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Fostering Resilient Cities through Urban Green Infrastructure: A Complex Evaluation Method for Urban Green Morphology on a Budapest Case Study Site

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1.INTRODUCTION

As a contextual background, in this study, 'urban resilience' is interpreted as the capacity of urban environments to withstand and adapt to various adversities while maintaining their fundamental functions and identity (Meerow, Newell & Stults, 2016). It comprises the ability of cities to evolve and prosper amidst challenges such as climatic events, economic shifts, and social transformations. The concept has gained significant traction as a critical component in urban planning discourse, advocating for a development paradigm that harmoniously balances current urban progress with the enduring health and vitality of the urban environment.

Urban resilience is deeply connected to social equity and inclusion. Effective resilience-building involves preparing all community sectors for challenges and ensuring equitable resource management for recovery, which supports a fairer society. However, gentrification can represent a significant obstacle to urban renewal to achieve greater resilience (Kong et al., 2022).

The “appropriation of space" (Hory, 2023), where residents actively shape and repurpose their environment, reflects how local communities contribute to the district's adaptability and sustainability. In the context of Ferencváros, the ongoing transformation of former industrial and degraded residential areas into vibrant, mixed-use spaces exemplifies how appropriation serves as a critical mechanism for resilience. It aligns with the broader themes of urban renewal and socio-spatial dynamics explored in this dissertation.

As cities grow, they consume about 70–75% of natural resources, posing sustainability challenges that demand strategic management. In resilient cities, these pressures are addressed through sustainable urban planning by prioritizing compact, walkable neighborhoods, efficient public transport, and green spaces (Zucaro, Maselli & Ulgiati, 2022; Nilsson et al., 2022).

To advance these strategies, urban resilience must be framed within the broader context of sustainable development. This involves addressing the immediate challenges of climate adaptation and disaster risk reduction. It also requires promoting long-term urban sustainability through integrated policy frameworks and stakeholder collaboration. Therefore, the role of policy and governance cannot be overlooked. Resilient cities require multi-stakeholder governance frameworks to adapt to changing circumstances and effectively manage resources to meet the needs of diverse urban populations. By integrating resilience into broader urban planning processes, cities can create more adaptive, inclusive, and sustainable urban environments, better equipped to withstand future challenges (UN-Habitat, 2020).

Urban Green Infrastructure (UGI) is increasingly recognized as an essential strategy for enhancing urban resilience. It offers a viable solution to the challenges posed by climate change, urbanization, and socio-economic disparities. By integrating natural systems into urban landscapes, UGI provides sustainable alternatives to conventional grey infrastructure. These systems strengthen ecological resilience. They deliver cost-effective stormwater management solutions, support biodiversity, improve air and water quality, and reduce the urban heat island effect (Ranjha, 2016; Staddon et al., 2018).

Additionally, UGI plays a critical role in enhancing social resilience by improving public health and fostering social cohesion. Urban green spaces offer recreational opportunities, promote mental well-being, and contribute to social equity by ensuring that natural environments are accessible to all socio-economic groups. Economically, UGI provides significant advantages over traditional infrastructure by lowering capital and operational costs while delivering a range of additional ecosystem services. This dual benefit enhances resource efficiency, enabling cities to better withstand and recover from economic variations. However, the successful implementation of UGI necessitates careful planning, interdisciplinary collaboration, and continuous evaluation to ensure its effectiveness and long-term sustainability (Staddon et al., 2018).

In the quest for urban renewal solutions that address the acute political, social, and environmental disruptions, the cases of São Paulo and Budapest were examined. These cases were selected to broaden the understanding of regenerative urban strategies in diverse contexts. Ferencváros, a district within Budapest, emerged as the main axis of this study, serving as the central case study supporting the applied methodologies. The choice of Ferencváros was justified by the district's advanced stage of urban intervention. It navigated complex historical and political periods to achieve outstanding outcomes in urban renewal and the implementation of green infrastructure. It considers critical morphological features that underlie the area's resilience and relatively efficient operation.

The availability of information and field investigation feasibility were additional considerations that led to Ferencváros's selection as the central focus. The "Budapest 2030 Long-Term Urban Development Concept" outlines a strategic framework that prioritizes sustainability, resilience, and liveability, which are directly relevant to the objectives of this research. The concept emphasizes the sustainable urban resource management, the development of UGI, and the reduction of social inequalities—critical components in enhancing urban resilience. The focus on environment-friendly transport systems and community-driven urban renewal highlights the integration of Urban Green Infrastructure within sustainable urban planning.

Furthermore, Budapest's commitment to a compact city model that promotes public transport and limits urban sprawl supports the creation of urban integration. The renewal of urban sub-centers and the revitalization of brownfield zones align with the intention of efficient land use and green space preservation.

The investigative trajectory of this research is visualized in the diagram below (Figure 1), elucidating the flow from literature review through method application to the final synthesis of findings. It summarizes the research approach, highlighting the logical progression and interconnectivity of each phase.

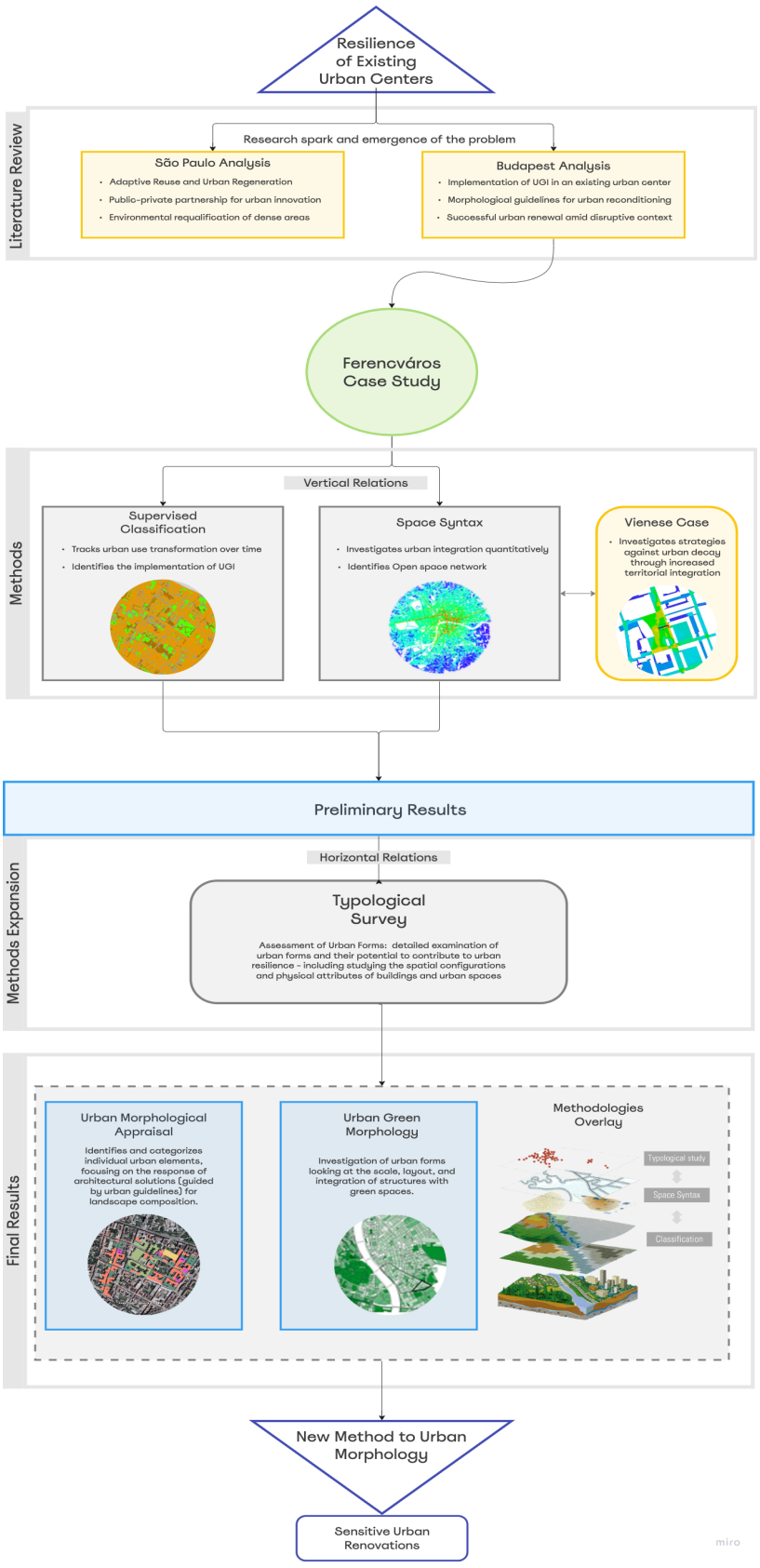


Figure 8: Research Structure Diagram

1.1. Case Study Introduction and Correlations

The restructuring of Budapest's 9th District, Ferencváros, exemplifies the broader trends of urban renewal observed across Central and Eastern Europe, driven by the post-socialist transformation and the integration of global urban development models adapted to local contexts (Tosics, 2006). In Hungary, the transition from a socialist to a market-oriented economy has significantly impacted urban planning, demanding innovative approaches to managing urban spaces and integrating UGI (Kovács & Szirmai, 2006). These changes reflect the necessity to consider preserving, replicating, and repurposing the outstanding morphological elements that provide this urban environment with its distinctive identity. Meanwhile addressing the challenges posed by the area's urban heterogeneity.

The enhancement of inner gardens and green spaces within Ferencváros, driven by design initiatives from the late 20th century, aligns with the aforementioned urban renewal trend and the criticality of UGI integration. These early efforts laid the foundation for the significant changes in the urban fabric that accelerated following the transitional period of the 1990s. In Budapest, particularly in Ferencváros, this phenomenon is well-documented, offering insights for urban planners in other post-socialist cities (Stanilov, 2007). Showcasing how green infrastructure can be integrated into existing urban fabrics as an alternative for existing voids and elevating community cohesion.

Urban rehabilitation efforts in the IX District have focused on addressing the legacy of industrial decline through various means, including the redevelopment of brownfields and the renewal of residential areas. Namely, the rehabilitation of Ferencváros has involved physical improvements to urban fabric, and efforts to encourage social cohesion and economic revitalization (Fürstand, 2007). The preservation and adaptive reuse of morphological elements in Ferencváros have been central to maintaining the district's diverse identity while adapting to contemporary urban needs (Kovács & Szirmai, 2006).

The grid-like structure of Middle-Ferencváros supports a coherent urban fabric that can adapt to changing conditions. This spatial arrangement facilitates the integration of new developments and the preservation of key urban functions, contributing to the district's overall resilience (Fürstand, 2007).

Ultimately, the regenerative urban approach showcased in the IX District enhanced its urban resilience. Namely by the integration and betterment of UGI, but also by the focus on cohesion and urban integration through spatial arrangement and morphological unity. Research into the design processes employed in this area, combined with an examination of the district's evolving urban fabric, provides insights into the multifaceted impacts of urban renewal and the adaptive nature of urban spaces.

This study critically examines the influence of green infrastructure on urban resilience within complex urban systems, thus developing a method for morphological assessment for urban renewals. It focuses on the Ferencváros district of Budapest as the primary case. Also included in the research are São Paulo's Parque Santo Amaro V, as a motivation sparkle, and Vienna's 3rd District. Experiencing the social disparities firsthand as a Brazilian profoundly motivated my interest in understanding how these inequalities influence urban development strategies. The stark contrasts in access to quality infrastructure, green spaces, and housing within São Paulo underscored the pressing need for inclusive and equitable urban planning. The comparative cases are selected based on their strategic employment of green infrastructure to achieve space cohesion and use of natural elements for urban regeneration while increasing urban density and preserving typical local characteristics (Pauleit et al., 2017).

This investigation is driven by the Circular Economy parameters for urban development and resilience, where green infrastructure is crucial in maintaining the essential morphological

characteristics of urban structures and fostering their conscious growth (Cheshmehzangi, 2022; Korhonen and Honkasalo, 2028). The morphological similarities between Vienna and Budapest allow for assessing the role of public spaces in urban cohesion. In contrast, São Paulo's distinct socio-economic conditions and comparable urban renewal financing mechanisms provide insights into the adaptability of such strategies.

The intent of this comparative analysis is pragmatic, aiming to refine actionable insights that could be applied to urban centers worldwide experiencing difficulties with development strategies. The findings presented in this research are expected to offer a significant tool for sustainable urban development, presenting evidence-based recommendations for interventions in regions grappling with social and environmental vulnerabilities.

1.2. Research Problem and Relevance

In today's context of rapid urbanization and resource scarcity, reconfiguring existing urban landscapes is essential to promote more sustainable and livable cities. Cities worldwide are adopting measures to address environmental, socioeconomic, and political challenges. Identifying vulnerable urban patterns, including areas with potential for transformation, is critical in expanding urbanization (Seto, 2024).

Examining the role of resilient structures in shaping urban environments—considering form, function, and utility—is crucial. Understanding the configuration of green infrastructure can also inform a circular approach to urban development, serving as a unifying element in the urban landscape composition (Li et al., 2023).

This Research on Design elevates the role of typological analysis, often underutilized in urban planning, to a central methodological tool. This approach allows for a nuanced understanding of urban forms and their potential to contribute to urban resilience. It provides a fresh lens through which urban spaces can be assessed and transformed. It bridges architecture, urban planning, landscape architecture, and layers of social sciences to explore the multifaceted concept of urban resilience. This holistic perspective allows a comprehensive understanding of how green infrastructure can be integrated into urban design for enhanced sustainability and resilience.

This research recognizes the unique challenges and opportunities present in different urban contexts, from post-socialist cities to rapidly urbanizing metropolises in the Global South. This sensitivity to context adds depth to the research and underscores the need for adaptive, locally relevant solutions (Hölscher & Frantzeskaki, 2021).

By investigating Urban Green Infrastructure not just as an ecological necessity but as a catalyst for urban renewal, the research suggests strategies for sustainable urban development. It proposes UGI as a multifunctional solution that simultaneously addresses environmental concerns, social well-being, and economic development (Winslow, 2021).

The research's reliance on empirical data provides an evidence-based foundation for urban design interventions. This data-driven approach is critical for supporting design decisions and policy recommendations.

While Ferencváros' urban renewal has been the subject of various relevant studies, this research attempts to break new ground by exploiting this case as a solid foundation for assessing the capacity and extension of typological analysis as a tool for discerning urban characteristics. Therefore, this study sets itself apart by employing typological analysis in isolation and articulating it with other physical analytical tools, such as supervised classification and Space Syntax. The intention is to refine and validate these methods for their applicability in adapting and expanding urban centers, contributing to a new perspective on pre-existing concerns related to urban development scope.

1.3. Methodological Approach Overview

The methodological approach of the study is intentionally bifurcated to encompass a robust analysis of urban resilience. The initial phase is anchored in quantitative analysis: the Space Syntax method is leveraged to gauge urban connectivity and integration, a key indicator of spatial coherence within urban fabrics (Van Nes, Yamu, 2021). This method, noted for its ability to articulate the invisible ties that bind urban spaces, is complemented by a thorough examination of the evolution of green infrastructure through the viewpoint of supervised classification—a technique that enables the nuanced differentiation of land use patterns as they pertain to ecological integration (Liu, Huang & Zheng, 2022).

Following this, the second phase, characterized by a qualitative analysis, interprets the quantitative data, providing context and depth to transcend the numerical values. The typological survey, central to this phase, serves as the investigative foundation, matching historical insights with current morphological observations. It is from this point that the study peels back the layers of urban resilience, revealing the intricate interplay between green infrastructure and urban form (AlSadaty, 2022).

The typological survey not only maps the historical trajectory of green spaces but also probes into their morphological significance, offering a comprehensive view of the urban ecosystem. This dual-phase methodological framework, culminating in the typological analysis, confirms the pivotal relationship between urban resilience and green infrastructure and illuminates the path toward sustainable urban development, ensuring that resilience is woven into the very fabric of urban planning.

1.4. Research Challenges

The study confronts challenges inherent to its scope, which predominantly addresses the physical aspect of urban spaces, possibly overlooking broader socio-economic factors. The dependence on data quality, in some cases collected by students under close guidance, further adds a layer of complexity. While the core principles of urban renewal and resilience were taught to the students, the Typological Survey methodology, despite thorough supervision, introduces subjectivity, indicating the need for methodological refinement.

Regarding the supervised classification and findings derived from Space Syntax analysis, cross-correlating these datasets with socio-environmental variables was necessary to enhance their validity. Such multidimensional correlation is critical to strengthen the reliability of the data, which, in turn, supports the hypotheses or assumptions made within the study.

Additionally, the study points to the nuanced task of incorporating historic structures into urban renewal, balancing heritage preservation with modern urban needs—a process that calls for strategic planning to improve urban liveability and sustainability.

1.5. Preliminary outcomes

The preliminary insights of this research can be synthesized in the following subcategories:

- **Relationship Between Urban Resilience, Density Management, and Green Infrastructure:**

The initial findings suggest a significant interconnection between the resilience of urban areas, the management of their density, and the presence and quality of green infrastructure. Resilient urban areas appear to benefit from a well-considered balance between built population density and accessible green spaces, which contribute to the ecological, social, and economic health of the city.

- **Application of GIS Technology in Land Use Classification and Space Syntax for Urban Integration Analysis:**

GIS technology has been instrumental in classifying land use within the urban context of this study. It has provided a detailed and accurate representation of the current land distribution and usage state, which is crucial for planning and managing urban growth and sustainability (Rodriges, 2023).

The Space Syntax preliminary findings suggest that this method can reveal how the connectivity and integration of different urban areas can be affected depending on the presence of green infrastructures. Green networks can actively contribute to achieving more urban integration and, therefore, to the resilience of the urban fabric.

- **Typological Surveys as a core method in Ferencváros:**

The use of GIS is not standalone; it complements and enhances the typological surveys that explore the historical and current physical forms of urban spaces and morphological constitution. When integrated, GIS and typological surveys offer a comprehensive view of the urban landscape, allowing for a nuanced understanding of how historical patterns of land use inform current resilience and sustainability practices.

Together, these preliminary insights lay the groundwork for understanding how urban design and planning can promote more resilient urban environments through strategic density management and the integration of green infrastructure.

1.6. Significance and Expected Contributions

This research attempts to delineate key morphological elements conducive to boosting resilience in urban areas. And to observe the efficacy of typological analysis as a tool for data collection in urban planning and landscape architecture. By leveraging this methodological approach, professionals are provided with methods to gather comprehensive insight into the physical nuances of urban landscape projects. This includes an understanding of both the physical attributes and spatial configurations of structures, as well as the integration of green elements, to inform and shape urban interventions. The ultimate goal is to embed urban spaces more coherently within their context, improving their capacity to withstand and adapt to possible ongoing or future disruptions.

2. RESEARCH OBJECTIVES AND QUESTIONS

The research, centered around Budapest's 9th District, systematically investigates urban growth and transformation phenomena. It examines the evolution of urban densification over time and how green infrastructure contributes to urban resilience. Therefore, investigating the interaction between man-made structures and natural elements.

The research critically examines the urban renewal processes, from the standpoint of Budapest's transition from a centralized political system into a market-oriented system. It seeks to understand the complex changes in the urban fabric impacting social dynamics, and citizen's well-being, as well as the housing supply strategies shaped by public-private investments following this systemic shift. The focus is on the resulting urban planning paradigms and their implications for social equity and spatial organization (Taraba, Forgaci & Romein, 2022). This analysis is crucial in understanding how these historical shifts continue to impact contemporary urban development and community well-being.

A significant portion of the research is dedicated to exploring how resilient urban structures enhance the urban living environment. This exploration includes an analysis of the integration of urban morphology and sustainability in urban design, with a particular emphasis on green spaces.

The aim is to reveal how these resilient forms not only enhance the aesthetic value of urban areas but also play a vital role in sustainable urban living, positively contributing to the environmental and social fabric of the city (Yamagata & Maruyama, 2016).

Moreover, the research comprehensively assesses the configuration of green infrastructure and its role in promoting sustainable and circular urban development. By examining its design and placement, and how UGI can be utilized to create more sustainable existing urban ecosystems, the research intends to provide actionable methods for profoundly understanding and tracking the changes in developing urban areas that aim to become environmentally sustainable and socially cohesive (Wang, Shen & Xiang, 2018).

The research questions posed in this study are grounded in an exploration of the elaborate interplay between urban design, resilience, and sustainability. This investigation seeks to unravel how Urban Green Infrastructure (UGI), as both an ecological asset and an integral component of urban architecture, can catalyze renewal and balance the increasing population density within existing urban fabric. The following questions are proposed to analyze various aspects of this interplay:

- **Exploring the Impact of Urban Green Infrastructure on Urban Performance**:
  How does the integration of UGI enhance the functional performance and liveability of urban areas?
- **The Role of Typological Appraisal in Urban Resilience:**
  What role does a detailed typological appraisal play in identifying resilient urban elements?
- **Reimagining Private Spaces for Public Benefit:**
  How does the conversion of private to semi-public green spaces influence urban cohesion and community interaction?
- **Benefits of Territorial Connectivity in Dense Urban Environments:**
  To what extent does establishing territorial connectivity in dense urban environments support urban resilience and circular economy principles?
- **Urban Green Infrastructure as a Strategy Against Urban Decay:**
  Can a comprehensive approach to UGI serve as a strategy against urban decay, and how could it be adapted for various urban contexts?

By addressing these questions, the research offers a practical tool for urban morphology investigation applicable to urban development, particularly in areas experiencing social, political, and economic challenges. It provides a clear mechanism for renovating urban fabrics undergoing population densification and their evolution in response to contemporary challenges.

3.LITERATURE REVIEW

The literature review conducted in this research was developed alongside the central problem, which is the critical need for reconfiguring existing urban centers to address the multifaceted challenges of contemporary urbanization. Recognizing that modern cities face increasing pressures from rapid urbanization, climate change, social inequality, and resource scarcity, this review aims to identify and analyze the theoretical foundations and practical approaches that have been employed to tackle these issues.

From a broad range of academic and practical experiences in European and South American contexts, the literature review utilizes the author's academic and practical experiences in Eastern Europe and South America. It examines how these strategies integrate with the morphological treatment of urban elements, both existing and proposed. The review explores how systematic and interdisciplinary approaches can be used to reimagine urban spaces, ensuring they are resilient, sustainable, and capable of supporting diverse populations.

The literature review also emphasizes the importance of understanding the historical, cultural, and socio-economic contexts that shape urban development. By comparing case studies from different regions, particularly focusing on the unique challenges and opportunities presented in São Paulo and Budapest, this review provides a comprehensive overview of how urban renewal has been addressed in different environments with similar tools. It highlights the need for adaptable and context-sensitive solutions that can be customized to the specific needs of individual cities.

Ultimately, this literature review serves as a foundational framework for the research, guiding the exploration of urban resilience, sustainability, and morphological innovation. It sets the stage for a deeper investigation into how these concepts can be practically applied to reconfigure urban centers, ensuring they are better equipped to meet the demands of the 21st century.

3.1. Urban Renewal Across Continents: Comparative Insights from São Paulo

The renovation of Budapest's 9th District illustrates an instance of urban resilience and renewal, notably during the critical period of the 1980s through the early 2000s. This era, demarcated by the systemic shift from a socialist to a capitalist framework, catalyzed the District's evolution through strategic design initiatives. These initiatives were orchestrated to bridge the urban voids, enabling a cohesive urban landscape.

Paralleling this, the Parque Novo Santo Amaro V project in São Paulo presents a pertinent comparative study, reflecting on the broader issues of housing deficits and strategic urban planning within different socio-political circumstances. The case provides a lens through which one can examine alternative approaches to urban development challenges, particularly in tackling social inequality and enhancing the overall urban quality of life.

Both case studies encapsulate the multifaceted obstacles that modern urban centers encounter, marked by fragmented infrastructures and social divisions. Budapest's response to the privatization of public spaces and São Paulo's navigation through the complexities of social vulnerability underscore a shared commitment to sustainable urban practice. Implementing green infrastructure and promoting community engagement emerge as common threads in their strategies to ameliorate living standards and reinforce urban resilience. Collectively, these cases advocate for holistic and integrated urban interventions, highlighting the invaluable lessons of historical urban transformations that inform and shape future regenerative initiatives.

Furthermore, in the context of this research, the following review intends to investigate all layers of similarities in urban renewal strategies in the affairs diverse from the scenario found in

Eastern Europe to evaluate their main guidelines and performance as a method, giving perspective to the investigation. This is a relevant bridge between places that, despite having different socio-cultural conditions, are experiencing accelerated growth, and are seeking alternatives for sustainable development.

Exploring the public-private partnership system for the renovation of deficient urban structures encouraged studying the Ferencváros District as a structurally analogous case. In addition, the "top-down" management approach - despite the existence of a layer of social interest - both renovations are based on the critical employment of morphological aspects and the tactical implementation of green elements. In both Ferencváros and Parque Novo Santo Amaro V, the highlight is the intricate articulation between those green elements and the proposed new buildings, providing the emergence of semi-public spaces and important axes of accessibility crossing through and connecting those areas.

3.1.1. Housing Policy in São Paulo and Innovation in Urban Renovation Initiatives

Examining São Paulo's housing policies and their impact on architectural and urban landscapes can be explored from the perspective of sustainable development practices and environmental regulations promoting urban renewal. Given the historical context of Brazil's housing deficit and the strategic policies in place, we will explore how these factors have influenced the quality of life and social inequality across the nation.

This session establishes a comparative analysis of traditional housing strategies against innovative approaches as exemplified by the Parque Novo Santo Amaro V project, designed by VIGLIECCA&ASSOCIADOS. Therefore, the analysis covers critical elements of this intervention, assessing its contributions to landscape architecture management and improving living conditions within disadvantaged Brazilian communities.

The project is introduced as a remarkable example of new public housing initiatives and how environmental considerations have been integrated into strategies for urban and social revitalization of deteriorated city areas. The session will navigate the complexities of the South American urban condition, characterized by its layered conflicts, fragments, and unresolved dichotomies, as an insight for reimaging urban renewals.

The effectiveness of Parque Novo Santo Amaro V's solutions weaves the locality into the broader urban fabric of São Paulo, raising the awareness of experimenting with new solutions when dealing with densely populated contexts. These solutions address the immediate housing shortage and tackle pressing environmental concerns, paving the way for a holistic approach to urban regeneration.

3.1.2. The South American Context

South American cities are composed of complex layers defined by unequal sociocultural backgrounds resulting in segregating and integrating territorial movements (Roberts & Wilson, 2009). This dynamic condition establishes diverse and discontinuous patterns, especially in large urban centers such as São Paulo. The urban configuration is conducted by a set of processes (confluent or divergent from each other), such as agglomeration, political actions, class conflicts, profit maximization, or planning decisions (Shearmur, 2011).

Similar to the process experienced by several European cities since the 1970s, São Paulo – which is one of the main economic centers in Brazil and South America (Gauthier, 1973) – has also been undergoing an intense change in social paradigms and spatial organization, because of the intensification of globalization trends and the decline of traditional manufacturing industries

plus the consequent rise of the service sector (Schreiber & Carius, 2016). This urban change and restructuring process reverberated unevenly in Brazilian cities, causing intense migratory waves towards the economic centers, triggering growing urban structuring and cohesion problems (Murray, 2017).

3.1.2.1. The Emergence of New Policies in São Paulo

The current Brazilian political circumstances have guided the country towards stagnation in housing production and the rehabilitation of consolidated centers. Recent indicators show the rapid growth of the housing deficit around the country, and especially in São Paulo (Municipal Housing Plan of São Paulo, 2016).

The city of São Paulo is the largest housing hub in the country, home to about twelve million inhabitants. It is also a major economic and cultural center in Brazil. Most of the urban trends emerging in this city later spread throughout the country, including when it comes to social policies, social housing strategic implementation, and urban renewal experiments.

Taking this scenario into consideration, innovative initiatives are being undertaken by the local government in an attempt to take control of housing policies, especially where related to social interest. The alternatives are emerging with the support of legislation and guidelines that deal specifically with long term urban planning and sustainable development, such as the Urban Development Plan (Law No.16.050 of July 31, 2014) and the Environmental Protection and Development Plan (São Paulo State Law No. 9.866/97) Thus, the Municipal Housing Plan of São Paulo (São Paulo State Law No. 619/16) seeks to define housing programs and strategies for action and articulate them in the former mentioned sectoral policies.

The social housing policies developed by the federal government were able to significantly impact the decline of the slum population in large Brazilian urban areas. Nevertheless, in São Paulo, despite the large investment in this area, the numbers reflect the opposite.

Accordingly, this study also seeks to highlight the differences between the national urban policies, which are currently decreasing in size and importance, and the local policies developed by the state of São Paulo, especially regarding architectural and urban landscape quality.

As a study case, the rehabilitation of Parque Novo Santo Amaro went much further than the partial demolition of the existing set of buildings and the construction of new dwellings, but it also improved the quality of the urban fabric of a consolidated slum area, promoting accessibility, creating open public spaces, and addressing technical solutions for environmental issues, beside the consequent amelioration of the urban landscape (Figure 2).

This kind of intervention is an unconventional alternative in using housing development as a mechanism to tackle cohesion hindrances in fragmented urban tissues and in an attempt to improve the sanitary and ecological conditions of communities located in areas of environmental sensitivity. Promoting the improvement of deteriorated urban areas and the support of low-income populations in central locations, facing the transformative force of the real estate market, are part of the "conflicts and unresolved contradictions" that the city’s government is constantly dealing with.

Figure 9**:** Sketch of the pedestrian overpass designed for Parque Novo Santo Amaro V.
Source: Viglieca & Associados, 2017

3.1.2.2. General Overview of São Paulo's Urban Structure

The city of São Paulo has a heterogeneous urban structure, resulting from a historically fragmented and multicentric expansion process, which gave rise to a segregated territory (Roberts & Sykes, 2009). Although analyses of urban segregation are commonly performed from a center versus periphery perspective, in Brazilian cities such as São Paulo, this type of interpretation is not so evident since, in some cases, the wealthy zones are interspersed with less structured neighborhoods, further away from the center of the city (Villaça, 2011).

Despite this heterogeneous scenario, most of the formally planned zones with consolidated urbanization and the metropolitan structuring zones are located in the city's center, in its northwest region. Those zones are where the main connection axes, dense public transport network, and the most extensive commerce and service hubs are found consecutively. The poorest neighborhoods, described in the São Paulo Urban Development Plan as "areas of urban vulnerability," are concentrated in the eastern and southern zones, where there is also greater concern about experiencing disorderly urban sprawl in environmentally protected areas (see Figure 3).

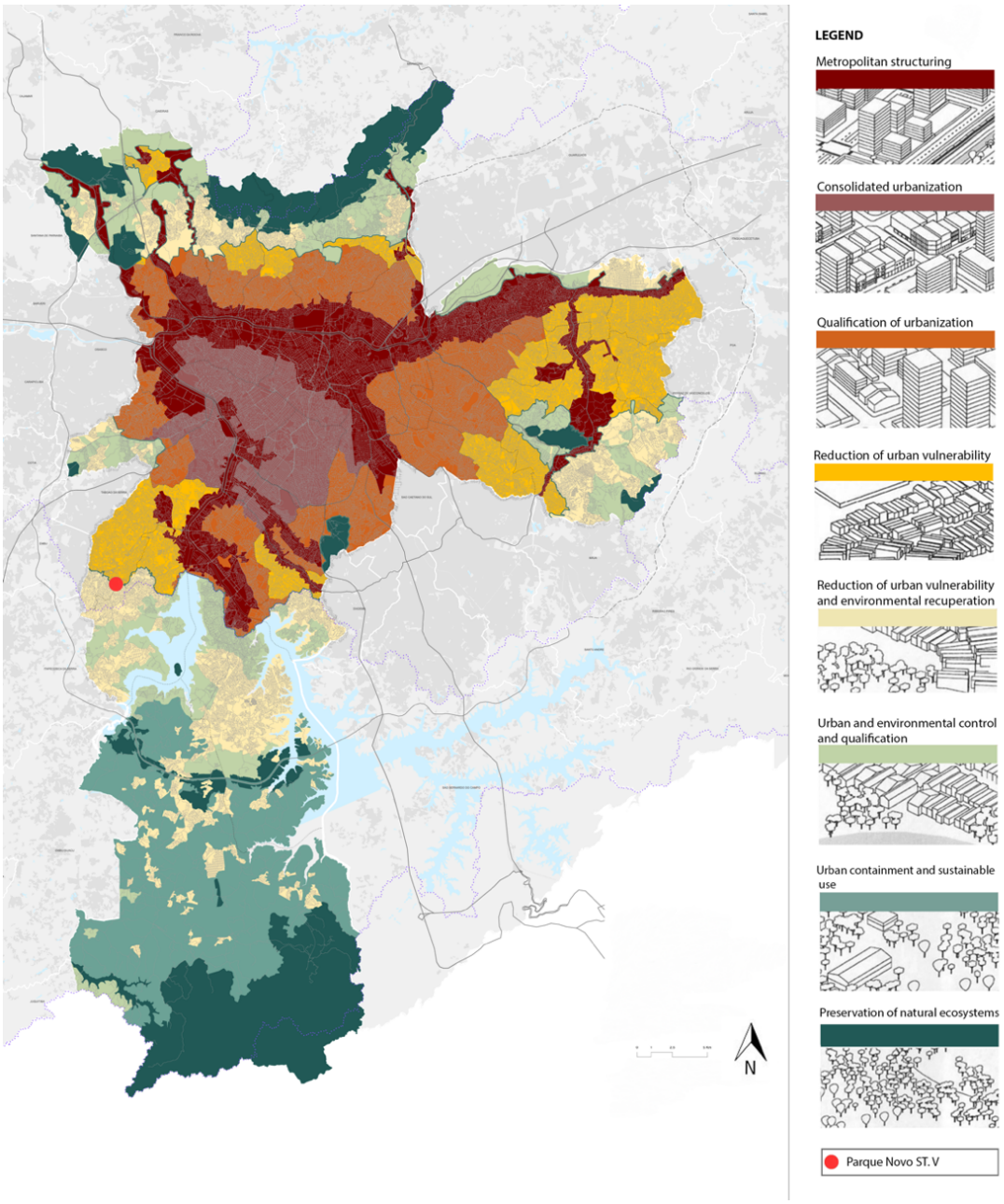


Figure 10: Urban structure of São Paulo.
Source: São Paulo Development Plan, 2014 – edited by author.

3.1.3. Regeneration of Urban Forms with Innovative Tools

In 2018, the São Paulo government announced the construction of 3,895 housing units through the national housing program "Minha Casa Minha Vida" (MCMV), targeting low-income families. Given the estimated deficit of 368,000 homes in São Paulo, this number indicates the Central Government's inability to manage the housing crisis in the country (Rolnik, 2015).

