Transformation of Danube Recreational Sites

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Abstract. The purpose of the research was to verify models of sustainable urbanization of the Danube riverside landscape in the suburban surroundings of Bratislava. The research focused on landscape-ecological forms of suburban urbanization in the contact of the river Danube, in the context of meanders of the Danube branches with the formation of recreational localities. The implementation of ecological principles was based on the concept of regional structures with a vision of the renewal of the ancient branches of the Danube for the creation of the climatic envelope of Bratislava from the southwestern side. The completion of the Petržalka, Slnečnice, Južné Mesto, and rural structures near Jarovce, Rusovce, and Čuňovo, conditioned by ecological urbanization, will acquire more landscape elements and a system of blue and green infrastructure. The hierarchical transition of the city to the suburban localities is solved by creating zones of recreation and sports on the Danube. Variant case studies of the "Danubia Park" near the village of Čuňovo are located on the southwestern bank of the Hrušov Reservoir of the Danube, with access to the Wild Water sports zone and the Danubiana Gallery complex. The research followed up on the verification of the recreational function in the landscape and focused on the level of low occupancy, the integration of sports and recreational functions, accessibility by all modes of transport, the penetration of recreation into the open landscape. For the identity of the original landscape, freely modeled connections to the riparian zone, work with water flow in the area, port, pedestrian and cycling connections to the EuroVelo route, outdoor museums of the Danube meadows, lakes and wetland communities, workouts, and multifunctional playgrounds, forms of wellness, sauna world and natural swimming. Ecological recreation concepts in the landscape of the Danube floodplains on the banks of the Danube used the modeling of banks, watercourse lines, meandering of recreational areas, green axes, play areas, elements, and zones. They used lighthouses and lookout towers for accent and orientation. The hierarchy of the release of small urban structures and loose forms of sensitive urbanization with functional flexibility and attractiveness proved the justification and location in the landscape of the Danube meadows, in the contact zones of the protected landscape and the watercourse. In this way, the importance of the suburban landscape structure is beneficial for the city not only in terms of functional attractiveness but also in terms of landscape protection and the climatic influence of the city's hinterland on its compact structures.

1. Introduction

The aim of the urban planner’s team research focused on solving recreational river areas was to verify the models of sustainable urbanization of the Danube riverside landscape in the suburban areas of Bratislava. The ecological significance of the Danube River has become increasingly important in recent decades in the context of weather fluctuations and the overheated urban structure of Bratislava. The possibility to renew the old-new Danube channels as the city’s bypass system proves to be a chance for...
the city, collapsing from heat not only in the summer months but also in the unbalanced urban environment without a broader scope for use of sport and recreation sites. The ancient geological context of the meandering Danube channels testifies the transformation of the wild river into a meandering river in each of the six stages in the interglacial period. [1] The program of return to the Danube channels is linked to the historical and geological traces of the Danube River, its inland delta, and uses the potential for today’s city and landscape context. Nowadays, grants with the Danube theme focus primarily on nature’s protection, a return to forming natural river channels and city network with a cultural promenade emphasizing the local urban identity. [2] The examination of relations between landscape and urban identity in these researches lead to the evaluation of spatial quality gaining in importance and orientation in the Danube region in terms of the genius loci cities and interconnection of local public spaces, validated by the DANUrB project. [3] The uniqueness of the geomorphological situation of areas on the Danube can be used by cities for various forms of contact with the watercourse, subsequently presented in real shapes of bank formation as a strategy of landscape architecture with the concept of promenades. [4] In this context, Bratislava has an advantage in position at the confluence of the Danube and Moravia and at the foot of the Carpathians. It is located at the intersection of two natural phenomena, the Danube River with alluvial forests and the forested mountains of the Little Carpathians. South below Bratislava are alluvial forests around the old Danube, Mošonský Danube, and Little Danube, forming Žitný Island. The river is an integrating element, which vision of the Danube channels spilled within alluvial forests, could reunite this area in connection with the inland Danube delta. This idea was validated against the Spatial plan of Bratislava by the projects CUPA and KOBRA. [5] Finding ecological forms for completion of the southern tip of the Bratislava suburb in our research focused on the landscape and recreational site of the Danubia Park near Čuňov. The city’s hierarchical transition to the suburban area was designed by loosening the development into the recreation and sports zones by the Danube. We used the climatic envelope principles of Bratislava, a city with meandering Danube channels and a more continuous landscape of alluvial forests.

