SHAPING RESIDENTIAL OPEN SPACE IN URBAN DENSIFICATION: GUIDING THE PROCESS TO PRESERVE ENVIRONMENTAL QUALITY AND HEALTHY LIFESTYLES IN NIŠ, SERBIA

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ABSTRACT

In the post-socialist period, multi-family housing estates in Central and Eastern European cities underwent extensive transformations, reflecting on both urban landscape and quality of life. One of the most prominent issues that inhabitants of these estates are facing nowadays is the disappearance of public open space in their immediate residential environment. On the other hand, contemporary urban planning policies and approaches promote green open spaces as a valuable asset for creating resilient cities, particularly within residential land use. Therefore, the question arises - how to shape public open space in inherited estates of collective housing that underwent urban densification, according to sustainability principles?

By presenting the transformation of a residential site in the post-socialist city of Niš, this paper examines the implications that vertical extension of residential buildings had on public open space, and reviews development perspectives envisioned in the standing planning document. Given the fact that public open space is a vital element of the quality of housing, it is the standpoint of this research that residential open spaces need to be preserved in urban densification in order to enable recreation options and social interactions. Additionally, implementing the concept of urban greening in open space brings manifold benefits regarding environmental quality and resilience. The objective of the paper is to establish how the process of "vertical densification" affected existing public open spaces in housing areas at a micro level, and to identify the key open space potentials for retrofitting. The results of this study should help in defining guidelines and strategies to preserve public open space and greenery in urban densification.

KEYWORDS _ *Urban planning and design; Housing; Vertical extensions of buildings; Public open space; Greening*

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 paved areas are known to cause the urban heat island effect (Taha, 2004). Implications of intense urbanization are particularly visible in the urban landscape of post-socialist cities throughout Central and Eastern Europe.

In the post-socialist period, extensive transformations of urban fabric unfolded in former socialist cities. One of the urban functions that underwent significant changes was residential use. Spatial transformations of existing multi-family housing estates implied, among others, densification of urban structure (Hirt & Stanilov, 2007; Dinić Branković et al., 2018). Urban densification unfolded both *horizontally*, as new construction at the expense of open/green space in urban blocks, and *vertically*, as extension of residential buildings by constructing additional floors on top of them. The focus of this study is on vertical urban densification.

In post-socialist Serbia, legislative framework first enabled vertical densification through the Law on Upgrading Buildings and Converting Common Spaces into Dwellings (1994), while more detailed conditions were defined through the Law on Construction of Buildings (1995). In turbulent transition times of the 1990s, vertical extension of residential buildings quickly became the dominant type of housing development because it did not require any new locations or new communal infrastructure. Therefore, this type of development was favoured by a large number of stakeholders in the housing market: sitting inhabitants, new inhabitants, developers, local government and politicians (Čanak, 2003). The Law on Maintenance of Residential Buildings (1995) specified that upgrading, as a part of management of residential buildings, was responsibility of the homeowners, that is, Housing Association at the level of a particular building. Therefore, vertical densification occurred at the scale of a single building /plot. This development pattern was not recognized as controversial by planning institutions and professionals, thus creating a multitude of issues in space. One of the major consequences of such piecemeal approach involves devalued aesthetics and lack of coherent style (Hirt, 2006). This "patchwork architecture", which is also recognized in other CEE cities as a specific design expression, is referred to as "hybrid spatiality" (Golubchikov, 2014; Vranic, 2016).

At the beginning of the transition period, little or no attention was given to public open space as a prominent feature of socialist housing estates, nor was its importance in urban matrix perceived during compaction processes. Public open spaces and green areas, which made up a high share of urban fabric in the socialist period (Stanilov, 2007) have perished under the onslaught of new construction (Hirt & Kovachev, 2006), both in terms of quantitative and qualitative decrease (Vasilevska et al., 2014). Aside from the obvious disappearance of open space during horizontal densification, vertical densifications also resulted in significant transformations of open space due to: (1) increased residential densities, (2) increased needs for services, amenities and parking that were generated by new construction, and (3) incoherent architectural styles of structures framing open space.

