economic, ecological, and social aspect of that area. Contemporary economic, cultural, and social conditions contribute to the change and development of shopping centers, turning them into new magnets in the organization of the immediate urban environment (Đukić & Cvetković, 2016).

3.1. Socio - social aspects of shopping centers

In the modern course of urban development, one of the most important changes is reflected in the reshaping of public space, which has the characteristic of not only changing the role in the public life of all citizens, but also influencing the very way of communication between members of society (Petrovic 2009). The role of public spaces, from ancient times is to gather residents on spaces where questions of the general social interest are resolved. As much as cities change and affect the transformation of public spaces, their basic role is to attract many people to a certain place in order to satisfy certain needs and participate in a complex network of social roles and positions, and accordingly position themselves in society (Stanic, 2010). Some theoreticians believe that shopping centers are a good solution for establishing order against disorder on the streets, not referring exclusively to the disorder caused solely by traffic jams, lack of space for unhindered movement or the opposite, but to the chaos caused by crime and political disagreements to which public space is exposed. The magic of the shopping centers is carefully constructed to contrast with the perceived weaknesses of the modern city and the supposed disorder of its terrifying streets. The social space of the shopping center presents itself as a kind of metaphorical and idealized version of the city street (Dzekson, 2002).

Consumer places have always been public spaces of economic and trade connections, but also of social liveliness that resulted from various events that occur in these places, as well as communication and interaction of participants. Thus, shopping centers, even to a greater extent than other places of consumption, are establishing themselves as social spaces. The American sociologist G. Ritzer believes that since shopping centers are intended primarily for commercial purposes, it is a real irony that they have become a kind of community or local club whose advantages they find and where all age groups gather (Ritzer, 2009). However, Sharon Zukin believes that although they are places of mass gathering, sociability in shopping centers is characterized by sterility and social uniformity (Zukin, 1998). Jan Gehl believes that if the spaces where daily chores are carried out allow for casual entertainment, then such spaces can be viewed as quality spaces, which further leads to the conclusion that the social aspects of shopping centers can affect the quality of the immediate urban environment (Gel, 2016).

Viewed from the point of view of architecture and urbanism, objects and spaces that stimulate diverse social contacts and contextualize the spaces of shopping centers in accordance with the culture of the socio-spatial entity in which they are located can reduce the negative effects of "non-place" and the globalized homogenization of consumption space. With the evolution of shopping centers and the formation of a space that is suitable for the organization of various events, the shopping area becomes a meeting place and a place of activity, thus contributing positively to the social characteristics of the immediate urban environment. The tendency of shopping centers is to absolutize Gruen this transfer, that is, the point where we stop being guided by our attitudes and emotions and completely surrender to the fluid ``space'' of products, prices and advertisements. This is only possible when we are not aware of the need to leave, but when we feel ``at home'' in the shopping center. The reason for the demand for shopping centers in today's society lies in the ability of these spaces to meet the needs of routine consumption (Gruen, 2016).

Much research that have been conducted show that people prefer visiting shopping centers because of: climatic comfort, content concentration, safety, accessibility and parking, product brands, content and activities, easy navigation, etc.

4. CASE STUDY – KOSOVSKA MITROVICA

This case study analyzed the urban renewal and construction of shopping centers in the area along the banks of the Ibar river in Kosovska Mitrovica after the 1999 war in Kosovo and Metohija until today. The historical evolution of the division of the city and how the newly built shopping centers infiltrated the daily life of citizens of different ethnic communities is shown.

4.1. History of the city division

Kosovska Mitrovica is a town settlement and the seat of the municipality of the same name in Serbia, which is located in Kosovo and Metohija and is one of the oldest settlements in this region. It is mentioned for the first time in medieval written documents. The name Mitrovica originates from the 14th century, after the church of Saint Demetrius of Thessaloniki, which was under the Zvečan fortification, and which in 1315 the Serbian king Milutin donated to his endowment - the Banjska monastery. As a result of the 1999 conflict, Kosovska Mitrovica became an important border town between areas dominated by Serbs and Albanians. Over the centuries, until the 1990s, Mitrovica was a multicultural city, an important industrial center, an important communication hub and a center of cultural development. The process of polarization of the urban community was less noticeable, observed from the late 1980s until the radical division in 1999 and is connected with the process of political transformation, the breakup of Yugoslavia and the Albanian-Serbian conflict over Kosovo and Metohija. After the bombing in 1999, this city became the focus of ethnic conflicts between the two communities. The international forces of KFOR and the UN police occupied the main bridge on the Ibar river to prevent the escalation of the conflict. The division of the municipality of Kosovska Mitrovica into two de facto municipalities, North Kosovska Mitrovica with a Serbian majority, and South Kosovska Mitrovica with a Albanian ethnic majority, institutionally, geopolitically and ethnically, contributed to its functioning as two separate cities even today.

4.2. Urban transformation and analysis

The area in question (the coast) is located on the right bank of the Ibar river, not far from the eastern bridge in the southern part of Kosovska Mitrovica, where the majority Albanian ethnic group lives. This border area occupies an area of 15 ha, and was built in the period from 1962 to 2001, according to the only planning document of the GUP from 1962, according to which the purpose of city services is foreseen in that part. It can be seen from Figure 1 (a,b) that the built physical structure did not change until 2004. Spontaneous urban renewal from 2004 to today has transformed this area. According to the principle of individual, locational design, the furniture factory was reconstructed, the HTZ equipment factory, the Auto-moto Association and several warehouses were demolished, and shopping centers (Lux moll, Emona city- Viva fresh store, Interex and ETC) were built on that land. A block of individual housing and a social housing building were removed, and several high-rise multi-family housings were built. Based on the maps in Figure 1, it can be concluded that until 2004 there was no spatial and functional connection of built structures within the area, which indicates the poor quality of the urban environment. After 2004, with the positioning of shopping centers, the spatial concept of the coastal area fundamentally changed. By transforming the existing structure and creating new forms through the positioning of the consumption space, the coastal area was reshaped, and the new type of buildings reflects the individualistic and materialistic nature of the social structure, taking over the former functions of public city spaces. Newly built shopping centers have an impact on the immediate urban environment viewed through the dimensions of the physical and functional `offer` that the space provides, the social dimensions of `use`, i.e. the interaction and activities that the space offers to different ethnic communities, and the symbolic dimensions of the `meaning` of the space, as well as their relationship.

(a) (b) (c)

Figure 1. Transition of urban renewal through time and ambient changes of the coast:
(a) the state of the spatial structure in 1995: 1. Auto-moto association, 2. HTZ equipment factory, 3. Warehouses, 4. Furniture factory, 5. individual housing, 6. social housing; (b) state of spatial structure in 2004: 1. Auto-moto association, 2. HTZ equipment factory, 3. Warehouse, 4. Furniture factory, 5. individual housing, 6. social housing, (c) state of spatial structure in In 2022: 1. Shopping mall ETC, 2. Shopping mall INTEREX, 3. Shopping mall Emona city-Viva fresh store, 4. Lux mall, 5. multi-family housing.

4.3. Data collection and analysis

Relevant data were collected by the observation method, that is, by observing and recording the behavior and social interaction of users in the subject area, by communicating with citizens of Serbian nationality and personal experience, in different quarters several years ago. A matrix was used to record the number, structure and behavior of users in different time intervals. The target population for this case study consisted of all age groups of visitors from both ethnic communities, and the research showed that mostly young people with families and women are the most active visitors to these shopping centers. What is characteristic is that the majority of users of shopping centers are citizens of Serbian nationality, while the employee are Albanian nationality. Table 2. shows the results of the research in which period of time the Serbian population visits shopping centers, which indicates that this population mostly uses the services of these consumer areas in the interval from 14:00 to 20:00. It should be noted that there are also those who do not use the services of shopping centers at all, but the percentage is small.

Table 3. shows the results of research recorded based on many years of communication with the Serbian population about the factors that influence their daily visits to shopping centers, even though they are positioned in the coastal area on the south side of the city, which was not accessible to them for many years due to the division and physical sovereignty of the area. The research results indicate that the Serbian population visits shopping centers because of the variety of offers and services. The variety of products is adapted to the population with different budgets, and the concept of `branded goods', which is offered and attracts many consumers, should be emphasized (rating 4.2).

Table 2. Use of shopping centers by Serbian population in time period 8h - 22h

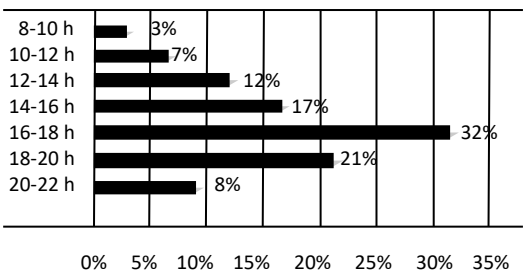
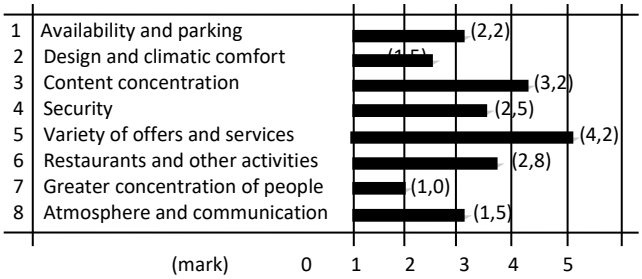


Table 3. Factors of use of shopping centers by Serbian population



The offer of food products and catering services in restaurants has a positive effect on consumer satisfaction (grade 2.8). The advantage of a location-concentrated offer where you can get the desired product in a short time with all the comfort of shopping in a closed, air-conditioned center is another reason for the large number of visitors to shopping centers (rating 3.2). The attractiveness of the interior space and climatic comfort is not a decisive factor in the use of these commercial spaces, but certainly an advantage in the concept of using these spaces. (Grade 1.5). The modern trend of installing surveillance cameras in shopping centers aimed at controlling potentially problematic consumers in a divided society in terms of security and control is another factor that makes them decide to consume goods and services in shopping centers. It should be emphasized that the safety factor also refers to the physical environment and the safety of the pedestrian path that the Serbian population from the north moves on (grade 2.5). Given that the shopping centers are located in the coastal part of the city within a radius of 100 m, from the eastern bridge that separates the north from the south part, along with all the components of the urban environment, the respondents point out traffic connectivity, accessibility, proximity and a sufficient number of open parking spaces as advantages due to which they decide to visit every day. (Grade 2.2). A higher concentration of both populations is observed in periods of the year when there are religious or national holidays, so mass gatherings are avoided then (Grade 1.0). The atmosphere in shopping centers is made up of modern interior spaces (Đukić, & Cvetković, 2016), where mostly foreign music, scents and lighting provide a pleasant ambience attractive to consumers. From personal experience and from conversations with citizens in shopping centers, interactions between ethnic groups are realized at the most modest level, of low intensity. Social activities of low intensity refer to the communication (Amin, 2002) of visitors and employees with the awareness of a possible starting point of contact on other levels, maintenance of previously established friendly ties and information about the offer and services in mutual communication (grade 2.1).

5. LIMITATIONS ON RESEARCH

The fact is that the research was conducted in limited conditions, in the area along the banks of the Ibar River, which for many years was inaccessible to the Serbian population due to the polarization of the city of Kosovska Mitrovica. These limitations should be taken into account when interpreting the research results. During the preparation of the case study, there was no understanding of the municipal administrations when it comes to obtaining geodetic bases and plans. Difficult and insufficient communication with the larger Albanian population is another limiting element in the implementation of this research. Results may vary due to the inability to conduct research in a more efficient manner.

6. CONCLUSION

The analysis of relevant data provided answers to the questions about the role of urban renewal of the river bank and the construction of shopping centers, about its positive contribution in terms of improving the urban environment and the greater intensity of use of this space compared to its earlier social and symbolic value. In relation to the previous quality of the space, the activities and the intensity of the activities carried out in that space are changing, as well as the frequency of users of the space and the time they spend there. Residents of this divided city from different ethnic communities make connections at a low level by visiting shopping centers, but this interaction is also the beginning of integration and a way to improve inter-ethnic relations. Therefore, shopping centers can be considered tools that contribute to conflict transformation efforts in the context of this divided city.

Urban renewal and construction of shopping centers on the bank of the river Ibar in the southern part of Kosovska Mitrovica is: on the one hand, a concern for social and functional integration as a response to the social and spatial segregation of the city and, on the other hand, a means of marketing localities and places that are consumed by all ethnic groups. Urban renewal can be considered as a mechanism for the integration of the population in divided cities, which has been proven on the example of Kosovska Mitrovica.

This research is important for Kosovska Mitrovica, and it can serve as a basis for exploring the same issues in other divided cities in Kosovo and Metohija, as in cities in the former republics of Yugoslavia.

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MODELS OF INFORMAL URBAN DEVELOPMENT

Marko Milosavljević

University of Belgrade - Faculty of Architecture, Republic of Serbia
PhD., Student, markomilosavljevic118@gmail.com

Eva Vaništa Lazarević

University of Belgrade - Faculty of Architecture, Republic of Serbia
PhD., Full Professor, eva@arh.bg.ac.rs

Jelena Marić

University of Belgrade - Faculty of Architecture, Republic of Serbia
PhD., Assistant, jelena.maric@arh.bg.ac.rs

ABSTRACT

The process of settlement development is conditioned by legal, sociological, cultural and logistic factors which create the form of standards and limitations that shape space. Supported by a legal basis, a certain area may represent construction potential. The focus in this research is on the determination of a potential space adaptable for permanent or temporary use. Concurrently, the goal of this paper does not only include the process of settlement development, but the paper is also focused on problems in the development process. Considering that the legal basis often deconstruct the process of settlement development, the task of this paper is to investigate various factors that result in unplanned, free and individual construction, enlightening the profiles of informal space development. Through examples in practice, the methodology of systematic review of literature including achieved scientific results in the field of informal urban development will be applied, and an analysis will be made of the application of guidelines for the implementation of planning documents in the area of National Park "Tara", National Park "Kopaonik" and Park of Outstanding Features "Vlasina". In practice, informal development is often associated with the theory of uncontrolled and unpermitted construction, but an insight into the results achieved by this research will comprise an insight into various profiles of informal urban development that do not only include unpermitted and illegal construction, but are the result of theoretical shortcomings and gaps in legal regulations that will be considered in further research. The goal of this research paper is to identify problems in planning elaboration and their impact on spatial development, as well as to investigate possibilities for the application of informality models observed through the systematic review of literature to selected case studies. In accordance with the foregoing, the research is focused on the procedure for the implementation of spatial plans for special-purpose areas and on the impact of these plans on spatial entireties.

Keywords: *Informal development, legislation, construction potential, profiles of construction, planning elaboration*

1. INTRODUCTION

The concept of informal, as a modern term at a global level in the second half of the 20th century, theoretically sets an opposite approach to formal in the sphere of educational, sociological, urban and development systems (Kim Dovey, Incremental urbanism, 2018). Informal development arises out of individual or cluster activities of every individual capable of interpreting possibilities and limitations and of elaborating a design, solution beyond a controlled system supported by legislative, formal regulatory acts (Hesam Kamalipour, Habitat International 2020). Considering the application of legislation in the domain of a protected area of extraordinary and great importance, goals and issues of the subject of research are set. Spatial and

functional entireties supporting several classes of public and other purposes within their borders continuously tend to widen the useful borders (Kim Dovey, Incremental urbanism, 2018). Within the interpretation of the difference between formal and informal in a development system, the problem of "informal" as potentially illegal or uncontrolled may be elaborated and development arising out of this model is opposed to formal, due development.

Through an analysis of diverse, abundant literature addressing the potentials of "informal" and analysing the advantages and shortcomings, potentials and deficiencies of informal, as well as the indicators and values of informal development, one gains the impression that interpretation from the local aspect is opposed to interpretation at regional and global levels to a great extent. The concept of "degree of informality" raises the question of whether what is informal is also illegal and whether it must necessarily be illegal. Is it inevitable for cluster planning to become informal and, first of all, what is a cluster and what is an individual in planning (Harris, R., 2017)? What is informal planning like and has the interpretation of informal in Serbia through the planning programme been reduced to a pronounced degree of a potential, organised offence and the so-called "grey zone" or is it defined as an incidental, individual factor of groundless planning support? The goal of this research paper is to provide answers to the said questions, as well as to any forthcoming ones, that will be set as support in the preparation of the paper.

The goal of this research is to identify the hidden threat arisen due to the incomplete preparation of a Spatial Plan for a special-purpose area and due to a lack of elements for the further elaboration of a certain zone in this planning document, as a separate problem. Speaking without theoretical justifiability that this is a case of a planning gap, the goal is to apply the models of informal to the said problem, which would be applied from available literature and scientific researches, and determine this as a characteristic of the creation of an urban area, which is not presently considered an element of uncontrolled construction, but which may be considered introduction to informal development. In this research paper, the goal is to identify problems related to the level of details in the urban elaboration of the Spatial Plan for the special-purpose area and to identify the problem of its direct application. The Spatial Plan for the special-purpose area is the basis for direct implementation on the respective plot, but in its textual and graphical parts there is no basis for detailed elaboration, i.e. there are no specific urban parameters for further implementation.

The scientific justifiability of this research paper is reflected in widening the knowledge related to a problem which has not been given special importance in the domain of urban and strategic spatial development, as can be established on the basis of comprehensive research. The scientific justifiability of this research is also reflected in the results of case studies used as examples – used spatial plans for special-purpose areas in interaction with the research results achieved in the domain of formal and informal urban spatial development with the use of foreign and domestic examples. The examples used, relevant to the subject of the research, indicate the use of potential omissions in the procedure for the preparation of a planning document as an implementing act for individual or cluster needs, and they are applied in this research paper as models of good or bad practice. The indication that interventions are possible precedes the observation of a problem in its initial stage, in the stage of observing the potential of a certain space or location, zone, and this research paper makes conclusions that are supposed to be applicable in the further practice of planning elaboration.

2. METHODOLOGICAL APPROACH:

The methodology applied in this research paper is related to the application of scientific research results obtained in the field of spatial planning and informal urban development (systematic review of literature), for the purpose of understanding the concept of informality. In this case, the analysis applied is related to the interpretation of the categories of informal. The method for analysing the potential threats, weaknesses of and possibilities for interventions in a certain zone of a special-purpose area will be presented by the application of possible scenarios recognized as examples in practice with the use of implementing planning documents.

The criteria for the selection of case studies in this research have comprised the profiles of elaboration areas of the same rank. In this case, the criteria are as follows:

- Purpose of the area: protected natural resources – outstanding features of natural resources;
- Profiles of protection: protected areas – national park / park with outstanding features;
- Different applications of urban parameters;
- Different applications of legislation due to time intervals.

3. THEORETICAL RESEARCH:

The concept of "informal" is applied in various profiles of scientific fields. The reliance of this concept is the concept of formality, i.e. the concept of regulated status generally present in a "fair" culture. Considering the spatial development process, i.e. the development process of a functional entirety – space that, depending on its capacities, may represent a certain urban block, urban tissue, infrastructural section or a whole settlement, by basic rules its elaboration has been carried out by the application of regulative and legal norms prescribed by a third party – decision-making party (controlling party) that defines the general and specific terms and conditions for the determination of possibilities and limitations of construction. Therefore, the urban planning has been done with the application of a spectrum of legal planning acts, acts of law and by-laws and it covers a certain space through the aspects of development. Although the decision-making, controlling party, the so-called competent authority, is regarded as the designer and organiser of regulated spatial development, the subjective interpretation of the space implemented by the above mentioned competent authority by permanent or temporary users of that space may contribute to general dissatisfaction which is often preceded by the neglect of these users' role.

A planning document is elaborated by experts from various scientific research fields. The planning document prescribes general and specific rules, depending on its category, and it represents the direct basis for the implementation of a certain area. One of the goals of the planning document is to set the rules of horizontal and vertical control on an individual plot if this is an urban plan, or this may be a spatial plan that may be considered the direct basis for further implementation on the characteristic subject matter plot. In addition, the task of the planning document is to make guidelines for further implementation, to prescribe specific terms and conditions and redirect the elaboration of a certain area through mandatory preparation of a planning document of lower order or a design. The general question is whether the third, competent party correctly prescribes something as formal. To what extent formal is really formal? In what percentage is an interested party, participating party, involved in the elaboration of a certain planning document, a certain act of law or by-law and, first of all, what us the power of participation? The professional parties, whose role is the preparation of such a by-law, often consider an area in theoretical terms, i.e. consider it only within the framework of envisaged urban parameters prescribed by other by-laws – rulebooks or existing planning documents applied as examples of good practice. The said professional parties often are not permanent or temporary users of the area covered by a planned planning document, which may have adverse effects on the understanding of advantages, possibilities and threats of the covered space. Insufficient investigation and unprocessed additional analyses of the space often lead to a final product of a certain planning document that will primarily be professionally supported. In practice, its application might be disputable in certain sections. From the date of application of a planning document, i.e. from the date of its adoption in the Official Gazette, its application will be the subject of a subsequent analysis of its efficiency. This is related to the elements of implementation by which, through the preparation of individual conceptual solutions, urban and preliminary designs or urban plans, the presence or absence of successfulness of the prepared planning document will be determined (Gligorijević Ž, 2017). Considering that the theoretically supported implementation elements of a planning document often cannot be implemented due to insufficiently examined analyses after its adoption, consequences become visible over time through individual interaction of every person with the covered area.

3.1. Planning Gap

For better understanding of the problem of informality in spatial development, this research continuously discovers knowledge of applied practice related to the foundations of legislation at the level of the Republic of Serbia. Theory of applied practice has not been determined by previous researches, but, as a concept in the practice of implementation of planning documents and strategy of spatial and urban planning, it is designated as "a planning gap". According to free interpretation, the planning gap comprises areas not supported entirely or partially by a planning basis, and therefore this concept is not only related to implementing planning documents but also to the foundations of their preparation, legislation and by-laws. In practice, the planning gap is most often interpreted as failure in the application of regulative acts, but its existence is increasingly frequent. The theoretical, planning or legal gap does not have its scientific research background and therefore its definition cannot be given concisely and clearly in this research. The reasons for mentioning this concept have arisen out of the need to determine the case study of this research paper and, accordingly, the following questions arise: Are the case studies of this paper regarded as elements of informal development or are the shortcomings of their foundations, planning documents and regulative acts regarded as elements of the planning gap? What is the difference between informal development and the planning gap and can these two

concepts be categorized as the same problem by the determination of the profiles of informal development in spatial and urban planning, or can the so-called planning gap be regarded as introduction to informal development?

3.2. Systematic Review of Literature: "Models of Informal Urban Development" *(Harris R., 2017):*

The urban character of informal development is manifested through several models and profiles, in particular through latent, diffusion and incorporated or dominant models. The author of this paper raises the question of the norm of informal. The author also implies the assumptions that informality represents failure or limitation in planning. Omissions in the preparation of a planning document occur in the dysfunction of all the previously mentioned participants (Roy, 2009). The authors of informal development research often suggest that a planning omission is unforeseeable threat that often cannot be controlled and this is why the concept of informality in planning is very complex. The main reason for informal development research arises out of the thin line between legal and illegal and out of ultimate outcomes in planning (Harris, R., 2017). Following the previous views of the author, as well as the views from the literature used, the foundation for understanding the previously mentioned omissions through an analysis of the data in a planning document is set. It is assumed that imprecise or inconsistent elaboration of a space leads to various types of construction and use of the potential of the space. The question of whether the lack of basic parameters directly dictating the elaboration of a facility on a specific plot is also deemed informal development, states the key theory of planning gap. It is suggested that the planning gap initiates individual construction that is supported by the existing rules and legal norms, and as such it is not regarded as an offence, but as a consequential result of the previously mentioned groundless analysis (Connolly, 2009).

Latent informality arises out of hidden, unforeseen problems, omissions unconsciously or consciously arisen out of the established regulation of space (Harris, 1991). Starting from the specific rules of arrangement and established urban parameters that arrange certain neighbourhoods and construction areas with horizontal and vertical control including communal equipment, wider and narrower contexts of usefulness of an implementing space, relation towards neighbouring existing and planned facilities and height in accordance with the existing and planned height regulation, detailed elaboration of a space is only carried out in entireties divided into zones. The complexity of the applied analysis includes several participants in every part of the covered space for which a planning document is prepared (Cornelius, 1976).

Diffusion or apparent informality, the so-called most widely known profile of informality, is related to fragmental elements that cannot be controlled by a certain planning document, that are spatially invisible (in demographic terms) and that are related to fragmental development at small scales (Harris, R., 2017). They are related to the elements of housing units, common rooms in a certain facility and they are implemented through the internal role of every neighbouring owner of a certain entirety, plot or private space (Harris and Kinsella, 2017).

In order to better understand this profile, in practice regarding the fulfilment of construction requirements, there is often an outstanding possibility for agreement among the neighbouring owners of certain plots, spatial entireties, which is reached upon the collection of construction requirements. Certain boundary lines defining the distance of the planned facility in relation to neighbouring facilities can be shifted on the basis of internal agreement, consent of a neighbouring owner, upon which the horizontal control from the prescribed and adopted planning document is not applied. In terms of diffusion, this profile may also refer to the free form of a cluster in which participants, owners of separate parts of a certain urban zone or area individually develop the space in accordance with their own needs on a long-term scale.

The profile of **dominant informality** is especially significant and examples of this profile in practice are increasingly represented. It arises out of cluster, migration groups that apply free, individual or uncontrolled construction in an area that is not covered by general rules of arrangement in relation to existing and planned purposes. The profile of open, i.e. dominant informality often results in positive regulation of the state as is, i.e. regulation of the state as is that meets the needs of individuals, individual participants (Castells and Portes, 1989).

3.3. Application of the Models of Informal Development in the Examples of Selected Case Studies:

The methodological approach of space syntax and syntax of systematic review of literature relevant to the analysis of informal development initiates an analysis of examples of informal in various scientific fields and as such it leads to the conclusions that will be applied in further research as the elements of good practice or elements of bad practice in the special-purpose area of National Park "Tara", special-purpose area of National Park "Kopaonik" and Park of Outstanding Features "Vlasina" the implementing planning documents of which address general and specific problems of the implemented goals, strategy and planning elaboration. In further research, the models of latent and dominant informalities will be applied, as they are more significant in the domain of spatial and urban planning in the Republic of Serbia than diffusion informality related to small areas.

3.3.1. Models of Latent Informality in the Special-Purpose Area of:

National Park "Kopaonik"

Upon an insight into Referral Map 3 of the Spatial Plan for the Special-Purpose Area of National Park "Kopaonik": Guidelines for the Implementation of the Plan, it has been established that the borders of parts implemented by the mandatory preparation of an urban planning document or by the existing urban planning document are visible. Depending on implementation, three profiles of the application of planning documents are stated, in particular as: implementation by detailed regulation plans that should be harmonized with amendments to the Spatial Plan, implementation by detailed regulation plans that are completely harmonized with amendments to the Spatial Plan and implementation by direct application of the rules of arrangement and construction derived from the Spatial Plan. In further research, this paper is focused on problems in the implementation by planning documents that should be harmonized with the amendments. The view included in the section titled: Guidelines for the Implementation of the Plan in the textual part of this planning document states that lower order planning documents may exceptionally be applied in parts that are not contrary to the adopted Spatial Plan for the Special-Purpose Area of National Park Kopaonik[2]. In addition, the Spatial Plan may also prescribe the time limit for making amendments to the existing planning documents, but no part of such a plan is declared null and void. The main question posed at this moment is: Who implements the procedure for investigating the harmonization of the existing planning documents with the just adopted planning document, i.e. spatial plan?

In accordance with the Law on Planning and Construction, a Plan Committee is formed for verifying the harmonization of regional spatial plans, spatial plans of a local self-government unit and urban plans at their preparation stage, within 15 days from the date on which they are submitted for verification3. This Paragraph of the Law on Planning and Construction is applied at the time a planning document is being prepared, for verifying its harmonization with the higher order planning document, the spatial plan for a special-purpose area, but it is not known which controlling person assesses the harmonization of the existing planning documents with the spatial plan for the special-purpose area if no decision on their amendments has been made. This factor is regarded as a reverse verification system. It is supposed that different rules of arrangement and construction of the existing detailed regulation plans and spatial plan for the special-purpose area will represent a problem in the further application of the Guidelines for Implementation, considering that the Law on Planning and Construction does not define any competent authority, i.e. competence in the implementation of the previously mentioned procedure.

[2] Section 5.0 Textual part of the Spatial Plan for the special-purpose area of National Park "Kopaonik" ("Official Gazette of the Republic of Serbia", number 89/16)

3 Article 33, Paragraph 7 of the Law on Planning and Construction

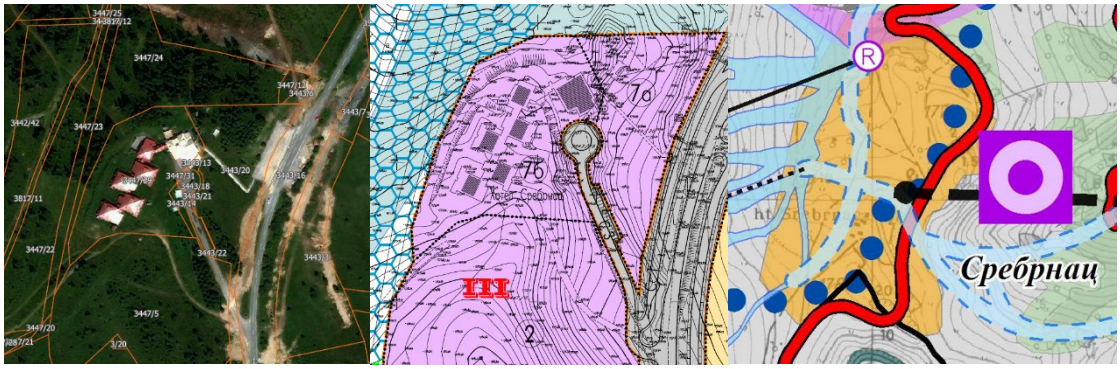

Figure 1: Integrated graphical presentation of the comparison of the planned purposes of areas and graphical presentations from the Detailed Regulation Plan of "Srebrnac" ("Official Gazette of the Municipality of Brus", number 06/07) and the Spatial Plan for the Special-Purpose Area of National Park "Kopaonik"

National Park "Tara"

Upon an insight into the graphical presentation of Referral Map 4: Guidelines for the Implementation of the Spatial Plan for the Special-Purpose Area of National Park Tara ("Official Gazette of the Republic of Serbia", number 44/20), it has been established that the surface area of the direct implementation of this Spatial Plan is visible and that its percentage is significantly higher in relation to the surface area of implementation based on urban planning documents.

In order for a certain spatial plan to become the basis for direct implementation on a characteristic cadastral plot, the textual content of this plan must include the basic and specific parameters of construction, requirements, limitations and possibilities for construction, which will, in the subsequent period, inter alia, become the basis for the preparation of a conceptual solution, urban and technical preliminary design or lower order plan. A spatial plan of this rank is prepared with a scale of R 1:25000, while an urban detailed regulation plan, as an example in this comparison of scales, is prepared with a scale of R 1:5000. The relation comprising five times higher scale as the main difference between these two planning documents at this stage seemingly does not represent any trepidation factor regarding the quality of implementation on the respective cadastral plot.

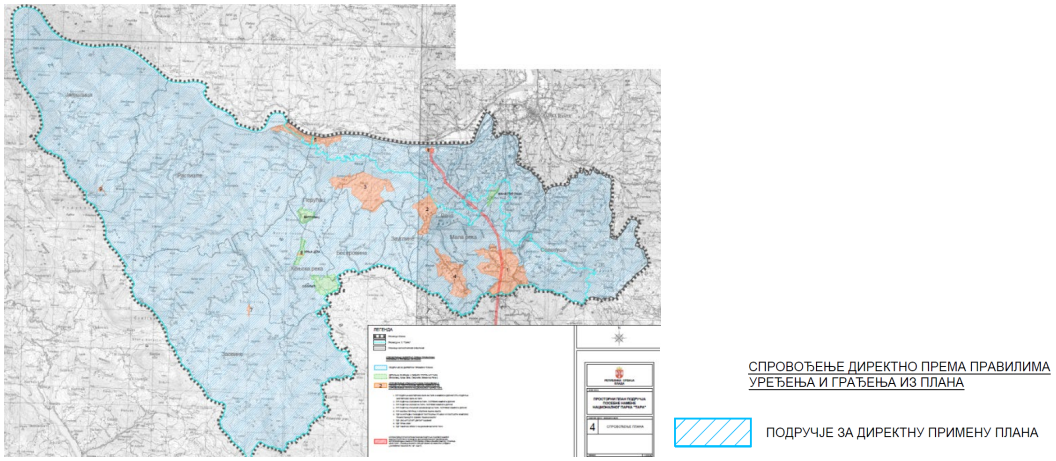

Figure 2: Referral Map 4: Implementation of the Plan, Spatial Plan for the Special-Purpose Area of National Park "Tara"

A detailed regulation plan also presents analytical geological and technical points, coordinates of the planned regulation along each individual cadastral plot clearly visible within the borders of the covered area. In a plan of this scale, the existing and planned purposes are also visible. Unlike a detailed regulation plan, a spatial plan prepared with a five times larger scale cannot support this level of details and therefore the determination of the planned purpose of areas, as well as the regulation approach to the respective area become disputable. On the assumption that a certain plot enjoys a certain purpose of public or other land, and without a list of cadastral plots that enjoy certain planned purposes being included in the textual part of this planning document, the implementation of a cadastral plot or certain zone might entirely go in the wrong, incorrect direction and further elaboration of a design or conceptual solution will be acknowledged, adopted and

approved without any possibility for revision, considering that neither the processors of the said design nor controlling persons competent for defining the requirements for construction can prove the exactness and correctness of the planned purpose.

Cadastral plots number 2436/1, 2177/2 and 2178 have been analysed, all belonging to the Cadastral Municipality of Zaovine, Municipality of Bajina Bašta. Upon an insight into Referral Map 1, it can be noticed that at this stage it is not possible to precisely determine the planned purpose without the used geodetic background of the area covered by the Spatial Plan being correspondent to the data from the cartographic presentations of GeoSrbija. The determined state as is, visible in the graphical presentation, is that subject matter plots number 2177/2 and 2178, both positioned on the southern side of the graphical presentation, belong partially to construction land and partially to the seventh class agricultural land.

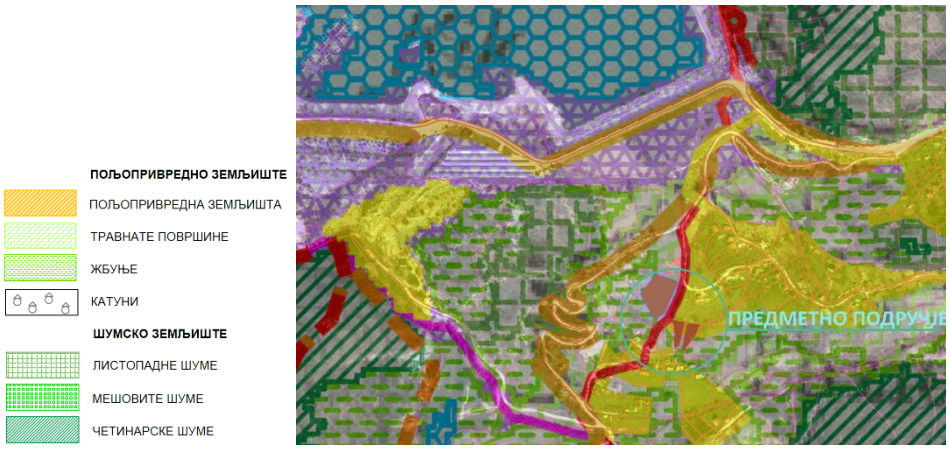

Figure 3: Integrated cartographic presentation and Referral Map 1: Special purpose of space, Spatial Plan for the Special-Purpose Area of National Park Kopaonik with marked cadastral plots

The determined state renders reasonable implementation impossible considering that the textual part of this Spatial Plan does not include the cadastral plots that enjoy the status of construction land. Although the practice in the preparation of planning documents is to list cadastral plots that enjoy the status of construction land and although such listing is an integral element of a planning document, in this case this practice has not been applied. An example of impossibility to determine the planned purpose on a certain cadastral plot, with a planning document being the basis for direct implementation, can be regarded as the latent profile of informal development, in accordance with the previously categorized profiles from the literature used. This example may be considered a process of intentional or unintentional, conditional utilization of the situation of state as is and the planning omission.

3.3.2. Models of Dominant Informality in the Special-Purpose Area of:

Park of Outstanding Features “Vlasina”

One of the characteristic examples of the dominant informality to be used for the interpretation of this research paper is the Detailed Regulation Plan of “Vlasina Rid” (“Official Gazette of the Municipality of Surdulica”, number 43/13) that within its requirements regarding the rules of construction retains the existing as is states of construction zones categorized as Neighbourhoods (*Mahala*), limiting the construction to interventions, adaptations and rehabilitations by which the existing volume and dimensions of an object and state as is are not changed4, all in accordance with the realization of the Spatial Plan for the Special-Purpose

4 Article 53, Paragraph 8 of the Law on Planning and Construction (“Official Gazette of the RS”, number 72/09, 81/09 – correction, 64/10 – Decision of the Constitutional Court, 24/11, 121/12 – Decision of the Constitutional Court, 42/2013 – Decision of the Constitutional Court, 50/2013 – Decision of the Constitutional Court, 98/13 – Decision of the Constitutional Court, 132/14, 145/14, 83/18, 31/2019, 37/2019 and 9/2020, 52/21);

Area of Park of Outstanding Features "Vlasina" ("Official Gazette of the Republic of Serbia", number 133/04)[5]. In this case, Article 53, Paragraph 8 of the Law on Planning and Construction has been applied, for facilities that are not implemented by the procedure with location requirements, but by directly available elements of the implementation of the planning document through the procedure for the preparation of documentation required for obtaining a construction permit.

4. CONCLUSIVE CONSIDERATIONS:

One of the main reasons for which this paper tends to present the informal through different degrees of informality is the observed application of several research papers that in their theoretical propositions deal with the profiles of informal development. According to Harris, R., one of the adopted conclusions is that the informal need not be the state as is in a physical existing form, presented through an example of constructed facilities, but it may also be presented through other forms. One of the mentioned forms indicates hidden, latent and unexamined problems that are not even categorized as problems but whose results are manifested in stages requiring many years in some cases. It is this characteristic of the informal that is the reference this research refers to. In theory, latent informal development, as the most useful in this research, arises out of existing implementing planning documents for a characteristic area, whose elements of space elaboration do not include sufficient parameters that would control the spatial development. This theory is preceded by the view of the authors of the literature used which emphasizes the role of all different participants that, through their individual roles, make joint contribution to the preparation of a certain act or planning document. The absence of only one of the said participants lowers the quality of and represents an omission in the preparation of an implementing act that will be established and that will become regulatory and, adopted as such, it will be the basis for further implementation and its parameters will lead the development of a certain zone or functional entirety in an unplanned, often wrong direction. The consequences of such development are not regarded as illegal and not authorized by law, but their application, the use of such a space, will be determined as informal when results achieved fail to meet the needs of each user of the space, having adverse effects on a wider context. Informal development is equally influenced by individual and cluster interventions. In this paper, particularly in the part related to the analysis of case studies, the research indicates integrated influence of individual and cluster activities. The conclusion is that individual comprehension of the construction conditions enables interventions on one's own plot according to parameters whose shortcomings are already visible in the procedure for the preparation of the respective design and conceptual solution. Individual construction on a certain space whose conditions have not been processed in detail in a certain planning document increases the number of interested individuals, processors and investors and finally, cluster construction is executed consisting of various processors, uncoordinated design solutions, facilities built according to various urban parameters and with various visual shapes. With the aim of justifying this theory, the areas of outstanding features of National Park Tara and National Park Kopaonik have been used. These areas are not the basis for the comparative method implementation, but they are predominantly connected as protected natural resources, and therefore they have been used as examples in practice, whose planning elaboration is disputable in certain sections. This paper indicates the negative potential of planning elaboration that leads to informal although at this moment it is not regarded as informal. In this particular case, the research paper relies on the concept of informal development as a hidden threat that is not applied as such in planning elaboration and that, depending on the needs of users and interested parties, need not necessarily become manifest in the near or distant future.

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NATURE BASED DESIGN SOLUTIONS- CURRENT STATE AND PERSPECTIVE FOR FURTHER USE IN SERBIA

Aleksandra Rančić

Faculty of Civil Engineering and Architecture - University of Nis, Serbia
PhD student, Teaching Associates, aleksandra.rancic.arh@gmail.com

Danica Stanković

Faculty of Civil Engineering and Architecture - University of Nis, Serbia
PhD., Full Professor, danica.stankovic@gaf.ni.ac.rs

Milan Tanić

Faculty of Civil Engineering and Architecture - University of Nis, Serbia
PhD., Full Professor, milan.tanic@gaf.ni.ac.rs

Aleksandra Cvetanović

Faculty of Civil Engineering and Architecture - University of Nis, Serbia
PhD student, Teaching Associates, aleksandracv.arch@gmail.com

ABSTRACT

It is fact that human relation to the natural environment is out of harmony. Contemporary architecture is permanently in search of sustainable architectural solutions that produces a viable physical spaces in the function of human needs and planet as a whole. In order to strengthen human/nature relation in urban areas, nature and its components should be embedded in the building itself, as well as in its surroundings and interior space. A great deal of researches explore the beneficial outcomes of natural features integration in architectural design (vegetation walls, green roofs, greenery in the interior, aquatic elements, stone, plants, etc.), highlighting among all advantages: energy savings, minimized environmental pollution, reduction of CO_2 emission, improvement of indoor air quality, positive benefits on users' health and well-being, stress-reducing effects in physical environments, etc. This paper explains the issue of mutual relation human/nature/architecture and proposes a redefined and innovative methodological framework for its revival in the urban environment. The research defines basic naturalistic principles and especially points to the importance of active application of design concept founded on the nature and its components. Foreign nature based architectural practice was analysed through a series of examples in order to single out effective solutions and sustainable techniques that can be adapted and applied to the climate and territory of Serbia. Considering that mentioned architectural approach based on the use of nature is still not quite widespread in Serbia, this study aims to promote strategies and ecological solutions, that provide and target both human and environment welfare.

Keywords: *architecture, human, nature, nature-based principles, design solution, sustainability*

1. INTRODUCTION

Human/nature cohesion has existed since the inception of civilization. Human beings always interact with the nature, starting from construction of shelters and their use, nature has been used as a predominant part in the plans and designs (El-Ghobashy & Mosaad, 2016). The life forms over time have developed survival abilities suited to diverse environmental conditions. In the period of the technological development and rapid urbanisation human life and work style fundamentally transformed and modified relationship of each other as well as the attitude towards the environment. The newly established environment can be characterised as

overcrowded built environments prevailed by physical structures and the heavy infrastructure that supports their functioning. Such an environment suppresses living systems and causes harmful effects on wellbeing and health condition, both for humans and remaining living environments. In this transition process of environment development, nature environment has been affected. In such threatening circumstances for existence of human and environment and with the aim to save the life on the planet it has been turned out as necessary required creating and applying of sustainable urban development strategies and practical design solutions. Through-out the time these strategies progress and impacted on the derivation of sectoral-focused policy strategies. Among others a green approach singled out in response to the environmental and energy crisis, underlining climate change and all the outcomes connected with atmospheric warming. Every single item has become coloured in green (green technologies, green materials, green architecture…). Beneficial effects of connections between humans and nature are widely recognized for sustainability (Folke et al. 2011; Zylstra et al. 2014). It was still 2005 when Kellert asserts that low environmental impact design has become the primary approach of sustainable design and development today (Kellert, 2005). In comparison with the ecological aspect of sustainability the other columns that underlie the concept of sustainability are barely noticeable. But in the last decade, next to the “green wave” nature based design has got cosmic recognition in architecture, especially in response to society's needs. A lot of empirical studies have brought evidence about the advantages of positive human communication with nature such as providing them with restorative experiences, expediting healing processes, and reducing sick building syndrome symptoms, reinforcing mental and physical health and refreshing environmental awareness (Mahan, 2015; Nisbet and Zelenski, 2013; Sandifer et al, 2015). Understanding the importance and the role of nature in human development, Kellert suggests “restorative environmental design” which in the focus puts reinstatement of the human/nature relationship in the urban environment (Kellert, 2005).

Since the issue of interdependence of human/nature and architecture is the subject of many disciplines, application of transdisciplinary approach which includes different profile of experts such as urban planners, architects, landscape architects, biologists, botanists, psychologists, engineers etc. is required in the process of reviving external and internal ambience by introducing nature. First part of the paper deals with the issue how different disciplines and sub-disciplines interpret the relationship between human and nature and deal with position of architecture in mentioned relation. After that the examination of current literature in the domain of the defining the nature based design solution was performed. Because there is a deficiency of proposals of the most favorable nature based design solutions and suitable typologies peculiar to different contexts and urban design this paper tends to define practical design solution based on the multi-layered inclusion of nature and its elements. Ways of integrating nature and its components, potential fields or areas of implementation in the urban environment were analysed and examined on numerous of foreign built examples. After an extensive analysis of foreign practice in the field of nature based design, existing architectural practice in Serbia was considered, with the aim to establish and to evaluate current state. The main goal of the research is formation of a theoretical and conceptual framework in gaining rules and guidelines for designing novel natural buildings to be unified with the surrounding environment.

2. CORRELATION HUMAN/NATURE AND ITS 'BLENDING' WITH ARCHITECTURE

Over the last century, research has been increasingly directed toward understanding the human/nature relationship (Guiney and Oberhauser, 2009). Yang says that nature is the precondition and foundation for the existence and development of human and society (Yang, 2018). Researchers, health care experts, and ecologist equally have begun to investigate the potential connection between the human/nature relationship and its impact on overall human’s health (physical, mental, and social health according to World Health Organization’s definition) (Thompson Coon et al, 2011; Cameron et al, 2006). Gould and Schultz conclude that understanding the varied psychological, cultural, and spiritual connections between human and nature can be difficult (Gould and Schultz, 2021). Saymour adds that human–nature relationship can be experienced through various biological, ecological, and behavioral connections. Multiple mixing fields and sub-fields address nonmaterial aspects of human-nature connections (Muhar et al. 2018). These fields include connectedness with nature studies, cultural ecosystem services, environmental psychology, environmental education; environmental sociology (Gould and Schultz , 2021). Benefits include positive outcomes for health (Shanahan et al, 2016), the cognitive development of children (Giusti, 2019), and overall happiness and well-being (Capaldi et al, 2014). Kellert points out that restorative environmental design includes the additional goals of minimizing harm and damage to natural systems and human health as well as enhancing the psychological and physical state of the organism by fostering positive experiences of nature in the built environment (Kellert, 2005). This

expansiveness in scientific and professional work, in domain of diverse gnoseologies and methodologies, suggests special interest to these aspects of human-nature relationships.

The human is the centre of natural exploitation and built environment, a belief that has been existed since the initiation of civilization when human started to adapt into the natural environment and to articulate nature into built-environment (Widodo, 2019). The mutual action of nature and architecture has a longstanding tradition. In relation human/nature, architecture appears as energetic opportunity of reconnecting people with nature. An architect has inspired from nature in order to obtain soft and fresh ideas and visions. In order to achieve beneficial naturalistic improvement of the urban environment it is necessary to understand existence of the multilayeredness and the essence of the human/nature relationship. Taking into account that nature brings comprehensive advantages to the human wellbeing and physical, mental and social health the introduction of nature in urban areas provides everyone chance to experience nature. Also, architecture through the contemporary way of dealing with nature, retakes its missing aesthetic features that it had earlier. The balance with natural elements visible in public areas seems to infiltrate into the internal space, creating a kind of entrance zone that erases the edge between the physical structure and its surrounding. The introduction of sustainable solutions based on nature inclusion in the composition of buildings and urban design does not only challenge architects and urban planners, moreover it enriches their projects by creating a new kind of environment – transition space. Today, when planning and constructing for the contemporary cities, it is important to establish strategies how to satisfy our longing for cordial contacts with nature and how to fulfill our need for a safe and healthy environment. In current situation, with increasing urbanization and accompanying environmental problems, human, nature and architecture must be observed as one holistic unity. In this paper it has been proposed that the impoverishments can be countered by integrating different types of formal references to nature within architectural design. A widespread inclusion of such shaped architecture can produce a compensation for the lack of natural forms in the human urban environment.

3. ABOUT NATURE BASED DESIGN SOLUTIONS – NBDS

According to research conducted by Miller sustainable building that totally meets the LEED criteria could be created while ignoring the human need for contact with nature… (neglect the other pillars that underlie the concept, such as social and economic) (Miller, 2013). It is much more productive to meet both if there are conditions for such action. So, NbDS represents a much wider field. It includes implementation of nature and its elements through exterior and internal surrounding of the building thus establishing cohesive unity. This design approach uses the positive benefits of natural systems combined with conventional engineering. NbDS represent technical solutions instead of conventional ones – based on, derived from, sustained by or copied from natural systems and processes with the aim to fulfill a purely functional need. The realization and the opportunity for broader use of NbDS by incorporating nature into a range of sectoral and overarching strategies to meet societal challenges, at the global scale, has grown significantly in recent years. NbDS certainly applies to the sustainable management and use of nature for addressing a wide range of challenges such as socio-environmental challenges, including following issues: climate change, biodiversity degradation, water security, water pollution, food security, human health, and disaster risk management etc.

4. METHODS FOR IMPROVING AMBIENCE BY COMBINING ARCHITECTURE AND NATURE

Due to the benefits that nature provides to humans and the whole environment it is crucial to discover innovative methods or to predict the smart use of the existing ones for introducing nature and its' elements in the urban surrounding and buildings. Architects and engineers certainly play an important role in the relief process, because their operations and activities can significantly contribute to protection of the environment and humans. The joint action of several nature based methods achieves a higher level of success and effectiveness of the building and its surroundings in urban matrix. Blending of nature and its components with architecture has produced different forms of designing. The literature review of the solutions that are directly or indirectly related to nature for the environmentally improving purpose of urban areas and human wellbeing a rough classification of design solutions has been done with the mapping of a specific form of designing. This classification is illustrated in a tabular form below.

Tabele 1. Classification of design solutions

Type of design solution	*Description*	*Specific architecture*	*Type of experiences with nature*
Nature based solutions	*Uses the power of functioning ecosystems as the infrastructure upon which to provide or enhance natural services that benefit society and the environment*	*Vernacular design Organic design-naturalistic Bio-architecture Biophilic design Nature inclusive design*	*Direct experience of nature Indirect experience of nature Experience of space and place (Kellert and Calabrese, 2015)*
Nature derived solutions	*Includes wind, wave and solar energy projects, which are also needed to achieve a low-carbon and sustainable future but are not based directly on functioning ecosystems*	*Green passive design*	
Nature inspired solutions	*Uses innovative design and/or employ materials, structures and systems modeled on or inspired by nature and by biological processes*	*Biomimetic design Biomorphism and bioutilization Biophilic design*	

According to IUCN three types of nature based solutions can be distinguished. In order to effectively meet not only environmental challenges also and human's inherent need for nature they suggest combination of selected types of solution depending on context (IUCN, 2020). In the following part of the chapter basic principles that provide direct/indirect human/nature contact within the built environment and that has comprehensive influence on the environment protection, are analysed. In 2015 Kellert and Calabrese are considering potential types of experiences with nature and they emphasize:

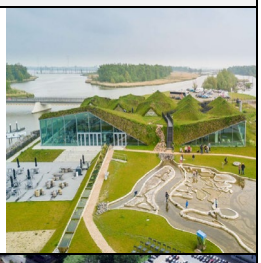
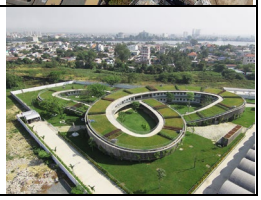
- *Direct experience of nature*- the building design that directly makes use of the natural elements such as light, air, water, plants, animals, weather, natural landscapes and ecosystems and fire.
- *Indirect experience of nature- t*he indirect experience of the nature is emphasized in the design. The images of nature, natural materials (wood, clay, mud, stone, bamboo, etc.,), a colour palette that consists of colours found in nature - natural colours (earthy, shades of grays, blue, brown, earthy green and rusty shade), simulating natural light and air, naturalistic shapes and forms, evoking nature, information richness, age, change and the patina of time, natural geometries and biomimicry are the main methods.
- *Experience of space and place*- the components of this criterion refer to the natural connections of space, sense of place and natural connotations. Prospect and refuge, organised complexity, integration of parts to wholes, transitional spaces, mobility and wayfinding and cultural and ecological attachment to the place make reference to the natural settings that the humans are accustomed to (Kellert and Clabrese, 2015).

According to Kellert, initial and evident strategy is to provide the possibility for a direct experience of nature (Kellert, 2005). This direct experience can be realized according to different design interventions: integrating plant life in the built environment, providing views of the outdoor (natural) environment, natural lighting and ventilation, exposure to water near or within buildings (e.g. fountains), inclusion of (controlled) fires in a building, integrating animals in the built environment (e.g. butterflies, fish, birds), incorporating greenery on the building envelope (e.g. vines, 'green roofs'). In architectural space, simple and minimalistic design without unnecessary lines and forms, and natural materials that are allowed to age can create an environment that will keep users more connected to nature. Combining architecture and nature is not only about the designing of spatial elements but also about the impact caused by architecture on the environment on a larger scale. The waste generated during the construction and after the building is built should be minimum, and the entire process should be carefully planned. The use of solar panels, rainwater harvesting systems, natural heating and cooling systems, waste recycling, and sewage treatment systems, for example, supply vital resources to the users of the structure while simultaneously reducing the structure's environmental effect on a larger scale. Nature-based design solutions such as green roofs, rain gardens, or constructed wetlands can minimize damaging runoff by absorbing storm water, reducing flood risks and safeguarding freshwater ecosystems. Also it produces consumers aware of their obligation and responsibility to the environment and nature.

4.1. Examples of foreign practice

In this part of chapter, forms of nature appearance in the urban environment were examined. Using analytical-synthetic method the types of NbDS implemented in varied category of buildings and its surrounding are reviewed and summarized in the table below. Some of the analysed examples do not represent nature based solutions in whole but contains certain elements and processes that could be include in future design praxis.

Tabele 2. Display of the analysed foreign examples

Type of building, Location, Year of construction/design, Architects	*Implemented naturalistic principles Sustainable techniques in design Important determinants*	*Appearance of the building (source: www.archdaily.com)*
***Biesbosch Museum**, Werkendam, The Netherlands, 2015 Studio Marco Vermeulen, Cultural architecture*	*landscaped parterre; freshwater tidal park; green roof and green canopy adds ecological value, water continues inside the museum building; large transparent surfaces - glazing is fitted with heat-resistant glass that eliminates the need for blinds, sanitary wastewater is purified through an on-site willow filter, the vegetation absorbs the nutritious nitrogen and phosphate found in the wastewater, helping the willow trees to grow; a biomass stove maintains the building's temperature, water from the river flows through the same piping to cool the museum, minimalism in the interior space, natural materials, natural colours.*	
***Library Delft University of Technology**, Delft, The Netherlands, 1998, Mecanoo, Cultural architecture*	*building of glass and grass, spacious green roof and transparent facade, zenithal lighting through glazed cone on the roof, the atmosphere in the building is warm, the floor has the colour of the Sahara and the furniture is made of warm MDF board, the building is energy efficient; the grass roof has an insulating effect and reduces large changes in temperature; the vegetation retains the rain water; slow condensation of this water creates natural cooling in summer; it also provides excellent noise reduction; the grass roof is freely accessible for walking and lounging*	
***The Algae House,** Hamburg, Germany, 2013, Splitterwerk Architects, Apartment complex*	*cube-shaped, five-storey passive building comprised of fifteen apartments; algae powered building, bio-adaptive façade, zero-carbon apartment complex200m² of integrated photo-bioreactors, passive-energy house generates biomass and heat as renewable energy resources dynamic shading, thermal insulation and noise abatement, highlighting the full potential of this technology*	
***Turó De La Peira's sports center** Barcelona, España, 2018, Anna Noguera + Javier Fernandez, Sports architecture*	*landscape integration of a singular greened building in an interior urban block; respect for the environment; a garden that provides quality of life and serves as a support of biodiversity; the building minimizes its impact to the garden with a green gallery that surrounds it; the volume is one more element of the garden, not mimicking but dialoguing with it; naturalized interior spaces; The natural lighting, the vegetation and the use of wood provide a warm atmosphere; A green gallery surrounds the building protecting it from the sun and creating a bioclimatic space energy efficiency and self-sufficiency; wooden structure, everything is wood, pillars, beams, stands, walls, and also the floor parquet; green façade; the water recycling system*	
***Bosco Verticale**, Milan, Italy, 2014, Boeri Studio, Apartment building*	*Vertical Forest', two towers of 80 and 112 metres, hosting 480 large and medium trees, 300 small trees, 11,000 perennial and covering plants and 5,000 shrubs. screen of vegetation, needing to create a suitable microclimate and filter sunlight, and rejecting the narrow technological and mechanical approach to environmental sustainability; the Vertical Forest increases biodiversity; it promotes the formation of an urban ecosystem, spontaneous factor for repopulating the city's flora and fauna; the diversity of plants helps to develop the microclimate which produces humidity, absorbs CO_2 and particles, produces oxygen, and protects against radiation and noise pollution*	
***One Central Park**, Chippendale, Australia, 2014, Ateliers Jean Nouvel, Mixed architecture -apartment retail*	*integrated experience for living in harmony with the natural world; there are a beguiling assembly of motorised mirrors that capture sunlight, and direct the rays down onto Central Park's gardens; key among them are its vertical hanging gardens, cantilevered heliostat, low carbon tri-generation power plant and internal water recycling plant; water sources include: rainwater from roofs, storm water from impermeable surfaces/planter box drainage, groundwater from basement drainage systems, sewage from an adjacent public sewer, sewage from all buildings within the Central Park community, irrigation water from all green walls, drinking water from the public water main*	
***Farming Kindergarten**, Biên Hòa, Vietnam, 2013, VTN Architects, Educational architecture*	*green atrium, green roof, he building is conceived as a continuous green roof, providing food and agriculture experience to children, as well as an extensive playground to the sky. The green roof is a triple-ring shape drawn with a single stroke, encircling three courtyards inside as safe playgrounds. Recently, an experimental vegetable garden was realized on its top. Five different vegetables are planted in 200m2 garden for agriculture education.*	

Triodos Bank, *Driebergen-Rijsenburg, The Netherlands, 2019, RAU, Offices architecture*	*the building was constructed using laminated timber, cross-laminated timber and unprocessed timber components; curving glazed facades and a timber structure that can be taken apart and remounted; the building has a structure that is made 100% of timber; architecture focuses on humans, but also follows function, nature and culture; key aspects are sustainability, transparency, excellence and entrepreneurship; organic form that curves around existing trees and creates three partially enclosed outdoor spaces; three transparent towers are connected at different points on the ground, first and second floors; inside the building, the large spaces and the use of glass creates a sense of openness that promotes increased contact between employees, visitors and the public; natural materials, natural colours*	

4.2. Current state in Serbia

All over the world there is still bounded exploration of the manners how the cognition of nature-based solutions can upgrade urban policy and planning to enable their integration and to become a dominant trend. Liu points out that in addition to existence of tools, models, design guidelines, standards, and protocols, there is still a need for an integrated and system-thinking framework for nature based solution implementation and impact evaluation that integrates nature into local policy frameworks, socio-economic transition pathways, and spatial planning (Liu et al, 2021). Despite its solid scientific underpinning, in Serbia nature based design exists only in a symbolic form and as sporadic occurrence. In the current architectural expression there is form of nature integration such as vertical and horizontal green and living surfaces combined with tools for energy efficiency achieving. Primarily, Serbia represents country with the existence of limited nature based approach as conception through strategic plans and local action documents, but the benefits of their implementation have not yet been sufficiently recognized and is still not widely applied in architecture. Also, in the former Serbian architectural practice, the presence of architectural form of building that ensures the inclusion of nature and its elements (the atrium form of building) - is noticeable (Stankovic et al, 2019).