Besides the difficulties faced by the centralized national housing policies to meet the local needs for dwellings, the limiting conditions imposed by MCMV hinder diversity in urban forms, leaving aside the intrinsic complexity of areas of unplanned occupation. The local government also had low control concerning constructive parameters and the financing processes. Therefore, it is clear that the National Housing Program, in addition to not meeting the expected quantitative

expectations, also does not achieve the qualitative standards in terms of urban morphology and architectural typologies.

A new framework, better adaptable for the renovation of existing urban forms, which is more suitable for the existing spaces and/or buildings (Bishop & Williams, 2012), has emerged in this panorama: a wave of innovative methods, aiming for new financial backgrounds, and mainly grounded in the fact that the existing urban hubs can be restructured. Also, regarding urban green infrastructures, the core idea is to guarantee a comprehensive network of green public areas (in various scales and forms) for areas of extreme population density.

The parameters required by the traditional national housing policy stimulate suburbanization, demand urbanization of natural landscapes (requiring more extensive investments), and encourage architectural standardization. Under this regime, the urban green infrastructure is also not considered, which results in poor or inexistent urban green network planning.

The MCMV residential program does not demand any analysis of the pre-existing fabric, causing difficulties in the city's mobility system. There are no requirements for green space networks (see Figure 4). For this reason, this type of urban solution has a low percentage of green spaces and permeable surfaces, which also overloads the rainwater infrastructure. The construction legislation of São Paulo also does not limit the minimum distance between buildings within the same plot, which significantly compromises the landscape quality in these areas (see Figure 5).

Figure 11: Urban landscape MCMV in housing estate area – São Paulo.
Source: Google Maps

Figure 12: Comparison between favela occupation and MCMV housing developments. Source: by author

The demographic density of the São Paulo favelas was estimated, in 1987, at 446.2 people per hectare (Brazilian Institute of Geography and Statistics, 2014), a value that approximates the average found also in housing estates built through the MCMV program (200 - 400 p/ha) in the central areas. Despite the similarity, these urban configurations are entirely different structures.

Still concerning the density analysis, favelas present relatively low building height due to the low level of construction technology. MCMV housing developments meet state contractual demands, seeking to reach the most significant number of housing units with the lowest cost possible. Most of these residential developments consist of five-floor buildings, reaching the limit of the requirement for elevators.

A further difference that defines the two types of urban housing is that the housing estates are car-oriented – also a result of the requirements for accessibility and public security, and the determination that each unit must have at least one parking lot. In São Paulo's favelas, typically, most roads do not support the traffic of cars, and so the flow of pedestrians is possible only in narrow alleys – most of them between 1.5 and 3 meters wide (Silva, 2000). The public transport axes are placed on arterial routes that cross or surround the territory.

In the urban conjuncture of MCMV housing complexes, the green space network is often restricted to mandatory preservation (green space for protection) of non-building areas due to high inclination, flooding zones, or environmental significance established by law. The São Paulo construction code also determines the minimum amount of permeable surfaces, which reflects in the implementation of interstitial grassy gardens. These areas are primarily for private or semi-public use, as they have restricted or prioritized access for the residents of the buildings. Their maintenance is also a private responsibility. For this reason, they are usually in a good state of

management, despite the low biologically active surface typically found on this kind of designed green spaces in such circumstances.

This way, the Parque Novo Santo Amaro V project, located in the south of São Paulo, proposed by Viglieca & Associados, is a good example of social housing that has managed to overcome the barriers defined by extremely restrictive legislation and the low cost construction technics, in order to achieve a better urban environment and landscape design (see Figure 6). In this case, the green system in this project is also wholly public, maintained by the state.

Figure 13: Parque Novo Santo Amaro V - implantation in urban context.
Source: by author

3.1.4. Disordered Urban Expansion and Environmental Impacts

The disordered urban expansion of the metropolis, without the implementation of basic urban infrastructure, especially in the southeastern region, where water resources are more vulnerable to pollution, has resulted in environmental degradation. The occupation of slopes, riverbanks, streams, valley bottoms (conducive to seasonal flooding), and floodplains by slums and clandestine urban subdivisions has affected water quality and compromised the continuity of the public water supply for the metropolitan region of São Paulo.

In this sense, the Development and Environmental Protection Plan - PDPA (State Law No. 9.866/97) established, among other definitions, planning and management instruments for the Protection and Recovery of Watershed Areas (APRM). The PDPA's main intention is to monitor the application of specific APRM legislation and guide the actions of public authorities and the

civil society, aiming at the protection, recovery, and preservation of watersheds of regional interest (see Figure 7).

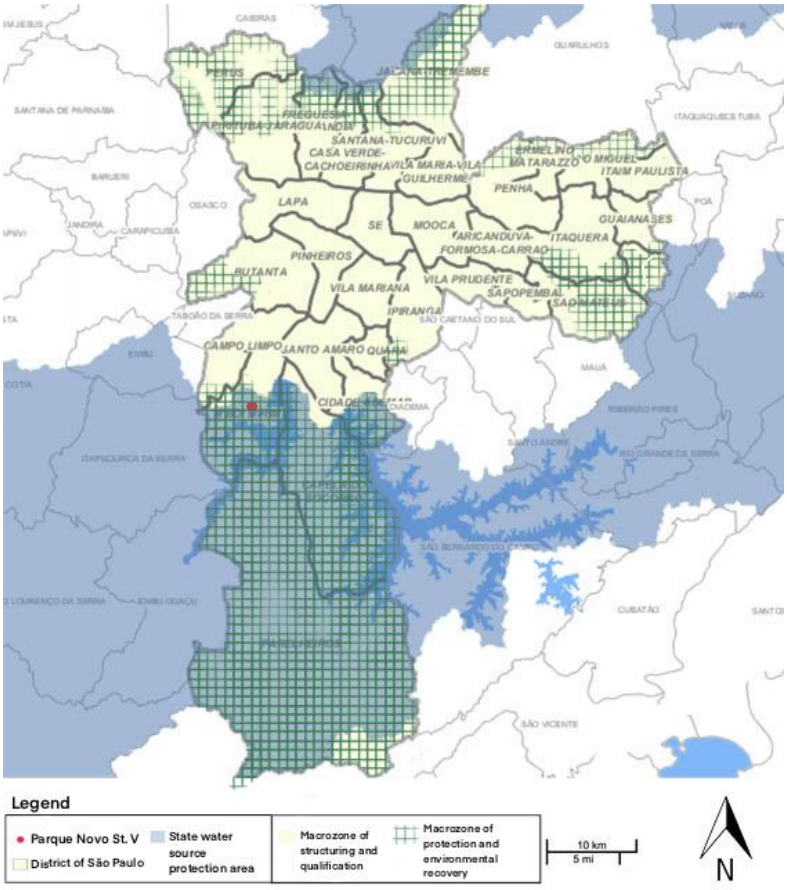


Figure 14: Parque Novo Santo Amaro V – location in the Water Source Protection and Environmental Protection zones. Source: São Paulo Development Plan, 2014 – edited by the author.

The city of Sao Paulo experiences exponential growth in its population and, consequently, in its urbanized areas. This process highlights the contradictory dynamics of continuous expansion, generating precarious suburbanization and territorial fragmentation.

Considering the highly heterogeneous and complex pattern of the urban context of Parque Santo Amaro, and because of the need to see the city as a whole and its parts (Ungers & Vieths, 1999), the regeneration of this district of priorly predominantly residential use, symbolizes a movement opposed to the disorderly urban sprawl, willing to implement focal infrastructural elements into the deficient urban environment. Thus, the project aims to radiate improvements in the territory by improving landscape and environmental conditions far beyond the delivery of only the necessary housing units.

Good "urban acupuncture" must promote the conservation or rescue of the cultural identity of a locality or community (Lerner, 2003). The project developed by VIGLIECCA & ASSOCIADOS considers the various layers that compose the urban structure of Parque Novo Santo Amaro V respecting important physical-environmental factors that guided the morphology of the original implantation and can also be considered relevant elements for the construction of the community's identity, such as the inclined relief and the stream. This design conception was built along the lines of the "urban acupuncture" concept, based on physical and abstract elements that connect the city's layers and unify them, spreading the results of its improvement performed on a local scale instead of on a broader horizon. More details on how public policies were applied

to reshape the landscape and environmental conditions in Parque Novo Santo Amaro V can be found in Annex 2.

3.1.5. Lessons Learned from a Public-Private Partnership

The city of São Paulo is composed of a complex and fragmented urban structure resulting from the Brazilian segregationist social conditions. In spite of this background, the local government has been adopting new measures to regenerate and integrate consolidated areas of social interest into the city's urban fabric. Despite the political and financial limitations, acting against the rapid and disorderly growth of the city has become one of the operational guidelines of the city, aiming to reduce environmental and landscape impacts and improve living conditions in peripheral areas (Pasternak, 2006).

The Parque Novo Santo Amaro project emerged from the need to articulate the requirements determined by environmental protection and requalification legislation introduced by the Urban Development Plan (Law 16.050/14) . This was made through a residential and urban infrastructure project, seeking to meet several local demands, such as the need for more housing units, the improvement of water management and environmental conditions, and the implementation of urban mobility elements.

Finding alternative measures to deal with conflicts, fragments, and contradictions intrinsic to cities is essential for their management and progress (Delsante & Bertolino, 2014)- especially in the context of South American urban centers . São Paulo has found opportunities for the solution of specific social dilemmas, and they have been able to align alternatives that overlap several layers of the urban structure. Through the complex application of small and medium-sized interventions, it is possible to see results that radiate on a large scale in the urban territory and landscape.

As a result, the improvement in spatial layout and the quality of the urban landscape is illustrious. The architectural and urban design provides solutions for some of the significant social and physical problems in the Parque Novo Santo Amaro project. However, the site's current state does not reflect some of the aspirations initially sought (Trancoso et al., 2015).

Even though the functions were rationally distributed in the spatial layout in confluence with the newly established flows, conflicts emerged from use. The commercial spaces initially planned for the maintenance and improvement of local commerce are currently maintained by external traders, and this also implies confrontations in the management of the space. The quality of the green infrastructure elements and the maintenance of public spaces, in general, do not reach expectations after years of use. This is a typical scenario, especially in state developments in Brazil's social fragility areas.

As the main lesson to be learned from this housing project for future interventions in similar context, it can be stated that in order to meet social demands in fragile urban areas, it is also necessary to address solutions for environmental conditions. This way, the project becomes more resilient, intertwining physical (tangible) aspects with social and cultural values (intangible). However, after years of implementation, it is now evident that projects such as Parque Novo Santo Amaro V (Figure 8) cannot achieve their full transformative potential in isolation. For this, they must be connected with an extensive network of congruent interventions.

Figure 8: Aerial image – urban insertion.
Source: Viglieca & Associados, 2017

3.2. Confronting Disruption: The Case of Ferencváros

Understanding the urban development of densely occupied areas - especially in historical urban fabrics - may be a significant step towards constructing socially and ecologically sustainable urban environments. Urbanization is a relevant phenomenon in the characterization of the economic structure of a city, country, or region, which is an outcome of a large concentration of human resources. However, the consolidation of this socio-spatial model has raised issues related to large-scale resource management and sustainable planning (Arnfield, 2003).

Despite representing only 2% of the world's territory, it is estimated that 75% of natural resources are consumed in urban agglomerations (Ribeiro & Gonçalves, 2019). The intense urbanization process experienced in the last century worldwide has increasingly evidenced the need to rethink the ecological values and the quality of life in dense urban centers.

Acknowledge the intricateness of the urban structure, and its layers can help find feasible alternatives to improve its performance. The urban structure can be recognized as a complex set of elements that stress establishing patterns that condition (or induce) the future changes in the physical and social spheres. The gradual emergence of urban spaces results from agglomeration processes, segregation, rent-seeking, political actions, class conflict, profit maximization, or planning decisions (Shearmur, 2011).

Public space is one of the elements that better comprise cities' psychological and physical space (Berg. 2016). Therefore, the public environments present in the urban structure can be understood from two perspectives: the public sphere as a social condition and the public space as a material arena. Both are intertwined in the conformation of the cities' landscape and the urban social interactions, solidifying the experience of using the space. "Open, accessible, inclusive public space may serve as the venue of social interactions that teach the values of tolerance, engagement, and citizenship." (Hirt, 2014).

Post-socialist cities tend to be equipped with structures oriented to public open spaces and green infrastructure. Many of them were entirely conceived under the perspective of the public domain; others, previously established (such as Budapest), underwent adaptive processes to recreate or merge sections of the urban fabric through this conception. Under the circumstances of the socialist regime, public spaces had the structural function of articulating the land subdivision

and zones of use of the urban territory. They played the role of indoctrinating and shaping the emergence of a new lifestyle. (Hirt, 2014).

New urban spatialities were designed to provide a setting for new types of social relationships. Concerning urban green infrastructure, some elements were typically inserted in modern developments aiming to ameliorate their socio-spatial conditions, such as large urban green spaces encircling housing estate areas, playgrounds, public sports fields, kindergarten gardens, and schoolyards, for example (Gavrilidis et al. 2017).

Since the end of the communist regime, there has been a continuous movement towards privatization and restructuring of public spaces. Also, during the process of social-political transition, urbanization patterns and trends emerged, marked by the intense decay in the density of central areas and the significant rise of urban sprawl – in the case of Budapest.

In articulation to that process, the introduction to the market-based investments disrupted the 'mono-centric model' executed in the communist cities, expanding the boundaries for commercial and office activities and allowing the resurgence of new secondary centers (Hirt & Stanilov. 2014). In addition, the diversification in the land use structure has also led to the emergence of high-income suburban residential hubs, increasingly connected to the urban infrastructure, public transport, and green network.

Because of the aforementioned urban movement, the new economic model has enlarged the need for affordable dwellings with better living conditions and good accessibility to the main commercial and institutional hubs within the post-socialist cities. This scenario has compelled the redefinition of empty or underutilized urban spaces to make feasible the implementation of residential developments compliant to the emerging population's necessities.

Those reframed urban voids went through diverse initiatives, calling for the “state-led gentrification” of socially degraded areas or relying on altering the former functions of the targeted urban territories and redefining the social stigmas associated with them. Van Gent and Botterman (2018) highlighted that "capital-intensive urban redevelopment has increasingly been cured and sometimes initiated by the State."

Besides the rapid urban renewal process, it is possible to identify adequate evidence of urban resilience that makes this physical and social space resistant to the new disturbances (Ribeiro and Gonçalves, 2019). Adaptation, recovery, and transformation are some of the more remarkable pillars verified in this intervention.

3.2.1. Planning Evolution: conceiving the public-private partnership

According to Ribeiro and Gonçalves (2019), the concept of urban resilience is related to the capacity of an urban territory to adapt to possible disruptions, perpetuating urban dynamics and existing physical conditions that characterize a place and its landscape. In addition, it enables the emergence of new socio-spatial expressions. The study area analyzed at Ferencváros had its urban renewal process carried out through uncertain periods of significant political and social changes (Figure 9).

Figure 9: Tompa Street at Ferencváros District.
Source: by author

Initiated by the Municipality of Budapest in collaboration with the District Government, the Middle-Ferencváros urban renewal project began in 1986 during the final years of the state socialist era and continued into the early 1990s. Unlike other large-scale restructuring processes, this initiative was driven by public authorities rather than private developers.

In the 1970s, urban plans for Middle-Ferencváros supported the almost complete demolition of the existing late 19th-century housing stock. The intention was to replace these structures with modernist, multi-story blocks, reflecting contemporary architectural trends. However, by the 1980s, there was a shift towards more moderate intervention strategies, and a detailed urban plan adopted in 1983 proposed demolishing only the worst-quality, low-rise workers' tenements. This plan, initiated by the District Council and developed by Gábor Locsmánd, emphasized replacing substandard buildings with multi-story residential structures (Figures 10 and 11). It also included substantial environmental impacts, such as creating landscaped communal courtyards within the interior of the blocks and widening some narrow streets, aligning with prevailing international trends favoring preservation over wholesale demolition.

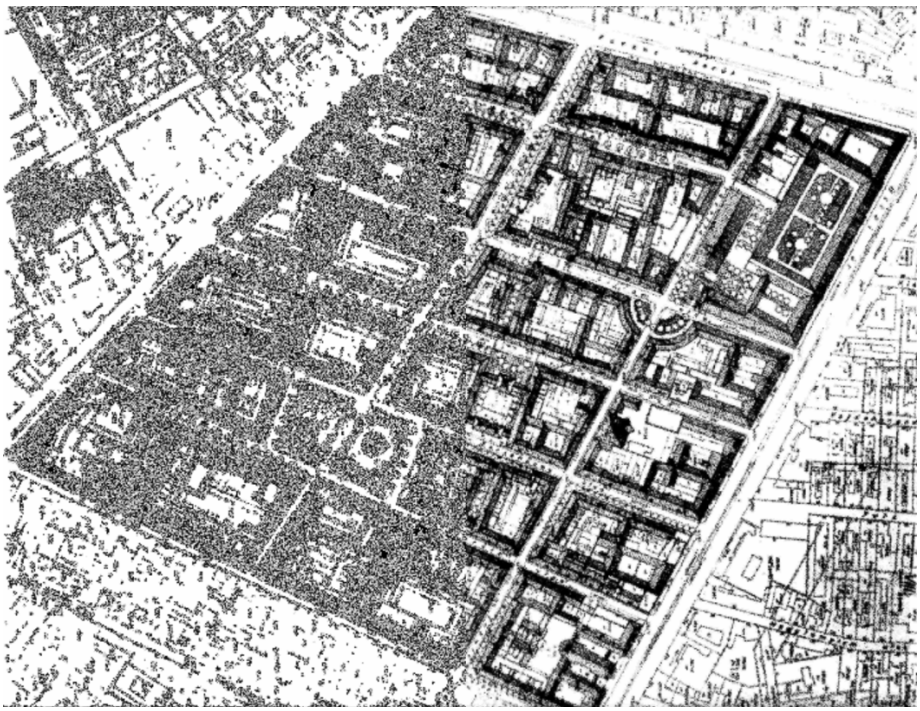


Figure *10*: *In 1983, G. Locsmándi developed the initial plan for the reconstruction of Middle-Ferencváros.*
Source: Locsmándi, 2008

After the political changes of 1990, a crucial decision was made to retain the public residential stock instead of selling it to sitting tenants. Maintaining public ownership was seen as essential to manage the planned operations effectively. The district established a public-private partnership company, SEM IX Ltd., modeled after the French system of Sociétés d'Économie Mixte (SEMs). This company played an important role in realizing the project's objectives, coordinating development efforts, and engaging with private construction firms.

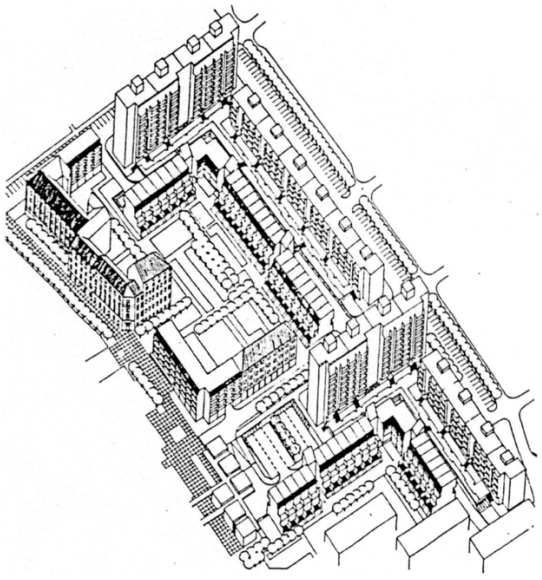


Figure 11: Modern panel houses in the first plan for the reconstruction of the middle Ferencváros.
Source: Locsmándi, 2001

The implementation process involved close cooperation between SEM IX Ltd., local government committees, and the district office. The vacating of buildings slated for demolition was managed internally, allowing for better oversight and coordination. This approach differed from other districts where private developers handled such activities, and it helped ensure that residents' needs were considered during the transition.

Starting the renewal process earlier than other districts provided Middle-Ferencváros with a competitive and economic advantage. In the late 1990s, approximately 60 percent of the subsidies from the Budapest Rehabilitation Fund were allocated to the Middle-Ferencváros redevelopment area (Locsmandi, 2008).The district significantly enhanced environmental qualities without increasing permitted density figures in its building code. During the construction boom after 2000, these improvements made the area more attractive to developers and residents alike, without compromising urban density or quality of life.

Initially, due to low housing demand and the collapse of state-owned development companies, the district had limited options for selecting developers, and formal tendering procedures were not used. However, as interest grew, the district introduced sophisticated tendering and public procurement processes in collaboration with SEM IX Ltd. Detailed technical specifications, preliminary subdivision plans, and preliminary contracts were included in tender dossiers. A diverse jury evaluated submissions based on multiple attributes, including architectural quality.

SEM IX Ltd. was established with a financial structure that included minority shareholders, such as a Hungarian consulting firm holding a 30% share. The company's financial strategy involved using proceeds from the sale of public properties to cover infrastructural improvements, landscaping, and demolition costs. Profits were reinvested into building affordable housing for displaced residents, renovating buildings designated for preservation, and creating public institutions like childcare centers. The company's operations were transparent and accountable, with annual reports submitted to the district government and oversight provided by a board comprising local government delegates and private partners (Locsmandi, 2008).

In the later stages of the intervention, a more market-oriented urban approach was adopted, affecting the design and accessibility of street-level areas and, in particular, increasing the density of urban blocks renovated in the early 2000s. Nonetheless, despite these changes, the resulting developments remained typologically consistent with the characteristics of Budapest's historic areas (Locsmándi, 2001).

3.2.1.1. Urban Intervention Management

The municipality of the 9th district refers to the existence of four "centers of gravity." At the logistical level, those centers (see Figure 12) were used as guidelines for developing the activities and as temporal markers to implement the actions. The project developers identified the locations based on the level of social vulnerability found and the maximum transformative potential. These areas were thought of as poles of irradiation of the improvements, relying less on public investments over time to achieve the same beneficial results idealized at the first stage homogeneously at all the intervention areas. Physical renewal, in this case, plays a unique role in urban regeneration. (Roberts & Sykes, 2008)

The regenerative process experienced in this region is mainly based on its gradual change of function. Specifically in this case and in other successful examples of urban regeneration, this change, resulting from constantly updated political, social, and economic demands, was identified as a possibility of entrepreneurship, having, therefore, a managed transformation process (Roberts & Sykes, 2008).

Figure 12*: *Gravity Centers articulated by green pedestrian axis
Source: by author

Regarding the physical elements used as tools for territorial transformation, four artifices outstand: integration and consolidation of community courtyards, creation of green alleys for pedestrians, building's frontal setbacks, and reformulation of green public squares system. Those elements were articulated to provide the emergence of complex green infrastructure in the area. Nevertheless, the urban design was conceived to avoid severe disturbances in the typological characteristics, respecting modularity, ratio distribution, scale, and even materiality aspects (Figure 13).

Figure 13: Recently constructed building with frontal setback and under construction common courtyard accessible directly from public street.
Source: 2021 - by author

Furthermore, a crucial layer of the Urban renovation in Ferencváros is the configuration of the tendering and procurement procedures. Tender documents include technical specifications, subdivision plans indicating public property, and preliminary contracts outlining building deadlines, obligations, and minimum purchase prices. A diverse jury—comprising the chief architect, the chief executive of SEM IX Ltd., and committee members from various political

groups—helps reduce political pressures. The open tendering process allows candidates to observe each other's presentations.

Submissions are evaluated based on multiple criteria, including architectural quality. Applicants initially submit rough building plans, which are later refined in consultation with the district's chief architect before final contracts are signed. SEM IX Ltd. is authorized to handle preparatory tasks for the district, such as planning, designing, and improving public spaces and infrastructure. The maintenance costs for landscaped courtyards, however, are assigned to property owners through condominium agreements.

Public investments, on the other hand, including the renovation of public rental buildings, are executed through procurement procedures regulated by Hungarian legislation that is consistent with European Union standards. SEM IX Ltd. operates on behalf of the district without its own planning and construction departments. All major decisions are made by the local government to ensure alignment with public interests (Locsmandi, 2008).

3.2.1.2. Urban Green Infrastructure promoting socio-spatial cohesion

Despite the importance of defining the centers of gravity for the systematization of the intervention process, the primary mechanism used to unify the heterogeneous and disconnected urban fabric was implementing a green infrastructure network. The development of these multifunctional green spaces, strategically designed along with the full extension of the intervention area, promotes equal access to green spaces in the middle region of the district.

Among the benefits sought by implementing a comprehensive green system are an increment in urban permeability, improvements in social cohesion, and adaptation to climate change – which, under all aspects, drives the resilience of this urban territory (Pauleit et al., 2019). Increasing the biologically active green surface and ensuring accessibility to open green spaces were essential aspects of the strategy for creating an integrated framework for a healthier urban environment (Kaplan, 1995). Towards that perspective, the new green spaces were accomplished by redesigning former residential plots and brownfields.

Approaching the concept established by Kropf (2017), "configuration is an arrangement of parts, and a type is a configuration with a degree of modularity and integration as a cultural habit. The type is a configuration that is or has been actively reproduced. While each example of a type might be slightly different, the configuration remains the same."

In line with that notion, the reconfiguration of the historic courtyards and the entire demolition of some poorly conservated buildings, despite being antagonistic to the movement of typological perpetuation, allowed the revival of the area's configuration (Figure 14). As a result of this process, it is possible to highlight the improvement in public health performance, equal access to leisure, strengthening of social relations, protection of biodiversity, and increase in local economic activities (Pauleit et al., 2019).

Figure 14: Remaining urban block before and after the demolition of residential buildings for the implementation of an urban park Ferencváros.
Source: Google Earth

3.2.1.3. Adaptability of Urban Areas

Resilient urban environments can be defined as a set of characteristics *"consisting of identifiable parts that through localized interaction (process) produce stable patterns (structure) across temporal and spatial scales" (Ernstson, 2010).* Given that approach, the *"recognizable parts" of a city can be determined as remaining elements contributing to the consolidation of the urban structure and its landscape conditions.*

In the urban (and social) restructuring that took place – and still unfolds significant changes – in the middle area of Ferencváros, it is possible to observe several "identifiable parts" that resisted the inevitable transforming forces (Ribeiro & Gonçalves, 2019), emanating mainly from political sources (Figure 15). In this case, specifically, the local government had the legislative power, determined restrictions, design, and construction guidelines, and owned most of the properties and plots in the intervention region.

Figure 15: Resilient urban elements: prior industrial building converted into high-end housing – Ferencváros
Source: Municipality public data, 2008

Therefore, the urban structure maintained its production of stable patterns, despite undergoing significant changes at the typological level by implementing extensive green infrastructure and the new architectural and landscape solutions achieved. Furthermore, elements relevant to the definition of urban morphology were carefully maintained, such as the network of streets, the delimitation of the blocks, and the plots' patchwork. The transformation emerged mainly from rearranging urban voids or underutilized areas, such as those with inappropriate

functions for residential zones or occupied with low-rise buildings with few housing units and no commercial function attached (Locsmandi. 2001).

Redesigning the predominantly residential multifunctional blocks was one of the focal points of the area's regeneration project. Despite being heterogeneous, the blocks mainly were composed of traditional typological buildings - commonly found in historically occupied zones in Budapest – except for the urban voids left by the old small industries interspersed in the urban fabric (Figure 16).

In general, each building was equipped with its courtyard, in many cases, dimly lit, lacking green elements, and in poor maintenance conditions. The urban reconstruction project called for the demolition of some wings of traditional buildings, or in some cases, their complete demolition, to generate enough space to implement a shared green infrastructure.

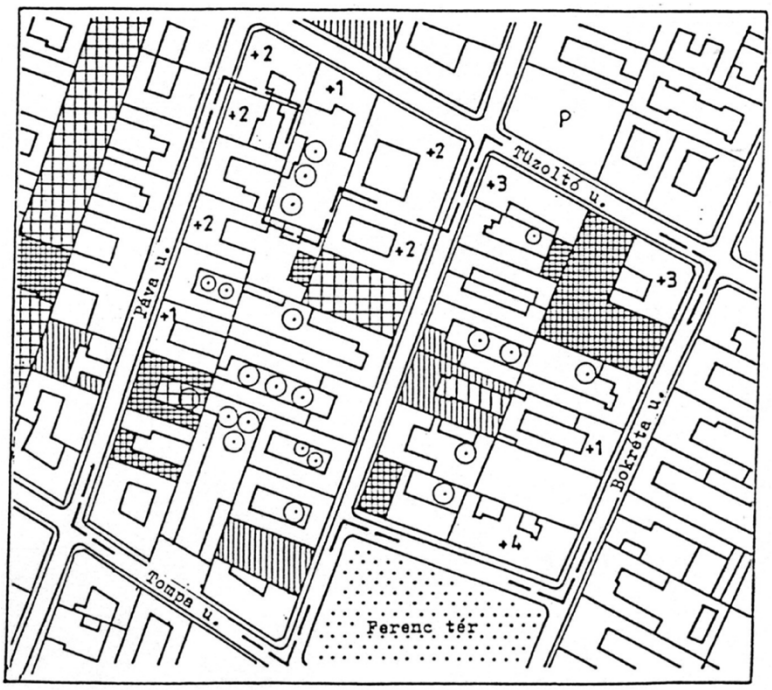


Figure 16: Older blocks of middle Ferencváros - hatched areas as prior small industries
Source:

This new configuration implied a radical change in the use of courtyards, resulting in the strengthening and multiplying social relations in this space without detracting from the urban landscape's main features. The blocks had their average occupational ratio maintained, with the building's facades composing a continuous alignment and volume and proportions similar to the pre-existing state. However, in many cases, they became transparent and permeable after the implementation of new green pedestrian axes.

An innovative aspect of the project was the development and enforcement of a comprehensive development plan that considered both the realization aspects and detailed arrangements of new buildings and communal spaces. A notable strategy involved the district retaining ownership of common courtyards while granting easements to developers to construct underground garages beneath parts of these spaces. In return, developers were responsible for landscaping the courtyards, enhancing communal environments for residents (Locsmandi, 2008).

Accessibility to the urban open spaces was positively complexified. A new spectrum of public and semi-public areas emerged from the prior concentration of private-use areas. Meaningful visual connections were established and enhanced by new local regulations, which do not authorize the placement of opaque barriers blocking the view through the gardens, for example.

3.2.2. Preliminary Insights from Budapest

Urban resilience is a highly pertinent concept to post-Soviet cities, which underwent significant political and social disruption processes, implying a severe restructuring of their physical and psychological spaces (Ribeiro & Gonçalves, 2019). Furthermore, the dynamics of accelerated urban expansion in post-Soviet cities required the restructuring of sub-dense areas, intending to provide space for creating new mixed-use centers inserted in the central context of cities (Nilsson et al., 2013). Given the analyzed intervention, the persistence of typological urban patterns is notorious, besides the massive implementation of urban green elements, which steadily impacted the project's development and the current raising in the quality of life in the neighborhood.

By analyzing the regeneration of the middle region of Ferencváros, it is possible to identify typical elements present in urbanization processes in Budapest and other post-Soviet large urban centers as a consequence of the massive process of privatization of public space (Hirt, 2014). However, some characteristics of this development stand out, such as implementing green infrastructure to strengthen social relations and the local economic scenario – factors that indicate the strengthening of sustainable practices.

The study of this area helps to identify the political and design measures that guided the emergence of a healthier, potentially more sustainable, and consecutively more resilient urban environment, providing space for urban green infrastructure, higher-quality housing, and multifunctional public areas. As the scope for further investigations, it appears relevant to specify the social and ecological advancements and the sustainability capacity of the new urban environment after the project consolidation by analyzing the urban green forms in detail.

Despite the positive aspects arising from the restructuring of this urban territory, the process of establishing major redesign guidelines and configuration of the social spatialization in the area followed the characteristic flow of the "top-down" management model, without active community participation (European Environment Agency, 2020). This conformation, commonly used in introducing the market economy in post-socialist countries (Hirt & Stanilov. 2009), tends to result in segregationist practices and intense gentrification. However, besides the criticisms of being exclusionary due to the displacement of lower-status inhabitants, Middle-Ferencváros managed to mitigate some concerns. The district secured substantial resources for renovating old public rental buildings, allowing many residents to remain in their homes after renovation. Importantly, rental fees were not raised to market levels, making upgraded housing affordable for existing tenants. This effort reduced the severity of criticism compared to similar projects in other districts.

The lessons learned in this revitalization process can also be relevant for other urban centers having difficulties adapting to drastic changes in their social, political, and economic conditions, especially considering the imperative ecological adaptation. The redevelopment in São Paulo's Parque Novo Santo Amaro V also mirrors a global movement towards updated urban solutions. It signals a shift away from outdated regeneration methods or an uncritical accelerated expansion towards more sustainable and critical urban planning practices.

The knowledge gained through the practices adopted in this intervention can be applied in other future urban regenerative projects with a similar state of affairs. Improving the quality of the city's public spaces can also be an outcome of public-private partnerships. Building upon the literature review, this study narrows its focus to Ferencváros in Budapest. Thus, the research aims to examine the impact of design choices on the urban environment using cross-morphological analysis. The emphasis is on how these solutions created a more lively urban environment, with access to green infrastructure, diverse local commerce, and public transport facilities. The selection of Ferencváros hinges on the availability of comprehensive data, the feasibility of on-site assessments, and the opportunity to closely observe the recent changes. This case stands out due

to the maturity of its renewal efforts, offering clear insights into the challenges and opportunities of urban redevelopment.

3.3. Key Concepts Collection

3.3.1. Urban Voids and Transformative Potential

Urban voids, characterized by their indeterminate functions, are a common urban phenomenon, especially in cities fighting severe urban decay or rapid peripheral expansion due to historical patterns of land use or industrial decline. In the district of Ferencváros, such voids materialized primarily from small-scale industrial obsolescence and, subsequently, from the neglect of residential buildings. These underutilized spaces have historically contributed to the district's stigmatization, facilitating visual blight, inefficient resource utilization, and spatial disconnection.

However, this study posits that these urban voids possess inherent potential for regeneration. The successful repurposing of these spaces can significantly requalify the district's historic urban fabric, producing benefits that span social, economic, and environmental layers. The approach taken involves a reintegration of these voids into the urban matrix, addressing community needs and leveraging the area's characteristics, like the utilization of enclosed courtyards, to enhance urban efficiency and access to green areas.

Furthermore, analyzing urban forms and connectivity is key to recognizing vulnerable patterns within the urban fabric, especially in more fragmented territories comprising urban voids (Boeing, 2018). Urban form, which includes the physical layout and structure of the city, significantly influences how residents interact with the environment and with each other. By examining urban forms, planners and researchers can identify areas prone to social isolation, economic decline, or environmental degradation.