Contemporary urban planning policies and approaches promote sustainable urbanism. This concept is defined as "walkable and transit-served urbanism integrated with high performance buildings and high-performance infrastructure" (Farr, 2007), with compactness and access to nature being its main principles (Adhya et al., 2011). With the implementation of sustainable urbanism and a variety of ecological features, the traditional residential neighbourhood draws on the so-called "eco-neighbourhood" model. This neighbourhood is designed to balance urbanization and environmental protection, and involves the principles of public participation, greening, sustainable mobility, network of public open spaces and multifunctionality (Codispoti, 2022). Such neighbourhoods also promote the "shared space" design approach, which implies streets that unify pedestrian and low-speed motor traffic within the same - shared space, by favouring walking and cycling, de-prioritizing motorized vehicles and emphasizing the social aspects of shared space (PPS, 2017).

Green public open spaces play a very important role in sustainable urbanism, and represent a valuable asset for creating resilient cities (UN, 2015). New Urban Agenda suggests creating open, safe, inclusive, accessible, green and quality public spaces that are multifunctional areas for social interaction, health and well-being, economic exchange and cultural expression, that enhance resilience to disasters and climate change, and that are designed and managed sustainably and equitably (UN Habitat III, 2016). Therefore, public open spaces are a crucial element of urban fabric, particularly within residential land use, and need to be planned and designed sustainably. They enable urban recreation, restore nature to urban landscape, enhance visual appeal of the area and frame the setting for social interactions, thus empowering physical and mental health of residents. Additionally, un-paving and greening of outdoor spaces in densely built urban areas favours biodiversity, microclimate and stormwater management, thereby improving environmental quality and enhancing the overall resilience of cities to natural disasters.

The initial hypothesis of this research is that preserving and retrofitting public open space in residential areas results in greater social and environmental quality of the neighbourhood. Therefore, the goals of this paper are: (1) to establish how and to what extent the process of post-socialist vertical extension of residential buildings affects public open space at the micro level, and (2) to identify the key elements of urban design that contribute to sustainable public open spaces in inherited housing estates.

MATERIALS AND METHODS

This paper explores the shaping of public open space in a typical multi-family housing estate that underwent vertical urban densification in the post-socialist period, by using a segment of the neighbourhood Stara železnička kolonija in the City of Niš as a case study. Niš makes a suitable research polygon for exploring the effects of buildings' vertical extensions on public open spaces, because as much as 80% of the total building stock in socialist housing estates was upgraded with one or more additional floors (Vranic et al., 2016). The selected study area involves a part of the neighbourhood Stara železnička kolonija and covers 0,64 hectares. This particular site was chosen for two reasons: (1) to best reflect the implications of vertical extension of structures on open space, which was extensive in this case, and (2) the site has a vast existing public open space that was preserved in urban densification, thus generating great re-shaping potential for the neighbourhood.

The paper uses empirical research, review of relevant literature and planning documents, and ENVI-met software simulations of shading in the study area. Methodological framework is conceptualized on description, analysis and synthesis, and structured in the following way: exploring the selected study site, reviewing the effects of building transformations on public open space, investigating the change in shading of public open space generated by buildings' vertical extension, and reviewing standing planning documents. Synthesis of study findings is used for discussing the shaping of public open space in line with sustainability principles.

STUDY AREA IN THE NEIGHBOURHOOD STARA ŽELEZNIČKA KOLONIJA, NIŠ

Original urban setting

Residential neighbourhood Stara železnička kolonija is located in the Municipality of Palilula, Niš, in the vicinity of the central city zone (Figure 1). The neighbourhood was developed in the 1940s as a workers' settlement for the railway company, on a slightly sloping terrain. The neighbourhood was created with residential use only and without necessary communal/utility infrastructure. Afterwards, water and sewerage were brought in, so the apartments were remodelled to create kitchens and bathrooms.