5. DESIGN PROPOSALS FOUNDED ON NATURALISTIC PRINCIPLES

Because nature is so varied in form and function, different measures can have very different results, and it is, therefore, difficult to determine what measures will achieve what results. NbDS represent very specific context proposals:

- Application of professional solutions in the process of urban planning, that are not related to the context and also could be adapted to the specific region and which have proven in the world as effective solution;
- Use of favorable professional solutions in the process of architectural designing which includes:
  - spatial analysis- maximum utilization of the conditions and characteristics of the location and minimize the negative ones (correct orientation of the building in relation to the prevailing winds, sunlight; appropriate design solution – architectural form of building; solving facade planes through an adequate ratio of openings and full wall panels; green/living envelope of structure - greening in whole and in part roof and/or wall planes, etc.),
  - actions to increase the amount and quality of nature in built environment public spaces: areas of conserved productive ecosystems, such as forests or wetlands; areas of manicured grass and trees, with benches and leisure amenities that facilitate social contact and exercise; allotments; community gardens; natural lakes, ponds, rivers, and streams; artificial lakes, ponds, rivers and streams; street trees; plant beds; “Pocket parks” (small areas of nature),
  - apply modern and high-quality technical-technological solutions and materials that reduce the building's energy needs and make it energy efficient,
  - apply materials and equipment that contain a certain percentage of recycled materials and that can themselves be recycled after the end of the building's life,
  - apply renewable energy sources to meet part of the energy needs of the city,
  - implement management and use of rainwater,
  - implement recycling of used water,

  - incorporation of space and elements for flora and fauna in designs in order to sustain the natural environment and ecosystem services.
- To properly manage waste, both during construction and during the use of the building in its entire life;
- Implement measures to ensure adequate comfort for all users of the building (temperature and air quality, lighting, acoustics...)
- Encourage users of buildings to change their behavior during work and stay in buildings (implementation of measures to encourage users to use energy, water and other resources properly in the building and outdoor).

6. CONCLUSION

There could be a balance between humans and nature where both can thrive and benefit from each other, because of nature based design. In order to control and to prevent negative impact to the natural environment urban planners, architects, designers and other engineers and specialists from divers disciplines that relate to nature have to act together by changing the way of designing the cities and the building and move toward to naturalistic approach. NbDS are the pathway to integrate cities into nature and reinvent urban progress as a constituent of course of nature. Therefore, in this paper are discussed design principles and solutions based on nature inclusion that eliminates the negative impact on the environment, and also has focus on human well-being, physical, mental and social health. These design principles are singled out as practical nature based proposals for future use in Serbia. This paper has intention to stimulate using of naturalistic design approach. There are two sectors for nature introducing: design solutions that need to be implemented in the initial stages of designing process and in the process of "refreshing" existing buildings (reconstruction and revitalization processes based on nature use). It is of great importance not only to influence on active application of the naturalistic approach in the beginning of design process and but also to create the conditions for the naturalistic revitalization of existing buildings and theirs surroundings. It is important to make science-driven decisions, to apply the right solution in the right place with intention to achieve a healthier and greener city that benefits ourselves and every single living organism around us.

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THE INFLUENCE OF TRAVEL BEHAVIOR AND BUILT ENVIRONMENT ON CARSHARING-FACILITATING NEIGHBORHOOD PREFERENCES

Juan Wang

Guangzhou HKUST Fok Ying Tung Research Institute, Guangzhou, China
PhD., Postdoc, Juanwang@ust.hk

Gamze Dane

Eindhoven University of Technology, Eindhoven, the Netherlands
PhD., Assistant professor, g.z.dane@tue.nl

Harry Timmermans

Eindhoven University of Technology, Eindhoven, the Netherlands
PhD., Full professor, H.J.P.Timmermans@tue.nl

Pengyu Zhu

The Hong Kong University of Science and Technology, HK
PhD., Associate Professor, pengyuzhu@ust.hk

ABSTRACT

Carsharing-facilitating neighborhood (CFN) is a new concept that integrates carsharing and car-reduced planning to reduce private car ownership and improve residential environment. To date, little is known about how residents' travel behavior and built environment influence their CFN preferences. This study first applies a latent class model to a CFN stated choice experiment in the Netherlands. Two latent classes are identified. "CFN enthusiasts" primarily concern about housing benefits, carsharing service quality, and green space density. People belonging to "CFN enthusiasts" are more likely to often travel by green transportation and live in condos near shops and entertainment facilities. "CFN conservatives" concern about housing benefits and private parking availability. People belonging to "CFN conservatives" are more likely to hold negative attitudes towards green transportation. Then, the binary logit models are applied to the two latent classes to identify the influential factors on the preferences of CFN shared-car travel destinations. According to the results, "CFN enthusiasts", especially those who frequently travel by public transport, prefer to use CFN shared-cars for travelling to transit stations and other cities for occasional visits. The research results can significantly contribute to designing future CFN with better acceptance and social impacts.

Keywords: *carsharing-facilitating neighborhood, travel behavior, built environment, latent-class model*

1. INTRODUCTION

The increase in private car ownership has led to adverse influences on residential environment as more residential green/public spaces are being used for parking, meanwhile, on-street parking narrows cycling lanes and poses potential threats to pedestrians' safety (Li, et al., 2017; Shoup, 2017). Inspired by the potential environmental benefits and the growth in popularity of carsharing, municipal governments and real-estate developers are thinking about how to integrate carsharing as a primary impetus into car-reduced residential development (Herranz, 2020). Thus, the concept of carsharing-facilitating neighborhood (CFN) was first proposed in Europe. CFN is coordinated by local governments and dedicated public-private neighborhood management organizations, integrating carsharing services, car-reduced neighborhood planning measures, and

appealing dwelling characteristics to reduce private car use and achieve sustainable neighborhood development (Herranz, 2020).

Although some efforts have been made to study the feasibility of CFN, two fundamental questions remain unexplored: 1) how do individual travel behavior and urban built environment influence people's preferences to live in CFN? 2) what destinations do people prefer to use CFN shared cars to travel to? To fill these research gaps, we conducted two analyses using the CFN survey data in the Netherlands. First, a latent class model will be applied to the CFN stated choice experiment taking into account the effect of people's travel behavior and built environment attributes. The unobserved heterogeneity in CFN preferences will be examined by identifying multiple latent classes based on people's preferences. Meanwhile the influences of travel behavior and built environment on latent class membership probabilities will be investigated. The estimation results will identify the target CFN market segments who are more willing to live in CFNs in relation to particular travel behavior and built environment, and provide implications on CFN design principles for the target segment. Second, binary logistic models will be applied to respondents' choices of preferred destination of using CFN shared cars separately to the identified segments from the latent class model to understand their travel preferences and how their travel behavior and built environment influence such preferences. The results aim to provide understanding about how to optimize CFN carsharing services to cater to different CFN resident segments' traveling demands.

2. LITERATURE REVIEW

CFN shares similarities with several concepts proposed in the 1990s, such as car-reduced/car-free neighborhood. The core ideas of these concepts are constructing pedestrian and cycling networks and providing high quality public transportation to reduce private car use and ownership (Kushner, 2005; Melia et al., 2013). In these traditional car-free/car-reduced neighborhoods, carsharing also served as a tiny supplement to public transportation at substituting private vehicles. However, due to the limited popularization of smartphones, carsharing didn't play a major role in such neighborhoods where a shared-car was designed to serve approximately 50-500 households (Melia et al., 2013). Kushner (2005) has suggested that carsharing should be adopted in car-free/car-reduced neighborhoods, integrated as part of the municipality transport networks to serve as a substitution for the residents' use of private cars. Witnessing the fast growth of carsharing in the last decade, companies, researchers, and municipalities are starting to reconsider the feasibility of integrating carsharing as a major impetus into car-reduced development (Herranz, 2020; Van de Glind, 2016). In 2016, the organization "shareNL" in the Netherlands pioneered a symposium that invited policymakers, entrepreneurs, and researchers to discuss how to develop carsharing real estate (Van de Glind, 2016). The symposium concluded that real estate developers lack knowledge of the target group for CFN. It signaled the fact that knowledge regarding CFN feasibility is insufficient. In 2020, Merwede, a well-reported CFN project in the City of Utrecht, was proposed in the Netherlands. This project serves 12,000 residents across 60-acres, integrating robust walking and cycling networks, public transportation services, and a large fleet of shared-cars (approximately one shared-car serving every three households) to reform the car-dependent lifestyle (Herranz, 2020). However, since Merwede is still in the planning phase, it is not clear how the residents will react to it. Wang, et al. (2020) did the first research to investigate the feasibility of CFN, where a CFN stated choice experiment survey was conducted to understand people's preferences to CFN, and it was concluded people's willingness to live in a CFN is on the average negative, varying with CFN attributes and individual demographics. However, a clear research limitation exists in the research, as the influence of travel behavior and built environment on people's preferences to CFN, which can provide significant implications on CFN development, were not discussed.

3. METHODOLOGY AND DATA RESOURCE

To understand people's CFN preferences, a structured questionnaire was designed. The questionnaire consists of three major parts: A CFN stated choice experiment to extract people's CFN preferences; questions to inquire respondents' CFN shared-car travel destination preferences; questions to inquire respondents' socio-demographics, travel behavior, and residence built environment.

The stated choice experiment is a methodology typically used to investigate hypothetical choice situations, which has a long history in researching residential and travel choices (Louviere et al., 2000). It combines attribute levels of key attributes to create choice profiles based on stated choice experiment design principles. Based on stated choice experiment design principles, fifteen top influential attributes of CFN, each of which

takes on different levels, were selected (see table 1). To generate CFN alternatives, an orthogonal fractional factorial design that satisfies attribute level orthogonality and balance was conducted. After that, choice sets were created by randomly combing one alternative with another alternative. As a result, 128 choice sets were created. Each choice set contains two CFN alternatives and a choice of "I like neither" (please see this video https://www.youtube.com/watch?v=iiAq5FmOWAY for the details of our stated choice survey). Based on block design principles, 16 blocks were created. Each block consisted of eight choice sets, which was assigned to each respondent. To provide implications of how to specialize CFN carsharing service based on people's demand, questions were asked after the stated choice experiment to understand people's CFN shared-car travel destination preference. Specifically, respondents were asked to choose from a list of possible CFN shared-car travel destinations, including offices, public transportation stations, shops, other cities (for occasional visits), etc., to indicate their preferences of CFN shared-car use.The questionnaire was distributed through an online survey. By sending the link to the members of a professionally managed panel6 in September 2018, the survey was conducted in twelve cities7 that are evenly distributed in the highly populated areas in the Netherlands. The time that each respondent used to complete the survey was recorded. When the number of targeted responses was obtained and the samples' demographics were checked representative of the population demographics of the surveyed cities8, the access to the questionnaire was closed. The data collection ended with 823 completed responses. After that, the data was cleaned. Responses with a completion time shorter than 3 minutes (the average was approximately 12.5 min) were omitted. After cleaning, 610 valid responses were obtained.

4. ESTIMATION RESULTS

4.1 Latent class with different CFN preferences

A latent class model was thus selected to apply to the CFN stated choice experiment to identify distinct utility functions among population segments and quantify the probability an individual with certain profiles belonging to a particular class (Hagenaars et al., 2002; Hensher et al., 2005; Vermunt et al., 2002). For the utility function, the dependent variable is the respondents' choice in each CFN choice set, and independent variables are the 15 key CFN attributes and respondents' social-demographic attributes, travel behavior attributes, and built environment attributes. According to the estimated results, the two-class model produced meaningful interpretive results and a good goodness-of-fit, with a McFadden's Pseudo Rho-squared of 0.337.

The estimated part-worth utilities for two latent classes are presented in Table 1. According to the results, two latent classes were identified regarding the CFN preferences heterogeneity. For latent class 1, the estimated coefficient of constant is significant and positive, indicating that this latent class is significantly willing to live in CFN. We term latent class 1 as "CFN enthusiasts". In contrast, for latent class 2, the estimated constant is significant and negative, indicating that this latent class is significantly unwilling to live in CFN. We term latent class 2 as "CFN conservatives". Another difference is embodied in the difference of statistical significance between the two latent classes. According to this result, both "CFN enthusiasts" and "CFN conservatives" are most concerned about housing-related attributes. However, "CFN enthusiasts" concern more about carsharing-related attributes than "CFN conservatives". A possible reason is that "CFN enthusiasts" are more willing to use carsharing services in such neighborhoods, thus care more about the quality of carsharing services. Besides, two latent classes show different tastes in transport-residential planning related attributes. "CFN enthusiasts" show significant concerns about green space density. It may indicate that the motivation of "CFN enthusiasts" to live in CFN is to pursue better neighborhood quality with greener environment. However, "CFN conservatives" significantly dislike having zero private parking spaces, and prefer having at least one private

6 The panel name is Panelclix, the most extensive panel in the Netherlands. https://www.panelclix.nl/

7 The twelve cities are Amsterdam, Rotterdam, The Hague, Utrecht, Eindhoven, Almere, Groningen, Delft, Arnhem, Helmond, Haarlem and Leiden.

8 The sample demographic was calibrated based on the official population statistic (CBS). https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/wijk-en-buurtstatistieken

parking space. It may indicate that “CFN conservatives” intend to keep private car ownership even if they live in CFNs.

Table 1. Estimated coefficient part-worth utilities for two latent classes

		Class 1 (CFN enthusiasts)	Class 2 (CFN conservatives)			Class 1 (CFN enthusiasts)	Class 2 (CFN conservatives)
	Constant	1.642***	-2.866***				
Carsharing cost	free	0.382***	0.433***	Private parking (per unit)	0	-0.019	-0.253**
	1 PTa (25% PCb)	0.079	0.180		1	0.040	0.223**
	2 PT (50% PC)	-0.107**	0.056		2	-0.076	-0.201*
	3 PT (75% PC) (Base)	-0.354	-0.670		No restriction (Base)	0.055	0.231
Waiting time (min)	≤ 10	0.104*	-0.031	Green space density	Increased green space density	0.085**	0.054
	11 – 20	0.040	0.064		Decrease green space density (Base)	-0.085	-0.054
	21 – 30	-0.079	-0.025	Safety of children's play area	Safer children's play area	-0.005	-0.016
	> 30 min (Base)	-0.065	-0.007		Current safety of children's play area (Base)	0.005	0.016
Parking distance to home by walking	≤ 5 min	0.105*	0.063	Housing type	Semi-detached/detached house	0.132**	0.125
	6 – 10 min	-0.107*	0.066		Row house	0.100*	-0.036
	11 – 15 min	0.082	0.074		Low-rise condo (4 - 6 floors)	-0.129**	0.057
	> 15 min (base)	-0.080	-0.203		High-rise condo (> 6 floors) (Base)	-0.103	-0.146
Parking distance to destination by walking	≤ 5 min	0.012	-0.091	Home ownership	Own	0.038	0.056
	6 - 10 min	0.063	0.079		Rent (Base)	-0.038	-0.056
	11 - 15 min	0.009	0.132	Housing costs (€)	600	0.632***	0.901***
	> 15 minutes (Base)	0.037	-0.119		800	0.251***	0.378***
Commuting distance (km)	≤ 5	0.013	0.209*		1000	-0.206***	-0.515***
	6 - 10	0.026	-0.178		1200 (Base)	-0.677	-0.765
	11 - 15	-0.076	0.329***	Housing living area	40 m2	-0.354***	-0.602***
	> 15 (Base)	0.037	-0.361		70 m2	0.011	-0.031
Public transportation station distance (m)	200	0.040	0.154		100 m2	0.147**	0.212*
	400	0.042	0.001		130 m2 (Base)	0.196	0.421
	600	-0.021	-0.082	Year of construction	Earlier than 1960	-0.243***	-0.237*
	800 (Base)	-0.060	-0.072		1960 - 1980	0.047	0.095
Location	Inner city	0.017	0.048		1981 - 2000	0.080	0.004
	Inner suburb	0.025	0.130		Later than 2000 (Base)	0.117	0.138
	Suburb	0.046	-0.052				
	Rural area	-0.087	-0.125				

The estimated coefficient of latent class membership is presented in Table 2. The membership probabilities of being "CFN enthusiasts" and "CFN conservatives" are respectively 0.529 and 0.471. One of the main focus of this study is the effects of travel behavior and built environment on latent class membership. Regarding the effects of travel behavior, frequent travel modes to public transportation stations have significant effects on latent class membership. Particularly, people who frequently walk to metro stations are more likely to belong to "CFN enthusiasts". A possible reason is that convenient access to metro stations can largely satisfy these people's travel demands. As a result, these people are less car-dependent, which encourages them to join CFNs. The results also show that people who frequently cycle or take public transportation to train stations are more likely to belong to "CFN enthusiasts", while people who frequently walk to train stations are more likely to belong to "CFN conservatives". A possible reason is that people who need to take transit to train stations are attracted by the CFN carsharing service to connect to train stations. The respondents' most frequent travel modes are also found with significant influence on latent class membership. Particularly, people who cycle frequently are more likely to belong to "CFN enthusiasts". A possible reason is that these people enjoy green transportation and have less demand for car use/ownership, thus living in CFNs is in line with their car-free

lifestyle. Last but not least, travel attitudes show significant effects on latent class membership. Particularly, people who hold positive attitudes toward green transportation (e.g., "public transportation is pleasant to travel with", "cycling makes me happy") but hold negative attitudes towards private cars (e.g., "too many people drive alone") are significantly more likely to belong to "CFN enthusiasts". This result is consistent with previous findings that people who are fond of green transportation are more likely to accept innovative and sustainable transportation alternatives (Acheampong and Siiba, 2020; Kim et al., 2005). Regarding the effects of respondents' current residential built environment on latent class membership, the accessibility of public transportation stations has insignificant effects on membership probability. A possible reason is that the effect of travel modes to public transportation stations exceeds the effect of their accessibility. The results also show that people who currently live in condos, especially low-rise condos, are more likely to belong to "CFN enthusiasts". Two possible reasons may lead to this result. First, people living in condos have no/smaller private garden(s) than people living in houses, thus they are more likely to be attracted by the higher green space density in CFNs. Second, high population density in condos may worsen the parking pressure, which pushes these residents to choose a car-reduced neighborhood. Another built environment attribute with significant effects on membership probability is the availability of facilities. Particularly, people whose residences are close to shops and entertainment facilities within 2 km are more likely to be "CFN enthusiasts". A possible reason is that these people have less car dependence for their daily routines, which facilitates their acceptance of CFN.

Table 2. Estimation coefficient of latent class membership probability

		Class 1 (CFN enthusiasts)	*Class 2 (CFN conservatives)*			*Class 1 (CFN enthusiasts)*	*Class 2(CFN conservatives)*
Class membership probability		*0.529*	*0.471*				
Constant		*-1.477***	*0*				
Travel habits				*Built environment*			
Mode ownership (Multi-choice)	*Car*	*0.097*	*0*	*Distance to bus/tram station*	*<500m*	*0.061*	*0*
	Public transportation month card	*0.171*	*0*		*500-1000m*	*-0.050*	*0*
	Carsharing membership	*0.310*	*0*		*>1000m*	*-0.011*	*0*
Frequent travel mode to bus/tram station	*Walking*	*-0.295**	*0*	*Distance to metro station*	*<500m*	*0.081*	*0*
	Cycle	*0.424*	*0*		*500-1000m*	*0.046*	*0*
	Others	*-0.128*	*0*		*1000-1500m*	*0.165*	*0*
Frequent travel mode to metro station	*Walk*	*0.644***	*0*		*>1500m*	*-0.292*	*0*
	Cycle	*-0.240*	*0*	*Housing type*	*High-rise condo*	*0.127*	*0*
	Bus/tram	*-0.032*	*0*		*Low-rise condo*	*0.292**	*0*
	Others	*-0.373*	*0*		*Row house*	*-0.054*	*0*
Frequent travel mode to train station	*Walk*	*-0.402***	*0*		*Detached house or villa*	*-0.365*	*0*
	Cycle	*0.165*	*0*	*Housing location*	*Inner city*	*-0.012*	*0*
	Bus/tram/metro	*0.159*	*0*		*Inner suburb*	*-0.196*	*0*
	Others	*0.077*	*0*		*Suburb and rural area*	*0.209*	*0*
Generally frequent travelling mode (Multi-choice)	*Walk*	*-0.123*	*0*	*Within 2km availability of facilities (Multi-choice)*	*Shops*	*0.143***	*0*
	Bike	*0.325****	*0*		*Entertainment*	*0.211***	*0*
	Public transportation	*-0.030*	*0*		*Open*	*-0.324*	*0*
	Car	*-0.023*	*0*				
Travel attitudes	*Public transportation is pleasant to travel with.*	*0.237****	*0*				
	Cycling makes me happy.	*0.132**	*0*				
	Walking wastes time.	*-0.021*	*0*				
	Too many people drive alone.	*0.152**	*0*				
Demographics							

Gender	*Male*	*-0.176**	*0*		*Primary/ secondary*	*-0.135*	*0*
	Female	*0.176*	*0*	*Education*	*Vocational*	*-0.279**	*0*
Age	*18-35*	*0.311*	*0*		*HBO/Bachelor*	*0.071*	*0*
	36-50	*-0.009*	*0*		*Master/PhD*	*0.343*	*0*
	51-60	*-0.226*	*0*	*Household type*	*Couple with children*	*0.443***	*0*
	>60	*-0.076*	*0*		*Couple no children*	*-0.314**	*0*
					Single no children	*-0.344***	*0*
					Others	*0.215*	*0*

4.2 Influential factors on the preferences for CFN shared-car travel destination

Due to the different travel habits, two CFN latent classes may have different preferences of CFN shared car use. To understand the influence of people's travel behavior and the built environment on their preferred destinations using CFN shared-cars, binary logistic models are estimated. Each preferred destination type (i.e., office, public transportation station, shops, other cities) serves as the dependent variable in one binary logistic model, where chosen is coded as "1", otherwise "0". People's demographics (control variables), travel behavior, and built environment are entered as independent variables. The models are estimated respectively on "CFN enthusiasts" and "CFN conservatives". The estimation results are presented in Table 3.

Table 3. Estimation marginal effects on CFN shared-car travel destinations

		Office		*Public transportation station*		*Shops*		*Other cities (For occasional visits)*	
		Class 1 (CFN enthusiasts)	*Class 2 (CFN conservatives)*	*Class 1 (CFN enthusiasts)*	*Class 2 (CFN conservatives)*	*Class 1 (CFN enthusiasts)*	*Class 2 (CFN conservatives)*	*Class 1 (CFN enthusiasts)*	*Class 2 (CFN conservatives)*
Travel behavior									
Mode ownership	*Car*	*0.052*	*-0.071*	*0.158****	*0.014*	*0.036*	*0.057*	*0.099*	*-0.137*
	PT month card	*-0.030*	*-0.023*	*-0.037*	*0.041*	*-0.038*	*0.008*	*0.022*	*-0.028*
	Carsharing membership	*-0.037*	*0.388*	*-0.018*	*0.091*	*-0.042*	*0.250*	*0.059*	*-0.190****
Frequent travel mode to bus/tram station	*Walking*	*0.091*	*0.017*	*0.028*	*0.026*	*0.079*	*0.018*	*-0.077*	*0.207*
	Cycle	*0.107*	*-0.040**	*0.114*	*0.103*	*0.089*	*0.376*	*-0.145*	*0.459*
Frequent travel mode to metro station	*Walk*	*-0.130**	*-0.015*	*0.110*	*-0.015*	*-0.002*	*-0.073*	*0.097*	*-0.052*
	Cycle	*-0.102*	*-0.024*	*0.088*	*-0.055****	*0.067*	*-0.140****	*-0.010*	*-0.142*
	Bus/tram	*-0.065*	*-0.034**	*0.035*	*-0.007*	*0.070*	*0.003*	*-0.017*	*-0.066*
Frequent travel mode to train station	*Walk*	*-0.107**	*0.001*	*-0.174****	*-0.045*	*-0.169****	*0.012*	*0.065*	*0.037*
	Cycle	*-0.168***	*0.055*	*-0.141**	*-0.035*	*-0.206****	*-0.015*	*0.297***	*-0.093*
	Bus/tram/metro	*-0.079*	*0.022*	*-0.097*	*-0.066*	*-0.144**	*-0.001*	*0.110*	*0.000*
Generally frequent travel mode	*Walk*	*0.027*	*-0.037*	*0.049*	*-0.042*	*0.111***	*0.034*	*-0.004*	*-0.077*
	Bike	*0.038*	*0.001*	*-0.081*	*0.010*	*-0.048*	*-0.040*	*0.122*	*0.165*
	Public transportation	*0.100***	*-0.015*	*0.122***	*0.037*	*0.051*	*0.031*	*-0.027*	*0.082*
	Car	*0.109*	*0.097***	*-0.157***	*0.011*	*-0.006*	*-0.005*	*-0.086*	*0.118*
Attitude	*PT is pleasant to travel with.*	*0.001*	*0.015*	*0.037**	*0.026*	*-0.009*	*-0.010*	*0.048**	*-0.045*
	Cycling makes me happy.	*0.019*	*-0.003*	*-0.001*	*0.009*	*-0.040***	*0.013*	*-0.041*	*0.026*
	Walking wastes time.	*0.005*	*-0.005*	*-0.023*	*-0.004*	*-0.006*	*-0.021*	*-0.007*	*-0.022*
	Too many people drive alone.	*0.005*	*-0.019**	*-0.027*	*0.002*	*-0.044***	*0.010*	*0.059***	*0.038*
Built environment									
Distance to bus/tram station	*<500m*	*-0.010*	*-0.098*	*-0.105*	*-0.004*	*-0.131*	*0.097*	*-0.151*	*0.080*
	500-1000m	*-0.040*	*-0.037*	*0.021*	*-0.043*	*-0.140***	*0.131*	*-0.203**	*0.057*
Distance to metro station	*<500m*	*0.149*	*0.025*	*0.051*	*-0.017*	*-0.011*	*0.267*	*-0.151*	*0.202*
	500-1000m	*0.065*	*-0.042***	*-0.002*	*-0.024*	*0.182*	*0.020*	*0.045*	*0.174*

	1000-1500m	0.011	0.099	0.101	0.165	0.040	0.236	-0.059	0.020
Housing type	High condo	-0.038	0.048	0.121	-0.028	-0.105	-0.095	0.147	-0.143
	Low condo	-0.106	0.016	0.081	0.057	-0.132*	0.036	-0.031	-0.034
	Row house	-0.151**	-0.016	0.101	0.019	-0.073	-0.038	-0.014	-0.040
Housing location	Inner city	-0.032	-0.005	0.071	0.015	0.024	-0.119***	-0.181**	0.032
	Inner suburb	-0.045	0.036	0.059	-0.02	0.062	-0.016	-0.187***	0.195
Within 2km availability of facilities	Shops	0.010	0.023	-0.084	-0.023	0.079	-0.161	0.016	0.050
	Entertainment	-0.048	-0.016	0.011	0.016	0.072	0.094*	0.178***	0.006
	Open	0.014	0.054**	-0.156*	0.018	0.070	0.107**	-0.003	0.120
Demographics									
Gender	Male	-0.045	-0.029	0.056	-0.029	0.113**	0.020	-0.210***	-0.071
Age	18-35	0.688***	0.746***	0.099	-0.041	0.304**	0.177	0.054	-0.180
	36-50	0.595***	0.427**	0.011	-0.060	0.342***	0.032	0.269**	-0.204
	51-60	0.442***	0.279***	-0.011	-0.051	0.202**	-0.029	0.223**	-0.241
Education	Primary and secondary	-0.145***	-0.106**	0.018	-0.031	0.104	0.098	-0.040	-0.050
	Vocational	-0.088	-0.059	0.123	-0.027	0.066	0.004	-0.156*	-0.085
	HBO/Bachelor	-0.040	-0.049*	0.033	-0.020	-0.062	0.101	-0.083	-0.047
Household type	Couple with children	-0.123**	-0.029	0.019	-0.012	-0.030	0.023	-0.029	0.068
	Couple no children	-0.082	-0.059	-0.049	-0.015	0.189*	0.002	-0.014	0.048
	Single no children	-0.013	-0.018	-0.074	-0.034	0.181*	-0.035	0.141	-0.006

Regarding the influential factors of using CFN shared-cars to travel to offices, “CFN enthusiasts” who often walk or cycle to metro and train stations less prefer to use shared-cars to travel to offices. A possible reason is that the convenient connection to public transportation reduces their demand to drive CFN shared-cars to their offices. For “CFN conservatives”, people who frequently travel by car and hold non-negative attitudes towards car use are more likely to use shared-cars to travel to their offices. This result may signal the potentials of CFN shared-cars to replace the private car ownership of “CFN conservatives”. Regarding the influential factors on using CFN shared-cars for traveling to public transportation stations, “CFN enthusiasts” who frequently travel by public transportation, own cars but use cars infrequently, and hold positive attitudes towards public transportation, prefer to use shared-car for traveling to public transportation stations. For “CFN conservatives”, few factors show significant influence. Regarding the influential factors on using CFN shared-cars for traveling to shops, “CFN enthusiasts” who often walk, cycle, or take public transportation to train stations less prefer to use CFN shared-cars to travel to shops. A possible reason is that most survey cities have the spatial structure centered around train stations where shops are densely located. Thus, “CFN enthusiasts” who can get access to train stations by convenient green transportation modes can easily get access to shops. As a result, these “CFN enthusiasts” have low demand to use CFN shared-cars to travel to shops. The result also shows that “CFN enthusiasts” who hold negative attitudes towards cycling and positive attitudes towards car use prefer to use CFN shared-cars to travel to shops, while “CFN conservatives” who live within 2 km to shops less prefer to use CFN shared-cars to travel to shops. Regarding the influential factors on using CFN shared cars for occasional visits to other cities, “CFN enthusiasts” who often cycle to train stations and hold positive attitudes towards using public transportation, but hold negative attitudes towards car use prefer to use CFN shared-cars to travel to other cities. However, “CFN enthusiasts” who live in city areas less prefer to use CFN shared-cars to travel to other cities. A possible reason is that for long-distance travel, “CFN enthusiasts” prefer driving CFN shared-cars to reduce the number of public transportation transfers. Few factors show significant influence on “CFN conservatives” regarding their preferences to use CFN shared-cars for traveling to other cities.

5. CONCLUSIONS AND DISCUSSIONS

In this study, the influence of travel behavior and built environment on people’s CFN preference is investigated. As a result of latent class model, two latent classes, “CFN enthusiasts” and “CFN conservatives”, are identified based on people’s CFN preference heterogeneity. First, “CFN enthusiasts” significantly care about the housing benefits (housing costs, living area, housing type, year of construction), quality of carsharing services (costs, booking time, parking distance) and improvements of neighborhood environment (green space density). Based on the membership probability, people who often cycle, hold positive attitudes towards green transportation, and live in condos close to shops and entertainment facilities are more likely to belong to “CFN

enthusiasts". This result signals that green transportation fans are more likely to be the target audience of CFNs, and it is important to ensure high-quality carsharing services and improved neighborhood environments for them. The results of the binary logistic model show that travel behavior and built environment have significant influence on the preferred destinations of using CFN shared-cars. Notably, "CFN enthusiasts" who frequently use public transportation show significant preferences to use CFN shared-car to travel to and from public transits. However, even for the "CFN enthusiasts" who have convenient green transportation to train stations, they show significant preference to use CFN shared-cars for occasional visits to other cities, probably to reduce the number of transfers in long-distance travel. Based on the preferences of "CFN enthusiasts" for CFN shared-car use, the CFN carsharing services can be specialized to transit-based and rental-based to cater to their demands.

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WHAT CAN WE LEARN FROM THE CHARACTERIZATION OF NEW CAIRO'S URBAN VOIDS?

Aya Elshabshiri

The American University in Cairo, Egypt
Research Assistant, a.elshabshiri@aucegypt.edu

Mahmoud Elkady

American University in Cairo, Egypt
Research Assistant, mahmoudelkady@aucegypt.edu

Toka Abufarag

The American University in Cairo, Egypt
Research Assistant, tok*aabufarag@aucegypt.edu*

Sherif Goubran

The American University in Cairo, Egypt
Assistant Professor, sherifg@aucegypt.edu

ABSTRACT

Urban voids are places of limited value and often negative empty spaces in the urban environment that are unused, underutilized, or abandoned. Generally, these voids are incoherent with their surroundings and disruptive to the urban fabric. In the context of Cairo, where urbanization has been and still is occurring rapidly, many urban voids exist and there is limited work that maps or characterizes them. Authors such as Roger Trancik, highlight the need to identify these 'gaps in spatial continuity' to fill them with functions. This research will study urban voids in New Cairo (Egypt), situated between the older Cairo region and the New Administrative Capital. The study utilizes satellite maps and GIS, complemented by field visits to document urban voids, focusing on a residential neighborhood that is fully developed and mostly occupied. Previously published urban void typologies are used to analyze and categorize urban voids in the study area. The outcome is a series of graphical representations that quantitatively chart the number and typologies of voids in the study area. Physical site characteristics observed are correlated with the GIS mapping to extract urban attributes that can be used to define, categorize, and analyze urban voids in similar contexts. Thus, the research presents and applies a framework for the study of urban voids that can be adopted for the study of urban voids in Egypt's newly developed urban communities. Through the mixed methods approach, the research fills the gap in urban void research by providing generalizable criteria for analysis and documentation, providing important lessons for planners and policymakers.

Keywords: urban voids; void typologies, spatial mapping; leftover spaces; urban planning

1. INTRODUCTION

An essential goal in the design of cities and neighborhoods is connecting people together and meeting their daily needs. However, as the population grows, people have become disconnected from their community and necessary amenities and facilities. One of the underlying problems that could lead to this deterioration is the existence of empty and underutilized spaces called urban voids, which are generally attributed to poor planning and land management. Hashem et al. (2022) state that every new city has many vacant or undefined spaces because of the ill-design and planning approaches that produce undefined spaces that turn into wasted spaces. This is based on the original theoretical developments by Trancik (1976), in his book Finding Lost Space.

In the context of Cairo, Egypt, where urbanization has been and still is occurring rapidly, many urban voids exist. In fact, these voids can be seen in both established and new urban agglomerations. These spaces, however, can hold many opportunities to be revitalized. For example, they can be turned into urban public spaces such as public gathering spaces, parks, plazas, or a place for activities that engage people and enhance the public realm (Hashem et al., 2022). To prevent urban voids and revitalize existing ones, they need to be first mapped, defined, and analyzed.

2. LITERATURE REVIEW

2.1. Urban void definition, causes, and potential

Research on urban voids began approximately 30 years ago with a book called *Finding Lost Space* by Roger Trancik, in 1986. According to the author, these areas, which he refers to as 'lost spaces,' are unwanted, negative, and empty. Additionally, they are without human interaction or measurable boundaries and dispersed without any order or relation all over the city; thus, they do not connect elements coherently and do not contribute positively to the urban fabric of a city. These 'lost spaces' commonly occur along railways, residential areas, underdeveloped roads, deserted military courts, and industrial areas (Trancik, 1986; Hashem, 2022; Pluta, 2017). Lynch (1981) describes void spaces as 'neglected,' 'useless,' 'empty areas,' and 'waste zones.' He discussed two types of lost spaces: those with unknown functions (e.g., leftover undefined spaces) and those with specific uses (Lynch, 1981; Omar & Saeed, 2019). Gawad et al. (2019) characterize urban voids as 'spaces that lack the sense of balance, well-being, and cues of the environment or lose their memories and meanings.' The authors describe urban voids as 'leftover spaces, highways voids, vacant land, deteriorated waterfront, sunken plazas, and vast parking lots.' Moreover, Zecca and Laing (2020) describe an *Urban fragmented void* as the antithesis of solid, a built-up space devoid of any specific value. It is generally unpleasant and results from the improper spacing between two built-up areas. The immediate effects are a sense of degradation, being cut off from the rest of the city, and incompleteness. Moreover, they are abandoned, neglected, and forgotten. Drawing on original theoretical developments on urban voids proposed by Tranick (1986), Pluta (2017) indicates that urban voids are incoherent and out of context with their surroundings, disturbing the urban fabric. 'Urban voids are undesirable urban areas that need redesigning, making no positive contribution to the surroundings. They are ill-defined, without measurable boundaries, and fail to connect elements coherently.' Not only do these places become homes to the physical collection of dirt and garbage, but they also weaken the city's aesthetic aspects, attracting homeless people and criminals. Consequently, this creates an epicenter for different social problems. Many know that spaces exist between buildings; however, they are unnoticeable in their daily lives (Pluta, 2017). To make an impact on the residents' memory, urban spaces must be reevaluated to redefine and transform them into memorable places by considering the possibility of building on urban voids instead of new land elsewhere (Lopez Garcia, 2016).

According to Lopez Garcia (2016), the loss of urban space's value is the beginning of its decline and its trajectory to becoming an urban void. Many factors can cause the appearance of urban voids in a city. For example, they can be created due to misunderstanding the urban fabric and designing without considering the context. Another cause of the appearance of a void is when the space is not used the way it was intended to be used. For example, as they become unused and further lose their value in the city, voids can appear from an underutilized park or lane that could serve as a garden for the surrounding residents (Pluta, 2017; Hashem, 2022). Furthermore, urban voids can occur due to designers' inadequate consideration of the natural features of the city (Pluta, 2017; Hashem, 2022; Omar & Saeed, 2019). Moreover, economically, the decline of land value in a location may lead to the inability to yield revenue, which then leads to abandonment and negligence of the area. With the progression of time, the abandonment of land increases, causing it to deteriorate further, as well as social and economic costs (Hudson and Shaw, 2011). Urban voids could also be created due to flawed political decisions and ineffective communication between decision-makers and stakeholders. Lastly, inadequate land management combined with high usage of cars can make a particular downtown area unattractive, further leading to urban voids (Hashem et al., 2022; Trancik, 1986).

However, hidden in urban voids are many opportunities. Urban voids can be transformed to the point where they can successfully meet society's needs. For example, a 'leftover space' could be used as a landscaped sanctuary of 'foliage,' peace, and 'tranquillity' if it is successfully designed and safety ensured (Akkerman and Cornfeld, 2010). According to Pluta, 2017, high urbanization causes the disappearance of 'empty and silence zones;' this increases the importance of 'undeveloped, open spaces' of which the existence or scarcity 'become the measure of reference for future projects.' Recognizing that empty space is a scarce commodity, it must be

invested in and designed with care (Pluta, 2017; Omar & Saeed, 2019). As such, one of the most significant advantages of urban voids is their ability to be easily adaptable; therefore, they should be carefully treated, so they do not lose their adaptability or flexibility. One example of the adaptability of urban voids is renovating a previously abandoned building. The building could be adapted to successfully carry out many activities to meet the city's needs (Pluta, 2017). A downtown back alley is another example of a void with a high potential for transformation. By renovating the space into a place such as an 'open-sky pedestrian mall and a playground,' it would become secure and appealing, reducing the danger that would otherwise be present in an abandoned urban void (Akkerman and Cornfeld, 2010). Further, start-ups, recreation groups, and small activity-related get-togethers can reach immense popularity within the city, contributing to city life's development since it allows them to grow in a 'flexible, open environment' (Pluta, 2017). Moreover, adding 'adaptive street furniture could transform [these places]' (Akkerman and Cornfeld, 2010).

2.2. Categorization of urban voids

To understand urban voids better and be able to efficiently transform them into valuable areas, it is best to categorize them. This has been done in several ways:

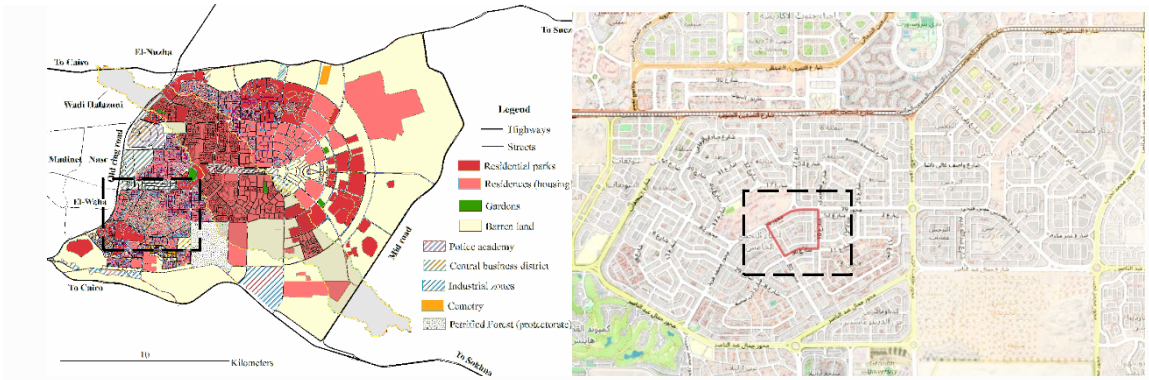
Table 1: Categorization of urban voids.

By	Categorization System	Discussion
Hashem et al., 2022	Urban buffer zones: an urban buffer zone is a transitional piece of land that can be found between two different kinds of functions. One example of these buffer zones is the restrictions due to zoning ordinances such as setbacks, marginal spaces, and residual spaces. Infrastructural: dead areas around and in public infrastructure Transportation voids: such as an oversized or oversupplied street that is usually formed due to a lack of initial analyses or improper space allocation. Large-scale plots: Parking lots, neglected abandoned areas, and unused land belong to this category and are usually caused due to lack of stakeholder engagement.	According to the author, urban voids can be categorized depending on their size and ownership. It is not as extensive as Hamlin's categorization system below, but it serves to identify urban voids at a smaller scale such as a neighborhood.
Lee and Lee, 2016	**A plot** is a basic unit of urban space that can be developed or altered by landholders, it can contain two types of voids: pilotis and rooftop spaces. Pilotis are described as the ground floor of the building used for parking and are a by-product of creating parking areas in limited conditions. Rooftop spaces are typically utilized as outer storage, or for small-scale gardening, however, they are rarely used actively. **A block** is a more extensive unit that gathers plots and can be considered a basic unit of development. It contains spaces between buildings and set-backed spaces that are usually small and sporadically placed in low-rise residential spaces; thus, they are considered an unclear area to utilize. **A community** is the most extensive unit involving plots, blocks, and streets. In terms of urban voids, a community may contain oversized streets that elevate the number of cars, which threatens pedestrians. Over-supplied streets are similar to oversized streets, though they also contain repeated streets because of inadequate method of design and poor acts.	The authors categorize urban voids depending on where the urban voids occur, they could occur on a plot, block, or community. This system can be useful because knowing where a void occurs is important in order to revitalize voids into suitable functions that can serve on different levels. However, for this research, it may be hard to quantify pilotis and rooftop spaces since they are usually found in private spaces, i.e. plots.
Hamlin, 2016	**Horizontal planes** have little to no space-defining vertical elements and are typically large, flat spaces generally seen in parking and vacant lots. These spaces usually have a less than 1:1 height-to-width ratio. However, sparse vegetation or roads border the edges. More broadly, horizontal planes are almost always noticeable and accessible to people along the entire edge. Two subcategories of horizontal planes are paved and unpaved planes. Paved Planes are no smaller than 40m^2 extensive areas of pavement (e.g., concrete and asphalt). Aside from their primary utilization for servicing and parking needs of the surrounding businesses, they can improve the urban fabric by unlocking their potential for secondary and tertiary functions. Unpaved planes are considerable, areas of grass or gravel that are usually found as vacant lots, brownfields, or unpaved parking lots. They are likely to retain remnants of past activities. **Vertical Planes** are typically found adjacent to roads or other urban void areas and are 1-story or 2.5 meters high and at least 10 meters long. Retaining or engineered walls and windowless architectural walls are subcategories of vertical elements. Engineered walls are generally seen around and in elevated infrastructure and on steep slopes and are frequently utilized for keeping back land with changes in grade They are usually much longer because of their locations and purpose. Windowless exterior architectural walls of buildings can be the product of removing the adjacent structures or buildings, though they might further be seen as low-utilized spaces.	Hamlin, 2016, classified urban voids in terms of their scale and location. This is an extensive and detailed categorization system as it specifies sub-categories for each category. It also specifies the minimum dimensions each category should have, as well as their relationship with their surroundings and their location in the built environment. This system is beneficial because it enables designers and stakeholders to understand the urban void under study to be able to revitalize it into suitable functions.

	Enclosures include elements such as dense vegetation and built forms that aid in defining the edges of the area, enclosures are usually utilized for parking, servicing, and storing waste receptacles. Furthermore, an enclosure is required to consist of vertical elements on a minimum of three sides. These spaces are usually visible from adjacent buildings and, the public realm, and are commonly adjacent to roads and linked to a passageway. There are two types of enclosures, bays and rear lots. Bays are highly visible and accessible to the general public while bordered and enclosed along three sides. As for the fourth side, it is typically a road that provides entrance to the area and is adjacent to another urban void area or public domain. Regardless, it is possible for bays to have secondary entry points. Rear Lots are usually less visible from the public domain, and easily accessible through passageways or horizontal planes. Rear lots tend to have a higher sense of enclosure. **Passageways** feature alleyways and laneways and are normally framed by building or dense vegetation and are defined as having an elongated XY-plane, no wider than 20 meters. The prolonged, framed configuration tends to steer the user through the area providing an indication of movement, directionality, and visual orientation. In order to categorize a space as a passageway, it should have a minimum of 1:1 height-to-width ratio. Passageways can be considered as areas that serve as a bridge between the public and semi-private spheres. Laneways can have irregular shapes and can have breaks along their axis. These breaks frequently serve as secondary entrances to an area or lead to other urban voids. Laneways are broader than alleyways, allowing for heavier traffic to pass through the area. These areas tend to feel more private and are narrower than the average road. Alleyways function similarly to laneways in that they give users access to enclosed rear spaces while also potentially serving as a space for nearby businesses to service their customers. Alleyways are typically enclosed and are frequently smaller, shorter in lengths than laneways and stronger in rectilinear form.	
Omar and Saeed, 2019	**Naturals** are located around metropolitan areas. **Interiors** are located in already built cities, that appear between an already built city and a new urban development. **Interstitials** are located close to a natural element or infrastructure such as motorways, and railways. They are usually linear in shape.	This categorization system is more generalized towards a bigger area like a city rather than a smaller area like a neighborhood.

3. RESEARCH METHODOLOGY

The research uses a mixed-method approach, adopting both qualitative and quantitative research tools. Like Hesham et al.'s use of descriptive-analytical methods in their thorough assessment of the development and potential of urban voids in Cairo. The mixed methodology maps, describes, and catalogs the surveyed urban voids to contribute toward creating a framework for the study and categorization of urban voids, with a specific focus on creating a list of criteria to determine what qualifies as an urban void. The first research method involved preliminary mapping through satellite images that allowed the refinement of the selected zones. The second research method was first-hand field visits that entailed recording observations and the documentation of the surveyed voids, as well as understanding their potential. Lastly, GIS analysis was conducted for the surveyed zones. To assess urban voids in the context of Cairo's rapid urbanization, the selection criteria of the plot dictated the choice of a recently planned city that is also old enough to have been completed. Concerning Cairo's constant expansion into the desert, it was important that the area lies between the older neighborhoods of Cairo and the latest construction, the New Administrative Capital. As such, New Cairo was selected for the analysis and was subsequently surveyed for a fully developed neighborhood representative of the rest of the city. The selected neighborhood is located southwest of New Cairo in the 3rd District of the 5th Settlement area, one of the first areas to be developed in New Cairo in the early 2000s. The residential neighborhood is 0.27 km^2, an average area of a typical neighborhood in New Cairo.



(a) (b)

Figure 1: (a) Map of New Cairo (Saleem, 2018), and (b) Map of the selected neighborhood in New Cairo.

3.1 Data Analysis

To determine the categorization of empty spaces in the selected areas as urban voids, data collected from the field visits and the GIS mapping exercise was divided according to criteria adopted from relevant literature that ensures a reliable and generalizable understanding of urban voids beyond the parameters of the investigated plot. Using a set of criteria for verifying the definition of an urban void not only ensures consistent results but also sets a precedent for future research efforts tackling urban voids. The criteria chosen to define an urban void cover the key descriptions from existing literature, including lack of (social) function, emptiness or vacancy, neglect and lack of maintenance, disruption of the urban fabric, and the lack of values such as social, environmental, and economic values (Lynch, 1981; Trancik, 1986; Hudson & Shaw, 2011; Lopez Garcia, 2016; Pluta, 2017; Zecca and Laing, 2020; Hashem et al., 2022). Each criterion has a score of 0 (no), 1 (somewhat), or 2 (significant), adding to a total score of 12. Areas with a score of 6 or below are considered urban voids (Table 2a). Areas that qualified as urban voids were further analyzed according to the designed framework. The areas were categorized into eight types of urban voids that have been deduced from the analyzed literature (Hashem et al., 2022; Hamlin, 2016; Lee and Lee, 2016). The categories cover a full spectrum of possible urban voids in New Cairo (Table 3b).

Table 2: (a) Urban void criteria, (b) Urban void categories.

(a)

No.	Item
1	Low Utilisation of Space
2	Low Uptake/ Maintenance
3	Lack of Urban Context
4	Loss of Social Value
5	Loss of Environmental Value
6	Loss of Economic Value

(b)

No.	Item
1	Alleyways/Urban buffer zones or passageways
2	Laneways/Urban buffer zones or passageways
3	Infrastructural
4	Transportation Void
5	Paved Large Scale Plot/ Horizontal Plane
6	Unpaved Large Scale Plot/ Horizontal Plane
7	Vertical Planes (empty walls or retaining walls longer than 10m)

4. RESULTS AND DISCUSSION

Two site visits took place. The first was on a workday afternoon, while the second was during weekend evenings where it is usually expected to see amenities such as parks utilized by families. It seems that most urban voids are passageways between blocks of buildings, in addition to some horizontal plane-type voids that mainly consist of underutilized non-maintained parks. Even though the height of the buildings to street width ratio is 1:1 to 1:2, which is considered less than the minimum of 1:3 (USGBC), the streets are built for cars with no consideration for pedestrians; thus, no sufficient sidewalk areas exist. And if they do exist, they are unusable sidewalks with either broken pavement or unpaved with unmaintained plant growth that hinders walking,

leading to urban voids. Below is a table of the areas mapped. Based on the criteria above, each area was determined to be either an urban void or not.

Table 4: Areas mapped in a New Cairo neighborhood.

ID	Name	Area(m2)	Utilization	Uptake	Function fits in urban fabric	Value			Overall score	Is it an urban void	Category
						Social/ cultural	Environ-mental	Economic			
1	Park 1	1283	0	1	2	1[a]	2	1	7/12	false	-
2	Unpaved sidewalk	570	0	0	2	0	0	0	2/12	true	Buffer zone
3	Structure on traffic island	66	0	0	0	0	0	0	0/12	true	Transportational
4	Traffic island	304	1[b]	0	2	0	0	0	3/12	true	Transportational
5	Unpaved sidewalk	1160	0	0[c]	2	0[d]	0	0	2/12	true	Buffer zone
6	Traffic island	135	0	0	0	0	0	0	0/12	true	Transportational
7	Wide intersection	275	1	1	0	0[e]	0	0	2/12	true	Transportational
8	Passageway	460	1[f]	0[c]	2	0	2[g]	0	1/12	true	Buffer zone: Laneway
9	Sidewalk	173	1	0[h]	2	0	1[i]	1[j]	5/12	true	Buffer zone
10	Fence	55	2	2	2	0	0	2[j]	8/12	false	-
11	Passageway to park 2	129	0	0	2	0	1	0	3/12	true	Buffer zone: alleyway
12	Park 2	9484	0	0[k]	2	0[a]	2	0	4/12	true	Large scale plot: unpaved
13	Passageway to park 2	157	0	0[h]	2	0	0	0	2/12	true	Buffer zone: alleyway
14	Passageway to park 2	170	0	1	2	0	2	0	5/12	false	Buffer zone: alleyway
15	Passageway	101	0	0[h]	2	0	0	0	2/12	true	Buffer zone: alleyway
16	Parking lot	2024	2	1	2	0	0	2[l]	7/12	false	-
17	Passageway	565	1[f]	0	2	0	0	0	3/12	true	Buffer zone: alleyway
18	Park 3	2805	0	0	2	0	0	0	2/12	true	Large scale plot: upaved
19	Passageway	337	1[f]	0[h]	2	0	0	0	3/12	true	Buffer zone: alleyway
20	Abandoned house	651	0	0	2	0	0	2	4/12	true	Large scale plot: built
21	Sidewalk	209	0	0,[c]	2	0	0	0	2/12	true	Buffer zone
22	Passageway	725	0	0	2	0	0	0	2/12	true	Buffer zone: alleyway
23	Sidewalk	136	0	0	0[m]	0	0	0	0/12	true	Buffer zone
24	Passageway to park 2	86	0	0[h]	2	0	0	0	2/12	true	Buffer zone: alleyway
25	Traffic island	874	0	0[n]	2	0	0	0	2/12	true	Transportational
26	Park 4	733	0	0[h]	2	0	1	0	3/12	true	Large scale plot: unpaved
27	Unpaved street and sidewalk	172	1[f]	0	2	0	0	0	3/12	true	Transportational
28	Passageway	572	1[f]	0	2	0	1	0	4/12	true	Buffer zone: alleyway

29	Park 5	1864	0	0	2	0	1	0	3/12	true	Large scale plot: unpaved
30	Unpaved street and sidewalk	390	1 [f]	0	2	0	0	0	3/12	true	Transportational
31	Passageway	597	1 [f]	1 [h]	2	0	2 [g]	0	6/12	true	Buffer zone: alleyway
32	Park 6	1944	0	0	2	0	1	0	3/12	true	Large scale plot: unpaved
33	Passageway	837	0	0	2	0	1	0	3/12	true	Buffer zone: alleyway
34	Passageway	207	0	0	2	0	1	0	3/12	true	Buffer zone: alleyway
35	Park 7	1977	0	0	2	0	1	0	3/12	true	Large scale plot: unpaved
36	Traffic island	1360	0	0 [c]	2	0	1	0	3/12	true	Transportational
37	Passageway	760	0	0	2	0	1	0	3/12	true	Buffer zone: alleyway
38	Passageway	520	0	0	2	0	1	0	3/12	true	Buffer zone: alleyway
39	Passageway	179	0	0	2	0	1	0	3/12	true	Buffer zone: laneway

[a] no furniture to allow for gatherings and social interaction, but there are pathways; [b] vegetation; [c] broken pavement and garbage; [d] unsafe; [e] it is not people oriented, does not allow for social interactions; [f] mostly by cars, but not by people; [g] can accommodate different modes of transportation, has some greenery; [h] garbage; [i] has trees but does not accommodate people; [j] serves a school; [k] garbage, sandy areas with patches of overgrown grass; [l] serves school and shops; [m] no pavement for sidewalk; [n] broken pavement, plants are not maintained, garbage.

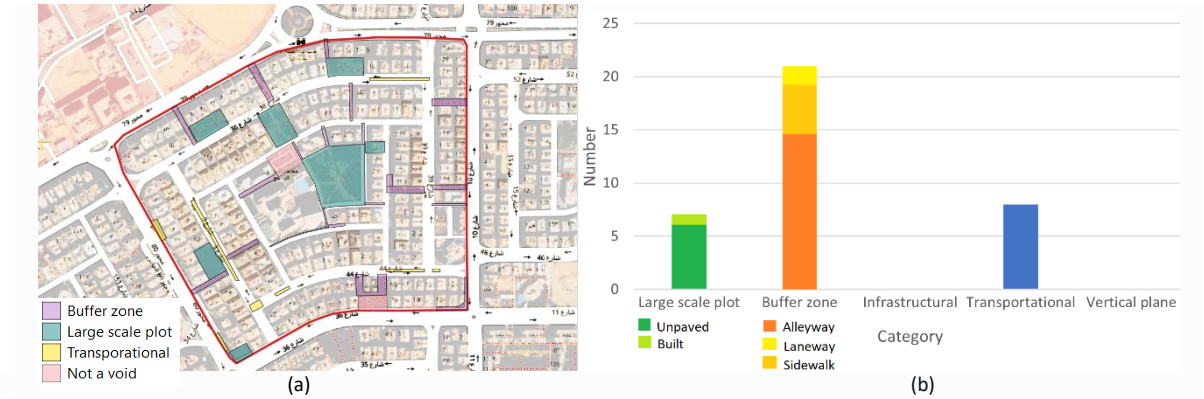


Figure 2: (a) GIS mapping of the categories found in the neighborhood under study, and (b) Urban void category prevalence.

4.1. Discussion

This study found thirty-six urban voids in the neighborhood under research. Based on the results above, the three categories observed are buffer zones, large-scale plots, and transportational urban voids. Moreover, buffer zone voids, especially alleyways, are most prevalent, accounting for 21 of the 36 voids found. Looking at the neighborhood map (Fig. 2), one can see the abundance of passageways between every row of approximately five to six buildings. Unfortunately, nearly all of them are considered urban voids as people do not utilize them. Some contain pots of plants that are usually not maintained, with trash infesting those plants, and some also are used for parking cars (Fig. 3a). Large-scale plots consist of 7 out of the 36 voids found in the neighborhood under study. Most large-scale plots are abandoned parks that are cleaned and maintained once every month, according to a gardener that works there, which is not enough as they are filled with garbage, sandy areas, and unmaintained grass growth (Fig. 3b,c). Furthermore, there is a lack of furniture and functions in most of the voids that encourage social interactions and gatherings and thus score low in the social value criteria. However, most of the parks have pathways for walking. In addition, transportational-type voids account for 8 of the 36 voids, which consist of broken and non-maintained traffic islands and sidewalks (Fig. 3d,e), as well as an oversized street intersection (Fig. 3f).