In this context, connectivity concerns people's capacity to move throughout the city and access essential services, green spaces, and social opportunities. High levels of connectivity tend to facilitate stronger social ties, better economic opportunities, and improved environmental outcomes (Hepcan, 2013). Consequently, poor connectivity can exacerbate vulnerabilities by creating barriers to movement and access.

Therefore, a comprehensive analysis of urban forms and connectivity, in articulation with the opportunities found in reintegrating urban voids, can help urban planners to design more cohesive, inclusive, and sustainable cities (Park et al., 2014). By identifying and addressing vulnerabilities in the urban landscape, planners can work to mitigate risks and improve the overall resilience of urban systems. The preliminary findings of this research in this concern underscore the value of reimagining urban voids as opportunities for urban consolidation and functionality.

3.3.2. Urban Density and Open Areas Parity

Defining the ideal density of an urban territory has been a highly discussed subject among academics and professionals in the field of contemporary urbanism. Identifying the delicate combination of factors that underlie the balance between the urban sprawl and the amount of space necessary for human social life (Choldin, 1978), is an issue with greater relevance in a context where the ever-increasing population desires to achieve a healthier and more sustainable future, owing to the exponential intensification of the climate change process (Kamal-Chaoui and Robert, 2009).

When developing an approach on this topic, it is necessary to be aware that the urban density is unique in each location and is rather a matter of performance (Acioly & Davidson, 1996). Socio-cultural factors directly impact the composition of density and the individual experience of interacting with the environment, also towards the perspective of sustainability (Bramley & Power, 2009).

Like other European cities, Budapest has its central core dense, compact, and highly integrated with the rest of the urban fabric (Benkő, 2011). However, this urban configuration becomes more heterogeneous and less dense in areas located in the "expanded city center" between the second and third transportation rings, which consecutively makes those areas more susceptible to transformation and possibly less resilient (Ribeiro & Gonçalves, 2019).

Adapting the physical and social conditions in historic urban areas can be significant steps of a strategic plan for enhancing resilience in areas susceptible to transformations and disturbances (Ribeiro and Gonçalves, 2019). Density, when seen as one of the primary structuring elements of morphology, can be manipulated in order to produce urban conjunctures more adequate to the contemporary needs of a city, without necessarily disfiguring its spatial key definitions (Acioly and Davidson, 1996).

The global understanding of urban density must be carefully balanced with the open area system and green infrastructure, whether for public-private or semi-public use. Finding the adequate distribution of dwelling in the urban territory must be associated with quantitative issues of the urban network flow (and the capacity of the urban infrastructure a compounded system), and qualitative matters, such as distribution of functions, landscape constitution and control, and accessibility to green/leisure spaces (Richards, Passy & Oh, 2017).

In this case, it is necessary to interpret the rebounds of the adaptative recovery process of Ferencváros, also under the scope of the inner courtyards' reconfiguration. From this perspective, the intervention aimed to produce a more integrated and healthier territory, through the use of urban green infrastructure strategies, without drastically reducing the levels of occupational density and minimizing the impact on the historical morphological arrangement of urban blocks.

3.3.3. Urban Cohesion as a Policy

More than two-thirds of the population of the countries of the European Union currently live in urban areas. Despite the growing effort to include the urban development agenda as a mainstream element of the bloc’s Cohesion Policy, it was only in the period between 2007 and 2013 that the EU established it as one of its main development guidelines. At first, the European Commission began to investigate the problems to a conceptual degree and act on an experimental basis, which later also resulted in intergovernmental cooperation agreements in the field of urban development in favor of cohesion (Cotella, 2019).

On a global level, this was a response to a major paradigm shift: the advent of the intensification of the globalization process, which boosted the strengthening of international ties, aiming to achieve economic and social prosperity. However, the trend towards globalization occurs unequally in different contexts. The developing world countries would have more opportunities to access exponential growth, while facing difficulties in income distribution and expanding the city’s infrastructure network. Around the world, in Asian and South American cities, or even in post-Soviet centers, two eminent development patterns can be identified: peripheral growth (both office spaces and houses) and the participation of the private sector in infrastructure provision (Di Palma et al., 2016). Despite the similarities, the socioeconomic particularities of each region outlined the conditions for the occurrence of this process. Little has been studied regarding the reverberation of this phenomenon in post-socialist urban centers,

especially concerning adaptive measures for their inclusion in a global urban network (Richardson & Bae, 2005).

This scenario was also asymmetric among the countries of the European Union, which motivated the intensification of isolation and urban segmentation (Cotella, 2019). Post-Soviet countries, such as Hungary, only joined the political–economic bloc later, and faced challenges left by the communist legacy, such as deficiencies in urban infrastructure, management of mass-housing estates, and environmental problems (Van Kempen, Vermeulen & Baan,2005).

With the end of the communist regime, the urban centers previously inserted in this socio–spatial conjuncture went through an initial population shrinkage, marginalization, and isolation (Hirt and Stanilov, 2009). Public policies played a fundamental role in structuring the privatization operation and introducing the market-based economy. Cities underwent, therefore, an acute adaptive procedure through a situation of disturbance of the political and social order (Hirt, 2014). The emergence of supranational government institutions, such as The International Monetary Fund and the European Union, has represented an antagonist trend towards the local urban trends, promoting homogenization and cohesion of the European territory (Kazepov, 2004).

On the one hand, it was essential to create mechanisms to ensure urban resilience, both in the socioeconomic scope and morphologically, by preserving urban patterns and social aspects, making cities more attractive and competitive (Murray, 2017). On the other hand, investments in green infrastructure to promote urban resilience did not follow the same tendency in most eastern European cities. The case of Ferencváros stands out in this context, especially for the centralized coordination between public and private interests to rebuild a sizeable urban stretch.

Environmental issues are one of the most significant drawbacks to urban development, considering the interdependence between social, economic, and environmental dimensions for achieving sustainable urban development (Elkington, 1997). In cities with infrastructural limitations, such as Budapest, the obstacles in promoting social cohesion are even more significant. For this reason, mitigating accessibility to green infrastructure can be a tool for territorial integration and a consequent increase in urban resilience (Pauleit et al,. 2019).

Vienna is often an analogous example at the urban-structure level when establishing a comparative framework with Budapest. These cities share numerous similarities due to their intertwined historical processes. Despite the gradual disconnection they have gone through since World War II, recently, both have faced a common issue: urban decay and increasing urban voids (Lichtenberger, 1994). Notwithstanding their divergent political conditions, between 1970 and 1990, several projects targeting the renovation of central areas emerged in those cities.

One of the biggest obstacles in observing changes in cities is the lack of detailed and model-ready morphological data at the urban scale. In Vienna, GIS data analysis proved to be efficient in obtaining the morphological heterogeneity across the urban landscape, which implies the possibility of using this method to track changes in the infrastructure of Budapest (Hammerberg et al., 2018).

The IX District of Budapest is an example of the requalification of an emptied historic area with heterogeneous territorial occupation, marked by the existence of urban voids (initially occupied by small- and medium-sized industries) (Locsmándy, 2005). The voids generated by restructuring the regional industrial production system contributed to the acceleration of the urban decay process and territorial fragmentation, making it difficult for the population to remain in the area (Reed, 2007). Historic urban morphology, traditionally found in eastern central European cities, is also found in Ferencváros. Before the intervention, most buildings had typological characteristics such as continuous and aligned facades and individual courtyards (Locsmándi, 2011).

In this intervention, the restructuring of the courtyard system was essential for implementing an extensive system of green infrastructure in the region, shaping the intensification of green areas in the densely occupied urban fabric.

3.3.4. Identity in Recent European Context

The socioeconomic complexity of the European structure is evident in urban conditions found in different regions, especially when considering the contrast between the east and west of the continent. Post-socialist cities faced physical and morphological restructuring challenges, which diminished their ability to diversify their identity (Petrović, Backovi & Toković, 2022) Despite efforts to mitigate these discrepancies, disturbances still reverberate in these territories.

Under the communist regime, Eastern European countries prioritized affordable housing and other social security aspects as the backbone of their welfare state. However, the political transition initiated in 1989 led to a rise in social inequality. These changes notably affected Budapest, with an increase in social disparities and poverty concentration, especially observed during the initial years of political transformation. These shifts directly influenced the physical and cultural composition of the urban environment, resulting in new patterns of urban segregation.

In this context, Budapest is distinguished by its comparatively diverse population and social stratification among Eastern European cities. As recently as the early 2000s, different inner-city neighborhoods in Budapest were experiencing unique social mobility trends. Some areas showed signs of isolation, while others progressed towards higher income brackets, enhanced social standing, and more elevated general integration. At present, many of the most stigmatized areas have either completed or are currently undergoing urban revitalization initiatives (Kovács, 1998).

The restructuring movement of urban territories is understood at an international level as one of the essential guidelines for strengthening the European bloc. These measures aim to support cultural multiplicity, emphasizing the individuality of the different social configurations that compose the block, thus promoting community well-being. By stimulating the development of underdeveloped areas and avoiding large migratory movements that disrupt social and economic stability in the region, homogeneous economic growth is fostered. Imbalance in this systematic arrangement results in more competitive urban centers with difficulty in absorbing the intense migratory flow, challenging urban planning and development resources. In contrast, less competitive cities suffer from shrinkage and decay (Wolff & Wiechmann, 2018).

In addition to economic growth, preserving cultural heritage and protecting the urban landscape are increasingly recognized as essential factors for constructing a people's cultural identity. Historic buildings are critical for economic growth through urban renewal (Tweed & Sutherland, 2007). In a broader context, urban renewal offers an opportunity to reevaluate strategies for facilitating sustainability and resilience within a community. This process is a means to tackle the potential for integrating sustainable and resilient development principles into historical environments, considering the contemporary need to achieve the maximum potential of use and performance of existing urban areas while preserving the integrity of the original architectural heritage (Taherkhani, Hashempour & Lofti, 2020).

Hungary's urban development strategies have changed significantly towards creating more livable spaces since the country's entry into the European Union. This shift has brought about a new economic and financial context, increasing attention on heritage conservation, sustainable practices, and democratic use of cultural assets. Notably, there is a growing emphasis on improving urban spatial quality as a key element of urban governance. In this context, landscape architecture has become a powerful tool in shaping contemporary urban design. As Hungary aligns with European standards, landscape architecture becomes more crucial in creating urban spaces that increase urban connectivity and prioritize the community's well-being and the environment (Fekete, 2022).

The growing concern for sustainability in urban centers also boosts renewal strategies that aim to contain carbon emissions, minimize resource consumption (natural and environmental), and manage waste and energy consumption more efficiently. Energy insecurity has been a central agenda in international discussions about the energy crisis on the European continent, highlighting

the challenges that have recently been enhanced in the regional political articulation to consolidate a compliant society with the concepts of the circular economy, proving economic prosperity and the viability of the social structure currently existing in Europe (Halkos & Gkampoura, 2021).

The escalating temperatures within urban environments, exacerbated by the confluence of climate change and urban densification—even in transitional areas such as the analyzed area of Ferencváros—generate substantial health risks. Mitigating these risks requires strategic interventions, among which urban green infrastructure is vital, integrating urban green infrastructure functions as a mechanism for natural temperature moderation, water management, and improved conditions for urban biodiversity. In the context of climate-induced urban challenges, expanding urban green infrastructure emerges as an imperative for the existence of health-resilient urban communities (Liu et al., 2023).

In this scenario, urban renewal strategies play an essential role in Europe's political, cultural, and social conformation and in the subsistence of urban centers in this region (Khadour, Fekete & Sárospataki, 2023). However, in Eastern European countries, such as Hungary, the renewal process tends to occur more slowly and on a lower scale of intervention. This process intensified in Hungary around 2010 when funds from the European Union for urban renewal were accessible, in parallel with the increase in private investments in various sectors, including the real estate sector. The renewal of District IX, Ferencváros, in Budapest (see Figure 17) was based on the use of tools for the adaptation of urban fabric, including its intrinsic morphological qualities, through the implementation of mixed-use enterprises, primarily real estate, in a comprehensive and articulated manner with a new green infrastructure layer and public spaces.

At the same time, the special opportunity for rehabilitation was that the properties were largely under state ownership. In addition to tidying up the public spaces, the aim was to break up the very dense 19th century fabric of courtyards by linking them together to allow for a more livable use of the shared internal green spaces.

The interventions sought to differentiate the external and internal communal and transitional spaces by creating piazzas with small setbacks to the street space, thus improving the wetting of the street and the rear frontage. A qualitative differentiation of some community spaces would also improve community life (Locsmándi, 2005).

However, despite its very careful and planned nature, the successful regeneration process, as described in Figure 17, has been criticized by sociologists for the strong gentrification that has accompanied the process (Eszter, 2010).

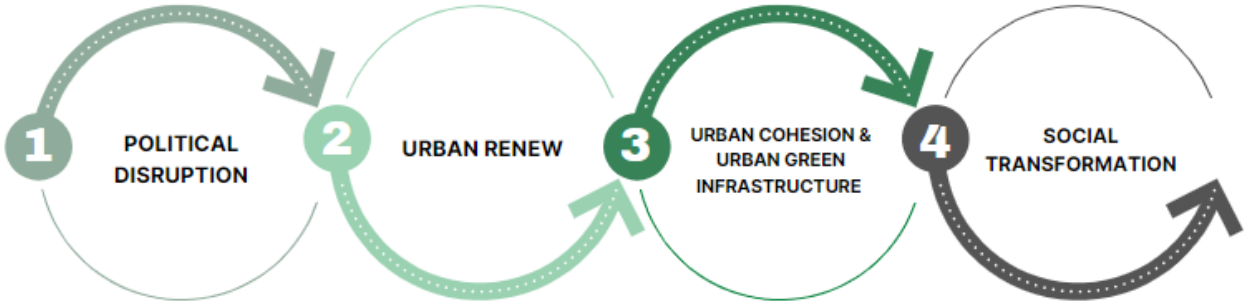


Figure 17: Diagram depicting the order of events in the urban renewal process in Ferencváros.

3.3.5. Modern Heritage Relevance in a Heterogeneous Urban Environment

During the socialist period, a significant portion of Urban investments were centrally planned (Tofiluk, Knyziak & Krentowski, 2019). In Budapest, a master plan devised in 1960

played a crucial role in identifying suitable areas for housing developments. This undertaking shaped new residential expansion zones and influenced the renovation of existing urban territories, aiming to meet the newly redefined living standards in both central areas and areas in the transitional belt of urban environments (Benkő, 2015).

Thus, in socialist cities, the establishment of housing estates designed under modern ideology and guidelines served as a means to meet the growing housing demands of the expanding urban population but also, in specific contexts, address issues of urban renovation and stretched population density in areas considered inadequate or underutilized. This approach supported the mass production of housing estates for new residents and the renovation of existing urban areas (Dekker et al., 2005).

With transition to a new political regime in Eastern European cities - explored above - the previously developed modern residential structures from the socialist period came under scrutiny due to various factors related to their constructive techniques, aging, design, and symbolic value. These structures began to be questioned as a viable urban development model in light of the altered circumstances (Tofiluk, Knyziak & Krentowski, 2019). Moreover, some of these buildings (or entire neighborhoods) have acquired a negative stigma and have become symbolic of the political background that initially facilitated their construction in the region. In the current contemporary context, new parameters such as sustainability, technical feasibility, and harmonious integration into the urban landscape further challenge and complicate the existence of these modern buildings.

The dynamics of generational transformation is another crucial aspect in comprehending the current social condition within modern post-socialist communities. As the buildings themselves age, so do the original residents of these housing estates. This demographic shift brings about noticeable changes in the principles of communal living. With globalization and the rapid advancement of technology, urban societies have witnessed a shift towards individualistic tendencies. This societal transformation puts urban systems, initially developed for communal purposes, as mentioned earlier, to the test (Benkő, 2015).

When considering the criteria for developing sustainable cities suitable for human-scale living, four pillars stand out as essential: compactness, density, diversity, and integration (Bibri, , Krogstie & Kärrholm, 2020). Notably, many prefabricated housing estates from the twentieth century, conceived under the modernist paradigm, are directly or indirectly aligned with these factors. This inherent adaptability makes them well-suited for meeting contemporary requirements (Benkő, 2015). Consequently, in the post-privatization era, new urban governance structures tailored explicitly for large housing estates have emerged (Pirrus & Leetmaa, 2023). In Budapest, these housing estates constitute a significant portion of urban housing and accommodate a substantial population.

Green infrastructure plays a fundamental role in the modern developments mentioned before on various scales. The residential complexes constructed in Budapest during the 1980s and 1990s display more ambitious green solutions compared to earlier decades. These efforts were aimed at offsetting the declining prestige of these developments (Bakay, 2012). Public spaces have become an effective platform for fostering alternative governance strategies and reshaping the position of large housing estates within the urban agenda of post-socialist cities (Pirrus & Leetmaa, 2023).

3.3.6. Role of Resilient Structures

The significance of resilience in urban development lies in its emphasis on adaptability. As cities evolve, the ability to adapt to changing circumstances becomes paramount. This flexibility can mean the difference between sustained growth and development and long-term decline. Resilient cities are characterized by their dynamic nature, continuously adjusting to new realities rather than remaining fixed in outdated patterns (Kong et al., 2022).

A holistic approach to planning is a preliminary indication of resilient urban development. By considering environmental, social, and economic factors, city planners and policymakers can create urban environments that balance growth with the health and happiness of their residents (Sharifi & Yamagata, 2018). This integrated perspective helps ensure that development is economically viable, socially equitable, and environmentally responsible.

Incorporating resilience into urban development strategies is also about risk reduction. Cities that prioritize resilience are better equipped to handle emergencies and disasters with minimal damage. Moreover, they can recover more quickly from such events, maintaining critical functions and services even under duress (Shukla, Das & Mazumbert, 2023).

Another aspect of urban resilience is its contribution to the quality of life for city dwellers. By safeguarding infrastructure against potential disasters and ensuring the continued operation of the economy and critical services, cities can protect and even enhance living conditions for their inhabitants in the face of adversity (Simon, Griffith & Nagendra, 2018).

The pursuit of resilience often sparks innovation in urban design and infrastructure. The challenges associated with developing resilient cities demand creative solutions, leading to advances in technology and governance that make urban areas more robust in the face of challenges and more livable and efficient on a day-to-day basis (Pike, Dawley & Tomaney, 2010).

Understanding the resilience of urban forms as a combination of physical, social, and cultural elements is essential for defining successful transformative and adaptive processes in urban fabrics. In this regard, Budapest's 9th district is an outstanding example of transforming a complex historical urban context by implementing different renovation strategies to improve the social character without drastically disrupting the existing urban morphology. With an analytical approach to the renovation process, this research seeks to address the transformative and adaptative process that occurred while preserving urban heritage and providing new layers of use for the area. Furthermore, courtyards have great relevance for the definition of well-being in areas of high occupational density and for the morphological structuration of Budapest's urban fabric over time. Therefore, it is intended to create a method capable to identify the connections between the emergence of a healthier, greener, and consequently, more resilient urban environment to implementation of urban morphology related knowledge, while conceiving a Urban Green Network.

4.METHODS AND MATERIALS

The methodological framework for this study integrates insights from two key references on urban development and revitalization. The first set of principles was derived from Barcelona's innovative practices, as organized and documented by the Barcelona Urban Ecology Agency (Urban Ecology Agency of Barcelona, 2020). This approach leverages Barcelona's successful strategies for sustainable urban transformation, with a focus on urban ecological advancements.

The Barcelona Urban Ecology Agency [1] is a municipal initiative dedicated to making the city more sustainable and livable. It collaborates with the municipality on projects like the "superblocks," which address challenges such as air pollution, noise, traffic congestion, road accidents, health issues, and a lack of green space (Roberts, 2019). Superblocks prioritize pedestrian areas, greenery, and human interaction while minimizing space for vehicles, creating neighborhoods where cars are restricted to the perimeter and interior spaces are used for leisure, sports, and social interactions. This approach improves air quality, reduces noise, and encourages community cohesion.

Barcelona's broader commitment to sustainability is reflected in initiatives like the "Citizen Commitment to Sustainability 2012-2022 – Compromís 22" and the Climate Plan 2018-2030. These plans emphasize increasing green spaces, reducing greenhouse gas emissions, and centering city planning around people. The Urban Mobility Plan further supports superblocks by promoting social cohesion and public health (Kleinman Center for Energy Policy, 2024). The Superblocks initiative highlights the value of community engagement and adaptability in urban planning.

The second set of guidelines comes from the LEED Reference Guide for Neighborhood Development[2] (U.S. Green Building Council, 2014). This certification program provides a framework for assessing sustainable neighborhood design, focusing on sustainable land development, Urban Green Infrastructure, and green building practices. LEED-ND aims to create environmentally responsible, economically viable, and socially equitable communities. Projects seeking LEED-ND certification must meet prerequisites and earn points across various sustainability categories (U.S. Green Building Council, 2024).

The intersection of concepts from the Barcelona Urban Ecology Agency and the LEED Reference Guide for Neighborhood Development forms the basis for the analysis of urban morphological elements in this study, focusing on social benefits and urban ecology:

- **Smart Location & Linkage**[2] aligns with **functional aspects**[1] by integrating development into existing urban landscapes and communities to reduce the need for automobile travel, encouraging walking, biking, and public transit use.
- **Neighborhood Pattern & Design**[2] corresponds to **socioeconomic aspects**[1] by promoting diverse, vibrant communities with various uses, housing types, and public spaces that facilitate social interaction and economic activity.
- **Green Infrastructure & Building**[2] is directly related to **environmental aspects**[1], emphasizing using sustainable building materials, energy efficiency, water conservation, rainwater retention, and creating green spaces with higher green intensity to reduce environmental impact and enhance resilience to climate change.

These correlations show how urban development strategies can simultaneously address functional, socioeconomic, and environmental goals to create sustainable, livable urban environments, all assimilated with the help of methodologies and classification systems built primarily from morphological concepts. See Figure 18 below:

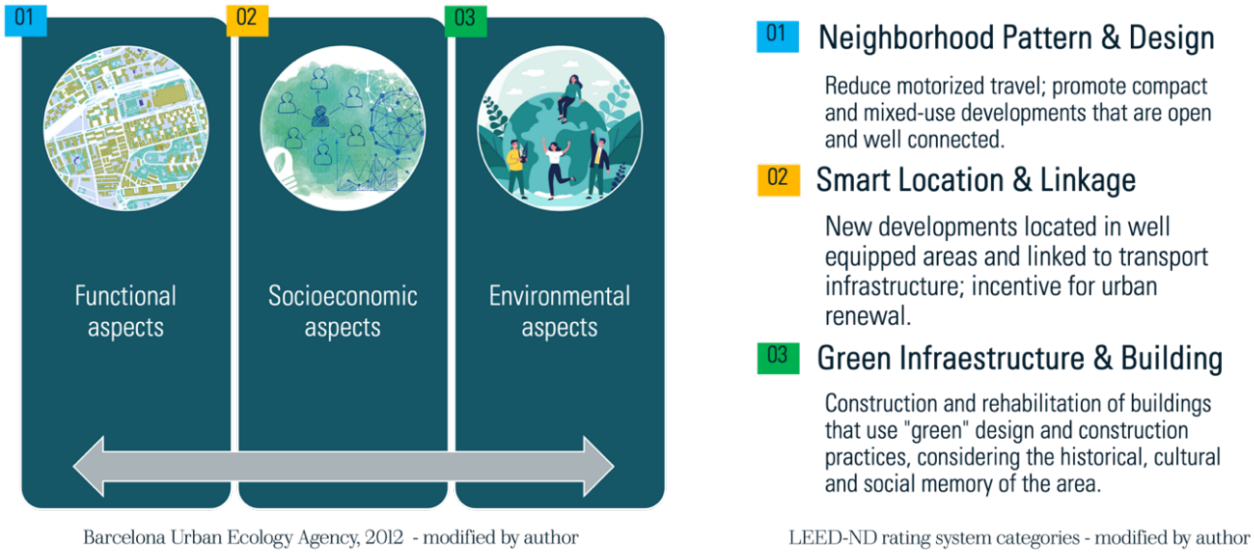


Figure 18: Morphological Concepts. Source: by author.

The methodology of this dissertation was developed from the interpretation of the mentioned practical approaches to urban planning and morphology. It has a multi-layered system to analyze the complexities of urban renewal processes, particularly focused on post-Soviet cities characterized by extensive heterogeneity and a need for restructuring, potentially through the implementation of green infrastructure. The framework contains three evaluation phases from the two main source materials. They were organized using interconnected evaluation criteria. The main outcome of this framework should be a comprehensive understanding of the subject matter related to the evolution of its urban fabric (see Figure 19).

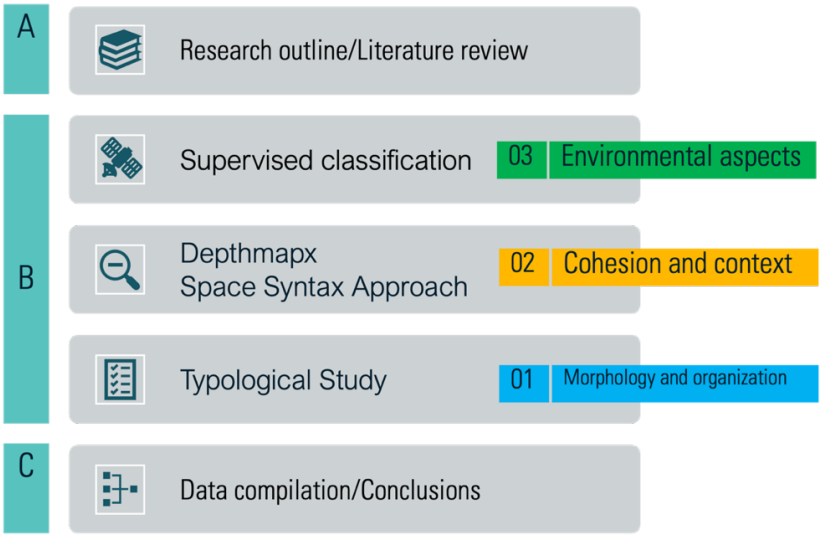


Figure 19: Visual representation of the research structure. The methods are based on the correlation between the concepts determined by the Barcelona Urban Ecology Agency and the LEED Reference Guide for Neighborhood Development. Supervised Classification explores the Environmental Aspects, emphasizing the impacts of Green Infrastructure and Building practices. Space Syntax analysis is employed to assess Cohesion and Context, focusing on the strategic placement and interconnection of urban spaces in line with Smart Location and Linkage principles. Lastly, the typological study concentrates on the Morphology and Organization of urban areas, reflecting on Neighborhood Pattern & Design to ensure that urban forms contribute to a cohesive and functional urban fabric.

4.1. Phase A: Establishing the Contextual Foundation

This phase includes a literature review covering forty years of the district's urban development and history, offering a qualitative backdrop for the urban renewal case study. The review focuses on how political changes have influenced urban planning, particularly the development of green spaces and their contribution to urban resilience.

Ferencváros was chosen for this study due to its abundant data, which supports a detailed morphological analysis and the development of a categorization system. The District's diverse urban structure, from sparsely populated to dense areas, provides a comprehensive view of design decisions and their effects on the urban landscape.

The geographical and logistical suitability of Ferencváros allows for effective on-site investigation, enabling real-time data collection that grounds theoretical discussions in observable reality. The study's timing is crucial, as Ferencváros has recently undergone significant transformations, making it ideal for examining contemporary urban renewal practices and trends, as illustrated in Figure 20.

Figure 15: The IXth district and its Mid-Ferencváros part marked in red within Bud*apest, showcases its comprehensive reach spanning from the central areas to the more sparsely populated city zones. The highlighted red patch denotes the focus of the research site, which is adjacent to a low-density ring that acts as a buffer, detaching the urban core from the suburban periphery. Historically, this belt accommodated small-scale industries and railway lines, many of which have since been deactivated. – by author.*

The maturity of renewal efforts in Ferencváros allows for a clear assessment of both challenges and successes, offering a thorough understanding of the planning and execution phases. The District's dynamic environment, featuring new green infrastructure, active commercial zones,

and accessible public transport, provides a model for creating integrated and resilient urban fabrics. The research aims to deliver insights applicable to other urban centers facing similar renewal challenges.

4.2. Phase B: Empirical and Spatial Analysis

In this phase, the research employs analytical methods to assess the physical and social cohesion of urban spaces:

- **Supervised Classification:**

This tool is employed to track the evolution of green infrastructure by processing satellite imagery over time. It uses qualitative and quantitative land-use and land-cover mapping to highlight changes within the urban landscape, pinpointing demolitions, new construction, and the evolution of streets and green spaces (Csapó & Lenner, 2016). This analysis is based on historical data, with key years selected (2000, 2011, and 2021) to provide a comparative framework that reflects the political and social shifts impacting urban management and development. The process, supported by GIS technology, categorizes land into natural and artificial classes, allowing for the analysis of urban development patterns and the identification of changes over time (Thekkan et al., 2022).

- **Space Syntax Analysis:**

This method is used to understand and quantify urban integration and connectivity. It helps in identifying how different urban forms influence movement and social interaction, thereby impacting the resilience of a neighborhood (Ostwald and Lee, 2023).

Space Syntax serves as the initial layer of physical investigation. It provides a theoretical foundation for understanding the spatial organization of urban areas as part of their "morphic language," a term designated to describe the systematic patterning of settlements. In this research, the Space Syntax methodology uses DepthmapX software to conduct a series of connectivity and integration calculations. This involves transforming road network maps into segment maps and conducting Full Angular Segment Analysis to determine levels of urban integration. The examination, which includes angular analysis of road axes for pedestrian and vehicular movement, is accurate and considers varying radii to capture the nuances of urban connectivity. Results from this analysis are interpreted through a visual color scale that denotes the levels of integration and connectivity, aiding in understanding how the urban fabric's layout affects social interaction, space cohesion, and urban integration (Yamu, et al., 2021).

- **Comparative Urban Integration Strategies: Vienna and Budapest**

Vienna and Budapest present relevant similarities in their urban structure, resulting from their intensely connected historical development, especially during the second half of the nineteenth century. Geographically, those cities played a prominent role in Central-Eastern Europe, sharing political concerns, characteristics of their public life, and the nature of their economic basis (Cohen, 1987). Despite the numerous similarities that are still visible, these cities underwent significantly different political processes after the Second World War. For this reason, they also adopted different measures for common problems: urban decay and increasing urban voids (Lichtenberger, 1994).

Between 1970 and 1990, several projects for the renovation of central urban areas emerged in both cities, although under different political perspectives, since Hungary and Austria were divided by the Iron Curtain (Michaela, 2008). At this historical moment, the communist bloc was already facing structural problems, a scenario that led to the fall of the regime in the early 1990s

(Kocsis, 2015). The political instability experienced in this period is identified in the constant changes in the renovation and development strategies of the IX district of Budapest.

Unlike the guidelines adopted in Vienna, the tactic of combating urban decay in Budapest did not focus on the extensive renovation of existing buildings (and, more specifically, housing) located diffusely in the urban fabric. Actions were taken more punctually, addressing solutions for areas of intense slums (Lichtenberger, 1994). In this scenario, the IX District of Budapest differs from the general context of interventions centrally delegated to other city areas. In the process of political transition, the renovation project of this district was submitted to relevant changes, gradually eliminating major demolitions and morphological alterations, and bringing it closer to the Viennese renovation methodology.

In the late 1990s, this district of Budapest was still characterized by its heterogeneous land use, lack of territorial cohesion, and the existence of urban voids left by old, deactivated industries (Locsmándi, 2011). Urban patterns like this have high transformative potential, especially in cities in the growing expansion process and acute real estate speculation, as is the case of the two cities under evaluation in this case study. Strengthening resilience in urban territories that are undergoing a process of decay and enabling the development of the socio-cultural sphere in contexts of vulnerability is a sustainable alternative for the development of urbanities (Reed, 2007).

Landstrasse, the Third District of Vienna, has witnessed intense restructuring comparable to those in Budapest's IX District. This district is also characterized by a diverse pattern of urban utilization, with a predominant middle-class residential fabric interspersed with urban voids. Historically, these voids served as sites for small-scale industries and orchards, reflecting a rich industrial past. The recent changes have been focused on redefining these spaces, transitioning them into integrated parts of the urban context while preserving the unique historical identity of the area. This thoughtful approach to urban renewal has successfully blended contemporary living with the district's storied heritage (see Figure 21).

Figure 21: The Landstrasse District in Vienna is outlined in red on the map. It comprises a transitional character, reaching from central locations and neighboring the city's first District to less dense southern

areas when it approaches the outskirts. The highlighted red patch denotes the focus of the Space Syntax research site, which was, until recently, an urban void previously occupied by local industries.

In the case of the mentioned districts, to understand how those territories were able to resist and overcome disturbances in their urban structure, even in such unstable political, economic, and social contexts, it is necessary to evaluate the impact of planning the green infrastructure in these places (Ribeiro & Gonçalves, 2019). Furthermore, preserving and adapting morphological characteristics intrinsic to the territories, especially in renovation projects, can be a tool to encourage urban resilience. The aspects are also directly related to the increase in territorial connectivity and consecutively result in the prevalence of urban cohesion, improving the performance of these areas both in terms of sustainability and user experience.

4.3. Phase C: Typological Survey

Finally, the typological survey is applied to filter the essential architectural and urban planning characteristics that have shaped the urban transformation. In the context of this research, this phase is considered a projection of previous results since the elaboration of the typological study requires data that guide its construction. Therefore, morphological characteristics identified in the Space Syntax and Supervised Classification -from phase B-, were used in selecting the investigation sites and structuring the questionnaire to determine which elements corroborate the previously found conditions.

The survey is divided into two stages, first, it focuses on the morphology of buildings, and later the spatial organization of green elements, crucial for landscape architecture and urban planning (Pauleit, Hansen & Pribadi, 2021). This phase synthesizes the data and insights gathered from the empirical analysis, offering a view of the adaptative recovery processes within the urban area. The scope of each of the typological investigation stages is as described below:

- **First stage**: Concerning architectonic and urbanistic elements - aims to interpret the urban structure and morphological changes resulting from a first wave of renovation efforts. It is designed to understand, categorize, and evaluate the interventions both individually and holistically. This survey examines factors such as land use, commercial and service unity, residential characteristics, and the urban landscape, emphasizing the role of green spaces. It assesses how these elements contribute to public space quality, accessibility, and the complexity of spatial connections. It is integral to understand how the restructured courtyards and the introduction of new green spaces contribute to the district's overall resilience and socio-spatial interaction.
- **Second stage:** The urban green typological survey focuses on the evaluation of green elements within the urban landscape. It covers various aspects of green urban morphology, including the size, shape, and form of open spaces, as well as the management and ownership practices that influence these areas. The physical environment subgroup within this tool considers the functions and special features of green spaces, evaluating significant structures, pavements, and natural elements that contribute to user experience. The assessment of vegetation types and forms, from individual trees to lawns and mixed vegetation surfaces, rounds out this evaluation of the district's green infrastructure.