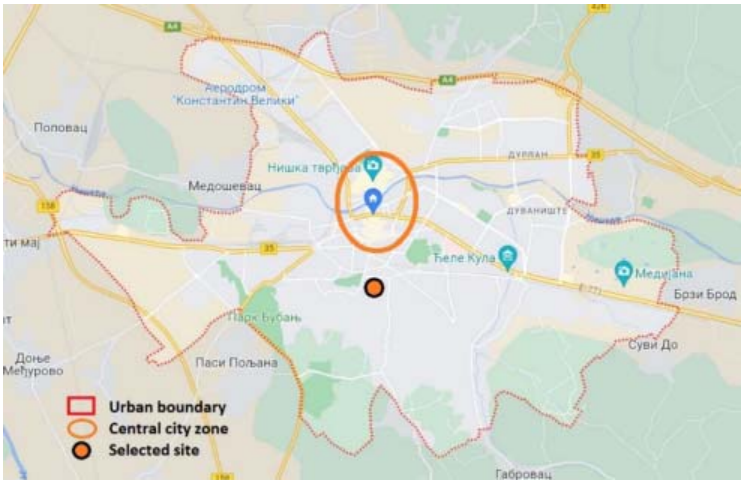

Figure 1: Position of Stara železnička kolonija neighbourhood in the urban area of Niš. Source: Google map, drawing by Milena Dinić Branković

Figure 2: Stara železnička kolonija neighbourhood. (a) Original urban setting in 1941. (view from the south), (b) Transformed urban setting nowadays (view from the north), (c) Transformed urban setting nowadays (view from the south). Sources: (a) https://www.facebook.com/photo/?fbid=1161561377513462&set=a.369421733394101, (b, c) photo by Milena Dinić Branković

Figure 3: Study area in Stara železnička kolonija neighbourhood. (a) Original urban setting analysis, (b) Existing site analysis, (c) Vision for the site. Sources: (a, b) drawing by Milena Dinić Branković, (c) Fifth modifications and additions of the Plan of General Regulation of the Municipality of Palilula – Phase I, 2019

At the time, the neighbourhood was a represent of modern architectural style. Original buildings were designed as 2-storey structures (Ground floor+1) with sloping roofs (Figure 2a). The buildings were aligned into linear rows, with open space of good size in between (Figure 3a). This common space had lush greenery, and in spite of the lack of amenities, it was actively used and maintained by the residents. Some of the ground floor apartments originally had private entrances from the courtyard, thus secluding them from upper-floor housing. All of these features contributed to the strong sense of community. At the time the settlement was built there were no parking needs, but in the later years several parking garages were constructed in the neighbourhood, for those inhabitants that owned cars. Also, in the 1990s, a new pathway for combined vehicle and pedestrian traffic was traced across the site.

Transformed urban setting

Original buildings were upgraded in the period 2008-2013 with 2 additional storeys (Figures 2b, 2c). This represents an addition of 100% in building height, therefore making this transformation quite extensive. Transformed buildings also have sloping roofs. During this transformation, the buildings were completely renovated and central heating was introduced. Since no infill development occurred at this site, there was no decrease in size of open space. Due to good location and some refurbishment, the settlement gained popularity with urban dwellers.

Within the study site there were no changes to building use, all structures remained residential, except in the case of one basement conversion to business use. This was a spontaneous change, enabled by the semi-buried basement construction on the sloped terrain. The population doubled with vertical extension of buildings, and is now approximately 360 residents in the explored area. Since upgraded buildings remain low-rise housing, the density at the site is not excessive and amounts to 560 inhabitants/hectare.

Regarding the parterre level, a large portion of public open space along existing streets was converted into parking lots as a planned action within the redevelopment project (Figure 3b). Inner-block open space was also arranged with vast green areas and some modest urban furnishing. Northern part of the site preserved more trees, while the southern open space remained grassy with medium-sized greenery. Existing private entrances of some ground floor apartments were preserved during building remodelation, thus enabling more privacy and a higher level of housing quality.