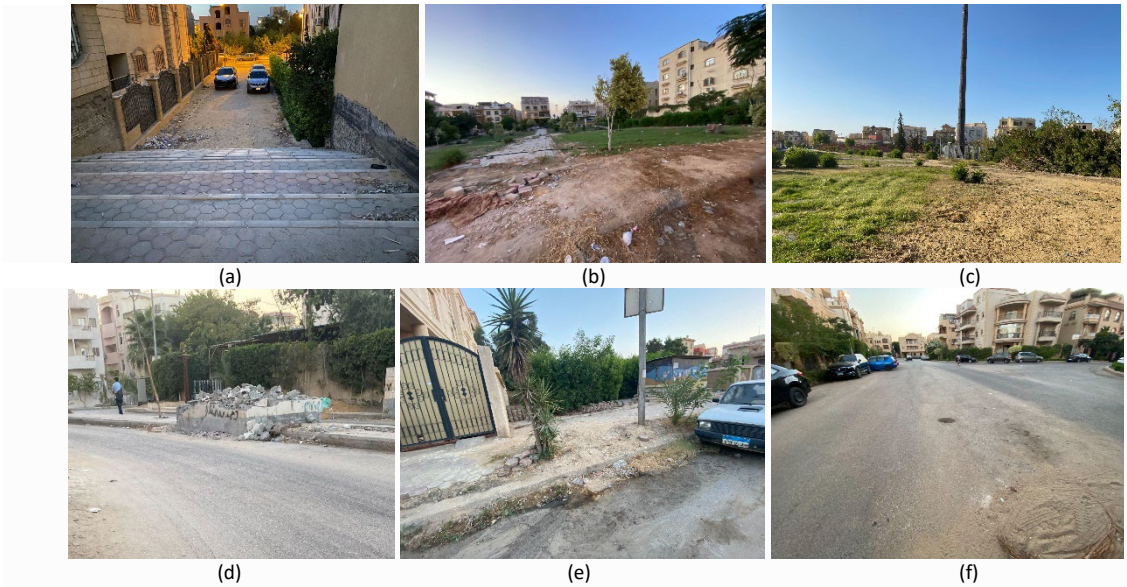


Figure 3: (a) Void no. 8, a buffer zone type with cars parked in it (b) Void no. 18, a large-scale plot type of void, (c) Void no. 12, a non-maintained empty park, (d) Void no. 3, a broken structure on a traffic island, (e) Void no. 5, broken sidewalk pavement, and (f) Void no. 7, a wide street intersection.

There is a correlation between the utilization of public spaces, how much they are maintained, and how much value they hold. For example, 25 of the 36 voids that scored 0 in utilization also scored 0 in uptake and maintenance. Additionally, 23 voids that scored 0 in utilization scored 1/6 or less across the three types of values, social, environmental, and economical, combined.

5. CONCLUSIONS AND RECOMMENDATIONS

Thirty-six urban voids were found in the neighborhood under study; the three categories that were most observed are buffer zones, large-scale plots, and transportational urban voids. Moreover, the study found a correlation between the utilization of public spaces, how much it is maintained, and how much value it holds. Therefore, the municipality should evaluate the potential each urban void holds to create healthy, community-enhanced neighborhoods. One opportunity found in the neighborhood is that most of the original functions of the urban voids under study fit in the urban fabric of a residential community, such as passageways for people to walk and take shortcuts, sidewalks, and parks. Despite that, people are not encouraged to use them, and sometimes it is impossible to use them. Another opportunity this neighborhood has is the proximity of parks and green spaces to most residents. Unfortunately, as stated, they are neglected. Revitalizing the urban voids by encouraging activities like 'events or exhibits such as art displays and performances' to take place and by adding features and 'locally designed and built amenities like seating and tables' that encourage social interactions and gathering can increase the space's social value and community sense among the residents. 'Even streets provide opportunities for the placement of permanent or temporary active recreation equipment and programming' (Project for Public Places, 2016). Moreover, adequate nighttime lighting is also crucial, as it is lacking in some parks. The municipality must improve nighttime lighting to attract more people throughout the day while providing them with a sense of safety. People can also be encouraged to open small businesses in those spaces to increase their economic and social value. Environmental value somewhat exists in the neighborhood due to vegetation and pathways that allow for different modes of transportation, such as biking and walking; however, some pavements are broken and not maintained, hindering walking and biking. Therefore, the municipality of New Cairo should put more effort into continuously up-taking those voids, improving their safety and aesthetics so residents can use them successfully.

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INVESTOR ARCHITECTURE – CASE STUDY: THE CITY OF NIŠ

Hristina Krstić

PhD., Assistant Professor, hristina.krstic@gaf.ni.ac.rs.

Vladana Petrović

PhD., Assistant, vladana.stankovic@gaf.ni.ac.rs.

Milica Živković

PhD., Assistant Professor, milica.zivkovic@gaf.ni.ac.rs.

ABSTRACT

Recently, Niš, the 3rd largest Serbian city, has faced the increased demand for apartments, which has led to the rapid growth in the residential sector. Many high-rise buildings are randomly springing up all over the city, changing its skyline and existing urban pattern. The demand for living space is high, but the quality of the same offered on the market is quite questionable. This paper is focused on a case study of newly constructed residential district in the city of Niš, which aims to valorize its architectural and urban characteristics in order to figure out the level of impact that such construction trend is leaving on the city and its residents. The case study done for this research could serve as a representative sample, which depicts the current state of the architectural trend not only in Niš, but in the whole country.

Keywords: residential architecture; investor architecture; urban pattern; the City of Niš

INTRODUCTION

In recent years, Niš has become big construction site when it comes to housing construction. It seems that the famous Čika Jova's (Jovan Jovanović Zmaj, Serbian poet) verses, "wherever you find nice place, plant a tree there", are reinterpreted in Niš in the way: "wherever you find nice place, plant the building there", and that in the literal sense! Spaces that were once planned as green areas between buildings are turning into buildings, and new "neighbors" significantly change the conditions of micro-location (Fig. 1). Thus, apartments in old buildings, primarily oriented towards free spaces, with adequately planned views, suddenly lose their initial characteristics. It occurs an obvious destruction of privacy, insolation, compositional unity etc., that is, basic factors that are important for the normal life in a multi-family building, as well as architectural harmony. The physical proximity of neighbors, and often, direct visual contact achieved by insufficiently thought-out placement of facade openings of new buildings, mismatched with the position of the openings of existing buildings, directly affect the reduction of the level of privacy, both for current and new future users. The distance between buildings is no longer adapted to the adequate insolation of residential units. New buildings cast a shadow on old ones and vice versa. Spaces aimed for rest and recreation are permanently lost, and the new architecture is often not adapted to the context. A bunch of new problems arises.

Figure 1: Newly constructed building in the space that once used to be open air space between two residential buildings. https://www.google.com/maps/preview

Although the economic situation of Niš is not at an enviable level, especially compared to the capital of the country, it can still be noticed that there is a certain progress in the economic sense, which has caused the demand for apartments in Niš - the demand that, could be said, has never been bigger. Evidently, there is demand, as well as offer, but what is questionable is the quality of the market offer and also what future users are willing to accept from the market.

The residential architecture of Niš is very specific. It is woven from a mix of different styles or simply something that cannot be called a style, but, perhaps, the influence of various political and economic circumstances and difficult times that the city faced during its existence, i.e. the struggle of expertise and inexperience. A large number of buildings were created by illegal construction, i.e. without a construction permit, and therefore without any control or approval. The fact that a huge number of buildings were "wildly created" conditioned the adoption of the Law on Legalization of Buildings [6]. Although this law will not solve the problems caused by unplanned construction, it still tries to put the situation in order, at least in the legal sense.

THE ANALISIS OF THE LOCATION

The space in the city municipality of Pantelej, bordered by St. Pantelejmon Boulevard from the south, Matejevac Road from the east, Studenička Street from the west and Gornjomatejevačka Street and the A4 highway from the north, with an area of about 62 ha, represents a great potential for the expansion of the city (Fig. 2a). According to the General regulation plan of the city municipality of Pantelej - Phase I [3], the location is primarily intended for residential use. With newly designed streets, the given location should be divided into blocks, in which it is possible to build family and multi-family residential buildings. The location itself is very favorable for the development of a new residential area. The natural and man-made factors found on the site give the location an advantage over many other potential locations in the city. The terrain is generally flat, the insolation and ventilation are excellent, and the distance from the central city core is not far. In terms of infrastructure and public transport, the connection with all parts of the city is good.

After the construction of Somborski Boulevard (the old name of St. Pantelejmon Boulevard), i.e. the connection of Matejevac Road with Kosovka devojka Street, began the expansion of the construction of multi-family buildings in this part of the city. The existing settlement started slowly to expand from Studenička street to the east, that is, from Somborski Boulevard to the north. With the gradual construction, which was at first without adequate control, a new settlement began to spring up, which brought a large number of new residents to this part of the city and initiated the development of the accompanying service and commercial activities.

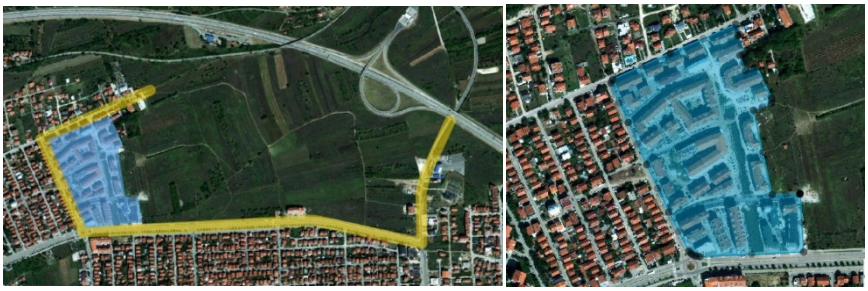

Figure 2: a) The area of the settlement's expansion; b) The subject location.
https://geosrbija.rs/

Figure 3: The view of the subject location
https://www.google.com/maps/preview

For the purposes of this work, an urban-architectural analysis of a part of the residential area in the city municipality of Pantelej in Niš, bordered by St. Pantelejmon Boulevard in the south, Studenička Street in the west and Gornjomatejevačka Street in the north, was carried out (Fig. 2b, Fig. 3). On the eastern side, the space

is undeveloped and currently there is a field with low, medium and partially high greenery. The approximate area of the analyzed location is about 8.2 ha. If we exclude a couple of family buildings, on the periphery of the analyzed location, the settlement is built with multi-family buildings that are organized in the form of closed or open rows or are placed as free-standing buildings. The maximum number of stories of the buildings is ground floor + 6 stories + attic. The first buildings in this part of the settlement sprouted about fifteen years ago, and constant construction continues to this day.

Why was this particular part of the settlement chosen for the analysis? Because it concentrates a large number of examples of the city's contemporary architectural practice in one place; because the construction of the space started from scratch (the space was free for construction); because the buildings of this settlement can be taken as a representative sample of contemporary tendencies in investor architecture, because the analysis does not only refer to buildings as individual, but also to the broader aspect of urban planning and fitting. The aim of the paper is to point out, through a case study, the problems faced by the City of Niš in the process of accelerated housing construction and to appeal to the urgency of alarming the profession in order to prevent the inhuman construction, which has taken off. The idea is to raise awareness of the problems faced by contemporary construction practice in Niš and to point out the exigency of the action of the profession. Therefore, the scope of the work is investor architecture, shown through the analysis of one representative example. The main scientific methods applied in the work are the analysis of data recorded on the site, synthesis and comparison.

After the visit of the location and the analysis of the recordings collected there, the following problems, which will be shown in more detail, were identified: parking problem; lack of sufficient green areas; absence of high-quality common spaces for social interaction of residents and children's play; poor furnishing of the open space areas; inadequate physical distances between buildings; safety and privacy of apartments on the ground floor level; aesthetic value of the architecture of buildings.

Parking

Parking is one of the main ongoing problems in the city of Niš. When it comes to the inherited core, it must be adapted to the situation, but when it comes to newly built spaces, it is imperative to plan adequate parking in advance. This does not mean simply meeting the rules prescribed by the appropriate planning documents, but also a deeper analysis of the form and manner of parking, primarily in relation to other functions that dominate the location. It is desirable, for example, when it comes to above-ground parking, to predict the parking lot at an adequate distance from the entrance to the building, to make a distance between the parking and the ground-floor apartment units by the insertion of an appropriate green buffer zone, not to disrupt pedestrian communications around the building, and the like.

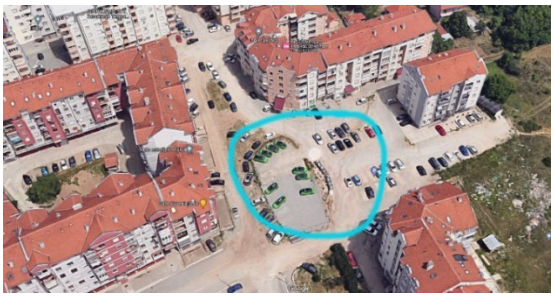

Figure 4: Unorganized free space between buildings, occupied by cars - a potential place to create a square with greenery, facilities for residents to gather and socialize and children to play.
https://www.google.com/maps/preview

Based on the construction rules for high-density housing in the city area given by the General regulation plan of the city municipality of Pantelej - Phase I [3], for the analyzed location it is necessary to provide a parking space within the building plot, which should be dimensioned based on the condition to provide at least one parking place for each apartment and additionally one more parking place on 70 m^2 of usable area of the office space. By examining the situation on the site, it is concluded that, despite the existence of a certain number of underground and above-ground garages and planned (marked) parking spaces, a sufficient number of parking spaces is not provided for the housing capacity that currently exists. In this regard, a large number of "wild" parking lots were created, which occupied almost all free areas, ideal for other types of content (Fig. 4). It was also notices that the majority of above-ground parking lots are inadequately designed, primarily in terms of their positioning. Cars are practically everywhere around the buildings. This resulted in a large amount of

concrete and a reduction (or, in some parts, the absence) of greenery. The main views of most residential units are directed towards concrete and cars. Parking right next to the building seriously impairs the quality of the living in ground-story housing units: there is constant noise, the emission of harmful gases in the immediate vicinity of the living space is increased, and the degree of privacy and the views are unnecessary to be discussed (Fig. 5).

Figure 5: a, b) Parking on unorganized surfaces; c) Parking right next to the ground-floor housing units.

Green areas

According to the construction rules for high-density housing in the urban area, given by the General regulation plan of the city municipality of Pantelej - Phase I [3], for the analyzed location, it is necessary to provide greenery and free spaces within the construction plot that should be the size that is at least 20% of the area of the construction plot. On the site, we find a different situation: the greenery exists only in traces. The only more significant green area (Fig. 6) was retained by the protest of the citizens of the settlement in 2020, when the residents came out into the streets to fight against construction in the settlement and demand a green and more organized settlement. Accustomed to the practice that buildings spring up in the neighborhood like mushrooms, the citizens made a protest walk and managed to keep the only free area that existed on the site, which was in danger to be turned into another inhumane building for living. The existence even of this kind of free area is a big advantage for the whole settlement, especially for the buildings that extend along its edges. However, its full potential is still not used. Apart from the "breathing space" that neighboring buildings gained, slightly better views and better ventilation of this part of the settlement, the useful value of this space is still at its minimum. It mainly contains unplanned, low-lying greenery, partially enriched with young trees in some parts and a small part equipped with modest furniture for children's play, maintained in an inadequate manner.

Figure 6: Free space that was threatened by the potential construction of new residential buildings.
https://www.google.com/maps/preview

The formation of parking lot in a place where there should be common open areas, thus the consequent loss of parks, spaces for children to play, for walking, for sitting and resting, significantly affect the quality of life and the comfort of housing. In addition, the residential units at the location are mostly of small, reduced, areas, adapted to the low paying capacity of customers. In this regard, in order to reduce the square footage of the apartment, the open areas within the apartment are generally designed with minimum square footage, so it is necessary to supplement them with common free areas. Although small, the apartments are often home to multi-member families, who cannot even use their balcony at the same time.

Spaces for social interaction of residents and children's play

"Liveability of a place is justified by the habitable and comfortable environment of the place. The factors that classifies the liveability of a place are built and natural environment, social stability and cultural, recreational and entertainment opportunities. More the liveability of a place, more will the quality of living in that community. … Liveability and open spaces are very strongly connected to each other and go hand in hand."[1] The humanity of the settlement is mainly reflected in the existence of spaces that promote social interaction between its inhabitants, provide conditions for rest and relaxation and introduce nature into the urban environment. Elements such as greenery, water or natural shade are imperative of contemporary urban design. At a time when social alienation has taken hold, it is necessary to try in every way to animate residents, to encourage social gatherings, encourage the neighbors to socialize and join common activities, which is possible to achieve through urban planning. In the analyzed location, there are almost no such spaces. If we exclude the modest children's park, mentioned in the previous section, or a couple of improvised gardens (Fig. 7), all other spaces between the buildings are absolutely unattractive, one might even say repulsive, for a longer stay and serve exclusively as communications to the entrance to the buildings intertwined with vehicular traffic. Although they are not currently used for that purpose, it is possible to map places convenient for the formation of spaces for social interaction of users in the form of smaller squares or transitory gardens with outdoor furniture for sitting and relaxing. Figure 8 shows an example of a possible transformation of the use of the space, which would, in addition to useful outdoor functions, also contribute to the improvement of the residential comfort of the residential units themselves, through the completion of the visual ambience of the surroundings.

Figure 7: a) Spontaneously created space for socializing; b) Fenced garden.

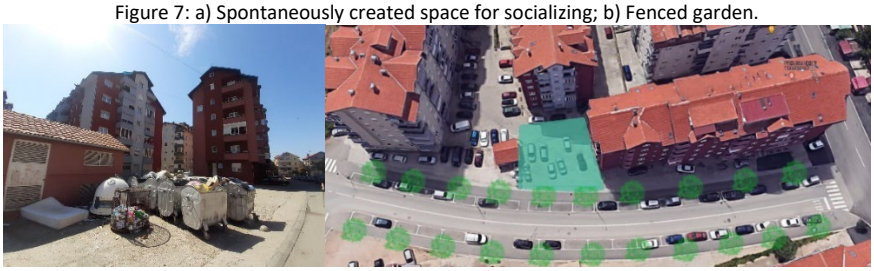

Figure 8: The space that is currently used for garbage disposal containers and informal parking, ideal for forming piazza. https://www.google.com/maps/preview

Poor furnishing of the open air spaces

By recording the current situation on the site, it is concluded that the settlement is particularly lacking in urban furniture, above all in the most basic ones - trash cans, benches for sitting and lighting outside of the residential streets. It is a common practice in Serbia that private investors, as is the case in this location, do not take too much care of the parts of the plot that they cannot charge. To provide an apartment, eventually parking and that's the end of the story - that's roughly the impression one gets. Whose obligation is the arrangement of free spaces, that is, in which way it is necessary to arrange free spaces, seems that is not very clearly defined. It is logical that the investor within the building plot has the obligation to arrange the parterre as well, which he often does only in the drawings, while in practice the matter remains unfinished. It is interesting the fact that on a large part of the analyzed location, the investor, and plot owner, is the same person (data found by looking at the Real Estate Cadastre), which could make the design and furnishing of the open spaces easier, by unification.

Physical distances between buildings

The basic element that affects the quality of the living space is the orientation and sun exposure of the space. “One of the highest values in town planning evaluation of a housing complex is the way buildings are grouped in space. Their mutual position, insolation conditions, accessways and potential for arrangement of open space areas directly and mostly depend on the compositional arrangement.” [2] The Rulebook on conditions and norms for the design of residential buildings and apartments [4] provides basic guidelines when it comes to the disposition and orientation of apartments, and the construction rules for high-density housing in the urban area, given by the General regulation plan of the city municipality of Pantelej - Phase I [3], prescribe that the distance between buildings has to be at least half the height of a higher building, that is, it can be a quarter of the height of a higher building, if the buildings on the opposite sides do not contain openings for lighting of residential premises (except openings for auxiliary rooms). Getting to know the situation on the site, one comes to the conclusion that in most cases, physical distances are highly debatable. In some parts, the distance of neighboring buildings is exactly at the minimum, while in some parts it is far below the minimum (Fig. 9). And this stands out as the biggest problem. The mutual vicinity of the buildings directly affects the residential comfort of the units. Primarily, the apartment units are in the shade, so the sun exposure is low. Due to reduced air circulation, ventilation is also reduced. In a large number of cases, due to the opposite setting of the openings, users are exposed to direct views of the neighbors from across.

Also, another problem, when it comes to distances, is that the users were not initially familiar with the future development of the location, that is, when buying apartments, they did not know if and in which way the area around will be built in the future. For example, the building at the corner of Studenička Street and St. Pantelejmon Boulevard did not exist nor was there any indication that it would be located there, due to the proximity of the roundabout and the relatively small free area. The residents of the building next door may have chosen that location and those apartments because of the southern orientation and views that will not end few meters from them, which was the case after the new building was added.

The distance between the buildings is now impossible to change, but the space between the buildings could be enlivened with greenery, which would also create a visual barrier in between.

Figure 9: Distances between the buildings and the use of in between space.

Safety and privacy of ground floor apartments

The situation found on the site indicates that apartments on the ground floor have lower quality living conditions than apartments on higher floors. All the identified problems mentioned above are also the causes of the poor quality of the living space of the residents on the ground level. Ground-floor apartments in multi-family housing differ in their characteristics from apartments on higher floors, even if their functional solutions are the same. The fact that they have direct contact with the ground, apart from certain limitations, also brings numerous advantages, which should be used in favor of increasing the living comfort of these residential units. Ground floor apartments within the buildings possess some characteristics of individual housing, which is a great advantage. If housing has significant individual characteristics, its quality is improved [5]. So, if there is a possibility, it is desirable to attach a part of the yard to the apartments and provide them with a larger open area. As this is not possible in this case, due to the already small open spaces between the buildings, which are used as pedestrian and vehicular communications, the uses of public areas should at least be reorganized:

stationary traffic should be distanced from the facade fronts and a buffer layer, at least with a minimal strip of greenery, should be created (Fig. 11). Direct parking next to openings or terraces of residential units creates unhealthy living conditions. Exhaust gases from cars directly pollute the air that enters apartments through facade openings. The noise and vibration generated by the car disrupts the normal functioning of the occupants. Views from the apartment to the outside space are unattractive and do not offer visual rest. The absence of a barrier at the private-public transition threatens the intimacy of housing. Users are exposed to the random glances of passers-by, which greatly disturbs peace and privacy (Fig. 10).

Figure 10: Apartments on the ground floor - concrete, cars, absence of planned greenery.

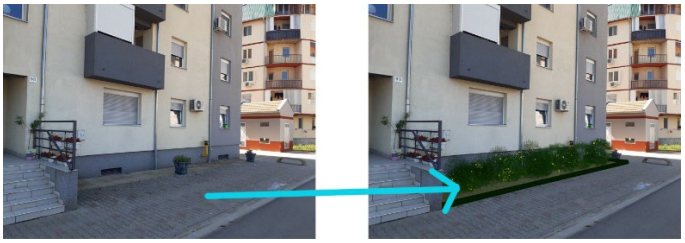

Figure 11: A simple way to improve the ambience of the building and ground floor apartments.

Design value

It is easy to come to the conclusion that the feature of investor architecture is often actually the absence of architecture. This may be too harshly stated, but a large number of examples confirm this claim. In the analyzed location, different approaches can be observed when it comes to the design of buildings. Mostly, the form derives from the function, without an additional tendency to play with masses and volumes, which makes the architectural composition, by itself, and also in the wider context, tend to become monotonous and boring. On the other hand, facade decorative elements - such as accentuated edges of openings (window framing with a striking color), accentuated lines of mezzanine panels or ornate details of fences on the apartment open areas tend to push architecture into the field of kitsch. The random selection of colors, without a deeper analysis of the environment, introduces disharmony into the space and creates chaotic and unattractive image that characterizes the entire neighborhood (Fig. 12).

Figure 12: Unevenness of aesthetic expression of the buildings.

CONCLUSION

Based on the analyzed residential complex, it can be concluded that when approaching the design of the new building, a more detailed elaboration of the concept in all aspects, and above all, in the functional and aesthetic aspects, is inevitable. The key problems that stand out on the site, and which can be solved at this stage, are definitely parking and the lack of green areas. The proposal is to group smaller parking lots into larger ones and locate them in places sufficiently distant from the ground floor apartments, in order to improve the living conditions of those tenants, and disburden the rest of the free area from stationary traffic. Parking lots should be paved with grid paving slabs that allow grass to grow, which could, at least in a minimal percentage, compensate the lack of greenery – the imperative is to get rid of asphalt as much as possible and strive for more natural materials in the parterre. This will significantly improve the ambient value of the space, and also significantly affect the microclimate of the settlement. Also, the proposal is to regulate by law that an investor must be obliged to arrange the area around the building and to equip it with all the necessary outdoor furniture that will be used by the residents.

In the already built-up parts of the city, we are faced with an existing physical structure that is very difficult or in some cases even impossible to change. On the other hand, in the analyzed area, we encounter pure free space, with absolute freedom for planning and designing. The question arises: why was it allowed to reach the current situation of the settlement, in such, one could say, almost ideal, conditions?

The conclusion of this work is that, if the damage has already been done, the interventions can attempt to mitigate it, and the existing bad practice should be taken as a negative example and a lesson for the further construction of this location and other similar locations in the city.

The issue is more complex, because many actors are involved. Is it the fault of the investors who, in the majority of cases, are primarily guided by the idea of maximum profit? Or is it the fault of the experts hired by the investor to plan and design the space? Or is it the fault of those responsible for project approval? Or is it maybe the fault of those who will live in the apartments? The chain of actors is not small, and each link in the chain bears its own responsibility. By harmonizing the needs, possibilities and obligations of all, a solution can be reached.

The investor has a clear goal - to make money and he does not hide it. The buyer's goal is to buy himself a place to live as cheaply as possible. If he is not aware of what is good and what is bad, he is satisfied with what is offered, and the main problems arise later, during the use. In this regard, it can be reached the conclusion that it is necessary to educate future users, buyers of new real estate. One gets the impression that people just need to have a roof over their heads, without delving into what kind of living conditions that "roof" will bring to them, which is, by the way, paid very dearly. Because as long as there are buyers, there will be sellers. Investment architecture has become a trend in Serbia. The primacy is given to the profit of individuals, and the most important, basic thing, which is man, as a user of space, is completely marginalized and neglected. Rational construction is not the synonym for s bad construction, and a bunch of successful international examples of good practice can prove it.

And finally, behind everything should stand the profession. There must be quality control of what is offered on the market and there must be clearly defined criteria that must not be lowered at any cost. Also, the state could stand on the side of its citizens and with certain subsidies encourage not only users, but also those who design, plan and build. It is necessary to create more detailed master plans, announce calls for tenders and to make more studious assessment of resources. Much more should be invested in the process that precedes design, analysis, and not use an established pattern that has proven to be a template that sells easily and quickly.

Also, what is most important, humanity must come first. The end user must be at the center of planning and design process. The main question: "for whom it is being designed", should be reviewed in more detail, because it is questionable how the investor sees the user.

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LAND USE PATTERNS CHANGES - CASE STUDY SREMSKA KAMENICA, SERBIA

Marina Carević Tomić

University of Novi Sad, Faculty of Technical Sciences, Department of Architecture and Urbanism, Serbia
PhD., Assistant Professor, marinac@uns.ac.rs

Ranka Medenica Todorović

University of Novi Sad, Faculty of Technical Sciences, Department of Architecture and Urbanism, Serbia
MSc, Teaching Assistant, ranka.medenica@uns.ac.rs

ABSTRACT

Recent interventions on the preparatory works for the building of fourth bridge in Novi Sad, Serbia, attracted expected attention of public. The bridge should connect the city of Novi Sad, on the left Danube bank, and the settlement of Sremska Kamenica, also part of the urban area of Novi Sad, on the right side. The focus of citizens' concern is mostly on the outcomes in Novi Sad, but the other side would be affected, as well. The paper analyses land use patterns in Sremska Kamenica, where one end of the new bridge should be. It is expected that the eventual finalisation of the bridge would have implications on the construction processes and land use changes so the main idea is to reveal possible trends of development. The current disposition of land uses in Sremska Kamenica is the result of several different influences, among which accessibility is one of the most noticeable. Construction of the new bridge would divert traffic flows, which would make some locations more attractive for building and introduction of non-residential uses, currently prevailing in the settlement. To assume changes in mobility patterns, the Space Syntax methodology would be used. Conclusions would be drawn based on the contextual analysis and investigation of urban plans.

Keywords: land uses; land use patterns; mobility patterns; suburbanisation; Novi Sad

1. INTRODUCTION

Novi Sad is the second largest city in Serbia, and the main centre in the Autonomous Province of Vojvodina. The city lies on the left Danube bank, but the urban area spreads out on the right bank, too, encompassing settlements of Petrovaradin and Sremska Kamenica (Figure 1). In the decades after the World War II, the development of the conurbation consisting of Novi Sad and Petrovaradin and Sremska Kamenica was planned, so one of the main goals was the concentration of public facilities, new residential and work spaces on the right bank of the Danube, in order to form another developmental pole. This planning goal was not achieved due to specific social, political and economic processes, especially since the 1990s, and further growth took place in areas that were not intended for construction, mainly in the western part of the territory in the immediate vicinity of the city (Kostreš, 2012). Unplanned suburbanisation, sprawl and illegal construction slowed down the development of the whole city during the transition and post-transition period.

Suburbanization is one of the most striking and dynamic spatial phenomena of the urban transformation of the post-socialist city and its metropolitan area(Sýkora & Bouzarovski, 2012; Szabó, Szabó, & Kovács, 2014). At the same time, the expansion of urban functions beyond the boundaries of a compact city usually takes place to a highly fragmented and dispersed spatial pattern of urban sprawl, accompanied by mostly negative ecological, economic and social consequences (Sýkora & Stanilov, 2014). In the given circumstances of intense transition processes, the conceptualization and understanding of socio-spatial transformations of urban and suburban settlements are important from the aspect of influence that the physical structure and distribution of urban functions have on the quality of life in the city, economic growth, social equality and sustainable urban development (Zhong et al., 2017).

A new stage in the suburbanisation of Novi Sad could be expected after increasing the number of links between two sides of Danube bank. Currently, two parts of the city are connected by three bridges, but for many decades urban plans envision five of them. Recently, some preparatory works for the fourth bridge are being carried out. The bridge should connect the west parts of Novi Sad, on one side, and the settlement of Sremska Kamenica, on the other, but would also be on one of the main routes, linking the city with the broader surroundings through highway E75 and othe national roads. This means that the bridge itself and accessing roads and surroundings would also be a sort of a new gate to the city, leaving the first impression on those coming in. More importantly, the construction of the new bridge would induce many changes in the ways the city functions, so the whole process attracted expected attention of general public. The focus of citizens' concern is mostly on the outcomes in Novi Sad, but the other side would be affected, as well. Finalisation of the bridge would divert traffic flows – presumably, the traditional centre of Sremska Kamenica, now overloaded with transit traffic, would be less busy, at the same time, other locations would be more loaded, but also more attractive for building and introduction of non-residential uses, currently prevailing in the settlement. On the other hand, urban plans for the area surrounding the ring road in Sremska Kamenica do not consider the importance of the new routes, and provision zones for family housing.

The paper analyses land use patterns in Sremska Kamenica, especially the ring road area, where one end of the new bridge should be. It is expected that the eventual finalisation of the fourth bridge would have implications on the construction processes and land use changes so the main idea is to reveal possible trends of development. The paper concludes by two possible scenarios elaborating the opportunities for future evolution of the ring road area, settlement of Sremska Kamenica and the city of Novi Sad, as a whole.

Figure1: Novi Sad with Sremska Kamenica and Petrovaradin, with the position of the new bridge (in red)

2. METHODOLOGY

Previous research of the land-use patterns showed the diversity of issues and complexity of relations among land-use patterns and other urban phenomena in the contemporary city. Specificaly, in Sremska Kamenica, current disposition of land uses is also the result of many different influences, among which accessibility is one of the most noticeable (Carević, 2017). For this reason the research approach of the paper is

based on the combination of Space Syntax[9] tool, site surveys, contextual analysis and planning documents reading.

Space Syntax methodology is used to investigate current and future mobility patterns and the accessibility of the ring road area. The analysis are done for the whole urban area of Novi Sad – for current state, for planned state[10], and for planned state with a suggestion for improvement of the given fragment. Since the urban matix of Novi Sad is characterised by linear centres along main routes, the measurement used in Space Syntax is normalised choice, predicting through-movement potential. Previous application of the Space Syntax for Novi Sad showed significant matching with the real situation.

3. BROADER CONTEXT

The functional and morphological linkage of settlements is accompanied by parallel processes of urban expansion and deconcentration on the one hand, and the re-concentration and formation of sub-, i.e. secondary centers on the other (Krehl, 2016), which leads to the differentiation of functions within the urban structure. The concentration of urban functions, which were previously exclusively related to the historic city core, is being moved to suburban locations, whereby establishing a balance in the (de)centralization of urban functions represents an important challenge of contemporary spatial and urban development (Meijers, Hollander, & Hoogerbrugge, 2012).

The growing disparity in the quality of life and accessibility between central urban areas, peripheral urban areas, suburban and rural settlements is singled out as one of the key problems of spontaneous and uncontrolled urban growth in the Republic of Serbia (*Strategija održivog urbanog razvoja Republike Srbije do 2030. godine*, 2019). This trend is visible in Novi Sad and its surrounding, as well. Generally it can be said that the lack of central functions is one of the biggest challenges of the physical structure of suburban forms and specific type of undefined urban-rural settlements (Dinić, 2015).

4. CASE STUDY – SREMSKA KAMENICA, SERBIA

Sremska Kamenica, together with Petrovaradin, is part of the urban area of Novi Sad. After World War II, the settlement began to realize a greater degree of dependence on Novi Sad, with which it was spatially connected by the construction of bridges over the Danube. In last decades the settlement has been significantly expanded territorially, mostly by illegal construction in zones formerly reserved for holiday homes.

In previous general urban plans, the space west of the ring road in Sremska Kamenica was partly intended for protective greenery and partly for a non-building area (wider hinterland of the city and fertile arable land), then it was a intended as a reserve for housing and construction, after that for special uses, and in current plans it is zone for family housing (Plan detaljne regulacije KIP u Sremskoj Kamenici, 2007). The vicinity of Novi Sad, natural qualities, nice vistas over Fruška Gora Mountain and the city of Novi Sad, made this area attractive for living, so large number of illegal houses was built even before plans allowed it. Building of the fourth bridge would make this site even more attractive, so careful reconsideration of the planning goals is needed. The area would be more accessible, as well, which would probably result in more intensive motor traffic. This could cause higher air pollution and noise levels, which is not suitable for residential zones. It is interesting to notice that Corona virus pandemics increased interest of citizen for suburban locations around Novi Sad as place of living and working, which affected the real estate market, through greater demand and higher prices.

The urban plans state that the spatial concept for this area should be realized through the organization of space, that enable Novi Sad, Petrovaradin and Sremska Kamenica to develop socially, spatialy and functionally as a single city on the Danube (Plan detaljne regulacije KIP u Sremskoj Kamenici, 2007). However, the ring road sharply separates two parts of Sremska Kamenica, living the west side of ring road unintegrated with the traditional centre and Novi Sad. The ring road spreads along abandoned railway (built at the beginning of 20th century), so the two sides of the road were not connected in the past, and now function as separated, as well.

9 A formal way of looking at cities that sets out from the study of the network of space – streets and roads – that holds the system together (Hillier, 2009).

10 If all urban plans are realised.

The paper examines the possibility to connect the west side of the ring road strongly in order to create favourable conditions for establishing non-residential functions. The area east of the ring road is not the item of interest of this paper, because it is mostly completed residential zone. Yet, it is worth to say that the former railway is planned to become recreational "Green path". The urban plan for this path is not finish, but it is expected that it could influence the future character of the ring road.

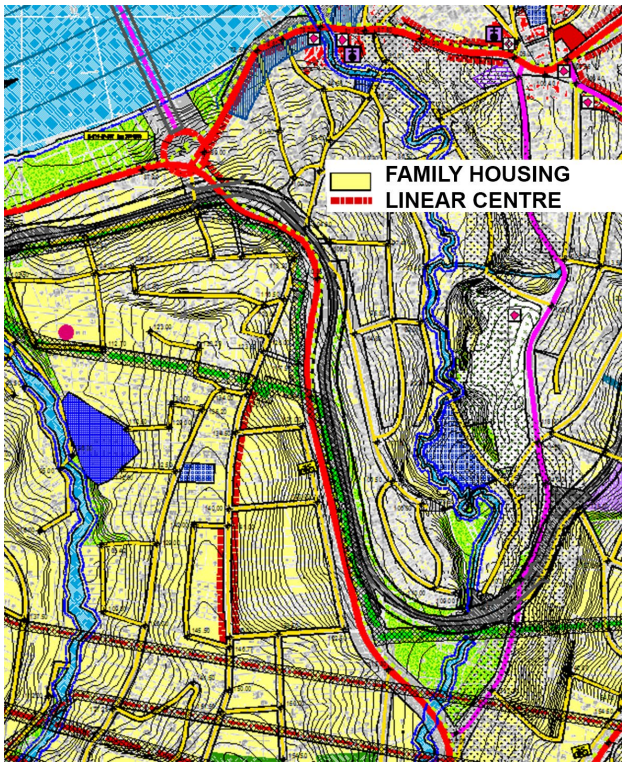

Figure 2: The extract from the Plan of general regulation of Sremska Kamenica and the surroundings.

4.1. Land use patterns

Specific functions unique in the wider area (such as institutes of oncology, pulmonary and cardiovascular diseases, Basic Police Training Centre, SOS Children's Village) make Sremska Kamenica stand out as a sub-centre of the Novi Sad area on the right bank of the Danube (Kostreš, 2012). Except these specific functions, the majority of non-residential uses that meet the vital needs of the population are concentrated in the traditional centre – central functions, public services, education, child care, health, culture and religion. The diversity of activities in the centre of Sremska Kamenica is higher than in other parts of this settlement[11], but still quite low concerning that the rest of settlement consists mostly of the housing. The considerable development of non-residential uses in the neighbourhood was noted in the 2000s, when the number of inhabitants in Sremska Kamenica was significantly increased, due to the sprawl. At the same time, it is also a period of stabilization of the economic and political situation in the country (after turbulent 1990s), and it is assumed that these factors together influenced the creation of a favourable environment for the emergence of business and service activities. Yet, the largest part of the population still works in Novi Sad, which makes daily migration very intense, and significant investments in the development of the economy and an increase in the number of jobs are necessary (Kostreš, 2012). A period of strengthening of the old centre led to a kind of saturation, followed by the process of decentralization, which was accelerated by the construction of new faculties and other primary non-residential buildings that induced the development of accompanying

[11] 86% of housing, 7%, of primary non-residential uses and 7% of secondary uses. The methodology used for land-use analysis was Mixed-use Index, defined by and here used redefined version where uses are classified on residential, primary non-residential and secondary (non-residential) uses (Carević, 2017), based upon Jane Jacobs's theory (Džejkobs, 1961/2011).

secondary programs as well (Carević Tomić et al. 2018). A kind of new linear centre was formed at one of the entrances to Sremska Kamenica along the busiest street (Vojvode Putnika Street). This route goes through the traditional centre, and connects suburban settlements along right Danube bank with Novi Sad. In recent years the trend of establishing and concentration of non-residential functions along the main road further continued toward the suburban settlements. Eventual construction of the fourth bridge would possibly divert the traffic from this route, and make the ring road and its surrounding more accessible and busier, and consequently more attractive for non-residential uses. However, the plans don't consider the ring road as the opportunity to settle new non-residential functions. In plans the place for non-residential uses (linear centre) is along Fruškogorska Street – the main road of the zone west of the ring road.

4.2. Movement analysis

Typical urban settlements in the Republic of Serbia are characterized by a compact urban core, as well as the dispersal of the urban area into peripheral urban zones and suburban settlements along important road routes (*Strategija održivog urbanog razvoja Republike Srbije do 2030. godine*, 2019). This is the case in Novi Sad, too, where the development of linear centres along the main streets is significant, as well.

Selected ring road area and other settlements along the Danube are connected to Novi Sad through the centre of Sremska Kamenica, but construction of the new bridge would relief the centre from the transit traffic, and at the same time the ring road would be more loaded.

Figure 3 shows current accessibility in Novi Sad (3a), and in ring road area (3b) in Sremska Kamenica. Red segments are more accessible, and along those routes the most non-residential uses are concentrated (especially along Vojvode Putnika and Karađorđeva Street).

Figure 4a shows the accessibility in Novi Sad in hypothetical situation that all urban plans are realised. It is visible that the ring road in Sremska Kamenica (4b), would have higher accessibility than it is today. Figure 4c shows the suggested alteration of the access road parallel to the ring road. It is noticeable that the accessibility of this access road would be much improved if it is connected to the ring road. This intervention could create favourable conditions for development of non-residential uses alon the access road, leaving the central part of the residential zone peaceful and less loaded by traffic.

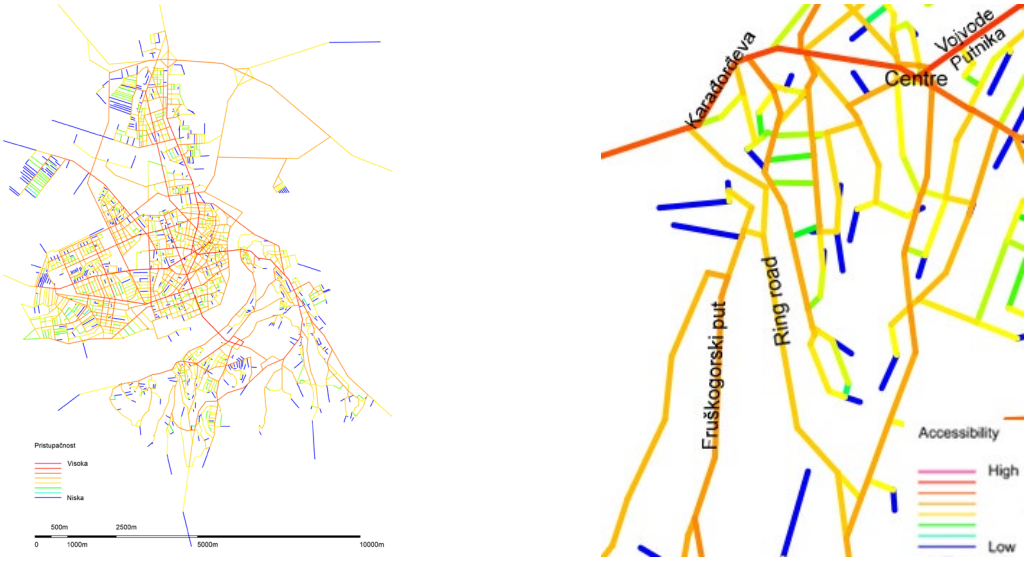

Figure 3: (a)Urban area of Novi Sad and (b)ring road area in Sremska Kamenica – Analysis of accessibility (choice measurements, global radius)

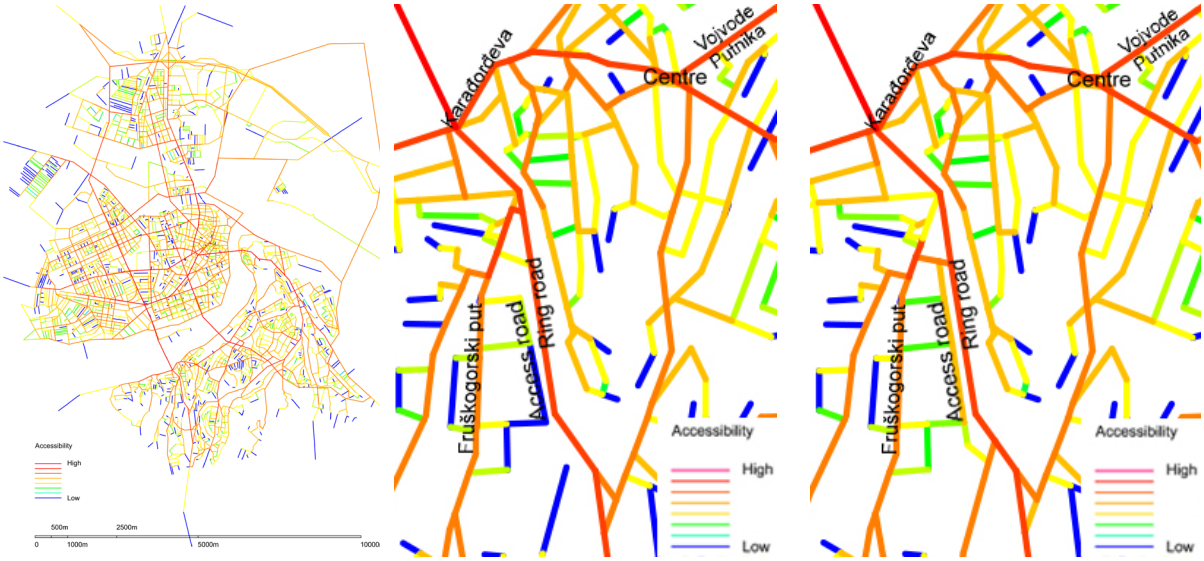

Figure 4: (a) Urban area of Novi Sad, (b) ring road area in Sremska Kamenica in case all urban plans are realised, and (c) altered ring road area in case all urban plans are realised – Analysis of accessibility (choice measurements, global radius)

5. DISCUSSION AND CONCLUSIONS

Without careful analysis of the outcomes of the new bridge construction, it could bring mostly unfavourable consequences to the surrounding of the existing ring road – more motor traffic, more noise, more air pollution, etc. On the other hand higher accessibility achieved through direct connection of this area and Novi Sad, could be used to improve the state at the location.

Recent construction of residential complex and hotel in the ring road area shows that there is interest among investors for more intensive use of this site. Plans allow construction of so called complementary uses in the residential zone, but letting investors to build non-residential uses in the middle of the residential zone, and determining the fringe, overlooking the frequent road, for housing, could decrease the quality of life.

Generally, there could be two possible scenarios of land use patterns regarding the type of the street network in the continuation of the bridge.

In the first scenario the street network of the residential area west of the ring road stays unconnected with the ring road, as it is in plans. This means that new access street (Figure 4b) remains with the low accessibility, which means unsuitable for most non-residential uses. At the same time, it would be unfavourable for housing, as well, because of the proximity of busy and noisy road.

Second scenario consider direct connection of the new access street with the ring road (Figure 4c) in order to achieve better accessibility, and to create favourable conditions for development of non-residential uses (offices, commercial, retail, services, recreation, etc.). Planed guidelines could direct the development so that more exposed lots ought to be used for non-residential uses that need higher accessibility, while at the same time the rest of the area could stay peaceful for family housing as it is now.

Planning documents[12] envision large area along Fruškogorski put Street for mixed uses and central functions, since it was a spine of the whole area for a long time. On the other hand, previous researches (Carević, 2017) showed that beside high accessibility, one of the necessary conditions for development of mixed uses is also high building and population density, which is not the case in the selected area, so it seems necessary to reconsider the idea, and to find alternative locations for this kind of functions. Eventual construction of the fourth bridge in Novi Sad, would for sure increase the accessibility and attractiveness of the areas along the ring road so it seems reasonable to explore opportunities for more intense use of this zone. For this reason it is important to rethink possible consequences in order to preserve prevailing residential character, but also to

[12] Detailed Regulation Plan of KIP in Sremska Kamenica and Plan of general regulation of Sremska Kamenica and the surroundings

enable incorporation of complementary non-residential uses on suitable locations with the aim to improve living conditions, to increase the number of jobs on the right side of the Danube, and to influence commuting.

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THE IMPACT OF POST-SOCIALIST TRANSFORMATIONS ON MULTIFAMILY HOUSING: A CASE STUDY NIŠ, SERBIA

Jelena Đekić

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Assistant, jelena.djuric@gaf.ni.ac.rs

Milena Dinić Branković

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Associate Professor, milena.dinic@gaf.ni.ac.rs

Milica Igić

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
Assistant, milica.igic@gaf.ni.ac.rs

Milica Ljubenović

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Assistant, milica.ljubenovic@gaf.ni.ac.rs

Mihailo Mitković

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
Assistant, mihailo.mitkovic@gaf.ni.ac.rs

ABSTRACT

After the fall of the socialist regimes in the 1990s, the countries of Central and Eastern Europe began the process of transition from socialist to capitalist system, which included political, socio-economic, cultural and other changes, as well as changes in urban structure. Transition in Serbia, as one of former SFRY republics, took place under specific political and socio-economic circumstances, with a delay of a decade compared to other countries in the region. Multi-layered transformations caused changes in physical and functional structure of inherited multifamily housing from socialist period – large housing estates (LHE) and development of new types of multifamily housing. The paper analyses the post-socialist changes in Serbia and their impact on multifamily housing, with a focus on the city of Niš, as a case study. Multifamily housing is especially influenced by: privatization in the initial phase and restitution in the later phase of transition, shifted roles of public and private sector in housing development, legislative changes and changes in urban planning. Inherited LHE experienced physical and functional transformations, including multi-storey housing extensions, residential and commercial infill construction, qualitative and quantitative reduction of green areas, fragmentation of space, etc. On the other hand, post-socialist changes significantly influenced the characteristics and spatial distribution of new multifamily housing in the city.

Keywords: *multifamily housing, large housing estates, post-socialist transformations, City of Niš*

1. INTRODUCTION

The end of state socialism marks the beginning of reforms leading to market economies and democratic governance; hence, the term "transition" is commonly used for the post-socialist period (Hirt, 2015; Sýkora, 1994). After the fall of socialism, most of the countries in the region record an increase in unemployment, an explosion of the inflation rate, collapse of state-guaranteed services (social assistance, unemployment benefits, state health care, etc.), drastic drop in living standard of the majority of the population and a sharp increase in

social stratification (Hirt, 2015). Fall of socialist regimes across Central and East European countries in early 1990s was followed by multi-layered transformations, starting from political, institutional and socio-economic, to changes in the urban structure. The transition begins with political decisions, which represents the fastest, short-term change, while other changes are slower and last longer. As Sýkora (2009) pointed out, transitional processes do not take place in a vacuum, by replacing one reality with another, i.e. the collapse of the old structure is not followed by the immediate introduction of a new, well-developed system. The model proposed by Tosics (2004) consists of three main elements of transition: basic political decisions, introduction of detailed regulations and establishment of public policies. Each of these transition elements is followed by a corresponding phase: vacuum period, adaptation period and adjustment (functioning) period, respectively. After the adjustment period, real market-oriented development begins and the transition is complete (ibid.).

The transformation of urban structure is the last and longest-lasting phase of transition and results in urban fabric are visible only after a certain period. Functional changes in cities, such as expansion of commercial areas, transformation of industrial zones and changed character of housing, deeply affected changes in urban structure, including changes in housing areas.

Although housing policies in former socialist countries may significantly differ, they have a common origin in so-called Eastern European housing model, which was based on the limitation of property rights, extensive central planning and politically determined allocation of subsidies. Two important drivers determined the development of the housing sector during the socialist period: 1) housing was a political priority and 2) centralized management of the economy enabled governments to direct resources to certain sectors (Tsenkova, 2009). Post-socialist changes in the housing sector can be described as the disintegration of the Eastern European model. By moving away from this housing model, market mechanisms gain a more significant role in the housing sphere, while state responsibility, power, and resources weaken. State budgets for investment in housing and subsidies are reduced, with a simultaneous reduction of state housing funds due to privatization and / or restitution (Mandič, 2010). As stated by Stanilov (2007), the main principles of housing reform are privatization, deregulation, and reduction, i.e. cessation of state funding. Rapid withdrawal of state participation in the housing sector, through a drastic reduction in state subsidies and a reduction in the direct supply of housing, resulted in an escalation of the housing crisis, which was noticeable even in the period of socialism. The intensity of housing construction was reduced at the end of the 1980s, experienced a sharp decline in the early 1990s (Pichler-Milanovich,2001) and reached a minimum in 1993-94 (Stanilov, 2007). Recovery of the housing sector began in the mid-1990s, in the countries that started political and economic reforms earlier (Czech Republic, Hungary), and later it was transferred to other countries. Simultaneously with the state withdrawal from housing construction, started the privatization of the existing housing stock and housing development with private capital.

Although the transitional changes in the countries of Central and Eastern Europe share some common characteristics, there are also specificities that make the difference between individual transitional sub-models. Transition in former SFR Yugoslavia took place under specific political and socio-economic circumstances, with a delay of a decade compared to other countries in the region, and Serbia, as former Yugoslav republic, is still going through the transition process.

The paper deals with characteristics of multi-story housing in the post-socialist period. The key research aim is to investigate the specific economic, political and social changes in Serbia since the 1990s, which set a platform for the emergence and evolution of multifamily housing development modes, on the example of the City of Niš.

2. TRANSITIONAL PATH OF SERBIAN CITIES

Transformation of socialist cities towards a capitalist model began in the 1990s, showing common characteristics in all countries, known as "general transition path", but also the specifics conditioned by different starting positions, political, economic and social factors. As a result, numerous subtypes of development can be recognized within the general model of the post-socialist city. SFR Yugoslavia was not a part of the Soviet bloc and had a more liberal socialist system (self-governing socialism), which gave it a better starting position for a successful and faster post-socialist transformation. On the other hand, the breakup of the federation and the war conflicts, slowed down i.e. blocked transitional changes in former Yugoslav republics. In addition to specific “Yugoslav transitional path”, there are also difference in transitional paths between Yugoslav cities. According to the classification given by Tosics (2005), there are two subtypes of post-socialist cities in the former SFRY: 1) Slovenian cities, which are closer to Hungarian cities than to other cities of the SFRY in terms of development trajectory; and 2) other cities of the former SFRY.

After the breakup of the SFRY, during 1990s, Serbia suffered the most severe consequences, including war conflicts, admission of refugees from former republics and provinces, deep economic crisis, international sanctions and bombing. Therefore, the transition path of Serbia consists of three characteristic phases: (1) transition before transition (Neducin, 2014) – period which begins with Yugoslav distancing from the Soviet bloc in the 1950s and introduction of self-governing socialism; (2) blocked transition – period between 1990 and 2000 (Bolčić, 2003; Lazić & Vuletić, 2009; Backović, 2005); (3) delayed transition or starting the transition for the second time, after 2000 (Uvalić, 2010).

In 1990s, when other post-socialist countries were undergoing the transition, Serbia and other former SFRY republics experienced stagnation, absence of transformations and regression compared to the pre-transitional period. Urban planning in Serbia in this period is characterized by: lost planning legitimacy; non-existent or unclear concept of public interest; centralization of government and planning institutions; lack of expertise, support and administrative capacity for planning at the local level; lack of regional management and planning; lack of strategic planning; inadequate or ineffective implementation mechanisms; prevailing "physicalism" in planning; lack of participation, openness and transparency in the planning process; confusion about domestic ownership patterns and incomes, which hindered foreign direct investment; constant disturbances in the land market; underdevelopment of the national land use policy; political instability, corruption and clientelism (Vujošević & Nedović-Budić, 2006).

The period after 2000 in Serbia is marked as late transition or starting transition for the second time (Uvalić, 2010). Serbia entered the transition process with a delay of a whole decade and, as socialist cities rapidly transform in order to reach the level of development of capitalist cities, changes in Serbia accelerate in order to reach the level of development of cities that started the transition earlier. Economic reforms and the transition process in 1990s were additionally slowed down by the intertwining of political and economic interests of political elite, so the real transition started only after the political changes in 2000 and the fall of the socialist regime.

Overall changes and periodization of transition influenced the pace of development and spatial distribution of multi-story housing in post-socialist city. The early phase of the transition (1990 - 2000) is characterized by mass privatization of socially owned housing units, withdrawal of the public sector from housing, weak private sector and state-owned urban construction land, which is not on the market. In later phase, after substantial political changes in 2000s, private sector gradually strengthens, the process of restitution begins and property rights on city construction land change (Đekić&Vasilevska, 2021). Having in mind the significant impact of transitional changes to the housing sector, the paper analyses characteristics of multifamily housing development in the post-socialist period.

3. POSTSOCIALIST CHANGES AND MULTYFAMILY HOUSING IN THE CITY O F NIŠ

Post-war development of the city of Nis was marked by great demographic growth and spatial expansion. Number of inhabitants and apartments in Niš increased more than four times between 1945 and 1980, while the effectively built city space increased more than six times in this period (Krstić & Medvedev, 1983) Increase in number of inhabitants began in the 1950s and is mostly the result of mechanical growth - migration from rural areas to the city. Industrial development, especially development of electronics and metal processing, required a large number of employees and caused the influx of residents from rural areas. The increase in population and dynamic economic development in Niš, were not accompanied by adequate communal and housing construction, which, paired with lack of regulations and urban planning norms, led to the appearance of massive illegal housing construction on the outskirts and the expansion of the city.

Sharp decline of industry, economic crisis, increased rate of unemployment and other socio-economic changes that marked 1990s in all CEE countries, were particularly dramatic in Serbia (former SFRY republic) due to collapse of the federation, war conflicts and long-term international isolation. Niš, one of leading industrial centres in the former SFRY, failed to reposition itself in the years after the 1990s and experienced a dramatic economic decline and population stagnation (Vasilevska, et al., 2015). Under the influence of the economic decline and the reduced allocation of the budget for housing development, the housing sector in Niš experienced regressive changes. The most prominent changes in housing sector in 1990s include lack of significant public investment in housing development and the complete absence of investment in rental and social housing, double reduction in housing production and the closure of leading publicly owned building companies. The number of residential units built in 1991 was around 1450 (approx. 5 apartments per 1000 inhabitants), while in 2003 this number dropped to 450 residential units (1.8 apartments per 1000 inhabitants)

(ibid.). Following the trend of privatization of socially owned housing in Serbia, the housing stock in Niš was almost completely privatized during the 1990s (98.7%) (SRLE, 2005). Gradual recovery of the housing sector started together with economic recovery after the political changes in 2000s. Total number of 529 apartments completed in 2012. (2 apartments per 1,000 inhabitants) indicates a slight increase in residential construction in Niš, but still at a low level compared to the pre-transition period.

