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THE DESIGN OF RAILWAY AREAS FOR COHESION AND URBAN MOBILITY

Olteanu Alexandra Maria¹, Bodea Sonia²

¹Technical University of Cluj-Napoca, Faculty of Architecture and Urban Planning

²University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Horticulture and Rural Development Affairs

Abstract:

This paper examines the transformations of railway infrastructures and their impact on urban development and local communities, with a focus on developing an urban planning strategy aimed to revitalize the railway and industrial areas in Cluj-Napoca. The primary aim of this research is to promote better integration and connectivity between different sectors of the city, thereby facilitating more effective social and economic inclusion between both sectors. By addressing these aspects, the goal is to create a more balanced and prosperous urban environment, where resources and opportunities are distributed and accessed equitably and sustainably. The design proposal was developed based on the analysis of three distinct areas from Cluj-Napoca city, with the aim of identifying opportunities for a more prosperous and integrated urban development. Through careful evaluation of these areas, efforts were made to understand the specific needs and the potential of each one, in order to achieve an efficient solution for improving residents' quality of life. This holistic and detailed approach has contributed to shaping a comprehensive vision for urban revitalization in these regions of the city.

This work, grounded in the detailed analyses presented, has successfully identified and proposed new spaces of interest and connection within the city. By carefully examining the data and urban context, a series of opportunities have been outlined for developing key areas intended to become focal points and centers of activity within the community.

• Introduction

The concept of "landscape" (Landschaft) was first introduced in the scientific and geographic context by German geographer A. Hommeyer in 1805, defining it as the appearance of a territory as seen from a dominant viewpoint. Landscapes are portions of territory perceived by the population, shaped by the interplay of natural and human factors. Different disciplines interpret landscapes based on their unique concerns. Historians see them as products of cultural heritage, while economists view them as sources of raw materials. Medicine explores landscapes for their therapeutic potential, and ecologists study them as habitats influenced by human intervention. Geography approaches landscapes scientifically, creating a subdiscipline for their analysis, while landscape architecture focuses on designing functional, aesthetic, and ecological spaces. This field considers both natural and human land characteristics to develop sustainable, transformative solutions [1], [5], [11], [13], [15].

The urban environment, with its inherent complexity and external and internal influences, is in a state of constant evolution. This continuous change is reflected in the urban landscape, which acts as a flow of interconnected systems and eras, gathering historical moments within a single space. Cities and their landscapes, shaped by long-term evolution, reflect the cumulative development of human society and its collective inclinations. This evolution unfolds within increasingly coherent geographic and human structures characterized by distinct populations and areas such as residential, functional, cultural, administrative, and political zones. The city emerged and evolved to establish a viable environment with defined territorial and functional boundaries, while maintaining a continuous and reciprocal connection with its surrounding areas [2], [12]. The railway space is exclusively intended for railway vehicles, with access limited to specific designated points. These vehicles are both inseparable from and interdependent with railway infrastructure; no other types of vehicles can utilize these tracks. Railway infrastructure goes beyond the tracks themselves, including critical facilities such as passenger and freight stations, workshops, locomotive depots, water and coal stations, and signaling devices. Collectively, these elements form what W. Schivelbusch characterizes as the "machine ensemble" in his comprehensive cultural history of train travel. Due to their functional and structural autonomy, railways become dominant territorial features, exerting a profound impact on adjacent areas. These areas may undergo various changes—becoming more attractive, experiencing degradation, division, restriction, or even complete redefinition. Regardless of their initial identity, they often become known, sometimes tragically, for their proximity to the railway [6], [9].

As railways expanded across various regions, particularly during the latter half of the 19th century, their development coincided with a period when urban and regional planning were either nascent or not fully established as distinct disciplines. Over time, accumulated experience contributed to the creation of guidelines and quality standards for railway projects, supported by evaluation mechanisms used by local or central authorities. These emerging standards and guidelines gradually shaped and refined the railway construction and development process [4], [10]. Within the European Union, it has been officially acknowledged that concerns related to spatial quality have frequently been overshadowed by economic priorities. The 2002 Guiding Principles for Sustainable Spatial Development of the European Continent, established by the European Conference of Ministers Responsible for Regional Planning (CEMAT), stress the importance of "harmonizing economic and social demands with the ecological and cultural functions of the territory." In terms of mobility and transport, this means recognizing "European corridors" as more than mere transport infrastructure, emphasizing their interaction with settlement patterns and the necessity for environmental and landscape preservation. More broadly, transport corridors should be planned as tools for spatial development, incorporating large-scale spatial planning within transport infrastructure initiatives to foster balanced growth [7], [14].