Implications of vertical extensions of buildings upon public open space at the site

Use of space. Although there was no infill development at the site, some changes in the use of open space are evident. Due to population increase and newly designed small-scale housing units in the upgraded residential floors, the need for parking spaces increased to approximately 90. There is now an evident lack of parking space, since only 70 are provided. Existing parking garages are deteriorated and are not being used. Therefore, aside from planned parking along the buildings and existing streets, usurpation of open green space by vehicles also occurs (Figure 3b). The northern part of open space was fenced as a inhabitants' spontaneous initiative to preserve remaining greenery at the site. Some equipment for children was installed in the part of open space, but no amenities for other user categories were provided. The inhabitants have no common area for gathering and social interactions.

Aesthetics. Vertical extension of existing buildings in Stara železnička kolonija was not considered at the level of the entire urban setting. On the contrary, the transformations were implemented at the level of an individual building/plot, each of them having their own architectural expression. This "single building upgrade" approach resulted in a variety of styles within the entire neighbourhood, and is quite obvious in the explored site, too. The "patchwork architecture" of residential buildings consequently devalued the aesthetics of public open space that is framed by those structures (Figures 2b, 2c).

Not much attention was given to shaping outdoor residential space at the time of the transformation, and the easiest way to deal with this issue was to preserve open space as it was – green, with several planted trees in the northern part of the site. However, existing greenery is characterised by poor landscaping and insufficient maintenance. Along with non-existent furnishing, this resulted in modest urban design. Private entrances to ground floor apartments are not contributing to the visual appeal open space at all, in terms of tying the vertical frame with the parterre. The issue of waste disposal is not properly resolved, since waste containers are located along the new central pathway in plain sight, without any kind of visual barrier. Therefore, the overall aesthetics of this public open space is quite poor, regarding both horizontal arrangement and vertical framing.

Environmental quality. The lack of developers' consideration for public open space during urban densification, which resulted in preserving green areas, turned out to be a favourable outcome in the environmental context. There is now no paving in the inner-block area, and total green area in direct contact with the ground amounts to 0,30 ha, or 47% of total site area. Therefore, the microclimate at the site is favourable in hot summer months, while vast green surface accommodates stormwater during intense rainfall.

Shading. Shading at the explored site is simulated in two scenarios: the original urban setting, and the transformed urban setting. The timeframe for the analysis is set between 10 AM and 6 PM, when residents actively use open space. Increased building heights also increased the horizontal projections of building shadows, as illustrated in Figure 4. Given the fact that vertical extensions of structures were quite extensive compared to their original height, the transformation had significant implications on shaded surfaces at the parterre level in all analysed hours of the day, except at noon when the sun is positioned very high (Dinić Branković et al., 2022). The increase in the surface of shaded areas between two scenarios, in favour of the scenario of upgraded buildings, is given in Table 1.

Table 1: Increase in the surface of shaded areas in the scenario of upgraded buildings

Time	**10 h**	**12 h**	**14 h**	**16 h**	**18 h**
Surface	410 m^2	100 m^2	885 m^2	1200 m^2	225 m^2

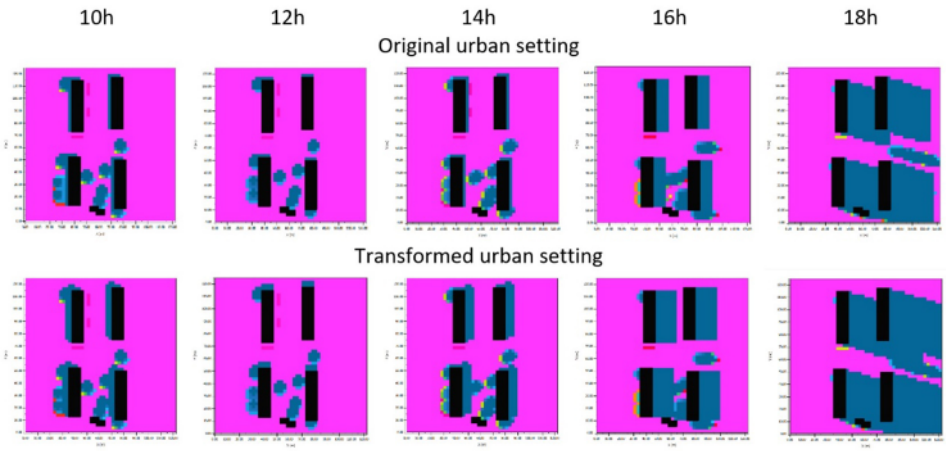

Figure 4: Direct sw radiation in the original and the transformed urban setting in the analysed timeframe.