At the beginning of the 1980s, when multi-storey housing construction in Niš was in full swing, Public enterprise for urban planning prepared a Study of Long-Term Development of Collective Housing in Niš 1981-1991-2000 with a spatial development plan (ZURB Niš, 1981). The aim of the study was to examine the possibilities of further expansion of multifamily (collective) housing on the territory of the City of Niš. The Study analysed three variants - two greenfield locations at the city outskirts and the reconstruction of the central city area. The cost analysis showed that reconstruction of central city area is 30% more expensive than construction on greenfield locations, due to the high costs of residents' displacement. According to the Study, the most favourable variant for housing development in the first phase (1981-1991) was a greenfield location next to existing residential area, which was partially equipped with infrastructure. The proposed locations were incorporated in the General Urban Plan of the City of Niš 1995-2010, thus creating a planning framework for multi-story housing development in greenfield locations on the outskirts of the city. The reconstruction of the city center was planned as a gradual and continuous activity throughout the entire period, depending on the availability of construction land and private capital. The post-socialist development of multifamily housing in Niš actually followed the proposed variants, but it was also directed by available construction land (land ownership) and private capital. The analysis of urban fabric of the city of Niš showed that post-socialist multifamily housing development mostly includes:

1) multi-story housing extensions of existing residential buildings;
2) new construction on greenfield sites on the outskirts of the city;
3) new infill development (mainly in underbuilt socialist housing estates);
4) reconstruction of the central city zone – conversion of individual to multi-family housing
5) construction of larger scale on brownfield or greenfield sites.

3.1. Multi-storey housing development in early phase of transition

Serbia was one of the countries that started privatization in early phase of transition and introduced restitution much later. In early 1990s, almost 100% of socially owned apartments in Serbia were privatized, while the restitution process still was far from beginning. Socially owned flats were sold to sitting tenants at low prices, through so-called "gifted privatization". On the other hand, due to delayed restitution, property rights over nationalized land and buildings, mostly in central city area, remained unresolved. Such ownership conditions, combined with a weak private sector in the initial years of the transition, led to the emergence of two characteristic types of multifamily construction: (1) "construction without building plot" – multi-story housing extensions; (2) new construction on greenfield locations on the city outskirts.

3.1.1. Multi-storey housing extensions (MSE)

Different types of housing extension (building upgrades, closing of balconies and terraces) and appropriation of common spaces in buildings, represent a characteristic post-socialist interventions aimed at providing additional living space in multi-family housing. When occur sporadically, these transformations can be considered as individual strategies for improving living conditions. On the other side, multi-storey housing extensions intended for the market in Niš are of such proportions, that they represent a special phenomenon of housing development on the host building, without construction plot – the phenomenon of "building on a building". Upgrading of residential buildings with flat roofs became a trend in the transition period and one of the most prominent legacies of post-socialist urban transformation in Niš (GSA Nis, 2006). The scale of MSE ranged from individual buildings to the size of a residential block and entire settlements, i.e. 80% of the inherited multi-storey housing stock was transformed by MSE (Vranić et al., 2014).

Lack of control and "laissez-faire" approach towards this type of urban development by state authorities, who believed it could alleviate chronic housing shortages and improve the living conditions of the population, created favourable conditions for private developers to build where they want (Bouzarovski, et al., 2011). From the investor's point of view, the main economic reasons for upgrading of existing buildings were: the lower cost of construction than the cost of building on free space and the high value of the locations, mainly in the broader city center. Multi-storey housing extensions "attacked" all buildings suitable for upgrading, regardless

of age and location (Fig. 1). Only high-rise buildings and buildings with sloping roof were spared. These new structures were often statically defective, built with no aesthetic criteria and no additional open, green and parking spaces for new housing units (GSA Nis, 2006). As pointed out by Brankovic et al (2022) spatial transformations of existing housing stock, including upgrading of buildings, were implemented through piecemeal interventions and without a coherent plan. No ex-ante evaluations of the site were performed to determine the impact of building upgrades upon urban environment and quality of life (ibid.).

(a) *(b)* *(c)*

Fig. 1: multi-storey housing extensions of buildings from various periods: (a), (b) – pre-socialist period; (c) - socialist period
Source: (a), (b) –https://www.google.com/maps; (c) – photo by: Jelena Đekić

Having in mind that housing estates from the socialist period make up a large part of the multi-storey housing stock in Niš, they were massively affected by multi-storey housing extensions. An analysis of the housing complex Krive Livade from socialist period, showed that more than 60% of buildings (64.4%) have been upgraded. Out of the total number of upgraded buildings, 30% are one-story upgrades, which may represent individual extensions of living space, while multi-story upgrades – two or three storeys, make up around 70%. These findings support the claim that the largest number of upgrades was built by private investors for the market, and represent not only an individual strategy for improving living conditions, but a specific form of multi-storey housing construction.

Although private capital was the main driver of housing upgrades, they were also supported by planning documents and legislation. After the wholesale privatisation of state owned housing in the 1990s, sitting tenants became collective owners of their housing estates, and therefore, responsible for their maintenance and management. Due to years of economic recession, impoverished households were hardly able to keep up with basic running costs, and thus unable to undertake any major renovation. The Act for the Renovation of Flat Roofs, adopted in 1995, allowed the housing extensions over the existing multi-story housing buildings, for one or exceptionally more floors. This act opened the door for private developers to utilize the existing housing stock as an infrastructure for building new apartments under favourable conditions (Vranić, 2014). General Urban Plan (GUP) of Niš 1995-2010, the key urban plan for the city area, also supported housing extensions. Provision of the required number of apartments, beside other solutions, was planned through the reconstruction, extension and superstructure within the existing residential blocks in the built-up area of the city. Allowed or recommended interventions included extension of one floor, or an attic with a sloping roof, or extremely more floors based on specially proven expediency.

3.1.2. New construction on greenfield sites on the outskirts of the city

In the conditions of a weak private sector and scarcely available and expensive construction land in the central city area, private investors focused on housing construction on greenfield sites on the city outskirts. These new development sites had similar initial conditions to those of the socialist housing estates - development on greenfield sites on the periphery with a good traffic connection to the centre, but different development conditions produced completely different results. Socialist housing estates were planned as neighbourhood units, built on state-owned land and funded from public budget. On the other side, formation of privately owned individual plots with individual multi-story housing exclusively assigned to the market and development without any consideration of the wider context in new multifamily housing areas, led to total space fragmentation and the absence of spatial integrity. Lack of control and lost legitimacy of urban planning

in the initial phase of transition led to often violations of planning rules, increase of illegal construction and numerous changes to planning documents aimed to legalize existing irregularities. The consequences in the area include excessive construction and density of population, lack of open space and green areas, small distance between buildings, insufficient number of parking spaces, etc.

Figure 2 shows a multifamily housing area Somborska-Studenička, that developed in the early 2000s on the very outskirts of the city, next to the existing family housing. The analysis of the Somborska - Studenička housing area, showed that physical and functional structure of the area is largely a result of systematic violations of building rules, as well as deficiencies of planning documents. Investor-driven development resulted in spatial and functional fragmentation of space, loss of open and green areas (both public and private), lack of basic public services, pedestrian inaccessibility and congestion of space, affecting the quality of life of residents at the neighbourhood level (Fig. 2).

(a) *(b)* *(c)*

Fig. 2: Multifamiliy housing area Somborska-Studenička: (a) the whole area; (b) selected block of buildings; (c) distance between buildings
Source: (a), (b)- *https://gis.ni.rs/smartPortal/gunisPublic, (c) - photo by: Jelena Đekić*

Numerous changes to planning documents for this area proved to be a bad solution because they mainly focused on specific problems, without re-evaluation of overall planning concept. The plans aimed to establish control over the future development of the area, but they actually legalized existing irregularities and made a basis for further abuse. It seems that the planning lagged behind the construction from the very beginning of development - instead of development following the plan, plans usually followed the development. The fact that section Somborska - Studenička is only a part of wider area, which is currently under the pressure of housing development, arises the need for profound changes in the way of planning. Long-term solutions need to be devised in collaboration between planners and market actors.

3.2. Multi-storey housing development in later phase of transition

The next phase of transition (after 2000.) is characterized by strengthening of private sector and greater availability of construction land in the central city zone. New conditions enabled the expansion of construction to all parts of the city, including the city core, and increased scale of construction. Therefore, multifamily housing development in later period of transition can be described through following types: 1) new infill housing development, mainly in underbuilt socialist housing estates; 2) reconstruction of the central city zone – conversion of individual to multi-family housing 3) construction of larger scale on brownfield or greenfield sites.

3.2.1. New infill housing development

Infill development refers to the construction of buildings on previously unused or underutilized land within an existing urban fabric. Due to late restitution, construction land in city center is still burdened by unresolved property rights. On the other hand, due to lack of public finances, peripheral locations are often poorly equipped with infrastructure and unsuitable for multi-family housing development. Large housing estates (LHEs) from socialist period, with well-developed urban infrastructure – public services and utilities, good connection with city center, large open spaces, green and recreational areas, become attractive for residents and private investors. Along with city expansion, some of these areas are integrated in wider central city zone and positioned as secondary city centers, which makes them even more attractive for housing construction, i.e. infill development. New infill housing development, primarily in LHEs, is the result of several factors, including:

- lack of available locations for multifamily residential construction in the central city zone;
- weak interest of investors for construction in peripheral locations due to poor infrastructure and lower profits;
- good traffic connections, infrastructural equipment and underutilized land of socialist LHEs;
- legislative change of status and ownership structure on the construction land;
- restitution - return of undeveloped land to pre-war owners;
- mismatch of planning documents and new conditions of multifamily housing development.

The delayed restitution in Serbia is an ongoing process, which currently shows its effects exactly through the construction of free space between the existing buildings. This infill development can be described as very dynamic in terms of pace, and almost "aggressive" in terms of its impact on the affected area. Besides economic conditions and legislative changes, the decisive factor that contributed to the development of infill construction at local level are urban planning documents. In the case of the City of Niš, planning documents didn't recognize socialist housing estates as fully developed complexes, where further construction should be banned. In addition, public open space and green areas in LHEs are not marked as separate land use - the whole LHEs' areas are marked as high density residential zones, without provisions related to already built-up areas of LHEs, which creates a planning basis for further construction of the area.

Fig. 3: Examples of new infill housing development in LHEs in Niš , Photos by: Jelena Đekić

Although infill construction has some positive effects, as it cause the influx new residents and improves the social and physical structure of existing residential areas (Szafrańska, 2014), negative effects are mentioned more often. Infill construction is criticized for its chaotic and random development (Treija, et al., 2018) and negative effects including over-densification of existing residential areas, systematic failure of infrastructure to absorb new development, noticeable disappearance of open space and continued deterioration of housing conditions in many neighbourhoods (Hirt & Stanilov , 2007).

3.2.2. Reconstruction of the central city zone – conversion of individual to multi-family housing

The reconstruction of the central city zone i.e. conversion of individual to multi-family housing begins in the later phase of the transition, and currently represents the most common type of multi-storey housing construction in Niš (Fig.4). Planning documents for the City of Niš, which are currently in force, foresee an increase in housing density and number of floors in the central city zone. The number of floors is increased up to five in residential areas of medium density and up to seven floors in residential areas of high density. The goal is to gradually increase the number of floors in the central city core, i.e. to gradually replace individual housing in central city zone with multifamily housing and /or business-residential buildings.

(a) *(b)* *(c)*

Fig. 4: Reconstruction of the city core, period 2006-2021: (a) – 2006 (source: https://gis.ni.rs); (b) – 2011-2013 (source: www.geosrbija.rs/); (c) – 2021 (source: https://gis.ni.rs)

The transformation of the city center is uneven, random and dictated by the availability of construction land. Multi-story residential buildings often "sprout" in the middle of single-family housing blocks, often connected with main streets with narrow access paths – Fig. 4(c). Maximum number of floors and the height of buildings were defined in planning documents in relation to the surface of the construction plot, which led to a mixture of buildings of different number of storeys in building block. Low-rise family housing mixed with high-rise multifamily housing of different number of storeys, create an impression of chaos and a “saw-shaped” streetscape. Investors' aspirations towards maximum profit often lead to the violation of construction rules. Thus, together with strengthening of private capital, illegal construction spreads to all parts of the city, including the inner city core. Violation of existing building rules and urban planning, still unadjusted to the conditions in which private capital shapes the city, cause numerous problems - loss of greenery on individual private plots, lack of common spaces within a block of multi-storey buildings, insufficient number of parking spaces, traffic congestion and reduced quality of built environment and quality of life.

3.2.3. Construction of larger scale on brownfield and greenfield sites

Economic recovery and a improved living standard of the population cause a greater demand for housing. At the same time, the private building sector strengthens and gradually reaches the proportions of former state-owned building companies. Besides domestic building companies, participation of foreign capital and companies is also present in the structure of building sector. Rising demand for residential space and changes in private sector resulted in emergence of larger-scale residential projects on brownfield and greenfield locations in the city.

(a) *(b)*

Fig. 5: Construction of larger scale: (a) Novi Niš - brownfield site; (b) Vagres City - greenfield site Source: https://gis.ni.rs/smartPortal/gunisPublic

Figure 5 shows two examples of larger scale construction in Niš: 1) mixed use complex “Novi Niš” on brownfield site in inner city area - Fig. 5(a); and 2) housing complex “Vagres City” on greenfield location in wider central city zone - Fig. 5(b).

The area of the construction site for mixed use complex Novi Niš is approx. 15 ha. The complex is located in central city zone, on brownfield site of former military complex. Preliminary design for new mixed-use complex includes different uses: multi-family housing, retail center, university and healthcare center, green and recreational areas, etc. – similar to projects of socialist housing estates.

From the perspective of housing development in the post-socialist period, this project is significant for the following reasons:

- Land recycling – conversion of the site of former military complex into the secondary city center;
- First project of "socialist-scale" mixed use complex in the post-socialist period in Niš;
- Public-private partnership in housing development.

Although the project started back in 2014, only a small part of residential buildings has been built to date. Meanwhile, the preliminary design has changed several times, so it is uncertain whether it will be a mixed use area, which includes less profitable uses (education, culture, etc.), or the unprofitable uses will disappear and only profitable ones will remain.

Multi-family housing complex Vagres city is located in wider city centar, on greenfield location intended for housing according to the valid planning document. Although at first glance it is similar to the new construction on greenfield location from early period of transition (Somborska-Studenička), it is important to emphasize certain differences. As previously mentioned, development of Somborska-Studenička housing area started before planning, with participation of a large number of smaller private investors, systematic violations of building rules and frequent changes of planning documents with aim to legalize the current state and to set rules for further development. Multi-family housing complex Vagres City is developed in compliance with the planning documents, by a single investor. In this case, the investor had the opportunity to create a quality residential complex, since there were no limitations from surrounding construction. However, the results are similar in both cases: monofunctionality – multifamily housing without public services and consumer contents, excessive construction, small distance between buildings, lack of open space and green areas, etc.

This leads us to the conclusion that in conditions of "mature" or completed transition, when the private capital – domestic and foreign, shape the urban fabric, revisions and changes of planning documents are necessary, in order to shape future development at the level of planning documents.

CONCLUSIONS

After the fall of the socialist regimes, countries of Central and Eastern Europe began the process of multi-layered transformations, including political, institutional, socio-economic and changes in urban structure. Post-socialist transformations in all countries follow the general transition path, but certain specificities - transition sub models, can also be recognized. Due to specific political conditions, transition in Serbia started almost a decade later in comparison to other countries in the region, which affected all aspects of development, including housing development. The paper analysed post-socialist multifamily housing in Niš, with aim to explain interrelation between overall changes and housing development.

Multifamily housing construction in post-socialist period is mostly shaped by private capital and available construction land, and occurs in different volumes and forms all over the city. However, in seemingly random development, certain order can be observed in relation to period of development, distribution in urban fabric and scale of development. In the initial period of transition, multi-storey housing extensions and small-scale construction on the outskirts of the city are the most common types of development. The lack of control and the lost legitimacy of urban planning in the initial phase of the transition led to violations of building rules and an increase in illegal construction. Later phase of transition is characterized with economic recovery, strengthening of institutions and gradual adaptation of urban planning to the new conditions, but also with strengthening of the private capital and inflow of foreign capital. Along with the strengthening of private capital, construction is moving towards more attractive locations (infill construction in socialist housing estates and construction in the city center) and the spatial scale of construction is increasing – construction in wider city center (Vagres City) and recycling of brownfield sites in the city core (Novi Niš). Housing development shaped by private capital shows numerous disadvantages caused by investors' striving for maximum profit. Since the future housing development will be set in this direction, the revision of planning documents and control of their implementation is necessary, in order to establish a balance between the demands of investors and the public interest, i.e. to ensure the development of higher-quality areas of multi-story housing.

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CITY AND TRAUMA

AN AGENCY OF DISASTER, DESTRUCTION AND DISCOMFORT IN CREATION OF URBAN IDENTITIES

Sonja Lakić

CY Cergy Paris University, France
PhD., Marie Skłodowska-Curie - EUTOPIA-SIF Postdoctoral Research Fellow, sonja.lakic@gssi.it

Jelena Prokopljević

Pompeu Fabra University, Spain
PhD., Associate Professor, jelena.prokopljevic@upf.edu

ABSTRACT

Working across different disciplines, scales and a variety of media, this research in progress and a publication in the making, co-edited by Dr Sonja Lakić and Dr Jelena Prokopljević, sheds a light on a trauma as an essential part of being the urban. Here, a group of authors reads, analyses and interprets trauma across different cities, environments and/or geographical areas, tracing diverse experiences within and/or beyond nation, a social group or a built environment. In its original meaning, trauma, (from Greek τραῦμα) is a wound - a physical injury; a painful cut; a discontinuity of tissue that provokes an intense and lasting stress. In psychology, trauma extends beyond spatial and temporal boundaries of the physical trauma; moreover, it is an emotional response to the latter. Trauma relies on memory. It generates an abnormal, disruptive narrative, disconnected both from the real experience and from the previous life of the subject. This collective effort discuses trauma as an important element of urban identity and urban history, as well as a disruption in the urban memory, seeking to understand how trauma translates in an urban landscape on a variety of scales. This is a conversation about destruction, construction, repression/imposition, division/discrimination; a discussion on laws, policies and political struggles; contemplation on a sudden growth or disappearance of a large portion of urban population, and an exploration of a trauma as a stimulus for literary and artistic creation (Caruth, 1996), for the sake of the future of cities we inhabit.

Keywords: *city; trauma; urban identity; urban history; urban landscape; urban memory*

1. INTRODUCTION

In its original meaning, trauma (from Greek τραῦμα) is a wound. A physical injury; a painful cut; a discontinuity of tissue that provokes an intense and lasting stress. Physical traumas are occasioned by destruction: wars, accidents or natural disasters; by arbitrary violence: physical, sexual or psychological; by unwanted changes imposed by an authority.

In psychology, trauma extends over the spatial and temporal boundaries of the physical trauma; moreover, it is an emotional response to it. For Freud, this response is a means of protection of the psyche and results either in amnesia - partial or total - of the traumatic experience or provokes a recurrent thought, feelings and actions that relate with the trauma in a specific way. Trauma relies on memory; however, it generates an abnormal, disruptive narrative, disconnected both from the real experience and from the previous life of the subject. Like in the Hitchcock's film Spellbound (1945) the mind creates strange landscapes that partially represent the trauma and partially its interpretation.

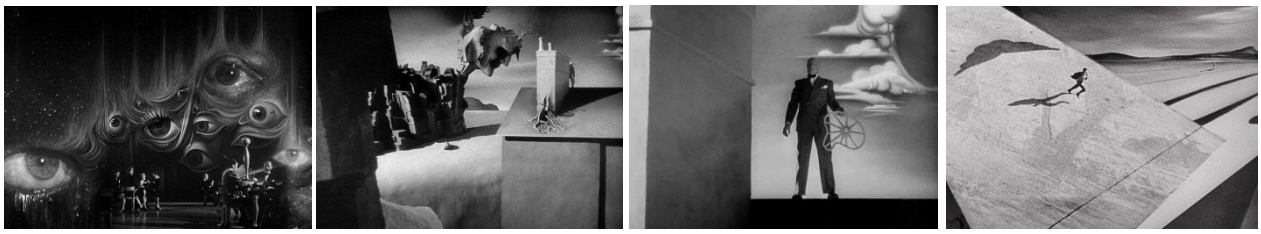

Figure 1: still shots from the film "Spellbound", directed by Alfred Hitchcock (1945).

In her book "Unclaimed Experience: Trauma, Narrative, History" (1996) Cathy Caruth explores the rhetoric content of trauma, often unsaid or hard to express, as basis for literary and artistic creation. The way we express traumas and we deal with them becomes part of our identity and, in a broader sense, traumas define our collective history. In the words of Caruth, "history, like trauma, is never simply one's own, … history is precisely the way we were implicated in each other's traumas". Collective traumas mark different generations that revisit, research and reinterpret them, so there can be traced a continuity of traumatic experiences within a nation, a social group or a built environment.

The volume "Future of Trauma Theory" edited by G. Buelens, S. Durrant and R. Eaglestone (2014), points to a more complex and contextual approach to the study of traumas: they can't be conceptualized exclusively within a historic, physical, social, cultural or even political framework, but rather operate at an intersection of all those elements. Different social groups understand differently the question of Nazism or Holocaust, the 9/11 trauma has been included in different ways within an official state discourse depending on the context, the discrimination against LGBTI collectives, women or immigrant population, occupies sometimes opposite place in discourses of different religious or political realms, similar as the question of mass murders, ecological disasters and more recently, the COVID pandemics.

In the similar way traumas form part of the urban history and urban identity. Their presence in the built environment is often layered corresponding to different epochs and different traumas. Destructions and new constructions, radical changes of the urban layout, impositions of policies and restrictions, sudden growth or disappearance of large portion of urban population, political struggles and their consequences, etc. have marked urban environment throughout the world, in especially intense way since the 19th century. In the urban space, traumas tend to scale, to relate with specific places, buildings, neighbourhoods or communities. A shooting in a high school, although a national tragedy, marks the identity of a specific neighbourhood in a long term; the war operations tend to affect differently the urban space, not only as an act of destruction, but also in the process of posterior rebuilding. When defining the three principles of reconstruction, in his book "War and Architecture" (1993), Lebbeus Woods takes into account both the destroyed and the remaining parts of a building or an urban structure, as carriers of memories, of the trauma and of the previous life. The reconstructed body is neither like the old one, nor totally new, it is a hybrid that contains all the elements: the pieces of the original, the traumatic disruption, its interpretation and the reconstruction.

2. THE AIMS OF THE RESEARCH AND TYPOLOGIES OF TRAUMA

The aim of this research and collective publication is to explore different ways in which trauma operates in the urban space, how it persists as continuity in the urban memory and how, through a process of adaptation, it triggers elements of new urban identity. For the sake of clarity, traumas are initially classified according to their origin forming the following typology:

1. Traumas of destruction
2. Traumas of construction
3. Traumas of repression / imposition
4. Traumas of division / discrimination

This paper will reflect our research and thoughts on each one of them, using this typology also as a guideline. The conclusions will summarize the ways that the traumas of the past have shaped the present identities of our urban spaces.

2.1 Traumas of destruction

The term "trauma(s)", standing next to the concept of "destruction", would, instantly and with no doubt, make an ordinary (wo)man immediately think of a war, that is, a specific form of spatial violence caused by the latter. Here, an image of a divided Berlin would instantly come to one's mind. Flashes from dissected Nicosia,

the so-called “peace lines” across the former war zone of Belfast, as well as all the harm done in Israel/Palestine, Afghanistan, Iraq, Syria, and, as from recently, Ukraine, would follow next. The images from the 1990s former Yugoslavia are, in this case, also impossible to ignore, and difficult to forget. These altogether remind one of not only an organised violence against urban environments and, most of all, civilians, but also, represent a bare witness of a trans-generational trauma. The aforementioned examples should be understood as a very particular form of destruction known as ”place annihilation” through warfare (Hewitt, 1983). This is a particular form of “socio-spatial production” with the military taking on the role of “‘architects’ and ‘urban designers’ who reshape cities, buildings and public spaces” (Ristić, 2019: 37). This kind of a widespread political violence and the politics of exclusion, as exercised during the 1990s conflict across former Yugoslavia, for example, is widely recognised as “urbicide” (Coward, 2009). Here, deliberately targeting buildings, which originally allowed for a plural public space, made whatever the aims of ethnic-nationalist regimes to come true across the country that is no more (Coward, 2009).

De(con)struction, is, obviously, a counterpart to construction. In the book “On Altering Architecture” Fred Scott argues:

“All buildings, once handed over by the builders to the client, have three possible fates, namely to remain unchanged, to be altered or to be demolished.” (Scott, 2008: 1)

Thus, one builds and, also, one *smashes*. The 1972 controlled implosion of the high-rise middle-class public housing complex of Pruitt-Igoe in St. Louis represents one of the most famous destructions on the both sides of the Atlantic. Total thirty-three eleven-story high rise buildings were originally designed in accordance with the finest principles of modernist architecture hence characterised by a well-ordered master plan that separated cars and pedestrians, a vast open space between the buildings, and, finally, apartments showering in daylight, catching the views. Pruitt-Igoe, however, soon became well known after violence, shabbiness, vandalism and overall chaos, and, consequently, a powerful symbol of the social, racial and architectural tensions in the mid-20th century cities across the United States of America. The complex, which has been labelled as a failure of architecture, a failure of policy, and, moreover, a failure of society, finally came to an end in a live-on-TV broadcasted demolition, not only marking “the day modern architecture died” in the USA, but also serving as the prototype for the de(con)struction of similar projects elsewhere.

Image 2: July 15, 1972: Pruitt-Igoe’s demolition. In his 1977 book “The Language of Post-Modern Architecture”, Charles Jencks refers to this day as the moment modern architecture in the USA died: “Modern architecture died in St Louis, Missouri on July 15, 1972, at 3.32pm (or thereabouts)."
Photo source: Michael J. Baldridge / Polaris Images.

2.2. Traumas of construction

New plans and projects are usually presented through suggestive images that promise great improvements of the urban functionality, commodity and quality of our cities. The realised projects generally tend to respond to those initial intentions depending on the quality, length and efficiency of the execution process. It is precisely the process of the execution and the extension of the urban tissue affected by the

intervention that draws the line between the realised utopia and an urban trauma. Often the lengthy and deficient urban transformation generates a disruption that requires a lasting adaptation and re-adaptation of the users, generating unforeseen perceptions and evolving into different identities of the urban space. Two examples: one from New Belgrade and other from Barcelona are presented to illustrate this idea.

Construction of New Belgrade started in the late 1940s and actually continues now, more than seventy years later, after numerous changes of conceptions, architectural and urban forms. The first plans envisioned a new capital city with governmental institutions, monumental public spaces, culture, education and generous greenery. Once begun, the plans were postposed for over a decade, leaving a visible skeleton of the governmental headquarters on the horizon of the future green Danube waterfront and a sea of sand poured from the riverbed to build a solid ground on the marshlands.

The first housing blocks were inhabited in 1949 and the process went on: during the following decades the housing mega structure grew, according to the General Urban plan of 1950 and each block of Le Corbusian dimensions was delivered to the citizens right after its completion. Only a basic urbanization accompanied the housing construction: a road connection with the public transportation and public facilities that followed the model of micro districts. The most valued playgrounds were the sand dunes of the construction sites and the enormous cement pipes used for draining the terrain. The new neighbours, often newcomers from the provinces with a diverse cultural background, adapted their old way of life to the new urban setting. Unplanned uses appeared in the prefabricated high-rise: interior corridors were used to store sour cabbage and pickles' buckets, dry clothes, even keep shoes. The undefined open space of the block was the place where to clean carpets, pieces of furniture and cars, and in the autumn to roast peppers on a self-made barbecue. Meanwhile the historic centre of Belgrade maintained its function of the state capital, and continued being the city with recognizable identity, a concentration of cultural, educational and leisure time facilities, among generations of Belgrade citizens, a preferred place to live. New Belgrade was the modern "other", the undefined work in process that had changed its urban conception several times. The idea of the monumental administrative centre was definitely abandoned in the early 1980s on the wave of economic and political turbulences that swept the country during the following decade. These changes, but especially the constant condition of undefined and unfinished made possible the following stages of the urban densification of New Belgrade, during which many of the free spaces and children's playgrounds were requalified and privatised, ending up as new residential blocks. During the first decade of the economic transition to the market economy, what used to be the individual unplanned appropriation of the communal spaces grew in scale to occupy street sidewalks and ground-floors, additional floors and whole new type of temporary, semi-legal constructions on the public spaces and on the waterfront.

Image 3: Children at an improvised playground in New Belgrade. Source: "Novi Beograd-Novi Grad", Direkcija za izgradnju Novog Beograda, Beograd, 1961.

Two central streets of Barcelona, cut through the historic core of the city and separated by almost a century in their construction, have generated at the same time, enormous and traumatic urban transformations and new spaces and uses that form part of the contemporary identity of the city. The master plan for the city extension (Ensanche district) designed by the engineer Ildefons Cerdà and approved in 1860 defined the Barcelona's characteristic urban fabric dominated by the squared blocks of the similar size (113 by 113m) and orthogonal street grid, 20m wide to provide optimal insolation and ventilation. The growing city was occupying the military protection grounds, scarcely built and criss-crossed by water streams and roads. Nevertheless, the plan had its eco on the existing medieval city that grew on top of the Roman remains, re-using the material vestiges and densifying the structure until making it unrecognizable and unliveable in some parts. Plan Cerdà included 3 avenues: A, B and C that crossed the Old Town as continuation of Ensanche streets.

The first traumatic opening of one of the new streets took place between 1908 and 1926, Via Laietana was cut through the densely built area of the Old Town, just next to the fortification from the Roman time. A new 20m wide street required the demolition of more than 2.000 residential blocks, workshops and medieval palaces, some of which have been later rebuilt elsewhere to enhance the medieval "gothic" character of the old town. A little less than hundred years later, another of the Cerda's avenues was planned and the execution was carried out in three stages, between 1988 and 2012, including the opening of the vide Rambla de Raval avenue and adjacent squares with public institutions. The process comprised the demolishment of around 2.500 residences, 480 commercials and the expulsion of around 7.000 inhabitants.

The South Raval, known pejoratively as China Town (Barrio Chino), although never had actually been populated by Chinese immigrants, is one of the city's old neighbourhoods surrounded by the second medieval walls from the XIV century. Having absorbed the early industrialization in the first part of the XIX century, Raval have turned into the workers' neighbourhood, with its southern part especially badly maintained, overcrowded with deteriorated residential blocks where living and environmental conditions were way below healthy minimum. The early Modern Movement plans for sanitisation of this area, presented at the CIAM IV meeting in Marseille, already planned a process of voiding of this part of town and creation of green zones with Le Corbusian high-rise administration towers and open residential blocks.

The new projects of the Cinematheque, a high category hotel and numerous subsidized housing blocks aimed at renovating the urban population and especially the activities, such as low category commerce and craft, prostitution and all sorts of illegal transactions, most of which took place in the streets. The process of

construction produced a long-lasting intermediate state where the old activities continued with new neighbours settling in, occasioning new type of urban conflicts. Forced evictions, mobbing, real-estate violence on one side and robberies, drug-dealing, prostitution and all kinds of social violence on the other, marked the everyday of a neighbourhood that is still seeking strategies for a constructive coexistence.

2.3. Traumas of repression / imposition

Cambridge Dictionary states that to impose means to officially force a rule, tax, punishment, etc.; to be obeyed or received; to force someone to accept something, especially a belief or way of living. To live in a city means to get oneself familiar and, moreover, follow a vast of rules, laws and legislations that authorities impose, expecting one to accept them and fully obey. Those in charge of cities, that is, those in power, often erase memories of a specific period, replacing it with their own, enforcing their own beliefs. This happens either by building and/or destructing, or erasing and (re)writing the urban history by inscribing urban environment with the names and/or events that are part of whatever the political agenda. Repression and imposition unfold whenever a regime calls for "a new historiography" (Palmberger, 2012) hence are part of the nation-building process or a quest for the new urban and/or national identity.

This conversation on city and trauma introduces one of the darkest periods of the history of Banja Luka, Bosnia and Herzegovina and, for the first time ever in academia, brings to light the 1993 amendments to the Law on Housing Relations and, precisely, the newly introduced policy of rationalisation. Originally introduced as a form of apartment swaps that was not to be considered as an obligation of any kind (Šaćirović, 2014), the rationalisation, however, unfolded in a rather forceful way, becoming a trauma itself. The process of swapping was initiated once an original donor of an apartment (an enterprise that provided a worker with the latter) estimated that a tenant-occupied dwelling was too spacious for them. After being notified, tenants would leave the apartment they originally resided in and next moved into a different, donor-provided unit of a smaller size. The fact that a tenant moved out from their home hence moved into an apartment that was considered more suitable, however, did not necessarily mean that the game was over: the evictions could simply go on and on and last until forever (Šaćirović, 2014). Furthermore, the precise criteria on those who got to be subject to rationalisation were allegedly never established: those moving out were chosen "rather selectively", and, most importantly, without providing any previous personal consent to do so (Šaćirović, 2014). What the Law described (and prescribed) as a rather benign process of an apartment swapping, in most of the cases, unfortunately, unfolded in series of quite violent evictions of tenants of the non-Serb ethnicity.

The evictions, locally known as "deložacije", took place massively and almost on a daily basis across the city, targeting even elderly and disabled tenants of Serbian ethnicity. After an unsuitable tenant moved out, those considered being of a better fit (namely then-considered elites and those of priority, such as internally displaced people and refugees) moved in. A certain number of dwellings acquired through the evictions were assigned to war participants, casualties and handicapped, supposedly in accordance with the Law-prescribed norms (Šaćirović, 2014). The rationalisation-triggered mass evictions coincided with the authorities-initiated practice of the alteration of the local urban landscape that first and foremost came in the form of the renaming of the built environment. Aiming to demonstrate who runs the world, the ethno-nationalist politicians, apart from rechristening specific national(istic) memories and heroes, imposed an afresh-established architectural vocabulary, which took on the form of a vast number of Orthodox churches constructed wherever/whenever possible. The aforementioned practices altogether represent examples of political violence and the politics of exclusion that first and foremost established "the new ethno territorial order of space" (Pignotti, 2013). For those profiteering from the policy of rationalisation, the latter evidently represented an example of a "good political correctness" (Van Houtum and Van Naerssen, 2002). For those that "deložacije" eliminated as the different and inappropriate, replacing them with those considered more suitable, rationalisation, obviously, had a whole another meaning: their right to the city of Banja Luka was denied, along with their home, basic human rights and a dignity.

Today, nearly three decades since the Government of Republika Srpska pioneered this beyond-controversial policy, how and why exactly did one get to be picked to leave their home remains a mystery. So do the names of those who were in charge of the overall process of labelling the unsuitable tenant(s), simultaneously prioritising the decent ones. It is, nevertheless, important to stress that what seemed to be an amendment to the Law, in fact, represented somewhat a lethal weapon: rationalisation was a strategy of a "purification of space" (Sibley, 1988). "Deložacije" eliminated the different and the other and, finally, replaced them with those more appropriate and of a better fit, that is, as ethnically clean as possible. This practice of "(b)ordering and othering" (Van Houtum and Van Naerssen, 2002), marked quite a perplexing regime-initiated era of the

rewriting of the local urban and cultural identity, and affected local housing and dwelling experience, transforming the architecture that embodied Yugoslav ideology of Brotherhood and Unity into a battlefield and a politically highly contested arena of the nation building.

2.4 Traumas of division / discrimination

Among the many cases of divided cities that exemplify this typology of urban trauma, Berlin is probably the emblematic, most documented and studied example. The construction of the Wall since 1961, activities and life conditioned by its existence, the struggle to overcome the division, both pre- and post-1989, the destruction, memorabilia and the afterlives of its pieces, have generated a vast body of research and artistic work.

Nevertheless, divided cities are not always imposed by a political or military division, in some cases they are products of a modernizing impulse that leaves the historic part disconnected from the future development. In 1960s, the new capital city of Pakistan was planned by Konstantinos Doxiadis, relocating the state administration from the old capital Karachi. The new city, an example of a functionalist utopia implemented in a completely different cultural context, defined the position of the main state institutions along the central Jinnah Avenue, starting the development of the so-called Blue Area into a central business district. While the modern capital, planned on the basis of grid structure of 2.000 by 2.000m, open blocks and imported western architectural styles, the I.J.P. Road (Islamabad/Inter Junction Principal Road) separated it from the city of Rawalpindi. Today, this part, founded before the XI century, conserves the traditional Islamic small-scale urban fabric with division of uses and crafts in different sectors. The effect of this division is twofold in social composition of both parts and in the distribution of wealth on one side, and as a generator of specific, in-between structures and uses that appear in the large urban blocks of Islamabad and in the free zone on the outskirts of Rawalpindi.

Divisions in the urban space are sometimes produced by a striking economic difference, generating favelas, slums and ghettos. Mumbai slums are well known example of centrally located slums, originated in the process of industrialization and railway construction, but eventually developed as specific diverse communities separated from the surrounding modern urban fabric. Dharavi slum in Mumbai is the largest and most populated one in the world, located between the two main inter-urban railway lines and close to the city's airport. Its population is around 1 million inhabitants on the surface of 2,1 km2, with almost compact urban structure of temporary, low quality self-built houses. Although physically detached from the main areas of urban development, Dharavi forms an important part of the city's economic and social life.

3. (TOWARDS) CONCLUSION

This paper introduced the notion of city and trauma, shedding a light on research in progress, simultaneously announcing a publication in the making, co-edited by Dr Sonja Lakić and Dr Jelena Prokopljević. Classifying traumas in four different typologies, we here read, analysed and interpreted how a variety of disturbance unfolds across different cities, environments and/or geographical areas. Seeking to understand how trauma translates in an urban landscape and, moreover, alters the everyday lives of ordinary people, we approached the problem from a variety of scales, tracing diverse experiences within and/or beyond nation, a social group, a built environment, and/or socio-political context. We demonstrated that trauma is not only a constitutive element of urban history; it is essential in formation of urban identity and urban memory, regardless who/what orchestrates it. Trauma, moreover, translates well in the built form of cities whereby architecture serves as somewhat a medium that facilitates it. Urbicide, political exclusion, imposition and/or repression, undefined and unfinished construction, organised demolition, broken and/or failed promises related to inadequate urban planning and insensitive urban renewal, altogether with different forms of violence, such as evictions and those of arbitrary, political and social character, and, finally, natural disasters altogether stand for a trauma. Trauma, therefore, comes in different forms; it disrupts; it hurts; it alienates; it establishes new social (b)order; nevertheless, it seems to be an essential part of being the urban.

Looking at the bright side of life, the traumatic post-war condition of ethnically divided city of Mostar, Bosnia and Herzegovina, served as the catalyst for creativity and imagination of local population, which, unlike variety of institutions (local, national and international) and an official local urban planning practice that altogether failed in overcoming disunion, significantly contributed to shaping an alternative version of Mostar (Lakić, 2016). Looking beyond the existing and the given, afar from status quo, from 2005 onwards, a variety of civil society actors employed different forms of art in public space and organised a variety of symbolic events,

aiming to prove that Mostar is much more than just another divided city. The good guy Bruce Lee of Mostar, followed by series of interventions of "Abart" artistic production, "Čokoladni neredi" / "Chocolution", and, finally, local Street Arts Festival, were, obviously, triggered by political conflicts, broken promises and different forms of violence. Relying on "sensory and emotional experience" these practices, here understood as urban imaginaries, represented a manifesto of "unconscious social desires" and, as such, constructed "imaginary social alternatives" (Bloomfield, 2006: 46). Yet, these have significantly contributed in achieving what has been missing for ages – a more unified everyday, retrieving Mostar as it once was – shared rather than divided. And the future looked bright. Even for a while.

Finally, not aiming for a consensus of any kind hence a final conclusion, but rather, extending an invitation for a further conversation on city and trauma, we here offer a food for thought, brought to the world by Esra Akcan, one of the contributors to the upcoming book:

"Can societies ever heal from acts of state violence, or do the ghosts of disappeared individuals and their erased ideas continue to haunt cities? … Can societies heal by architectural revenge, by demolishing buildings, instantly constructing new or older ones, or even building them slowly? … How does a postconflict society constitute justice through architecture? Beyond designing memorials, can architects participate in countering violence and facilitating the grief process? If buildings have historically been the media through which ruling powers not only erect their monuments and show off their power but also act out their aggression and take their revenge, can they also be platforms where societies heal?"

(Akcan, 2019: 91)

NOTES ON CONTRIBUTORS

Dr Sonja Lakić and Dr Jelena Prokopljević, born and raised in former Yugoslavia, are founders of DISCO_Observatory of DISComfort, operating worldwide, yet, based in Paris and Barcelona. They co-authored this paper as somewhat an introduction of DISCO, particularly aiming to announce the forthcoming book on city and trauma, a collective effort that they co-edit, gathering voices of most prominent contemporary minds from different parts of the world.

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WOMEN'S PERCEPTION OF SPATIAL SAFETY AND PARTICIPATION IN HISTORIC CAIRO'S STREET MARKETS

Toka Abufarag

The American University in Cairo, Egypt
Research Assistant, tokaabufarag@aucegypt.edu

Sara Samir

Cairo University, Egypt
Masters Candidate, sarasamirrr97@gmail.com

Aya Elshabshiri

The American University in Cairo, Egypt
Research Assistant, a.elshabshiri@aucegypt.edu

Sherif Goubran

The American University in Cairo, Egypt
Assistant Professor, sherifg@aucegypt.edu

ABSTRACT

This research examines how selected spatial factors affect women's perception of safety. It focuses on women who participate in the labor force in areas of economic bustle in Historic Cairo, namely its markets. The research examines the following variables: (1) perception regarding spatial safety on the street as controlled by the street network, (2) vegetation as a facilitator and inhibitor of feeling safe in public places, and (3) outdoor lighting, all using a qualitative spatial analysis methodology. The research contrasts how these spatial factors, namely their existence or absence, measure up against women's perception of safety. Specifically, we analyze the physical factors through spatial analysis and collect data on working women's self-reported sense of safety through interviews. In addition, we analyze the urban fabric in terms of street activity and gain insights regarding women's participation when combined with the interviews conducted with women who work locally. The site chosen for data collection is El-Attaba Street, which boasts a source of economic bustle in Historic Cairo. It is hypothesized that 1) a balanced male-to-female ratio in terms of street activity, 2) increased visibility of the street in terms of its volume, 3) a decrease in street obstacles, 4) creation of open-sighted vegetation and 5) increased visibility due to proper lighting can positively affect the women's perception of safety. We conclude by providing a series of simple urban design recommendations to help make historic street markets inclusive. While focused on Cairo, the recommendations are appropriate for other historic cities in developing countries.

Keywords: women; urban design; spatial safety; gender perceptions; street markets; historic Cairo

1. BACKGROUND

The vibrance of Historic Cairo's economic zones are undeniable. Almost as undeniable as its lack of female labor force participating in some of its retail economic zones. This observation calls into question a wider issue: What are the spatial factors that drive womens to perceive the economic zones of Historic Cairo as safe spaces to work?

1.1 Defining Historic Cairo

Historic Cairo is a defined zone, according to URHC (Urban Regeneration Project for Historic Cairo). This zone was proposed in 2012 and includes a "buffer zone" around the monuments as a way to protect the urban and social fabric of the site and its surrounding communities, especially "buffer zone boundaries were proposed in order to prevent

developments that would harm the visual integrity of the Historic City and its relationship with its geographical setting" (URHC, 2014). Map of the zone and its buffer as provided by the official URHC final report:

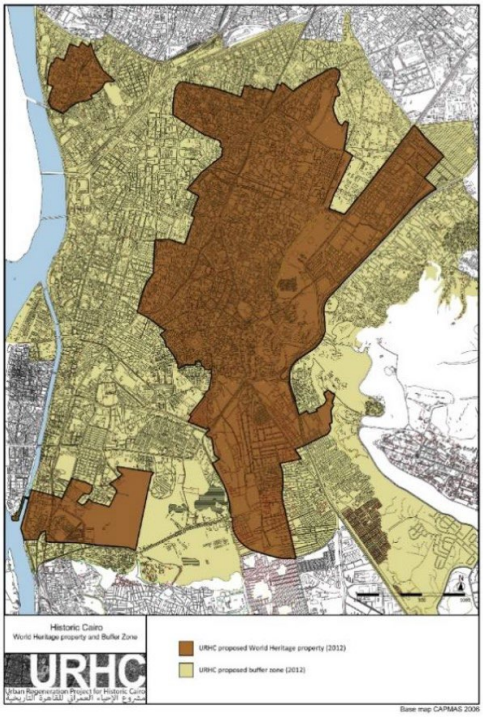


Figure 1: URHC, 2014.

1.2 Factors and variables affecting empowerment

Safe space relates to empowerment, or feeling enabled, when spoken in the context of women-related research. One must understand the different factors and variables surrounding the word to delve into empowerment-related research. According to Samman and Santos (2009), the impact of empowerment lies within two factors: expansion of agency as well as opportunity structures. Agency is defined as one's ability to take control of their choices and generally involves having control over one's life decisions. Opportunity structures relate more to the context or surroundings that enable or disable an agent from making purposeful choices in their lives. These two concepts are paramount in the journey toward understanding (and identifying) the different factors that lead to the empowerment, or disempowerment, of women, as agents, in their contexts. Furthermore, Samman and Santos (2009) further explore the different spheres, domains, and levels of agency. In the case of this research, the sphere in concern is the economic marketplace, the domain is the participation in the labor market, and the research is concerned with the community level. Thus, it is understandable that in order for empowerment to take place, agents need to be present in an empowering context, sphere, level, and domain. So, in order to understand the agents in concern, women of Historic Cairo, in relation to the economic sphere and labor market domain, one must study the community around them on a meso-level as well. This research tackles the context, and thus the opportunity structure aspect of empowerment.

1.3 Defining Safe Spaces

To discuss safe space, it is important to define what it meant historically and up to this day. According to "Safe Space: Towards a Reconceptualization" (2014), the idea of a safe space came into being around the late 20th century, especially one that related to women's movements. According to feminist movements, this idea of space was naturally brought to being as a reaction to protect the marginalized from being violated and harassed. It is enabling "a certain license to speak and act freely, form collective strength, and generate strategies for resistance", (Safe Space: Towards a Reconceptualization, 2014). The concept of feeling safe exists when compared to the dichotomy of feeling unsafe due to an imminent threat of violence, which is seen as an action done to a person. Placing them in a position of passivity. This position of passivity related to feeling unsafe due to possible events that may transpire out of one's control, is usually gendered and show up as "gendered power relations, and can be understood as a product of systematic structural violence rather than actual attacks", (Safe Space: Towards a Reconceptualization, 2014). This is a strong realization as it shows how this fear may stop certain factions of society from freely inhabiting certain spaces,

while enabling others to freely inhabit the same spaces, even though that fear is not based on actual events but rather on a sense of structurally embedded sense of unsafety. It is problematic to define spaces as safe vs. unsafe as they enable "masculinist social control" when it comes to regulating how women should use a certain space (Safe Space: Towards a Reconceptualization, 2014). Thus, these definitions are often patriarchal and driven by the social context.

1.4 Egypt and (Un)Safety in Its Public Spaces

Within the context of Egypt, the safety of public spaces is often discussed and studied given the heavy existence of patriarchal social norms driving these dialogues to be continuously questioned. According to Zakarriya (2019), the act of "inferiorization" is a political tool used by regimes to oppress women and keep public spaces under authoritarian control. This act refers to acts driving women towards less public participation due to the mentality of viewing the public space as violent and inaccessible. During the revolution of January 2011, women's bodies and sexuality were occasionally targeted via narratives of "masculinist culture" origin, which redirected the attention away from the revolution and towards a topic of women's safety at times; an act that Egyptians usually get directed towards on a daily basis as a justification for a lot of society's acts and problems i.e. security. "Egyptian women's prevalent image in public and political spaces is restricted by sexual violence, shame, and vulnerability", (Zakarriya, 2019). This constant societal reminder of shame, dishonor, and anxiety leads women to have feelings of "hiding" out of the public space (Zakarriya, 2019).

2. LITERATURE REVIEW

After reviewing previous literature that discusses issues of safety and female-friendly space, related to spatiality, it is important to outline safe space criteria to help set out the methodology of the paper. Three factors are going to be tackled: (1) Perception regarding spatial safety on the street as controlled by street network design, (2) Vegetation as a facilitator and inhibitor of feeling safe in public places, and (3) outdoor lighting. To start, it is important to note how Jane Jacob's definition of safe space tends to fall short in Egypt. According to Hemeid (2018), it is mentioned that according to Jane Jacob that to have a space one must allow for mixed activities to occur in a mixture of old and new buildings surveillanced by users. Hemeid mentions that this is the factual scenario of Egyptian streets; however, Egyptian streets are still perceived as unsafe. Thus, Jane Jacobs failed to keep marginalized women into account when stating her theories, given the gendered perspectives associated with space in the Arab world. Secondly, according to Ilahi (2009), sexual harassment is the biggest factor determining women perception of street safety. The prevalence of sexual harassment cases in urban public spaces drives women towards privatizing their own spaces, increasing males' dominance in public spaces. Thirdly, according to Mohamed and Stanek (2020), the perception of safety in spaces is determined by two factors: unbalanced male to female presence and high volume of foot traffic in streets where it may appear safe, while in fact, it allows for decreased visibility and an "unseen" characteristic that allows men to engage in harassment acts without fearing to be seen. High foot traffic areas are also dangerous around corners, stairs, parking spots, or anywhere that allows for harassers to hide. Mohamed and Stanek (2020) suggest urban designers increase space volume, increase visibility, and decrease obstacles that may act as unsafe spots. Fourthly, according to de Rooij & van Nes (2015), the perception of a space as safe vs. unsafe lies within the spatial integration of a street network. To elaborate, a spatially integrated street network offers a mixture between shops and ground floor entrances overlooking the street. This mixture encourages people of all types to engage in the street and causes it to be a safe space. On the other hand, when a space is designed to have no spatial integration, i.e. no ground floor windows or entrances, a perception of unsafety ensues. The second factor relates to how vegetation may be used as a design tool to enhance safety or increase feelings of unsafety when not used properly. According to Hashim et al. (2016), "more open understory vegetation design provides adequate lines of sight and increases perceived safety". Moreover, according to (Luymes & Tamminga, 1995), vegetated walkways in urban contexts may offer an unsafe atmosphere and are hindered inaccessible to minority groups. It is concluded that there are principles to abide by when designing vegetation in urban contexts: "visibility of others, visibility by others, choice and control, solitude without isolation".

Lastly, according to Dastgheib (2018), light is one of the most important factors when it comes to women perception of street safety. Proper lighting helps in two things: natural surveillance and social integration. The two factors are interrelated, and once one is achieved, the other usually ensues with it. The paper concludes that visibility equals safety. Unsafe spaces by women are judged by having: obstructed views, difficulty escaping, a high percentage of hiding spots, an un-illuminated "visual spatial boundary", inability to make out faces and obstacles ahead, high glare, and uneven light distribution along the path. Several other social factors formed a recurrent theme in the literature. These factors drive this paper to have subsequent ones, tackling these issues. These sources include a journal by Gekoski, Gray, Adler, and Horvath (2017), where another factor comes into play: the types and accessibility of public

transport. It is suggested that public spaces and transportation dominated by males induce a higher rate of sexual harassment. Thus, making it another medium of unsafe existence for women. It is evident that the issue of sexual harassment affects many factors of empowerment regarding women's existence in public spaces. The literature suggests that no interdisciplinary studies are tying urban spatial factors and perception of women's safety with female labor force participation in Historic Cairo. Moreover, there is a lack of resources talking about Historic Cairo perceived as safe/unsafe spaces by women.

3. METHODOLOGY

This research measures the following independent variables: (1) Perception regarding spatial safety on the street as controlled by street network design, (2) Vegetation as a facilitator and inhibitor of feeling safe in public places, and (3) outdoor lighting; in relation to the following dependent variable: the perception of women towards safely participating in the labor force in Historic Cairo. For the sake of coming up with comparable results, the selected economic zone should be of the same activity, namely: retail or sellers. It was observed that comparing zones that host different activities (eg: craftsmanship vs. retail) was compromising the quality of the data. The data collected will consist of two parts: (1) observations and mapping by the researchers regarding percentage of women's participation, as well as the spatial factors mentioned, (2) interviews with women working on site regarding the percentage of women participation, as well as their perception on participating (Table 1). The results will be presented as maps, in addition to qualitative narration of the interviews. It is hypothesized that a balanced male-to-female ratio in terms of street activity, increased visibility of street in terms of its volume, a decrease in street obstacles, creation of open sighted vegetation, and increased visibility due to proper lighting will show up as positive responses relating to women's perception of safety. The site chosen as an area to host this exercise of data collection is Al-Ataba. The site is within the borders of Historic Cairo and was chosen for two reasons: firstly, it provides a major source of economic bustle in Historic Cairo; and secondly, it hosts retail economic activities. Male to female ratio balance in public transportation is a social factor that is to be further studied in future, and subsequent, papers.

Table 1: Interview Questions (noting that the questions' structure change as the interview naturally progresses)

No.	*Question*
1	*Do you work here?*
2	*When do you start working? When does the 'Souk' open?*
3	*Are you familiar with the people working here everyday? The men?*
4	*What changes do you notice in your physical surroundings everyday?*
5	*How many women work on the street?*
6	*How many women work in the shops?*
7	*Why?*
8	*Do you feel safe working in your environment?*
9	*Have you ever been violated in your spatial setting? By men or any other factors?*

4. RESULTS

4.1 Mapping

Figure 2: snapshots of the context

Al-Ataba was visited twice on weekdays, from around 12 PM to 3 PM. The visit was carried out on foot. Observations (Fig. 2) were made regarding the number of women working on carts vs. in shops, the number of female vs. male customers, the appropriation of space taken up by the males vs. females, and the other different activities that some women in the surrounding area in which they were engaging. In addition, four interviews were carried out with women working in Al-Ataba (Figure 3).

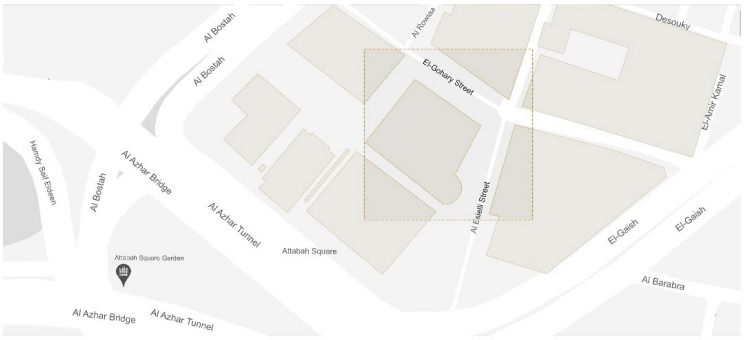


Figure 3: Overview of Al-Ataba (highlighted box indicates the zone mapped in details).

Maps were produced to assess the safety of dynamic spaces for women. The solid and void map (Fig. 3-a) shows how carts are organized in a moment of time. Usually, the shopping carts lined up from the pavements to the middle of the streets formed a micro-street network for the "souk ." Al-Ataba is a very wide street with a narrow pedestrian walkway on both sides and one that runs along the middle to separate vehicles moving in opposite directions. The pavements on either side are left empty for pedestrians to walk; however, the middle pavement is lined up with sellers and buyers, making it very hard to stop walking if you walk beside the sellers. To negotiate, one must step between one seller and the next to make room for passersby. A momentary stop means an imminent invasion of one's extreme personal space. Regardless of gender, one would be pushed to the side for the passerby to continue walking. The crowded souk is divided into two sections, made up of mobile carts, each headed by a male (Fig. 4-b), shown in the street activity map.

Furthermore, the street activity map (Fig. 3-b) describes the male-to-female ratio working in either the street or the shops. It is evident that no women work on the movable carts. On either side of the street are shops, where women primarily work as shop assistants to help the buyers. The street carts, with their "micro-street network" configuration, have the occasional room to form a streamline of moving humans, as shown in the solid and void map (Fig 4-a). Males, heading the cart and blocking the way for any women to pass through, dominating the area. Female buyers tend to move in groups and through empty gaps between the carts or through the pavements. Almost every 3 in 4 buyers were women clustered in groups. It is clear from the street activity map that the shops' area has a balanced male-to-female ratio of 13-11, contrary to the street area where the carts are.

Finally, the lighting analysis map presents the street and retail lighting in the area (Fig. 4-c). All lighting occurs on the edge of the shops' street. Thus, lighting diminishes as one goes towards the middle of the street, and is crowded with people and carts (Fig 4-b).

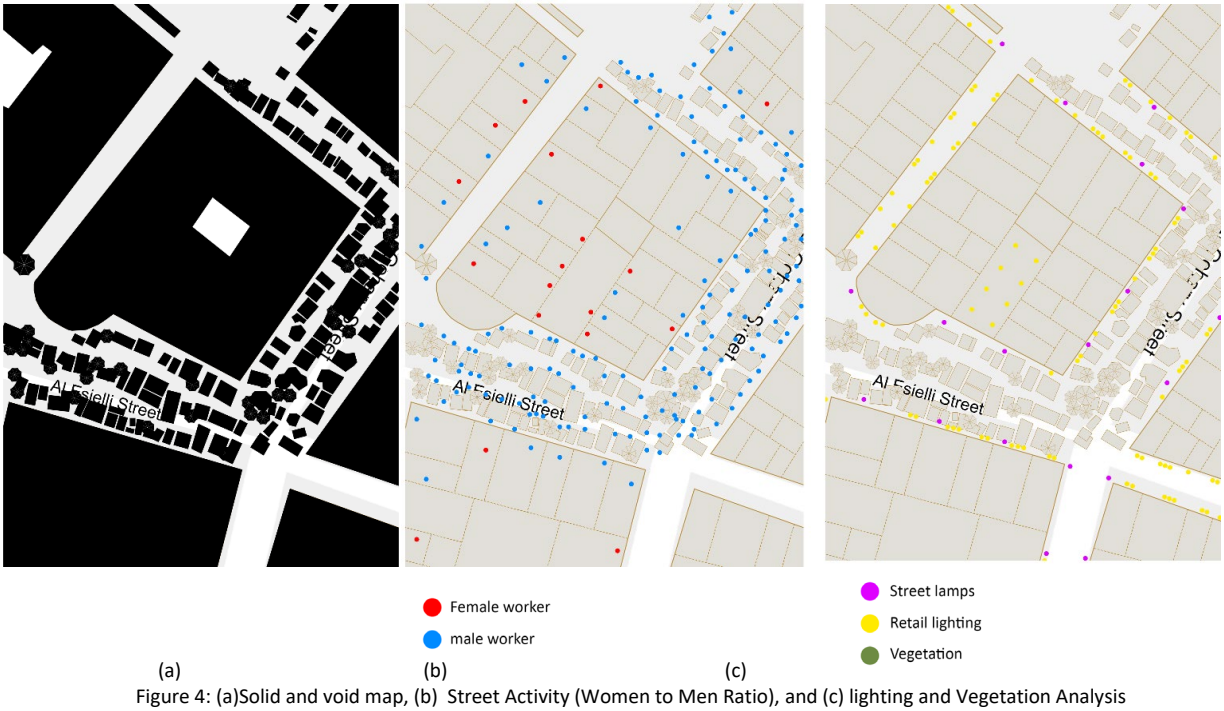


Figure 4: (a)Solid and void map, (b) Street Activity (Women to Men Ratio), and (c) lighting and Vegetation Analysis

4.2 Interviews

Interviews were also conducted to support or deny the observations made from mapping findings qualitatively. The first interview was with one of the women working as a shop assistant on one of the sides of the street. Her name, as well as the rest of the interviewees, shall stay anonymous. She was first asked about the nature of the "Souk" and its working hours. She affirmed that she works in the shop and that everything opens by 8 AM daily. In terms of familiarity with the people working there, she stated that the carts change places daily. The shops are the constants. When asked if women work there, she stated that most of the shops are run by female assistants, "women and girls", but that no woman could work on a cart. "It would tire her. Once the municipality comes, they all run with their luggage. Besides, what woman could handle standing beside all of these men selling and shouting? All passersby giving her comments or violating her space? There is no room to stand, literally". The interviewee hinted at the apparent unsafety of the space for women. Throughout the interview, she had her hands crossed, indicating a protective or defensive stance. She stood at the shop entrance where she had a bit of her own personal space to exist in, instead of going out on the pavement to be violated by passersby.