As the research integrates outcomes from the three analytical methods, each method is explained in detail within the context of its results. This approach clarifies how each component contributes to the study's findings. By combining historical insights, spatial metrics, and morphological characteristics, the methodology offers a framework for assessing urban resilience and, therefore, guiding future interventions to enhance resilience and sustainability.

4.4. Underscoring the Methods' Connections

The association between these methods lies in their combined contribution to understanding urban resilience, each focusing on different urban aspects. Supervised Classification examines the distribution and changes in green infrastructure, providing a broad view of the urban landscape. Space Syntax analyzes the spatial configuration of public spaces, linking green spaces to social interactions and accessibility. Typological Analysis assesses private plots and buildings, exploring how they fit into the broader urban structure and support or disrupt connectivity and cohesion identified by Space Syntax. Together, these methods offer a comprehensive view of urban resilience.

The methods are connected in a cumulative manner, where each build on the insights of the previous one, creating a wide understanding when combined. Such as:

- **Environmental Baseline** (Supervised Classification) and **Spatial Configuration** (Space Syntax): Supervised classification provides a map of green space patterns over time, which is used to understand how these spaces link public spaces via Space Syntax analysis.
- **Spatial Configuration** (Space Syntax) and **Architectural Integration** (Typology): The connectivity and integration patterns revealed by space syntax are further examined through typological analysis to see what physical features contribute to or detract from the green patterns.
- Holistic Urban Analysis: Together, these methods allow for a comprehensive analysis that considers how the natural environment (urban green spaces), public spaces, and private plots interact to influence urban resilience. The integration of these methods ensures that each layer of urban analysis is informed, providing a more complete picture of how urban areas function and how they can be improved.

5.RESULTS AND DISCUSSION

This chapter compiles the results of the investigation into urban resilience demonstrated through the renewal processes in Ferencváros, Budapest, and draws comparisons with similar regional interventions. It provides a comprehensive overview of how historical, physical, and cultural factors converge to redefine urban spaces, enhancing resilience and sustainability.

The history of Ferencváros, dating back to the 1990s, reveals a once densely populated residential area with limited pedestrian pathways and greenery. Strategic urban planning by the local government has sought to preserve historical urban morphology while introducing significant improvements. By connecting urban voids, expanding green spaces, and establishing new pedestrian links, the neighborhood has experienced enhanced urban health and connectivity, contributing to a resilient and integrated urban fabric. The research also highlights the transformative role of courtyards in Ferencváros. Their reconfiguration has created a healthier, greener environment as part of the broader Urban Green Network initiative.

The study extends its analysis to similar interventions in Vienna and Budapest, emphasizing shared morphological characteristics rooted in historical and cultural ties. Both cities have transformed urban voids left by deindustrialization.

A key component of this study is its methodological approach for detailed urban analysis, combining Supervised Classification with Space Syntax, as supported by GIS technology. The findings demonstrate the effectiveness of landscape architecture strategies in addressing urban challenges and suggest potential for broader application in future urban interventions.

Lastly, the chapter reflects on socio-political changes in post-socialist cities and their impact on urban resilience, examining international public policies and suburbanization dynamics. The study assesses how recent urban planning initiatives, aligned with public policies on land use and environmental management support the requalification of historically occupied urban fabrics.

The results presented in this chapter illustrate urban renewal from heritage preservation to the incorporation of green elements, indicating a path toward cohesive urban development. Introducing solutions that have revitalized the areas' structure, such as the strategic reconfiguration of courtyards in Ferencváros, providing valuable insights for regenerative urban strategies.

5.1. Reframing Historical Courtyards and Urban Voids to Achieve Urban Integration

The middle area of the IX district of Budapest, other than presenting typical characteristics found in the mixed-use central historic regions of the city, such as the proportions and layout of urban blocks and built structures reproducing urban patterns, this area is also composed of urban voids left by former industries. This conjuncture is typical of transitional urban stretches located between the city center and the suburbs in Budapest (Benkő, 2011).

The building set comprised mostly closed urban blocks, in which the subsequent facades continually granted the impermeable aspect both physically and visually, from the pedestrian's perspective. The narrow, long lined, and poorly lit courtyards usually had little or no permeable floor area without green elements.

The elaboration of the proposal for the renovation of the district IX started in the '80s. Still, the process only reached its maturity between the late '90s and the beginning of the 2000s, when the most significant transformations occurred (Locsmandi, 2011). The core idea emerged from the intention to accomplish a comprehensive green infrastructure network, with nodular and linear elements, that would allow a better urban connectivity, accessibility to green areas, increased biodiversity, and strengthening of the economic and social scenario in the intervention area (Heidt & Neef, 2008).

To achieve these goals, one of the main measures adopted was the restructuration of the system of private areas, starting with the integration of courtyards. Those relatively small areas, previously accessible only by individual entrances, were integrated, generating wide spaces for communal use with shared maintenance. This change enabled the creation of multiple accesses and the implementation of extensive green areas.

In addition to allowing recreational use, the newly designed green areas are also intended to improve housing conditions for the inhabitants living in the units facing the inner courtyard. Furthermore, the intervention aimed to generate greater permeability in the urban blocks and increase the availability of commercial areas, in addition to developing better conditions of use and more visibility for activities performed at the floor level of the buildings.

The Middle-Ferencváros area is demarcated as a zone for "Small Scale Green Network Development (Alternative Solutions)" within the Budapest 2030 Concept, highlighting its strategic role in the broader green infrastructure framework of the city (Budapest Municipality, 2017). This designation emphasizes the district's potential for innovative green solutions to address urban sustainability challenges in a densely built environment (figure 22). The emphasis on small-scale green network development articulates the district's historical context and spatial constraints, allowing for targeted interventions exploring the traditional courtyards and the edges of the urban blocks.

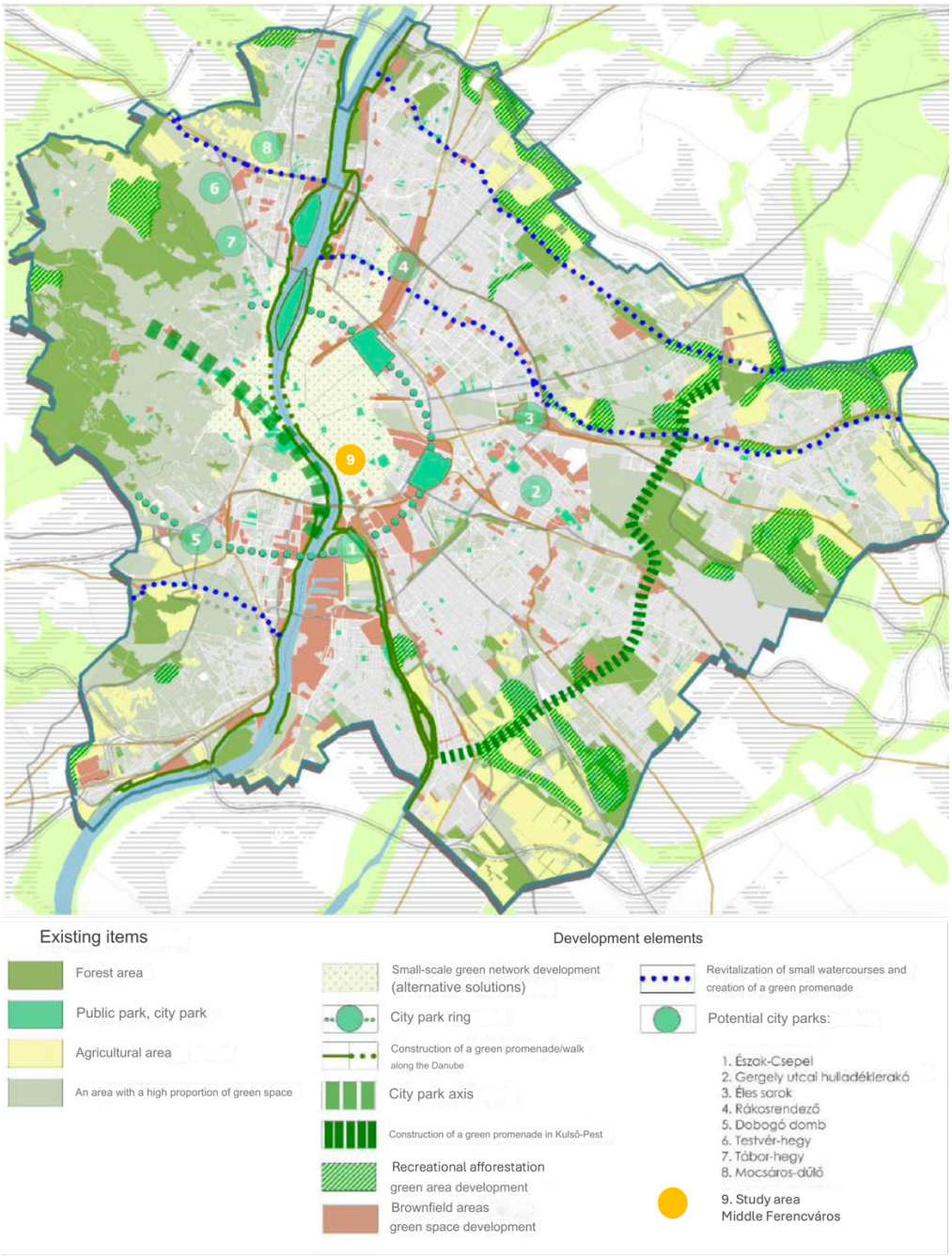


Figure 22: the Budapest 2030 Concept - *Development of Green Infrastructure*
Source: Budapest Municipality, 2017

5.1.1. Integrating Former Urban Voids

Before the renovation work started in the middle of Ferencváros, this region was characterized by its heterogeneous state being, at this time, considered a medium-density area occupied mainly by lower-middle-class residential buildings and small industries. Non-residential use represented about 21% of the total area (Locsmandi, 2011). The urban voids left by inactive industries intensified the lack of territorial cohesion and problems related to the composition of the urban landscape (Monclus and Díez Medina, 2018).

5.1.2. Filling urban voids with green infrastructure

Some buildings were selected for total or partial demolition as part of the territorial and landscape integration strategy. Most of them were in municipal ownership, which facilitated the management of the renovation action. Other municipally owned buildings were determined for renovation. A percentage of the new areas obtained with these measurements, in articulation with the voids of the former industrial plots, was designated to establish green spaces (figure 23).

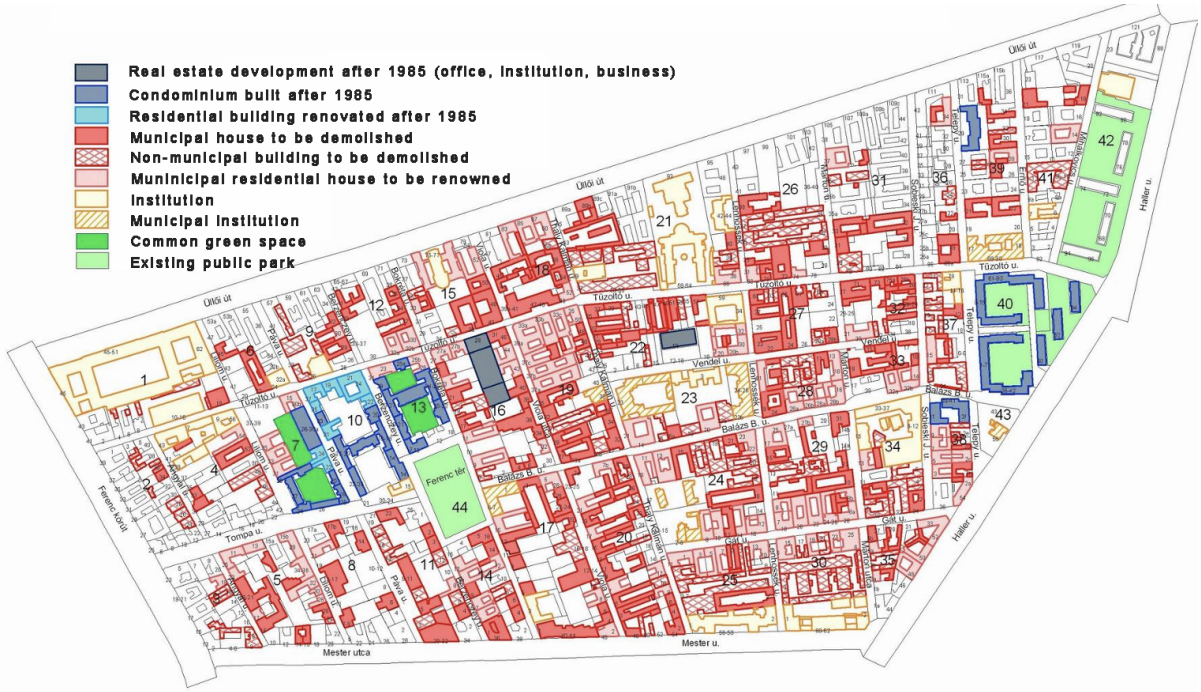


Figure 23: Land use analysis of middle Ferencváros, 1990 (Municipal data)

Furthermore, surrounding Middle-Ferencváros, significant portions of land were designated as Brownfield areas dedicated to green space development, as outlined in the Budapest 2030 Concept (See figure 22). This proximity to planned green space expansions positions Ferencváros at a critical juncture in Budapest's urban renewal strategy.

5.1.3. Space Syntax as Tool

The Space Syntax is the first layer of physical investigation applied to this study. It relies on the comprehension that the spatial organization of a settlement is part of its “morphic language” (Hillier et al., 1976). In that conception, the space syntax theory is used as a tool to analyze the systematic production of patterns. The DepthmapX software was used to run multiple connectivity and territorial integration calculations in the renovated zones (firstly in Budapest and later in the selected District in Vienna for comparison purposes).

The angular analysis of the road axes, whether exclusively for pedestrian use or designated for the passage of cars, was performed following appropriate parameters for locomotion in urban areas, considering the accessibility of the public transport network or primary services either on foot or with motorized vehicles (Cirianni et al., 2018). The detailed investigation process in the DepthmapX took place in the following steps:

- The active maps of the road network were converted into segment maps.

• A Full Angular Segment Analysis was performed to obtain more refined results (although it makes the procedure considerably more complex and slower). The radii determined for this study varied between 400, 800, 2500, and 5000 meters.

• The results concerning this survey are listed within the connectivity and integration tabs provided under the Attributes List.

In order to interpret the results obtained in the DepthmapX, it must be considered that this software utilizes a visual color scale to denote the levels calculated in each of the analyzed segments. In the case of this study, the warmer colors indicate a greater degree of integration and connectivity on the axis.

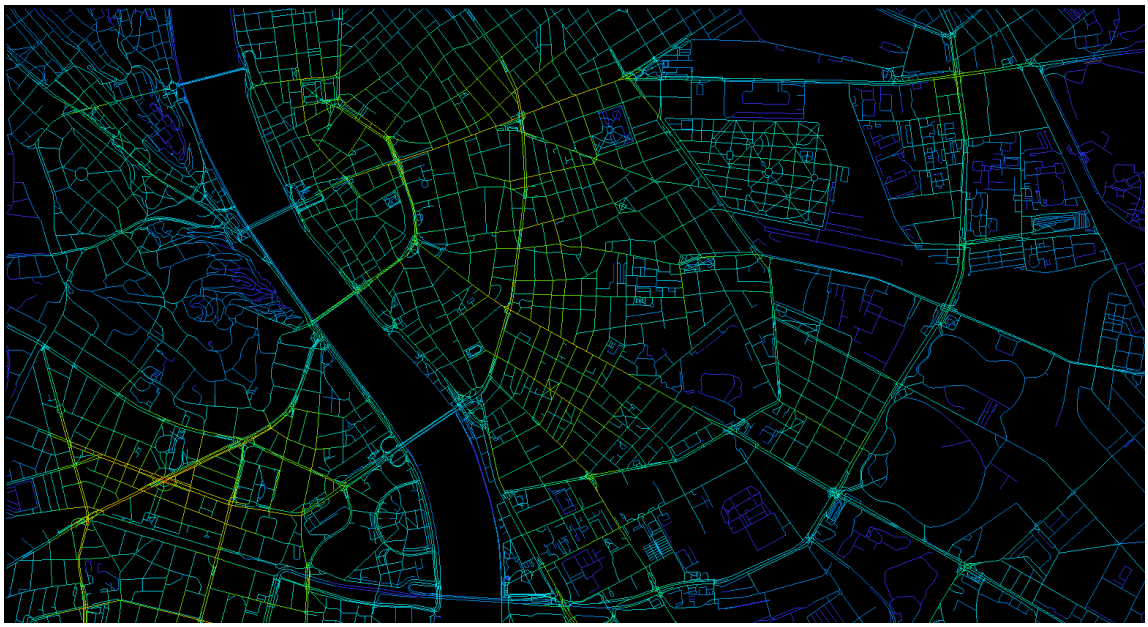


Figure 24: Global integration analysis of Budapest's southern region network (2020) performed on DephtmapX. Source: by author

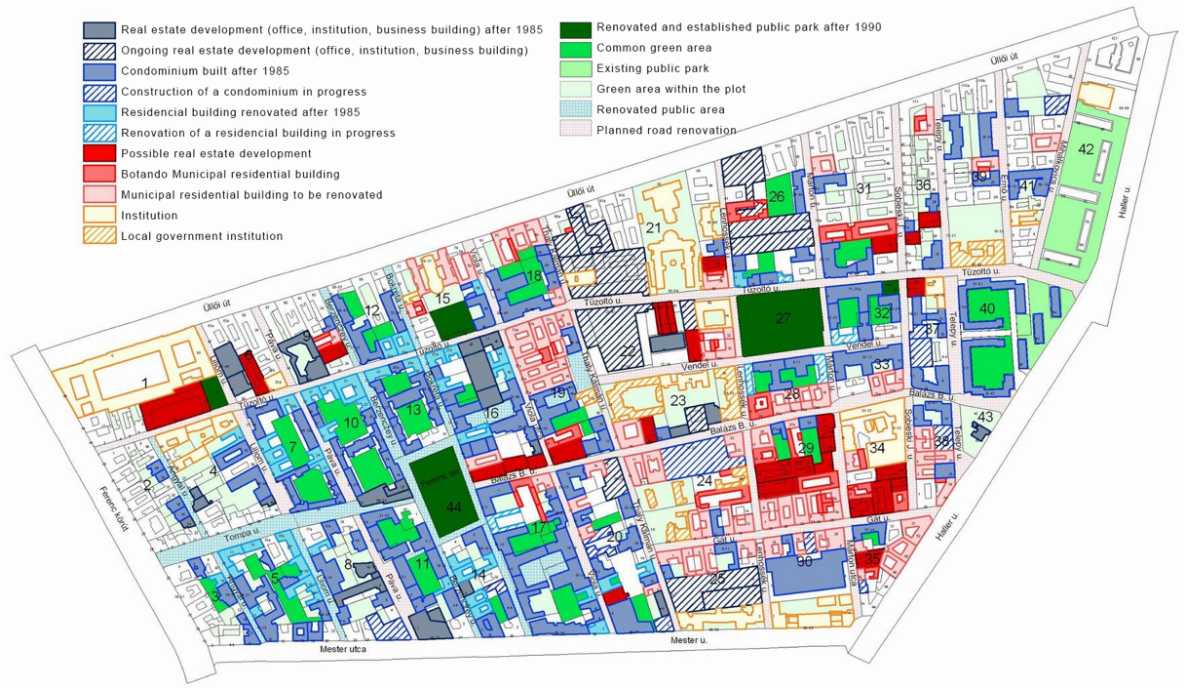


Figure 25: Land use analysis of middle Ferencváros, 2007– increased public or semi-public green areas. Source: Municipal data

With the mentioned tools, this analysis aims to assess the correlation that exists between the transformation of private courtyards into larger shared green spaces (figure 25) and the growth in territorial integration. The results lead to a further assessment of the different green forms and their individual performance in terms of integration and connectivity in the urban territory (Batty,2003).

5.1.4. Raise in Urban integration in Ferencváros

For a better understanding of the results obtained from the techniques of the analysis of spatial configurations, it is essential to highlight that, in the scope of the Space Syntax spatial theory, human behavior (forecasted activity) is the great mitigator of the investigation. According to Hillier, et al., (1976) referencing the works of Whitehead, (1961, p. 674), “activity means the origination of patterns of assemblage, and mathematics is the study of pattern”.

With the DepthmapX application, an analysis of the integration of the chosen network was performed. The evaluation radius setup as a calculation basis for this study was 800m, considering that this is an adequate average distance for walking on urban stretches from any point to the closest connection to the public transport network, or primary services, for example (Cirianni et al., 2018).

As input for the first phase of the investigation, the road network was used from the middle of Ferenceváros region dating from 1990. At that time, the road network and the pedestrian paths coincided in almost the entire territory. Thus, it is possible to notice that the axes (primary spatial components) allowed restricted territorial integration due to the morphological configuration of the area, limiting movement to the edges of urban blocks - a typical feature of historic urban settings. As an outcome, those conditions lead to a territory with lower levels of integration, symbolized on the map by the dominant presence of cold colors (figure 26).

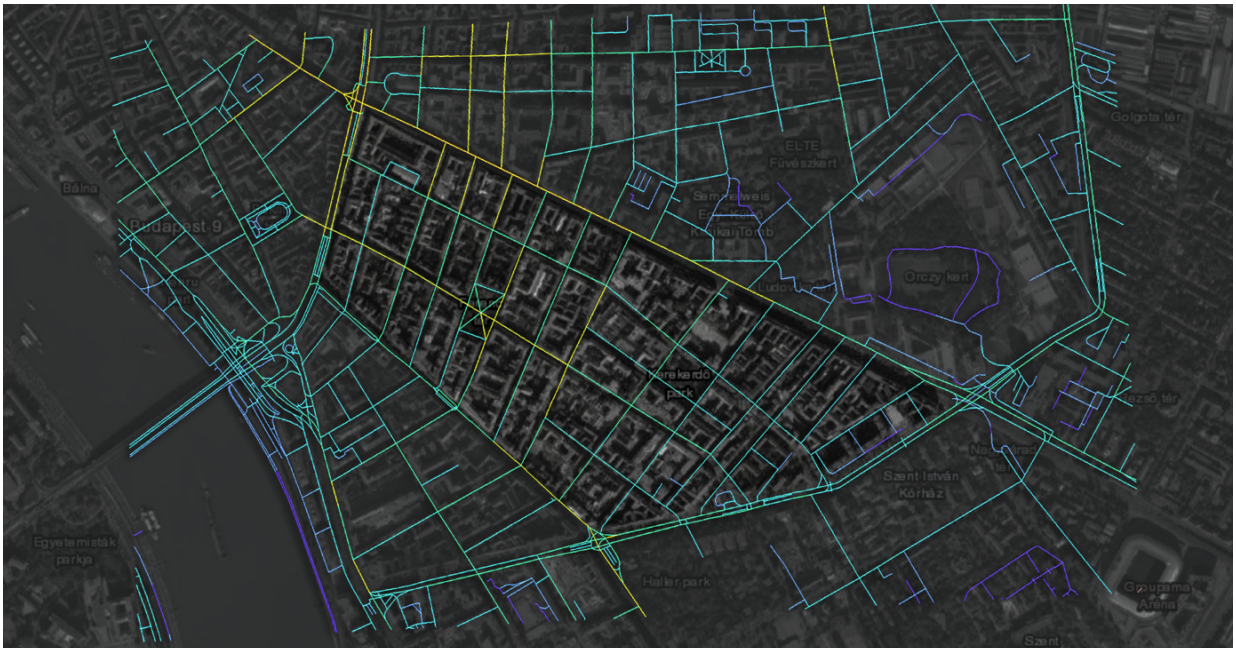


Figure 26: Global integration analysis of middle Ferencváros (1990) performd on DephtmapX.
Source:by author

For the second step of the analysis, the same parameters were defined in the software work environment. However, as an input, it was used the road network established after the

implementation of the urban renewal, dating from 2020. As indicated on the map (figure 27), several new pedestrian-only axes have been implemented, crossing the inner section of the urban blocks, represented by the color cyan. It represents not only a significant growth in quantitative terms of integration, but also meaning quality improvement, since all the designed new axes are part of the green infrastructure network implemented. The prominence of the longitudinal axes is further emphasized, as their significance has increased following urban restructuring along Tompa-Balázs Béla streets and Üllői Avenue. They are now indicated in warmer colors over a larger portion of their length (Fürstand, 2007).

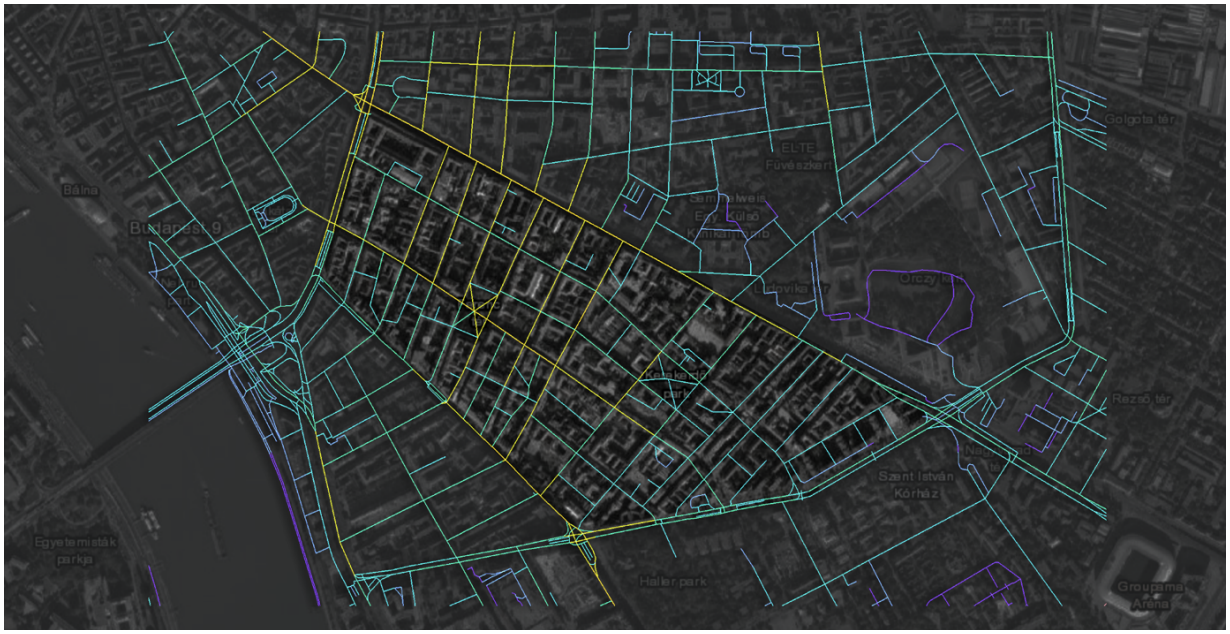


Figure 27*16*: Global integration analysis of middle Ferencváros (2020) performd on DephtmapX.
Source: by author

Looking back into Ferencváros urban structure from the 1990's, we can observe a heavily built area with mostly residential use. The urban blocks lacked enough pedestrian connections and green spaces, which resulted in an unhealthier urban environment with decreased resilience.

When proposing such a bold intervention to an urban concentration, specially a historical one, it is of utmost importance to carefully identify all factors involved in order to propose the correct way of modifying them an achieve the prosed goal. After analysing the plan proposed and executed by the Hungarian government, it is feasible to say that the intervention was successful in reducing the levels of occupational density while minimizing the impact on the historical morphological arrangement of the urban blocks.

Furthermore, by integrating the urban voids, demolishing some housing blocks and increasing and connecting the green spaces, they successfully improved the connectivity by creating new pedestrian roads, connecting the streets with the interior part of the new open areas. Additionally, by creating new and bigger open areas where people could enjoy the benefits provided by green spaces, the urban health improved, creating a much more resilient neighborhood.

The application of this method, as a first step of urban integration analysis, aimed to interpret the rebounds of the adaptative recovery process of of Middle Ferencváros, under the scope of the inner courtyards' reconfiguration. These results indicate the success of such landscape architecture approach when dealing with an urban intervention of this character, opening up the discussion of the feasibility of applying such methods to future interventions. Budapest being a city with a heavy character of courtyard-based architecture, understanding and improving successful intervention

methods applied in the past can only benefit the city, the citizens and the environment, creating a more resilient city.

5.1.5. Ferencváros and Landstrasse: Interventions Background

The renovation of Budapest's District IX went beyond the emerging need to expand residential areas on the city's outskirts. At first, the intervention was planned under modernist standards, prioritizing the demolition of historical buildings to create an entirely new urban fabric that would allow access to green areas, public buildings for community use, and housing units also following the modern guidelines (Locsmándi, 2011). The design principles underwent transformations, also adapting to the new political terms. With the establishment of the market economy, the district's municipal government owned most of the properties in the region and managed to make the renovation process possible through public-private partnerships. New rules outlined the characteristics of public and private spaces and green areas (figure 28), also stipulating measures for the preservation of a set of historic buildings, strengthening the urban landscape, as well as allowing the original population to remain in the neighborhood (Kovacs, Wiessner & Zischner, 2013).

Figure 28: Pedestrian path segregated from the green courtyard by a planted hedge at IX District, Budapest (2021). Source: by author

Vienna's Third District (Landstrasse) has also undergone significant transformations. As in the IX District of Budapest, this area is also marked by the heterogeneous occupation, predominantly middle-class residential use, and the existence of urban voids previously occupied by small industries and orchards. The densification of this area intensified in the early 2000s and was also characterized by rules stipulated by the city hall (Andexlinger, 2015). In 2019, a new block with mixed-use buildings and large, publicly accessible green areas was entirely erected in the region (figure 29). This project meets similar guidelines to those found in Budapest's district. In this case, the design is mainly articulated by a substantially green public square that works as a

connecting axis between the center of the neighborhood and the riverside of the Danube River. The rest of the public areas are distributed among the courtyards generated by the layout in which the buildings are implanted, functioning as green areas for leisure and contemplation designed for pedestrians, with no access for cars. Although the system of courtyards is based on the traditional typology of traditional buildings in the city, in this context, the areas are not enclosed, being interconnected with each other and with public roads (directly or indirectly).

Figure 29*17***:** Newly reconstructed urban block - public pedestrian paths in the green shared courtyards, Vienna (2021). Source: by author

Both renovation projects used a network of green areas and pedestrian paths, whether entirely public or not, to improve the performance of pre-occupied areas already established within the city. In this way, the objective of the development plans was to promote population density in areas that were already highly integrated with the urban fabric and the city's infrastructure, fostering territorial dynamics increasing their connectivity and integration.

Both urban stretches, in Budapest and Vienna, were submitted to evaluation two times: first, in a period corresponding to the first years of the 1990s, comprising the morphological status of the areas just after the significant political changes, and currently, when the renewal processes are already in advanced conditions and the reorganized urban stretches are highly integrated to their contexts.

5.1.6. Urban Green Infrastructure Bringing Cohesion

The analyzed urban stretches, in Budapest and Vienna, were submitted to evaluation two times: first, in a period corresponding to the first years of the 1990s, comprising the morphological status of the areas just after the significant political changes aforementioned, and currently, when the renewal processes are already in advanced conditions and the reorganized urban stretches are highly integrated to their contexts.

For the first stage of the investigation, the road network (key spatial components for the Space Syntax evaluation) of both areas dating from 1990 was used as an input. At that time, the pedestrian paths and the road network coincided in almost all extensions of both areas - except for some minor pedestrian ways in existing public squares. Consequently, it is visible that the axes configuration founded settled the territorial integration to low capacity due to the morphological configuration of the areas, restricting pedestrian mobility to the edges of the urban blocks.

Since the areas are inserted in the perimeter of historical urban development, the urban blocks have typical measures that revolve around 120x70m, initially having a configuration of continuous facades and a dense and impermeable core (Benkő, 2011). This conformation can be easily identified in the road network, still practically unchanged in both examples in the early 1990s. As in Vienna, the analyzed area in Budapest had a limited number of green and recreational areas, especially compared to the general scenario. of cities. The two areas were densely occupied (albeit heterogeneously) and had few leisure facilities linked to a comprehensive green area system.

Figure 3018: Global integration analysis of IX District of Budapest (1990); performed on DephtmapX.
Source: by author

Figure 3119: Global integration analysis of III District of Vienna (1990); performed on DephtmapX.
Source: by author

Although in the case of district IX of Budapest, the renovation process started from the central initiative of the city hall, and in Vienna, this is a more articulated continuous movement of expansion of the centrality and re-use of urban voids, the two cases are similar in many aspects. Foremost, they are innovative solutions that support the maintenance of the existing urban structure and simultaneously allow access to green infrastructure in areas lacking these systems. Vienna has been developing a sustainable development policy for decades, in line with the human scale of urban space use. For this reason, in this city, there are legal and financial mechanisms that facilitate the implementation of projects with these characteristics (Michaela, 2008).

In Budapest, in opposition to the scenario found in Vienna, despite the successful implementation of a green infrastructure (territorially cohesive in theory), in practice, some of the new green paths that cross the courtyards - publicly owned but privately maintained - were closed, with use restricted to the residents of the buildings. Therefore, although the results found in the evaluation of the road network dated 2020 indicate a significant increase in territorial connectivity in the renewed area of district IX, these data do not accurately reflect the reality of use currently found there. The city hall authorized the implementation of visually transparent gates and partitions in some points of the axial and nodular elements components of the green infrastructure network instituted. In some cases, the gates are not closed during the day, which leads to questions about territorial occupation political strategies, security requirements, and design solutions for space division (Benkő & Germán, 2016).

Figure 3220: Global integration analysis of IX District of Budapest (2020); performed on DephtmapX. Source: by author

The increase in connectivity at the intervention site is also evident in Vienna. In this case, the results directly reflect the use of space currently in terms of public accessibility. A significant portion of the increase in connectivity is due to the new public square that also works as a promenade connecting the Danube (an important structuring axis in the scenario of green infrastructure and mobility in the city) to the district's interior. This solution increased local and global connectivity and territorial integration in the region.