To promote a more sustainable integration of mobility and urban planning, a shift is needed from the conventional, limited view of railways as purely technological or utilitarian constructs. A broader perspective must be embraced, recognizing their formative and transformative roles in shaping urban landscapes and acknowledging their cultural value. The relationship between railways and urban spaces is complex and essential, representing a longstanding yet contemporary topic that demands thorough examination. Exploring the historical connections between railways and housing through disciplines like art history, architecture, and urban planning may provide valuable insights. However, literature that specifically focuses on the intersection of railways and housing is relatively scarce, with notable exceptions such as the work of H.J. Dyos in the United Kingdom [8], [3].

• Material and method

The detailed examination of Cluj-Napoca's railway evolution starts with an analysis of maps from 1769-1773, such as the Josephine Map, one of the oldest cartographic depictions of Romanian territory. It illustrates the city's concentric growth around the medieval Clus Fortress. While roads provided access from surrounding areas, the railway network in Transylvania was underdeveloped, leaving a gap at the future train station site. By the Habsburg Empire era (1853-1858), maps show the construction of a railway connecting the region's western areas to Cluj-Napoca, culminating at the station site. A topographic map from 1869-1887 depicts the continuation of this railway and the first station building, designed by Karl von Gega and constructed by the Warring company, inaugurated in 1870. By 1900, Cluj-Napoca's railway infrastructure had grown considerably, including an expanded station and new freight lines, as well as a wagon sorting depot, facilitating northern expansion. These developments solidified Cluj as a major regional railway hub, driving economic growth and spurring urban development around the railway infrastructure (Figure 1).

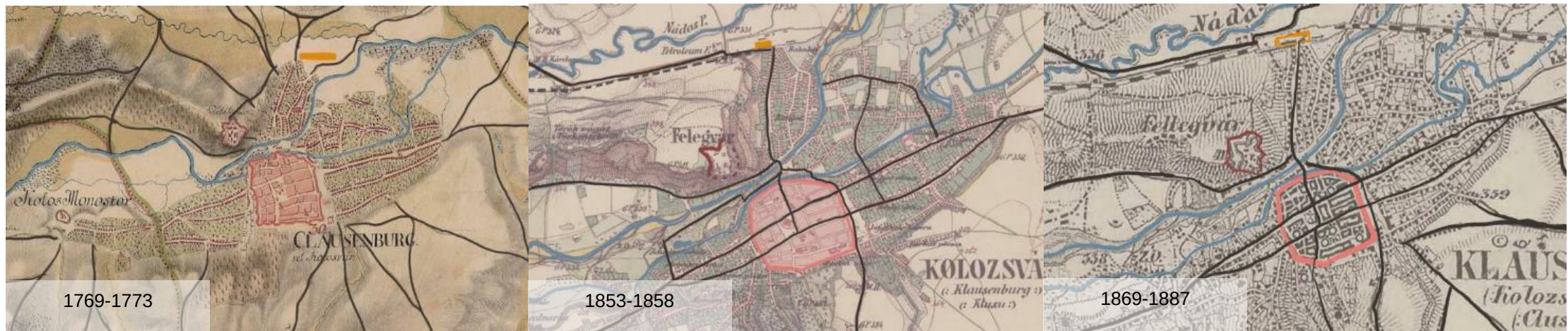
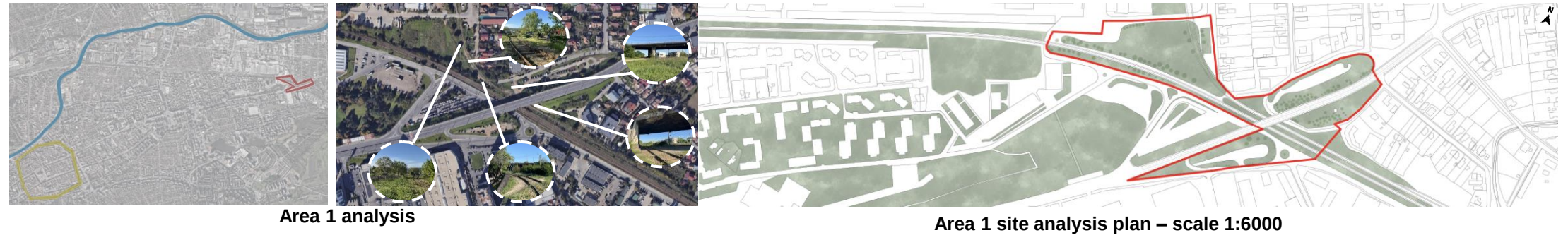