The second interview was also with a woman running a small watch store on the side of the street. The store must have not exceeded 1.5m by 2m. She stated that she had just started working in the store, and in the area in general, recently. She was not as familiar with the external cart owners or the system but was familiar with the people in nearby shops. The shop she worked in was connected internally with another watch store. When asked if she could spare some time for a brief interview, she was hesitant at first, "The owners of the shop would be mad at me". This indicated a lack of safety and security in the work environment. She also suggested that most of the shops have female assistants and directed me towards a shop nearby to help, proving that it is a spreading phenomenon of women working as shop assistants in the area. She barely leaves the shop, indicating that despite the small space, it is a safer space than the public areas outside. She mentioned, however, that the small area of the shop makes it very uncomfortable to work when a male customer walks in.

The third interview (Fig. 5(a)) was with a woman working in a clothes store for veiled women. She wore very modest clothing and had a brisk walking attitude. She was very dedicated in serving the customers and constantly looked over her shoulders. She, as well, was hesitant to talk at first due to the duty she had to fulfill, that is keep an eye out for the goods and the customers. She explained that theft is widespread and that she was entrusted with goods and had to be very careful. This further shows how unsafe and unpredictable the work environment is, always requiring vigilance and strength. It was evident that getting customers to buy was a very hard task and required full focus and attention to keep them from wandering off to the hundreds of other competition stores and carts. She confirmed much of the same information that the two previous women talked about: how the carts change places daily and the shops are constant, hosting mostly female assistants.

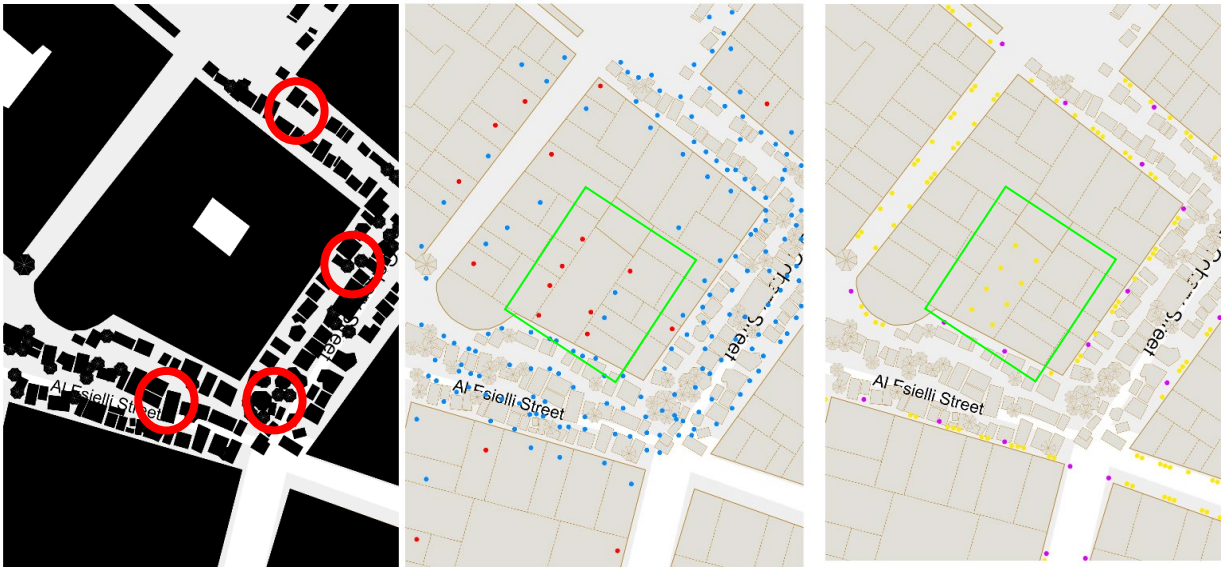
Outside of the street, on the garage pavement, a woman was observed holding a place there to sell drinks and snacks (Fig. 5(b)). When interviewed she was asked about the choice of place, "it is in the shade, and my luggage surrounds me. Not many can trespass that. It feels safer here than outside. I have visibility ahead of me, and Om-Omar (the public toilet's cleaner) beside me to keep me company". She was an older woman, in her 50s perhaps, and she has been hosting that shop for a long time. She did not seem to interact much with the men working in the garage.

Figure 4: (a) space of third interview, (b) space of garage pavement interview

5. DISCUSSION

It is evident from the mapping and interviews that women do not feel safe in Al-Ataba's public space. The first interview exemplifies how female sellers do not feel safe even outside their shops, seeking enclosure and safety in the "legal" parts of the street, instead of putting themselves in a situation where passers can easily invade their space, or instead of burdening themselves with the physical effort to evacuate whenever municipality comes. She confirms the results found in the street activity map that shows how crowded the carts are with male sellers. Female sellers are gravitating towards forming their own private entities. However, the point that reaffirms the hypothesis is that no woman assists as well. They are not present in any capacity due to the violated sense of space. It is noticed that when offered a place with a more private setting, like a shop or the corner of a garage pavement, they tend to feel more comfortable. Having fellow women around, or a more balanced gender ratio also makes a big difference. The clustering of women together while buying or working reaffirms the theory of privatizing space; an attempt towards creating an immediate safe personal space. It is also evident that the narrow "micro-street network" is offering a huge obstacle when it comes to allowing women to be sellers, or even buyers. Obstacles are present in the form of carts and crowds of people present in the way of the narrow "micro-street network" (Fig. 5-a). This can be especially seen in the area highlighted in green (Fig 5-b), where women tend to gather in an enclosure, as far away from the street as possible, while most of the men in the shops tend to be on the peripheries facing the streets. This is also confirmed by the second interviewee.

Furthermore, part of the reason women do not feel safe is because of the occurrence of thefts, which was a point of discussion in the third interview. The widespread theft could be due to the high traffic of people in Al-Ataba; the more people, the fewer people notice if things get stolen.



(a) (b) (c)

Figure 5: Micro-street Network Obstacle, (b) Female Enclosure, (c) Female Enclosure

Moreover, familiarity is also important. The second interviewee mentions that she is familiar with the sellers around her, but not with the sellers outside on the street because of the dynamic nature of the carts. This could be a factor that influences the perception of safety by women in Al-Ataba. Additionally, the 4th interviewee also mentions someone who works close to her and is familiar to her. Additionally, the street activity map along with the street light map further shows how crowded the street is while there is no sufficient lighting in the middle of the wide street, making navigation of the spaces difficult for women at night as well. Also, the crowdedness does decrease the visibility on the streets which is a bad characteristic agreed on here.

Furthermore, according to the interviews, there is an indicated lack of safety in the work environment for women in Al-Ataba. A lack of stability and job security insinuated by their lack of ownership when it comes to what they work in. The importance of shade and shelter from the site conditions and weather factors may be another crucial factor. It was initially hypothesized that a balanced male-to-female ratio in terms of street activity, increased visibility of street in terms of its volume, a decrease in street obstacles, creation of open sighted vegetation, and increased visibility due to proper lighting will show up as positive responses relating to female perception of safety. The mapping and interviews part confirms the hypothesis.

6. RECOMMENDATIONS AND CONCLUSIONS

The main methods used in this study was the mapping of solid and void, street activity and street lights, as well as conducting interviews with women who work in Al-Ataba. The results show that women do not feel safe due to an imbalanced male-to-female ratio in the streets, decreased street obstacles due to crowdedness and improper lighting –which leads to theft–, and the unfamiliarity of sellers on the carts. It is then recommended to the municipality of Cairo that since people are determined to sell on carts, despite it being illegal, the municipality should support the people's needs by managing and organizing Al-Ataba's dynamic outdoor shops instead of illegalizing it. In this way, the aspects of what makes a space safe in terms of foot traffic, obstacles, and lighting, among others, can be monitored and regulated. For example, spaces for the carts and sufficient spaces for people to walk to avoid obstacles can be assigned and designed according to standards. Moreover, shading elements can be provided to sellers since according to the 4th interviewee, she feels safer because of her place under the shade.

The methodology employed in this research is applicable to other dynamic spaces. Even though the mapping occurred in a moment in time, the common trend of the organization of the carts in Al-Ataba was captured. Moreover, interviews were conducted to validate the results found through mapping. Therefore, it is recommended for dynamic spaces that the space should be studied first to foresee any trends before mapping and to support that by conducting interviews or surveys with the people who use that space.

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VERTICAL FARMING AS A NATURE-BASED SOLUTION FOR SUSTAINABLE CITY REGENERATION: A LIFE CYCLE ASSESSMENT

Sara Samir

Cairo University, Egypt
Masters Candidate, sarasamirrr97@gmail.com

Toka Abufarag

The American University in Cairo, Egypt
Research Assistant, tokaabufarag@aucegypt.edu

Sherif Goubran

The American University in Cairo, Egypt
Assistant Professor, sherifg@aucegypt.edu

ABSTRACT

Rapid urbanization coupled with population growth expedites CO2 emissions. Greenhouse gas emissions exacerbate climate change's effects, including temperature rise, water-cycle disruptions, and extreme climate events. The global climate crisis and the economic stresses have resulted in a steady increase in the cost of utilities, which affect agricultural produce prices. To tackle this, researchers have been looking into ways to boost the efficiency of farming practices by increasing their production per unit area through emerging technologies. Vertical farming is an innovation in urban agriculture and is thought to be a solution to solve resource depletion problems. Vertical farms produce large volumes of agricultural products while reducing water usage and are generally resilient to changes in weather conditions. The study analyses a system of vertical hydroponic farms as a nature-based solution in New Cairo, Egypt, by presenting a comparative outcome of the environmental impact and resource efficiency of vertical farming versus traditional farming in terms of land use, water efficiency, and CO2 emissions using the Life Cycle Assessment (LCA) approach. The results show that vertical farms in areas such as New Cairo reduce up to 80% of GHG emissions and 60% of water consumption compared to traditional techniques. Considering the scarcity of agricultural land in urban spaces and the high value of land plots, this research emphasizes the potential of vertical farming as a solution for Egypt's urban areas. The study concludes by proposing recommendations for creating efficient vertical farming systems in hot arid megacities.

Keywords: vertical farming; life cycle assessment; environmental impact; CO2 emissions; agriculture; water scarcity

1. INTRODUCTION

Cities are a significant source of resource consumption and GHG emissions due to rapid population increase and urban activities (Climate Signals Beta,2019). It covers 3% of the earth's surface (United Nations, 2020). They are responsible for more than 70% of all carbon emissions (World Bank, 2020). Urban areas will absorb most of this population increase, continuing the past century's trend of rapid urbanization. About three million individuals take refuge in the cities every week (UN-Habitat, 2009), and by 2050, 68% of the world's population is expected to live in urban areas (United Nations, 2018). At the same time, the consequences of increased Greenhouse Gas (GHG) emissions in the atmosphere are intensifying globally. Cities must achieve net zero emissions by 2050 to avoid global temperature increases of 1.5 ° C or less (IPCC, 2018). To tackle these issues, the UNFCC guidelines urge cities to decarbonize key transboundary supply chains and sequester carbon from the atmosphere through the urban and regional landscapes. Urban areas play an important role in mitigating climate change as existing urban areas contribute approximately 75% of fossil fuel CO2 emissions (The World Resources Institute WRI, 2020). To find possible answers to these critical challenges, revolutionary approaches, such as technological developments, in urban areas are

examined. Vertical farming, such as hydroponics systems, is one of these techniques in urban areas and is thought to be the best solution to both agricultural food problems and climate change and resource depletion issues.

1.1. Vertical Farming Definition

A Vertical Farm belongs to a wide range of urban agriculture techniques. Urban agriculture is the activity of collecting produce in an urban environment in a variety of methods, with the goal of "contributing to resilience by supplying locally produced food and diversifying current food supplies, as well as enabling alternative income possibilities for locals." (Uludere Aragon et al., 2019). Vertical farming represents a new innovation for the emergence of practical solutions in the field of creating interactive urban spaces that perform productive functions and are also important for the leisure and recreation of city dwellers (Zareba, 2021). It increases land use and water and greenhouse gases efficiency of food crop production by expanding the growth of the third dimension: height. Taking this dimension into consideration, plants are stacked on top of one another to get a significantly larger output with a higher grade of plants in a more controlled environment, compared to the existing scenario on the same surface area as traditional agriculture (Kozai, 2018). This maximizes the efficiency of production in terms of land area, environmental conditions, water, energy consumption, and energy production methods. Growing vertically will also reduce cropland expansion, thus reducing global biodiversity loss - by about 75% relative to the business-as-usual scenario (Willett et al., 2019). This research puts forward the assumption that vertical farming will be built on the selected site's building rooftops as it represents a massive area in the site's urban fabric and uses natural lighting for photosynthesis.

Hydroponics is considered One of the well-established types of vertical farming where food grows soilless using mineral nutrient solutions in water. Hydroponics is defined by the Encyclopedia Britannica as "the cultivation of plants in nutritious water regardless of the mechanical support of an impermeable material such as sand or gravel" (Al-Kodmany, 2016). Hydroponics has been identified by experts from the National Aeronautics and Space Administration (NASA) as a viable technology for growing crops in space, such as onions, lettuce and radishes. Therefore, the researchers improved the hydroponic system by increasing its productivity and water efficiency.

1.2. Vertical Farming in Egypt

Egypt faces the same global threat of limited access to natural resources aggravated by population increase, economic growth, and energy poverty. These pressures reduced access to the already scarce resources and the difficult economic situation added to the problem of achieving long-term food security. All of these factors had a strong impact on urban development and planning. Egypt's future urban development plan for 2050 states that over 40% of Egypt's land will be developed to evolve its available natural resources and provide around 20 million jobs (General Organization for Physical Planning, 2013). Egypt is expected to experience a physical water shortage by 2025, with grain production expected to fall by 11% due to water shortages used in irrigation (IFPRI, 2018). Other key concerns that are currently facing Egypt include climate change and the transition toward the zero-carbon era. These concerns have grown since Cairo became the most polluted capital in the middle east and the second most polluted city in the world (The World Health Organization, 2018). Therefore, vertical farming can be considered a solution for the previously mentioned climate, water, and land concerns. Nowadays, vertical farming, and mainly hydroponic systems, are beginning to emerge in the Egyptian market. Consumers looking for affordable, organic, and pesticide-free crops prefer hydroponic products.

1.3. Life Cycle Assessment (LCA)

LCA is a commonly used tool to assess the impact of a product or a process on the local and global environment based on its materials and resources. LCA can identify the life cycle stages that require improvements to achieve a better performance in terms of environmental impacts (Kozai et al., 2016). There are various frameworks for conducting LCA but the most commonly used and globally accepted is the ISO (International Organization of Standardization) standardized LCA framework (Matthews et al., 2015). LCA is based on an iterative process with four steps: goal and scope definition, inventory analysis, impact assessment, and interpretation (Fig.2). Two ISO rules provide general guidelines for the assessment, thereby allowing great flexibility to practitioners, namely: ISO 14040 and ISO 14044 (ISO, 2006).

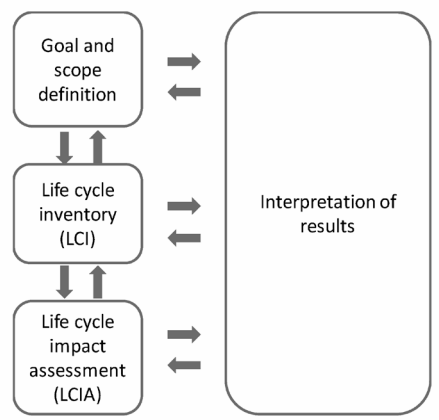

Figure 2: Life cycle assessment framework (ISO 14040-14044)

2. METHODOLOGY

This research aims to identify a theoretical framework of vertical farming in urban areas of hot arid climate regions as an integrated approach to realize sustainable urban development, mitigate the impact of rapid urbanism, and accomplish zero-carbon cities. Furthermore, to conduct a comparative life cycle assessment (LCA) for the present, the environmental impact of vertical farming technology, and a traditional agricultural approach in terms of land use, water consumption, and CO2 emissions. It examines the role of vertical farming in planning zero-carbon cities and in alleviating the ills of rapid urbanization. The results will provide landscape architects and urban planners with insights to strategically adjust vertical farming practices in the context of global climate change. This is important since vertical farming engages multiple disciplines of natural sciences, architecture, and engineering and affects both people and the environment.

This study analyzes a fictional urban vertical farm in New Cairo located on the southeastern edge of Cairo governorate, Egypt. It is one of the new cities built in and around Cairo to relieve congestion in the downtown area. All the inhabitants (100%) of the government live in urban areas (CAPMAS, 2022). The fictive vertical farm is adapted to the climate and site and can therefore be used in a comparison with rural agricultural data related to this hot arid climate. The farm harvests tomatoes as it is the first crop harvest among vegetables and represents 28% of the total agricultural production in Egypt with 6.75 million tons in 2019 alone (FAO, 2021). The question arises on whether vertical farming can be considered a suitable technology for reducing CO2 emissions and water resources in the hot arid climate in terms of environmental sustainability.

The main goal of this paper is to conduct a comparative LCA on the environmental impact of locally grown vegetables (tomato) in vertical farms versus using traditional agriculture methods in the hot arid climate and to find out whether vertical farming could be feasible technology for decreasing CO2 emissions and growing crops primarily for human food. The objective of this LCA is to compare the use of land, water, and CO2 emissions of a vertical farm with traditional methods of cultivation in this climate. Based on the background data gathered from relevant studies, environmental impacts are assessed through multiple environmental impact indicators, and in the end, the results are compared. This study was conducted in accordance with ISO 14044 (2006), which defines the requirements and guidelines for performing LCA. The study is conducted using a cradle-to-gate approach, taking into account only the environmental impacts caused by the operation phase (Fig.3). During the operational phase, this strategy involves the production of input energy and the use of water, fertilizers, and materials.

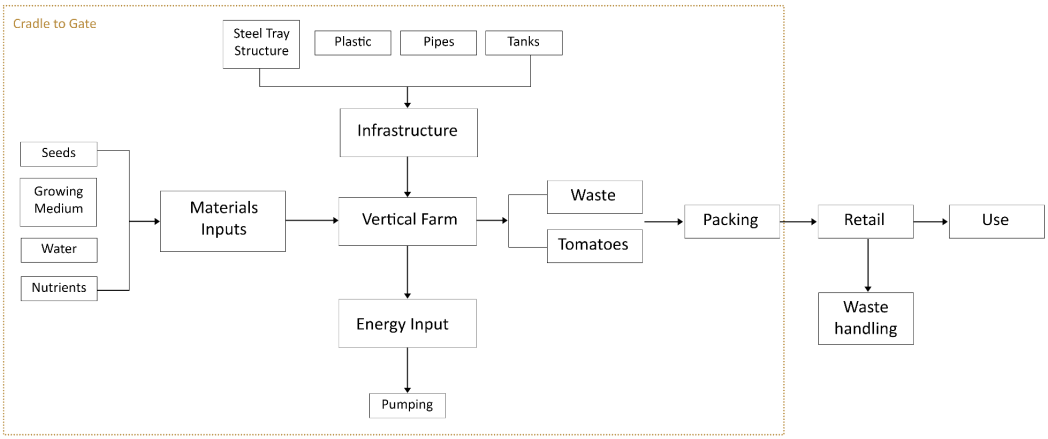

Figure 3: System boundary for the life cycle assessment of a vertical farm including the inputs and outputs of the system

This study is created using OpenLCA 1.11.0 software, an influential Life Cycle Assessment engine for product sustainability (GreenDelta, Germany). The characterization factors were extracted from the agriballyse database, which is integrated into the openLCA software. Inventory data was imported to the openLCA software to perform LCA. The impacts were calculated with the ReCiPe 2016 Midpoint (H) method. This method uses midpoint-to-endpoint calculations with characterization factors. Midpoint indicators focus on single environmental problems, for example, climate change or acidification. Endpoint indicators show the environmental impact on three higher aggregation levels (Huijbregts, et al., 2016). According to the guidelines of ISO 14040 and ISO 14044, the selection of impact categories and categorization is a mandatory step in the life cycle impact assessment. Choosing an appropriate system boundary allows emissions from direct and indirect inputs and even downstream processes to be accurately estimated. The indicators were selected based on their relevance to the built environment. Therefore, this study focuses on the environmental impacts of vertical farming in terms of climate change or Global Warming Potential (GWP) measured in CO2-equivalents, the Water Footprint (WFP) as it is determined only for the cultivation process. The water used for the construction of the facility and the water used during and after transport is excluded. Finally, the Land Use or the Land Footprint (LU/LF) is a measurement of the required area in m^2. The functional unit is selected to be (1 kg) of fresh tomatoes.

Due to the limited amount of available data, the data used in this study are referenced and collected from scientific studies that discuss the efficiency of vertical farming. The plants were grown in polystyrene plastic pots with a growing medium. The water consumption per kilo of tomato is 10 liters in hydroponics with recirculation of the drains (Kooten, 2008). According to (Kroggel, 2018) and (Hochmuth, 2008) nutrients will be neglected due to their low abundance in hydroponic tomato cultivation. The required infrastructure was included in the assessment (with different assumptions about the service life). Post-purchase transport and waste treatment were not included in the assessment and they are out of the scope of this paper. All material inputs were assumed to be installed within a 50 km radius for all infrastructure components and other fasteners as the site is located in New Cairo, Egypt. 50 km is the average distance from each industrial area to the site chosen in New Cairo. However, since the culture medium and packaging are locally sourced, the transportation distance was assumed to be 30 km. Tomato packaging and post-consumer waste handling were excluded from the study.

Table 1: Life Cycle Inventory Analysis table

Category	*Process/Flow*	*Amount (annually)*	*Unit*	*Transport Distance (KM)*
Infrastructure	*Tray (Polystyrene)*	*50*	*kg*	*50*
	Plate (Polyethylene)	*20*	*kg*	*50*
	Pipes (Polyethylene)	*15*	*kg*	*50*
	Water Tank	*65*	*kg*	*50*
	Pump	*7*	*kg*	*50*
Materials Inputs	*Seeds*	*1200*	*Number of seeds*	*30*
	Nutrients (N)	*-*	*kg*	*-*
	Phosphate (P)	*-*	*kg*	*-*
	Potassium (K)	*-*	*kg*	*-*
	Water	*80,000*	*litres*	*-*
Transportation	*Material Inputs (Truck)*	*30*	*tonne.km*	*-*
	Land transport of plants	*6*	*tonne.km*	*-*
Outputs	*Plants*	*4104*	*kg*	*-*
	Waste Handling	*216*	*kg*	*-*

3. RESULTS

A LCA of 1 kg of fresh tomato was performed, and the results for the three different impact categories were compared with traditional agriculture in the discussion section.

3.1. Global Warming Potential (GWP)

This category comprises greenhouse gas emissions in kg which cause a greater environmental amount of greenhouse gases that in turn increase the radiative forcing capacity resulting in an increase in the global average temperature which eventually leads to climate change (Steinmann, 2016). The GHG emissions formula calculates the amount of CO2 equivalents produced by producing one tonne of material. The result shows that one kilogram of hydroponic tomatoes produces (0.157 kg CO2 eq.). As shown in Table 2, the system infastructure produces 40% of the total GHG emissions of hydroponic tomatoes.

Table 2: The amount of GHG (kg CO2eq.) emissions concerning production inputs

Inputs	*Infrastructure*	*Material Inputs*	*Transportation*	*Others*	*Total GHG*
Tomato	*0.115*	*0.034*	*0.004*	*0.004*	*0.157*

3.2. Water Footprint (WFP)

Based on the literature review, vertical farms are assumed to be closed systems in terms of water use. Thus, the water use efficiency is the theoretical maximum efficiency, 100%. Water consumption consumed per one kilogram of hydroponic tomato is 10 liters. Using the ReCiPe 2016 Midpoint (H) method, the Water Footprint can be calculated. This classification calculates "the consumption of water based on the water dissipated, integrated in the goods, moved to other areas or discharged into the sea". For example, the water that has been used no longer seems viable in terms of production for people or habitats. "(Fazio, 2018; Verones & Huijbregts, 2016). The calculation reveals that the Water Footprint impact of one kilo of hydroponic tomato is (0.024 m^3/kg).

3.3. Land Footprint (LF)

With the use of the ReCiPe 2016 Midpoint (H) method, the Land Footprint can be calculated. This category calculates “the sum of the area of land occupation and the transformation of land for production of the product” (including all sublayers of resource production and use). (Benini, Castellani, Vidal-Legaz, De Laurentiis, & Pant, 2019) This is a midpoint calculation method. The endpoint indicators would have generally focused on the damage caused by land use and land use change to biodiversity, which would make it difficult to compare it to rural agriculture as very few researchers have studied this relation. (De Baan, Alkemade, & Koellner, 2013; Souza, Teixeira, & Ostermann, 2015).

(0.005 m^2 crop eq.).

4. DISCUSSION

The study compares the environmental impacts of both the LCA model findings and previous studies on rural tomato agriculture. This comparison provides significant data on the practicality of the vertical farming concept, as it both validates the truth of the promises made about vertical farming and demonstrates the limitations of rural agriculture approaches. Even though rural agriculture is one of the oldest forms of food production, the amount of Life Cycle Analysis studies is limited, especially with assessing only tomato production.

According to Abdelkader (2022) tomatoes produced an amount of GHG (3742 kg CO_2 eq. ha^{-1}) emissions in Southern Egypt. GHG emissions were generated for producing one ton of tomato 940.6 kg. Secondly, according to Almeida (2014), each kilogram (kg) of fresh tomatoes produced in the current greenhouse emits 2.28 kg CO2 equivalents (eq) and uses 122 liters (L) of water. Third, according to Page (2012), the carbon and water footprint of each kilogram of fresh tomato delivered to Sydney varies by season and production system. The carbon footprint varies between 0.39 and 1.97 kg CO2e, while the water footprint varies between 5 and 53 liters per kilogram. According to Eshun (2011), 8,544 kg CO_2-equivalents of greenhouse gas were emitted per hectare of tomato production in Ghana.

Table 3: Comparison data, extracted and converted to fit the functional unit of 1 kg of tomato

Source	*Model Results*	*Abdelkader, 2022*	*Almeida, 2014*	*Page, 2012*	*Eshun, 2011*
General Information					
Type	*Vertical farm*	*Open field*	*Greenhouse*	*Greenhouse*	*Open field*
Location	*New Cairo, Egypt*	*Sohag Governorate, Southern Egypt*	*Northern Italy*	*Sydney, Australia*	*Navrongo , Ghana*
Irrigation	*Hydroponics*	*furrow and flood methods*	*Drip irrigation*	*Drip irrigation*	*Drip irrigation*
LCA Information					
Scope	*Cradle to gate*	*Cradle to gate*	*Cradle to gate*	*Cradle to grave*	*Cradle to gate*
Program Used	*OpenLCA 1.11.0*	*OpenLCA 1.10.3, CROPWAT 8.0 program*	*Simapro software*	*Simapro software*	*Excel, scientific equations*
Data Source	*Research, papers, environmental databases, OpenLCA databases*	*Researches, surveys, face-to-face questionnaire, CLIMWAT 2.0 database*	*Ecoinvent*	*Research, environmental database, agricultural studies*	*Tono irrigation project as a case study, interviews, researches*
Indicators	*ReCiPe 2016 Midpoint (H)*	*CML2 baseline V3.04/EU25, ReCiPe 2016 Midpoint (H)*	*IPCC 2007, CED; v.1.05*	*WUE, ReCiPe Endpoint*	*IPCC 2006*
Environmental Impacts					
GWP (kg CO2 eq.)	*0.157*	*0.374*	*2.28*	*0.39 - 1.97*	*0.8544*
WFP (m^3/kg)	*0.024*	*-*	*0.122*	*0.005 - 0.053*	*-*

Table 3 shows a clear difference between the results of the examined model using vertical farming techniques and the results from the literature on traditional farming methods. The climate change impact of an open field or greenhouse agriculture is higher than vertical hydroponic farms due to the number of nutrients and transport variables. In the meanwhile, the greenhouse shows the highest environmental impact on the GWP due to energy use. Previous studies have argued that the hydroponic vertical farm guarantees low water consumption. In the table above, this is also clearly visible as the vertical farm has a water footprint of 0.024 m3 water/kg of fresh tomatoes. At the same time, greenhouses and open field crops use twice as much water in most cases due to the old irrigation techniques. The land footprint contains one of the most commonly used claims to support vertical farming from various sources due to the numerous cultivation plans on the same acreage. Compared to traditional agriculture, vertical farming uses more than 70% less land because 1 m² contains 11 seeds in traditional farming, while vertical farming can contain up to 33 seeds per m².

5. CONCLUSION

The aim of the study was to analyze the difference in greenhouse gas emissions and water consumption between the vertical farming method and traditional methods. Life cycle assessment was used to simulate vertical farming, and the literature provided previously collected data regarding traditional methods. The study was aimed at hot arid climates to simulate Egypt's urban conditions. Results demonstrated as environmental impacts, clearly show a significant gap between the GWP (kg CO2 eq.) and WFP (m3/kg) of the two methods. Vertical farms use significantly

less water and have a better environmental impact on global warming. Thus, we see it fit that urban designers, architects, and business owners incorporate this method when setting out projects. Traditional farms use valuable space and consume more resources while also emitting more greenhouse gases. According to this study, vertical farming offers a good solution to combat this issue. Vertical farming can replace whole farms, divisions in food-production manufacturers, as well as rooftop farms for sustainable house-owners who want to grow their own produce. The scope of this study covered the cycle between materials to production. Further studies are recommended to further understand the environmental impact of packaging and retail handling.

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IMPLEMENTATION OF ICT TOOLS IN URBAN DEVELOPMENT DECISION-MAKING PROCESSES: EXPERIENCE OF THE (SMART) CITY OF BELGRADE

Vesna Teofilović

Faculty of Architecture University of Belgrade, Serbia
PhD student, vesna.vladi@gmail.com

Ksenija Radovanović

Faculty of Architecture University of Belgrade, Serbia
PhD student, radovanovic.ksenija@gmail.com

Eva Vaništa Lazarević

Faculty of Architecture University of Belgrade, Serbia
PhD., Full Professor, eva@arh.bg.ac.rs

Jelena Marić

Faculty of Architecture University of Belgrade, Serbia
PhD., Associate Professor, jelena.maric@arh.bg.ac.rs

ABSTRACT

Information and communication technologies (ICT) have paved the way for the modern digital revolution to enter all levels and areas of society, including the urban development processes. In shaping the urban policies these tendencies are recognized as the smart city concept, which is expected to contribute greatly to the democratization of the decision-making process. Throughout various policy documents of the City of Belgrade the smart city concept is promoted as a tool for improvement of the overall sustainability of the city. Special focus is set on the improvement of existing and the application of new forms of citizen participation in urban development processes as benchmarks for achieving the primary goal of social inclusion and the rights of citizens to participate in the shaping of (urban) policy. This paper explores the possibilities of e-Participation in the formulation and implementation of decisions relevant to urban development, as well as the challenges of implementing the smart city concept at the level of detailed urban planning. The methodological approach is focused on positioning the smart city concept in City of Belgrade urban policies and positioning of e-Participation within this larger framework. The analysis of specific examples from Belgrade practice is aiming to provide insight into the way, manner and scope of applying digital tools in the processes of spatial and urban planning. In the final discussion, we tackle the main weaknesses and advantages of the use of digital tools in the decision-making processes of urban development, as well as possible guidelines for improvement.

Keywords: *urban development; smart city; ICT; e-participation; policy.*

1. INTRODUCTION

The digital era brings technological and developmental innovations and transforms modern society, and thus the urban development of cities, in an extremely dynamic, fast and hitherto unknown way. Understanding the essence of changes, using their full potential and adapting the planning system to modern tendencies is of crucial importance for the urban development of cities. In this regard, the main goal of this research is to shed light on the relationship between the strategic determinations of the city's urban development according to the principles of the smart city concept and the realistic scope of their implementation in urban practice. The

applied research methods include the identification of the basic principles of the *smart city* and the analysis of the position of participation within this concept, the analysis of the similarities and differences of participation and e-participation, the analysis of the concept of the smart city in the public urban policies of Belgrade, as well as the analysis of application of ICT tools in the contemporary urban planning practice of Belgrade based on three recent examples. The main results of the research include the identification of the basic settings of the smart city concept in public urban policies and the current overview of the situation with insights into the way, manner and scope of the application of ICT tools in the processes of planning, participation and decision-making in planning practice, and as such, represent the starting point for work on further improvement of this process. The research indicates a slight progress related to the technological aspect of the application of ICT tools in participation processes, while there is almost no progress at the decision-making level. For the full implementation of the smart city concept, further refinement of public policies is needed through a holistic, not only technological approach. Analysis of the implementation of the concept in urban planning practice indicates numerous weaknesses, which is why the first and necessary steps would be the establishment of clear procedures, transparency and democratization of this process.

2. FROM THE SMART CITY CONCEPT TO E-PARTICIPATION

2.1. The smart city concept

Numerous studies of the relationships and interdependence of city development, the use of ICT tools and the smart city concept first appeared in the last decade of the 20th century in parallel with the increasingly intensive development of digital technologies, and the term smart city itself originally referred to the use of information and communication technologies in the development of cities (Čolić Damjanović et al., 2016; Milovanović Rodić et al., 2021; Milošević, 2022). The contemporary perception of the smart city concept has significantly moved away from the initial narrow perception through the use of technologies and focused on a holistic approach to the development of cities through increasing efficiency, competitiveness, attractiveness, safety and security, economic and ecological sustainability and improving the quality of life for its citizens and the community (Čolić Damjanović et al., 2016). In this sense, a smart city is seen as an ecosystem of smart solutions in which actors and stakeholders dedicated to sustainable development are gathered and in which new technologies are used to achieve the goals of sustainable development (Palgo smart, 2021). According to the European Commission (EC, 2022), smart cities are those that use technological solutions to improve the management and efficiency of the urban environment, but here it is also emphasized that a smart city must go beyond a simplified view of the concept from the use of technology, towards better resource management, reduction of harmful emissions and meeting the needs of the population. On the other hand, it is illusory to expect that digital technology by itself will contribute to the development of smart cities without engaging crucial actors, developing the most suitable methodologies in all other social spheres and increasing the democracy of society. Focusing only on the digital-technological aspect of a smart city represents a serious threat to the development of the entire concept and may cause failure in its implementation (Le Blanc, 2020). However, the degree of digitization of society and the willingness and ability of society to apply ICT tools in the service of its overall benefit, urban development included, still represent a fundamental prerequisite for the implementation of the smart city concept in urban development policies.

2.2. Characteristics of the smart city model with a position of participation in the decision-making process

In order to see the position of participation in decision-making within the concept of a smart city, we will rely on the smart city model presented in the research from 2016 by Čolić Damjanović et al., which is based on the European model of smart cities (ESC, 2007, 2015) and was used during the development of the smart management model within the strategic settings of the development of Belgrade. According to Čolić Damjanović and a group of authors (2016), the key features of the smart city model are: smart management, smart economy, smart environment, smart living, smart people and smart mobility. The main purpose and goal of smart management is participation, i.e. starting a process for the inclusion and participation of citizens in key topics of public importance, as well as the use of ICT, while some of the main factors of smart management are: (1) political strategies and perspectives - refers to the establishment of visions and plans for future development, different levels of management and their improvement and directing further development towards smart management policies that are both sustainable and adaptable; (2) transparent management - it is crucial for effective administration and the legislative process, as well as for the provision of accurate and

reliable data and information and the proactive participation of interested parties in decision-making processes; (3) participation in decision- making - using primarily e-Participation ensures the active and individual involvement of citizens in decision-making processes on relevant public topics; and (4) public and social services (ICT and e-government) - refers to the possibility of obtaining general and individual information for various public services through digital technologies, they represent an important technical tool of the smart city concept. This model looks at the position of participation in the concept of a smart city as a part of the segment of smart management, that is, the relationship smart city - smart management - participation - participation in the decision-making process is identified. In this sense, participation, i.e. e-Participation is a branch of smart administration with a special focus on the engagement of citizens in deliberation and decision-making processes (Le Blanc, 2020). Based on this model, it is clear that smart governance is not just placing public services in the digital space and improving their delivery, but rather a set of processes mediated by digital technology that have the potential to improve the overall quality of policy and decision-making and enable wider interactions between citizens and administration (EC, 2009). Public participation in the provision of public services and their direct participation in decision-making in a transparent process are some of the key elements of smart management (Čolić Damjanović et al., 2016; Le Blanc, 2020).

2.3. Participation and e-Participation in urban planning

The concept of public participation or participation in urban planning has numerous definitions independent of the concept of a smart city, but it can be summarized as a democratic procedure based on the principle that everyone who has an interest or can suffer a certain impact from a certain planning decision on a spatial or urban plan must have the right and the opportunity to be actively involved in the processes of preparing, developing and deliberating on the provisions of the planning document, so that the plan itself has full legitimacy (Stojkov et al., 2015). Observed through the prism of power in deciding on the urban development of cities, participation can be linked to civic power in the process of urban planning (Milošević, 2022). Participation puts the user in focus and further enables his participation in the planning process with the aim of more successful implementation of planning solutions and the use of urban space (Milošević, 2022). Depending on the degree of democracy of the society, the positive aspects of public participation in the decision-making process in urban planning are recognized through the improvement of the quality of decision-making, strengthening of democracy in society, respect for the moral code of planners, familiarization with the social context in which planning is carried out, building trust in the relationship between citizens and administration, reliability of implementation of the plan, better information of planners and the public, improvement of the sense of civil belonging and recognition of the value system of the local community, while serious challenges are identified as legal restrictions, financial, personnel and bureaucratic barriers, opposition of laic and technocratic attitudes in planning (Stojkov et al., 2015). Definitions of e-Participation found in academic and professional literature also vary, but most of them are based on the basic concept of using information and communication technologies (ICT) to involve citizens in decision-making processes and the provision of public services (Tambouris et al., 2007; Le Blanc, 2020; Milošević, 2022). It is considered that the interaction between citizens, public administration and decision-makers is key for the process of e-Participation and that the absence of any of the components of this triangle indicates the absence of e-Participation, in other words, articulation with formal institutional processes is key for this process (Le Blanc, 2020). There are several researched levels and scales of citizen participation in the decision-making process (Milošević, 2022), but according to Tambouris et al. (2007), based on a comprehensive overview, the process of e-participation includes five levels: (1) e-Information, which refers to a one-way online channel that enables citizens to be informed; (2) e-Consulting which is a limited two-way channel aimed at gathering feedback and alternatives; (3) e-Inclusion, which refers to working with online actors to understand and take into account public concerns; (4) e-Collaboration, which represents an improved two-way cooperation between citizens and the administration, in which citizens actively participate in the development of alternatives and the selection of preferred solutions; and (5) e-Empowerment that facilitates the transfer of influence, control and creation of public policies to the public. The level of participation achieved in society is determined by the level of development and democracy of the society itself, and the highest level is the substantive public participation in decision-making. Bearing in mind the above, traditional participation is seen as a one-way, mostly formal, poorly effective process of an informative nature that makes it difficult, or even impossible, to conduct a public dialogue between actors of different interests, motives, capacities and powers (Stojkov et al., 2015; Milovanović Rodić et al., 2021; Milošević, 2022). In this sense, it represents a passive form of participation that satisfies the lower levels of the participatory process and requires a dedicated improvement in order to

become more purposeful (Milošević, 2022). Although the key difference between traditional participation and e-Participation is the mediation of ICT tools in the participation of citizens in this process, as a result, e-Participation transforms and improves traditional participation by opening the possibility for two-way communication at all levels between citizens and administration, which increases the chances of a participatory process towards transparency, democracy and essential participation of citizens in decision-making (Tambouris et al., 2007; Milošević, 2022).

3. THE SMART CITY CONCEPT IN PUBLIC URBAN POLICIES OF BELGRADE

The basic document of urban development in Serbia is the Sustainable Urban Development Strategy, which was first adopted by the Assembly of the Republic of Serbia in 2019 in accordance with the needs of planning the urban space, solving urban development problems and with the regard to the potentials that urban settlements carry as generators of development activities. The smart city concept is not explicitly singled out as a strategic commitment of urban development, but a commitment to digitization and development of communication platforms as instruments of urban development is expressed, with special promotion of ICT tools in urban and spatial planning and participatory and communication processes. Digital transition represents one of the 12 priority topics of the EU Urban Agenda, on which the Strategy relies, with a focus on better collection, use and management of data and accessibility of digital services. The strategy recognizes the need to improve existing participation with the aim of achieving a balance of interests of various stakeholders in planning the urban development. The City of Belgrade Development Strategy traditionally represents an umbrella strategic development document that defines development goals and priorities by areas up to a set time frame, along with defining the responsibilities of key actors and indicators for monitoring the success of their implementation. Currently, Belgrade is in an unenviable situation in terms of strategic development documents, considering that the validity of the City of Belgrade Development Strategy until 2021 (hereinafter: Strategy 2021) has expired, and that the new is in the draft phase and has not been adopted to date. According to Damjanović et al. (2017), the main ambition of the Strategy 2021 was to fit into European development priorities and principles, so the inclusion of the smart city concept was one of the innovations of this document. In this regard, the strategic commitment to the principles of the smart city concept is reflected in setting a vision for the development of the city of Belgrade as a competitive, sustainable and smart city dedicated to improving the quality of life of its citizens, which is generally planned through minimal waste of resources and maximum use of ICT. One of the main strategic goals of this document is smart management that ensures quality, efficient and effective provision of services to all users. In order to achieve the established goal, the priorities and measures of the five-year implementation of the Strategy were set, which include transparency, user participation, involvement of all interested parties, direct communication between authorities and citizens, and early involvement of the public in planning processes (Damjanović et al., 2017). The draft Strategy until 2027, which was presented for public discussion in February 2022, set a somewhat different vision of the development of Belgrade as a comfortable, competitive, safe, open and sustainable city, without an explicit visionary commitment to a smart city. However, this document expresses the determination towards the implementation of the smart city concept within one of the strategic development priorities related to the planning and development of a sustainable city and urban infrastructure, as its development goal, which is realized through the following measures: the establishment of a city center for monitoring and coordination of all components of city development, development of innovative models of city planning and application of the concept of polycentric growth and development of the city. In the domain of inclusion and participation, as also one of the set priority goals of city development, a strategic commitment was expressed that everyone must have a way and the opportunity to propose, support or oppose some direction of a project or initiative of city development, either through traditional or e-Participation. Based on the insight into the strategic determinations of the city's development, it is noticeable that the smart city concept is reduced to the use of information and communication technologies in order to optimize the use of city services. Focusing only on the digital aspect prevents a holistic approach to the urban development of the city, which is the primary goal of the smart city concept.

4. ANALYSIS OF THE APPLICATION OF ICT TOOLS IN MODERN URBAN PRACTICE OF BELGRADE

4.1. Deciding on the future of the Old Sava Bridge

Citizens are invited to decide on the potential locations where the steel arch structure of the 'tram' bridge over the Sava River could be moved by taking part in online polls organized twice, in 2017 and 2019. Both

surveys were organized through the 'Beokom service', that was launched in 2016 by the City Administration as a step towards the fulfilment of the strategy of the City of Belgrade, which refers to the opening of digital channels and greater participation of citizens in making decisions concerning the functioning of the city (Beoinfo, 2016). Although the online polls used to decide on the future of the Old Sava bridge were not organized as part of the process of creating a planning document, this example was included in the research precisely because of the intention to use the results of the poll to change the planning solutions previously established through a legally prescribed participatory process (Spatial Plan of the Area special purposes of arranging part of the waterfront of the City of Belgrade - the area along the Sava River for the project "Belgrade on Water", 2015). As part of the first online survey published on July 21, 2017, citizens had the opportunity to propose locations for moving the bridge structure and vote for one of the already proposed locations (Blic, 2017a). Although the interim results of the survey were released to the public in the following days (Blic, 2017a; Blic, 2017b), the completion of the survey, or the final result, was never announced (Petrušić, 2020). As part of the second survey, organized in the period from October 25 to December 15, 2019, citizens chose between two locations, i.e. two projects. Only one of the two offered locations was listed as a 'winning' location in a survey organized 2 years earlier (Blic, 2017a). The second offered option envisaged that the arch structure of the Old Sava Bridge would be moved to dry land, in the Park of Friendship – Ušće (Park prijateljstva - Ušće), where it would have the combined purpose of a sculpture filled with cultural, commercial and similar contents (Beokom, 2019). Apart from the fact that it was not previously mentioned in public (Radojčić, 2019), this kind of intervention in the area of the protected Friendship Park was not foreseen by the Plan for the detailed regulation of multifunctional sports and cultural content in the area of the 'Park of Friendship' - Ušće (hereinafter: PDR Ušće), adopted several months before the opening of the second survey (PDR Ušće, 2019). During the duration of the second poll, doubts about the regularity and objectives of the vote were expressed in the public, first prompted by the statement of the representative of the City Administration who announced the winning decision two weeks before the start of the poll (Miletić, 2019). The source of citizens' anxiety was also an uncharacteristic jump in the number of votes during one weekend when about 4000 of the total 6290 final participants of the survey voted (Radojčić, 2019) and when the future winning solution took the lead, which it held until the end of the vote (Nikoletić, 2019). To date, no changes have been made to the Ušće PDR.

4.2. Use of ICT tools during the development of GUP Belgrade 2041

The development of the General Urban Plan of Belgrade 2041 began in 2019 (Decision, 2019), and the early public inspection (EPI) regarding the development of this plan was published on June 13, 2022. During the preparation of the report for the Regional Planning and Development Plan, the Urban Planning Institute of Belgrade, the processor of the planning document organized a survey called 'Towards Belgrade 2041: Initial Survey' (hereinafter: Initial Survey) with the aim of involving the wider public, with the goal that the questions were asked in such a way as to 'inspire in the direction of further searches for important topics, and not to determine decisions for concrete solutions' (Urban Planning Institute of Belgrade, 2021). The survey was opened on March 24, 2021, on the website of the Urban Planning Institute of Belgrade (2021), and the notice of its holding was placed on the websites of numerous institutions, authorities and organizations, as well as through the media. The survey was organized as electronic and anonymous, and was designed as a series of 22 mostly closed questions with an indication that it takes 10 minutes to complete. The results of the survey were presented along with the announcement about the start of the early public inspection of the GUP 2041 in an integral form, without special interpretation or clearly presented links to the solutions included in the concept of the planning document. The official announcement of the results included the comment that 'the coverage of citizens was not satisfactory' (Urban Planning Institute of Belgrade, 2022), considering that the survey was completed by 2298 citizens, i.e. about 0.6% of the population living in the area covered by the plan (Urban Planning Institute of Belgrade, 2022). On the day of July 2, 2022, the survey has the status of an active survey, and the number of respondents is 2304, which indicates that four respondents entered their answers after the overview was done by the processor (Urban Planning Institute of Belgrade, 2022). According to the results of the survey, the average time required for filling the survey, calculated for all 2304 respondents was 22 minutes. At the beginning of the EPI, another survey was organized under the name 'GUP of Belgrade until 2041 - Towards public dialogue in the course of early public inspection'. This survey was also organized as electronic and anonymous, with mostly closed questions, with an increase in the number of questions to 72 and an increase in the estimated time required to 30 minutes. The implementation of the new survey was announced as part of the announcement on the holding of the EPI on the website of the Urban Planning Institute of Belgrade, but not as part of the announcement on the holding of the EPI on the website of the City

Administration of the City of Belgrade. The goal of the new survey was to 'observe the views and opinions of citizens in relation to key development issues for which there are multiple opportunities and directions of development' in a 'quick and simple way' (Urban Planning Institute of Belgrade, 2022). Although the title of the survey suggested that it would be available for completion only during the EPI (June 13-30), the survey was 'unlocked' even after the end of the early public inspection. As of July 2, 2022, the survey has the status of an active survey, the number of respondents is 439, while the average time required to complete the survey is almost 1 hour and 25 minutes. A large number of questions and their complexity are possible causes of a low level of participation and an additional drop in the response of citizens to filling in the two online surveys organized during the previous stages of the preparation of the GUP 2041. Assessments of the expediency of participation in the survey may also be associated with the uncertainty regarding the duration of both surveys, i.e. the fact that both surveys were open for filling even after the indicated period of data processing (Initial survey) or after the end of the early public inspection (survey Towards public dialogue during early public inspection).

4.3. Participation in the planning of the 'Linear Park' project

The 'Linear Park' project was announced as the construction of a green corridor on part of the route of the relocated railway line, from the Concrete Hall (Beton hala) to the Pančevo Bridge, 4.6 kilometers long. Promoted as one of the city's most important projects, the future 'multipurpose oasis for rest and entertainment that will replace the railway and spontaneously erected buildings' was conceived on the model of New York's 'High Line', and the value of the investment was estimated at 55 -60 million euros (Mučibabić, 2022). In November 2019, the Secretariat for Environmental Protection of the City of Belgrade and the Center for Experiments and Urban Studies - CEUS started a series of partnership activities in support of the development of the Detailed Regulation Plan for the Linear Park (hereinafter: DRP for the 'Linear Park' project) (CEUS , 2020) within the international research and development project 'CLEVER Cities - Co-designing Locally tailored Ecological solutions for Value added, socially inclusive Regeneration in Cities'), financed by the European Commission through the Horizon 2020 framework (CEUS, n.d). This cooperation between the public and civil sectors was formalized through the establishment of the Working Group for the implementation of the 'Smart Cities' project, which was formed by the decision of the Mayor of Belgrade (Mayor of Belgrade, 2019), and numerous representatives of competent public sector institutions participated in its work, including representatives of the service chief urban planner, i.e. President of the Commission for Plans of the Belgrade City Assembly. The activities within the Smart Cities project included a series of events, public or those limited to representatives of individual stakeholders, which were held in parallel with the procedure of developing the DRP for the 'Linear Park' project. The partnership between the public and civil sectors in the preparation of this planning document was promoted as 'the first attempt to systematically involve experts and the general public in the process of creating an urban plan' (Mitić-Radulović, 2021). The number of organized activities, the use of different analog and digital formats of participation, the transparency of the process and the detail in the reporting really meant significant progress in relation to the minimal framework prescribed by law for the inclusion of citizens in the process of drafting planning documents (Radovanović et al., 2022), especially considering that the period of implementation of activities on the preparation of this DRP was the period of the outbreak of the Covid-19 virus epidemic. A detailed overview of the event can be found at the CEUS (Belgrade living urban laboratory - bellab.rs) website. However, even this organized process was exposed to criticism, both by the general public and by the partner organization of civil society (CEUS). The content of the remarks of CEUS (Clever Cities, 2021) and the adopted DRP for the 'Linear park' project (2021) show that the organized participatory process did not enable the essential influence of citizens on decision-making on some of the key aspects of the 'Linear park' project, which reinforced the suspicion that the purpose of such an organized participatory process was to legitimize the use of public resources for the purposes of increasing the value of private sector investments (Dević, 2021) and privatization of the coast (Jovanović and Tešić, 2021; Novaković, 2021). The general public criticized the coverage of the actors involved in the process, i.e. the apparent absence of public involvement of representatives of the private sector investors of numerous luxury housing projects planned along the route of the "Linear park" projects, as well as the absence of an explanation of their influence on the development of the planning document and the benefits of the project itself (Dević, 2021). The insufficient coverage of participation was highlighted as a basis for self-criticism, but now in the context of recognizing that a part of the later critical public completely refrained from participating in the participation process organized in the way explained in this section (Mitić-Radulović, 2021).

5. FINAL CONSIDERATIONS

The application of ICT tools in decision-making processes in urban planning can be considered a significant step forward in relation to the existing minimum legal framework for participation, which does not establish an explicit obligation for their application. However, the described examples indicate that in current practice in Belgrade, these tools are used with considerable arbitrariness in the design of the e-Participation process, i.e. in the way of data collection and processing, communication of results and their implementation in planning solutions, and open the question of the desired goal of applying ICT tools in the urban planning procedures. In the case of deciding the future of the Old Sava Bridge, citizens were invited to take part in two successive online surveys. After the publication of the final results, there was no official reaction to the doubts that were raised about their validity. Furthermore, even three years later, no steps were taken to implement the chosen solution. In the invitation to participate in the online surveys organized before and during the early public inspection of GUP Belgrade 2041, it was explicitly stated that the collected citizens' opinions will be of an informative nature only. The extremely small number of citizens who responded to the invitation to participate is probably a consequence of the combination of the purpose of the participation process, the selected e-Participation tool and the very design of both surveys, which contained extremely complex questions and required a significant amount of time to complete. Deciding on the 'Linear park' project is a positive development, given that it is a partnership project between the City Administration of the City of Belgrade and civil sector (CEUS), one of the goals of which was precisely the expansion of the participation framework. However, despite such cooperation, citizens failed to influence key aspects of the planning document, which increased the public's suspicion that the process itself was designed as a means of legitimizing the use of public resources for the purposes of increasing the value of private sector investments and further privatization of the waterfront. In the light of further activities on the formulation of public policy documents that envisage the digitization of the urban and spatial planning system, it is necessary to establish clear procedures for the inclusion of citizens in planning and decision-making processes, i.e. procedures for collecting, processing and implementing the collected information, while respecting the principles of transparency and democracy and with the clearly set goal of substantial participation, as a precondition for raising the quality of planning documents and the urban environment.

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FROM PLAY TO PUBLIC PLACE DESIGN

Jovana Janjić

Faculty for Architecture, Civil Engineering and Geodesy, University of Banja Luka, Bosnia&Herzegovina
MA Student, architect, jovana.m.janjic@student.aggf.unibl.org

Dubravko Aleksić

Faculty for Architecture, Civil Engineering and Geodesy, University of Banja Luka, Bosnia&Herzegovina
PhD., Associate Professor, dubravko.aleksic@aggf.unibl.org

ABSTRACT

Educational spaces provide a framework for school activities, i.e. adequate space for the educational process to take place, they largely participate in the educational process itself. The open space of schools, as a form of public space, provides a spatial framework for physical and social activities, primarily for children, but also for all residents of the local community. In practice, we most often come across spaces neglected during the design process, which support mostly only necessary activities.

Informal education is seen as a process that cannot be learned through theory, but is the result of experience and the gradual creation of a consciousness that enables connection between people and community, and to create a tangible environment. The process of informal education can be used as a tool to improve the quality of public spaces. When schoolyards, as a form of public space, are open to the city, they become part of public spaces and are open to all users as a playground. This paper analyses the possibility of applying tactical urbanism in the design process, as an adequate tool for participation in the process of learning through play. Applied to the schoolyard design, tactical urbanism represents a quality tool for this process, because it helps users to realize creativity and apply ideas in the process of schoolyard design.

Keywords: schoolyard; participation; public space; informal learning; tactical urbanism patterns

1. INTRODUCTION

Learning, perceived either as a systematised planned and institutionalised activity or as a spontaneous process, requires a suitable spatial framework. Since the beginning of the first forms of organised learning, adequate facilities have been built for this purpose. The turning point in the development of education is the 17th century, when significant construction of the system of pedagogical science began, and thus also the development of the associated spaces intended for education. The architectural approach to the design and spatial organisation of schools from the 17th century is based on the "bell and cell" principle, with time and space components of the learning being clearly defined. The spatial structure consists of a series of typical "cells", i.e. classrooms, which are accessed exclusively from one corridor [1]. This kind of architectural structure, viewed from a psychological aspect, enables monitoring and easier control. It is identified as an "architecture of discipline" [2], and with its "tool" of supervision and control, it is identified with institutions such as prisons, asylums, offices, hospitals, etc. Little to no attention at all was devoted to the design of the space around the school during that period. [1]. The school yard is viewed as a fenced, paved cage, and its importance in the education process is minimised.

Observed at the level of the Western Balkan region, we can see a certain progress in the education system. On the other hand, changes in the architecture of educational facilities have been reduced to a minimum and are mainly based on the modernisation of already existing educational facilities. These facilities were built in the past and they are intended to be suitable for different political, social and cultural conditions compared to those of today. The design of new buildings shows a tendency towards the modernisation of indoor space

mainly. However, observing the complex of educational facilities, it is evident that the associated outdoor spaces have been neglected to a significant extent, and the design patterns of traditional schoolyards have been retained.

2. METHODOLOGY

This paper aims to present an insight into the problem of public spaces related to educational facilities. In addition to the identification of spatial problems of educational facilities, the work introduces us to tactical urban planning, a tool that, by applying the bottom-up method, enables rapid spatial intervention, initiated by architects, and carried out by the primary users of the space - pupils and students. The paper does not define the exact methodology of the work, but presents the characteristics of the tactical urbanism, which are suitable for application in interaction with the desired target group of users.

The research presented in the paper aims to connect the phenomenon of play and the learning process with the process of public space design with an emphasis on the school yard design. The broadest goal of the work is primarily related to the improvement and modernisation of the design process. The participation of the users of the space in the design process results in higher quality project results, better insight into the needs and habits of the users and the potential way of use. Through the involvement of pupils and students in this process, as a result, the process of lifelong learning, learning through play and learning through work will spontaneously take place. This process indirectly affects the expansion of the education process beyond the activities prescribed by the formal plan. In addition to designing outdoor classrooms, users are given the opportunity to create spaces that are not primarily used for learning, but to some extent provide content of an educational nature such as botanical gardens, art pavilions etc.