The extent of additional shading of public open space is evident at 10 AM and at 2 PM, while the greatest increase in shaded areas is observed at 4 PM, when additional 1200 m^2 of the parterre level is covered with shade in the scenario of upgraded buildings. Additional shading is not present in the inner

open space between buildings at 6 PM, but exists in the outer open space (street). In spite of significant vertical extension of buildings, a small portion of inner public open space is still being exposed to solar radiation. This is explained by low ratio of maximum building height and maximum building distance (0.26), which still remained low after upgrading. It is also observed that vertical extensions of buildings have a more significant increase on shading of open spaces in late afternoon hours.

Planned vision for the urban setting

The standing plan for this site is the Fifth modifications and additions of the Plan of General Regulation of the Municipality of Palilula – Phase I, adopted in 2019. For the neighbourhood Stara železnička kolonija the envisioned land use is "Medium density housing". There are significant changes suggested to the existing urban matrix of the neighbourhood that involve tracing new streets and providing massive parking areas in inner-block space.

For the explored site, traffic setting suggested by the Plan is illustrated in Figure 3c. Existing streets that surround the site on the east, south and west are retained with the regulation width of 8 meters, while the northern street retains regulation width of 12 meters. Existing pathway – shared street in the middle of the site is being transformed into a standard-design 8-meter-wide street with segregated pedestrian and motor traffic. All existing parking provided within street area is cancelled, and new parking lots are created at the expense of inner-block open space. Furthermore, the suggested parking lot in the southern part of the site has transitory character, thus dividing the existing compact residential area into two smaller urban blocks.

It is evident that the existing Plan completely disregards the significance of public open space in residential environment and ignores the principles of sustainable urban planning. The vision of open space as the extended housing environment where social, recreational and environmental needs are met, is not recognized. On the contrary, the planned solution is completely subordinated to traffic needs, giving priority to motorized traffic and parking. The remaining open space does not enable the creation of a quality outdoor living area, neither in terms of size, nor in terms of layout and organization potential.

Discussion: transforming the explored site in line with sustainability principles

The standpoint of this research, which is aligned with the principles of sustainable urban planning, is that residential open spaces must be preserved through densification processes in order to bring social, functional and environmental benefits. Therefore, the future development of the site envisioned in the standing Plan is not considered to be a proper development pathway, and needs to be revised. Residential open space should be used for re-shaping the neighbourhood within a systemic action. Coherent planning for the area should incorporate outdoor activities and mitigate urban heath and flooding. This greener vision for the neighbourhood is spontaneously supported by the residents themselves, who initiated action to preserve existing greenery in the northern part of open space.

The traffic setting should organize parking for vehicles in street-adjacent open space, or underground, with design depending on the available space. In that way, the inner-block area may remain undeveloped for accommodating social and recreational activities. Surrounding streets in the east, south and west may be remodelled according to the "shared street" concept, since their length and significance in the street network allow for such a solution. The street design should implement greenery, set urban furniture and favour social contacts. Having in mind that the site is in the vicinity of central city zone, sustainable mobility solutions should be promoted with the local residents and bicycle parking provided, in order to limit the use of cars. This would also require systemic action at the city level, in terms of improving public transit and tracing bicycle routes citywide.