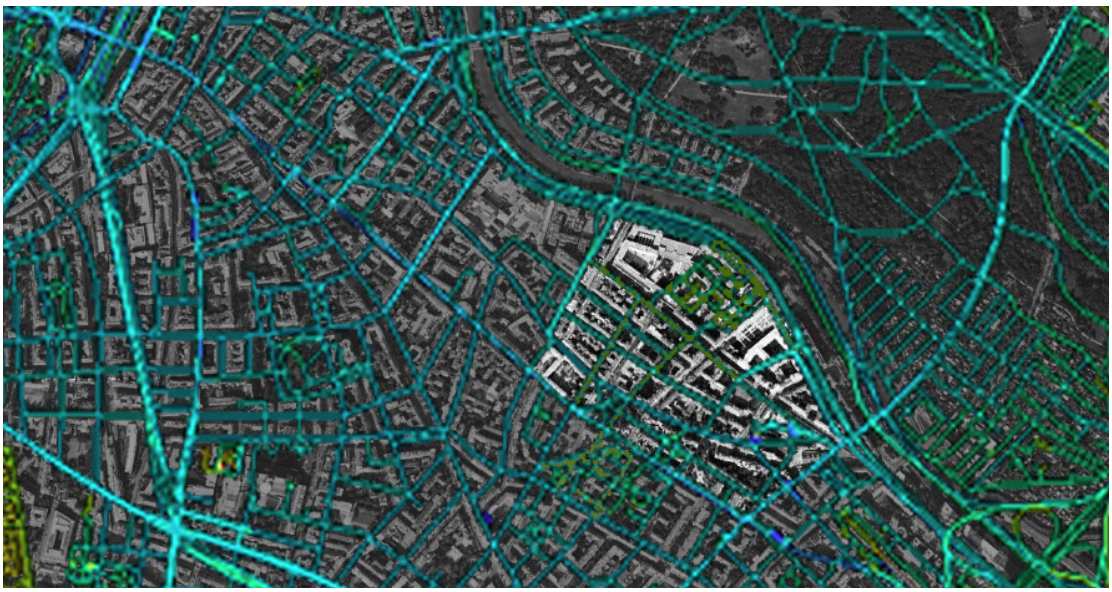


Figure 33*21***:** Global integration analysis of III District of Vienna (2020); performed on DephtmapX. Source: by author

Although the full-angular analysis performed with the Dapht Map does not distinguish between the different types of use of the roads, it is remarkable that all the new roads identified in the maps between the years 1990 and 2020 are of priority use for pedestrians. In Budapest and Vienna, the new axes implemented during the urban renovation process are concentrated inside pre-existing urban blocks, ensuring new layers of permeability to the originally closed blocks (Benkő, 2011).

5.1.7. Outcomes of the comparative framework and Discussion

Budapest and Vienna are cities that share many historical and cultural aspects, culminating in significant similarities in the morphological characteristics of the cities. Although it is challenging to establish comparative frameworks between urban centers immersed in such different political contexts in the contemporary historical period, it is possible to identify the reproduction of very similar patterns in specific regions of these cities.

The expansion movements towards the south of both cities have marked the renovation process and densified areas previously considered outskirts with heterogeneous occupation. There were many urban voids left by small and medium-sized industries and deactivated storage sheds leading to urban decay and a lack of urban connectivity. Regions with those characteristics in the III District of Vienna and IX District of Budapest are undergoing renovation processes whose backbone is the implementation of urban green infrastructure in conjunction with predominantly residential projects. This new configuration also presents new pedestrian paths that cut through the green areas of the newly built (and redesigned) courtyards. Moreover, the courtyards are essential morphological elements emphasized in both renovation processes, thus becoming symbols of the resilience of these historical urban fabrics.

The increase in connectivity and territorial integration followed by the implementation of green infrastructure is visible in Budapest and Vienna. However, it is worth emphasizing the different qualities of these territories in terms of accessibility to the public. Although the design conditions are relatively equivalent, the cultural and political particularities of the territorial management of each city result in different user experiences of the public space.

The results found may also be relevant for other cities in a similar context, especially in Central-Eastern Europe, in many of which the process of suburbanization has also intensified in recent decades. Understanding strategies for the requalification of historically occupied urban fabrics, combined with public policies for land use and land cover, can be a viable path to cohesion and, consequently, to stimulate urban resilience.

5.2 Tracking Urban Green Transformation with Supervised Image Classification

The application of this method to track green transformation relies on research on evidence of satellite image processing and map analysis to identify variations in the morphological structure and the green infrastructure over time. The methodology was drawn on qualitative and quantitative analysis of land-use and land-cover (LULC) mapping, highlighting the transformations that occurred in the polygonal of the study in historical periods remarkable in terms of variations in the pattern of urban development (Alhassan et al., 2020). The analysis was carried out in three different periods, in 2000, 2011, and 2021, to obtain parameters to establish a comparative framework. The input dates were defined based on milestones in the change in conduct in the management of the urban domain and migration movements—especially regarding Ferencváros—and the availability of material for investigation.

The study area comprises a specific region within the entirety of the IX District of Budapest and is located between the geographic coordinates 47°28′48.82″ north latitude and 19°04′38.91″ east longitude and has an extension of 71.5403 hectares. The database used is composed of digital images from orbital sensors made available by Google Earth Pro on its image catalog by NASA, and were processed in an IACS-compatible environment, on geographical information system (GIS). The software used in this analysis was ArcGis version 10.1, using the ArcToolBox tools extension, with components designed for Supervised Image Classification (SIC) such as Create Sign-nature, Filter Statistics, and Maximum Likelihood Classification (Oliveira et al., 2014).

The classes selected to carry out the supervised classification considering the artificial and natural elements that constitute the urban landscape. Land-cover classes are identified as natural earth resources (e.g., forests, water, bogs, marshlands), while land-use classes are considered artificial areas (e.g., agriculture, roads, cities) (Alhassan et al., 2020). The classes used for the supervised classification are vegetation, exposed soil, street, and building. These classes are essential to identify and follow the pattern of urban development in the region, highlighting demolitions, new buildings, streets and pedestrian paths, urban voids, and green areas over time. Twenty sample pixels for each of the classes mentioned before were obtained, thus enabling measurement on different dates.

Due to the relatively low resolution of the images accessed to perform the procedure, the results found present a degree of inaccuracy. In addition to that, clouds and shadows are expected in optical remote-sensor images, decreasing the precision of the analysis. The occlusion of features is another limiting factor, which reduces the available useful area of the image, compromising the quantitative analysis (Chen & Stow, 2002). Those factors also made it unmanageable to obtain images for classification before the 2000s, which were freely available, and with a satisfactory resolution.

Although some urban areas, mainly in Asia and North America, have been the object of scientific study with supervised classification, little material is produced on this subject in Eastern European cities. Furthermore, this methodology is commonly found in studies covering large territorial portions, often aiming to measure the growth of urban areas towards rural or natural environments, for example (Keuchel et al., 2003). In the case of this present case study, the SIC is

applied to identify changes in the urban morphology in a segment of the ninth district of Budapest, generating evidence of the renovation operation performed in this region.

5.1.8. Green Infrastructure Implementation

The Ferencváros requalification project differs from other initiatives in Budapest in this field, as it was set up to enhance urban resilience through the maintenance and improvement of morphological elements of structural importance to the urban fabric, such as the original layout of blocks, continuous facades, overall height, and plot size (or use of architectural elements that symbolize the original individuality of each of them, even when multiple sites were joined for the development of new development) (Levy, 1999). However, the courtyards are the most striking feature in the definition and spatial articulation in the region. These elements were restructured, enabling new layers of use.

The courtyards, initially independent, were primarily devoid of greenery or had poor and fragmented green areas with restricted access to the building's residents (Sugár et al., 2017). The restructuring proposed the unification of these elements, also encompassing the urban voids and creating a mesh of public or semi-public pedestrian crossings. The LULC maps produced from satellite images were used in method as a tool to define the impacts of this intervention on spatial conformation.

5.1.8.1. Social–Political Conjuncture and the Selection of Satellite Images

The first restructuring projects of Frencváros date from the late 1970s and were conceived under modern guidelines of spatial elaboration and articulation, foreseeing the demolition of most pre-existing historic buildings and emphasizing the creation of new roads, green areas, and buildings for residential and community use (Oliveira et al., 2014). The project underwent revisions in the 1980s, making it more adaptable to local circumstances, as shown in Figure 34. The decision to reconfigure the city's outskirts emerged from the increasing densification of its agglomeration belt, with the migratory movement from the countryside to the city, accelerating the demand for rapid housing construction (Kocsis, 2015). Despite the extensive planning, few changes were implemented in the area during this period.

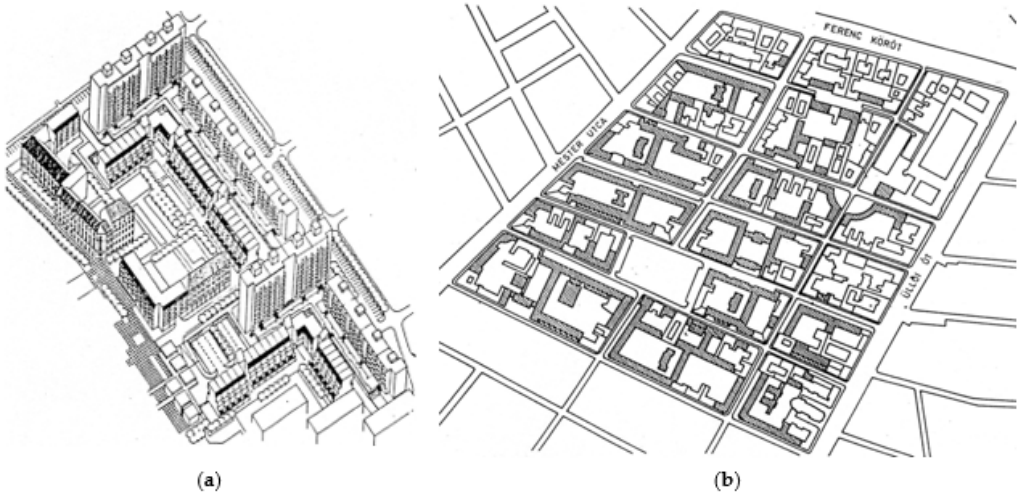


Figure 3422: Middle Ferencváros. **(a)** Scheme of a requalification plan from the late 1970s. Most of the historical buildings were set to be demolished and replaced by large prefab residential blocks

(Lichtenberger, 1994); (**b**) Revised master plan from 1982 to 1983. The original street network and the layout of the urban blocks are redesigned to bear wider streets and more extensive communal courtyards. For the first time, the intention to implement a public square was indicated in the south–central region of Middle Ferencváros. New buildings are hatched (Locsmándi, 2011).

The political transition process in Hungary began in the early 1990s, but it was only around the 2000s that national and international investments in real estate and public infrastructure expanded (Drahokoupil, 2008). The process of urban sprawl and suburbanization started in the late 19th century. This escalated in the mid-20th century in Budapest and impacted the densification of the Ferencváros region, a trend that continues to rise. Table 1 (Oliveira et al., 2014) indicates that the urban sprawl movement grew significantly between 2001 and 2011.

Table 3:. Continuous urban sprawl process in Budapest after the communist era.

Year/Region	1990	2001	2011
Proper Budapest	2,016,000	1,775,000	1.729,040
Agglomeration Belt	567,000	672,000	805,848
Total Agglomeration	2,583,000	2,447,000	2,534,888

Furthermore, as mentioned earlier, between 2007 and 2013, the EU established urban development as one of the most relevant factors for its cohesion policy. This decision boosted more evident transformations in the city's urban structure, especially in areas with significant transformative potential and subject to real estate investments, as occurred in the analyzed district (Meerow, Newell and Stults, 2016). For the reasons mentioned, the year 2011 was selected as one of the landmarks for the elaboration of this research. Finally, the third period selected for sampling was the year 2021, seeking to obtain more recent data that portray the current situation found in the place.

5.1.8.2. Urban Design in Favor of Green Infrastructure

At the local level, the end of the communist regime implied the return to self-governance in Budapest, accordingly, inferring the two-tier administrative system and the subsequent shift in decision-making from the city to the district level. This scenario of increasing the individuality and competencies of the districts resulted in their ability to reformulate their social and housing policies, making them capable of launching urban requalification projects (Kovacs, Wiessner & Zischner, 2013).

In the global policies scope, the set of new Sustainable Development Goals (SDG), established in the post-2015 Development Agenda in September 2015, is defined in the General Assembly of the United Nations (Pafi et al., 2016). Among the guidelines mentioned in the document, SDG 11.7 specifies the following for public spaces:

"*By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities".*

Regarding accessibility to green and leisure areas, Ferencváros presented deficiencies. The coefficients of accessibility to those areas in the district until the 2000s (when urban intervention was not yet consolidated) were below 9 m2 per capita within 15 min of walking distance stated by the World Health Organization (WHO Regional Office for Europe, 2002). To achieve these parameters, the system of integrated green courtyards was designed, in addition to the implementation of green elements at specific points on the streets—a measure that made the core and the edges of the blocks greener, also improving the landscape conditions of the place.

To meet the indicators of the World Health Organization and to achieve a better ratio between population density and accessibility to green open spaces, a new compact urban park (Nordh et al., 2009) was created from the demolition of some poorly conserved buildings and empty plots in the south–central region of the polygonal, as shown in Figure 35. The Kerekerdő park is one of the most significant public elements for the configuration of the green grid in the area, being a (public) confluence point for the green paths (Tzoulas et al., 2007). The same is true of Ferenc tér, a pre-existing square in the north–central region that also plays the role of a significant urban green infrastructure element.

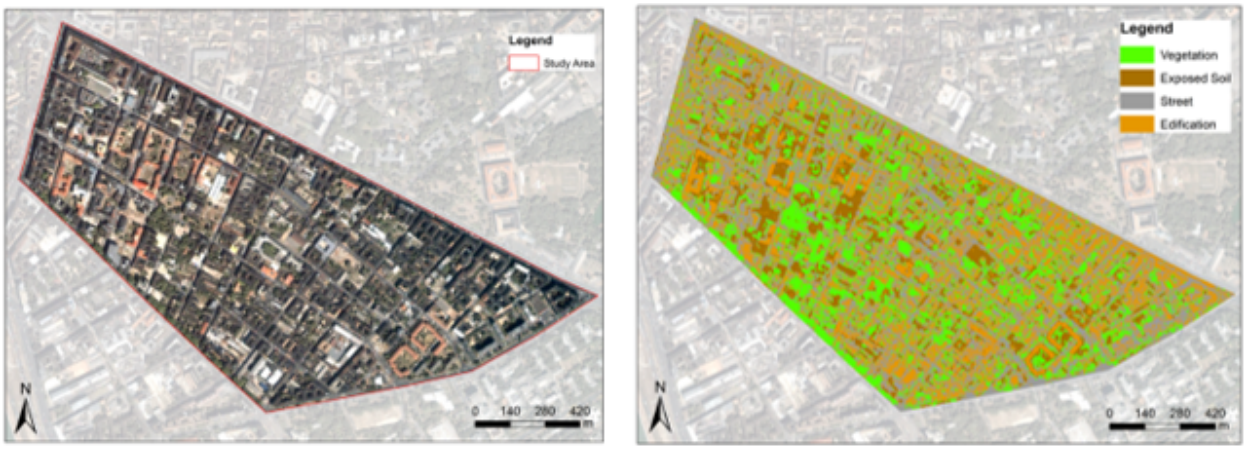
(a) (b)

Figure 35: Kerekerdő park analysis. **(a)** Process of establishing the Kerekerdő park from the agglutination of empty plots and the demolition of residential buildings (Locsmándi, 2011); (**b**) Kerekerdő park already in use in the early 2000s. The public space was designed to prioritize the integration of the territory and promote accessibility to green areas and playgrounds (Locsmándi, 2011).

Among the benefits achieved by implementing a comprehensive green system are strengthening social relations, increments in connectivity, improvements in urban cohesion, and an increase in local economic activities, leading to the resilience of this urban territory (Pauleit et al,. 2019). Ensuring accessibility to green open spaces is a possible response to a healthier urban environment (Kaplan, 1995). In that perspective, the presence of green spaces, pedestrian paths, and leisure equipment was accomplished by redesigning former brownfields and residential plots.

5.1.8.3. Overseeing Urban Transformations

As shown in Figure 36, the supervised classification performed in the satellite image of the 2000s reveals a territory still lacking a comprehensive urban green infrastructure. The green elements are presented in a fragmented and diluted way, evidencing the typological characteristics of a historical urban fabric ascended from closed blocks and buildings developed around relatively narrow and poorly lit courtyards, devoid of green components capable of significantly impacting the landscape composition and the quality of life for local inhabitants (Benkő and Germán, 2016).

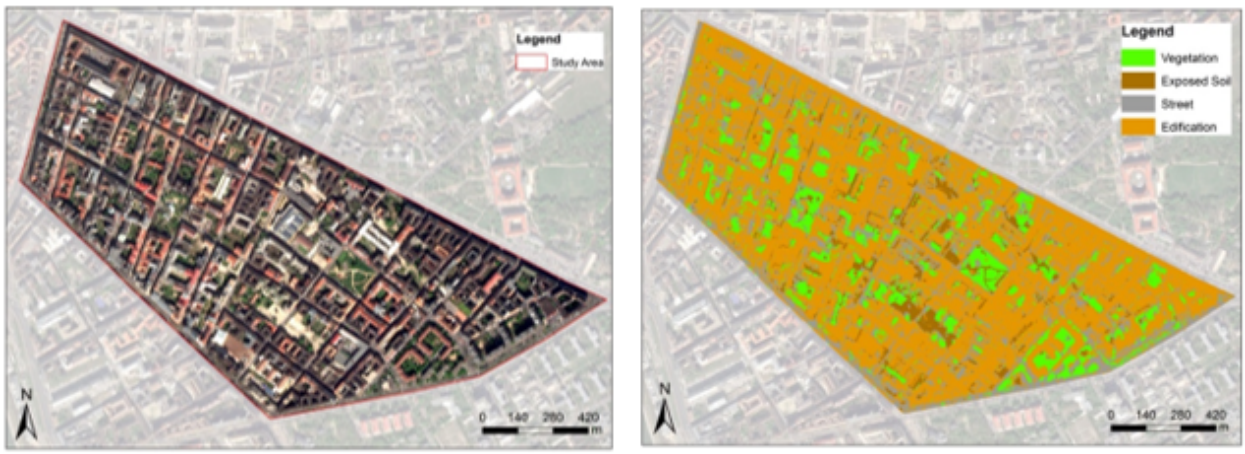


(a) (b)

Figure 3623: Ferencváros supervised classification. **(a)** Satellite image from the 2000s. It is possible to notice that most buildings have typological characteristics common to historic structures, which reverberate in the dense urban condition, despite the existent industrial voids.; (**b**) The supervised classification reveals urban fragmentation and the deficiency of green infrastructure in the area. Source: by author.

There are also high rates of exposed soil, indicating, currently, the prevalence of urban voids characteristic of deactivated industrial facilities (Locsmándy, 2005). These idle areas were mainly concentrated in the central portion of the study polygonal since the edges (better served by the public transport network and important mobility hubs), already in this period, were mostly occupied by residential and commercial buildings.

In 2011, it was already possible to visualize the grid of the green infrastructure defined in the urban requalification project, as indicated in Figure 37. The reduction in exposed soil areas is notorious, as are the growth of areas occupied by buildings. This period is marked by the coexistence of several new residential developments with old historic buildings in a poor state of conservation, designated for demolition, but most of which had not yet been demolished or rebuilt—except for a set of buildings located in the vicinity of Kerekerdő park (Balogh and Takács, 2011), in the south–central region of the polygonal. In this area, there is a marked predominance of exposed soil.



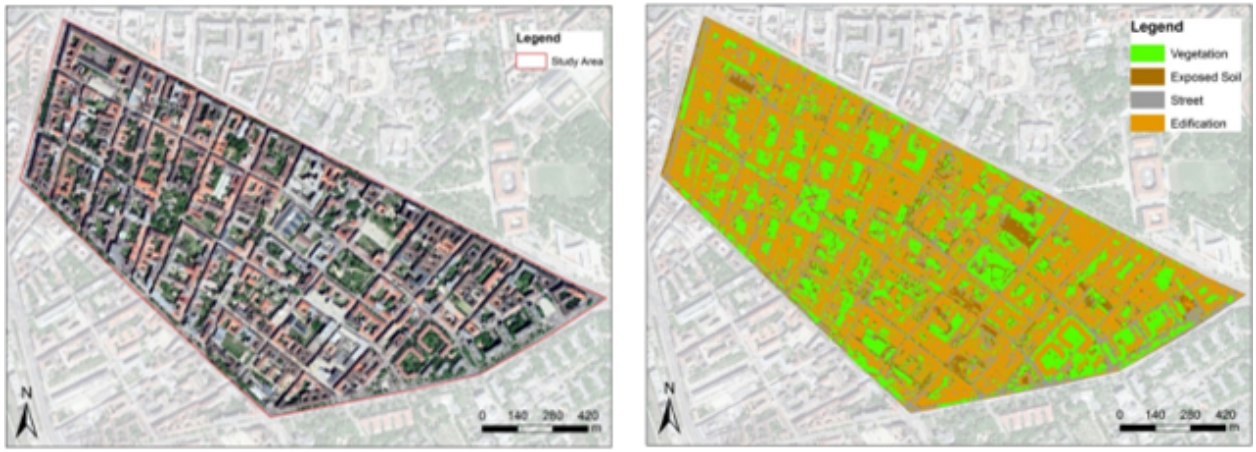
(a) (b)

Figure 3724: Green infrastructure grid outlined within the urban requalification project. **(a)** Satellite image from 2011. It is clear that the intervention has already reached a certain degree of consolidation, and the redesign of some urban blocks has already been completed, especially in the northern region; (**b**) The

supervised classification indicates the first significant advances toward urban cohesion and green infrastructure begins to emerge. Source: by author.

Despite the prominent involvement of the private sector in the reconstruction process, this was a project guided by the demands arising from the local public administration. Contrary to most districts of Budapest after the political transition, the local government was able to continue the Middle Ferencváros renovation project, as this area was officially designated as an "urban rehabilitation site" (Oliveira et al., 2014). For this reason, the stages of development of the intervention were defined primarily from the perspective of social conflicts and aimed to address solutions to the most urgent infrastructural deficiencies. The city designated the priority areas as "centers of gravity," and the green infrastructure would establish the articulation between them. The implementation of Kerekerdő park, for example, was one of the measures adopted to stimulate the development of one of the regions of the district with the most significant deficit in infrastructure, landscape conditions, and socio–spatial cohesion (Balogh & Takács, 2011).

Based on the 2021 satellite image analysis, visible in Figure 38, it is possible to observe the consolidation of the greenspace system. The intensification of linear and compact green elements, implemented in previous stages of the intervention in the planned urban fabric, is noted. At the same time, simultaneously, new shared courtyards were also established. At this stage, the proportion between green components and built area is more balanced than in previous stages of the requalification process, with approximately twice as many areas occupied by buildings as green areas, as indicated in Table 2.



(a) (b)

Figure 3825: Consolidation of the greenspace system. **(a)** Satellite image of 2021. Based on the morphological analysis, it is clear that the intervention has reached its stage of maturity; **(b)** implementation of green infrastructure is almost complete, and there are few areas marked as exposed soil. Source: by author.

Table 4: The total area occupied by each of the respective classes over time. Results were obtained with supervised classification. Source: by author.

Class Name	2000	2011	2021
Exposed soil	9,193,263	3,964,979	5,005,173
Street	26,787,694	13,280,933	11,864,784
Building	25,055,177	51,467,673	41,295,866
Vegetation	17,627,973	10,004,571	20,546,853

The green areas are also more equidistantly distributed throughout the territory, bringing the conditions currently existing in the district closer to the parameters established by the World

Health Organization concerning accessibility to urban public green areas (WHO Regional Office for Europe, 2022). However, there is still a denser strip of occupation where the urban green infrastructure system still did not reach its full potential, east of Kerekerdő park. This is one of the last “centers of gravity” among the priority areas for the requalification implementation. There is still a relatively high percentage of historic buildings that have not undergone renovation or demolition interventions in this area.

5.1.9. SIC Main Outcomes and Discussion

Changes in the social–political context of post-socialist cities caused challenges in terms of their ability to persevere as resilient urban forms, leading them to the need to adapt to the new model of social and spatial structuring. In this context, international public policies, mediated by the European Union, were designed to assist in the development of these cities, aiming at cohesion and reducing the gap—especially in terms of infrastructure and environmental management—that exists between eastern and western European cities (Hirt, 2014).

Parallel to these events, the dynamics of suburbanization and urban sprawl also guided cities such as Budapest to a scenario of social and physical fragmentation (also in terms of landscape conditions), particularly on the fringes of large metropolitan areas such as the situation found in Ferencváros (McMahon and Benedict, 2000). In this sense, green infrastructure is an essential component in the viability of sustainable urban planning, facilitating social cohesion and supportive social networks, enhancing equity, and the development of social capital and promoting a healthier environment (Barton et al., 2009).

The partial or total demolition of some historic buildings during the renovation process raises questions about urban heritage preservation and urban morphology. In that regard, Kropf (2017) states the following:

“Configuration is an arrangement of parts, and a type is a configuration with a degree of modularity and integration as a cultural habit. The type is a configuration that is or has been actively reproduced. While each example of a type might be slightly different, the configuration remains the same.”

Following that perception, demolition performed in some specific points of the district and the reconfiguration of the historic courtyards, despite being antagonistic to the preservation of urban heritage and its morphological characteristics, allowed for the revival of the area’s configuration. This process happened through the typological re-constitution, providing cohesion to the fragmented urban territory and boosting its resilience (Aksözen, Hassler & Kohler,2017).

The results reported show that the urban requalification of Ferencváros was efficient in improving territorial cohesion through a gradual reduction in urban voids (represented mainly by the exposed soil class) and the implementation of an extensive system of green elements. It is relevant to underline that the year 2011, as an intermediate period of evolution of the urban condition, presents classes with percentages of land use and occupation different from the general trend seen between 2000 and 2021 (Table 2). This movement is justified by the fact that this was a transition period, pointing to the coexistence of sections already restructured with others where the action was still in progress. The co-consolidation of the transformations was only confirmed in the outcome of the investigation carried out in the most recent image.

Figure 39, adapted from the Budapest Green Infrastructure Concept published by the city government in 2017, presents results consistent with the GIS data analyzed in this study. In Middle-Ferencváros, numerous areas are marked with a "Significant Reduction (greater than 25%)" in green spaces between 1995 and 2015. However, there is an even greater prevalence of areas indicated as having a "Significant Increase (greater than 25%)." This reflects the extensive spatial reorganization undertaken in the region to establish a coherent green infrastructure. At the

same time, predominantly residential buildings were constructed on previously vacant, underutilized land, or land resulting from the demolition of historic buildings.

Furthermore, the supervised classification of satellite images has proved to be a robust method for analyzing the gradual reconstruction activity. The LULC maps produced with the help of GIS tools provide a detailed report on the development of the different layers that combined composed the urban fabric over time in the narrowly selected periods (Rwanga and Ndambuki, 2017). Nevertheless, the relatively low resolution of the images used for the study resulted in higher misclassification rates because of the spectral similarity, mainly between the exposed soil and the building materials. The use of higher resolution images (produced by Sentinel-2, for example) and the employment of Synthetic Aperture Radar (SAR) to extract textural features could be possible solutions to this issue (Forget, Linard & Gilbert, 2018).

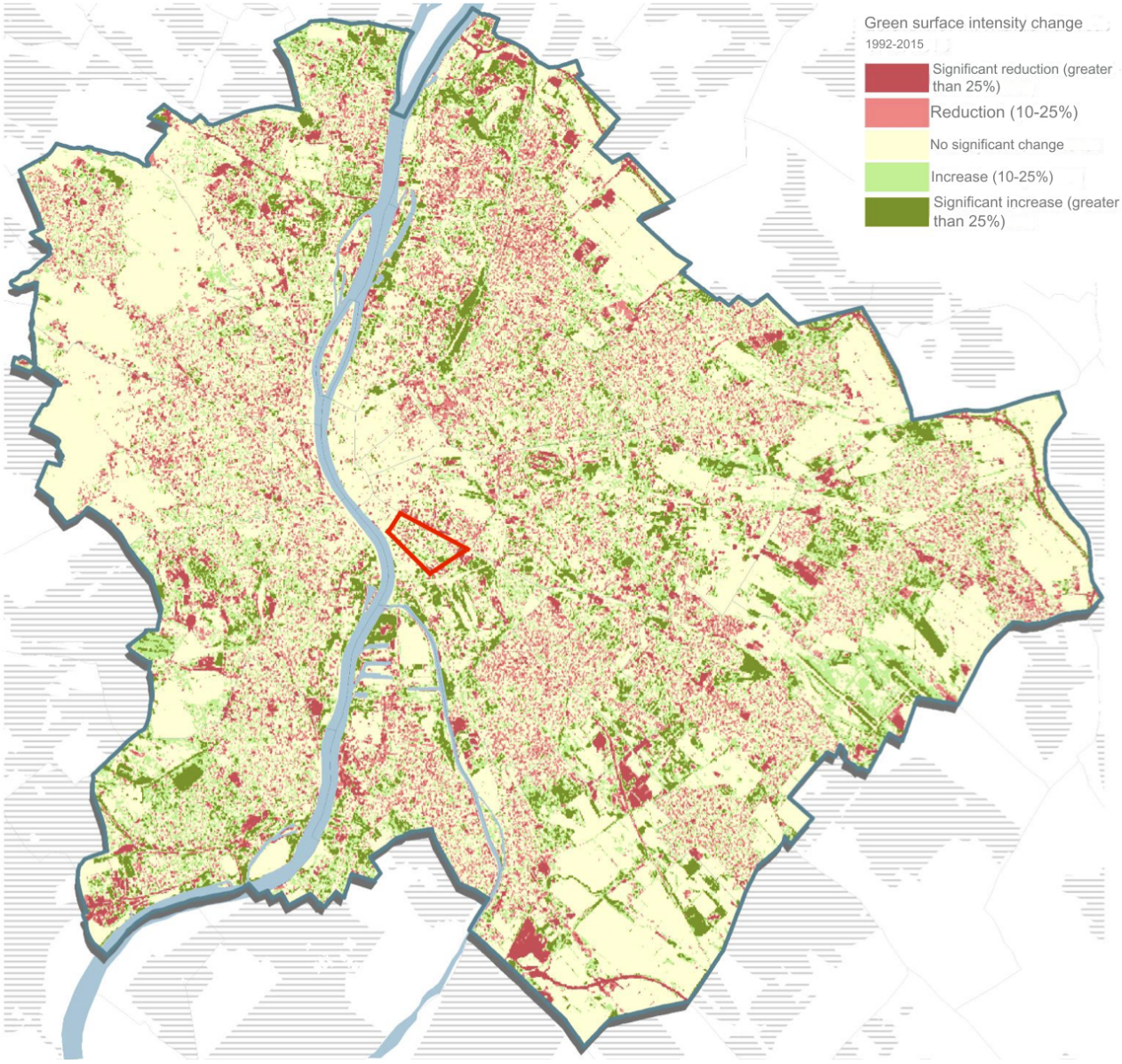


Figure 39: Budapest's change in green surface intensity from 1992 to 2015, with Middle-Ferencváros outlined in red. Source: Budapest Municipality, 2017

As Hammerberg et al. (2018) demonstrated in Vienna, the use of remote-sensing imagery to determine morphological features on an urban scale can be beneficial for tracking urban structure and precisely evaluating the performance of cities at the environmental level (Hammerberg et al.,

2018). The classes analyzed in the study proved to be substantially sufficient in the stratification of land-use information to capture the heterogeneity of the urban landscape morphology. Forget, Linard and Gilbert (2018) reported similar findings using supervised classification based on manually digitized training samples to capture the heterogeneity of urban areas in sub-Saharan Africa. Their automated approach achieved classification effectiveness comparable to manual sampling strategies. However, in their case study, they encountered inaccuracies related to the attributes of openly available aerial images—a difficulty also observed in the study conducted in Ferencváros.

The supervised classification as a method assisted in the correlation of the development strategies adopted by the public–private initiative with the remarkable historical events that defined the project's guidelines. Nevertheless, the impossibility of obtaining older images of free access conditioned the analysis to periods in which the intervention had already started, limiting the comparative framework concerning previous periods.

6. RESULTS PROJECTIONS

The typological survey in this research is presented as a key methodological tool to compile previous findings, analyze and understand the urban form and its evolution within the context of urban resilience. It is employed to dissect the physical characteristics and spatial arrangements of buildings and green spaces within the urban landscape, mainly focusing on how these elements contribute to the adaptability and functionality of the area.

The typological method allows for the identification of historical patterns, current usage, and potential areas for intervention, which are essential for any urban renewal process that aims to enhance resilience without compromising the historical and cultural integrity of the area. The typological survey bridges the gap between quantitative data collection, such as GIS and Space Syntax analysis, and qualitative assessment. It plays a crucial role in guiding the interventions by providing a detailed understanding of the urban morphology, which ensures that the transformations contribute positively to the urban context and support sustainable development goals (Wheeler & Beatley, 2004).

Using typological surveys, the research elucidates how strategic interventions in the urban landscape can revitalize and transform areas while fostering resilience and sustainability. This approach underscores the importance of a nuanced understanding of urban forms when planning for resilient cities and serves as a foundation for proposing informed and sensitive urban design solutions.

6.1. Urban Typological Survey

This layer of the investigative process required the employment of the Typological Survey method - an in-depth assessment conducted and translated into a Geographic Information System (GIS) database. The typological study was employed (and simultaneously evaluated) to comprehensively understand, categorize, and evaluate the elements implemented in this renovation interventions both individually and collectively (Serraos and Asprogerakas, 2019). Therefore, this method interprets the urban structure and its morphological adaptations.

Data collection for this research stage was executed through a threefold approach. Initially, the author personally instituted the methodological framework, pre-surveying a determined area to ensure fidelity to the conceptual foundation. This initial stage established the basis for the following phases, which employed focus groups to enrich the data spectrum, as depicted in Figure 40. This structured multi-phase process was instrumental in capturing a diverse range of insights, enhancing the robustness of the research outcomes. More details of the data compilation process and database for the urban morphological survey can be found in Annex 3.