3. EDUCATION AND PUBLIC SPACE: PROBLEMS OF SCHOOL YARD DESIGN

The principle of designing a traditional courtyard is directly related to the former principles of designing school buildings, where contact with the environment is prevented or limited. Courtyards are mostly large paved areas, without appropriate furniture, that only encourage activities of constant movement. By planning and designing such playgrounds with limited activities, it is easy to draw a parallel with prison yards, which unequivocally emphasises the possibility of monitoring users from the environment [3]. Considering that school is one of the first significant encounters between the young person and the built environment and the community, the experiences gained educational facilities greatly influence the way how a young person creates an image of its nearest social and built environment. Children's experiences of "public" spaces, where children's play spaces appear as isolated structures, negatively affect the creation of an image of the city and neglect the feeling of inclusion in the community.

According to Gehl [4], a large number of studies of children's play habits in residential areas show that children stay and play primarily in places where there is the most activity or in places where there is the greatest chance of something happening. This is particularly significant and related to the social development of children, which is largely based on observations of the surrounding social and physical environment. Observing adults and other children, children acquire the need for interaction, involvement in contacts and adopt new ideas for new games and patterns of behaviour [4].

The space of the school yard is a place where the school and the public space overlap. Open spaces following educational facilities, as a form of public space, should provide a spatial framework for physical and social activities, primarily for children, and for all residents of the local community to which area the educational facilities belong. The problem of the content offered by the space is directly related to the frequency and manner of its use. Looking from child’s or young person's perspective, empty, clean spaces can be challenging places, because they do not, in themselves, contain a "safe place" that will provide support from the psychological aspect of use [4]. It represents a place where many encounters happen, whether students meet each other, students and parents meet, as well as parents with each other. In the design of a modern schoolyard, you should have at least an informal place to sit and to have protection from different weather conditions. The frequent opinion that spaces are exclusively subordinated to school activities - primarily physical education classes and a place to stay during vacations, discourages users from spending their free time in one of these spaces [3].

The presence of children and young people in public spaces is not always tolerated, and spaces intended for children often aim to limit and protect them. Walls, fences and enclosures are the main elements that define children's space in public spaces for adults, thus creating a division of children's spaces from other spaces. The

segregation of the playground from the surrounding public is reflected in the way in which the planning of such spaces is approached, viewing them as a free-standing space, without seriously exploring the immediate surroundings. The fence is considered an integral and permanent component of the playground. From their first appearance, playgrounds were meant to physically separate children from the "adult" public space. The first playgrounds are described as “pieces of asphalt or concrete surrounded by a high fence". In fact, the first notions of a playground are tied to a large cage that would literally separate children from adults, thus encouraging the phenomenon of architecture of discipline and surveillance [5].

4. MONTESSORI SCHOOL IN DELFT: CASE STUDY

Quality public spaces can also be used as a tool for various educational activities and can be seen as an extension of the classroom. "Learning on the street" and learning outside opens up new concepts of education that enable all actors of society. The public spaces of the street and the square become spaces of learning, which expands the process of education and encourages the interaction of different elements of society with each other [3].

According to Herman Hertzberger: "The most important task of education is the implementation of the individual in the community through the development of a sense of personal responsibility, in such a way that the result of the progress of the community depends on the progress of all the individuals who make it up." This aspect of education cannot be learned directly, but is the result of experience and the gradual creation of awareness that enables a person to make contact with the community" [3, p. 151]. On the basis of the mentioned position, the school can be characterised as a micro-urban society [3]

Participation plays an important role in the process of the design of public spaces. As we can observe schoolyards as a form of public space, we can easily come to the conclusion that interaction between architects and users can bring significant improvements in the design process. The spatial framework of educational facilities indirectly influences social development and supports learning through activities in the space. Based on examples of good practice from around the world, the trend of shaping public spaces related to educational facilities can be observed from the second half of the 20th century until today.

(a)

(b)

Figure 1: (a) Students involved in the process of creating space by designing and building, and (b) Wall structure as territory, a point of contact and an element of play.

An example of the Montessori school in Deft [3, p. 186] shows the possibilities of shaping the public space while interacting with the users of the space. As part of the teaching process, students are encouraged and enabled to create a space following their personal needs, the needs of the group and the school requirements. The whole process was supervised and held in cooperation and mentoring with architects and teaching staff, while students were directly involved in the process of creating space by designing and building it (a). By careful selection of materials and dimensioning of the fence element, a multifunctional structure was created. Fence structure clearly determines the territory, while simultaneously becoming a point of contact between the educational institution and the city, as well as an element of play (b).

On the other hand, low-quality public spaces connected to the educational facilities can produce a feeling of not belonging to the space and alienation from the built environment. The sense of not belonging and being alienated from the space represents a problem at all spatial levels and is directly related to the marginalisation or complete neglect of the element of civic activism as a tool for the improvement of the built environment. Public activism among young people, as a tool for improving the quality of the built environment, has the potential to become a quality tool for improvement of school public spaces quality.

5. TACTICAL URBANISM: DEFINITION

Public activism as a form of participation in the design of space, can be an extremely useful tool, especially in the example of designing school yards. Through the user's direct participation in design, architects can provide useful information about a way how certain space is being used. After collecting all required data, it is possible to form clear guidelines for the design and can also help users to connect with the space. In order for the entire process to be well-managed and adequately implemented, it is desirable to use already known tools of civic activism in urban design. One of such tools is tactical urbanism.

Tactical urbanism is defined as a small-scale intervention that serves a larger purpose or the skills of planning and manoeuvring to achieve a goal. According to the creators and pioneers of tactical urbanism, Mike Lydon and Anthony Garcia: "Translated to cities, Tactical Urbanism is an approach to neighbourhood building and activation using short-term, low-cost, and scalable interventions and policies. Tactical Urbanism is used by a range of actors, including governments, business and non-profits, citizen groups, and individuals. It makes use of open and iterative development processes, the efficient use of resources, and the creative potential unleashed by social interaction." [6, p. 2]. Tactical urban planning is a process beneficial for all actors, because it provides citizens almost an instant redesign and reprogramming of public space, and enables the development body to accumulate ideas for the processes they need to implement. Unlike "do-it-yourself" urbanism, which shows the initiative of individuals, tactical urbanism can often be initiated by institutionalised bodies in order to test ideas and implement rapid changes [6].

6. WHY TACTICAL URBANISM

Tactical urbanism has a wide range of applications for interventions aimed at improving cities, such as Interventions within settlements, parks, freeing pedestrian zones, etc. According to the research of scientific works that give insight into the possibilities of applying tactical urbanism, not enough examples were found that show the possibility of applying this tool in school complexes, primarily school yards, and then not even on the buildings themselves. Based on the analysed characteristics of tactical urbanism, it is considered a tool suitable for use by young people of high school age and students from several aspects.

Seen from the perspective of the possibility of development of young people and children, tactical urbanism is considered a suitable tool because it enables quick and easy application of learning through design and enables immediately visible results, which is a very important feature due to maintaining the actor's focus. Considering that it is an informal method of work, it enables a faster flow of ideas, more direct contact of young people and direct communication with the creators of the project. The role of the architect in this process is to initiate the intervention itself, supervise the process, channel ideas and direct their application in the concrete space.

Tactical urbanism relies on the implementation of new spaces or the regeneration of existing spaces. It is based on the coexistence of new and old spaces where this approach focuses on concepts and processes within the existing urban design. A user defines required quality and participates in decision-making of an urban design process. Also, citizens often directly participate in the construction of new spaces, professional workers are not engaged, and materials that already exist on regenerated objects are used. [7]

Finally, through the prism of using tactical urbanism as a research tool, it is possible to create a trial plan for the regeneration of neglected school spaces. In the very definition of tactical urbanism, Mike Lydon and Anthony Garcia state as one of the most common applications of tactical urbanism the use of this tool as a zero-phase or early implementation tool that is used as a test project before embarking on a long-term investment. Therefore, all spaces can be viewed as a testing ground. Tactical urbanism represents a short-term intervention in the form of a real-time test for a project idea. In this way, the city functions as a laboratory. If the project does not work as planned, the budget will not be completely depleted, and future design options can use the lessons already learned. On the other hand, if the project works, small-scale changes are used as the first step in realising long-term change. This iterative process not only creates better projects but also continues the process established during conventional planning. [6]

7. CONSLUSION

Identifying the spatial problems of public spaces following educational facilities is a basis for thinking not only for architects, but also in the fields of pedagogy, sociology and other relevant disciplines that can significantly improve the quality of space through their efforts. The quality of public space and variety of activities being done in their spatial framework affect the quality of life of residents, which results in a city that nurtures the philosophy of "good life", i.e. the well-being of its residents, which makes it a desirable place to live.

The analysis of the way of using the space of educational facilities, questions the possibility of introducing adequate contents that enable the connection of the educational institution with the environment, the introduction of new forms of learning (outdoor school), and the way of implementing the process of education and lifelong learning in the community. Public spaces influence the comprehensive image of the objective, but also the subjective sense of belonging to the city and quality city life. Quality public spaces include spaces where users can satisfy their physical and social needs. People attract other people [4], and they need quality space for activities and socialisation outside their private facilities. Public spaces in the urban fabric face many problems of a physical and sociological nature. Sterile, enclosed spaces without an adequate level of equipment and content often look like abandoned units within the urban fabric. By placing physical barriers, we limit the use of space both in terms of user structure, but also in terms of impact on the environment and the city itself. In order for the city to become a "good place to live", an integral approach to designing the structure of educational spaces as an initiator of many social events is needed. Every public space of educational facilities is closely related to local contextual specificities and as such cannot be viewed on a global level. Therefore, from the aspect of institutionalisation of rules and regulations, it is desirable to give only rough and indicative guidelines that would define the tasks for the application of civic tools.

Therefore, tactical urbanism represents an exceptional tool for the design of public spaces, especially schoolyards. It enables learning through play. It encourages students to actively participate in the design of their own environment, to gain knowledge about space and direct experience of the importance of participation. In this way, open and colourful spaces are created, with all the necessary contents that can be easily supplemented with new spatial elements in accordance with the future needs of the users.

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OUTDOOR EXHIBITIONS ADAPTED TO THE NEEDS OF PEOPLE WITH DISABILITIES

Olivera Nikolic

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
assistant, olivera.nikolic@gaf.ni.ac.rs

Jasmina Tamburic

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
PhD, Assistant Professor, jasmina.tamburic@gaf.ni.ac.rs

Vladan Nikolic

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
PhD, Associate Professor, vladan.nikolic@gaf.ni.ac.rs

Milena Milosevic Micic

The Homeland Museum of Knjaževac, Serbia
museum advisor art historian, milenija2901@gmail.com

Mirko Stanimirovic

Faculty of Civil Engineering and Architecture, University of Nis, Serbia
PhD, Assistant Professor, mirko.stanimirovic@gaf.ni.ac.rs

ABSTRACT

Accessibility of museum buildings and exhibitions to people with disabilities is a very important topic in the world in recent years. Efforts are made to find inclusive solutions to overcome both physical and intellectual obstacles. In addition to removing obstacles to movement, each exhibition should be supplemented with interpretative and sensory elements: audio and subtitled video guides, sign language interpretation, IT tools, as well as tactile elements and maps.

This paper, creates and presents design solutions for outdoor exhibitions in park areas. The solutions will allow each exhibition to be easily adapted and optimized for to the needs of people with disabilities. The proposed design can become a universal solution for an outdoor use.

Keywords: *outdoor exhibition; people with disabilities; sensory experience; access; inclusion; park areas; architecture; design solutions; culture; universal design*

1. INTRODUCTION

Cultural institutions in Serbia and worldwide should be accessible to everyone. Collected data show that accessibility to the facilities and features of these institutions is one of the main problems, even today, a decade after the adoption of the United Nations Convention on the Rights of Persons with Disabilities (CRPD). According to World Health Organization data more than one billion people in the world live with some form of disability, of whom nearly 200 million experience considerable difficulties in functioning [1]. Every eighth inhabitant of the world has to live and perform daily activities while overcoming obstacles. Using data from the 2011 Census, it is concluded that 571,780 people with disabilities live in Serbia, which represents 8% of the total population of Serbia [2]. Disability is a physical or mental condition that limits a person's movements, senses, or activities. According to the Convention, all persons with all types of disabilities must enjoy all human rights and fundamental freedoms. The Convention is intended as a human rights instrument with an explicit, social development dimension. When it comes to social inclusion within cultural institutions, museums are

suitable for this type of social activity. Museums are vital public spaces that should address all of society and can therefore play an important role in the development of social ties and cohesion, building citizenship, and reflecting on collective identities.[3] Regardless of the character and type, museums as places of informal education are an address where social inclusion can be successfully implemented [4]. In support of this fact, the new definition of museum was adopted at the General Conference of ICOM in Prague in 2022. "A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability." Although there is a tendency for museums not to not be closed places where cultural heritage assets are kept, but public, open to all visitors to the place, case studies show that even large museums have not fully succeeded in their intention to become museums for all by applying the principles of the universal design.

By researching the accessibility of museums to people with disabilities, using the method of case study, analysis and synthesis, this paper discusses the approach of outdoor exhibitions in order to improve the accessibility of museum contents to a larger number of categories of people, especially for people with disabilities. The results of the research are presented in the form of a model of an exhibition stand for outdoor exhibition.

2. OUTDOOR EXHIBITION

The concept of an outdoor exhibition space has been around for almost two and a half centuries. The idea of the open-air museum dates to the 1790s. The first proponent of the idea was the Swiss thinker Charles de Bonstetten, and was based on a visit to an exhibit of sculptures of Norwegian peasants in native costumes in the park of Fredensborg Palace in Denmark,"Valley of the Norsemen"[5]. He believed that traditional peasant houses should be preserved against modernity, but failed to attract support for the idea. Skansen is the world's first open-air museum, founded in 1891 by Artur Hazelius. It is situated on the island of Djurgården within the city limits of Stockholm. Visitors to Skansen meet a miniature historical Sweden reflected both in the buildings and their surroundings – from the Skåne farmstead in the south to the Sami camp in the north. The venues illustrate the different social conditions in which people lived in Sweden between the 16th century and the first half of the 20th century. [6] Over time, outdoor exhibition activities developed. As well as indoors, exhibitions can be classified into *permanent* and *contemporary outdoor exhibitions*.

2.1. Outdoor permanent exhibition – open air museum

Permanent open-air exhibitions are a part of the open-air museum. This concept is especially popular in Japan, USA, United Kingdom. A common feature of open-air museums is the organization of exhibitions through permanent exhibitions, which are supplemented or adapted over time. Temporary exhibitions, in this mode of exposure, are very rare.

Analyzing the *theme* of the open-air museum exhibition, the following typology is created:

- archaeological open-air museums
- ethnological open-air museums
- sculpture open-air museums
- memorial open-air museums
- contemporary open-air museums

Open-air archaeological museums are built, mostly, on archaeological sites and aim to contribute to a stronger experience of a given historical period for the visitors through the reconstruction of architecture and lifestyle.

(a) (b) (c)

Figure 1 – Archeological open air museums : a) Pločnik Archeological Open Air Museum (5500 – 4700 BC), Plocnik, Serbia b) Karnak Open Air Museum (about 1250 BC), Luxor, Egypt c) Göreme Open Air Museum (67 AD), Cappadocia region, Turkey

Ethnological open-air museums are organized near cities, most often by transferring structures from the rural areas of the region, or in rural areas that have been assessed as having cultural heritage worthy of protection. An open-air ethnological museum provides visitors with information about traditional ways of building in a certain area, lifestyle, crafts, and tangible and intangible heritage.

(a) (b) (c)

Figure 2 - Ethnographic open-air museums : a) Ethnographic Open Air Museum Riga, Latvia ; b) Norsk Folkemuseum, Open Air Museum, Skøyen, Oslo, Norway, c) The open-air ethnographic museum "Etar", Gabrovo, Bulgaria

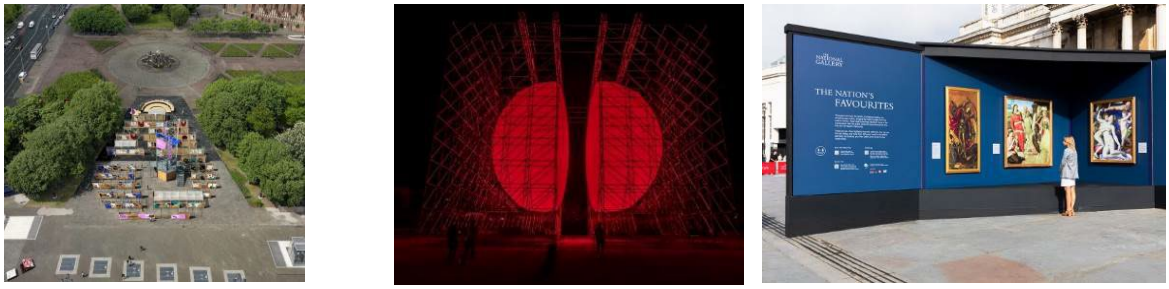
Outdoor sculpture museums are organized in park areas. They display parts of rich collections of sculptures, mostly large formats by famous sculptors and artists. One of the most famous museums of its kind, and the first in Japan, is the Hacon Open-air Museum. It covers an area of 7ha and contains about 1000 exhibits. The museum exhibits a valuable Picasso collection, 20 art collections of Henry Moore set in the natural outdoor setting, as well as spatial structures such as Sefra con Sefra, Woods of nest, La pleureuse and others..

(a) (b) (c)

Figure 3 - Hacon Open-air Museum, Japan, a) Picasso collection, b) La pleureuse sculpture, c) Woods of nest structure

2.2. Outdoor temporary exhibition

In addition to permanent museum installations, temporary exhibitions are also organized outdoors. Like open-air museums, they have a long tradition. An exhibition is most often organized in the courtyard of the museum or on public areas of squares and streets. This type of exhibition gained a particular importance in the years of the corona virus pandemic when museums had to find ways to maintain interaction and contact with the public. The changes were conceived in two directions: the use of digital technologies in order to create virtual exhibitions and the organization of exhibitions in open space. In 2020 and 2021, in the world, not realized large exhibitions, so-called "blockbusters" [7], and very successfully organized outdoor exhibitions were presented to the audience. Only some of them are shown in Figure 4.



(a) (b) (c)

Figure 4 – Successful examples of outdoor exhibitions (a) Open Air Exhibition – “Knowledge City Berlin 2021”, 2021, b) "Plásmata: Bodies, Dreams, and Data" the largest open-air digital art exhibition in Europe, Pedion tou Areos public park, Athena 2022, c) 'Inside Out' 20 life-size replicas of the nation’s favourite paintings, The National Gallery, Trafalgar Square, London, 2021.

In addition to the mentioned examples, less successful exhibitions were also realized, where non-purpose stands were used for exhibition, sometimes fences were also used. On those occasions, the proportions and height of the exhibited material were poorly estimated. The design of the exhibition is reminiscent of a "wall newspaper", Figure 5, and the exhibitions generally lack a design that would evoke emotions in the visitors. [8]

(a) (b) (c)

Figure 5 –The less successful examples of outdoor exhibitions (a) Exhibition “King Milan Square through time” Historical archive and National museum of Niš, 2021, b) “One house - two theater stories: Ivan Haitl and the printing house 'Talija'” Serbian National Theater et al, 2019, c) „The Constitution of May 3 (1791)", Central Archives of Historical Records in Warsaw, Toronto, 2021.

Occasional open-air museum exhibitions are significant for several reasons:

- They are more accessible to a wider audience like casual passers-by, strollers, whole families
- they are more available in terms of accessibility for people with disabilities
- they more immediately promote the topic and provide marketing
- they are free

On the other hand, their design and spatial organization are quite limited due to several issues:

- the material on which it is displayed must be waterproof
- the spatial organization and exhibition design are limited by the shape and dimensions of the exhibition stands, unless they are specially designed
- mainly it is not possible to exhibit objects but only images and textual material,
- there are restrictions on lighting

All these reasons necessitated the research, which aims to find a design proposal for the exhibition stand, that would provide such a design of outdoor exhibition spaces, making them safe, flexible for the exhibition organization, accessible to mobility impaired people, as well as to blind and visually impaired people.

3. DESIGN OF EXHIBITION STAND FOR OUTDOOR EXHIBITIONS

Outdoor exhibition stands could be classified into three categories *by shape*: *linear, trapezoidal and spatial structures*. The shape affects the stability and safety that are essential due to outdoor weathering. Linear stands must be anchored in the base, or have their own base that will not hinder the accessibility of the exhibition visitor, Figure 6. Trapezoidal displays are stable, if their base is not too wide, they allow unhindered movement and access to the displayed material. They are not suitable for blind and partially sighted people and for displaying tactile material because their base can hinder access for blind people. The spatial structures of the stands are the most suitable in terms of stability, but also the exhibiting potential. Tactile legends and drawings are easily accessible to blind and visually impaired persons on vertical or angled surfaces, and can optionally display tactile figures.

(a) (b) (c)

Figure 6 –The examples of linear outdoor exhibitions stands (a) "The Silk Road: A Living History" Uzbekistan, 2021 b) The open-air gallery, Velenje, Slovenia, 2013. c) "Le Chiottisme", Paris, 2010.

(a) (b) (c)

Figure 7 – The examples of trapezoidal exhibition display stands (a) "Figures of Change", London 2022, b) "Build Hope In The City" outdoor exhibition, Dublin, 2017. c) „The Living Lights Exhibition" Edinburgh, 2014.

(a) (b)

Figure 8– The examples of exhibition stand spatial structure (a) Open air exhibit about Chopin, Warsaw, 2018. b) "Planet Moscow" outdoor photo exhibition, All-Russian exhibition centre VDNH, Moscow, 2017

The stands must be lighted so that the exhibition is accessible to visitors even in the evening hours. It is convenient for exhibit stands to have their own lighting system, as well as their own power source so that they do not depend on the infrastructural equipment of the outdoor exhibition space. Nowadays, own power source is simply achieved by using solar photovoltaic panels.

4. DESIGN OF THE EXHIBITION STAND FOR OUTDOOR EXHIBITIONS ADAPTED TO THE NEEDS OF PEOPLE WITH DISABILITIES

The inspiration for this research was found in a structure for temporary exhibitions on Boulevard Eloirol, near Piata Unirii in the City of Cluj-Napoca, the capital of the Transylvania Region, in Romania. The structure was built at the end of 2021 by The Municipality of Cluj, for the purposes of the "Exhibition of photographs dedicated to the heroes and martyrs of the December Revolution of 1989". After the exhibition is closed, the structure continues to be used for outdoor exhibitions, and every month or two a new exhibition is organized by one of the museums in the city or the NGO organisations.

(a) (b)

Figure 9–Exhibit displays for outdoor temporary exhibitions (a) outside, b) inside

The exhibition stand structure is simple to build. The frame system of wooden uprights and beams is anchored to the base. The space intended for the introductory poster of the exhibition is more pronounced than the other units where the frames for exhibition posters are located. The span of the structure, proportions of elements and units, as well as the format of exhibition posters are formatted according to standards and are also suitable for access by people with mobility impairments. The frame system, with slats constituting the infill, allows exhibition posters to be formatted differently, owing to their simple installation in a wooden structure.

The structure lacks its own lighting. The outdoor billboards are illuminated by street lights. Also, there are no Braille legends and the realization of the exhibition does not involve the use of tactile drawings or figures. Guide tactile strips for people with visual impairments are missing. However, these defects can be easily rectified on this structure according to the instructions for supplementing the design of exhibitions for disabled people.

In 2018, the guidance ACCESSIBLE EXHIBITIONS FOR ALL: 2018 TOOLKIT A GUIDE TO CO-DESIGNING EXHIBITIONS WITH DISABLED PEOPLE [9] was published. The rulebook defines the needs of people with disabilities and the proposal for co-designing, and their implementation ensures that the exhibition is accessible to everyone. By applying those principles to the outdoor exhibition stands, the principles of the universal outdoor exhibition design are realized.

Open-air exhibitions are accessible to visitors with movement impairments because obstacles in the form of height differences and aisle widths have been reduced to a minimum. For this reason, the design of the stands is primarily aimed at achieving accessibility for people with visual impairments. In order for the design of the exhibition to meet the needs of all visitors, the exhibition stands must be designed as follows:

- the poster should be placed at a lower height, the lower edge should not exceed 75cm, it is best if the lower edge is at 60cm
- the font used on the poster must not be smaller than 16pt, practice shows that it is good to use a minimum of 96pt for titles and 36pt for the text
- it is necessary to provide a contrast between the background of the poster and the letters

- exhibit display must have an inclined surface for displaying tactile legends in Braille or for displaying Braille guides book and tactile images
- exhibit display must have a pedestal for exhibiting tactile figures - when the theme of the exhibition allows it
- poster must be illuminated
- it is recommended to use QR codes and other tools that enable interaction with the content available on the Internet, such as 3D models, audio and video content, interpretation in sign language, subtitles in foreign languages, etc.
- in the exhibition area, between exhibition stands, there must be guide tactile strips for guiding visitors with visual impairments.

Exhibitions in the interior space are often complemented by multimedia and interactive content. For this purpose, sensitive computer equipment is used, which cannot be used outdoors due to the atmospheric conditions in the external environment. For the needs of this paper work, a model of the exhibition stand for outdoor exhibitions was created that corresponds to the requirements defined in the previous paragraph - Figure 10.

Figure 10– Modular unit for exhibit displays stands for outdoor temporary exhibitions

5. CONCLUSION

In this paper, using the method of analysis and synthesis, many examples of exhibitions from the country and abroad organized in the open air were reviewed. It was concluded that this type of exhibition is particularly important for the people with mobility impairments because outdoor spaces contain significantly fewer obstacles, and that it became especially prevalent during the corona virus pandemic, when the doors of museums and galleries had to be closed. By synthesizing knowledge about outdoor exhibitions, a typology of permanent outdoor exhibitions according to the most represented theme, as well as a typology of exhibition stands used for outdoor exhibitions, was derived. The exhibition stands were analyzed from the aspect of accessibility for people with disabilities in order to create a universal design. The principles for co-designing exhibitions with disabled people were applied when designing outdoor exhibitions, and a list of requirements was formed that an outdoor exhibition stand should fulfill. Then a model of the exhibition stand was created that meets the needs of sensitive groups of people for experiencing the exhibition, too. The design of the stand is such that it allows the creation of pathways of different shapes in the exhibition area, and if a single modular unit is used, the design can be applicable for bus stops or rest stops in parks and public areas. The proposed design can easily be redesigned for other uses, but the design principles related to accessibility for people with disabilities must be observed.

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SPECIFIC CHALLENGES OF PLANNING SMALL SHRINKING TOWNS

Milica Ljubenović

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Assistant, milica.stj@gmail.com

Ivana Bogdanović-Protić

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD, Associate Professor, ivana.bogdanovic@gaf.ni.ac.rs

Jelena Đekić

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD. student, Assistant, jelena_djuric@ymail.com

Milica Igić

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD. student, Assistant, milica.igic989@gmail.com

Mihailo Mitković

Faculty of Civil Engineering and Architecture, University of Niš, Serbia
PhD. student, Assistant, mihailo.mitkovicgaf@gmail.com

ABSTRACT

Urban shrinkage is evidently a process that is very pronounced in the world. Accordingly, a significant amount of research has dealt with the characteristics, causes and consequences of this phenomenon. Based on this, it became clear that the existing planning policies and instruments are not suitable for solving the problems caused by urban shrinkage, and therefore new approaches and strategies to planning shrinking cities have been explored. However, these planning approaches mainly focus on larger cities, while the shrinkage of small towns is not sufficiently researched, and thus neither is their planning. Taking into account the specifics of urban development of small towns and the fact that the developed planning approaches cannot fully address the problems caused by their shrinkage, planning the recovery of small shrinking towns requires special attention. Based on a critical analysis of approaches and concepts for planning shrinking cities, this paper outlines specific issues and puts forth recommendations for planning shrinking small towns.

Keywords: *shrinking cities; urban shrinkage; small towns; urban planning*

1. INTRODUCTION

Urban shrinkage pose a major challenge for planning. Due to demographic and economic growth as dominant trends during industrialization, urban development has been associated with continuous growth, and therefore urban shrinkage has been treated as a marginal and temporary process from a planning point of view. Contemporary planning was thus completely unprepared to deal with the problems and challenges of urban decline. Traditional planning instruments and mechanisms are not suitable for use in the context of shrinking cities, and there is a need for new concepts and approaches adapted to the problems caused by this phenomenon (Bernt, et al., 2014; Martinez-Fernandez, et al., 2012). It is emphasized that urban planning in the context of shrinkage is even more important than in the context of growth (Schatz, 2010). Alternative strategies that do not rely on population growth are gaining attention, although planning still requires considerable effort and research (Pallagst, et al., 2017).

Small towns have not been the primary focus of shrinking cities research, however, the largest number of shrinking cities in Europe belong to small and medium-sized towns (Schlappa & Neill, 2013). Their shrinkage is pronounced especially in Central and Eastern Europe (Pirisi & Trócsányi, 2014; Leetmaa, et al., 2015; Ljubenović, 2022). Small towns have specific structure, and the manifestation of urban shrinkage in them differs. The causes of these various changes are reflected in insufficient resources in the field of education, research and skilled jobs, and often in insufficiently developed transport infrastructure. They have different prerequisites for urban and economic development than large cities and city-regions and require different solutions to the problems of shrinkage (Lang, 2005).

Against this background, this paper focuses on planning the development of small shrinking towns. This included the crytical overview of the existing and reccommended approaches of planning shrinking cities as well as the specific aspects and challenges of planning small towns. Based on that the main issues and recommendations for planning shrinking small towns are synthesized.

2. THE CAUSES OF URBAN SHRINKAGE OF SMALL TOWNS

Compared to larger urban areas, small towns have their own specifics of both development and urban shrinkage. There are also many differences between individual small towns and they face different challenges depending on their territorial, economic and institutional context, as well as natural and historical factors.

Global economic changes had a stronger impact on small towns, as they were placed in direct competition with larger cities. Small towns used to have a stable position in the settlement network as trade and service centers in rural areas, and later as smaller industrial centers. In many small towns the majority of jobs were in industry, and they were particularly affected by deindustrialization, which is the main driver of their shrinkage (Fertner, et al., 2015). Due to the lack of educational and scientific infrastructure, they could not transform their economy and provide jobs for the residents who lost their jobs (Fol & Cunningham-Sabot, 2010).

Small towns have a role in ensuring the quality of life not only for their inhabitants but also for the surrounding rural population. They are sources of jobs and services for the surrounding rural area, but they are also consumers of rural products. Rural population decline directly affects the decline of service and trade functions of small towns. Global production and transportation of products, especially food, have weakened the role of small towns as markets for local rural products (Božić, 2017).

Demographic changes, including negative natural increase, emigration and ageing are closely related to post-industrial shrinking cities (Bernt, et al., 2012; Haase, et al., 2016). They affect also small towns, especially those with peripheral position and weak functional relations with surroundings (Valtenbergs, et. al., 2015).

Political changes and institutional context have a strong impact on development of small towns. Post-socialist transformation had dramatic effects on the cities of Central and Eastern Europe. It particularly affected small towns and peripheral rural areas, which lost their economic base and were left with no future perspective (Wiechmann & Bontje, 2015). The post-socialist transition and integration into the European Union have created a large polarization within the settlement system (Pirisi, et al., 2015).

The national urban system and the position of the city in the settlement hierarchy is especially significant for small towns. The regional context directly influence the performance of small towns in terms of economic and population growth (Servillo, et al. 2014), and small towns located in a structual weak region also face shrinkage. The peripheral position of small towns that leads to their shrinkage can be caused by geographical distance or transport links, but it can also refer to the position in relation to the decision-making process and institutional networks (Cox and Longlands, 2016). The centralization of central place functions and the concentration of public services in larger cities, cause the closing of certain functions (courts, state administration) in small towns, which results in the loss of jobs for an educated workforce.

3. PLANNING FOR SHRINKAGE

Planning approaches to shrinking cities vary and largely depend on how urban shrinkage is percieved. Accordingly, four policy responses can be distinguished (Hospers, 2014): (1) ignoring shrinkage; (2) counteracting shrinkage; (3) accepting shrinkage and (4) utilizing shrinkage. The first two growth-oriented reactions mostly proved unsuccessfull or even led to further shrinkage. Instead of attracting new population, the researchers emphasize that planners should shift the focus to retaining those who remain (Schatz, 2010). By accepting urban shrinkage, the main goal is to improve the quality of life of citizens. This approach requires an innovative planning process with communication elements (Humer, 2018), which involves a strategic

approach to planning, in order to explore new development opportunities. The main alternative concepts developed in theory and practice to solve the spatial problems created by the appearance of vacant buildings and land are *smart decline* (Popper & Popper, 2002) and *right-sizing* (Schilling & Logan, 2008). The goal of both approaches is to adapt the social and physical infrastructure to the existing residents. The largest number of interventions and strategies for solving urban shrinkage comes from the American and German experience, and they are usually aimed at solving the problem of empty or underused buildings and land. Interventions are carried out in the segment of housing, land use, infrastructure, public services, social capital, and they were all applied in larger cities.

Challenges facing shrinking cities require cooperation of many different actors and residents, and engagement of all governance levels. Horizontal integration of social, economic and environmental actions is necessary at the local level, but vertical integration of policies at different levels of governance is equally important (Wiechmann, 2008). Higher levels control the lower ones, while coordination is carried out from the bottom-up. The regional level is particularly important as a spatial platform for better efficiency in adapting the settlement structure (Müller & Siedentop, 2004). The main outcome of the planning process is an integrated development strategy, that is, an adaptation strategy, which should be aligned with local challenges and opportunities. Techniques that are recommended in the strategy development process include a detailed analysis of the current state, which would create a good information base for modeling future development options, for which the use of scenario methods is suggested. Cities need to reinvent themselves and it is a learning process that depends a lot on the input of citizens, the business environment and public agencies (Schlappa & Neill, 2013).

4. SMALL TOWNS DEVELOPMENT PLANNING

4.1. Policies and institutional aspects

Small towns have certain potentials in territorial policies at the macro, meso and micro levels (ESPON 1.4.1., 2006). At the macro level, they represent an important element in European polycentric urban development, by promoting territorial cohesion on the one hand and strengthening the competitiveness of individual regions on the other. In peripheral areas, where there is no possibility of polycentric development, small towns can play an individual role in providing a minimum level of services for these areas.

At the European level, the importance of small and medium-sized cities is increasingly recognized and highlighted in the documents such as European Spatial Development Perspective (ESDP), Territorial agenda 2030 and Urban Agenda for the EU 2016. Although the potentials and specific development challenges of small and medium-sized towns are recognized in European documents, they are taken as a single category without differences in their role or function.

At the national (meso) level in European countries, there is no explicit policy on small and medium-sized cities (Servillo, et. al, 2014). The focus is mainly on larger urban areas as the main drivers of growth and development, while small towns are neglected. The national institutional system has a great influence on the development of small towns, especially the process of decentralization, multi-level coordination and territorial cooperation. Generally, in almost all European countries sub-central level of government has gained more competences, but the speed of decentralisation vary. With decentralization, small towns get more responsibility, but often combined with reduced competences (Valtenbergs, et. al., 2015). They usually do not have enough capacity to shape the institutional framework if they act alone. Involvement of the private sector in small towns is generally a challenge and it is mostly the public sector that drives and plays the main role (Servillo, et al., 2014).

Horizontal cooperation between municipalities has an even greater role in the development and implementation of strategies than the assistance of the national or subnational level (Servillo, et al., 2014). This cooperation depends a lot on the size of the municipality and the competence of the local government. In countries where the local authority has jurisdiction over a wider area than a small town, it is easier to include partnerships between small towns and planning authorities in spatial plans.

4.2. Possible development directions

The development directions of small towns are conditioned by a mixture of social, economic, demographic and political factors at the international, national and sub-national level (Valtenbergs, et. al., 2015). Small towns can be seen from the exogenous development point of view, where location factors for

industry, services and high-tech activities are considered. Accordingly, factors that can attract and retain companies and residents in the area are searched for and based on that public investments are recommend or not (ESPON 1.4.1., 2006). The second approach, which is more qualitative, evaluates the attractiveness of the city based on its specific characteristics - endogenous development. The potential of the region is defined through its centrality and specialization. Internal strategies refer to the identification and development of local resources. The basic strategic goals of the development of small towns should respect the specificity of the place (Božić, 2017). The history and tradition of a place can be a potential and inspiration for creating new values.

In recent years, the potential and role of small and medium-sized enterprises in creative economies and the attraction of the creative class have been increasingly explored. Researches show that small towns can also play a role in creative economies (INTELI, 2011; Selada and Cunha, 2012). Small towns and even rural areas can attract creative people, mostly based on the quality of life and the quality of the place. These amenities do not have to be the same as in big cities. They refer to the unique characteristics of the territory, natural or created, and to the aesthetic, social and economic values.

The advantage of small towns at the local level is also reflected in the possibilities for the development of a high quality of life in contrast to socially seggragated settlements on the outskirts (ESPON 1.4.1., 2006). Kwiatek-Sołtys and Mainet (2014) propose the development of "residential urbanism" for commuters with diverse amenities for everyday life, strong and safe communities, and affordable housing. It is very important to improve the connectivity of small towns (Cox & Longlands, 2016). For daily migrants, it refers to better access and traffic connections to neighbouring cities. In this way, more residents can choose to live in a small town that offers a better quality of life and travel to work in neighbouring cities. It is also necessary to connect towns well with their surroundings, so that residents from the surrounding area have access to work and services, and at the same time to enable easy access to the surrounding tourist and recreational facilities.

For peripheral towns, located outside the main traffic corridors, a broader regional context and cross-border cooperation is recommended. In order to overcome the peripheral role, small towns must participate in regional, national and international urban networks (Leetmaa, et al., 2015). Cities can be connected through infrastructural and strategic cooperation and form polycentric regions, which further leads to the creation of dynamic zones of global integration (Siljanoska, et al., 2012). Integration into transnational networks can help small towns to be more visible in the global space so that they can better promote achievements in the field of culture, education or sports (Valtenbergs, et. al., 2015). This can be achieved by networking, using EU funds for territorial cooperation and relying on the institutional capacities of transnational organizations.

5. PLANNING CHALLENGES AND RECOMMENDATIONS FOR THE DEVELOPMENT OF SMALL SHRINKING TOWNS

Small towns have fewer resources and opportunities to deal with the consequences of urban shrinkage than large cities. They have limited size of economy as well as their human capacity. Many small towns depend on public finances, making them vulnerable to austerity measures. They generally have outdated infrastructure and insufficient accessibility, and there is also a lack of investment (Valtenbergs, et. al., 2015). Due to limited organizational capacities, small towns often do not recognize their potential (Božić, 2017). Typical institutional challenges in declining small towns include lack of services, insufficient administrative capacity, declining tax revenues due to emigration and aging, and challenges of cooperation between municipalities (Valtenbergs, et. al., 2015). Territorial challenges include aging infrastructure and insufficient connectivity. The high cost of brownfield mitigation is an additional challenge for small towns.

The general approach to urban shrinkage is applicable to small shrinking towns as well, but taking into account mentioned constraints and specifics of their development, certain issues need to be further considered. Regarding the economic development of small shrinking towns, considering the decline of industrial activities, short- or medium-term support of the existing industrial sector is necessary, and in the medium or longer term, a change in the territorial role of small towns and diversification of the economic sector (Servillo, et al., 2014). The existing territorial capital and functional role of the town represents a basis that must be supplemented with new innovative activities (e.g. knowledge-based economy, tourism, agriculture) which would improve the local economy and attract and retain the appropriate population (e.g. tourists, well-qualified workers, young people) which is necessary for the development of the regional economy. Therefore, in the long term, it is necessary to support new resources, which would enable a diverse local economy, in addition to the development of our own.

As it has already been pointed out, the great opportunities for the development of small towns are based on local endogenous resources. Endogenous concepts, unlike growth-oriented approaches, integrate qualitative aspects such as creative capital, social and financial capital, sustainability and quality of life (Wirth, et al., 2016). The concept of creative strategies represents one of the possible directions of development of small shrinking towns (Ljubenović, et. al, 2020). Specific local functions such as culture, entrepreneurship, local communications, identity or management practices are historically rooted and determine the locality's ability to respond to external influences (Leetmaa, et al., 2015). These characteristics together constitute social capital, and generally, small towns have favourable conditions for its development. However, in some exceptional cases, the population's ties to the city are so low that they are overcome by individual tendencies and prevent joint action. Therefore, it is necessary to have open dialogues between different actors and mutual support in the implementation of strategies. An important prerequisite for the development of local potential and capacity for action is intersectoral communication and cooperation, mutual trust and joint learning processes that include actors from civil society, local economy, government and administration (Burdack and Kriszan, 2013).

The implementation of development goals and strategies based on local resources and connectivity cannot be realized only by the city administration, but requires the involvement of various actors, as well as all levels of governance. In order to strengthen the hidden potential of shrinking small towns, national support for regional development through a strong policy of innovation-oriented interventions is necessary. Individual entrepreneurial initiatives are an important economic driver, and it is necessary to protect local entrepreneurs who represent the specificity of small towns and are threatened by competition from large shopping centers (Božić, 2017).

Spatial policy should be aimed at attracting and retaining families who may be looking for a different way of life compared to larger cities (Servillo, et al., 2014). In that aim, it is necessary to strengthen awareness of the quality of life in small towns (Božić, 2017). In some countries, such as in France, quality of life has already become a tool of local actors for the development of small towns (Kwiatek-Sołtys & Mainet, 2014). In small shrinking industrial towns where it is difficult to attract new firms or small towns where there is potential for daily migration, residential attractiveness is a priority. Small towns are less exposed to the crowds and stress of big cities and offer access to natural resources. Accessibility to services is an important prerequisite for development and in order to compete with other urban areas small towns must explore creative ways of providing services, including shared service delivery, mobile services, e-services (Valtenbergs, et. al., 2015).

In order to retain young people, it is necessary to invest in the education quality, but also in entertainment and cultural amenities, provision of housing at an acceptable price, opportunities to work at home (Božić, 2017). On the other hand, with the increase in the number of the elderly population, it is necessary to take care of the elderly, that is, to develop policies for the integration of the elderly population into society. This can be achieved by involving citizens in future planning, heritage preservation and health services.

New concepts of urban development are often difficult to implement due to a lack of resources and actors. Strategies must therefore formulate realistic, effective goals that relate to existing local resources and potential. The development policy of a town can hardly be effective without a comprehensive overview of the wider area of and observing it as an element of the wider regional structure (Batunova, 2017). External networking is important because ideas and expertise often come from outside, as well as subsidies. However, local networking is also necessary, because many projects can only be implemented with the support of citizens and the involvement of local businesses or civil society organizations (Burdack and Kriszan, 2013). Inter-municipal cooperation is recognized as an important mechanism for the development of shrinking small towns. Cooperation should be based on the complementary potentials of these areas and existing connections. Small towns can also cooperate with large cities to exchange experience, although this kind of partnership is more difficult to establish (Valtenbergs, et. al., 2015). The capacity of small towns to cooperate is often limited. National and regional policies should support territorial cooperation between towns and surrounding areas to enable better access to services and other urban functions. Shrinking small towns can be platforms for policy innovation and experimentation to implement pilot projects in service delivery, citizen participation and other areas. If they prove successful, these projects can be replicated on a larger scale.

The challenges of development of small shrinking towns, together with possible strategies for overcoming them are sistematized in Table 1.

Table 1: Challenges and recommended strategies for successful development of small shrinking towns

Challenges			*Strategies*			
Economic	*institutional*	*Territorial*	*economic*	*social*	*institutional/ governence*	*territorial*
lack of resources *limited size of economy* *limited human capacity* *dependence on public finance finances* *lack of investment* *high cost of brownfield mitigation*	*lack of services* *insufficient administrative capacity* *declining tax revenues* *insufficient decentralization – low competence of local goverment*	*aging infrastructure* *insufficient connectivity* *peripheral position*	*diversification of the economic sector* *innovative activities* *supporting new resources* *individual entrepreneurial initiatives* *creative strategies based on local potential*	*strengthen the awareness of the quality of life in small towns* *investing in education, entertainment and cultural amenities* *provision of affordable housing opportunities to work at home*	*national support for regional development* *intersectoral communication and cooperation* *involvement of various actors and all levels of governance - joint learning processes* *integration of the elderly population into society*	*change in the territorial functional role* *considering wider regional structure* *inter-municipal cooperation* *cooperation with rural areas* *creative ways of providing services*

Taking into account general recommendations for planning shrinking and considering specific development and planning issues of small towns, specific requests and guidelines for planning small shrinking towns can be defined:

- comprehensive vison which considers town as an element of the wider regional structure;
- systemic integral approach, with clearly defined objectives and measures of implementation, monitoring and management, active participation of all actors and defined financing models;
- increasing awareness of depopulation and a realistic assessment of current and future demographic conditions;
- development of an integrated strategy depending on the specific characteristics of the town - physical, geographical, economic, social and cultural characteristics;
- improving the way of communication and obtaining information by involving citizens from the very beginning in the planning process;
- using EU funds or the institutional capacities of transnational organizations for territorial cooperation;
- forming partnership with neighbouring rural areas;
- networking, inter-municipal and cross-border cooperation (especially for border towns) in order to become important centres regardless of their location.

CONCLUSION

Small towns are an important element of the settlement network. They create a crossroads between large urban and rural areas, encourage territorial cohesion, and preservation of their central functions and vitality is one of the main challenges of regional and spatial development in Europe. The effects of urban shrinkage in many of them are very serious and difficult to confront. That is why planning their development requires special attention. Approaches to planning shrinking cities are still being explored, but there have been already various alternative concepts developed in practice in order to adapt the social and physical infrastructure to the existing residents, and it is also clear that it is important to recognize urban shrinkage in the early stages and to act before it progresses too far.

Although they are developed for the use in larger cities, the planning principles and process are also suitable for small shrinking towns. This includes a strategic approach to planning with participation of many different actors, such as government, civil organisations, business networks, educational facilities, and citizens, as well as engagement of all governance levels. The joint action of these stakeholders is necessary to develop an integrated strategy in order to adapt local urban structure to problems of shrinkage. However, small towns face some specific challenges, which requires special concerns. They have very limited financial possibilities as well as political power to implement the desired measures and goals. Therefore, they need creative solutions and innovative planning process in order to reinvent themselves. Moreover, they need a strong financial and planning support of national and regional levels and the problems caused by urban shrinkage cannot be addressed only at a local level. At higher levels, the role that small towns play in a given territory and the challenges they face should be identified in order to develop an integrated place-based approach.

It can be concluded that networking on different spatial scales is the key precondition for the successful development of shrinking small towns and the efficient implementation of proposed measures. This includes local networking and strengthening the social capital, cooperation with other towns and cities to share knowledge and join resources, and there is also possibility to join one of the European or global networks of small towns. This way small shrinking towns can overcome their peripheral position in national settlement system.

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BUILDING HERITAGE MANAGEMENT - SOME EXPERIENCES FROM SERBIA

Ana Momčilović Petronijević

PhD., Associate Professor, Faculty of Civil Engineering and Architecture, University of Niš, Serbia
ana.momcilovic.petronijevic@gaf.ni.ac.rs

Milanka Vasić

PhD student., Faculty of Civil Engineering and Architecture, University of Niš, Serbia
milanka3970@gmail.com

Aleksandra Ćurčić

PhD student., Faculty of Civil Engineering and Architecture, University of Niš, Serbia
ajkiro94@gmail.com

ABSTRACT

Architectural heritage is a non-renewable resource that we leave as a legacy to the future generations. Professional public is concerned about the manner in which our heritage is addressed regarding restoration and conservation as well as the manner it is treated considering organization and planning. However, this issue is of crucial importance forultimate consumers - its owners and community (local population or tourists). The practice of heritage management is therefore very important, particularly its proper inclusion into planning processes.

Despite the technical conservation of monuments, which is the most prevalent and generally accepted method, nowadays the inclusion of heritage in the social context is becoming increasingly important. Besides the economic evaluation of the diverse potentials of the urban heritage, it is necessary to enable the interaction of consumers with the heritage, and its revitalization through tourism potentials educational or some other appropriate activities.

This paper analyzes the heritage of Serbia in the context of the active management of architectural heritage. The analyzed issue is illustrated by the examples of the heritage that, after technical protection, remained just that - silent monuments of the past, quiet evidence of bygone times standing still today, which will require re-protection after a certain number of years. The examples considered are those of the monuments that are included in social flows, those that, after the necessary technical protection, have become an indispensable part of everyday life of one community. The paper examines the problem of whether the objects in question were adequately incorporated into the space where they are located, be it a touristic, educational or any other content, and whether they are treated with proper respect.

Keywords: architectural heritage; succession planning; tourism; cultural monument

INTRODUCTION

The current global economic transition and recession, as well as the decades-long social and economic transformation in the Balkans, constitute the socio-political stage on which many aspects of modern life take place. Such a social scene implies certain actions and reactions of a society to all aspects and factors of development, especially to three important domains of existence: ecological, economic, and social

Regardless of the fact that all processes are interdependent and conditional, and that development and protection in one sector cannot be viewed in isolation, but as part of a wider picture and mechanism of social development, inertia seems to be immanent in the place in which we reside.Culture and heritage clearly share the same fate, as a very important material testimony of our existence in this area.

Many artefacts, sites, or structures, as part of cultural heritage, should be adequately valorised, then adequately protected, conserved, and then adequately presented to the public. Society should treat cultural heritage, which is part of the memory of people inhabiting one area as a testimony of past centuries and ways of life, with due respect. All objects, which we classify as cultural heritage, are witnesses of the duration, development, progress of culture in a certain area, and as such they represent the continuity of the duration of a community and form a historical context. By conscientious protection and appropriate integration of these localities into the modern trends of economic and spatial development of a territory, conditions should be created for their duration, preservation, and existence in the future.

When we talk about the remains of earlier civilizations and past centuries, which can be found in several locations on the territory of Serbia, the perception of their importance and scale of value is somehow clearer if their authenticity and uniqueness are considered. The fact is that these buildings of our architecture and material cultural heritage officially recognized and placed on the UNESCO World Heritage List. Moreover, this list is expected to be expanded to include a number of other significant localities.

A large number of cultural assets are categorized as cultural monuments of exceptional and great importance, and this is how these objects and localities are protected, recognized, and affirmed.

Economic development and rising standards of living have had a global effect on human life, reflected in the evolvement of new habits that users and potential consumers/visitors of these cultural heritage monuments have developed. Tourism as an economic branch is expanding all over the world, and in that context, the management of cultural heritage should be viewed as one of the concerns of sustainable tourism. There are numerous examples of how the old walls of a fortress from the Midle Ages could be revived by incorporating contemporary contents. Most often they accommodate artistic contents: fine arts, musical concerts, etc., and all of that in addition to the basic visitor centres, which provides necessary services for tourists. Within the framework of contemporary trends in the tourism industry tourists visiting a particular location are provided with guides, actors actually, who are in certain costumes, by means of dialogues and performances, embody scenes from the historical eras that a certain monument, fortress or locality originate from. Such content, thematic and spatial adaptations can have a positive impact on the preservation of a certain monument, with the application of modern means and methods of conservation of the buildings themselves.

The synergy of the activities of all entities working on the active protection of cultural monuments is very important. As for the heritage management in Serbia, the factor of enthusiasm and active participation of individuals should be emphasized, since it is them who initiate these projects and bring about improvements with great energy and creativity. After proper reconstructions and after the introduction of new amenities, cultural monuments attract a greater number of visitors. The transformation of their content and the permanent care and maintenance during the operation/service, transform those monuments into important tourist destinations. The examples mentioned are the examples of good practice that confirms the aforementioned.

Heritage management is an important practice that initiates a wide range of activities and includes an ever-increasing circle of people who see their economic benefit in such projects. An adequate presentation of the expanded tourist offers, which contain other elements and amenities, expanded the presentation of gastronomy, sports, education, ethno-tourism, eco-tourism, results in the diversification of the offer itself, and consequently in a larger and diverse composition of target groups of visitors. Such practice has already proven beneficial in several localities throughout Serbia, such as: Golubac, Gamzigrad (on the UNESCO list), Viminacium, Manasija monastery, Pločnik locality, Lepenski Vir, Vinča, etc. There are also numerous areas that have acquired the status of special nature reserves, such as the Jerma river canyon, or Đavolja varoš, however, this paper analyzes the management of cultural heritage and cultural heritage buildings. The positive practice and results achieved by the Institute for the Protection of Monuments in cooperation with local communities is illustrated by several examples, moreover various ways in which the increasingly noticeable and mass attendance of these monuments is achieved are shown.

BUILDING HERITAGE MANAGMENT IN SERBIA – GOOD PRACTICE EXAMPLES

The way in which heritage is approached in planning is important both for experts in the field of protection, as well as for politicians and scientists, but also for citizens and tourists, as end users. (New Approaches to Heritage Planning, 2022). Without adequate management and inclusion of heritage in the life of citizens through certain events, cultural monuments might deteriorate and thus fade into oblivion despite the implementation of protection measures and proper maintenance. On the other hand, if one of the monuments

is a stage and a place where certain interesting events take place, it just becomes an unavoidable part of a planned visit to a city, one of the places on the list of things that must be seen, visited, photographed, a memory that you must preserve and take it with you. If the consumers and the target group of visitors are families with small children, then appropriate and thematic contents for children are included, because the interest or lack of it among children is often a factor that affects whether a monument is visited or not, so that the length of the visit of the monument largely depends on the animation of younger population. Therefore, nowadays, workshops for children, camps for children, some thematic adventure parks, or sometimes just suitable furniture for children's play, become one of the prerequisites for better functioning and use of cultural monuments and localities that we want to present to the public. The following examples presented in the paper illustrate good practice, which is becoming a prevalent factor regarding the protection of monuments and the management of cultural heritage in Serbia.

Viminacijum

Viminacium is one of the most important archaeological sites in Serbia. It is located near Kostolac, 12 km from today's Požarevac. This archaeological site represents a Roman military camp and the city that was built in the 1st century AD. It was one of the most important legion camps on the Danube. At one point in its history, it was the capital of the Roman province of Upper Moesia (Monumental Heritage of Serbia, 2007). The area of the former Roman city and military camp of Viminacium (more than 450 hectares of the outer city and 220 hectares of the inner-city territory) is located under arable land.

The research of this locality started in 1882 under the leadership of Mihailo Valtrović. Not long after, the research was led by Miloje Vasic, and later prominent Serbian archaeologists proceeded with the excavations alternately. The archaeological excavations were carried out in several stages: 1902/1903, 1972-1974, 1977-1992, 1997, and since 2000, the works on the excavation site have been conducted continuously. (Cultural Monuments in Serbia, 2022). At present, the archaeological excavations are conducted simultaneously with the activities focused on the conservation and preservation of the site.

The locality was protected by the law in 1949, while in 1979, a decision was made to proclaim this site an immovable cultural property of exceptional importance. It was identified as an archaeological site in 2009, and the spatial plan of the Viminacium special purpose area was adopted in 2015. In the same year, the site was included in the UNESCO tentative list of world cultural heritage.

In 2006, the *Viminacium Archaeological Park* was opened in this area. Within this complex, seven buildings are covered and open to visitors: the northern main gate of the legion camp, the Roman baths, an amphitheater, a mausoleum, a mammoth park, a scientific-research and tourist center (Domvs Scientiarvm Viminacium) and a craft center with kilns for the production of bricks (Viminacium Archaeological Park, 2022).

Domus Scientiarvm Vuminacium is a facility that can serve as accommodation for the research team on the site, accommodation for visitors, as well as for the organization of various thematic gatherings or congresses (Viminacium Archaeological Park, 2022). It was designed in the form of a rustic Roman villa, on two levels. In the lower part there are depots, museums, and halls, while the upper one is composed of a series of atriums around which are grouped offices, laboratories for research work, as well as accommodation facilities.

Limes Park, as stated on the official website, represents a new approach to congress tourism and summer open schools. This complex is located in the immediate vicinity of the research center. It was built as a replica of the Roman military camp found at the site of Viminacium. The idea was to offer the visitors and scientific workers accommodation in the barracks of the Roman legionnaires, so that they could experience the daily life of the Roman legionnaires as authentically as possible. In addition to the accommodation capacity, there is also a workshop space intended for all kinds of presentations, lectures, trainings, and workshops.

Figure 1 Scientific research and tourist center, ph. Darko Antić (left) Christ's monogram on the floor of the exhibition area (right), photo by Milanka Vasić

The adventure park is intended for children and adults. It contains a training ground with 15 different obstacles, and a high-altitude park with a zip line. All obstacles bear the names of Roman emperors and military leaders born on the territory of today's Serbia.

The mausoleum, measuring 20/20m, with a central building in the medium sector, is a part of the archaeological site, which is covered by a protective structure made of glued-laminated wood and plastic-coated membrane. It is open to visitors. Both the thermal baths and the North Gate of the camp are covered with a protective structure.

Within the Viminacium archaeological park, one can see a wooden replica of part of the Roman amphitheater from the 2nd century AD (Nikolić, 2018). The mammoth park has been singled out as a special attraction within the archaeological park. Namely, in 2009, during the excavations on the surface mine Drmno on the outskirts of the Roman site, the complete skeleton of a female mammoth was discovered. In 2012, fragments of several mammoths were found at the Nosak site. These finds were dislocated and transferred to the archaeological park of Viminacium. An appropriate protective structure was extended over the skeletons, which are in the underground space, while footpaths and a children's playground were incorporated into the surroundings. (Nikolić, 2017).

Today the locality is famous for its remarkable and diverse tourist offers, such as the following: tours with a professional guide, accommodation in the rooms within the visitor centre, food tasting the so-called Roman breakfast, Roman lunch, or Roman dinner (in a space that was built analogous to the authentic Roman ones). Moreover, this authentic experience includes one-day, five-day or seven-day children's whose purpose is the affirmation of the cultural heritage and its adjustment to the children's age. In addition to sports activities, children are offered excursions to the surrounding cultural assets, pottery workshops, as well as virtual tours of Roman sites, together with archery, orienteering. ... All these activities, as well as the sheer value of the presented and found material, have made Viminacium an indispensable point of visit as regards school trips. Numerous festivals and concerts have been held in this space since its inception. The archaeological park has hosted many international scientific and professional meetings in the field of archaeology, education, tourism promotion of heritage, etc.

Also, the Exhibition "Journey to the past - Itinerarium Romanum Serbiae - Viminacium" represents one of the best examples of promoting Serbia's cultural heritage in the world. Organized by the Belgrade Archaeological Institute, under the auspices of the Ministry of Foreign Affairs of the RS, the exhibition promotes the discoveries made by researchers at this site around the world.