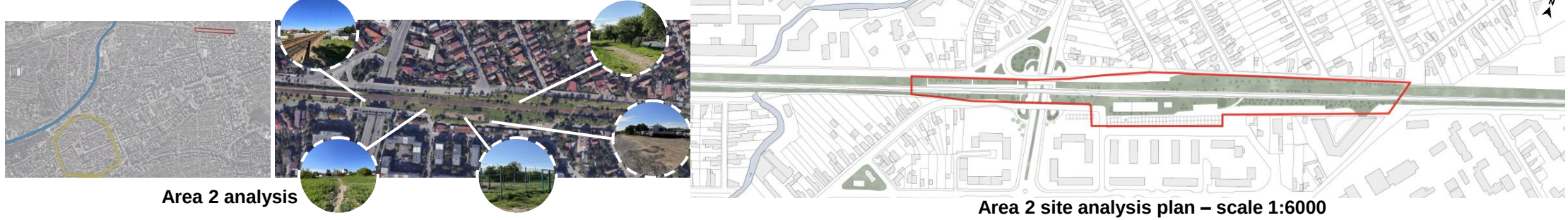
Figure 1. The evolution of the railway in the city of Cluj-Napoca

(Source: arcanum.com [16])

The first area proposed for analysis is located in the eastern part of Cluj-Napoca, specifically in the Ira neighborhood. It is a major traffic hub where Aurel Vlaicu Street crosses the railway line via a bridge, offering easy access to a food market, park, exhibition area, and various commercial spaces. The area has a significant typological difference between the northern and southern parts of the railway. In the north, individual houses on former agricultural land with narrow, long plots have minimal visual and environmental impact. In the south, collective housing, commercial spaces, institutions, public services, green areas, and economic activities reflect an urban planning strategy focused on densification and multifunctionality. The area benefits from good accessibility via public transport, vehicles, and pedestrian paths, but there are improvised parking spaces that deteriorate public space. The lack of designated crossings makes railway access difficult, leading to the creation of informal paths. Without permanent parking lots, residents have converted green spaces into parking areas, negatively impacting both the aesthetics and function of the area. These issues underlie the need for improved urban planning with solutions for parking and safe railway crossings. Vegetation in the area is limited, with species like *Juglans regia* and *Fraxinus excelsior*, as well as spontaneous vegetation contributing to local biodiversity, providing habitats for fauna and beneficial insects, and enhancing the area's natural appearance. A well-designed urban intervention is needed, including safe underground passage with proper lighting and surveillance. Converting the green space into organized parking and creating well-maintained public spaces would improve quality of life, discourage antisocial behavior, and enhance the area's safety, attractiveness, and environmental quality.



The second analyzed area is located in the Mărăști neighborhood, including the Clujana Halt railway station, an important traffic hub where Fabricii Street crosses the railway line. This area plays a key role in urban infrastructure by connecting different parts of the city but requires modernization to improve pedestrian and vehicle access and to support its ongoing development. The northern side of the railway is characterized by industrial zones, factories, and warehouses, as well as individual homes built on former agricultural land with narrow, long plots. In contrast, the southern side has collective housing and various commercial spaces, including shopping centers, educational institutions, medical centers, and public services, reflecting distinct urban planning strategies—the north remains more traditional and dispersed, while the south has evolved into a denser, multifunctional urban area. The area is well-served by public transport, vehicles, and pedestrian paths, but issues like improvised parking disrupt public space and traffic flow. Additionally, crossing the railway is problematic, with only one designated crossing and the emergence of informal, unsafe paths, complicating traffic management and infrastructure upkeep. Vegetation near the Clujana railway station is diverse, featuring deciduous trees, shrubs, conifers, and spontaneous plant species. Notable trees include *Pinus sylvestris*, *Robinia pseudacacia*, *Fraxinus excelsior*, *Betula pendula*, *Tilia platyphyllos*, and *Acer sp.* To address these challenges, a well-planned urban approach is needed, with solutions for managing parking, creating protective zones to prevent unauthorized railway crossings, and introducing new recreational spaces to improve accessibility, safety, and urban organization.