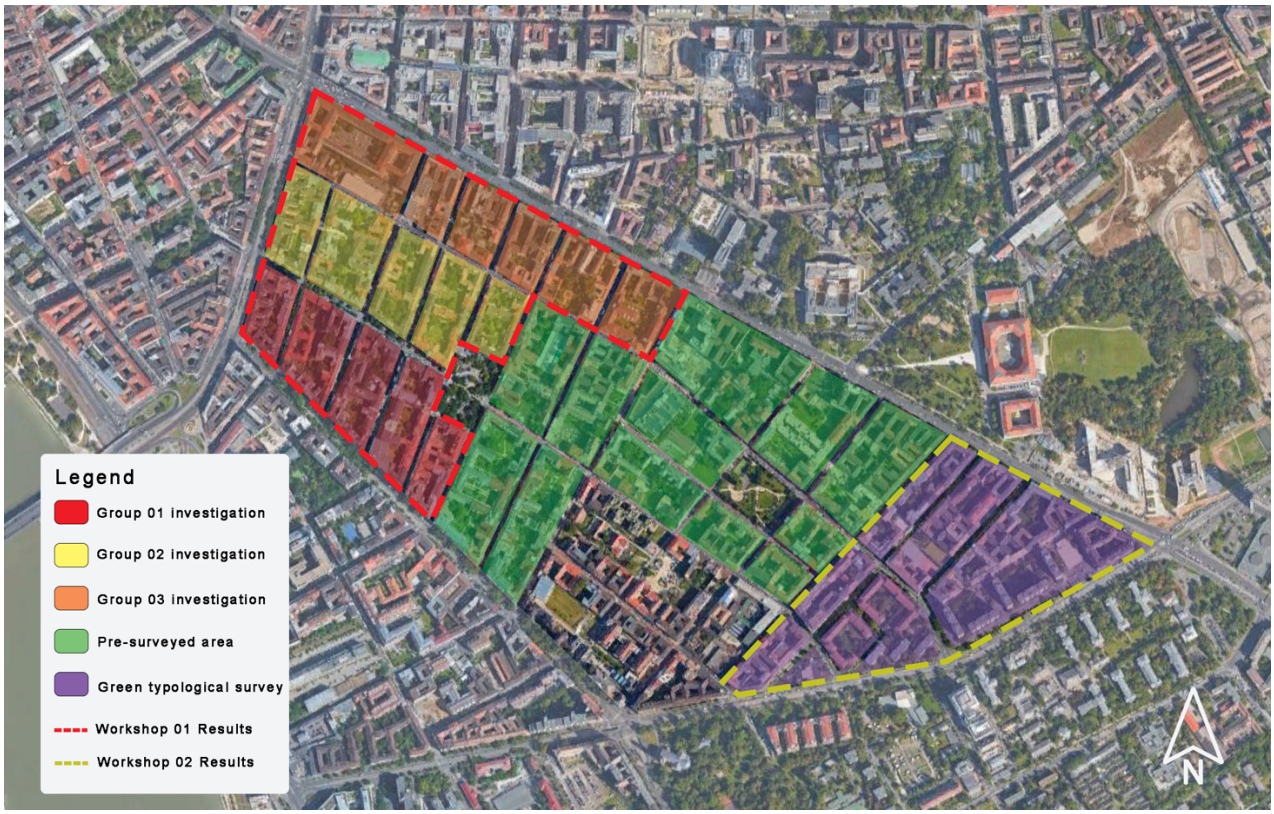


Figure 40: Urban Typological Survey *Strategy. Source: by author.*

6.1.1. The survey structure

The survey assessment presented in Figure 41 is divided into four evaluation subgroups:

A. Land Use—this subgroup examines factors related to the layout and spatial organization of blocks, as well as the constitution of the urban landscape. The assessment of these aspects directly impacts the quality, accessibility, and complexity of the public space and its spatial connections (Bertyák, 2021).

B. Commerce and Service Unity—this section investigates the physical aspects of existing commercial and service units within the surveyed urban territory, emphasizing how they contribute to promoting habitable public spaces. Additionally, it analyzes how the distribution and articulation of the service network at the street level impact the fluidity and permeability of the territory (Jacobs and Appleyard, 1987).

C. Residential—this subgroup focuses on elements related to the residential function of analyzed buildings. Given that residential use had the most significant prominence and predominance in the Ferencváros renovation process, the elements of this subgroup seek to identify how residential buildings, whether new or renovated, have adapted to the existing urban form and structured the conformation of space (Hasanzadeh, Kyttä & Brown, 2019).

D. Urban Landscape and Greenscape—this subgroup is designed to identify and characterize the constituent elements of the urban landscape. The implementation of green infrastructure was one of the tools used in the renovation of District IX, which significantly impacted not only the urban form and landscape but also the quality of public and semi-public spaces (Childs, 2010).

A	LAND USE								
	USE	RESIDENTIAL	0	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	1
	STOREY	01 FLOOR	0	02 FLOORS	1	03 TO 05 FLOORS	0	06 TO 10 FLOORS	0
	COURTYARD	NOT APPLICABLE	0	COMMON	0	PRIVATE	1		
	FRONTAL SET BACK	NOT APPLICABLE	1	WITH GREEN ELEMENTS	0	WITH NO GREEN ELEMENTS	0		
	LATERAL SET BACK	NOT APPLICABLE	1	ONE SIDE	0	BOTH SIDES	0		
B	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	1	02 ACCESS	0	MORE THAN 02	0
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	1	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	0	TO PUBLIC STREET	1	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	0	PERMANENT	1	SEASONAL	1		
	COVERED PROMENADE	NOT APPLICABLE	1	UP TO 02 PASSING UNITIES	0	ABOVE 02 PASSING UNITIES	0		
	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	1	50% - 80%	0	LESS THAN 50%	0
	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	0	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	1
C	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	1	ALLEY/COURTYARD	0	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	1	02 ACCESS	0	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	1	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	1	1970 TO 1990	0	1990 TO 2021	1
	GARAGE	NOT APPLICABLE	1	GROUND FLOOR	0	UNDERGROUND	0	COURTYARD	
	BALCONIES	NOT APPLICABLE	1	TOWARDS STREET	0	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	
D	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%	0	<50%	1	>50%	0		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	0	THROUGH RESIDENTIAL ACCESS	1	COMBINED	1
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	1	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	1	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	0	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	0	YES	1	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	0	RENEWED	1	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	0

Figure 41: Typological survey assessment used in field research. Source: by author.

The municipality of District IX implemented a renovation strategy that was divided into stages and gradually implemented in the most degraded urban areas, which were considered the "centers of gravity" (Locsmándi, 2001; Fekete, Hodor & Dai, 2021). These areas were targeted with new guidelines for urban renewal, and improvements were expected to radiate to other regions within the intervention polygonal (Roberts & Sykes, 2008).

As a first stage of approach and experimentation, a typological study was conducted in two of the leading "Centers of Gravity" identified by the district municipality. These areas had worse general physical conditions of public spaces and buildings and were characterized by a fragile social situation, with families in profound social vulnerability.

The survey was carried out in collaboration with students of the Master's course in Landscape Architecture at the Hungarian University of Agriculture and Life Sciences (MATE) as a proposed workshop activity. In this case, the typological investigation was used as a method aimed to consolidate important concepts about morphology and urban structure and raise the consciousness of young professionals and city residents about their surroundings, contributing simultaneously to the formation of informed and self-aware community members (Niemi, 2017).

To make the elements collected in Figure 41 more understandable for the focus groups, graphic icons were created. This approach aimed to reduce the probability of error in their judgments of the physical structure of the place. Some of the icons used can be seen in Figure 42.

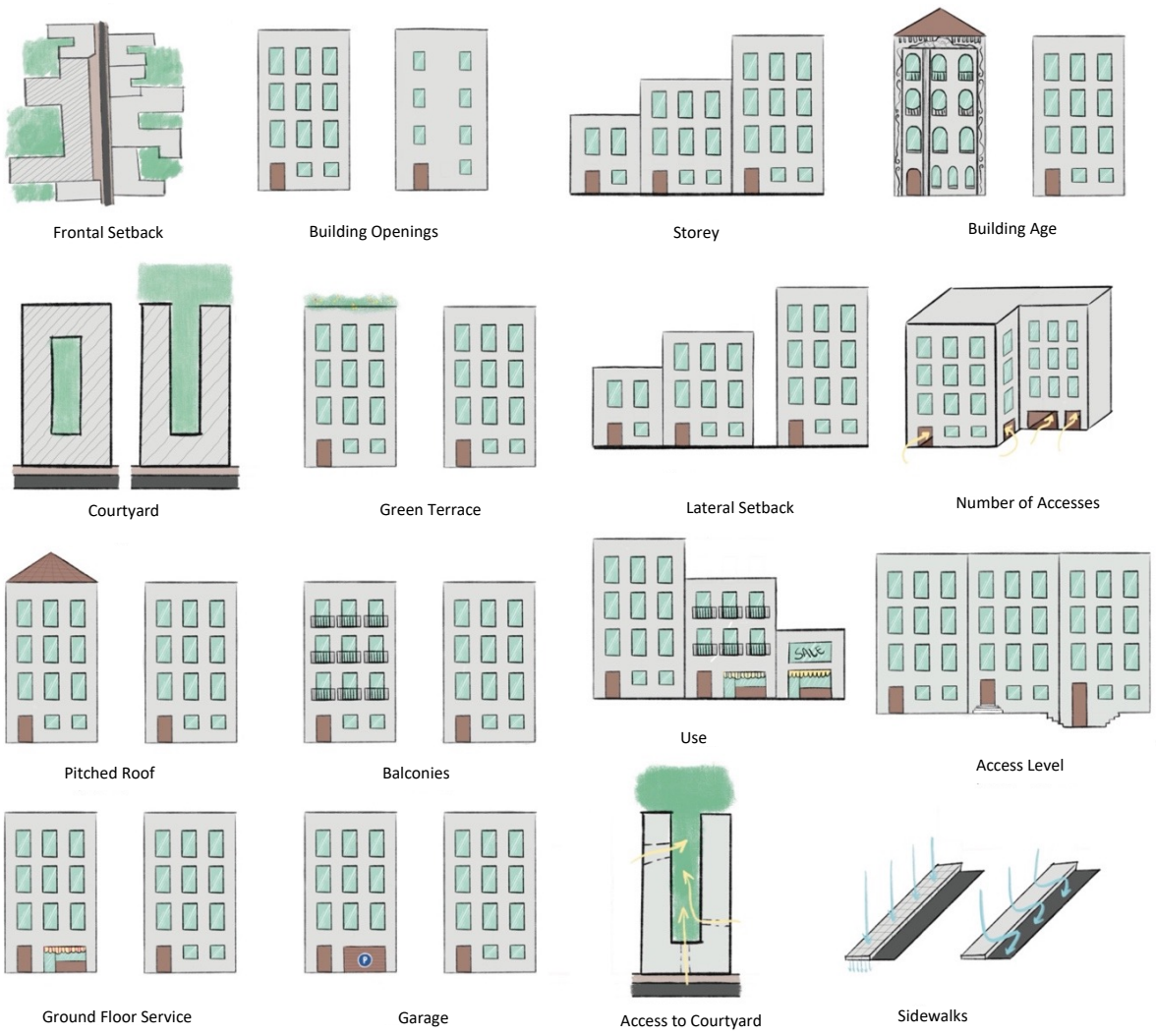


Figure 42: Icons created to facilitate visual identification by association in the research field. Source: by author.

Furthermore, to enhance focus groups' understanding of spatial assimilation and its correlation with morphology and urban spatial organization concepts, they were instructed to conduct photographic and graphical analyses (see Figure 43). These analyses aimed to identify the key elements influencing the area's urban configuration and green infrastructure while emphasizing the potential ecosystem services it offers. In a chapter written for Teaching Urban Morphology, Michael Barke (2018) argues the following:

"The importance of urban morphology is argued from three perspectives—philosophical, cultural, and practical. Urban morphology makes sense of the world around us, [...] demonstrates the importance of 'ways of seeing,' arguing for a philosophical approach that integrates physical, social, and cultural dimensions of cities. Culturally, understanding urban morphology is a prerequisite to an awareness of urban aesthetics and the layers of meaning attached to townscapes. Through such appreciation, its study adds to the quality of life. Practically, the study of urban morphology performs a vital educational function. Through the detailed study of urban form, we learn both what not to do and how to do things better, a vital objective in achieving successful and holistic urban management. Urban morphology provides an appreciation and unique training for integrating closely related fields of practical application such as urban design, planning, architecture, and conservation" (Barke, 2018, p.20).

(a) (b) (c)

Figure 4326: Pictures collected during a site visit to analyze the green infrastructure and layout of the studied urban blocks. **(a)** View from the pedestrian passage between Páva Street and Berzenczey Street. In this image, emphasis is placed on a semi-private space that serves as a connecting link between streets crossing through courtyards. This area grants local residents access to green spaces and extends its benefits to passersby. **(b)** View from Ferenc Square. The image showcases solutions implemented in Ferenc Square, Ferencváros, highlighting the strategic incorporation of green elements for spatial-functional zoning. These elements effectively segregate vehicular traffic from recreational spaces, both visually and functionally. The varied scales and features of the green elements create a nuanced gradation of use, offering protection to public space users. **(c)** View from a square at Páva Street in a building frontal setback originated after urban renewal intervention. In the image, the utilization of green public spaces is depicted as a buffer zone between residential buildings and streets. They enhance the quality of the pedestrian network and contribute significantly to the urban landscape. These green spaces play a dual role by creating a visually appealing buffer, promoting a sense of urban aesthetics, and improving the overall quality of the built environment. Source: by author.

After outlining the four evaluation subcategories—Land Use, Commerce/Service Unity, Residential, and Urban Landscape/Greenscape—the stage of interpretation and cross-referencing of the preliminary results began. The typological survey served as a study tool to correlate concepts and define parameters for evaluation systematically. This process facilitates theorizing by identifying significant subcomponents of distinctive attributes (Tiryakian, 1968).

Despite the diverse physical characteristics of the analyzed buildings and their surroundings when viewed individually, the first stage of the typological study identified high percentages of coinciding elements and urban trends. The values found in the evaluation assessment were visually linked to images of the study area in Figure 44, symbolizing and validating the data. These findings were also transcribed into graphics charts found in Figure 45.

As an outcome of this first experience, it was observed that most of the evaluated buildings are newly constructed but present essential historical references to the maintenance of existing morphological conditions (Khadour et al., 2021), such as the prevalence of pitched roofs and courtyards. Most of them do not have a frontal setback, an uncommon characteristic in this urban context, which, on the other hand, has shown to be a growing trend. New real estate developments in the region aim to generate more green and permeable public access areas and improve the urban landscape's general appearance. Changes were also identified in the materiality of exteriors, both on the facades—with the increase in glazed surfaces—and on the sidewalks, which tend to be composed of materials permeable to water in newer buildings.

D	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%	0	<50%	1	>50%	0		
2	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	0	THROUGH RESIDENTIAL ACCESS	1	COMBINED	1
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE (GREEN)	0
4	SIDEWALK	TRADITIONAL	0	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	1		
5	FRONTAL SET BACK	NOT APPLICABLE	0	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	0	WITH GARDEN	1
	PITCHED ROOF	NOT APPLICABLE	0	YES	1	COMBINED	0		
7	MANTAINANCE STATUS	NOT RENEWED	0	RENEWED	0	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	1

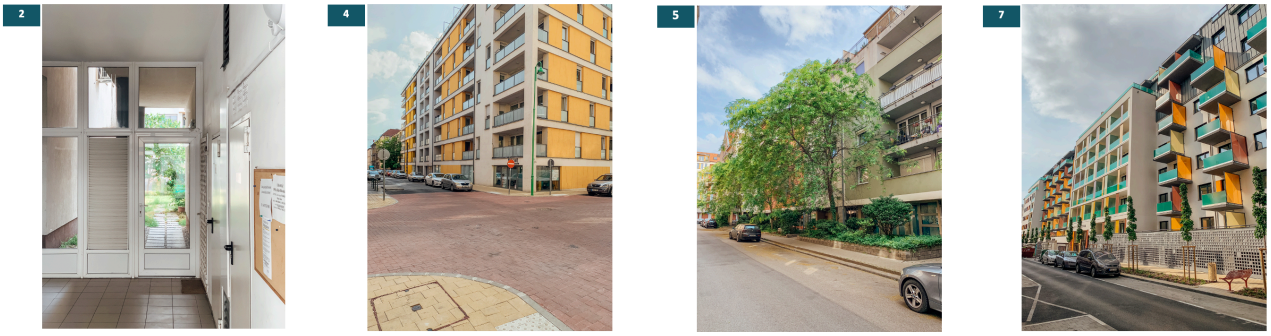


Figure 4427: Evaluation criteria of the typological survey linked to photos of the study area exemplifying the findings. Source: by author.

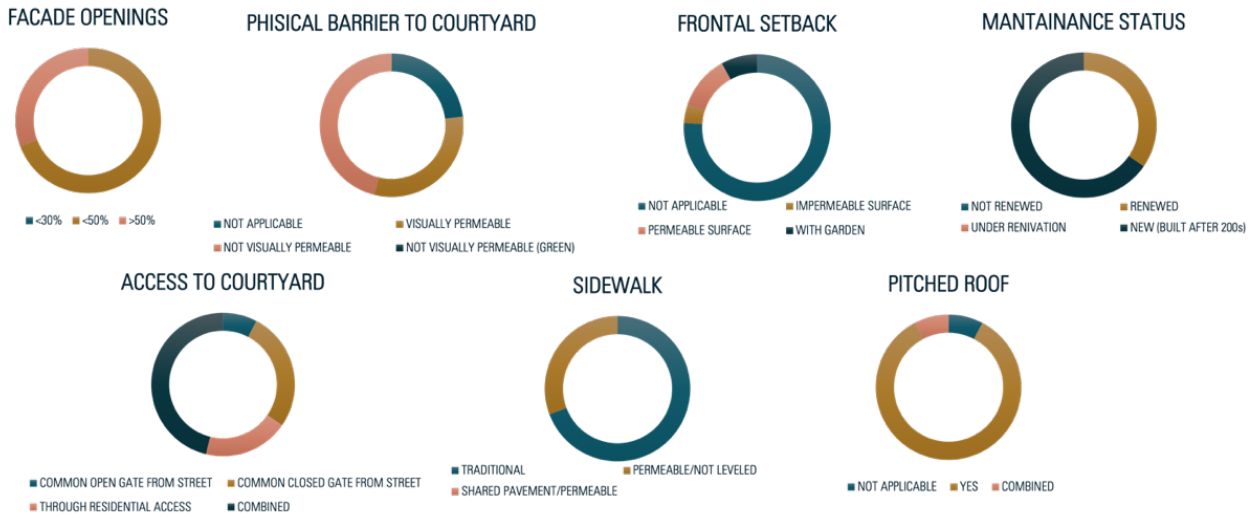


Figure 45: The graphs, derived from the data compilation, pertain to specific elements within the typological survey subgroups (refer to Figure 44). These highlighted elements exhibit some of the most distinct characteristics observed in the study area.

The urban typological analysis within the selected study area revealed a unique architectural landscape shaped by morphological continuity. Despite the influx of new construction due to the ongoing urban renovation, the area retains a strong historical character, with a preponderance of buildings from the 19th and early 20th centuries. The findings reveal that within the 206 units evaluated by the first focus group, only 10.19% of the unities surveyed accounted for new constructions. In contrast, a substantial majority of 89.81% constituted historic buildings, whether renovated or awaiting renovation (See table 3).

Table 3: Typological Survey - Focus group 1 results

SUMMARY	LAND USE								
	USE	RESIDENTIAL	53	COM/INST/SERV	17	EMPTY PLOT	0	MIXED	136
	STOREY	01 FLOOR	3	02 FLOORS	11	03 TO 05 FLOORS	148	06 TO 10 FLOORS	45
	COURTYARD	NOT APPLICABLE	41	COMMON	11	PRIVATE	151		
	FRONTAL SET BACK	NOT APPLICABLE	130	WITH GREEN ELEMENTS	31	WITH NO GREEN ELEMENTS	45		
	LATERAL SET BACK	NOT APPLICABLE	152	ONE SIDE	37	BOTH SIDES	14		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	17	1 ACCESS	68	02 ACCESS	41	MORE THAN 02	57
	TYPE OF ACCESS	NOT APPLICABLE	17	PUBLIC STREET	157	GREEN ALLEY/COURTYARD	4	STREET AND ALLEY/COURTYARD	3
	EXTENSION COMPONENT	NOT APPLICABLE	154	TO PUBLIC STREET	25	TO ALLEY/COURTYARD	3		
	EXTENSION CHARACTER	NOT APPLICABLE	156	PERMANENT	19	SEASONAL	7		
	COVERED PROMENADE	NOT APPLICABLE	132	UP TO 02 PASSING UNITIES	35	ABOVE 02 PASSING UNITIES	15		
	GROUND FLOOR SERVICE	NOT APPLICABLE	32	80% - 100%	51	50% - 80%	65	LESS THAN 50%	30
	ACCESS LEVEL	NOT APPLICABLE	17	STREET LEVEL	144	BELOW STREET LEVEL	9	ABOVE STREET LEVEL	10
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	9	PUBLIC STREET	126	ALLEY/COURTYARD	11	COMBINED	59
	NUMBER OF ACCESSES	NOT APPLICABLE	9	1 ACCESS	126	02 ACCESS	50	MORE THAN 02	20
	GREEN TERRACE	NOT APPLICABLE	180	YES	10	COMMON USE	10		
	BUILDING AGE	NOT APPLICABLE	10	BEFORE 1970	82	1970 TO 1990	75	1990 TO 2021	34
	GARAGE	NOT APPLICABLE	153	GROUND FLOOR	33	UNDERGROUND	18	COURTYARD	1
	BALCONIES	NOT APPLICABLE	77	TOWARDS STREET	60	TOWARDS ALLEY/COURTYARD	43	STREET/ALLEY/COURTYARD	22
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	61	<50%'	64	'>50%'	75		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	5	COMMON CLOSED GATE FROM STREET	41	THROUGH RESIDENTIAL ACCESS	146	COMBINED	3
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	57	VISUALLY PERMEABLE	33	NOT VISUALLY PERMEABLE	105	NOT VISUALLY PERMEABLE (GREEN)	7
	SIDEWALK	TRADITIONAL	163	PERMEABLE/NOT LEVELED	10	SHARED PAVEMENT/PERMEABLE	25		
	FRONTAL SET BACK	NOT APPLICABLE	139	IMPERMEABLE SURFACE	21	PERMEABLE SURFACE	22	WITH GARDEN	16
	PITCHED ROOF	NOT APPLICABLE	64	YES	121	COMBINED	14		
	MANTAINANCE STATUS	NOT RENEWED	57	RENEWED	118	UNDER RENIVATION	2	NEW (BUILT AFTER 200s)	21

This duality of old and new emphasizes the physical preservation of historical buildings and urban patterns and the retention of the morphological features while improving the area's livability and ecological capacities.

6.1.1.1. Urban Elements Categorization

The subsequent investigation stage involved categorizing the subcomponents found in the study area based on the typological study's data analysis. Five categories (T1, T2, T3, T4, and T5) were developed to capture the different types of buildings and other elements that constitute the urban fabric. This process of grouping the subcomponents aimed to achieve a more cohesive understanding of the study area, like the zoom-out technique in observational analysis. Here are the descriptions of the categories:

- **T1—Newly constructed building (compliant with urban renewal requirements)**

These buildings present diverse uses and were built after the 2000s. They usually conform to the regulations set by the construction code guidelines established for urban renewal (see Figure 46).

Simultaneously with efforts to enhance integration and accessibility to urban green spaces, a noticeable decline in occupational density has been observed in urban blocks with a higher concentration of such buildings. This phenomenon is particularly prevalent in post-socialist cities, such as Budapest. The process of urbanization in post-socialist nations since 1990 has often led to a reduction in the density of existing urban structures, while land use patterns at the expanding peripheries of city regions have started to sprawl (Gerten, Boyko & Fina, 2022).

(a) (b)

Figure 46: Residential buildings located on Lenhossék Street. **(a)** A juxtaposition of a renovated traditional historical building (T2) and a contemporary, newly constructed building (T1)—both entirely residential—defines a typical urban landscape in Frencváros. The noticeable distinctions in scale and constructive standards between the two buildings also add a dimension layer to the urban composition; **(b)** shared courtyard maintained by the residents of the newly built and renovated historic buildings. Source: by author.

- **T2—Traditional historical building (reconstructed)**

These buildings have various uses and physical features typical of the city's central areas. They are part of the "typological" buildings that follow the patterns of the historical urban morphology replicated in the inner city (see Figure 47). This category includes buildings that have been renovated to fit the new urban context while maintaining their aesthetic identity, modularity, and materiality (Kocsis, 2015).

Preservation involves the essential duty of safeguarding the authenticity, character, and operational effectiveness of historical buildings. The urban renovation in Ferencváros was conducted under the idea that the renovation must present an opportunity to restore and enhance the practical utility of our architectural heritage, preventing its decline. Customized interventions can simultaneously elevate building preservation, diminish energy consumption, and improve user comfort, ensuring the enduring relevance of these structures and the resilience of their urban surroundings (Buda et al., 2021).

Figure 47: Buildings at Gát Street highlight the heterogeneous character of the area. The distinctions between the two mixed-use buildings within the same complex arise from their conservation status. The structure on the left side of the image has recently undergone renovation, whereas the one on the right awaits refurbishment. Source: by author.

- **T3—Traditional historical building (not restored or reconstructed)**

These buildings have various uses and present physical features typical of the central areas of the city. They are part of the "typological" buildings that follow the patterns of the historical urban morphology replicated in the inner city. This category exclusively includes non-renovated buildings that are close to their original conformation. In many cases, these buildings are in poor condition and may pose risks to their users due to the potential collapse of their components (see Figure 48). Moreover, several are not fully integrated and adapted to their surroundings' physical and sociocultural conditions, leading to land-use fragmentation.

The current state of this building type, especially concerning the ones located in the IX District, is strongly connected to the significant urban decay that affected specific central areas of Budapest, particularly during the period spanning from 1970 to the mid-1980s. This decay was primarily a consequence of rapid urbanization under the late communist development guidelines and modernist constructive techniques in a period marked by the construction of housing estates, followed by the proliferation of condominiums and other residential resolutions (Kocsis, 2015).

Starting in the 1960s, Ferencváros encountered substantial obstacles in its revitalization initiatives. The lack of significant rehabilitation during the socialist era exacerbated these issues. By 1989, the accumulated cost of postponed maintenance in Budapest was estimated to reach as high as HUF 200 billion or approximately USD 3.3 billion, which amounted to roughly 10 percent of the country's annual GDP in that period.

An additional key element influencing the current status of historic buildings in the area under study is the 1993 Housing Law (Kocsis, 2015). This law granted the local municipalities the discretion to forgo the requirement of privatizing their tenement properties as long as rehabilitation projects were accepted. This strategic measure afforded the Ferencváros municipality substantial control over the real estate speculation encircling these properties, then earmarked for either demolition or renovation as part of the district's revitalization efforts. Consequently, buildings falling within this typological category remain in their original state, awaiting interventions.

Figure 48: Structures at Viola Street vacated and isolated by the local municipality have languished for years, awaiting renovation efforts. Local residents were either compensated or relocated to alternative housing managed by the municipality while awaiting the completion of the construction works. However, this strategy intensifies challenges tied to urban gentrification, furthering the displacement of vulnerable populations to the city's outskirts. Source: by author.

- **T4—Large-scale institutional building**

These buildings are intended for institutional use and are larger than the typical subcomponents of the pattern identified in the analyzed urban region. They usually deviate from the conventional configuration of implantation and land use, although in some cases, they present typological elements that approximate the local morphological characteristics. They often serve as landmarks that stand out in the urban fabric and are crucial in constructing the symbolic imaginary of the urban context's users (see Figure 49). It is also worth underscoring that in this district region, there is a notable presence of educational institutions, making this area one of the centers of this activity in the city.

Figure 49: Contemporary aspect of the facade of the Semmelweis College building at Thaly Kálmán Street.
Source: by author.

• **T5—Urban Void**

Underutilized, vacant, or abandoned urban spaces that lack defined functions—arising from urban decay, economic shifts, planning decisions, or natural disasters— that create gaps within the city's fabric. In Ferencváros, many of these vacant urban spaces resulted from the demolition of previously existing buildings on the site. The demolition may have been due to incompatibility with the ongoing urban renewal requirements, inadequacy, decay of the original use, or real estate speculation (see Figure 50). Many urban voids identified in District IX resulted from the deactivation of former medium- and small-sized industrial facilities [18].

The extensive economic transformation experienced by post-socialist nations led to significant deindustrialization while driving the growth of consumer and producer services. This process created a surging demand for commercial and residential spaces, such as new offices, retail facilities, and mixed-use buildings in and around urban centers. As a result of these shifts, there was a substantial increase in suburbanization, urban expansion, and, consequently, the occupation of underutilized former industrial areas (Kovács et al., 2019).

Figure 50: Urban void at Lenhossék Street, undergoing preparations for residential development scheduled to start in 2023. Source: by author.

As depicted in Figure 51, only a minority of historic buildings in the study area did not undergo any requalification. As a result, these subcomponents are poorly integrated into the established urban fabric after the intervention. These buildings are organized around private and closed courtyards and generally require restoration. However, most historic buildings underwent restoration and adaptation procedures to fit the new urban proposal. For instance, some buildings were integrated into the network of green areas (primarily for semi-public use) by creating green pedestrian alleys and integrating courtyards. The study area also has a relatively high percentage of buildings intended for institutional use, which reflects the purpose to generate new uses/flows and connect the location to the regional scale.

Despite this region’s wide variety of institutions, educational organizations stand out in number and scale. The Semmelweis University Center of Theoretical Medicine, for example, was opened on 6 November 2008, in Tűzoltó Street. The significance of this establishment extends beyond its academic role, as it has become a symbol of district revitalization. Due to its size and

prestige, it has brought a substantial influx of individuals, including many international students and instructors, to an area previously in a state of decline. Thus, its architectural characteristics also differ drastically from those found in its surroundings, not only because of its scale but mainly due to its architectural characteristics and contemporary construction solutions—with emphasis on its large glazed facades and skylights, which allow transparency and connection with the exterior, and its flat slim concrete roof with sections covered in green for water retention. This facility is strategically located within walking distance of other essential components of the Faculty of Medicine, including dormitories, clinics, and hospitals, thereby integrating it into a robust network of medical and healthcare institutions at the regional level.

Figure 51: Buildings in the study area identified according to the categorization of typological subcomponents. Source: by author

6.1.2. Urban Typological Survey Main Outcomes and Discussion

These results demonstrate the effectiveness of using a typological survey combined with a GIS database to analyze morphological conditions in urban areas undergoing renovation. By assessing the area in place and collecting data through this method, it is possible to draw a parallel between the social and spatial segregation within the IX District of Budapest and the work developed in the past decades toward increasing urban performance and promoting global resilience. Therefore, categorizing urban elements can aid in identifying recurring patterns in the structure of cities and, consequently, make it feasible to derive benchmarks for renewing and expanding existing urban territories.

Moreover, the categorization through urban typological analysis can help identify areas that need improvement or revitalization. By analyzing the different categories of urban elements, it is possible to identify areas that lack infrastructure, public spaces, or green elements and develop strategies to fill these gaps (Kolokotsa et al., 2022). In the case of Ferencváros, typological study revealed the municipality's renovation strategy, which involved prioritizing the renovation or replacement of existing urban sub-elements to achieve a more cohesive urban fabric. It is a viable method for documenting dynamic changes within urban spaces. This approach proves particularly

valuable when examining architectural ensembles in urban environments undergoing rapid transformation. Consequently, this methodology extends its utility to the study of the adaptability of spaces, aiming to foster physical and social resilience, possibly dealing with political or environmental disruptions (Fuentes, 2010).

Furthermore, the documentation of physical transformations in the urban environment can be further complexified from the perspective of their social unfolding. In the case of the region analyzed in Ferencváros, there are significant indications of gentrification tendencies despite the application of some preventive measures to avoid the displacement of the local population during the renovation process. The typological survey can identify changes in urban patterns and the emergence of new trends. However, as in the analysis of the gentrification phenomenon, the typological study must consider the broader context, encompassing both neighborhood-specific factors and the impact on the entire city, when analyzing new construction projects (Holm & Shulz, 2018).

Therefore, the execution of this study presented challenges linked to its nature. It may not comprehensively address the complex interplay of social and economic factors influencing urban development, as it focuses on the physical-spatial configuration. Also, its accuracy relies on the quality and completeness of the data collected by the students who collaborated on its execution. While foundational concepts regarding renewal and resilience of urban forms and morphological analysis have been effectively transferred to the students, incorporating the Typological Survey methodology presents a nuanced challenge. Despite the provision of assistance and supervision throughout the process, the inherent character of the Typological Survey methodology introduces a degree of subjectivity into the analysis. As a result, interpretations of urban elements may exhibit variability among different analysts, emphasizing the need for continued refinement and standardization in the application of this method.

This analysis highlights the challenges and opportunities of integrating historic buildings into urban renewal projects. The preservation and revitalization of historic buildings can be a valuable asset in urban renewal projects, contributing to creating more livable and sustainable urban environments (Fatiguso et al., 2017). However, this requires careful planning and implementation to ensure cultural heritage preservation while meeting contemporary society's needs and aspirations.

6.2. Typological Survey unveiling Green-Regeneration of Modern heritage

Post-socialist cities in Eastern Europe face unique obstacles due to the legacy of modernist spatial conception acclimated to the requirements of the previous political regime. Issues such as urban decay, inadequate infrastructure, and insufficient green spaces compound these challenges. Therefore, the reconstruction and adaptation of these cities aim to improve the quality of life for residents while preserving their unique cultural and historic character.

Despite the growing recognition of green infrastructure's ecological importance and associated benefits to the quality of life, especially in densely occupied urban environments, its contribution to the morphological structure of urban areas has yet to be largely disregarded (Whitehand, 2019). Even in the formulation of modern masterplans, although, in many cases, there was a commitment to maximizing public green spaces, the emphasis often lies on the layout of architectural components rather than prioritizing the relationship between those and the particular features of the green elements. At this level, the application of this method seeks to analyze the morphological impact of green infrastructure on urban environments through a broad typological investigation. By examining how green elements shape urban spaces' physical character and

landscape, the study aims to highlight their crucial role in promoting sustainability and fostering urban resilience.

This session, under typological survey guidelines, aims to assimilate the main characteristics of public green spaces in Budapest's IX district, which was adapted to meet contemporary standards of performance and well-being in European cities. The methodology was developed using materials and analyses gathered during the Urbanism workshop conducted in the spring semester of 2023. A comprehensive curriculum comprising theoretical and practical classes and guided technical visits facilitated content generation. During the workshop, specific parameters were established to ensure the definition of high-quality standards for data collection and interpretation.

Figure 52: View from Telepy utca. Source: by author.

6.2.1. The selection of the study area

The study area chosen for this analysis is a Southwest corner of the core study area in Middle Ferencváros (figure 53). Over the years, this area has been the subject of ambitious renovation projects initiated since the 1970s. These projects aimed to reconstruct the historical urban structure from a modern perspective. However, the majority of these initiatives were not effectively implemented, except for specific interventions, such as the housing estate situated on Haller Street (Locsmándi, 2011). The polygon specified for this study encompasses the aforementioned housing estate and the surrounding blocks. This approach allows for examining the interaction (or lack of connection) between the built complex and the green elements within these blocks, which exhibit distinct morphologies.