2. Characteristics of Bratislava’s southern city recreational areas
Bratislava’s development assumptions in the past and today, are determined by significant natural phenomenon - the river Danube with protected areas of the Dunajské luhy and the massifs of the Little Carpathians. The city is located on the important geopolitical crossroads of Central Europe. Its spatial potential is highlighted by the connection to Vienna, the border areas, and the towns of Lower Austria, Burgenland, and Hungary adjacent to the city of Győr. According to the BAUM project, this region is part of the spatial regional development strategy and has been “evaluated by several international organizations, including the Empirica study, in terms of development potential as the most promising ecological and economic international region in Central Europe” [6] and at the same time is an important recreational area of the southern city with protected natural areas.

The demand for spending time in nature for Bratislava’s inhabitants is growing and is literally alarmed by the situation in the context of increasing urbanization and climate change, as well as the pandemic situation. Availability, clean environment, quality of services, competition, the ability to attract visitors in an ever-expanding portfolio of interesting locations are playing an increasingly important role in the recreation's offer. These must carry unique added value, which has the potential to create increased interest in visiting the recreational sites, otherwise, its high potential will not be assessed sufficiently. The Danube River corridor, on the south of Bratislava, with an identical waterfront landscape of the Dunajské luhy and a vision to connect renewed channels to the Danube channel system [7] represents an important recreational area, but also an important ecological-environmental space. The research focused on the verification, liveability and evaluation of the potential of the suburban recreational areas in the locality of Danubia Park, near M.Č. Bratislava, Čuňovo, adjacent to the Hrušovská Reservoir, in the neighbourhood of the Divoká Voda on the Danube. It’s located on the southern development axis of Bratislava, in attractive surroundings, enhanced by the proximity of the
alluvium forests, the Ostrovné lúčky Nature reserve, the Danube dam, and the project of the renewed Danube channels. It’s an area with values and potential waiting for a revival for several years.

The hierarchy of recreational areas on Bratislava’s southern axis is based on Petržalka’s axis through the visions of the Southern City with Danube channels and islands to the rural areas of Jarovce, Rusovce, and Čunovo. At the end of the axis is the studied locality of Danubia park near Divoká voda, and Danubiana. From the heavily urbanized Petržalka with green infrastructure, it will join the Southern’s City axis with an overgrowing blue-green infrastructure connected to the rural areas. With growing distance from the city, green landscape systems and urban sprawl into the landscape are increasing. On the outskirt of urban areas appear new forms of farming such as small farms with ecological rural housing structures are increasing. Recreation integrated outside the city is growing on relaxed landscape forms and offering contact with protected landscape areas, presentation of Dunajské luhy, and direct recreation in Danubia Park. There is increasing importance in planned boat public transport between Bratislava and Šamorín, ports, pontoons, lookout towers, and accessible by bicycle transport of regional and international significance. The predominant landscape character of the "Danubia Park" in contact with the riverbed and shallow banks of the Danube River is close to the tri-border of Slovakia, Hungary, and Austria. In the past, the area was transformed by the construction of the Hrušovská Reservoir on the Danube, which was built as part of the Gabčíkovo Waterworks. Contact area - Danube alluvium forests, part of which was flooded with water, is the centre of research with the aim of transformation into the sport and recreational use. The city's spatial plan proposes to apply sports and leisure use in the model space for the needs of recreation of local to regional significance with involvement in the concept of the surrounding landscape and the structure of rural development.

Alluvium forests and wetlands are among the most endangered ecosystems in the world. With the urbanization, construction of bridges, the modification of banks, and the construction of the Gabčíkovo Waterworks, extensive changes took place in the landscape structure - deforestation, drainage of wetlands, and the transformation of the Danube channels into arable land. Much of the alluvium forest was destroyed here. The filling of natural connections between river channels and the main watercourse had a negative effect on the water supply and the dynamics of floodplains. The Gabčíkovo’s Waterworks construction meant the direct extinction of 2,500 ha of alluvium forests, the loss of fauna and flora, and the water regime of other areas was impacted. The residual areas were significantly affected by intensive forestry.

The proposed area of Danubia park is focused on transformation on the sport and recreational use. The city’s spatial plan proposes to apply sports, leisure, and public amenities in the model area for the needs of recreation with local to regional significance with involvement in the concept of transport accessibility from Bratislava and the context of the surrounding landscape and rural structure.