One of the greatest qualities of the existing setting is that residential open space is shielded from motor traffic. Therefore, inner-block open space should be organized to accommodate various activities for all age groups. Open space should be shared and retain its public character. Urban design solution should create a setting that fosters social contacts, children's play, and active and passive recreation. Gathering areas should be placed in areas of extended shade that resulted from vertical extension of buildings, in order to improve the thermal sensation of users in summertime period. Shade analysis showed that more extensive shaded surfaces resulting from vertical densification are present in the afternoon, which particularly affects the design of open space at the western edge. Also, implementing a community garden that would be maintained by the inhabitants is a suggested option when structuring uses. That way, the residents would have a contact with nature, which is considered vital for both physical and mental health in stresfull urban life. Community garden should be a shared space of semi-private character, available only to the residents of that particular neighbourhood. Given the fact that the inhabitants have already showed interest to maintain a part of green area, this amenity would be well supported.

Even though the open space at the explored site has significant green area now, it does not capitalize on that potential. It is necessary to enhance the appeal of open space by arranging existing greenery and planting local flowers and shrubs to add variety to the urban landscape. Greenery at the site has another important role - it can help in increasing the overall resilience of neighbourhood to natural disasters. Planting new trees is thus suggested as a technique for mitigating urban heat, since significant cooling potential of trees is established in urban densification (Dinić Branković et al., 2022). The trees should be planted in the northern inner-area of the site, so that shade would also be provided in morning hours. Preserving existing vegetated areas and introducing new elements of green infrastrucure (bioswales, cleansing biotopes, rain gardens, infiltration trenches, etc.) chould help in collecting, retaining and draining excess stormwater during extreme events. Also, ground floor apartments should get the opportunity to maintain greenery in the 5-meter-wide area adjacent to the building, in-between buildings. This should enable the inhabitants to personalize the space, improve their privacy of living, and enhance the overall appeal of urban landscape.

When it comes to the aesthetics of open space, visual enhancements at the explored site are quite possible in the horizontal plane. Aside from planting a variety of appealing local greenery and placing elements of green infrastructure, remodelling of outdoor area between buildings should also involve: (1) paving the area to a limited extent with porous material, so to enable gathering and social interactions, but also enable effective draining of stormwater, and (2) equipping the space with urban furniture suited to user needs, including a thought-out lighting plan. Regarding the vertical frame of open space, options to improve the aesthetic of buildings are limited. "Patchwork architecture" remains a permanent legacy of the transition period. However, some improvements could be achieved through remodelling the ground floor facades, and thus framing public open space vertically. Existing architectural elements, which interact with both the facade and the parterre and tie them together, should help in achieving this goal. These elements involve stairs, entrance porches to ground floor apartments, terraces, balconies and canopies.

CONCLUSION

This study endorses the standpoint that public open spaces represent a vital component of urban fabric and a backbone for public health and well-being. It is of crucial importance for social and environmental resilience of cities to preserve existing open spaces in residential areas, and additionally, to assign them public character that supports outdoor social contact.

In line with the first research aim, it can be stated that the process of post-socialist vertical extension of residential buildings affected public open space even though it did not involve a direct decrease of its size. The site examined in this paper illustrates how increased densities caused usurpation of open

space by parking, and how increased building height generated larger shaded areas in open space. This example also showcases that residential open space was not in the focus of developers within the process of vertical extension of existing buildings, thereby leaving it marginalized and underused.

Regarding the second research aim, the study concluded that open space should accommodate a variety of uses suited to inhabitant preferences, introduce appealing greenery, enhance landscaping, limit motorized traffic and promote sustainable mobility options. Also, the open space should capitalize on the potential of elements of ground floor facade, in order to create an appealing vertical frame. Vertical extensions could benefit the use of public open spaces by expoliting the areas of extended shade in summertime period.

This research also points towards the importance of incorporating contemporary urban planning and design principles and approaches in the revitalization of open space in existing multifamily housing estates. The explored case corroborates that these principles and approaches have not yet been comprehensively reviewed and implemented in Niš. Public open spaces in residential areas need to be preserved in urban planning regulations, and the first step towards that is the change in attitude of local planers and stakeholders. The next action is changing planning documents to incorporate sustainable solutions. It is therefore concluded that the City of Niš needs to embrace systemic and planned revitalization of public open spaces in inherited housing estates that underwent urban densification, thus setting the course for healthy urban lifestyles and increasing the resilience of entire urban area.

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