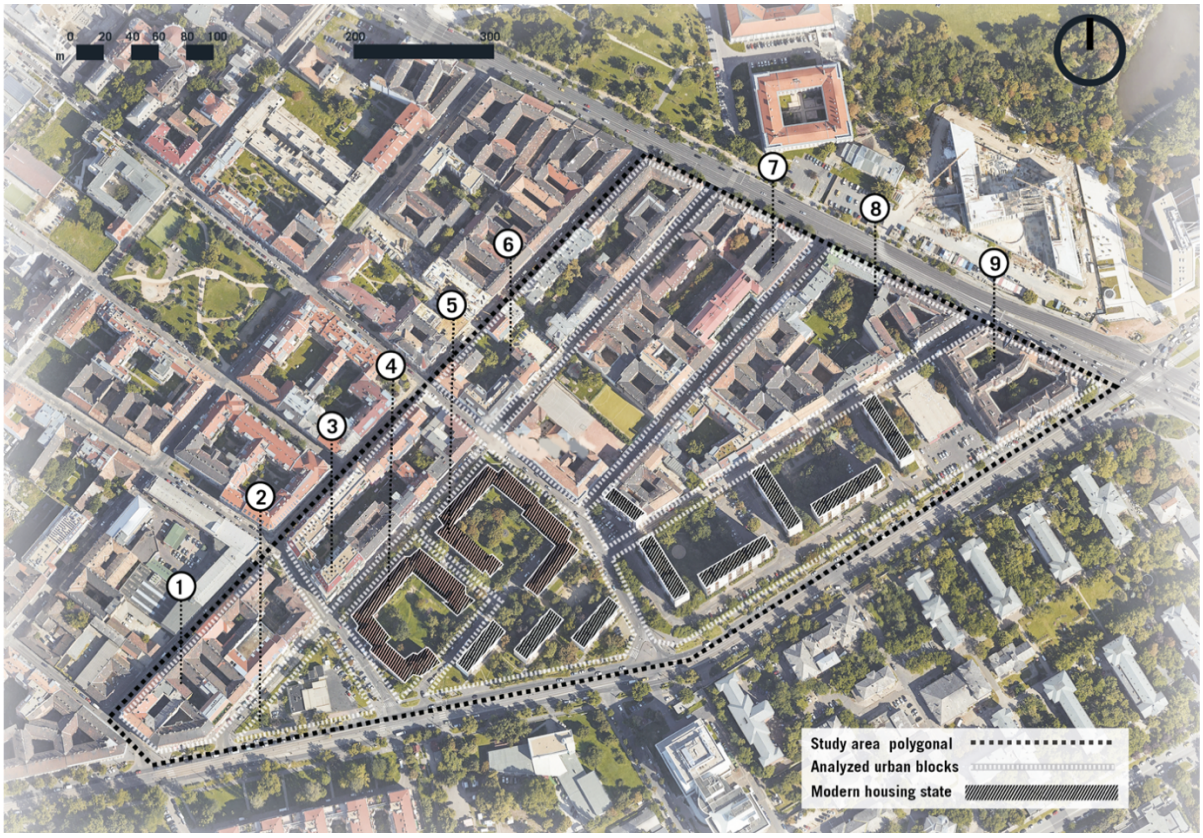


Figure 53: the study area. Source:by author.

Also, this particular area was selected to allow the workshop participants to identify, describe, and categorize the recurring types of green elements concerning the architectural ensemble. This location's abundance of diverse solutions enabled a comprehensive and varied analysis. The initial assessment of the existing structure concentrated on the different types of green elements present within the urban environment. These include green buildings, characterized by the incorporation of green features such as green roofs, green facades, or green balconies; green courtyards, which are open spaces surrounded by buildings and developed with greenery; green streets, which are linear open spaces designed for mobility and enhanced with green elements, in some cases through the inclusion of green frontal building setbacks; gardens, that can be described as green open spaces nestled among buildings; public parks, which are, for the sake of this investigation, large open spaces featuring significant vegetation designed and maintained to cater to recreational activities and contribute to ecological balance; and finally, the investigation also assesses public squares, urban open spaces accessible to the public and designed to accommodate recreational and leisure functions.

6.2.2. The Urban Green Typology Assessment

The assessment criteria are derived from the various recurring types of green elements mentioned above, ensuring a comprehensive evaluation. The table prepared for the in-loco investigation is divided into four evaluation subgroups devised to cover the structure and essential features of the area's use patterns (see Table 4).

First, the Urban Green Morphology covers the nature and form of the green spaces, including canopy coverage, dominant vegetation types, and spatial distribution. The focus is on how green

elements are arranged and the extent of their presence. The Ownership and Management Structure subcategory addresses the legal and operational aspects of the green spaces, including property ownership, management responsibility, maintenance, and patterns of use. It distinguishes between public, private, and mixed ownership, as well as levels of care. The Functional Role and Physical Environment subcategory focuses on the role of green spaces within the urban environment, detailing their function (leisure, residential, connection, etc.), the dominant physical characteristics (pavement type, outdoor furnishing), and their overall environmental impact. The Spatial Layout and Architectural Integration subcategory explores the spatial arrangement of green spaces in relation to the surrounding architecture, including the block structure, open space size and shape, and interaction with building facades. It focuses on how green spaces are integrated with urban design and architectural elements. These elements contributed to the overall evaluation of the spaces in terms of their functionality, aesthetics, and user experience (Zhu & Ling, 2022).

Vegetation forms and types played a significant role in the assessment, initially ranging from individual trees, lines of trees, groups of trees, hedges, individual or grouped bushes, flowerbeds, lawns, mixed perennial, and bushy surfaces. However, fewer elements were listed as recurrent in the assessment table. This way, the green pattern was analyzed, including the spatial organization and ratio of existing vegetation forms, the overlapping layers of forms, and their density status.

Table 4: Green typology assessment. Source: by author.

Urban Green Typology Survey										
Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%		20%< x < 70%		>70%					
Form (most relevant element)	Group of trees		Line of rees		Bushes		Lawn		Mixed	
Shape	scattered		linear		compact					
Ownership and Management Structure										
Management	Public		Private		Mixed					
Ownership	Public		Private		Public with private appropriation					
Maintanance Status	Intensively maintained		Extensivly maintained		Lack of care					
Pattern of use	Intense - protracted use		intense - connection path		Light - protracted use		Light - connection path			
Functional Role and Physical Environment										
Function	Leisure		Urban residential area		Connection		Other functions			
Ratio or percentage of green area	<20%		20%< x < 70%		>70%					
Dominant Pavement	Predominantly green cover		Water permeable paving		Non permeable paving					
Outdoor Furnishing	Not applicable		exinting, insufficient		exinting, sufficient					
Building layout	Not applicable		Unified Courtyard		Individual coutyard		Detatched Building			
Urban block structure	Transparent		Enclosed		Scattered					
Spatial Layout and Architectural Integration										
Size	small		Medium		Large					
Shape	Round		linear		rectangular		Triangular			
Space walls type	Bulding facade		Gable		High Hedge		Tree plantation			
Space walls ratio	1/1		1/2		>1/2					
Solar incidence	Low		Medium		High					

6.2.3. Urban regeneration is underway

In the early 2000s, the urban renewal initiative for the middle Ferencváros region gained momentum, characterized by the cooperation between public interests and active participation from real estate investors (Locsmándi, 2011). The local city hall coordinated this collaborative effort. The primary objective of this intervention was to establish a comprehensive green infrastructure and enhance population density within the area. To achieve this goal, two design guidelines were adopted, among other standards: the creation of shared green courtyards and the preservation of essential morphological elements that contribute to the region's urban and landscape intrinsic characteristics. Utilizing vacant land, whether originally unoccupied or resulting from demolishing inoperable historic buildings, played a crucial role in the renovation process, facilitating adaptation and restoration efforts.

However, it is essential to note that the renovation process did not unfold uniformly and simultaneously across the entire region. Instead, urban interventions were strategically implemented in designated "Centers of Gravity" as determined by the City Hall. As anticipated,

the positive transformations gradually extended to other parts of the area. While these interventions were dispersed throughout the territory, the renewal efforts were initially more concentrated along the Ferenc körút axis, with fewer noticeable effects observed in the vicinity of Haler Street - precisely within the study area.

6.2.3.1. The site layout

The housing estate examined in this study is situated within a highly diverse urban environment, which has also been considered for contextual purposes. In this particular case, the layout of the buildings is characterized by detached strip-like formations, a design choice viable for industrialized construction techniques. This architectural configuration is reflected in the arrangement of semi-closed green courtyards, with roads and car parking primarily located outside or at the ends of urban blocks (Wittmann, Kopáčik & Leitmannova, 2019). This particular configuration sets it apart from the surrounding blocks, where high occupancy rates and the traditional layout of historic buildings pose challenges to implementing a cohesive and extensive green infrastructure.

The analyzed area has yet to experience the impact of the urban renewal process, which allowed speculation on the ripple effects of renewal initiatives, especially in terms of the quantity and quality of green spaces. It is important to note that these areas remain in a state of high heterogeneity, primarily consisting of buildings categorized as T3 (Traditional historical buildings that have not undergone renovation).

Consequently, this particular area presents a blend of architectural elements that contribute to a diverse urban landscape, which is also reflected in the varying qualities of green infrastructure. Using Landsat 8 satellite data from 2 August 2022, an NDVI analysis was conducted (see Figure 54). This analysis revealed that modern housing estates predominantly occupy the greenest urban blocks, while the urban blocks consisting mainly of historic buildings that have not yet undergone renovation exhibited the poorest NDVI results.

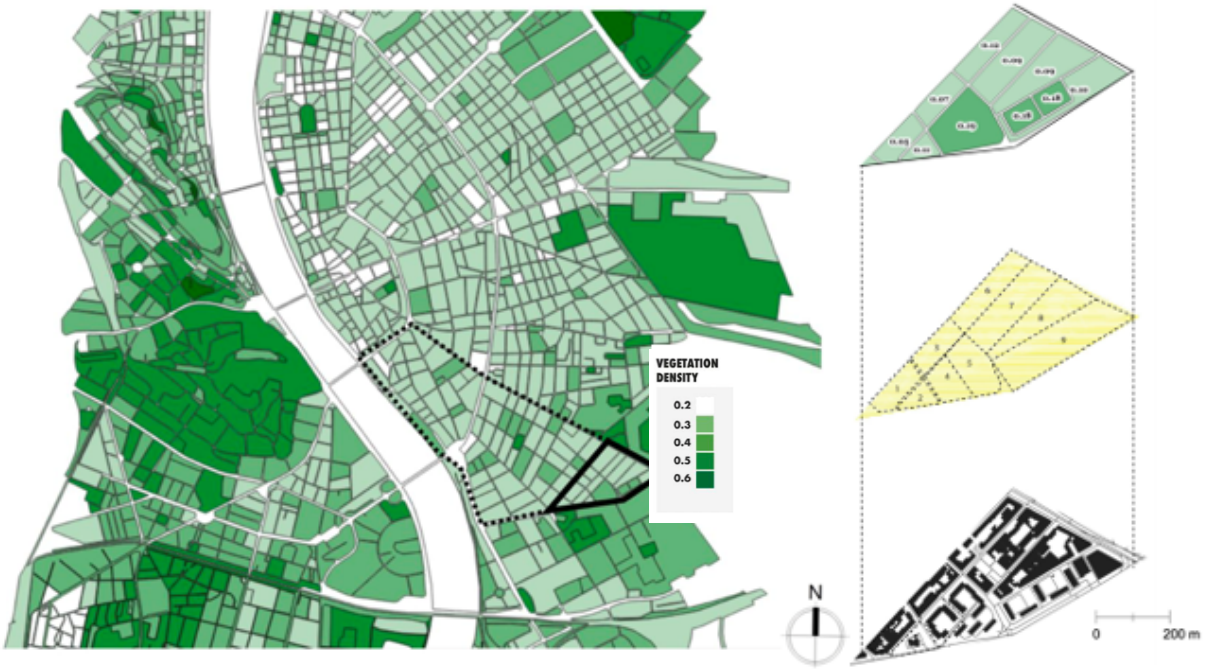


Figure 54: NDVI analysis highlighting the prevalence of green areas in renovated sections of Middle Ferencváros as well as in sections occupied by modern housing estates- Landsat 8 Satellite 2022.08.02. Source: outcome of the Urban Planning Workshop (MATE), 2023.

While the modern residential complexes show significant potential for transformation, they remain in a state of relatively low preservation. These areas still need to undergo substantial interventions within the broader context of ongoing urban renewal efforts in the neighborhood. It is worth noting that regions with a higher prevalence of green features tend to be situated in areas where urban renewal efforts have been more comprehensively implemented, particularly in the northwest study areas.

The prevalence of green areas within blocks undergoing advanced urban renewal is directly linked to the accelerated pace of gentrification and population displacement. Typically associated with urban renewal strategies in relatively small, central areas (Kovács, Wiessner & Zischner, 2013), gentrification takes on a nuanced character in this case. The analyzed area in District IX, with its heterogeneous nature and comparably lower population density than more central areas of the same district, underscores the need to reassess the industrial and railway belt encircling the city—a pattern observed in other European cities with similar configurations.

It is essential to note the diverse pressures exerted on local populations, whether directly or indirectly, compelling them to relocate to the outer rings of Budapest. While the significance of urban greening is widely acknowledged for fostering sustainability and climate resilience in cities (Weiszer & Fekete, 2021; Iungman, et al., 2023), introducing new green infrastructure may inadvertently contribute to the ongoing gentrification dynamics (Anguelovski, et al., 2022; Eplényi, Fekete & Kabai, 2007).

6.2.4. Green Typological Survey Analysis

The results of the typological study were analyzed through a comparative approach, aiming to assess the perspectives of each group of students on the various aspects outlined in the survey. It is necessary to note that all groups evaluated the same aspects in the same study area. The

collected data were then organized according to urban blocks and interpreted within these subgroups.

In this study, the housing estates spotlighted in the evaluation are situated in the urban blocks 04, 05, and 09, which visibly influence the area's green morphology and physical spatial organization. These blocks exhibit significantly more greenery and present larger open spaces, leading to increased sunlight exposure. This stark contrast with the surrounding urban blocks is noteworthy.

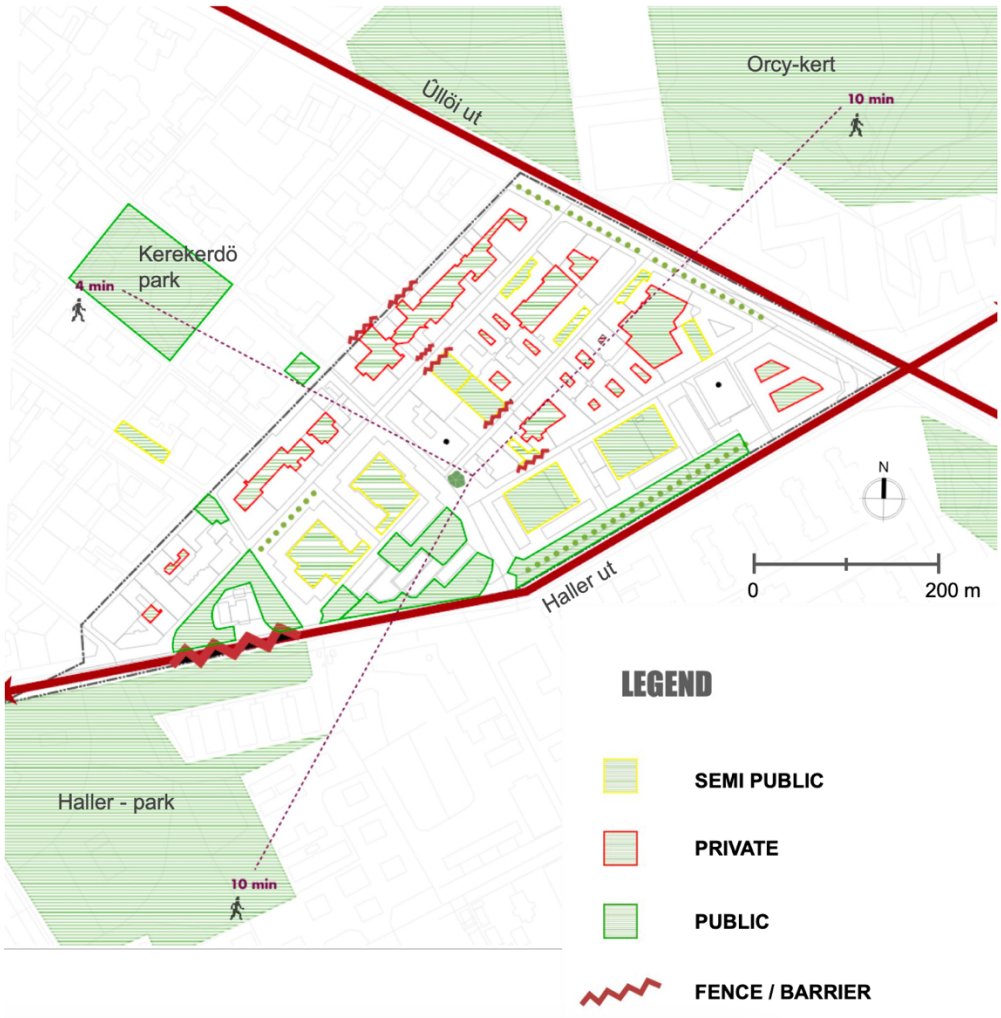


Figure 55: Accessibility analysis of green areas.
Source: outcome of the Urban Planning Workshop (MATE).

Based on the analysis, the following key outcomes have emerged from the study (see more details of the research structure and data compilation in Annex 4):

A. In **Urban Block 01**, regarding Urban Green Morphology, the groups' opinions were divided between scattered and compact shapes. Vegetation arrangement and type were found to impact shape perception. The block primarily serves private residential use, leading to a lack of public spaces maintenance. The Functional Role and Physical Environment analysis revealed a residential function with non-permeable pavement and enclosed infrastructure. Outdoor furniture was not present. The solar incidence was influenced by the interplay of horizontal and vertical elements, and all wall types were identified as facades. Comprehensive findings regarding urban block 01 are delineated in Table 5.

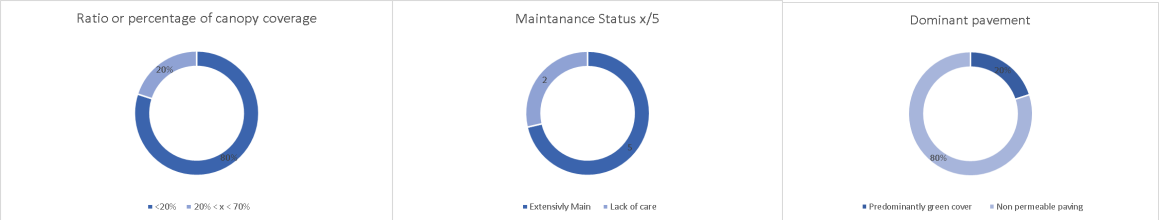


Figure 56: Highlighted items from Table 5.

Table 5: The urban green typological survey of block 01. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. Block 01 is characterized by sparse greenery and lacks public amenities, yet it is well-maintained, with private care attributed to its open areas. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	80%	20% < x < 70%	20%	>70%	0%				
Form (most relevant element)	Group of trees	40%	Line of trees	0%	Bushes	60%	Lawn	60%	Mixed	20%
Shape	Scattered	50%	Linear	0%	Compact	50%				
Ownership and Management Structure		0%		0%		0%				
Management	Public	10%	Private	60%	Mixed	30%				
Ownership	Public	20%	Private	60%	Public with private appropriation	20%				
Maintanance Status	Intensively maintained	0%	Extensivly Main	80%	Lack of care	20%				
Pattern of use	Intense-protacted use	50%	Intense - connection path	0%	Light - protacted use	30%	Light - connection path	20%		
Functional Role and Physical Environment										
Function	Leisure	0%	Urban residential	80%	Connection	20%	Other functions	0%		
Ratio or percentage of green area	<20%	80%	20% < x <70%	20%	>70%	0%				
Dominant pavement	Predominantly green cover	20%	Water permeable paving	0%	Non permeable paving	80%				
Outdoor Furnishing	Not applicable	100%	existing, insuficient	0%	exinting, sufficient	0%				
Building layout	Not applicable	20%	Unified Courtyard	40%	Individual coutyard	20%	Detatched Building	20%		
Urban Block structure	Transparent	20%	Enclosed	60%	Scattered	20%				
Spatial Layout and Architectural Integration										
Size	Small	100%	Medium	0%	Large	0%				
Shape	Round	0%	linear	20%	rectangular	60%	Triangular	20%		
Space walls type	Building facade	100%	Gable	0%	High Hedge	0%	Tree plantation	0%		
Space walls ratio	1/1	40%	1/2	20%	>1/2	40%				
Solar incidence	Low	80%	Medium	0%	High	20%				

B. **Urban Block 02** exhibited diverse vegetation and scattered shapes. Canopy coverage ranged from less than 20% to 20-70%. The block had extensive maintenance, mainly public ownership and management. It consisted of detached buildings with an average green area and predominant green cover. The block structure was transparent, but the outdoor furniture was insufficient. Solar incidence was high due to the relationship between horizontal space and vertical elements. Comprehensive findings regarding urban block 02 are delineated in Table 6.

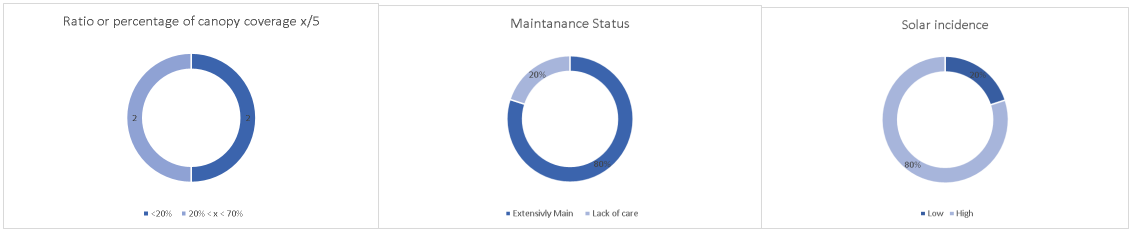


Figure 57: Highlighted items from Table 6.

Table 6: The urban green typological survey of block 02. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. Urban block 02 exhibits an unconventional urban layout characterized by a single establishment—a fuel-filling station—centrally placed in the plot and surrounded by well-maintained, mostly privately tended open spaces with

predominance of impermeable surfaces typical for such usage. The green forms display diversity, with groups of trees, lines of trees, and bushes. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	40%	20% < x < 70%	40%	>70%	20%				
Form (most relevant element)	Group of trees	25%	Line of trees	25%	Bushes	25%	Lawn	10%	Mixed	15%
Shape	Scattered	40%	Linear	20%	Compact	40%				
Ownership and Management Structure										
Management	Public	60%	Private	20%	Mixed	20%				
Ownership	Public	60%	Private	20%	Public with private appropriation	20%				
Maintanance Status	Intensively maintained	0%	Extensivly Main	80%	Lack of care	20%				
Pattern of use	Intense-protacted use	30%	Intense - connection path	30%	Light - protacted use	10%	Light - connection path	30%		
Functional Role and Physical Environment										
Function	Leisure	20%	Urban residential	40%	Connection	20%	Other functions	20%		
Ratio or percentage of green area	<20%	25%	20% < x <70%	75%	>70%	0%				
Dominant pavement	Predominantly green cover	30%	Water permeable paving	0%	Non permeable paving	70%				
Outdoor Furnishing	Not applicable	20%	existing, insuficient	80%	exinting, sufficient	0%				
Building layout	Not applicable	70%	Unified Courtyard	30%	Individual coutyard	0%	Detatched Building	60%		
Urban Block structure	Transparent	60%	Enclosed	20%	Scattered	20%				
Spatial Layout and Architectural Integration										
Size	Small	20%	Medium	40%	Large	40%				
Shape	Round	0%	linear	0%	rectangular	40%	Triangular	60%		
Space walls type	Building facade	50%	Gable	20%	High Hedge	0%	Tree plantation	30%		
Space walls ratio	1/1	20%	1/2	60%	>1/2	20%				
Solar incidence	Low	20%	Medium	0%	High	80%				

C. In **Urban Block 03**, the majority reported less than 20% canopy coverage with scattered and linear shapes. Management was mixed, and public ownership with private appropriation prevailed. Maintenance varied, with some areas lacking care and others being intensively maintained. The block was primarily urban residential, with less than 20% canopy coverage. The paving was mainly permeable, and a unified courtyard was present. Solar incidence perception varied among groups. Comprehensive findings regarding urban block 03 are delineated in Table 7.

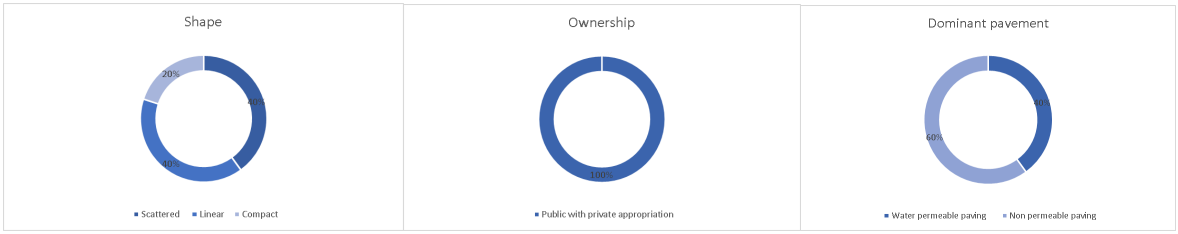


Figure 58: Highlighted items from Table 7.

Table 7: The urban green typological survey of block 03. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. The urban block features limited green coverage, predominantly composed of groups of trees. The ownership and maintenance of the area are split between public and private, explaining the relatively lower maintenance standards. The space walls are defined by higher buildings, with a ratio in relation to open areas close to 1/1. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	100%	20% < x < 70%	0%	>70%	0%				
Form (most relevant element)	Group of trees	50%	Line of trees	0%	Bushes	25%	Lawn	25%	Mixed	0%
Shape	Scattered	40%	Linear	40%	Compact	20%				
Ownership and Management Structure										
Management	Public	20%	Private	40%	Mixed	40%				
Ownership	Public	0%	Private	100%	Public with private appropriation	0%				
Maintanance Status	Intensively maintained	40%	Extensivly Main	20%	Lack of care	40%				
Pattern of use	Intense-protacted use	35%	Intense - connection path	15%	Light - protacted use	15%	Light - connection path	35%		
Functional Role and Physical Environment										
Function	Leisure	0%	Urban residential	100%	Connection	0%	Other functions	0%		
Ratio or percentage of green area	<20%	100%	20% < x <70%	0%	>70%	0%				
Dominant pavement	Predominantly green cover	0%	Water permeable paving	40%	Non permeable paving	60%				
Outdoor Furnishing	Not applicable	80%	existing, insuficient	20%	exinting, sufficient	0%				
Building layout	Not applicable	50%	Unified Courtyard	50%	Individual coutyard	0%	Detatched Building	0%		
Urban Block structure	Transparent	35%	Enclosed	50%	Scattered	15%				
Spatial Layout and Architectural Integration										
Size	Small	100%	Medium	0%	Large	0%				
Shape	Round	0%	linear	40%	rectangular	60%	Triangular	0%		
Space walls type	Building facade	100%	Gable	0%	High Hedge	0%	Tree plantation	0%		
Space walls ratio	1/1	80%	1/2	0%	>1/2	20%				
Solar incidence	Low	33%	Medium	33%	High	33%				

D. **Urban Block 04** held low canopy coverage with compact and scattered shapes. Sixty percent perceived private ownership and mixed management. Maintenance was most intensive, with some areas lacking care. The block showed light protracted use as the primary pattern. It was predominantly residential with over 70% green area, non-permeable pavement, and building facades as space walls. The open space was large and mainly rectangular, with varying perceptions of solar incidence. Comprehensive findings regarding urban block 04 are delineated in Table 8.

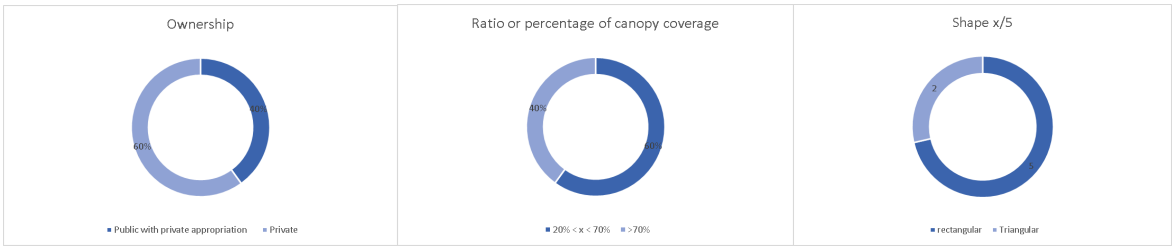


Figure 59: Highlighted items from Table 8.

Table 8: The urban green typological survey of block 04. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. This urban block presents a high percentage of green coverage, with variety in shape and larger open areas in rectangular format. It is primarily residential. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	0%	20% < x < 70%	60%	>70%	40%				
Form (most relevant element)	Group of trees	30%	Line of trees	20%	Bushes	15%	Lawn	10%	Mixed	25%
Shape	Scattered	40%	Linear	20%	Compact	40%				
Ownership and Management Structure										
Management	Public	0%	Private	40%	Mixed	80%				
Ownership	Public	15%	Private	55%	Public with private appropriation	30%				
Maintanance Status	Intensively maintained	40%	Extensivly Main	40%	Lack of care	20%				
Pattern of use	Intense-protacted use	40%	Intense - connection path	25%	Light - protacted use	25%	Light - connection path	10%		
Functional Role and Physical Environment										
Function	Leisure	0%	Urban residential	85%	Connection	15%	Other functions	0%		
Ratio or percentage of green area	<20%	15%	20% < x <70%	15%	>70%	70%				
Dominant pavement	Predominantly green cover	30%	Water permeable paving	30%	Non permeable paving	40%				
Outdoor Furnishing	Not applicable	0%	existing, insuficient	50%	exinting, sufficient	50%				
Building layout	Not applicable	0%	Unified Courtyard	75%	Individual coutyard	25%	Detatched Building	0%		
Urban Block structure	Transparent	60%	Enclosed	0%	Scattered	40%				
Spatial Layout and Architectural Integration										
Size	Small	0%	Medium	40%	Large	60%				
Shape	Round	0%	linear	0%	rectangular	100%	Triangular	40%		
Space walls type	Building facade	60%	Gable	10%	High Hedge	10%	Tree plantation	10%		
Space walls ratio	1/1	50%	1/2	0%	>1/2	50%				
Solar incidence	Low	0%	Medium	50%	High	50%				

E. **Urban Block 05** had canopy coverage higher than 70% with compact shapes. Management was mixed, and public ownership with private appropriation prevailed. Extensive maintenance and intense, protracted use were observed. The function was mainly residential with ambiguous green area percentages. Non-permeable paving was predominant, and solar incidence was low. Space walls included tree plantations and building facades. Comprehensive findings regarding urban block 05 are delineated in Table 9.

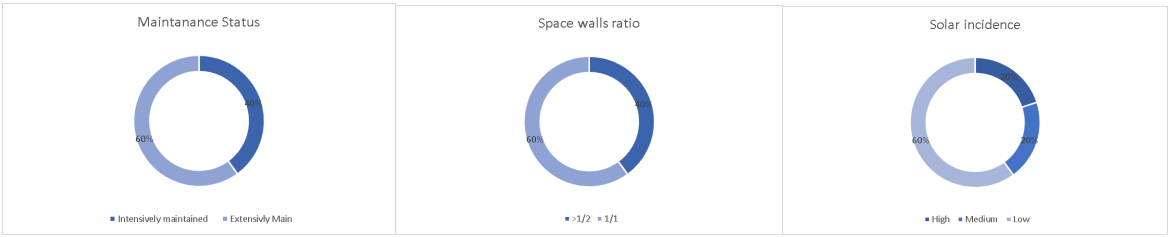


Figure 60: Highlighted items from Table 9.

Table 9: The urban green typological survey of block 05. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. This urban block presents a relatively high percentage of green coverage, resulting from a modernist urban design approach that also defines the layout of the buildings, thus configuring it as a transparent urban block. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	0%	20% < x < 70%	40%	>70%	60%				
Form (most relevant element)	Group of trees	30%	Line of trees	50%	Bushes	20%	Lawn	0%	Mixed	40%
Shape	Scattered	15%	Linear	15%	Compact	70%				
Ownership and Management Structure										
Management	Public	20%	Private	20%	Mixed	60%				
Ownership	Public	0%	Private	40%	Public with private appropriation	60%				
Maintanance Status	Intensively maintained	40%	Extensivly Main	60%	Lack of care	0%				
Pattern of use	Intense-protacted use	45%	Intense - connection path	15%	Light - protacted use	25%	Light - connection path	15%		
Functional Role and Physical Environment										
Function	Leisure	15%	Urban residential	50%	Connection	15%	Other functions	20%		
Ratio or percentage of green area	<20%	40%	20% < x <70%	20%	>70%	40%				
Dominant pavement	Predominantly green cover	20%	Water permeable paving	20%	Non permeable paving	60%				
Outdoor Furnishing	Not applicable	20%	existing, insuficient	40%	exinting, sufficient	40%				
Building layout	Not applicable	20%	Unified Courtyard	80%	Individual coutyard	0%	Detatched Building	0%		
Urban Block structure	Transparent	80%	Enclosed	0%	Scattered	20%				
Spatial Layout and Architectural Integration										
Size	Small	40%	Medium	0%	Large	60%				
Shape	Round	0%	linear	30%	rectangular	60%	Triangular	10%		
Space walls type	Building facade	40%	Gable	5%	High Hedge	15%	Tree plantation	40%		
Space walls ratio	1/1	40%	1/2	0%	>1/2	60%				
Solar incidence	Low	20%	Medium	20%	High	60%				

F. In **Urban Block 06**, private management and ownership predominated. Lack of care and intensive protracted use were observed. The function was entirely urban residential with low green area and non-permeable pavement. The block structure was transparent and enclosed. The open space was medium-sized and rectangular. Building facades were the space walls type, and solar incidence was medium. Comprehensive findings regarding urban block 06 are delineated in Table 10.

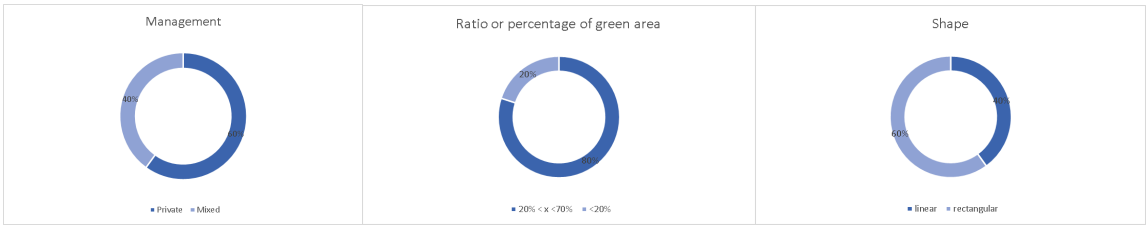


Figure 61: Highlighted items from Table 10.