The first phase of the research was focused on finding the landscape identity, the context of the Danube River, the proximity of the Wild Water sports complex, and the contact with the rural structure of Bratislava’s district - Čunovo. We compared the watercourse in historical maps of the Danube with alluvium forest channels: Massive changes of the area and riverbanks after the construction of the Gabčíkovo Waterworks as opposed to the current situation of high greenery in the area between the dam and the riverbanks. The second phase of the research focused on the return of landscape identity to the area according to the original Danube channels, the assumption of connection to the Protected Landscape Area Dunajské Luhy, the Danube Forest near Čunovo, the riverbanks, and the search for optimal rate of urban development of recreational structure and functions in the area.

Case studies of Danubia Park were conceived as a recreational area of Bratislava, or recreational-sports facilities of regional, supraregional and international importance.
The assessment method of examined variants of concepts of the “Danubia park” focus on the development of the area and quality of waterfront landscape from various angles: from maximum subordination to the natural environment, through the optimal rate of development in the landscape area, to the control of the space by the new urban-architectural structure.

The basis for the evaluation of the examined areas in the case studies A-C in the locality of Danubia park was the Spatial plan of Bratislava (figure 1), open map sources (orthophoto maps, cadastral and historical maps available through map services (OCG) of the Geoportal GKÚ. Field research was carried out in the examined areas, which validated and supplemented the obtained data.

For the quality assessment of Case studies A-C Danubia Park the following criteria have been set:

- ecological quality, preservation of landscape character
- the rate of loosening of the urban structure of the proposed sports and recreational area
- blue-green infrastructure, present in the morphology of the waterfront landscape
- attractiveness, accessibility, and functional complexity of the proposed equipment

Case study A of the Danubia Park (figure 2) is based on ultimate harmony with the natural environment. The genius loci of the landscape is enhanced by adding various types of native vegetation, which are suitably modified and adapted to educational use. It is characterized by a rich representation of alluvial flora and fauna, complemented by a system of pedestrian walkways, connecting bike path to the Eurovelo cycling route, and recreational island nooks, which combine attractive educational and leisure activities. The proposed meander and wetland parts of the lakes, thanks to footbridges and bridges, allow you to observe plants and animals. Architecture is sensitively set into the landscape with the use of natural materials. The high ecological quality of the design prefers the concept of a park-recreation zone in ultimate harmony with nature and evokes the scenario of the original alluvial landscape. The rate of loosening the urban structure allows to use the area for cycling, kayaking and canoeing, wellness, boat trips, lighthouse views, bird watching, educational trails to the Dunajské luhy museum, forest school, and two lenticular squares with cultural and societal events. The blue-green infrastructure, modelled by a new river meander, educational trails with a wetlands system, is supported by the undulating shaping of the waterfront landscape. The landscape attractiveness with a recreational function is complemented by the proposed educational and accommodation buildings, educational and social activities in nature.

Figure 1. Definition of the studied locality of Danubia park based on Spatial plan of Bratislava (left)

Figure 2. Case study B landscape-related to the natural environment, develops green areas with recreational use, landscape and ecological elements and a new meander of the Danube River channel (author Veronika Volková)
Case studies B Danubia Park (figure 3, 4) are characterized by the intersection of optimal rate of the proposed architecture into the landscape, which becomes the carrier of new functions. Adaptation of the Danube landscape in the Waterworks for new functional use, creating the overall design and detail of the natural environment revived modelling of terrain, designing pedestrian links, greenery planting, the use of water areas and canals, and adding elements of small architecture (gazebos, benches, playgrounds, educational and information boards, works of art, observable birds…). The proposed architecture adapts to the surrounding landscape and other natural and artificial elements contribute to the completion of harmonious landscape image. The ecological quality of the designs is high, the designs bring new uses that enliven the waterfront landscape. Swimming in a natural environment, wellness, sauna world, sports and recreation, forest school, educational centres, and a sufficient amount of naturally modelled living areas offer relaxation and an experience bonus. The rate of loosening the urban structure of the area is optimal. The blue-green infrastructure is complemented by a system of water areas with accompanying greenery, which contributes to the optimal climate of the area. The attractiveness of the area is complemented by new functions, which are focused on water sports, fishing, educational function, cycling, and residential tourism. The context of the architecture and recreational Danube functions complete the local identity, landscape colour, and atmosphere of the area.