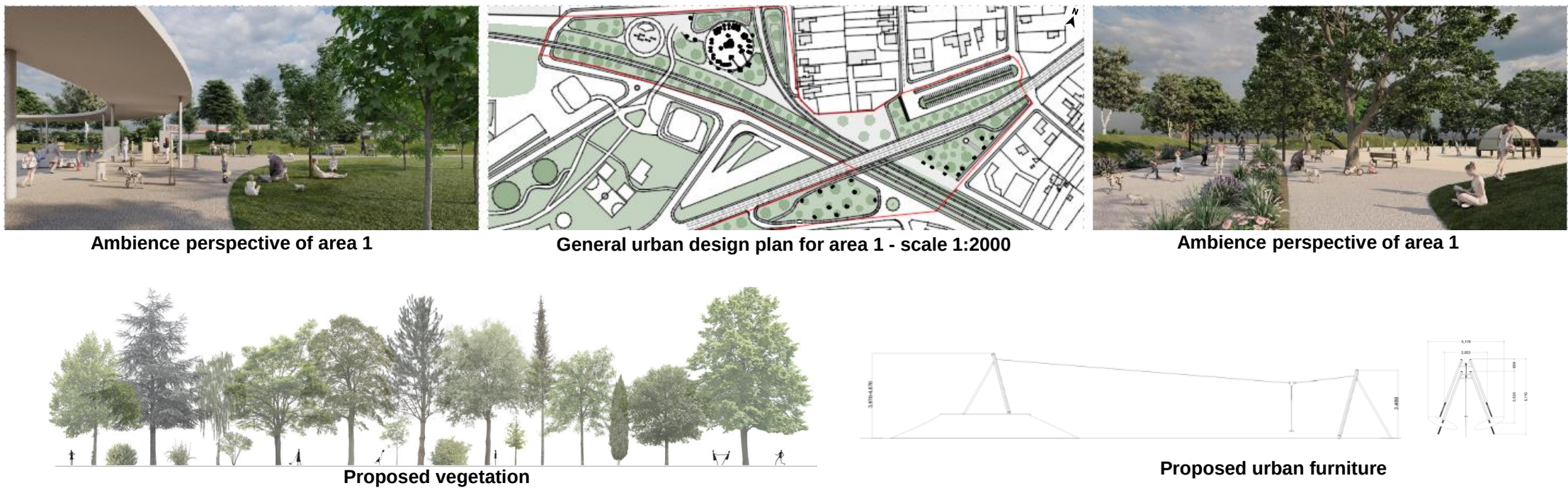


The third area analyzed is the Cluj-Napoca Railway Station, located in the northern part of the city. It serves as a major transportation hub, providing direct connections to the city center and integrating various modes of transport, enhancing accessibility and mobility for residents and visitors. The surrounding area features a mix of commercial buildings, accommodations, and restaurants, undergoing continuous transformation through infrastructure rehabilitation projects. Urban development focuses on expanding recreational connectivity, and encouraging economic and social growth. The southern part of the station is more developed with residential buildings and public facilities, while the northern part is dominated by industrial zones, some of which have been rehabilitated. The repurposing of these industrial spaces presents opportunities for new housing, commercial areas, and parks. The station area is well-served by public transport, with trams and buses improving accessibility, but parking remains inadequate, leading to illegal parking that disrupts traffic and public spaces. Underground passages, considered unsafe due to poor lighting, lack of surveillance, and misuse by homeless individuals, contributing to the area's degradation and insecurity. Vegetation around the station area includes large unused spaces, with about 50% covered by spontaneously developed plants. Waste and construction materials are also illegally stored. The area near the Nădăș river is more vegetated, with tree species such as *Salix sp.*, *Fraxinus excelsior*, *Robinia pseudacacia*, and *Tilia platyphyllos*. This area requires cleaning and landscaping to enhance its ecological and aesthetic potential. In contrast, the landscape near the small railway station and western bus terminal is more mineral-based, with limited vegetation, dominated by *Tilia cordata*. Near the bus terminal, a dog park features trees like *Pinus sylvestris*, *Tilia platyphyllos*, and *Abies alba*, along with spontaneous shrubs and trees, providing a valued green space for relaxation and recreation.