Figure 2 Mausoleum (left) and Mammoth park (right) photo Darko Antić

In this way, Viminacium is available to the interested consumers of all ages. With a very diverse offer, in terms of preserved, presented or replicated parts of the locality, but also in terms of social events, Viminacium is often not only a place to stop by for a short time, when traveling through this part of the country, but also a a destination chosen and favored by numerous visitors.

Gamzigrad

Gamzigrad is an archaeological site located near Zajecar. This site displays the remains of the Roman court architecture, the fortified imperial palace, which was built at the request of Emperor Gaius Valerius, Galerius Maximilian, at the end of the 3rd and the beginning of the 4th century. He built the palace in honor of his mother, after whom it was named *Felix Romuliana*.

Thorough archeological excavations conducted on the site have been in progress since 1953. Dragoslav Srejovic, one of the most renowned Serbian archeologists, managed the works at this site from the 70s of the 20th century. It is a large palace complex surrounded by a double system of ramparts. The older, inner, and the younger, outer fortifications with twenty massive towers almost squarely framed the palace space. The city comprised of the imperial palace with a small temple and a monumental altar in the northern part of the complex, and public buildings in its southern part (a large temple with crypts, thermal baths, as well as various palace facilities, a small temple, a large temple, and thermal baths). There are a tetrapylon and a memorial complex on the hill of Magura located immediately above the site. The buildings are richly decorated with frescoes, mosaics with figural and geometric motifs and decorations of great historical and artistic value. (Monumental heritage of Serbia, 2007). Research and conservation activities on the site have continued to this day with varying intensity.

The site was declared a monument of culture in 1948. In 1979, it received the category of exceptional importance, and in 2007, it was inscribed on the UNESCO list of world cultural heritage. This is also the only archaeological site in our country on this list.

Within the palace, there are no specially built facilities for the accommodation of guests. In the preserved towers, it is possible to organize exhibitions of different character. Although considerably smaller, in terms of the surface area, than the aforementioned Viminacium, Romuliana is part of various cultural projects. For example, in April of this year, a workshop called "Felix Romulijana digital laboratory" was held for high school students. This project aimed to strengthen awareness among young people about the importance of cultural heritage and the education of their peers. "Felix Romulijana digital laboratory" is a project led by the National Museum of Zaječar together with the Center for Urban Development and the project was supported by UNESCO. (Zajecarski dnevnik, 2022)

As part of the Romulijana Day 2021, children's puppet workshops and ceramics workshops for children were organized on the site (National Museum of Zajecar 2022). This year too, the Zajecar Cultural Summer is being organized in Romulijana, in which numerous musical performances and concerts were held. Also, classical music camps, and various artistic activities are the contribution of the National Museum of Zajecar, to this locality the contents that attract a constantly increasing number of visitors. Apart from outdoors, events are also held indoors in the western gate tower.

Figure 3 Posters announcing the Days of Romulijana 2021 and 2022 (Natinal Museum of Zajecar 2022)

Golubac

The fort of Golubac is a medieval fortress located in Djerdap National Park, on the right bank of the Danube. It is positioned downstream from the Golubac settlement. The city had a strategic character, it was built on a rock above the Danube, with a keep at the highest point and other towers and walls fan-shaped in two rows towards the weakest side - the west. It was originally built for cold weapons warfare, and the three southwestern quadrangular towers were later walled up from the outside with round reinforcements. Cannon holes can also be seen in some places. The only true polygonal cannon tower was built at the northern end of the bank. (Monumental Heritage of Serbia, 2007))

At the beginning of the 20th century, a main road was built through the fortress, which significantly damaged the gates of this fortress. Investigations of the site began in 1969, urged by the construction of the Djerdap HPP. Research and conservation works were carried out in several stages.

The fort of Golubac, as a cultural asset of exceptional importance, also belongs to the Golubački grad Nature Reserve, an area that represents the entrance to the Đerdap Gorge and at the same time the entry point to the Đerdap National Park. In 2011, the Republic of Serbia declared this area a tourist area "Golubački grad Fortress" which, thanks to the Project "Revitalization of the fort of Golubac " financed from the IPA Funds for 2011 and 2016, was equipped with infrastructure, while the Fortress itself was reconstructed. (Fortress Golubac Grad, 2022))

The visitor centre with a cafeteria and a souvenir shop is the starting point for people who embark on a tour of the fortress. The area of the Fort is zoned, and the price of the entrance ticket depends on the zone visited by the visitor. Depending on the difficulty of the path that must be taken to a certain point, there are restrictions. Thus, access to the green zone is allowed for all categories of visitors, to the blue zone only to adults, while the presence of a special escort is necessary for the red zone, and certain security measures are required for the black zone. In addition to visiting the fortress in this way, it is possible to see permanent and temporary exhibitions in the towers of the fortress.

The Golubac Cycling and Mountaineering Association, in cooperation with the Fort, ofers three hiking trails: "Rose and Lilac Path", "Golubac Ring" and “Spiritual Health Path". The fourth stage begins 2 km before the Golubacki grad Fort.

Various events are also organized in the fortress such as poetry evenings, concerts, as well as sports competitions. Thus, in May 2022, the fortress was the venue for the Red Bull Fortmaster, a unique race with obstacles placed from the quarry to the foot of the Đerdap gate. The Fort is no stranger to gastronomic manifestations, so the 1st Wine Days were held within its walls (Tvrdjava Golubački Grad, 2022).

The fortress is a partner in the "Castles and Regions" project. The leading partner is the National Museum of Hungary, and in addition to the Golubáčki grad Fortress, the participants were Estergom Fortress, Komarno Fortress, Višegrad Castle, and the museum in Sandomierz. (Castles & Regions 2022). As part of the project, a virtual exhibition entitled "Our common past for a common future" was held. As part of the project, the 1st international workshop "Fortresses for the Region - Region for Fortresses" was held, which brought together a large number of experts and researchers from the participating countries.

Figure 4 The fort of Golubac (left) and a view of the cannon tower (right) Photo Zdravko Jovanović

The Golubac Fort, therefore, very actively, by organizing various events and by an participating in various projects, attracts more and more visitors, whether it is the professional public, researchers, or visitors who visit this destination as tourists, who are motivated to spend their day ~~in~~ visiting the locality itself, walking in the surroundings, cycling along one of the paths, or visiting one of the exhibitions or occasional events.

Manasija

Manasija is one of the most important Serbian medieval monasteries. It is the endowment of the Despot Stefan Lazarevic. It was built in the period from 1406 to 1418. It belongs to the type of fortified monasteries. In the center of the complex is the Church of the Holy Trinity, a triconchal five-domed church with a lazout of a developed cross. According to the floor plan, it belongs to the Morava architectural school, while the exterior decoration is more western in style. Within the monastery complex, there is a refectory, followed by monastic cells, storerooms, a workshop, and a hospital (Cultural Monuments in Serbia 2022).

The first research works, led by Slobodan Nenadovic, were carried out in the period 1956-1964. It was declared a monument of culture in 1948 and received the category of exceptional importance in 1979. Research and conservation works have been conducted on several buildings in the complex which has contributed to its being well- preserved.

Manasija has become popular with tourists because of the event held in the monastery, called Just Out festival. It is the annual international festival of the unique concept K.A.M.F. and New Technologies (Festival JustOut 2022), traditionally held in August, this year organized by the White Eagles, an association of knights from Serbia. The goal of this year's event is to mark 6 centuries since the founding of the monastery. It gathers knights' associations from more than twenty countries. The festival was held for the first time in 2015. It is held each year ever since.

As part of the festival, visitors have the opportunity to see a large number of knightly fights (tap fights, shield and sword, two-handed ax, buckler and sword, two-handed sword). Fights are organized in two separate categories, for males and females. Also the program includes group fights. The reconstructions of various battles also attract a lot of attention - the reconstruction of a battle in a medieval village, the reconstruction of the Battle of Tafl - a castle for the king, etc. Moreover, archery tournaments are organized, as well as fire and sword games. There are also medieval workshops for archery, horse riding and the like, where visitors can feel the spirit of the medieval way of life. The entire manifestation is accompanied by an adequate music program (Festival Just Out 2022).

Various children's workshops with knights are also organized. An indispensable part of the festival is the culinary offer of enjoying medieval specialties and Serbian wine.

Figure 5 Festival Just Out, 2019, Photo Zdravko Jovanović

CONCLUSION

The paper presents the selected examples of cultural monuments on the territory of the Republic of Serbia, which have succeeded in becoming institutions owing to their innovative program activity, as well as conscientious management policy, coupled with the great enthusiasm of individuals and the synergy of institutions. These monuments of culture have surpassed their being purely cultural heritage and have become an integrated part of their community, favorite tourist sites for both local residents and an increasing number of national and international tourists.

There are several cities in Serbia that have exceptionally well-preserved fortifications in the heart of the city, because the cities historically developed around these historical cores. We can point out that the Petrovaradin Fortress is the host of Exit every year, and that the Nis Fortress is recognized as the Summer Stage -where the program of the Nisvil Jazz Festival and Film Encounters take place (this year for the 57th time!), and that the Smederevo Fortress is the venue for the international theater festival, as well as the International Film Festival. The Kalemegdan contains within its borders: the Zoo, the Art Pavilion of Cvijeta Zuzorić for permanent and temporary art installations. In the Kalemegdan, also in the Belgrade Fortress, there is the Military Museum, (whose impressive collection of weapons tells the poignant story of the main armed conflicts in our region as well as the suffering that inevitably accompanied them). The mentioned monuments occupy a very large area and are inside the city cores, which gives them an even greater importance, making them unavoidable regarding any architectural plans and investments. It is by their disposition in the very center of the city that they have imposed themselves as a recognizable symbol of each of the cities where they are located.

The paper describes the examples of the localities which are not located in the cities themselves, but which managed to come to life with a good approach and adequate management, and above all recognition of their value and potential by local self-governments and international funds. And they continue to grow, through the manifestations that are organized in them or around them.

As a final message and lesson for heritage management based on presented examples of good practice, in short: Viminacijum- adventure park, Gamzigrad- different workshops and artistic programs, Golubac - modernization of the tourist offer, sports and artistic content, Manasija – “Just Out” festival inspired by the medieval tradition, with a presentation of local wine and food producers. If we try to find a common thread, it can be concluded that a wide range of content and the gathering of different participants and entities in the maintenance and management of cultural heritage sites leads to improved results.

These examples show that the individual enthusiasts and their efforts, as well as wise management, and the synergy of institutions and self-government (the state), can breathe life into these localities, so that they become generators of new events, and stimulate the economic prosperity of the area where they are located. If it were not for that, these localities would have been forgotten and left to the ravages of time, like Fetislam, Caricin grad, and many others. Although they are in good condition from the aspect of technical protection, these cultural monuments remain only forgotten witnesses of the past and not participants in the present. As the witnesses of the past they can tell us memorable stories, but only if we recognize and uncover their beauty from under the layers of earlier eras and years and enrich them with new meanings.

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VANISHING OF VERNACULAR ARCHITECTURE - A CASE STUDY OF SOUTHERN SERBIA

Ana Momčilović Petronijević

PhD., Associate Professor, Faculty of Civil Engineering and Architecture, University of Niš, Serbia
ana.momcilovic.petronijevic@gaf.ni.ac.rs

Milanka Vasić

PhD student., Faculty of Civil Engineering and Architecture, University of Niš, Serbia
milanka3970@gmail.com

Ivana Cvetković

Institute for the Protection of Cultural Monuments, Niš, Serbia
Ivana.cvetkovic.ct@gmail.com

ABSTRACT

Folk, vernacular, architecture represents a very important part of cultural heritage. Considering that most of these buildings, in the southern Serbia are built in a wooden frame ("bondruk" or postand-pan system), with a wooden skeleton and earth filling, or some other earth-based material they are very susceptible to decay.

This type of heritage is even more susceptible to deterioration due to the action of atmospheric conditions compared to the structures and heritage made of other materials. Furthermore, the demographic emptying of the village and the lack of interest in these buildings, those are some of the main factors that lead to a lack of care for these monuments and their destruction and disappearance.

In this paper, we analyze houses built in the spirit of folk architecture in Southern Serbia. We would give an overview of the main damages that most likely would be seen on those types of buildings. We point out the main problems that will lead to decay of the vernacular architecture. We also propose some of the possible measures for the rehabilitation for those resulting damage, so that the facilities either can retain their basic function or to be adapted to a possible new usage. As an old saying goes: "Cherish or it will perish".

Keywords: *vernacular architecture, folk architecture, devastation, decay, country house*

INTRODUCTION

The territory of Serbia is very rich in cultural heritage. In our area there are remains of settlements of prehistoric man, then ancient cities, then Byzantine ones... Medieval churches form a large and significant part of our cultural heritage. Then there are fortifications and fortification systems from different eras, war memorials and monuments to suffering, monuments of classicism, academism, art deco... The legacy that we have, that we have been left to guard, and that we leave to future generations, is very diverse.

Most of the cultural heritage is valorized, and based on its historical or cultural value, it is classified into several categories. On the other hand, many works, which are part of our heritage, await their turn to be adequately valorized, then adequately protected, conserved and presented to the public. On the UNESCO World Heritage List, there are listed structures of our architecture and material cultural heritage objects, and it is likely that this list will be expanded to include some more significant sites. Then there is a large number of cultural assets, declared cultural monuments, which are categorized as cultural monuments of exceptional and great importance. These procedures and measures mean that these buildings and sites are recognized and protected, but also affirmed in this manner.

Problems of cultural heritage, which is embodied in the traditional architectural heritage, however, has a different treatment. Mainly, the structures of vernacular architecture, whether due to the nature of the materials from which they were built, or perhaps the more recent date of construction compared to some other heritage structures, are in a much worse condition compared to the others. Also, since this type of cultural heritage is dominantly found in rural areas, which is a synonym in Serbia for an undeveloped area, almost without exception, their poor condition is not surprising. Therefore, these buildings, almost with no exceptions, are quickly dilapidating and are in a very poor condition. It can be concluded from this that since the rural areas are in a poor condition themselves, it is not surprising that the vernacular architecture is devastated to this degree.

In the paper, we will present some examples of buildings of vernacular construction, which have been dilapidated and are in the process of disappearing. Be them the structures recognized as cultural assets, or those that still have not been, they have in common a poor current condition. If this trend continues, and if carelessness takes hold, we are in danger of being left without a large part of such monuments, which are an image of our identity. By losing these buildings, apart from the material, we also lose the intangible heritage in the form of various construction techniques and crafts associated with the traditional architectures, and unless a systemic effort is not made, and they do not receive a due attention, these skills and crafts will forever vanish just as these buildings

VERNACULAR ARCHITECTURE OF SOUTHERN SERBIA

Vernacular architecture is one of the forms of cultural heritage. Architecture without architects, built without professional guidance and any academic tradition. Structures of vernacular architecture are usually built for the local, individual needs of the users. These architectural works are limited by the material in a certain region, and are a reflection of local traditions and cultural needs.

When we study vernacular architecture, we do not investigate professional architects, their style or working method, but the design and construction skills of the local population, who are almost never mentioned as the authors of the building.

In Serbia, a significant part of the cultural heritage consists of structures of vernacular architecture. Such structures, apart from being material remains, also represent a testimony about the nature and characteristics of the available material, about the way of building and life in a certain environment, which differed from area to area.

Materialization

If we talk about the vernacular architecture of southern Serbia, the first image we have before our eyes is a house with white walls, wide eaves, with a wide porch, covered with S tiles.

Mostly, these are characteristics of a largest number of buildings of vernacular architecture in this area. They were constructed in the post-and-pan system, with different infill. These “punjenice” (infill cottages) were built, which depending on the manner of filling in the walls can be “kovanice” “čatmare” and “dolmare”. “kovanice” are characterized by the fact that the wooden frame of columns and braces was nailed over by thin boards which were roughly hewn with axes, and the daub made of mixed mud and straw was placed between the boards. The walls were plastered by mud on both sides (Momčilović Petronijević, 2010). “Čatmare” which are equally present, have the woven wattles for the walls, plastered on both sides with mud. The third type are “dolmare” whose walls were made of adobe, lain between the frame boards (Deroko, 1950). They are plastered with mud mortar on both sides and then painted in white.

What all the listed materials have in common is their exceptional lack of weather resistance. Those are porous materials that quickly absorb moisture from the air. Prolonged exposure to weather effects, without adequate maintenance, leads to gradual degradation and later collapse of buildings. This is aggravated by the fact emigration from the rural areas is still ongoing, so the largest number of buildings with elements of traditional architecture are abandoned, or they are inhabited only temporarily, and as such are left to natural decay.

DISAPPEARANCE OF HERITAGE

Many buildings of vernacular architecture, with monumental value, have been irreversibly lost nowadays, unfortunately. The reasons can be numerous, from wars, natural disasters to negligence and lack of interest or financial resources for maintenance and reconstruction. (Čurćic et al. 2020).

A part of this heritage, as other types of monuments, disappeared forever during the wars which ravaged this area. In the Balkan Wars, and alter in the World Wars, most of the cultural monuments perished. The most representative house of Niš in XIX century, The house of Bećir bay, which was later the Milan Obrenović's property and his summer residence, was burned down in 1916 in WWI. The house of the Nis trader Hadži Todorović, better known by its subsequent owners as the Hristodul house was destroyed during the aerial bombing in WWII. The house of Krivokapski was located near the Cathedral. It was a very valuable monument of old town architecture. It was destroyed in September 1944 during the bombing of Nis.

The house of the Turkish military doctor Zaharije Statas is also a building that possessed exceptional monumental values. It burned down in a fire in 1928. It is possible to list many other buildings, such as the house of the Niš priest Petar Ikonomović, the Niš quilt maker Živko Mihajlović, which were destroyed during the war. (Andrejevic, 1996).

Figure 1. Very valuable houses, in architectonic terms the Hristodul house (Kuća Hristodulovih, 2022) and the Zaharije Statas house (kuća Zaharija Statasa, 2022)

War destruction, unfortunately, could not be avoided. All spheres of human existence suffered great damage, including heritage. Unfortunately, the disappearance of heritage is happening even today, before our eyes, due to many different reasons. Although the process itself is much slower, it is certainly present. Monument by monument slowly succumbs to the ravages of time and slowly disappears

CASE STUDY

Buildings of vernacular architecture are perhaps one of the most neglected types of buildings in the context of conservation. Somehow, during technical protection, more attention was always paid to sacral architecture, war memorials, archaeological sites... In the past, even a very small number of researchers studied this type of heritage, compared to other types of monuments.

. Today, the situation should be somewhat more favorable. Unfortunately, after the field research, we did not get such an impression. Be it because of the nature of the material from which the vernacular structures were built, because of the demographic decline of the village, or for some third reason, but the situation on the ground is devastating. The buildings are not maintained, there is no interest in their renovation or any kind of technical protection, and they are generally in a very poor condition.

Figure 2 Generally very bad condition of the vernacular architecture structures, photo A. M. Petronijević

Figure 3 House in a Zaplanje village. Photos taken, two years apart, photo A. M. Petronijević

Ground level house in Gornji Prisjan village

By visiting several villages in the area of southern Serbia, it can be concluded that the structures of vernacular have really been left to decay. An illustrative example is a house in the village of Gornji Prisjan. The building was built in the spirit of vernacular architecture of this region. It is not listed as a cultural asset, and therefore does not enjoy any legal protection.

Figure 4 Condition of the building in 2016. Photo AMPetronijević

Corner house, built in the post-and-pan system, with an adobe infill. The shape of the house follows the angular shape of the plot, so the building has a base in the shape of the Cyrillic letter Г truncated at the end. The house is owned by a family that lives in another, newer building, in the same yard. Considering that it lost its primary purpose of housing, because the family moved to a newer building on the plot, the interest in its maintenance was also lost. In just three years, which passed between the first and the last photo of this building, the building completely vanished.

Figure 5 Condition in 2018. (left) and the entirely demolished building 2019 (right) photo A. M. Petronijević

Todor Kocić house in Jelašnica

Does legal protection of building and their listing as cultural monuments guarantees their survival?

Not even the legal framework is the guarantee for survival of such buildings. The old village house of Todor Kocic in Jelasnica was listed as the cultural asset as early as in 1986. It was recognized as building with monumental properties and pronounced the cultural monument, based on the Decree of the Executive Committee of Municipality of Nis of March 1983. (Institute for Preservation of Cultural Monuments Nis) it was located in the central part of the village, along the road going towards the Jelasnica gorge. The building was built in 1910. It is a one storey building with asymmetric floor plan. The ground level is built of stone, while the floor was built in the post and pan system. The roof, covered with S tiles, has a complex geometry because of such a floor plan. It is characteristic for its arcade on the porch (Cultural Monuments in Serbia).

Figure 6 Todor Kocic house - original condition (Kuća Todora Kocića, 2022) and condition in 2006 photo A. M. Petronijević

Although its architectural values were recognized by conservation experts and competent institutions, there was no salvation for this building. The lack of interest of the owner/heirs, if there were any, or simply the lack of financial resources, caused the house to disappear completely. The field visit in 2019, showed that when asking about the house, even the locals could not direct us to the right address. Only a few residents could remember the now long-demolished house, the only surviving parts being the overgrown stone wall.

Figure 7 Condition in 2011 and 2019. Hardly recognizable location where the building was located, photo A. M. Petronijević

Complex of watermills in Dušnik

Unfortunately, the buildings which have recently been listed as cultural monuments, or are in the process of being listed are in the similar situation. Let us observe the case of the watermills in Dusnik. The village of Dusnik is 13 km from Gadzin Han. The village is known, apart from the spring in Gornji Dusnik, for its water mills, the so called Dusnicke watermills (Simonović 1982). Along the stretch of around 1km, from Gornji to Donji Dusnik, there were 17 watermills built. Their architectonic, but also ambient value was recognized by the local community, so as early as in the 80's of the 20th century, here was organized the painting colony "17 watermills". The first scouting of the field was performed by the professionals of the Institute for Preservation of Cultural Monuments Nis in 2004. In 2009 the municipality of Gadzin Han, which recognized the tourist potential of these watermills, initiated he collection of documents for listing the watermills as cultural assets. In

2010, the team of the Institute for Preservation of Cultural Monuments Nis, which was in the field to collect the necessary documents, concluded that there were 11 watermills surviving of the original 17, and 8 of them being operational Momčilović Petronijevic and Cvetković 2016). Nowadays, these watermills are undergoing procedure of being listed as a spatial cultural-historical entity.

What happened in the meantime? Although the potential of these mills has been recognized, although it was been established that they possess ambient, practical, economic, historical, cultural, ecological, traditional, folk, architectural values, the mills have been neglected in terms of the physical and technical protection.

In the course of 2018, field visits resulted in concluding that out of the remaining 11 watermills: two were completely collapsed, two were partially collapse, two have a caved in roof, while the walls were stable, two had a partial damage of the roof, and only three watermills were found to be in good repair (Momčilović Petronijevic and Cvetković 2016). The field visit in 2022 revealed that some of the watermills could not be recognized. They were fully or partially collapsed, and overgrown. Only two watermills can be considered to be in good condition.

Figure 8 The same watermill photographed in 2009 (left) photo Cedomir Vasić, in 2016 (middle) photo A. M. Petronijević and 2022 (right). photo A. M. Petronijević

Figure 9. Celija watermill 2009 (left) photo Ivana Cvetković and 2016 (right), photo A. M. Petronijević

Figure 10 The same watermill photographed in 2010 (left), 2016 (middle and 2022 (right). photo A. M. Petronijević

CONCLUSION REMARKS

Due to globalization, industrialization and general modernization, there have been substantial changes in people's way of life. We cannot expect the buildings of vernacular architecture to live the life they once had, when the people who lived in them no longer live the same life. New requirements in terms of sanitary, thermal, and functional needs have led to substantial changes in the organization of homes. Furthermore, due to the construction of the road network, now also in rural areas, easily available construction materials enable

the rapid construction of houses that meet modern human needs. Therefore, it is more profitable for the owners to build a new building in which they will live in better sanitary conditions, than to maintain the old one. Their slow demise began by them losing the primary function of dwelling houses.

Given that, as previously stated, these buildings are located in rural areas, which are also poor areas, it is not possible to single out the vernacular architecture and view it as an independent and separate element, but it is only possible to look at it through the prism of development opportunities, and through current trends in the development of rural areas at this time. If the opportunities and potentials for the development of a rural area are greater, it means that the buildings of traditional architecture will be more easily preserved in that case. It can be discussed: is it also valid otherwise? Namely: does the existence of cultural heritage in a rural area in the form of traditional architecture increase the chances for the rural area development?

The fact is that even buildings that have already attracted attention, that is, that have already been recognized as cultural assets, are not in a much better position. As things stand now, even the protection institutions do not have a real and concrete model for the physical protection of monuments with mechanisms that would be effective in preserving these structures. Financial means, that is, economic interest is a key factor for the preservation of heritage, which is missing in this case. If appropriate planning documents can be provided, for example, tourist content at the location of the mills mentioned in the paper, then funds can be allocated to the owners from various funds for their restoration, and we believe that we would have a completely different picture on the ground. The inclusion of such facilities in any kind of sustainable activities would significantly improve their general condition.

It should be kept in mind when making decisions, giving recommendations or even providing funds, how important the role of the community itself and of individuals is. Education should raise people's awareness of the value and importance of these structures, and thus offer possible development directions and show that there is a perspective for such structures as well. Their participation in solving these problems is necessary, but a large number of things can be influenced by measures that are not repressive, but stimulating. The works on investigating and recording of these structures, on the one hand, leave through the recorded materials, information about the heritage itself, give an insight into the state of affairs, but they can also be used as a starting point for the involvement of experts from different fields, who from their aspect can give support to preserve the structures of traditional architecture, and convey the testimony of the architectural tradition in these areas. We owe it to numerous unnamed builders and leaders of construction groups, who created these structures in the past.

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GREEN RESIDENTIAL COURTYARDS IN THE REVITALIZATION OF CENTRAL CITY ZONE AND POSSIBILITIES OF USE IN THE CITY OF NIŠ, SERBIA

Milena Dinić Branković

University of Niš, Faculty of Civil Engineering and Architecture, Serbia
PhD., Associate Professor, milena.dinic@gaf.ni.ac.rs

ABSTRACT

Within contemporary urban planning policies and approaches, green open spaces in the urban landscape represent a valuable asset for creating resilient cities. This paper explores the revitalization of residential courtyards in central city zones that implement urban greening concept, and discusses the manifold benefits that it brings about. Best practice example of the City of Graz is presented to illustrate the revitalization of residential courtyards within a participatory planning process, and the benefits achieved regarding environmental quality, recreation options, social interactions and visual enhancement. These findings are used to establish urban planning and design guidelines for the revitalization of open spaces in multi-family housing areas in the central zone of Niš, and furthermore, to discuss measures and activities for successful implementation of plans and projects and enhancement of community involvement. The results of this study should help with retrofitting existing public open spaces in housing areas, in both policy framework and implementation in Niš, and make a good basis for further research on adaptation of densely built central zones to climate change.

Keywords: *urban planning and design; multi-family housing; public open space; greening; resilience*

1. INTRODUCTION

Increasing urbanization in the last couple of decades has resulted in the increase of paved surfaces and the decrease of greenery in urban areas. Paved surfaces, which are usually impervious, contribute to the increased volumes of stormwater runoff in a short amount of time, thus causing flash flooding (USEPA, 2005). Large amounts of pavement are also known to cause the "heat island effect[13]". As a result of heat stress in hot summers, particularly in inner cities, population experiences health problems, which may even result in deaths (Holstein and Schwaberger, 2011). Intense urbanization has widely been recognized in scientific research as one of the causes of climate change.

Re-introducing greenery into urban landscape is nowadays considered to be an imperative, both in urban planning policy and practice. Urban greening can help in increasing the overall resilience of urban areas to natural disasters, and thus adapting the built environment to the impact of climate change. In light of this fact, implementing blue-green infrastructure (BGI) and nature-based solutions (NBS) is particularly important in contemporary urban development. Blue-green infrastructure includes (Dinić Branković et al, 2020): (1) the blue component, which refers to urban hydrological functions, such as watercourses (rivers, streams) and still waters (lakes, ponds), and (2) the green component, which entails vegetated areas in urban environment, such as urban forests and meadows, parks and protective greenery. Nature-based solutions are actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively

13 "Heat island" is a phenomenon that occurs in urban environments with temperatures that are much higher than in natural environment, due to intensive urbanization and the increase of paved surfaces.

and adaptively, simultaneously benefiting people and nature (iucn.org). Green and blue elements in urban landscape, within the framework of nature-based solutions, can help in minimizing the vulnerability to risks such as heat stress and flooding from extreme rainfall. Greening central city zones is particularly important, since these are usually the most densely built areas of the city. Many cities around the world are exploring possibilities to use various types of urban greening in addressing climate change challenges. Network of public open spaces plays an important role in providing greening options, and the open spaces adjacent to multi-family housing are a vital part of this network. Cities such as Berlin, Vienna and Graz are already implementing revitalization projects that preserve existing and introduce new green spaces into inner-city courtyards (www.zobodat.at).

Another crucial topic for planning resilient urban areas concerns implementing sustainable mobility solutions, because of their benefits to the environment and public health. Traffic patterns suited to pedestrians and bicycles, along with developed public transit, are a preferred option for the city center, since they alleviate traffic congestions and enhance urban flow. Sustainable mobility routes are best fitted within the BGI grid, which is created by interconnecting various natural open spaces in urban areas with green or blue linear pathways (Dinić Branković et al, 2022b).

This paper discusses the main urban planning and design principles and approaches in the revitalization of open spaces within multi-family housing, and examines their potential use in shaping the post-socialist central zone of the City of Niš, Serbia. With a population of approximately 260.000 inhabitants (2011 Census), Niš is the third largest city in Serbia and a typical post-socialist city of medium-size. Post-socialist development period had significant implications upon the urban landscape of Niš, with urban densification and loss of public open space/green areas being the most remarkable features of transition (Dinić Branković et al., 2018). At the beginning of the transition period, no one considered how urban densification would affect the environment, microclimate and thermal comfort of users (Dinić Branković et al., 2022a). Urban densification, along with the increase of paved surfaces and decrease of green areas, had significant environmental impacts in the inner-city housing areas, including temperature increase, flash flooding and degradation of the ecosystem. However, urban planning approaches that involve NBS and BGI have not yet been comprehensively reviewed and implemented in urban planning policy and practice in Niš.

The initial hypothesis of this research, which is supported by contemporary urban planning body of knowledge, is that implementing greenery into dense housing areas in the center of Niš can help in increasing its urban resilience. Therefore, the main goals of this paper are: (1) to explore the benefits that the revitalization and greening of residential courtyards bring about to inner-city communities; and (2) to establish urban planning and design guidelines for revitalization of open spaces in multi-family housing areas in the central zone of Niš, which could help in addressing climate change challenges.

2. MATHERIALS AND METHODS

This paper explores the revitalization of open space in housing areas by using empirical research and literature review. Methodological framework is conceptualized on description and analysis of a selected best practice example, with the synthesis of study findings used for discussing urban planning and design guidelines in the case of Niš. In order to illustrate the benefits of greening the central city housing blocks, the paper first explores revitalization of inner-city residential courtyards in the City of Graz. This particular best practice example was chosen to best reflect the benefits of courtyard revitalization, since it implies several completed projects, whose effects can be evaluated. Additionally, revitalizing the courtyards of Graz was a greening initiative that illustrates what could be achieved in central zones of many European cities, particularly in those of similar size such as Niš. In Niš's Municipality of Medijana, where the central city zone is located, there are more than 90 public open spaces within multi-family housing areas that are in need of revitalization. Therefore, the City of Niš makes a suitable research polygon for greening the inner-city residential districts.

3. BEST PRACTICE EXAMPLE – REVITALIZING THE INNER COURTYARDS OF GRAZ, AUSTRIA

The City of Graz is the second largest town in Austria, with a population of approximately 300.000 people (www.citypopulation.de). It is the capital of the federal state of Steiermark, which is known for its vast number of forests and green areas. It is estimated that green spaces cover 40% of the urban area of Graz (Schwaberger, 2011). The strategic planning vision is to retain this valuable asset of green infrastructure in future urban development. Therefore, the Department of Spatial Planning and the Department of Construction and Building of the city of Graz have developed and implemented a range of green infrastructure projects within the GRaBS

project[14] (Green and Blue Space Adaptation for Urban Areas and EcoTowns). One of these greening projects involved revitalizing the inner courtyards in the center of the city, which was implemented in 2007/2008. This intervention could serve as a showcase for both planning professionals and local communities in many European cities on how to integrate green infrastructure into urban planning practice and development.

Urban matrix of Graz has many enclosed or semi-enclosed urban blocks, with courtyard buildings of the pre-modernism period aligned at the block perimeter. This is particularly the case in the center of the city. These inner shared courtyards are commonly semi-public or private open spaces. Before revitalization, many inner courtyards were desolate concrete areas used for parking, but some of them were well landscaped with greenery. Such courtyards with their green and open spaces are highly valuable in the densely populated urban area of Graz, both for the residents and for the entire urban area. Aside from their use for urban recreation, the courtyards also have a positive effect on air quality and micro-climate due to a variety of plants, and generally contribute to the improvement of the quality of life of local residents (www.gat.st).

Revitalization of inner courtyards of Graz began with a *concept phase*, which focused on the conservation of valuable green spaces. It was followed by the *participative planning process*. Having the main goal in mind, it was crucial to involve the local community in revitalization, especially regarding the future use and design of inner courtyards. The first step was to educate the owners and other private users on the importance of green spaces in inner courtyards, thus motivating them to take active participation in the process of revitalization.

The most important outcome of the participative planning process was *developing the Strategy* called Revitalizing the Inner Courtyards of Graz, that should help the city with future development of inner courtyards. Revitalization strategy included (Schwaberger, 2011):

- Creating incentives for the private owners to participate, both physically and financially,
- Conserving the intact inner courtyards,
- Improving access to inner courtyards (overcoming legal issues to acquire shared space),
- Eliminating disturbing fixtures and uses, and
- Extending and improving green space in the inner courtyards.

Another important outcome involved *delivering pilot projects*. The participative planning process was carried out in seven courtyards, where residents themselves suggested the design and use of their courtyards. The seven pilot sites were selected from twenty submissions (www.gat.st). The aim of the pilot project courtyards was to gain experience on how to deal with the problem of courtyard revitalization and greening in the future. Criteria for the selection of courtyards were the motivation of residents and different ownership structures, i.e., a mixture of private ownership and housing owned by the city of Graz. For some courtyard sites, the focus was on un-paving and greening, while for others it was set on improving accessibility for the entire community. The revitalization of three inner courtyards in Graz is presented in Table 1, in order to illustrate the successful implementation of the project.

Also, the project resulted in *improving cross-departmental cooperation*, such as the Department of Urban Planning, Department for Green Spaces and Water Bodies, Department of Construction, Office for Housing Affairs, Office for Youth and Family, etc.

Finally, the project resulted in *enhancing community involvement,* which represents a crucial point when preserving inner courtyards as green urban oasis. The costs of implementation were primarily borne by the owners, with the City of Graz providing a small amount of financial support. The owners received 1.000–2.000 euros in funding (www.gat.st). The condition was that the costs should not be passed on to the rent, but financed from the maintenance budget.

The planning process took around two months in total, and the call for tenders and implementation around four months. The total cost of the project was 100.000 euros, 50% of which was financed by the EU

14 GRaBS is a network of 14 project partners involved in integrating climate change adaptation into regional planning and development (climate-adapt.eea.europa.eu).

(www.gat.st). Initiatives like these should help in raising awareness of residents and users on the significance of green infrastructure in revitalization processes.

Table 1: Factsheet on the selected courtyards in the best practice example of Graz

Courtyard location	Jakob-Redtenbacher-Gasse 9	Schönaugasse 21	Bahnhofgurtel 65/Schmölzergasse 14
			
	Source: https://geodaten.graz.at/WebOffice/synserver?project=gruenes_netz_graz&client=core		
Courtyard size	120 m2	318 m2	197 m2
Building use	Residential	Residential	Residential
Ownership	Private	Private	City of Graz
Initial state	- Yard almost completely paved with concrete - A large children's slide with a swing took up most of the area.	- Yard divided into two sections - Paved area near the building (45 m²) accessible to the residents - Rear part of the garden with trees, vegetable and berry beds, fenced and inaccessible	- Yard completely paved with concrete - Tenants generally of the opinion that the yard should not be used
Revitalization			
	Source: Schwaberger, C., TCPA and GRaBS Project Partners, 2011. Green and Blue Infrastructure Exemplars from the City of Graz.		https://grazer.at/en/9faHlxXD/im-rahmen-der-gruenraumoffensive-grazer-innenhoefe/?gfactor=2
Amenities after revitalization	- Yard partially paved and partially covered with a lawn - New, smaller children's playground - Green perennial bed and potted plants shield the yard from the neighbours - Seating area under the balconies with green columns, and in the corner of the yard	- New user agreement, removal of the fence, all tenants have access - Seating area for everyone in the rear garden, lush greenery, renovation of the paved surface	**- L**awn with a swing, sandpit, seating area for the community in the sunny corner, flowering shrubs and a rubbish bin

4. INNER COURTYARDS OF RESIDENTIAL BUILDINGS IN THE CENTRAL ZONE OF NIŠ, SERBIA

Central zone of Niš is located in the Municipality of Medijana, the most densely built city territory. In the entire municipality of Mediana there are more than 90 public open spaces adjacent to multi-family housing, which represent a great capital and potential for the sustainability of urban area. The largest number of these public open spaces are undeveloped surfaces within socialist housing estates, which were designed in an open system of spatial organization, with a geometric layout of structures in parallel rows. However, in the wider central zone of Niš, numerous residential courtyards in a closed or semi-closed system of spatial organization can also be identified. Regarding the ownership structure of open spaces, it is very different. Some plots or parts of it are privately owned, while others are the property of the city or state. In terms of accessibility and use, these open spaces are shared, as public or semi-public open spaces.

Public open spaces in residential environment in the central city zone of Niš, like many other common open and recreational spaces within multi-family housing in the city, are areas with a high degree of publicity that do not fulfill their potential. The main characteristics of these public open spaces are:

- High level of physical and visual flow through space,

- Modest urban design and insufficient equipping with urban furniture,
- Modest landscaping and insufficiently maintained greenery,
- Large paved areas, mostly neglected and devastated,
- Burdening with vehicle traffic and parking lots,
- Unclear rights of usage.

The biggest issue for maintaining and using these public open spaces in the immediate surroundings of multi-family housing is their ownership structure. It is often that the jurisdictions of various city companies regarding open/green spaces are overlapping, and responsibility is transferred among them. Tenants do not feel such areas in their residential environment as their own, and do not take care of them. This results in poorly maintained public open spaces. Thus, some basic activities in maintaining open space become major issues, such as arranging, pruning and watering the greenery, repairing urban furniture, replacing light bulbs in public space lighting, replacing damaged paneling in the parterre, etc. Some of the open spaces adjacent to multi-family housing in the territory of the municipality of Medijana are completely devastated and need urgent action, including those in the central zone of Niš.

4.1. Cooperation of the City of Niš officials and the Faculty of Civil Engineering and Architecture of Niš

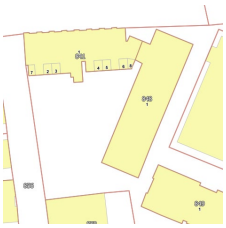
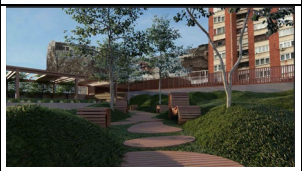
Problems in the functioning of public open spaces adjacent to multi-family housing were recognized by relevant institutions more than a decade ago, and the City of Niš started some activities on their revitalization. The initiative for the cooperation of the City and the Faculty of Civil Engineering and Architecture of Niš regarding the arrangement of open spaces within multi-family housing came from the Chief Urban Planner of the City of Niš in 2020. For the pilot project, four locations were selected in the area of Niš central zone, and they are presented in Table 2. The idea was carried out through the engagement of students of the IX semester of integrated academic studies of the study program Architecture, within the elective course Urban design and composition. More than 100 students who worked in groups participated in this task, which resulted in 32 projects.

The subject area in all locations was the common open and recreational space of a group of residential units, sized to suit several residential buildings. The project task involved restoration, revitalization and remodeling of open space - inner-block areas in a socially, ecologically and economically sustainable manner, with the main goal to create attractive residential environment, increase utilization and design potential of space, and improve the identity of space. The focus was on urban redevelopment and arrangement of public open spaces. Existing buildings were retained in terms of their disposition and volume, with the possibility of remodeling and enhancing interaction of the ground floor level with the parterre.

Methodology of work included the following steps: (1) analysis of standing planning documents and analysis of the existing state - potentials and limitations of the site in question; (2) identification and determination of people's needs, based on a survey and interviews with key actors in the area (tenants, users, local administration); (3) systematization of conclusions about the space and formulation of guidelines for remodeling; (4) urban-architectural design and modeling of space, through elaboration of uses, amenities, flows, functional and spatial relations and details. It was suggested to explore a realistic solution, which would be suited to the real needs of users, but also aligned with the potentials and limitations of the space in question and its environment. Special attention was paid to the shaping of traffic surfaces - by implementing "shared streets", improving pedestrian safety and ensuring the priority of pedestrians, as well as re-evaluating the capacity of stationary traffic. Options of implementing community gardens and natural elements for stormwater management were also explored.

This project was quite challenging for the students, who worked on it with their mentors. Additional motivation was the initiative of the city officials, along with the opportunity that some of the works might actually be implemented, entirely or in some segments. Truly high-quality and inspiring solutions have been created, which, if realized, would greatly improve the identity of the space and provide tenants with a modern and pleasant environment for passive rest, recreation and social interactions. Student ideas and proposals were presented to a wider audience, and especially to the tenants of these urban blocks, in the exhibition of works that was organized in November 2021.

Table 2: Factsheet on the selected sites in the City of Niš

Courtyard location	Nade Tomić / Svetozara Makovića  Source: https://a3.geosrbija.rs/	Generala Tranijea / Svetozara Markovića 	Nikole Pašića / Sinđelićev trg 	Nade Tomić / Nikole Pašića 
Courtyard size	2150 m2	1325 m2	1523 m2	1296 m2
Building use	Residential, with commercial uses on the ground floor			
Ownership	Republic of Serbia	Private / City of Niš	Private / City of Niš	City of Niš
Initial state	- Existing parking garages at the semi-buried level - Yard divided into two zones of different heights - Upper-level paved area used as unorganized parking - Lower-level area for gathering with poorly maintained greenery and no equipment - Poor lighting and safety issues	- Yard almost completely paved with concrete and used as parking - Unsafe intersections of pedestrian and vehicle pathways - No amenities for tenants	- Yard almost completely paved with concrete and used as unorganized parking - Unclear pedestrian pathways - No amenities for tenants - Small and devastated green areas - Poor lighting and safety issues	- Existing parking garages at the parterre level - Yard used as unorganized parking - Poor or non-existent lighting and safety issues - Poor stormwater drainage and flooding
Main issues listed in the tenant's survey	- Devastated urban equipment in the yard makes gathering impossible - Street and outer public open space occupied with parking spaces - Different yard levels are a barrier for elderly users	- Tenants generally of the opinion that the yard should not be used for social interactions, but for parking - Inadequate waste disposal (visible garbage bins)	- Open space occupied by vehicles and parking - Maintenance of the large self-sown walnut tree - No greenery - Insufficient parking for tenants	- Open space occupied by vehicles and parking - Poor maintenance of greenery - Inadequate waste disposal - Devastated yard pavement
Proposed design and authors	 Katarina Đorđević, Elma Hodžić, Lazar Pešić	 Natalija Miladinović, Anastasija Mitić, Aleksa Milenković, Nena Petrović	 Anja Stanković, Marija Nikolić, Gabrijela Ilić, Lazar Dinić	 Gordana Nenadović, Marija Ognjanović, Isidora Petrović,Tanja Petronijević

4.2. Further actions

Research done by the students of open spaces within residential districts in the center of Niš is only the first step in solving the complex issue of unorganized open spaces in the city. In the post-socialist period, urban planning and design practice in Niš has provided some good and innovative solutions for the urban landscape, which unfortunately remained only on paper. That is why implementation needs to be improved. The City of Niš is now facing a grand challenge - how to integrate the best students' ideas into the Urban Design Project and how to implement it? Implementation of such and similar projects is necessary in order to improve various residential environments in Niš territory, and is especially urgent in the area of the city center.

Given the number and significance of residential open spaces within the system of open spaces of the city, it is necessary to soon develop a comprehensive and realistic model of revitalization of open spaces in multi-family housing areas, and to develop mechanisms for the implementation of that model. The City of Niš has initiated the revitalization of public open spaces adjacent to multi-family housing in the Municipality of Medijana – each

of these spaces was recorded and listed, thus identifying more than 90 public open spaces in housing areas in need of revitalization. However, this is only the begging of the complex work that awaits.

Based on the presented example of best practice in Graz, some key recommendations can be singled out in this research, which should be considered when creating the model of revitalization:

(1) The first step in addressing the issue of public open spaces in multi-family housing areas needs to be to resolve the ownership of such open spaces, and to regulate their status in legal terms. In a situation where land ownership is unclear/unresolved, or several owners have rights over the same land, problems in maintaining that particular space arise, which is evident in the case of Niš. As seen in the case of Graz, good outcomes may be achieved with both ownership structures – city or private (shared between tenants), but obligations and rights need to be precisely determined.

(2) The second key point concerns establishing the cooperation of local community and key stakeholders within a participative planning process. Tenants are the vital element in conceptualizing open space, and their needs and preferences must be taken into account in the planning phase. Satisfaction of tenants with their housing environment is crucial not only for the initial arranging of open space, but also for maintaining and caring for that space in the future, and particularly for open spaces that are privately owned. Establishing proper cooperation between various relevant departments is equally important, such as the Urban Planning Institute, Department of Construction, Department for Public Utilities and Inspection Works, Public Communal Company "Mediana", Department for Property Management and Sustainable Development, etc. Also, improving the collaboration of these departments and the local community is a pre-condition for enhancing the entire planning process.

(3) The following crucial point involves developing a comprehensive revitalization Strategy for public open spaces in housing areas in the entire Niš territory, with specified urban design guidelines. The Strategy output should involve a typology of open spaces based on shape, size, use and ownership of space. In this document, the inner courtyards of residential buildings should be recognized as a specific type of open space, given their significance and potential for the shaping of a more sustainable central zone. The student projects of the four Medijana's open spaces could also help in establishing the proper design perspective. In light of the current urban planning and design approaches of sustainability and resilience, it can be stated that the urban design of inner residential courtyards in the central zone should prioritize on the following principles:

- Un-paving and greening the surface area,
- Devising realistic parking solutions,
- Improving sustainable mobility,
- Preserving existing greenery, such as quality trees, and introducing new one,
- Introducing BGI and NBS,
- Providing amenities for all user categories, along with improving access, to actively use the space,
- Improving waste disposal solutions,
- Remodelling the ground floor facades of buildings.

(4) The final key recommendation concerns the implementation of revitalization projects. The City of Niš should conceptualize a realistic Action plan for residential courtyards in the central zone, with measurable and verifiable results, and implement it in the defined timeframe. This plan should first define priority sites for revitalization (based on tenants' interest and motivation), than set realistic goals, and define measures and actions for achieving those goals. It is suggested to define various types of measures: (1) *incentive,* which motivate private owners of land to participate, as well as tenants themselves, such as financial resources and technical support in open space revitalization, (2) *educational*, which would explain the benefits of nature-base solutions and proper waste management - to raise ecological awareness of residents in the center and thus foster their motivation, (3) *institutional*, to enable better cross-departmental cooperation and improve the participatory process, and (4) *legislative*, which should establish the rights and obligations of all stakeholders in the process of courtyard revitalization. It is imperative that the Action plan also establishes financial and other resources for carring out the proposed meausres, than to set the implementation timeframe, as well as to identify the responsible persons for each measure and implementation stage.

4.3. Urban planning and design guidelines for inner residential courtyards in Niš

Un-paving hard surfaces of inner courtyards and their greening is absolutely necessary in all residential courtyards. However, from the aspect of motor vehicle traffic, it is necessary to distinguish two types of courtyards: (1) yards with undeveloped land that have no parking garages, and (2) yards with existing parking garages that are private property. In the first case, it is possible to completely green the yard surface area. This option is advised in order to improve environmental quality and ecology of the entire central city zone (increase surface permeability and thus improve stormwater management, improve microclimate, improve air quality, enhance recreation options, restore the ecosystem, etc.). Regarding the second case, yard garages are a legacy of the socialist period, when the level of motorization was significantly lower and it was possible to provide parking for residents. The optimal solution for these structures should be devised in agreement with the tenants and their preferences. Some of the garages are not used for parking, and it would be possible to explore other options for their use and potential remodelling. In some yards however, it would be necessary to retain vehicle access to the garages. Yard area should then be remodelled according to the "shared streets" concept. In that way, the cars would have access into yard space, but they would not have priority, and would have to share the parterre with user activities (childrens' play, gathering areas, active and passive recreation).

When revitalizing the inner courtyards in central zone within participative planning approach, the biggest challenge will definitely be to find a proper balance between green areas and surface parking lots. Given the expectations of residents in central areas regarding the provision of parking spaces, which was established in students' interviews, it is obvious that they are unaware of the current trends and contemporary planning principles for housing in central areas. It is therefore necessary to organize meetings with residents and education workshops, in order to explain to the public what are the benefits that greening and sustainable mobility bring to central areas. In historic, compact and dense urban environments, such as the central city, it is nowadays impossible to expect to have the "suburban comfort" with guaranteed parking. Some possible parking solutions for residents of central zone may involve constructing underground garages where available, or parking structures in adjacent available plots. These newly developed parking structures could provide some tenant privileges, but the residents in central zone have to be aware that this is quite a costly solution, and unfortunately not affordable to all. Moreover, it would be impossible to obtain one parking space per one apartment, which is the norm for new developments. Therefore, the residents of the center need to put the benefit of the entire community above one's personal comfort.

In light of frequent traffic congestions, the City of Niš needs to devise a network of sustainable transport, particularly in the central city zone. When it comes to inner residential courtyards in the center and their links to sustainable mobility routes, they should be greened and with an easy access to pedestrian and bicycle pathways. Regarding urban greenery, which is quite scarce in the central area, it is imperative to preserve existing greenery and provide new green areas, wherever possible. It is also advised to revise existing instruments of urban planning in Niš, in order to integrate BGI and NBS as a contemporary response to the challenges of climate change.

Other improvements are also necessary in open spaces adjacent to multi-family housing in the center of Niš. When deciding on the amenities in the open space, they should be provided in line with the users' structure (elderly, young singles, families with small children, etc.), in order to indeed be useful. Simple, cost-effective solutions for remodelling the space are often the best, as seen in the case of revitalized courtyards in Graz. Finding a proper design solution and placement for garbage bins seems to be an urgent need in many public open spaces in housing areas. Resolving this issue, which is not only aesthetic but also sanitary, is a pre-condition for actively using the open space. The revitalization process should also include educating the tenants on the importance of recycling household waste.

Therefore, a clean, neat, pedestrian-oriented, green courtyard, equipped with basic amenities in line with the needs of users, with proper lighting, and framed by attractive walls of the ground floor, appears to be the model of a residential courtyard that the local communities in Niš should aspire to.

5. CONCLUSION

Public open spaces in housing areas have a very important role in urban landscape, particularly regarding the overall resilience of cities to natural disasters. In line with the first research aim, it can be stated that the revitalization of residential courtyards that involves un-paving and greening, brings manifold benefits to densely built urban areas. Best practice example examined in this paper illustrates how the revitalization of

residential courtyards improved air quality and micro-climate, diversified recreation options, facilitated social contacts and enhanced visual appeal of the open space. The Graz courtyards revitalization also demonstrated how properly carried out participation processes, with well-established cross-departmental cooperation, result in quality urban projects, which get to be implemented quickly and with extensive support from local communities.

Regarding the second research aim, the results of this study identified key urban planning and design measures and activities that should help in revitalizing open spaces in residential districts in the center of Niš. Within urban planning policies and approaches, special attention should be given to greening, sustainable mobility, BGI and NBS, diversity of amenities and improved waste disposal. Aside from planning measures, this research also points towards the importance of the actions beyond urban plans and urban design projects. Proper implementation of plans and projects, along with effective on-site control and raising awareness of the local community, are vital issues for urban development of Niš as a resilient city. Therefore, the research proposes incentive, educational, institutional and legislative measures to empower courtyard revitalization. The students' elaboration and ideas of the four explored sites represent a valuable database, bring fresh perspective to revitalization of public open space, and provide good grounds for further activities in revitalizing residential courtyards in the city center.

Finally, it is the conclusion of this research that revitalized and greened open spaces in multi-family residential blocks would result in more favorable environmental impacts in the central zone of Niš, and thus contribute to achieving long-term sustainability of the city.

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ENABLING SUSTAINABLE TRANSFORMATIONS THROUGH PLACE-BASED URBAN DESIGN EDUCATION

Ksenija Lalović

University of Belgrade – Faculty of Architecture, Serbia
PhD., Associate Professor, ksenija.lalovic@arh.bg.ac.rs

Predrag Jovanović

University of Belgrade – Faculty of Architecture, Serbia
PhD., Teaching Assistant, predrag.jovanovic@arh.bg.ac.rs

Jovana Bugarski

University of Belgrade – Faculty of Architecture, Serbia
PhD Student, Teaching Assistant, jovana.bugarski@arh.bg.ac.rs

Filip Petrović

University of Belgrade – Faculty of Architecture, Serbia
PhD Student, Teaching Assistant, filip.petrovic@arh.bg.ac.rs

ABSTRACT

Global climate change influences on human settlements, create a new context and change the purpose of urban design education. It requires not only new urban design knowledge and skills, but most of all, it implies a different way of understanding the future of cities and, crucially, capabilities to shape it through immediate practical action. Education is recognised as the main leverage of this necessary professional and mindset capabilities shift. Therefore, academic architectural education started to evolve, searching for more effective educational methods and techniques. Future urban designers capable of enabling sustainable urban transformations should be prepared to cope with many uncertainties in a co-creative and integrating manner, in which resilience, adaptation and innovation, are becoming the keywords. In this paper, we present and discuss the outcomes of the education model developed under the integral theoretical framework of place-based education, applied at the bachelor's and master academic level at the University of Belgrade Faculty of Architecture over the last seven years. We argue that urban design education aimed to produce effective local responses to climate challenges needs to be learned through realistic problem-solving and in contact with stakeholders. The results indicate that this education model provides not only new professional competencies profile but also creates a niche of innovation that indirectly influences the building up of local social capital necessary to enable sustainable urban transformations.

Keywords: *urban design; climate change; sustainable urban transformations; place-based education; niche of innovation*

1. INTRODUCTION

Ensuring a healthy life in cities has reached the peak of attention across the planet in the past two years while facing the challenges of overstraining the health care system caused by the COVID-19 pandemic. Numerous health problems in cities are coming to the forefront of broader social attention and criticism, which require effective action and long-term sustainable results (Tsouros, 2015; UN-Habitat & WHO, 2020; WHO&WB, 2017). The complexity of fulfilling this requirement is reflected in the growing number of dichotomies within the public discourse on urban sustainability. The global health crisis is believed to be the result of a long-term mismatch between urban practices and global sustainable development policies. The

major economic recession in 2008-2009. (Robinson, 2012) pointed out the weaknesses of the global economy and redirected the focus of national policies towards economic recovery and development. This economic recession coincided with the culmination of the global urbanization trend, when for the first time in history more than half of the world's people live in cities (Zhang, 2016). The concentration of the population in cities has significantly increased the complexity of production and consumption of resources for life (IPCC, 2018) and the complexity of urban technological and infrastructural requirements (Coyle & Simmons, 2014). These challenges, currently reach the climax, with significant global political turbulences and enacted severe energy crises in the Europe. After more than five decades of the global discourse on sustainable development, at this moment more than ever, increasing the environmental footprint along with global climate change and expected severe socio-economic changes, position sustainable urban development in the place of challenges 21st century. There is strong discussion among scholars that facing the actual challenges of sustainable urban development requires continuous globally coordinated but local goal-driven proactive management and action (Geels, 2004; Watson, 2009; UN-HABITAT, 2010; Hens, 2010; Geels, 2011; O'Brien, 2012; Santander & Garai-Olaun, 2016; Mensah, 2019), and accordingly new innovative approaches and means of planning, design, and organization of the use of urban spaces that could enable sustainable transitions (Markard & Truffer, 2008; Jørgensen, 2012; McCormick et al., 2013; Parsons et al., 2016; Loorbach & Shiroyama, 2016). The need for sustainable transformations of cities and new approaches is underlined by the resolution of the global Agenda for Sustainable Development until 2030 (2015) and the Sustainable Development Goals (SDGs), especially Goal 11 - sustainable cities and communities, and Goal 3 - health and well-being. The New Urban Agenda (2017), as a framework for the localization of the 2030 Agenda and the achievement of the SDGs in the context of cities, as well as the New Leipzig Charter - The Transforming Power of Cities for the Common Good (2020), represent the basic policy framework for the realization of global and European agreements on sustainability at the urban level. Finally, the New European Bauhaus Initiative (2020) links the European Green Deal (2019) to everyday life and living spaces, calling on all Europeans to "imagine and build a sustainable and inclusive future that is beautiful to our eyes, minds and souls" together". The core basis of all this policies implementation is the social capacity to collaborate, that is, to co-create new effective solutions and actions (Mauser et al., 2013; Frantzeskaki & Kabisch, 2016; Morello, Mahmoud, & Gulyurtlu, 2018). Therefore, the future architects, involved in urban design and planning, must be competent not only to produce sustainable urban solutions, but also, to lead, or actively participate, in the process of social transition, influencing other stakeholders and decision-makers to understand and recognise the strategic values of new and innovative action approaches (Gruenewald, 2003; Geels F., 2004; Geels F. W., 2011).