Figure 3, 4. Case study B - proposals sensitively complement the natural environment with a looser urban structure and organic landscaping (authors: Monika Zacková, Bronislava Kajanová)

Case studies C of the Danubia Park (figure 5, 6) are in accordance with the functional use and spatial arrangement, which define the regulation limits of Bratislava’s Spatial plan but they have the highest density of the urban structure. The main axis aiming to the river is transformed through urban lines of cultural, social, and commercial facilities towards organically modelled waterfront promenades. The original waterfront landscape adapts to the scene of the "urban" promenade with a multifunctional public space, in combination with the multifunctional structure of temporary accommodation, culture, and sports. Only on the outskirts of the area are the free green areas preserved, which form a transition zone between the urbanized area and the original natural landscape. The blue-green infrastructure is complemented by a system of water areas that enliven the urban character of the area. The attractiveness of the Danube waterfront is enlivened by vital functions, oriented to business amenities, cafes, restaurants, temporary accommodation, sports facilities, and marinas.
Figure 5, 6. Case study C Proposals in which new development in the landscape environment has acquired a significant level and predominance of development in the surrounding natural environment of the Danube embankment (authors: Barinka- Sládečková, Zuzana Biroová)

3. Results and discussions

The first stage’s results of mapping and field research were information about the historical development of the meandering watercourse of the Danube River south of Bratislava, information from huge changes in the area after the construction of the Gabčíkovo’s waterworks, the current situation of neglected waterfront. The next step in the research supported orientation to the identity of river landscape of the Dunajské luhy for landscape design with confirmation of the alluvial landscape character and its specifics for the ecologically determined form of recreation and sports in the studied area.

The second stage’s result was the confirmation of the main landscape characteristics: the natural form of the riverbanks, vistas, shaping of the islands, contact with the alluvium forest, return of river channels, alluvial meadows and wetland lakes. These research results confirmed the approach of landscape formation with sensitive urbanization of the proposed entering pedestrian axes, proposed buildings according to scale and type of landscape, promenades on the banks, supporting transverse and longitudinal routes with meandering curves, vistas, and the location of observation towers and lighthouses.

The third stage’s result was the assessment of three case studies: A, B, C. These proposals proved various rates of support for landscape identity, ecological quality, completion of blue-green infrastructure, accessibility from Bratislava and its surroundings, formation of the border area, level of attractivity, vitality and related quality of design in the Danubia Park. Case study A achieved the highest quality of design, according to the best results of landscape ecological assessment, representation of naturally shaped forms of alluvial waterfront landscape, low urban structure density, level of attractivity and accessibility. Case studies B have more landscape design character, with a lesser return to the original alluvial landscape, alluvial meadows and open spaces, with a higher urban structure density, an optimal level of attractivity, and good accessibility. Case studies C show the predominance of an urban concept over the free ecological landscape design, a high level of functional attractivity, vitality, a great number of job opportunities, and good accessibility.

From the point of the current global ecological and local climate crisis are the most important and beneficial results of urbanization, which mostly support climate improvement, return to the original alluvium forest, sensitive development and interconnection by cycle routes, public transport, public boat transport, the area with attractions for leisure, sightseeing, and sports. The question remains the cost of operating the area, the small supply of employment resulting from the lowest rate of urban structure density possible, and the development of recreational and sports needs of the inhabitants of Bratislava, the wider area, and abroad.
4. Conclusions
The study of proposals concluded that the location of the Danubia Park adjacent to the Danube riverbank in the suburban area of Bratislava, in optimal connection with the surrounding landscape, has exceptional importance for sports and recreational use. The hierarchy of small urban structures and loose forms of optimal low urban structure density with functional flexibility and attractiveness proved the justification and location in the landscape of the Dunajské luhy, nearby protected landscape and the watercourse.

In this way, the importance of the suburban landscape structure is beneficial for the city not only in terms of functional attractivity for sports and recreation, but also supporting the protection of the alluvial landscape becomes important.

The emphasis on the identity of the Dunajské luhy is reflected in the shape of promenade riverbanks, wetland lakes, alluvial meadows, and the climatic effect of the city's suburban areas in connection with the old - new Danube River bypass channels.

We verify the contact rate of urbanization of the entire southern development of Bratislava from the compact structures of the future Southern City, through rural suburbs, ecological forms of farm housing and their connection to the management of the surrounding landscapes and the transition to agricultural areas. Danubia Park is a vision of the ecologically and landscape modelled area of Bratislava on the Danube River.

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