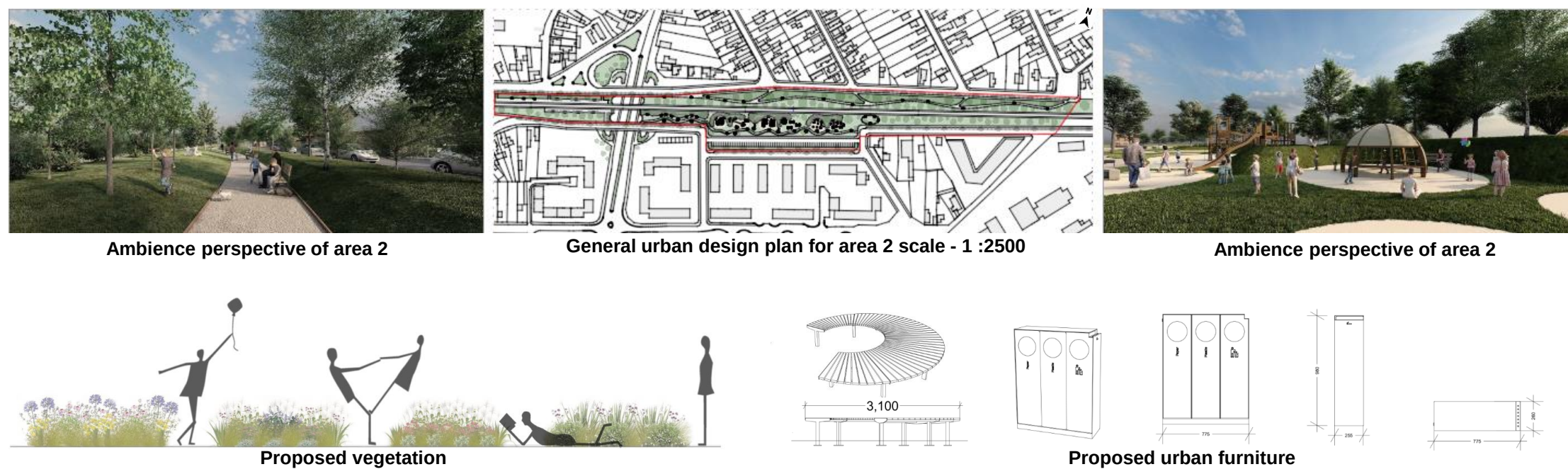


• Results and discussions

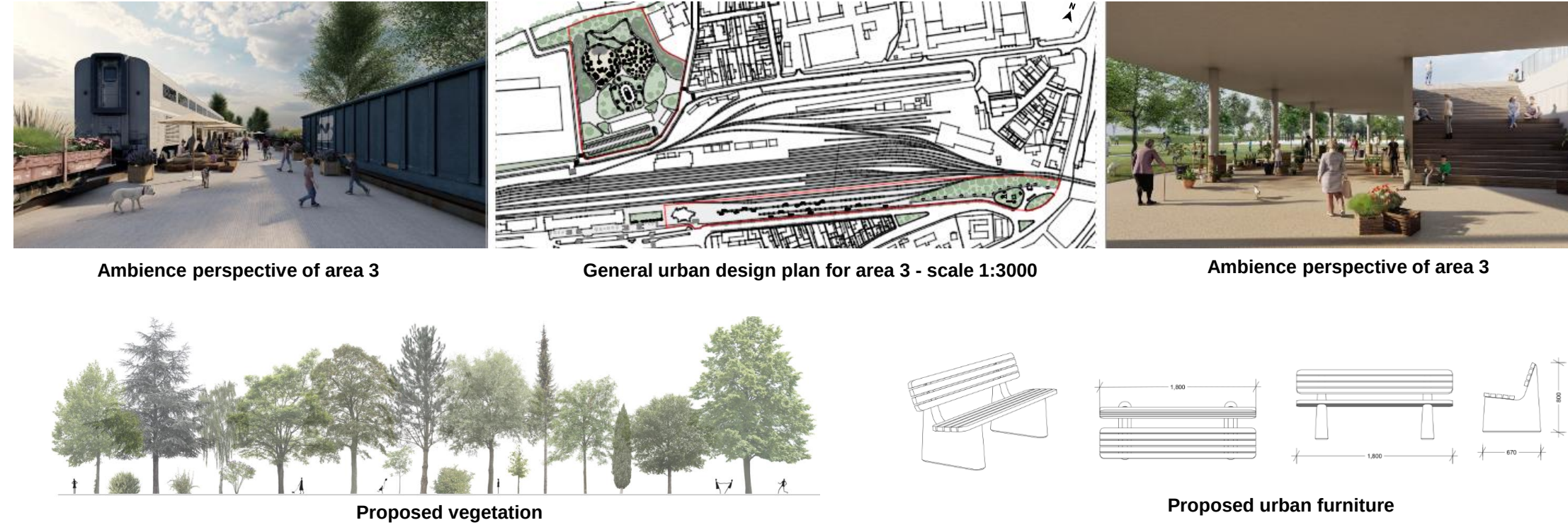
The proposed design concept focuses on addressing key challenges, including ensuring safe railway crossings, creating a parking area for residents and visitors, and expanding recreational facilities like the children's playground and an event pavilion. The project also aims to enhance city connectivity by adapting the road network to each zone's characteristics, in line with Cluj-Napoca Urban Planning Regulations. Pedestrian safety and comfort will be prioritized with wide sidewalks tailored to the pedestrian flow that integrates harmoniously with the urban landscape. The design aims to connect the current site to the future Aurel Vlaicu Park development, creating a cohesive environment. A key aspect of the plan is a new parking area that promotes efficient traffic flow, alongside measures to preserve the area's industrial heritage by repurposing old railway tracks into a memorial trail. Noise pollution will be mitigated through earth mounds and dense vegetation, which will also improve the area's environmental quality. To improve connectivity, pedestrian and vehicle bridges will be constructed to eliminate barriers and enhance access to commercial areas. Landscaping will focus on using tree and shrub species that improve visibility and safety near the railway tracks, such as *Acer platanoides*, *Betula pendula*, *Fraxinus excelsior*, *Tilia cordata*, and various shrubs like *Berberis thunbergii* and *Juniperus sabina*. In parking areas and along roads, shade-providing trees like *Platanus hybrida* and *Tilia tomentosa* will regulate summer temperatures. Public spaces, including the playground and pavilion, will feature solitary trees to ensure visibility and shading. Earth mounds will serve as play structures, with trees like *Morus alba* and *Quercus robur* providing cooling shade. Creeping shrubs like *Cotoneaster horizontalis* and *Juniperus horizontalis* will protect children from crossing over the mounds. The area's industrial heritage will be honored by a memorial path using former railway tracks, landscaped with flowering perennials and grasses such as *Achillea millefolium*, *Echinacea purpurea*, and *Lavandula angustifolia*, among others.