The urban development of cities in Serbia, in the last two decades, is still characterized by processes of social and economic transition, with consequent negative trends in the processes of urbanization and territorial development as stated in the Spatial Plan of the Republic of Serbia (2021). The key institutional framework for the localization of the Agenda 2030, the SDGs, and the New Urban Agenda in the cities of Serbia is the Sustainable Urban Development Strategy of Republic Serbia (2019), which recognizes six priority areas of sustainable urban interventions: 1) brownfield sites and industrial zones; 2) illegal construction; 3) urban matrices and central urban zones; 4) areas with a concentration of social problems, 5) areas with a threatened environment and 6) cultural heritage. In the context of Serbia, with inadequate solutions for the new plurality of interests within the market economy the post-socialist socio-economic transition imposed additional challenges to urban sustainability, in comparison to the named global (Vujošević, Zeković, & Maričić, 2012). Urban planning was practised as technocratic and exclusively expert-based in most cases (Zekovic, Vujošević, & Maričić, 2015; Mitić-Radulović & Lalović, 2021). To strengthen and ensure citizen participation in urban planning, and enable co-creation, the legislative changes in Serbia in 2014, introduced Early Public Consultation (EPC) as the first of the two milestones in the formal urban planning procedure when the government communicates the urban plan with the broader public. As a relatively new planning instrument in a society with a long tradition of centralised planning, EPC did not have a significant role in ensuring the sustainable transition until two years ago, when the first cocreation of the Detailed urban plan of Linijski park occurred (Mitić-Radulović & Lalović, 2021).

In this research, considering named global and local specificities and challenges, achieving sustainability in the context of Serbian cities is presumed as a complex problem, that requires synergistic and immediate action by the whole society. From the perspective of the architectural profession, solving the problem of urban sustainability in the 21st century requires finding new ways, techniques, and tools for effective action in the present moment with a qualitatively cumulative effect for future generations. Thus, the role and the performance capacity of architects and urban planners must change significantly compared to the usual ones.

From service providers, architects should transform into innovators and leaders of change towards local, and at the same time, global sustainability. Accordingly, the substance and learning method of academic curricula for architects must be fundamentally improved and changed to provide the graduates capable enough to face complex problem solving, even in small-scale architectural or urban design. Additionally, in many social contexts, such as Serbia, there is another challenge for young professionals: to be able to "cope and survive" in interaction with "old" professional approaches, which are predominant in practice. In that sense, in the University of Belgrade – Faculty of Architecture special attention was given to the development of academic curricula related to sustainable urban development that could build capacities of architects and architect-urbanist that can take the new, necessary role of leaders of change.

This article focuses on presenting the results of the application of a new educational model that was implemented in the last seven years of the National accreditation cycle. In the next chapter, the theoretical and conceptual background of the new education model will be described. Then the case study of experiences of the University of Belgrade – Faculty of Architecture will be presented and discussed, focusing on the impact on urban design and planning practice. In the end conclusion of this case study will be presented.

2. PLACE-BASED URBAN DESIGN EDUCATION FOR 21ST CENTURY

2.1. Urban design education conceptual model

Climate change is recognized within the scientific community as a multi-dimensional, complex, vague, and dynamic problem (Esbjörn-Hargens, 2010; IPCC, 2018), which means that different areas of human existence can influence and be influenced by climate change and that effects of climate change are at the same time interdependent and unpredictable. Climate change is not simply an environmental problem, it is about the human capacity of individuals and communities to respond to threats (Barnett, Matthew, & O'Brien, 2008). It is closely related to how humans perceive themselves in the world, how humans both create and respond to change and how they sustain development in balance with nature (O'Brien, 2012). Therefore, the integral approach is recommended as necessary, as a response to global calls for an end to the age of fragmentation in the field of sustainable development (Brown, 2007; Esbjörn-Hargens, 2009; Esbjörn-Hargens & Zimmerman, 2009). The Integral Sustainable Development approach is assuming the critical realism position, claiming that there are four distinct domains of reality that always must be considered simultaneously (Esbjörn-Hargens, 2009): - individual interiors, like psychology and consciousness of stakeholders; - individual exteriors, such as behaviours and routines, - collective interiors, like values, culture and worldview, and – collective exteriors, such as system organisations, and the physical environment. According to integral approach practitioners (Brown, 2007), if a particular methodology only considers one or two dimensions of reality, in most cases collective exteriors and maybe interiors, it addresses only "half" of the picture and therefore has a higher chance of failure (Lalović, Živković, Radosavljević, & Đukanović, 2019).

Although climate change is a global problem, it needs local and place-based solutions to confront its challenges. On one side, cities are particularly sensitive to climate change due to the high population density and construction. On the other, cities, as built environments and socio-ecological systems, are responsible for GHG emissions that intensify climate change (IPCC, 2018). Consequently, the climate-responsive approach to urban development emphasizes the need for activities to minimize negative impacts on climate, and adaptation strategies to face the consequences of climate change that cannot be avoided. A literature review reveals three main exposure urban units to climate change: - building integrity, which refers to the smallest spatial urban unit consisting of a building parcel and immediate surrounding, - urban green space, which refers to an urban neighbourhood spatial scale, and - human health and comfort which refers to a metropolitan scale of problem-solving (Živković & Lalović, 2011). Local climate-responsive urban planning, considers all main exposure units to climate change simultaneously, aiming to innovate measures and anticipate the actions, in urban design at both strategic and detailed levels, that will help their cities adapt to future climate change (Živković & Lalović, 2018). These measures need to be efficiently implemented. So, therefore, they must be adjusted to the local context, considering all domains of its urban reality integrally. All of this puts forward the importance of knowing and understanding specific local socio-economic and environmental conditions while looking for adequate design, which could be achieved only through intense communication and collaboration of all stakeholders and the public, that is, co-created, co-designed and finally co-implemented (Mauser et al., 2013; Frantzeskaki & Kabisch, 2016; Morello, Mahmoud, & Gulyurtlu, 2018).

2.2. University of Belgrade – Faculty of Architecture sustainable urban design courses - case study description

Urban design architectural education is oriented toward developing students' awareness, knowledge, skill, and abilities concerning urban space articulation as expected learning outcomes (Milovanović Rodić, et al., 2013). Any given learning task in urban design education is aimed to tackle one of three psychological domains: a) cognitive, which revolves around knowledge, comprehension, and critical thinking; b) psychomotor, which involves manipulative or physical skills; and c) affective, that describes the way people react emotionally, and relates to the development of values, appreciation, empathy, and attitudes that result from the learning process. Therefore, four educational formats are set to achieve these goals: seminar, studio, elective courses, and workshops. They are used as an opportunity to apply problem-based learning, aimed not only at comprehending the facts but also at developing relevant thinking strategies. Although learning about urban and urban design theories and concepts mostly happens in seminars, the basic learning unit in most bachelor's and master's urban design academic programs is an urban design studio, that enables students to connect theoretical knowledge with urban design methods and techniques while working in a specific urban context and applying “learning by doing” approach (Milovanović Rodić, et al., 2013). However, the prevailing author-oriented and transmission model of urban design education reduces studio works to passive abstract practices, disciplinary content, and technological skills, distanced from natural, social, and cultural realities. Such an abstract and general approach to education dismisses the idea of place as a primary experiential and educational context (Gruenewald, 2003), and disregards an integral view of reality. Therefore, the premise for grounding education in urban design to be adequate for current sustainability demands is place-based learning. The “place” is conceptualised as the centre of the experience, a meaningful context of human perception shaped by our experiences and culture (Gruenewald 2003). Place-based education is an approach to learning that builds upon natural and human geographies of place to create authentic, meaningful, and engaging, personalized learning experiences for students. It evolves from aspiration to overcoming the division between conceptual knowledge and living experience by directing students' attention to local places and communities (Živković & Lalović, 2018). Place-based teaching and learning are situated in realistic places, promote learning rooted in local conditions and use local surroundings as a context to integrate the curriculum into wider society. The place-based curriculum seeks to establish different connections with the environment and to motivate students for deeper engagement with their surroundings, including people, to promote local sustainability. It fosters cross-disciplinary and intercultural informed contextualisation of studied places' natural, cultural, and socioeconomic attributes (Živković & Lalović, 2018).

The University of Belgrade – Faculty of Architecture integrated a placed-based education model in a series of courses t, starting from the design studio of Bachelor of Architecture level of study, to Master level of study, with a series of theoretical discourse and elective seminars and design studios related to different aspects of urban sustainability transformations (Živković & Lalović, 2018). For this case study, which focuses on the effects of place-based urban design education on sustainable transformations, two learning formats were chosen for the analysis: - Design Studio 02a: Sustainable Urban Communities – introduced in second year of Architecture Bachelor's studies, and, - Theoretical ground of sustainable development - theoretical discourse seminar introduced at the second year of Master studies of Architecture. The method of carrying out theoretical and practical learning is based on the 4MAT didactic pedagogical model of Bernice McCarthy (2000) and combines several methodical tools and techniques, such as interactive presentation, focus group, comparisons, critical discussion, auto reflection and reflection, carrying out the process of student cognition through 4 methodical phases: 1. understanding meaning - why? 2. adopting concepts -what? 3. acquiring skills -how? 4. Adaptation - what if? (Živković & Lalović, 2018). Each level of learning represents a methodological and logical whole that provides students with different packages of understanding, knowledge and skills concerning urban sustainability in an integral way and across different spatial scales as illustrated in Figure 1. Additionally, place-based learning was additionally supported with the communication and interaction with the end users and key stakeholders, to strengthen the motivation of students, but also aiming to influence the problem cognition and perception of possible solutions of stakeholders. The assumption is that students' problem-solving approaches, unburthened with "daily" problems and practice constraints could influence the stakeholders toward "out of box” thinking.

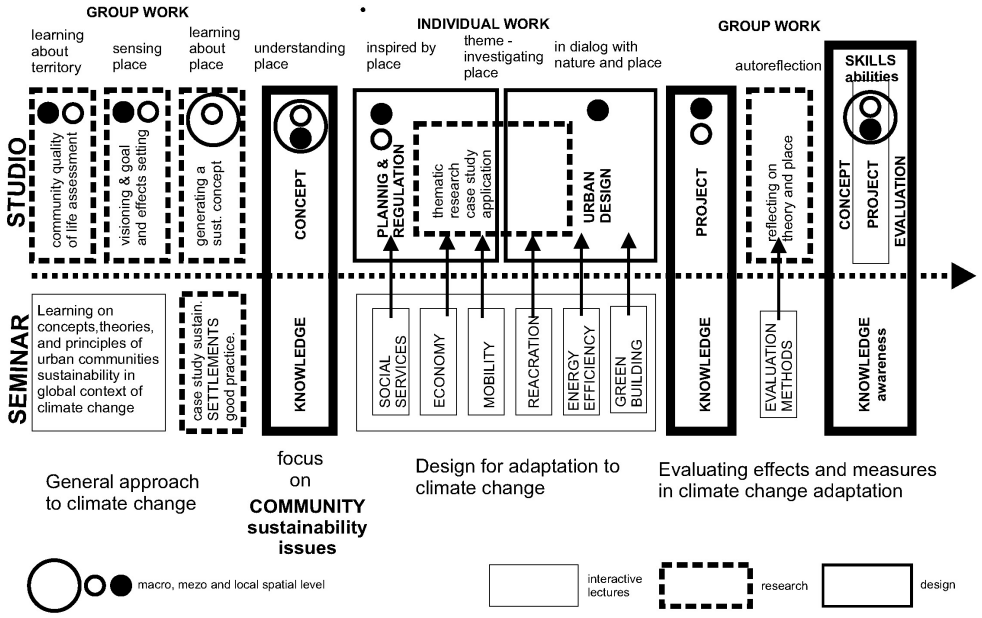

Figure 1: Structure and learning process of place-based urban design education applied in" Design Studio 02a: Sustainable Urban Communities", and in "Theoretical ground of sustainable development" where the "studio" place-based application is part of the exam task (Živković & Lalović, 2018).

The place-based model was successfully applied within named courses over the last National accreditation period of seven years addressing the actual sustainability problems in the context of Serbian cities of a specific real context, striving to involve the local community and at least one of the significant stakeholders of the City of Belgrade, which is chosen due to possibility to organise direct interaction. The overview of the sustainability topics and realised collaboration with stakeholders is presented in Table 1.

Table 1: Overview of the sustainability topics and realised collaboration with stakeholders within the curricula

Study level	*Course*	*School year 2015/16 theme*	*School year 2016/17 theme*	*School year 2017/18 theme*	*School year 2018/19 theme*	*School year 2019/20 theme*	*School year 2020/21 theme*	*School year 2021/22 theme*
BArch	***Sustainable communities' studio***	*Urban housing renewal for Bežanijska kosa*	*Resilient housing solutions for Ovča*	*Sustainable urban transformations of IMT industry*	*Localization of SDGs in transformation of Donji Dorćol*	*Localization of SDGs of Dunavski kej*	*Zemun Healthy Community*	*Settlements of Belgrade 2041_– new housing models*
	in collaboration with	*Local community*	*Local community City of Belgrade, Secretariat for Investment*	*Local community Town Planning Institute (TPI) of Belgrade*	*Local community TPI of Belgrade*	*Local community, TPI of Belgrade, City of Belgrade – Main Urbanist Office, Secretariat for Environment, Centre for Experiments and Urban Studies (CEUS)*	*Local community TPI of Belgrade,*	*Local community TPI of Belgrade, City of Belgrade – Main Urbanist office*
MArch	***Theoretical ground of sustainable development***	*Exploring sustainability policies over the Globe Regions*	*Integral analysis of open public spaces sustainability in Block 45 in Belgrade*	*Simulation of a participatory web tool to support CLLD a case study of Negotin*	*The concept of universal design within the sustainable development of Europe*	*NBS catalogue and co-creation pathway*	*Exploring the concept of a Healthy City through the EU sustainable practices*	*Exploring the sustainable practices of European cities*
	in collaboration with	*/*	*/*	*Within the bilateral Italian-Serbian International Research project*	*"Limitless" association Ministry of social affairs of RS Zero 2021 award*	*CLEVER Cities (Horizon 2020) project City of Belgrade – Main Urbanist office, Secretariat for Environment, CEUS (Mitić-Radulović & Lalović, 2021)*	*CLEVER Cities project City of Belgrade – Main Urbanist office, Secretariat for Environment, CEUS*	*CLEVER Cities project City of Belgrade – Main Urbanist office, Secretariat for Environment, CEUS*

2.3. Discussion of the results

Reflecting on the success of implementing the place-based education model into analysed formats several important experiences should be stressed out. Firstly, placed-based education that is aimed at enabling sustainability transformation in a specific context presumes good connections of academic staff with crucial stakeholders' representatives, including the public and civil sector. In this case, it took more than two years to establish them and to increase the significance of students' participation in actual urban problem-solving, as Table 1. represents. For the academic staff involved it was also a learning process. It brought fine-tuning of the abilities to communicate and transfer the latest research not only to students but to disseminate it directly to the wider public and decision-makers, through public workshops, exhibitions, and presentations. From the student's perspective the experience of being involved in direct communication with stakeholders, not only citizens but also with different authorities of the City of Belgrade, professionals, etc., was highly evaluated through annual queries. It brought additional motivation for work and strength to perform the learning tasks beyond "work as usual". From the perspective of stakeholders involved, the interaction with students and their research and design proposal was valued as inspirational and innovative. Over the years, the attitude of stakeholders changed and could be described as increased openness to new and different ideas. In the second place, applying the place-based education model within the seminar format represents a more significant challenge than within the format of Studio, also visible in Table 1. However, the experience and results gained indicate that is definitely worth the effort for several reasons: - it increases the number of different place-based studies and significantly scales up the comprehension of applied knowledge and understanding of students, - it increases the possibility of connecting the students work from different levels of study (as it was experimented from 2017), and - at the and it opens the possibility of masters student to gain first scientific or professional reference under the tuition of mentors. In this case, since it is the seminar in the second year of master's studies when students have five years of education almost finished, it was possible to engage them in themes which are related to scientific research projects of the faculty, or later to international scientific research projects. The applicative part of learning, with the seminar format, was done out of the formal class, within their exam research on the chosen place-based polygon. This learning approach also enabled fruitful critical theoretical and conceptual discussion during the classes. Finally, large number of students developed significant self-esteem, and social connections that enabled them to be employed after the graduation.

3. CONCLUSIONS

This article focuses on urban design education since it represents the field of the confluence of architecture on one side, and the urban planning profession on the other. In most contexts and Serbia, the architects are dominantly responsible for architectural and urban design and are significantly involved in the urban planning process with many other professions. However, the position and role of architects in the field of urban development changed with planning conceptual changes toward collaborative concepts and the enactment of strong sustainability policies. That is why the significant re-examining of academic architectural education curricula over the last two decades. In Serbia, lacking strong policies and strategies, and with practice eager to exploit the investor initiatives, the role of the architect-urbanist, and even the architect degraded to a level of simple documenting and articulating the decisions of decision makers, or investors. This trend is highly publicly criticised as “investor urbanism”, and is the reflection of their lack of power and capacities to influence the decision-making process. The placed-based education opens the opportunity to shift the architect's role from the mere observer to the proactive creator of solutions. This case study results show that this education model enables a significant change not only in academic education effectiveness but also in urban practice, influencing indirectly stakeholders by challenging their modes of thinking and seeing the reality with visible conceptual shifts and innovative solutions, implying that education could be one the most critical leverages of necessary global sustainable urban transition.

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ASSESSING THE DETERMINANTS FOR BICYCLE USE IN A MEDIUM-SIZED SUB SAHARAN CITY: THE CASE OF QUELIMANE, MOZAMBIQUE

Classio Joao Mendiate

Centre of excellence in transport planning, engineering and logistics, CST, University of Rwanda, Rwanda, classiomendiate@gmail.com

Alphonse Nkurunziza

Centre of excellence in transport planning, engineering and logistics, CST, University of Rwanda, Rwanda, nzizaalphonse@gmail.com

Manuel de a. Alcolete Lopes de Araújo

Muncipality of Quelimane, Quelimane, Mozambique, alculete8@gmail.com

ABSTRACT

This study assesses the determinates for bicycle use in a medium-sized Sub Saharan African (SSA) city with vibrant cycling culture. Using a socio-ecological framework, it is modelled cycling behaviour change based on socio-economic characteristics, latent physical and environment variables, and attitudinal factors. Data used was collected in Quelimane, Mozambique, involving 896 commuters. Factor analysis helped to construct latent variables used in the socio-ecological models, showing infrastructure challenges, weather and safety issues, economic benefits of cycling, other bicycle commuting benefits, and cycling facilities needs. A binary logistic regression model was conducted to identify the likelihood of cycling frequently by exploring the relationship between non -frequent cyclists (NFC) and frequent cyclists (FC). The analysis was based on changes in urban topology variables which is expressed in changes of the road quality between those cycling within the inner city (Z1), within the city periphery (Z2), and between the inner city and city periphery (Z3). For those cycling within Z1, it was found that latent attitudinal variables, such as cycling flexibility and comfort highly influential to increase the likelihood of cycling frequently. Gender, bicycle ownership, the economic benefit of cycling, and bicycle commuting benefits may lead to a higher likelihood of cycling frequently within the Z2. Finally, Employment status present a significant influence to increasing cycling frequency between Z3. The study points the enormous potential for bicycle use in Quelimane and provides empirical measures to overcome barriers encouraging cycle use.

Keywords: Bicycle, socio-economic variables, built environmental variables, attitudinal variables and urban typologies

INTRODUCTION

Cycling is recognized as a sustainable transport due to its intrinsic absence of direct emissions of pollutants, such as the Green Gas House emissions and low energy consumption (Massink et al., 2011). Furthermore, cycling is healthy, since it is an active mode and helps in coping with obesity and heart-related diseases (Bergström & Magnusson, 2003). It is adequate for dense urban areas and narrow roads in most outskirts areas of Sub-Saharan African (SSA) cities occupying less road space, enables flexible jobs, which are essential in African communities (Mendiate et al., 2020). For these reasons, increasing cycling use is a primary goal in political and professional agendas to achieve a sustainable urban future, particularly in SSA cities.

Despite the described benefits, bicycle use remains as a major challenge in many cities worldwide, and in SSA cities in particular. For example in large cities like Lagos (Nigeria), Nairobi (Kenya), Conakry (Guinea) and Kigali (Rwanda), cycling share is estimated to be less than 5% (Kumar & Barrett, 2008). The declining level of cycling is associated with a lack of adequate infrastructures for non-motorized transport, showing a generalized

association between cycling, poverty and poor incorporation of cycling in the political priorities (Nkurunziza et al., 2012). Notwithstanding this, there are a few examples where cycling is an exception like Tamale (Ghana) (Acheampong & Siiba, 2018), Kisumu (Kenya) (Mutiso & Behrens, 2011), Quelimane (Mozambique) (Mendiate et al., 2020), Mzuzu (Malawi) (Chilembwe, 2017), where the modal share of cycling could be estimated as high as 30%. This indicates that proper measures could trigger major behaviour changes in SSA urban context.

Evidence of variables influencing cycling is accumulating (Acheampong & Siiba, 2018; Nkurunziza et al., 2012), but a better understanding of the relationship between these variables in medium SSA cities is still a major academic challenge. In particular, three research gaps can be identified. Firstly, previous studies considered that the cities present a similar quality of the built environment between different urban zones. In SSA cities, the quality of road infrastructures declines as the distance to the inner city increases (Kumar & Barrett, 2008; Lall et al., 2017). This has an enormous influence on cycle use. Secondly, among the attitudinal variables used in most previous studies, limited attention has been paid to include variables related to the use of the bicycle for commercial purposes (taxi), being an emerging debate in medium-sized SSA cities(Mutiso & Behrens, 2011). Thirdly, although most studies have attempted to identify determinates for bicycle use, there are few studies focused on exploring this in urban contexts where there no public transport available. This could bring new knowledge as most people experience cycling as bicycle taxi passengers. Given this unique cycling context, it makes an interesting study to achieve a better understating about which are the variables potentially influencing people's cycling behaviour change.

Based on those important issues, the objective of this research is the identification of determinant variables influencing people's commute cycling in Quelimane, a medium-sized SSA city, with a perspective of a socio-ecological model. To this end, we examined the influence of socio-economic, attitudinal and built environment variables on people's decision to cycle, based on their travel patterns. The rest of the paper is organized as follows. The first section discusses the socio-ecological model for studying cycling. Then methods adopted are discussed, focusing on the questionnaire design and administration and the statistical analysis employed. The fourth section presents the results where the key findings are discussed in the fifth section, and final remarks are provided.

LITERATURE REVIEW

Given the relevance of cycling, in recent years a growing number of studies have sought determinants for bicycle use (Acheampong & Siiba, 2018; Fernández-Heredia et al., 2014; Nkurunziza et al., 2012). These studies have shown that socio-economic, built environment and attitudinal variables may all affect the individual decision to cycle (Acheampong & Siiba, 2018). In this respect, socio-ecological models have been widely used, as this approach allows identifying the effect of each set of variables on cycling (Acheampong & Siiba, 2018; Handy & Xing, 2011). However, these studies have seen too simplistic for not considering differences in built environment conditions widely visible in most SSA cities (Kumar & Barrett, 2008; Lall et al., 2017) and the usual non-availability of public transport in medium and small SSA cities (Mendiate et al., 2020). Examining the influence of these variables on cycling decisions, considering the influence of road network quality where most trips take place, can lead to a complex and more accurate model of variables affecting individual decisions to cycle.

There are three sets of variables associated with the influence of bicycling (Figure 1): (i) socio-economic aspects; (ii) physical and environmental factors; (iii) attitudinal factors. The socio-economic variables influence the individual ability and motivation to take cycling behaviour. The following socio-economic variables have been widely discussed: age, gender, income level, education level, employment status, household composition, and vehicle ownership (Acheampong & Siiba, 2018; Handy & Xing, 2011; Mendiate et al., 2020; Xing et al., 2010). Generally, age influences sensorial abilities and cycling abilities tend to decline with age (Fernández-Heredia et al., 2014). Gender is more linked to cycling culture than use (Garrard et al., 2008). A large number of studies point out that a man cycles more than a woman (Pochet & Cusset, 1999). Income and employment are linked to vehicle ownership and use (Handy & Xing, 2011). Education level is associated with the perception of individual cycling benefits (Xing et al., 2018). Household composition influences bicycle use (Boumans & Harms, 2005). Large households are likely to cycle more.

Physical and environmental variables, such as the quality of the road infrastructures, cycling facilities, tree cover, and heat and rain are also related to bicycle use (Nkurunziza et al., 2012; Segadilha & da Penha Sanches, 2014). It is usually reported that cyclists prefer paved streets with smooth pavements (Segadilha & da Penha Sanches, 2014). The presence of dedicated bicycle lanes reduces potential spots of conflicts between motorists

and cyclists (Acheampong & Siiba, 2018). Continuous tree shade reduces the temperature, making it more comfortable for people to walk and cycle (UN-Habitat, 2018). Cycling declines with very high temperatures as well as with rain (Winters et al., 2010). Studies have not examined the full influential spectrum of these variables on cycling decisions of particular role is the influence of road quality in SSA cities which declines with the increase of travel distances to the inner city (Lall et al., 2017). This means that the perception of these variables is very influenced by the built environment where trips finally take place.

Attitudinal variables seem also significant for bicycle use. These are subjective variables explicitly identified by users. Although the perception of the attitudinal variables is highly linked to the urban context, several clear patterns emerge. Bicycle use is generally associated with its flexibility, health benefits and reduced operational costs (Acheampong & Siiba, 2018; Fernández-Heredia et al., 2014). In the context of SSA cities, due to lack of public transport, cycling is also seen as a source of flexible jobs such as bicycle taxi, carrying loads in streets and also selling in streets (Mendiate et al., 2020; Mutiso & Behrens, 2011).

It is also worth to noting that these previous studies use an integrated design, establishing an association between these variables and bicycle use through considering that people cycle in a similar urban environment and they have access to public transport as an alternative commuting mode. For example, in SSA cities, the perception of cycling for those cycling frequently in urban zones with good road infrastructures implies that cycling is comfortable and could encourage more people to cycle. Different perceptions could have those cycling in an urban context dominated by unpaved roads. Such roads cause vibration and discomfort. Therefore, a stratified perception of the decision to bike or not is a step forward in designing effective strategies for increasing bicycle use.

3. METHODS

3.1. Case study description

Quelimane, a medium-sized city in Mozambique served as case study for this research. It has a vibrant cycling culture. Quelimane is the fourth largest city in Mozambique occupying an area of 9,759.61 hectares and reaching a population of 195,758 inhabitants (INE, 2015). The city has a road network of 452.79Km and 35% of them are paved. The inner city comprises of 41.87Km (9.2%) of the city's total roads where 32.32Km (77.19%) are paved. The city periphery has the largest road network in Quelimane. The road network in Z2 is about 240.12Km which represents (53.03%) of the city's total road network. However, only 82.93 Km (34.53%) of the roads are paved. The suburban area comprises of a road network of 170,802Km (37.77%). From these, 43,578Km (25.55%) are paved. Walking and cycling are the main commuting mode in Quelimane. Based on Mendiate et al. (2020), walking has a share of 45%, while cycling is 37%. It is worth noting that there is no public transport system in Quelimane. To fill the gap, bicycle taxi is becoming a prominent mean of transport. For instance, records from the municipality of Quelimane indicate that, as per the year 2017, there were about 3582 bicycle taxi operators. However, they are expected to be much more since this activity is not well controlled. Although Quelimane is a cycling city, currently, there is a mounting number of people shifting to private cars and motorcycles, forced by the growing travel distance to activities, but also by the reduced costs to purchase second-handed cars from the orient Asia. Therefore, there is an urgent need to define initiatives to promote cycling, which could provide empirical ground to archiving a significant cycling increase. Thus, Quelimane provides a good case study to better understanding why people cycle or otherwise to deliver the empirical intervention to increase cycling share.

3.2. Data collection

The study explores a broad array of socio-economic, and attitudinal variables that may potentially influence cycling choice. The data used in this analysis come from a survey conducted among 896 frequent and non-frequent bicycle users in Quelimane, Mozambique in the year 2017. Two sampling approaches were used. The first was an internet-based survey. For this approach, a total of 1284 invitation cards were delivered at different market and commercial centres. The second sampling approach was a face-to-face survey administrated for those not having access to the internet. This was conducted basically in large markets and main bicycle taxi corridors. A total of 535 individuals were finally engaged. This allowed having a sample with an 87% of confidence level and 5% of margin of error.

The questionnaire was divided into 2 main sections. The first section contains questions capturing commuter travel behaviour and their attitude towards cycling. Regarding travel behaviour, respondents were asked to

indicate their cycling frequency. Those indicating to cycle more than 3 times a week were considered as frequent cyclists (FC), while the others were considered non-frequent cyclists (NFC). Additionally, we asked the respondents to provide their previous day's cycling itinerary, by indicating their origins and destinations to each bicycle trip. All cycling trips taking place within the inner city were labelled as within Z1, and those taking place within the city periphery or sub-urban area and between these two zones were labelled as Z2. Finally, Z3 was labelled for all the trips occurring between the inner city and the city periphery or sub-urban area. In regard to cycling attitude, respondents used a Likert scale ranging from 1 to 7 to indicate the extent to which they agree or disagree with the 24 attitudinal statements of the questionnaire. Responses were grouped as 1-3 as disagree, 4 as undecided and 5-7 as agree. The second section of the questionnaire covers the standard socio-demographic variables such as gender, age, income, education level, employment status, household composition, vehicle ownership. The valid statistics of the respondents are presented in Table 1.

Table 2: Characteristics socio-economics of the respondents

Cyclists groups	% Frequent cyclists n=550 (61.4%) % Non-frequent cyclists n=346 (38.6%)	
Socio-economic variables		%
Gender	Male	69.2
	Female	30.8
Age	Young (<35 years old)	83.5
	Adults (>35 years old-<55 years old)	12.9
	Elderly (>55 years old)	3.6
Average monthly income (1000Mts ≈ 14USD)	Less than 3600Mts	50.7
	Between 3600Mts-10000Mts	39.8
	Between 10000Mts-21000Mts	7.9
	More than 21000Mts	1.6
Education level	Other levels	5.9
	Primary	29.8
	Secondary	59.9
	University	10.3
Employment status	Unemployed	11.6
	Informal jobs	31.3
	Formal jobs	57.1
Household composition	One-person household	3.3
	Single parents with children	57.9
	Couple without children	6.4
	Couple with children	32.4
Vehicle ownership	Do not own a bicycle	39.7
	Own a bicycle	60.3

3.3. Analysis

The overall analytical procedure follows two main stages. (i) Factors analysis and (ii) Binary logistic model. For all the analysis, SPSS Version 24 was used.

Stage I: Factor analysis

As a prelaminar analysis and to better understanding the underlying factors structure between the 24 attitudinal statements in the questionnaire, a factor analysis was used. The principal component was selected as the extraction method for considering that the sample responses are representative of the entire population. All small coefficients less than 0.5 were suppressed to enable having a robust result. The robustness of the results was obtained through Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity. The

obtained latent physical and environmental and attitudinal variables were used as input for the binary logistic model. Results are presented in Table 2.

Stage II: Binary logistic model

The broad array of 6 socio-economic variables were added to the latent physical and environmental and attitudinal variables are relevant for choosing bicycle frequently. These variables were examined in relationship to travel patterns per different urban contexts. Binary logistic regression models were employed to identify the relationship between these variables with different cycling behaviours (FC and for NFC). The socio-economic variables and the latent physical and environmental and attitudinal variables were considered as independent variables in the models, whereas NFC and FC were considered as the dependent variables in the model. Since cycling is highly influenced by the built environment around the frequent routes, 3 sub-models were implemented to analyse the influence of the 3 SSA classical urban typologies on cycling behaviour. These sub-models compared the influence of the different independent variables on cycling behaviour for those bicycling frequently within the inner city, within the city-periphery/suburban area and between the inner city and city periphery/suburban area. This allowed having a series of binary logistic models to estimate the probability of cycling more based on the urban context the trip takes place. This is an effective approach particularly for people cycling in SSA cities since the quality of the road infrastructures declines from the inner city to the suburban area (Lall et al., 2017; Mendiate et al., 2020). For the overall model fit statistics, the chi-square likelihood ratio test (of the fits of the model relative to the null), pseudo R^2 value (Nagelkerke R Square) were assessed. Results are presented in Table 3.

RESULTS

Factor analysis

A total of 24 items were used to measure the latent constructs of the attitudinal statements towards cycling. Table 2 shows the factors loading according to their common influence on bicycle use in Quelimane. Five-factor groups were obtained, with the Kaiser-Meyer-Olkins measure of sampling adequacy of 0.86, with a goodness fit (Bartlett's test of sphericity) approximate chi-square of 7073.09; df=276; Sig=0.00. From the 24 items loaded, only 22 were considered for the study for presenting an Eigenvalue greater than 1. The excluded percetion items are: My available time encourages cycling and Bicycling would be good for health promotion.

Based on the items loaded, within factor group 1(F1), travel distance, travel speed, lack of street signalization, poor pavement conditions, travel volume, lack of street signalization, presence of street vendors on main junctions, and lack of tree cover reflects the respondents perceived *road infrastructure challenges*. On the other hand, items loaded in factor group 2 (F2) street accidents, bicycle theft, rain, heat risk of accidents, these variables reflect perceived *weather and safety challenges.* Three items showing the *economic benefit of cycling* fall within the factor group 3 (F3). These variables are the opportunity to cycle for bicycle taxi, sell goods in the streets and carry loads in the streets. Moreover, four other items fall within the factor group 4 (F4) which shows the perception of *bicycle commuting benefits*. These variables are mode flexibility, mode comfort, cost and pleasure to ride. Finally, the loading variables such as the absence of shower at destination and lack of cycling park, load in factor group 5 (F5). This suggests that respondents perceived *cycling facilities' challenges* on their decision to cycle or not.

Table 3: Factor loading of questionnaire items

	Factors				
Perception variables toward cycling use	F1	F2	F3	F4	F5
Cycling long distances daily is tiring	0.55				
Frequent disrespect to speed limits discourages cycling	0.69				
Lack of street signalization discourage cycling	0.77				
Cycling on the uneven pavement is uncomfortable	0.79				
Mixed road traffic composition discourages cycling	0.70				
Cycling in the poorly lit street is uncomfortable	0.77				
Road encroachment caused by street vendors discourage cycling	0.69				
Not enough tree canopy shade along the streets discourage cycling	0.64				
Cycling is discouraged by the increasing rates of road accidents		0.55			
The prevalence of bicycle theft discourages cycling		0.62			

Bicycling in rain is uncomfortable		0.73			
Cycling in heat would make me sweat		0.78			
Cycling presents a risk of accidents or fall		0.69			
Cycling for bicycle-taxi services is convenient			0.86		
Cycling to sell goods on the street is convenient			0.75		
Cycling to carry loads on the street is convenient			0.87		
Cycling is flexible				0.70	
Cycling is comfortable				0.67	
Cycling is cheaper if compared to other means of transport				0.64	
Cycling is pleasant				0.65	
The absence of a convenient place to shower and change clothes discourage cycling					0.78
The absence of convenient bicycle parking discourages cycling					0.81
% of Initial Eigenvalues variance	5.81	2.69	1.87	1.52	1.36
% of initial Eigenvalues cumulative (n=55.26)	24.22	11.21	7.81	6.33	5.69

Variables influencing bicycle use

The result (Table 3) shows that for those cycling within the inner city (Z1) perceiving bicycle commuting benefits increase in 2.144 the likelihood of cycling more frequently if compared to those not cycling frequently.

For those that cycling within the city periphery or sub urban area (Z2), gender (2.457), vehicle ownership (6.252), perceived economic benefits of cycling (1.689) and perceived bicycle commuting benefits (1.311) may lead to increase the chances of cycling more frequently if compered to not cycling frequently.

When comparing NFC and FC cycling between the inner city and city periphery, the model indicates that an increase employment status may increase the in 2.236 the odds of cycling more frequently.

Table 4: Binary logistic regression model of the determinates for bicycling between non-frequent cyclists compared to frequent cyclists based on changes in urban typology

Explanatory variables	Within inner city *(Z1)*	Within city periphery/suburban area *(Z2)*	Between inner city and city periphery/suburban area *(Z3)*
Socio economic variables			
Gender (Male=1)	1.549	2.457*	1.315
Age (elders=3)	1.046	1.001	1.014
Income (>21000Mts=3)	1.842	0.984	0.171*
Education level (University =3)	1.499	0.863	1.554
Employment status (formal jobs =3)	0.812	1.037	2.236**
Household composition (Couple with children=4)	0.723	0.939	1.120
Vehicle ownership (Own a bicycle =1)	4.121	6.252*	0.747
Latent physical and environmental variables			
Road infrastructure challenges	1.710	1.103	1.821
Weather and safety challenges	0.463	0.670*	0.823
Cycling facilities challenges	0.962	0.953	0.678
Latent attitudinal variables			
Economic benefits of cycling	2.066	1.689*	1.911
Bicycle commuting benefits	2.144**	1.311*	0.878
n	66	753	74
Pseudo R^2	0.436	0.333	0.380
-2 Log likelihood	65.181	780.265	77.004
Model χ^2	χ^2 (1) =26.072	χ^2 (5) =210.393	χ^2 (2) =24.715
Sig	0.010	0.000	0.016

DISCUSSION AND POLICY RECOMMENDATIONS

This study has examined the influence of socio-economic and latent physical and environment variables and attitudinal variables on the decision to cycle or not, based on changes of urban typology in Quelimane, a medium-sized city in Mozambique.

The model's results reveal that those cycling within the inner city (Z1), cite the latent factor perceived bicycle commuting benefits to show a positive likelihood of cycling frequently if compared to not cycling frequently. From Table 3, flexibility and comfort present the highest loading within this latent factor group. These findings are consistent with Pochet and Cusset (1999), who found cycling as a flexible transport mode, particularly in busy urban areas. Lall et al. (2017) confirms when cite that the inner city of SSA cities often presents an urban environment characterized by mixed and slow vehicular traffic, therefore attractive for cycling for being more flexible and having a more predictable travel time than the other modes. Moreover, based on Section 3.1 the inner city of Quelimane presents better roads that contribute to smooth cycling. In consistency with Acheampong and Siiba (2018) who cite that good quality roads encourage people to cycle as it minimizes vibrations. These findings indicate that those cycling within the inner city can be persuaded to cycle more frequently when better roads and infrastructures oriented to cycling are provided. This is confirmed by Handy and Xing (2011) when cites that several studies show an association at the city level between bicycle commuting and availability of bicycle infrastructure.

For those cycling within the city periphery/suburban area (Z2), the model indicates that gender, bicycle ownership, the economic benefit of cycling and bicycle commuting benefits may lead to a higher likelihood of cycling. These results seem acceptable, according to several studies (Acheampong & Siiba, 2018; Nkurunziza et al., 2012), being a man increases the chances of cycling than a woman. This is particularly observed in the city periphery of the SSA city, due to poorly paved roads that require additional effort to cycle that women often cannot cope with. In addition, the results indicate that having a bike increases the likelihood of cycling frequently within the city periphery/suburban area. This is consistent with previous studies (Acheampong & Siiba, 2018; Mendiate et al., 2020) who cite that bike ownership increases the odds of cycling. For Mendiate et al. (2020), this is particularly important in urban contexts with limited car access such as the city periphery. Our findings regarding the economic benefits of cycling and perceived cycling benefits are consistent with Cervero (2000); Mendiate et al. (2020) and Mutiso and Behrens (2011) who found that bicycle in SSA cities is seen as a working tool, source of livelihood and a flexible mean of transport. Since the road network in the city periphery is narrow and irregular, cycling has enormous advantages over the other modes and obviously bicycle taxi gain prominence due to the impossibility of providing public buses in such a road network. The nature of this finding led us that NFC in the city periphery/suburban area can be persuaded to cycle more frequently when policy initiatives are focused on proving paved roads particularly in major bicycle taxi corridors and those roads connecting high utility activities. This could improve bicycle use, particularly for a woman and bicycle taxi passengers.

For those cycling between the inner city and city periphery (Z3) point having a formal job to increase the odds of cycling frequently. This result is aligned with Lall et al. (2017) who refer that in SSA there is a spatial miss much between jobs (often located in the inner city) and residence (in the periphery), therefore we could expect an improvement in the employment status could increase the need for daily cycling between these two urban zones, particular in cities like Quelimane, where there no public transport (Chapter 3.1). However, due to increased long distances and a mix of good and poor-quality roads that characterize these urban zones, it is expected that they could stop cycling as the social status also improves. Therefore, to increase cycling frequency, policy initiatives are expected to focus on unifying the quality of roads between these areas. These initiatives should be targeted at roads connecting dense residential areas to major formal employment destination areas.

6. CONCLUSION

This study provides new and potentially important insights into variables associated with the decision to cycle regularly. The results of this study showed that including changes in urban typologies was useful in capturing the real effect of these variables on cycling behaviour by underlining the impact of road quality changes between different urban zones in cycling frequency. In this study, the influence of these variables on cycling was captured using an ecological model.

The findings suggest multifaceted initiatives to increase bicycle use in Quelimane, on the focus of changes in urban typology along with the city. The study shows that for those cycling within the inner city (Z1), the latent

attitudinal variables such as flexibility, comfort are highly influential to increase bicycle use. NFC can be persuaded to cycle more by improving roads quality and providing cycling infrastructures. Most notable is that the study has confirmed that gender, bicycle ownership, the economic benefit of cycling, bicycle commuting benefits may lead to a higher likelihood of cycling frequently within the city periphery/suburban area (Z2). Since these urban zones comprise poor quality roads, policies to increase cycling should focus to improve the quality of the road surface particularly in major bicycle taxi corridors. Employment status have shown a significant influence on bike use for NFC cycling between the inner city and city periphery (Z3). Since these areas' present deep differences in the quality of the road's infrastructures, initiatives to encourage more people to cycle to jobs located in the inner city should be oriented to reduce the infrastructure quality gap.

Finally, since the study provides a richer insight into the variables that may potentially influence cycling by highlighting the major challenges to be addressed, and knowing that a considerable number of people in SSA cities experience cycling as bicycle taxi passengers, further should attempt to measure the influence of these variables based on their experience as bicycle taxi passengers.

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SMALL TOWN REVITALIZATION PLANNING: A CASE STUDY OF ELIXIR GARDEN, NEGOTIN, SERBIA

Katarina Medar

Faculty for Civil Engineering and Architecture, Serbia
PhD student, Research assistant, katarina.medar@gaf.ni.ac.rs

Ana Momčilović - Petronijević

Faculty for Civil Engineering and Architecture, Serbia
PhD, Assistant Professor, ana.momcilovic.petronijevic@gaf.ni.ac.rs

Slaviša Kondić

Faculty for Civil Engineering and Architecture, Serbia
PhD, Assistant, slavisa.kondic@gaf.ni.ac.rs

Milan Tanić

Faculty for Civil Engineering and Architecture, Serbia
PhD, Professor, milan.tanic@gaf.ni.ac.rs

Vojislav Nikolić

Faculty for Civil Engineering and Architecture, Serbia
Assistant, vojislav.nikolic@gaf.ni.ac.rs

ABSTRACT

Numerous small towns throughout Serbia and the Balkans have old industrial complexes that are no longer active, and whose shutdown affected the reduction of the number of inhabitants and stagnation in the development of the city in every possible way. Decentralization is often cited as the starting point for the further development of Serbia. In this regard, investment in the revitalization of smaller towns and municipalities plays an important role, and a renewal model can be sought precisely in the urban renewal of brownfield sites.

This paper presents the urban and architectural design of the mixed-use complex 'Elixir Garden' in Negotin, Serbia as possible model for revitalization of town. The future complex is planned on a brownfield site, the former Krajina vino industrial complex.

Keywords: *small town; urban and architectural design; revitalization; Negotin; urban planning; brownfield.*

1. INTRODUCTION

Old industrial complexes that are no longer active may be found in numerous small towns throughout Serbia and the Balkans. Their closure has had a negative impact on both the population decline and the city's ability to develop. Current demographic data related to the territory of the Republic of Serbia indicate the disappearance of smaller communities and the multiple expansion of the capital city. Research by the Republic Institute of Statistics shows a large decrease in the number of inhabitants in the eastern and southern parts of Serbia. The district of Bor, to which the city of Negotin belongs, recorded a 32.7% decrease in the number of inhabitants in the period between 1991 and 2011 (Lakčević, 2014).

Decentralization is often cited as the starting point for the further development of Serbia. In this regard, investment in the development of smaller towns and municipalities plays an important role, and a renewal model can be sought precisely in the urban renewal of brownfield sites. Favourable demographic trends are

necessary but not sufficient for increasing small town residential populations. The planners, investors, and town must provide an environment in which people want to live (Burayidi, 2018).

Brownfields can generally be defined as abandoned complexes, mainly for industrial purposes, which have reached the end of their operational life within the existing framework and, as such, have a negative impact on the urban core in which they are located. The post-industrial period has left behind a significant fund of brownfield sites all over the world. In recent decades, more developed countries have largely dealt with this issue and successfully implemented brownfield regeneration. Less developed countries, including Serbia, have many brownfield sites in almost all cities, which currently have a negative impact on the environment in which they are located because they represent unsafe, neglected, and often uncontrolled urban spots. Factories and warehouses were losing their former use, they became the liability in urban structure, adding to the crisis of the city centers and lowering the quality of city life. (Vaishar et al, 2022).

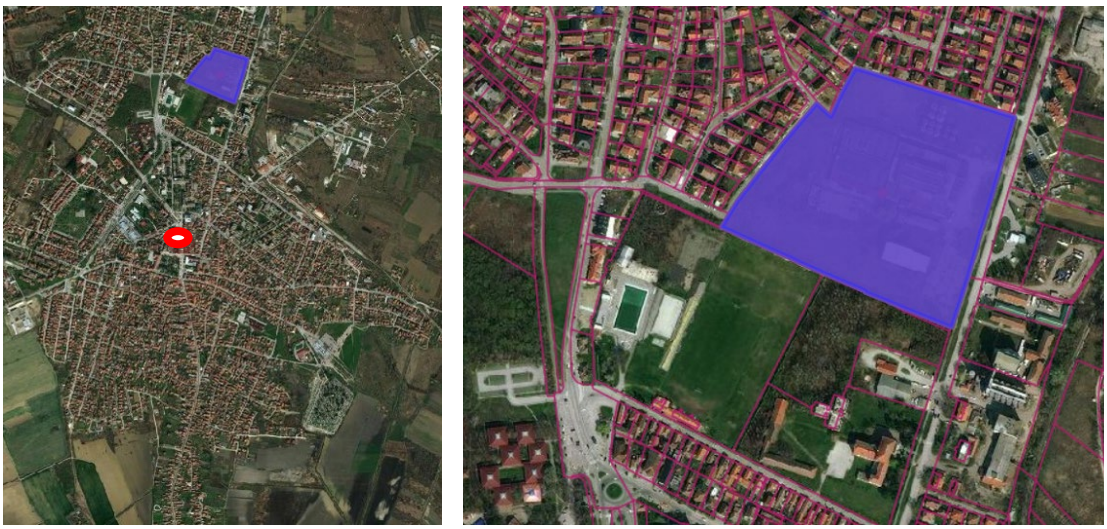
This paper presents the urban and architectural design of the mixed-use complex 'Elixir Garden' in Negotin, Serbia. The future complex is planned on a brownfield site, the former Krajina vino industrial complex.

2. URBAN AND ARCHITECTURAL DESIGN CONCEPT

2.1. Location

The site is a brownfield located in the northern part of Negotin municipality (Figure 1). The plot is shaped like a trapezium and is surrounded by three roads. This location used to be an industrial complex, wine production center "Krajina vino", founded in 1890. The complex is spread over a plot of 56,470 m2. All the buildings that were located on the plot were industrial (or were integral parts of the industrial complex). The existing building stock was to be completely removed because the listed structures were in poor condition and deteriorating, therefore their adaptation was not taken into account.

The immediate surroundings of the site comprises of mainly single-family housing (blocks on the north and west), while on the east side, the area is partially built with multi-family buildings. On the south end of the block are the Technical School and the city stadium complex. The city centre is about 1 km to the south, in the wider area of the location, within a fifteen-minute walk.



(a) (b)

Figure 1: (a) Negotin city centre and location, and (b) Building plot

2.2. Terms of reference

The design specifications included facilities of various purposes, predominantly housing and, to a lesser extent, public facilities. It was requested that the structures on the land be zoned, separating the residential facilities from the public ones. The largest percentage of the construction fund is for residential purposes, which includes two typologies, multi-family and single-family housing. The project program defines a capacity of over 850 housing units.

Public facilities included a preschool - a kindergarten, a retail shopping center and open sports fields.

2.3. Master plan concept and zoning

The basic idea behind the conceptualization of the master plan was to create a city within the city, a new urban fabric that can offer various content both to the future tenants of the complex and to the wider environment, the residents of the city of Negotin and its surroundings.

Respecting the context and environment of the location, the complex was zoned into several units (Figure 2). A new street was introduced in the east-west direction, which connects Miomir Radosavljević and Branko Ćopić streets, dividing the complex into two dominant parts, north and south, and physically zoning the space.

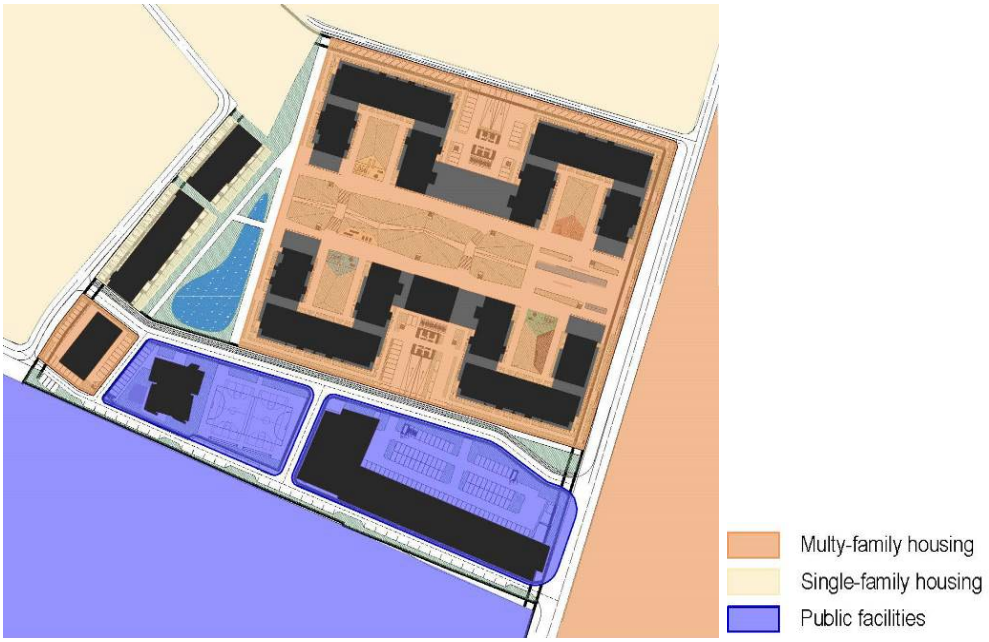


Figure 2: Master plan - zoning

Northern, dominant part of the plot is designed as a residential block. Single-family housing, which includes two groups of terraced houses, is located on the west side of the residential area. This part of the complex is a transition zone to the single-family residential zones on the west side of the Elixir Garden complex.

The rows are oriented in the northeast-southwest direction, in order to enable the most favorable orientation of the living area in the residential units. The terraced houses are organized so that the entrance zones and related accompanying facilities face the street from the north-west side, while the yards, and therefore the main facilities within the unit, face south-east, towards the interior of the complex.

A green area with an artificial lake is located in between these two parts of the complex (high rise multy-family and low rise single-family). In addition to improving the quality of the environment and socialization in the complex, this lake (Figure 3(b)) also has the function of retention for storm water, thus reducing the pressure on the city's sewage network.

(a) (b)

Figure 3: (a) Master plan, and (b) Terraced house and lake view

In the north-eastern, dominant part of the complex, multi-family housing is planned. Multi-family housing is organized into two physical units, southern and northern, both seven-storey buildings. The buildings are mostly the same, facing each other in a mirror image, with minor differences in the ground and last floor. The base is in the shape of two joined letters U, with penetrations on the ground floor. Residential units are located on all above-ground floors, and ground-floor apartments have private yards and private entrances, which increases the level of individualisation of these residential units.

Figure 4: Multy-family residential building, segment

In the southwestern part of the site, five-storey residential building for the workers of the Elixir Prahovo factory is planned (Figure 5 (a)). Due to the fact that temporary housing is planned in this building, the building is placed under the newly designed road, i.e. outside the residential block in the northern part.

(a) (b)

Figure 5: (a) Residential building for Elixir Prahovo workers, and (b) Kindergarten

Public facilities are planned in the southern part of the plot, under the newly designed street. To the east of the residential building for the accommodation of workers is a kindergarten. The building has a loose form, with a central atrium courtyard in the south, which is an extension and connection between the two preschool units.

A retail shopping center is planned in the southeast, towards the busiest road, Pikijeva Street. This position is closest to the city center and abuts the public area to the south. The Retail Park in the central part of the plan contains space for rent intended so that the settlement is supplied with supporting facilities necessary to the housing.

2.4. Traffic

The large number of residential units, over 850, resulted in a large number of parking spaces. In order to free the residential area from parking as much as possible, a large underground garage was designed under the

buildings and open central area. Vehicle traffic is left out of the complex interior, and garage ramps and above-ground parking spaces are located around the perimeter of the block. Inner part of the residential block is for pedestrian use only.

The newly designed street divides the complex into two parts, the northern, residential part (for permanent residence), and the southern, public and commercial part (with apartments for temporary use). New street is designed with a serpentine curve in a road, chicane, in order to slow vehicular traffic within the complex (Dinić-Branković et al, 2020). In addition to this, a ring service street will be places in the very south, along with public amenities.

2.5. Free spaces, greenery and social identity

Open green areas and spaces for socialization of tenants significantly influenced the design of this complex. Within the multy-family residential block 5 gathering centers are planned, organized in two levels. The central, largest gathering space is designed as linear promenade, with green areas that acquire a third dimension, to enable the conditions for planting high greenery and create a more natural ambience. On the eastern side, this gathering center ends with a square with water surfaces, towards Pikijeva Street, which is the highest rank in the area. In addition, 4 lower-level point gathering centers are planned within each of the U shape. They are more closed and intimate, with facilities for children and seating areas. Open sports fields are planned between the kindergarten and the retail park.

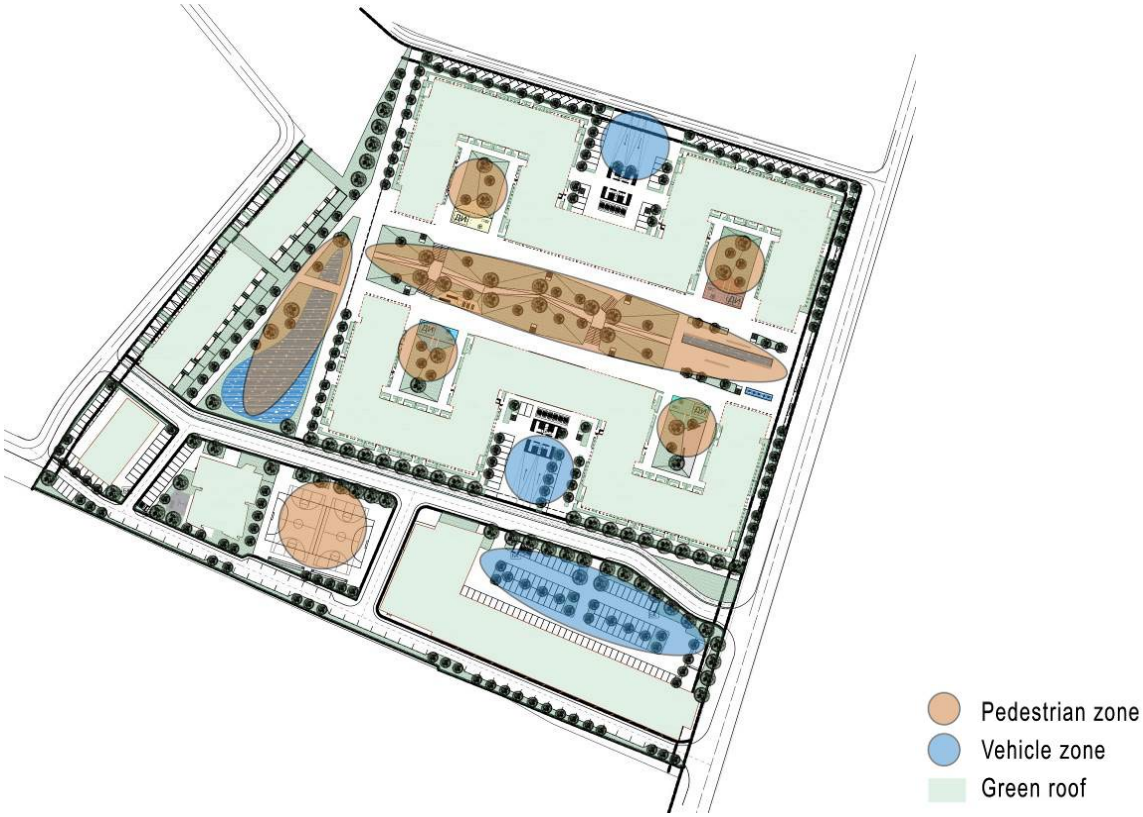


Figure 6: Master plan – free spaces, greenery and parking

The roofs of the buildings are designed as flat, green roofs. A green roof provides a rainwater buffer, purifies the air, reduces the ambient temperature, regulates the indoor temperature, saves energy and encourages biodiversity in the city (Kotzen, 2018). Beside all above, green roof in residential buildings are used a as open areas for residents socialization.

2.6. Visual identity

Buildings for multi-family housing are conceived as vertical gardens. The facades are designed in bright, pleasant tones. The dominant white color is broken by the random placement of wooden planters on all facade planes. They are designed with appropriate depths to support the cultivation of low and medium greenery.

The integration of shaded streets, active rooftops, courtyards and terraces, and deep, layered facades all minimise the impact of harsh sunlight, which in combination with natural ventilation and building systems, yield both internal comfort and minimise energy use.

3. CONCLUSION

The perception of small towns as being outdated or trapped in the past because they have not embraced the new, digital, global economy is common. In a world that is always changing, these communities are faced with a whole new set of opportunities and difficulties. Small towns and their community institutions now have to work to preserve their natural lands and preserve their small-town aesthetic with more constrained government resources while also engaging in long-term planning, creating thriving downtowns, and supporting sustainable development.

This is a project that looks beyond the scale of an individual building, or complex, to create a coherent piece of the city. The goal has been to learn from the past to build a contemporary place that can stand the test of time and to support Negotin's transition to a post-industrial economy by creating an attractive urban core that can be a magnet for both local and sub-local visitors.

In different sizes and layouts, a variety of dwelling typologies have been considered within the overall scheme, offering opportunities for families of all scales and helping to create a highly diverse community.

„Elixir Garden" complex represents a possible model for brownfield investments that could initiate revitalization of towns affected by depopulation by creating a vibrant new residential areas with public and commercial services, and thus improving quality of life.

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