The area near Clujana Train Station is a key community space, with plans for modernization and improved access to ensure efficient and comfortable transit. The northern part, currently a green strip for pedestrians, will be transformed into a space for work and relaxation. The southern part, which serves both locals and visitors, will feature a comfortable resting area, a children's park, an outdoor sports space, and a pet-friendly area. These additions will promote a healthy, active lifestyle, creating a vibrant, multifunctional hub that improves the quality of life and supports a sustainable urban environment. To enhance city connectivity, the street network will be adjusted according to Cluj-Napoca's General Urban Plan, with wide sidewalks to improve pedestrian safety and comfort. The design will optimize traffic flow, integrate road traffic with the urban landscape, and ensure accessibility for people with disabilities. The plan aims to reduce safety risks near railway tracks with visual and physical barriers, including earth mounds and tall vegetation, to deter illegal crossings. The train station platform will be upgraded to provide safe, more comfortable travel with covered areas. The northern green strip will be converted into a walking and relaxation area with benches, while the southern area will replace garages with an open parking lot, featuring vegetation to improve air quality and create a cooler environment. Social spaces, including seating areas, a children's park, sports facilities, and a pet space, will encourage recreation and community engagement. The vegetation plan will preserve the area's natural character, using native species like *Juglans regia*, *Fraxinus excelsior*, and *Robinia pseudacacia*, and adding trees such as *Acer platanoides*, *Betula pendula*, and *Tilia cordata*. Shrubs like *Berberis thunbergii* and *Juniperus sabina* will enhance safety and visibility. Shade-providing trees like *Platanus hybrida* and *Tilia tomentosa* will be planted in parking areas and roadsides. Public spaces, such as playgrounds and sports areas, will feature solitary trees like *Acer campestre*, *Betula pendula*, *Corylus avellana*, and *Fagus sylvatica*. Existing trees in the northern promenade, including *Robinia*, *Fraxinus*, and *Acer*, will be preserved, while new species like *Acer campestre*, *Prunus avium*, and *Quercus robur* will be introduced to enrich the green space.



The proposed design near Cluj-Napoca train station focuses on transforming the area, including the bus station, into a multifunctional park for recreation, relaxation, and socialization. The park will combine modern amenities with natural elements, especially along the Nădăș river, maintaining local vegetation and winding paths to preserve the area's natural character. Key features include safe playgrounds for children, outdoor sports areas, and a central pavilion for cultural events. Parking capacity will be expanded, visually separated by tree and shrub mounds to improve safety and comfort. A pedestrian link will connect the train and bus stations via an elevated walkway, ensuring safe and pleasant transit. Abandoned industrial elements, such as old railway tracks, will be incorporated into the space, possibly showcasing historic trains or repurposed for green spaces or kiosks. This development aims to foster social, cultural, and recreational engagement within the community. Street profiles will be tailored to improve connectivity and functionality, in line with Cluj-Napoca's General Urban Plan, including bike lanes and wide sidewalks for pedestrian safety. The park will offer spaces for all ages, including shade along the Nădăș River for relaxation, children's play areas, and a multifunctional pavilion. Parking spaces will be optimized with vegetation to create a cooler environment and improve air quality. A pedestrian connection between the train and bus stations will be maintained via an elevated walkway, enhancing safety. The design will honor the area's industrial heritage by repurposing abandoned railway tracks, potentially for exhibition spaces or small green areas. For the dog park near the bus station, the space will be modernized with a relaxation zone for tranquility amid urban activity. The vegetation plan will preserve the natural landscape, creating comfortable green spaces with a mix of ornamental plants and trees. In parking areas and streets, trees like *Acer platanoides*, *Platanus hybrida*, and *Tilia tomentosa* will provide shade and reduce heat. In the bus station area, species like *Acer platanoides*, *Betula pendula*, *Fraxinus excelsior*, and *Larix decidua* will discourage unauthorized crossings and provide relaxing spaces. Shrubs like *Berberis thunbergii*, *Cornus sanguinea*, and *Juniperus sabina* will enhance visual appeal. The rehabilitated railway tracks will feature large wagons planted with trees like *Betula pendula*, *Fagus sylvatica*, and *Prunus serrulata*, while smaller wagons will house ornamental plants like *Astibe arendsi*, *Coreopsis verticillata*, and *Echinacea purpurea*. The Nădăș River area will be preserved and enhanced with dense trees such as *Acer pseudoplatanus*, *Quercus robur*, and *Tilia cordata*, complemented by shrubs like *Cornus sanguinea*, *Forsythia suspensa*, and *Viburnum opulus*. High-traffic areas like the pavilion and playground will feature solitary trees such as *Acer campestre*, *Betula pendula*, and *Robinia pseudacacia* for shade and visual openness.



• Conclusions

Following historical documentation and site-specific analyses, the design scenarios proposed have the purpose of creating a stronger connection between the city's northern and southern parts. This connection offers both recreational and relaxation spaces within specially designed green areas, as well as new points of interest for residents and the general public. All developments aim to provide safety, comfort, and ambience to the areas. Additionally, new elements have been integrated, preserving the character of the area. For urban developments that include areas near railway lines, incorporating green spaces into the green-space network is recommended, using a sustainable landscape design approach accessible to the entire community. Another key consideration is the selection of plant species for these areas, which should be chosen in alignment with local conditions and to diminish noise pollution caused by trains.

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