Table 10: The urban green typological survey of block 06. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. This urban block presents relatively low green coverage. It stands out for its low relevance in terms of connectivity and urban integration, being primarily residential and with open areas privately used. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	40%	20% < x < 70%	60%	>70%	0%				
Form (most relevant element)	Group of trees	30%	Line of trees	10%	Bushes	10%	Lawn	10%	Mixed	30%
Shape	Scattered	40%	Linear	20%	Compact	40%				
Ownership and Management Structure		0%		0%		0%				
Management	Public	0%	Private	60%	Mixed	40%				
Ownership	Public	0%	Private	100%	Public with private appropriation	0%				
Maintanance Status	Intensively maintained	15%	Extensivly Main	15%	Lack of care	70%				
Pattern of use	Intense-protacted use	0%	Intense - connection path	0%	Light - protacted use	30%	Light - connection path	70%		
Functional Role and Physical Environment										
Function	Leisure	0%	Urban residential	100%	Connection	0%	Other functions	0%		
Ratio or percentage of green area	<20%	80%	20% < x <70%	20%	>70%	0%				
Dominant pavement	Predominantly green cover	0%	Water permeable paving	30%	Non permeable paving	70%				
Outdoor Furnishing	Not applicable	100%	existing, insuficient	0%	exinting, sufficient	0%				
Building layout	Not applicable	50%	Unified Courtyard	50%	Individual coutyard	0%	Detatched Building	0%		
Urban Block structure	Transparent	50%	Enclosed	50%	Scattered	0%				
Spatial Layout and Architectural Integration										
Size	Small	40%	Medium	60%	Large	0%				
Shape	Round	0%	linear	40%	rectangular	60%	Triangular	0%		
Space walls type	Building facade	100%	Gable	0%	High Hedge	0%	Tree plantation	0%		
Space walls ratio	1/1	70%	1/2	0%	>1/2	30%				
Solar incidence	Low	0%	Medium	70%	High	30%				

G. **Urban Block 07** presented less than 20% canopy coverage with scattered shapes. Mixed management and predominantly private ownership were observed. Lack of care and intense, protracted use were reported. The block function was mainly residential, with a low green area, non-permeable paving, and transparent and enclosed block structure. Solar incidence varied between high and medium, with building facades as space walls. Comprehensive findings regarding urban block 07 are delineated in Table 11.

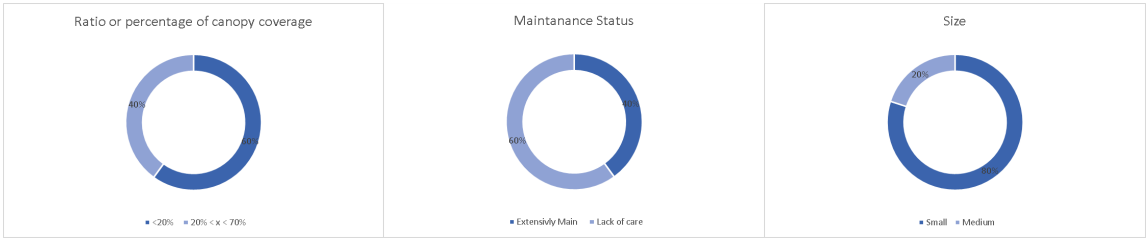


Figure 62: Highlighted items from Table 11.

Table 11: The urban green typological survey of block 07. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. This urban block is primarily residential, with a low percentage of green areas (which are characterized by the predominance of lawns and bushes). The open areas are small and poorly lit. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	80%	20% < x < 70%	20%	>70%	0%				
Form (most relevant element)	Group of trees	25%	Line of trees	0%	Bushes	30%	Lawn	30%	Mixed	15%
Shape	Scattered	50%	Linear	0%	Compact	50%				
Ownership and Management Structure										
Management	Public	20%	Private	50%	Mixed	30%				
Ownership	Public	20%	Private	60%	Public with private appropriation	20%				
Maintanance Status	Intensively maintained	0%	Extensivly Main	70%	Lack of care	30%				
Pattern of use	Intense-protacted use	50%	Intense - connection path	0%	Light - protacted use	30%	Light - connection path	20%		
Functional Role and Physical Environment										
Function	Leisure	0%	Urban residential	80%	Connection	20%	Other functions	0%		
Ratio or percentage of green area	<20%	80%	20% < x <70%	20%	>70%	0%				
Dominant pavement	Predominantly green cover	20%	Water permeable paving	0%	Non permeable paving	80%				
Outdoor Furnishing	Not applicable	100%	existing, insuficient	0%	exinting, sufficient	0%				
Building layout	Not applicable	20%	Unified Courtyard	40%	Individual coutyard	20%	Detatched Building	20%		
Urban Block structure	Transparent	20%	Enclosed	60%	Scattered	20%				
Spatial Layout and Architectural Integration										
Size	Small	100%	Medium	0%	Large	0%				
Shape	Round	0%	linear	15%	rectangular	70%	Triangular	15%		
Space walls type	Building facade	100%	Gable	0%	High Hedge	0%	Tree plantation	0%		
Space walls ratio	1/1	40%	1/2	20%	>1/2	40%				
Solar incidence	Low	80%	Medium	0%	High	20%				

H. In **Urban Block 08**, canopy coverage was less than 20% with linear and compact shapes. Management was mixed, and private ownership prevailed. The area was extensively maintained, with intense, protracted use. The function was residential, with less than 20% green area. Non-permeable pavement dominated, and the building layout had individual courtyards in a transparent block structure. Solar incidence was medium. Comprehensive findings regarding urban block 08 are delineated in Table 12.

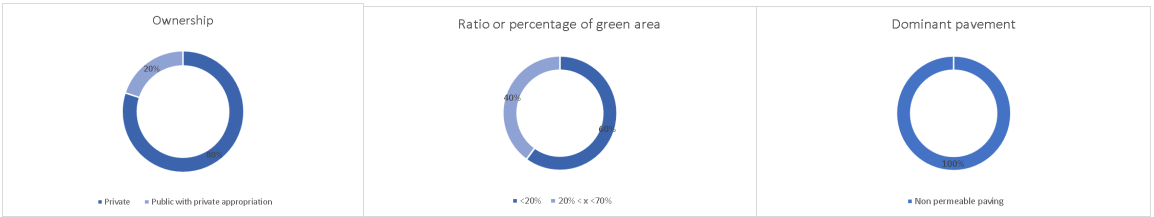


Figure 63: Highlighted items from Table 12.

Table 12: The urban green typological survey of block 08. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. This urban block is primarily residential, containing green spaces that, while not extensive compared to the built areas, showcase a variety of green forms. All the space walls are identified as building facades, and urban furnishings are absent. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	60%	20% < x < 70%	40%	>70%	0%				
Form (most relevant element)	Group of trees	25%	Line of trees	25%	Bushes	25%	Lawn	0%	Mixed	25%
Shape	Scattered	60%	Linear	40%	Compact	0%				
Ownership and Management Structure										
Management	Public	10%	Private	30%	Mixed	60%				
Ownership	Public	15%	Private	70%	Public with private appropriation	15%				
Maintanance Status	Intensively maintained	0%	Extensivly Main	40%	Lack of care	60%				
Pattern of use	Intense-protacted use	20%	Intense - connection path	0%	Light - protacted use	30%	Light - connection path	50%		
Functional Role and Physical Environment										
Function	Leisure	15%	Urban residential	85%	Connection	0%	Other functions	0%		
Ratio or percentage of green area	<20%	80%	20% < x <70%	20%	>70%	0%				
Dominant pavement	Predominantly green cover	30%	Water permeable paving	0%	Non permeable paving	70%				
Outdoor Furnishing	Not applicable	80%	existing, insuficient	20%	exinting, sufficient	0%				
Building layout	Not applicable	40%	Unified Courtyard	20%	Individual coutyard	40%	Detatched Building	0%		
Urban Block structure	Transparent	40%	Enclosed	40%	Scattered	20%				
Spatial Layout and Architectural Integration										
Size	Small	80%	Medium	20%	Large	0%				
Shape	Round	0%	linear	40%	rectangular	60%	Triangular	0%		
Space walls type	Building facade	100%	Gable	0%	High Hedge	0%	Tree plantation	0%		
Space walls ratio	1/1	70%	1/2	0%	>1/2	30%				
Solar incidence	Low	20%	Medium	40%	High	40%				

I. **Urban Block 09** comprises less than 20% canopy coverage with group trees and compact spaces. It exhibited intensive maintenance and a lightly protected pattern of use. The function was mainly residential, with over 70% green cover and a detached building layout. The block was large and rectangular, with building facades as space walls. Solar incidence was medium due to space wall ratios exceeding half. Comprehensive findings regarding urban block 09 are delineated in Table 13.

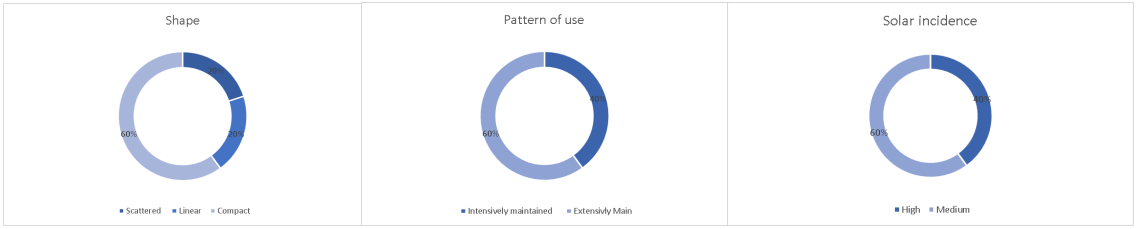


Figure 64: Highlighted items from Table 13.

Table 13: The urban green typological survey of block 09. It identifies key characteristics that define the green urban morphology, utilization, and upkeep of the space. Dominant features are marked in orange, while yellow denotes aspects without a single predominant element. This residential and enclosed urban

block presents an intense-proact pattern of use, which is noteworthy regarding accessibility and urban integration. While sparse, its green features exhibit a broad diversity of forms. Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	100%	20% < x < 70%	0%	>70%	0%				
Form (most relevant element)	Group of trees	30%	Line of trees	25%	Bushes	15%	Lawn	5%	Mixed	25%
Shape	Scattered	0%	Linear	50%	Compact	50%				
Ownership and Management Structure										
Management	Public	20%	Private	30%	Mixed	50%				
Ownership	Public	0%	Private	80%	Public with private appropriation	20%				
Maintanance Status	Intensively maintained	0%	Extensivly Main	60%	Lack of care	40%				
Pattern of use	Intense-protacted use	60%	Intense - connection path	20%	Light - protacted use	20%	Light - connection path	20%		
Functional Role and Physical Environment										
Function	Leisure	0%	Urban residential	80%	Connection	20%	Other functions	0%		
Ratio or percentage of green area	<20%	60%	20% < x <70%	40%	>70%	0%				
Dominant pavement	Predominantly green cover	0%	Water permeable paving	0%	Non permeable paving	100%				
Outdoor Furnishing	Not applicable	80%	existing, insuficient	20%	exinting, sufficient	0%				
Building layout	Not applicable	0%	Unified Courtyard	20%	Individual coutyard	80%	Detatched Building	0%		
Urban Block structure	Transparent	30%	Enclosed	50%	Scattered	20%				
Spatial Layout and Architectural Integration										
Size	Small	80%	Medium	20%	Large	0%				
Shape	Round	0%	linear	20%	rectangular	80%	Triangular	0%		
Space walls type	Building facade	100%	Gable	0%	High Hedge	0%	Tree plantation	0%		
Space walls ratio	1/1	80%	1/2	0%	>1/2	20%				
Solar incidence	Low	20%	Medium	80%	High	0%				

6.2.5. Main outcomes and Discussion

The urban green typological survey conducted in the area confirms the initial NDVI findings, identifying this part of the Ferencváros district as notably green, even though the urban renewal process has not directly impacted it yet. While "groups of trees" are the most common green elements, the distribution of the other analyzed elements remains balanced. The "property" category investigation indicates a mixed-use predominance in the area, with open spaces displaying a semi-private character, likely influenced by the prevalent residential usage.

The findings also highlight a transparent urban block structure, resonating with the area's modern spatial planning. Buildings are arranged discontinuously around common courtyards, promoting visual and physical permeability. This configuration, coupled with a robust articulation with the public transport grid, contributes to an "intense-protracted" usage pattern, displaying the area's prominent urban integration. The open spaces, primarily "small" and "compact," are surrounded by relatively tall building facades - the most frequent space wall found - yet present substantial sunlight, enhancing the quality of the open spaces and green elements (see Table 14).

Table 14: General results of the urban green typological survey – urban blocks 01 to 09.
Source: by author.

Urban Green Morphology										
Ratio or percentage of canopy coverage	<20%	60%	20% < x < 70%	30%	>70%	10%				
Form (most relevant element)	Group of trees	30%	Line of trees	15%	Bushes	20%	Lawn	15%	Mixed	20%
Shape	Scattered	35%	Linear	15%	Compact	50%				
Ownership and Management Structure										
Management	Public	20%	Private	35%	Mixed	45%				
Ownership	Public	15%	Private	65%	Public with private appropriation	20%				
Maintanance Status	Intensively maintained	15%	Extensivly Main	50%	Lack of care	35%				
Pattern of use	Intense-protacted use	40%	Intense - connection path	10%	Light - protacted use	20%	Light - connection path	30%		
Functional Role and Physical Environment										
Function	Leisure	5%	Urban residential	80%	Connection	10%	Other functions	5%		
Ratio or percentage of green area	<20%	60%	20% < x <70%	25%	>70%	15%				
Dominant pavement	Predominantly green cover	25%	Water permeable paving	15%	Non permeable paving	60%				
Outdoor Furnishing	Not applicable	60%	existing, insuficient	30%	exinting, sufficient	10%				
Building layout	Not applicable	25%	Unified Courtyard	40%	Individual coutyard	20%	Detatched Building	15%		
Urban Block structure	Transparent	40%	Enclosed	35%	Scattered	25%				
Spatial Layout and Architectural Integration										
Size	Small	60%	Medium	20%	Large	20%				
Shape	Round	0%	linear	20%	rectangular	65%	Triangular	15%		
Space walls type	Building facade	80%	Gable	5%	High Hedge	5%	Tree plantation	10%		
Space walls ratio	1/1	50%	1/2	20%	>1/2	30%				
Solar incidence	Low	25%	Medium	35%	High	40%				

The results of this study provide evidence supporting the adaptability of open areas within modern buildings, particularly when viewed through a comparative stance. The comparative framework employed in this study has also proven valuable in ensuring the reliability and robustness of the typological data. Adopting this approach makes the methodology more comprehensive, as the observed differences in the results have helped identify equivocations and critically evaluate the assessment parameters. Moreover, it has allowed for the consideration of subjective factors in the investigation regarding the multiculturalism of the groups involved in the process.

However, despite this urban type's potential flexibility and adaptability, this case study has revealed specific challenges to its resilience in terms of urban integration and accessibility (Ribeiro & Gonçalves, 2019). These challenges include the lack of functional diversity, as the analyzed blocks were predominantly residential, and the inadequate maintenance condition of public areas. These issues may derive from the semi-public nature of the urban layout inherent to this type of development.

Addressing the challenges mentioned above, further attention could be given to enhancing functional diversity within these urban blocks, encouraging the integration of mixed-use spaces that cater to the needs of the residents and the surrounding community. Additionally, improving the maintenance of public areas is crucial to ensure the longevity and attractiveness of these spaces (Khakzand, Yazdanfar & Mirzaei, 2016). These findings accentuate the importance of a holistic approach to urban development that considers the physical and environmental aspects and the social and cultural dimensions of the built environment.

7.CONCLUSIONS AND RECOMMENDATIONS

This dissertation explores the relationship between urban morphology and green infrastructure in Budapest's IX District. Using a methodological framework that combines spatial analysis with typological surveys. The aim is to understand how green infrastructure contributes to urban resilience. Focused on cities undergoing significant change, it uses Budapest's IX District as a case study to examine urban, ecological, and morphological adaptation.

Although the Budapest case serves as the central focus of this study, additional relevant connections were also explored. São Paulo and Vienna provide meaningful comparative insights into urban renewal and green infrastructure integration within dense city cores. São Paulo’s urban environment, marked by socio-economic disparities and a significant housing deficit, illustrates challenges and innovations in adapting traditional urban layouts to contemporary sustainability demands. The Parque Novo Santo Amaro project, for example, demonstrates how green spaces can address social vulnerability and environmental concerns, integrating public housing with ecological resilience.

Vienna, on the other hand, exemplifies a cohesive approach to sustainable development, embedding green infrastructure within its historic urban fabric. The renewal of the Landstrasse district showcases how green spaces enhance connectivity and preserve historical identity. Together, São Paulo and Vienna highlight diverse approaches to urban resilience—São Paulo under rapid growth pressures, and Vienna through strategic, integrated planning—demonstrating adaptable models for ecological and social sustainability in urban regeneration.

The conclusion synthesizes key findings and their relevance to regenerative urban strategies, emphasizing implications for urban planning and landscape architecture. The results offer evidence-based insights into resilient urban ecosystems, contributing to both academic studies and practical applications in the field.

The findings underscore the importance of a multidisciplinary approach to addressing urban environmental challenges and suggest pathways for future research and practice in urban resilience and green infrastructure integration.

The following matrix summarizes the research structure, connecting the formulated research questions, the methodologies employed, and the empirical outcomes. It illustrates how each component contributes to an integrated understanding of urban green infrastructure's role in promoting urban resilience and facilitating urban renewal:

Table 15: Research structure summary.
Source: by author.

Research Questions	Methods Used	Results Found
How does the integration of UGI enhance the functional performance and livability of urban areas?	- Supervised Classification to track changes in green areas in the IX District; - Typological Study to analyze green and open spaces' characteristics	- SIC revealed a **16.56% increase in vegetated areas** between 2000 and 2021, contributing to improved livability by creating accessible green spaces and enhancing ecological connectivity (p. 78). - The conversion of industrial voids into green areas also resulted in a **45.5% reduction in exposed soil areas**, improving environmental conditions (p. 78).
What role does a detailed typological appraisal play in identifying resilient urban elements?	- Typological Study to assess urban forms and their uses; - Space Syntax Analysis to understand connectivity	- Typological appraisal identified that **strategic green space placement** fostered urban resilience by enhancing adaptability and improving social interaction zones (p. 58). - Around **30% of green spaces** were composed of tree groups, contributing to both environmental and social resilience (p. 94). - The assessment of **206 buildings** found that **10.19% were newly constructed**, while **89.81%** were historical structures, either restored or awaiting renovation (p. 87).
How does the conversion of private to semi-public green spaces influence urban cohesion and community interaction?	- Space Syntax Analysis to evaluate urban integration; - Typological Study for space usage analysis	- The transformation of private courtyards into **semi-public green spaces** improved urban cohesion by fostering social interactions and inclusivity among diverse populations (p. 65). - These semi-public spaces were **publicly owned but privately maintained**, leading to varied usage and maintenance quality (p. 35).
To what extent does establishing territorial connectivity in dense urban environments support urban resilience and circular economy principles?	- Space Syntax Analysis to assess connectivity; - Supervised Classification to monitor green infrastructure evolution	- Improved **territorial connectivity** through new pedestrian axes enhanced resilience by improving social integration and facilitating more efficient resource use (p. 66). - Green infrastructure networks also improved both the functional and social integration of Ferencváros (p. 64).
Can a comprehensive approach to UGI serve as a strategy against urban decay, and how could it be adapted for various urban contexts?	- Supervised Classification to observe changes over time; - Typological Study to detail green space features and adaptations	- The comprehensive approach to UGI helped mitigate **urban decay** by converting **20,546,853 square meters** of underutilized land into green areas by 2021 (p. 74). - UGI demonstrated its adaptability by successfully integrating different urban contexts, contributing to improved environmental sustainability and social cohesion (p. 74).

7.1. Recommendations for further research

A thorough understanding of the morphological characteristics of urban areas can significantly enhance the effectiveness of renovation strategies. Conducting a typological survey to examine the architectural and spatial features that define an area provides valuable insights into historical continuity, building forms, and spatial arrangements. This ensures that any interventions respect and strengthen the existing urban fabric. When combined with methods like Supervised Image Classification, which assesses green space distribution, and Space Syntax analysis, which examines spatial connectivity, this approach offers a comprehensive understanding of urban spaces. Together, these methods address key dimensions—morphological, environmental, and social—qualifying planners to make informed, context-sensitive decisions that balance heritage preservation with sustainable urban development.

Based on the findings of this dissertation, some areas for further research are recommended to advance the understanding and application of urban green infrastructure (UGI) in sustainable development. Extended comparative studies on UGI across different cities, especially dense urban centers, would provide valuable insights into how green infrastructure can be adapted to various historical and socio-political contexts. Expanding the range of cities studied beyond Budapest, São Paulo, and Vienna could reveal broader trends and best practices in green infrastructure integration.

Longitudinal studies on UGI impacts are essential to understanding the long-term effects on social cohesion, urban resilience, and biodiversity. Tracking the evolution of recently implemented green spaces over time would offer data on their sustained benefits and limitations, particularly in high-density urban areas. This type of research could inform policymakers about the enduring value and potential challenges of green infrastructure projects.

Further refinement in typological surveys combined with advanced technological tools such as GIS, with high-resolution satellite imagery would allow for more precise morphological assessments. Integrating these tools can improve the quality of data on urban form and connectivity, enhancing the decision-making process in urban renewal projects by offering more targeted and context-sensitive interventions.

The analysis of public and semi-public space accessibility, especially regarding courtyards and other shared green spaces, is another crucial area for future research. Examining how increased accessibility to these spaces impacts social interaction and cohesion would be valuable for designing inclusive urban environments. Additionally, exploring models where private-public partnerships manage these spaces could provide insights into optimizing accessibility and maintaining green infrastructure effectively.

Community engagement models are essential for sustainable development, particularly in socio-economically diverse areas. Identifying best practices for involving residents in the design, planning, and maintenance of green infrastructure would enhance local ownership and improve project sustainability. Research into specific engagement models could provide practical frameworks that enhance the social and environmental outcomes of green spaces.

To facilitate detailed urban monitoring, further research on high-resolution remote sensing and SAR technology would be beneficial. These tools could improve tracking of urban morphological changes, providing data that supports sustainable planning practices. By capturing the details of green space transformations, remote sensing technologies would allow for more precise planning assessment, and identification of patterns that can be also found in other settlements, allowing the creation of a comprehensive database.

8.NEW SCIENTIFIC RESULTS

The most significant new scientific contributions of this dissertation can be summarized in the following theses:

Thesis 1: The basis of urban morphology of urban renewal areas of Ferencváros can be characterized by five building types that fundamentally define urban fabric and by which basic characteristics of urban forms can be described. Incorporating the dynamics of public and semi-public spaces into the analysis provides a deeper understanding of the interplay between urban forms, environmental context, and community functions.

The method focuses on a typological study that identifies and categorizes urban elements, with emphasis in features that align with regenerative urban strategies. By providing a detailed understanding of the urban fabric and linking these elements with green infrastructure networks, it highlights the ecological considerations in urban planning and the role of green spaces in urban morphology and livability.

Extending the analysis to public and semi-public spaces, the method examines their impact on community life and the dynamics of urban environments, offering insights into designing more resilient cities. Field investigations involving focus groups and surveys emphasize practical application and validate the method through empirical data.

Upon completing the typological study and examining the emergent trends, five distinct typologies were identified as constitutive elements of the study area's urban framework:

- **T1—Newly Constructed Buildings:** structures that align with the proposed contemporary urban design and renewal principles, enhancing functionality (e.g., increasing urban density and allowing more territorial integration) while being mostly typologically conceived.
- **T2—Reconstructed Historical Buildings:** These are historically significant buildings updated to meet current use and conservation standards while keeping most of their original morphological features. Some volumetric alterations can be found in many of the units classified in this category—mainly on the back courtyard wings or the roof configuration—but the scale, proportions, overall aesthetics, and access conditions remain preserved.
- **T3—Unrenovated Historical Buildings:** These are aging historic structures that preserve most of their original characteristics but await renovation or reconstruction to align with the renewed surroundings.
- **T4—Large-Scale Institutional Buildings:** Prominent buildings serving public or institutional functions, often symbolic and contributing to the area's identity.
- **T5—Urban Voids:** Underutilized, vacant, or abandoned spaces within the urban fabric that lack a defined function, result from economic shifts, urban decay, planning decisions, or natural disasters, and represent gaps in the urban fabric. These were key elements in the Middle-Ferencváros urban renewal, presenting opportunities for multifunctional developments, predominantly articulated with green spaces with public or semi-public access.

This method offers a comprehensive framework for analyzing urban morphology, bridging quantitative and qualitative assessments. It provides a holistic view that integrates historical development with contemporary urban challenges, guiding interventions that contribute positively to the urban context and support sustainable development goals. The dissertation contributes

significantly to urban studies through this method, offering a replicable approach for future research and urban planning initiatives.

Thesis 2. The time-lapse analysis of Supervised Image Classification proved the significant increase in green spaces in the long run, despite temporary reductions caused by renewal activities. Temporary declines in green spaces, due to the strategic reconfiguration of urban forms, can ultimately contribute to a more integrated and effective green infrastructure.

Supervised Image Classification (SIC) was used to analyze land use and land-cover changes over three different periods: 2000, 2011, and 2021. This approach helped establish a comparative framework to identify transformations in the urban landscape, emphasizing the evolution of green infrastructure over time.

The results indicated significant changes in land cover, especially in green areas and exposed soil. In several cases, the areas classified as exposed soil in the 2000s resulted from abandoned or underutilized former industries. In 2021, the research indicated a reduction of 45.5% in those areas. It also revealed a 16.56% increase in vegetated areas from 2000 to 2021. Notably, a 43.3% decrease in green spaces was observed in 2011 compared to 2000, which was initially puzzling. Further investigation clarified that this reduction was a temporary consequence of the urban restructuring efforts underway. During this period, smaller individual courtyards were undergoing transformation into larger, more cohesive green spaces. The strategic reconfiguration aimed to enhance the quality and continuity of urban greenery, setting the stage for the subsequent increase in vegetation coverage by 2021. This process underscores the dynamic nature of urban development, where temporary reductions in green areas can lead to more integrated and beneficial green infrastructure over the long term.

By 2011, the imagery analysis had already displayed a noticeable grid of green infrastructure and its comprehensive articulation of linear and nodular elements, indicating progress in urban requalification projects. By 2021, the consolidation of the green space system was evident, with a more balanced proportion of green components in built areas. The transformation aimed to enhance urban resilience, improving territorial cohesion by reducing urban voids and implementing green elements extensively. The study confirmed that the urban requalification of Ferencváros was effective in enhancing urban cohesion and green infrastructure, as evidenced by the gradual reduction in exposed soil areas and the increase in vegetation over the study period.

Thesis 3: Supervised Image Classification can provide the environmental baseline for the study by providing a clear overview of spatial changes, however, it does not explain how these green spaces interact with the built environment. The combination of methods Supervised Image Classification and Typological Survey can offer a more complete understanding of how environmental changes in green infrastructure align with urban and social dynamics.

In my research I, demonstrated the implementation of urban green infrastructure and details its morphology using a combination of supervised classification and typological survey. The area, characterized by historical urban structures, initially lacked comprehensive green infrastructure, exhibiting fragmented and sparse green elements. This deficiency was attributed to the morphological characteristics of the historic urban fabric, which evolved from closed blocks and buildings centered around narrow, poorly lit courtyards devoid of significant green spaces.

The study combines SIC and the Typological Survey to explore green space development from two perspectives: Environmental Baseline and urban Integration. SIC establishes the

Environmental Baseline by quantifying changes in green space coverage, mapping the expansion of vegetation, and the reduction of exposed soil. Typological Survey focuses on the morphological conditions, examining how different types of green spaces, such as historical courtyards or newly created parks, are integrated into the urban fabric. This analysis reveals the physical characteristics, uses, and roles of green spaces, showing how they influence social interaction and environmental function.

Thesis 4: The inclusion of urban green infrastructure elements in Space Syntax analysis allows for an assessment of urban areas from the perspective of spatial dynamics. Although the limitation of space syntax in analyzing green morphological elements lies in its primary emphasis on spatial relationships and connectivity rather than the qualitative attributes of spaces, this approach facilitates a more holistic understanding of urban environments, recognizing the interdependence of physical layout, green spaces, and urban life.

This approach combines quantitative and qualitative analysis, linking historical development with modern urban challenges. Space syntax analysis is a powerful analytical tool for understanding the spatial configuration of urban environments, particularly in terms of the open space network and how it influences movement, interaction, and accessibility within cities, its focus is predominantly on the spatial relationships and connectivity between different urban elements, rather than on the detailed characteristics of those elements themselves.

Based on the case studies of Budapest and Vienna strategic interventions driven by public-private collaboration, urban integration proved to be increased by the restructured urban blocks supplemented with accessible green infrastructure elements. Blocks became more porous with the addition of green alleys, communal courtyards, and cohesive green networks which revitalized the areas and enhanced resilience by aligning with the morphological guidelines identified in the typological assessment.

The study revises concepts from Space Syntax and applies them to urban green infrastructure. This adaptation enriches the understanding of urban integration, particularly how green spaces contribute to urban areas' spatial organization and connectivity.

Moreover, the study's use of Space Syntax to evaluate green infrastructure highlights the importance of thoughtful design in urban planning. It suggests that the strategic placement and configuration of green spaces can significantly impact urban cohesion.

Space syntax provides structural analysis, a valuable tool for understanding how people move through and use spaces but does not explore the specific attributes or quality of those spaces.

Green morphological elements, such as the types and forms of vegetation, its proportions, functions, and layout, for instance, require site-specific studies beyond space syntax's scope. These elements are crucial for understanding the ecological and social value of green spaces, their contribution to urban ecosystems, and their impact on human well-being.

To thoroughly analyze green morphological elements, the research integrated space syntax with GIS analysis (supervised classification) and typological survey (at the urban structure and green infrastructure level). This multidisciplinary approach allows for a comprehensive understanding that includes both the spatial configuration and the qualitative attributes of urban green spaces, examining the morphological aspects of green infrastructure and how these elements can be strategically utilized to enhance urban cohesion.

Thesis 5. The Urban Green Typological Survey (UGTS) I developed provides a structured method for evaluating urban morphology and the integration of green infrastructure, effectively identifying patterns and supporting urban trend projections.

Organized into four main subgroups—Land Use, Commerce and Service Unity, Residential, and Urban Landscape and Greenscape—the survey offers a comprehensive view of the urban fabric, based on the compilation of individual architectural and urban design elements, and facilitates the identification of recurring patterns. In large-scale urban renovation projects, such as Middle Ferencváros, this survey can forecast potential solutions and preventively address issues before implementation.

The urban typological survey revealed that the study area is primarily mixed-use (66% of units) indicating a balanced functional diversity in the zone where the renovation is most mature. The research area can also be considered a compact, low-rise urban form typical of historic European centers, with 73.3% of buildings lacking setbacks. Shared green elements in 63.1% of courtyards promote neighborhood cohesion, while the strong connectivity —evident from Space Syntax analysis—can be linked to elements such as the prevalence of dual access points (61.2% of buildings). Commercial units, accessible at street level (69.9%) and often featuring multiple entry points, enhance walkability and support interaction with residential spaces.

Courtyards with open gates (27.7%) and visually permeable elements (51%) increase the pedestrian experience and contribute to an open landscape ambiance. Traditional sidewalks, present in 79.1% of units, reflect the use of traditional infrastructure solutions while limiting permeable surfaces. Most buildings (39.8%) predate 1970, preserving the area's historical character, and establishing the modularity baseline for newer unities.

By recognizing recurring design elements and correlating survey data with findings from other analytical methods, this approach enables informed decisions on block layout, uses distribution, and green elements integration.

The evaluation subgroups are structured as follows:

- **Land Use**: This subgroup assesses the layout and spatial organization of blocks, examining their influence on public space quality, connectivity, and complexity. It helps define how land distribution and block structure affect public and semi-public space accessibility, especially from the perspective of the courtyards and building setbacks.
- **Commerce and Service Unity**: This section evaluates the placement and distribution of commercial and service units, analyzing how these contribute to dynamic, accessible public spaces. It seeks to understand the service units as a network, impacting the urban permeability, and their physical characteristics in connection to their immediate surroundings.
- **Residential**: This subgroup focuses on residential use, focusing on its urban integration and composition of historical patterns. In areas like Ferencváros, where residential use predominates, this analysis underscores how housing adapts within existing urban layouts, preserving continuity while accommodating new needs.
- **Urban Landscape and Greenscape**: This subgroup identifies elements particularly relevant for the landscape configuration, such as visual barriers and pathways, and assesses their impact on public space quality, highlighting the role of green infrastructure in enhancing urban environments.

Furthermore, visual aids, icons, and focus group activities can help standardize data collection, making the typological survey a valuable tool for capturing the complexities of urban renewal while balancing historical preservation with modern needs.

Thesis 6: The Urban Green Typological Survey (UGTS), along with NDVI findings, confirms that the southern portion of Middle Ferencváros exhibits substantial greenery, structured in a typical post-socialist modern arrangement, despite limited direct urban renewal efforts.

The second stage of the Typological Survey focuses on green infrastructure features and integrates with established concepts from the urban typological analysis, such as urban block structure, spatial organization, building distribution, ownership, and maintenance of open spaces. It evaluates physical attributes and qualitative aspects, including user perceptions of scale, modularity, strategic placement, and boundaries of green areas, besides their shape and patterns.

The four subgroups introduced to categorize the green elements are:

- **Urban Green Morphology:** This subgroup addresses the characteristics and arrangement of green spaces, including estimated canopy density, primary vegetation types, and spatial layout. This classification highlights how green components are distributed within the urban fabric and their relative density.
- **Ownership and Management Structure:** This subgroup examines the legal and operational dimensions, including aspects such as ownership status (public, private, or shared), management responsibilities, maintenance practices, and usage patterns. It provides insights into the level of care and accessibility based on ownership and governance.
- **Functional Role and Physical Environment:** this subgroup focuses on the purpose and ecological role of green spaces within the city, covering activities they support (e.g., recreational, residential, or connectivity functions), predominant surface materials, and the presence of furniture or pathways. It assesses how these spaces contribute to the broader environmental context and user engagement.
- **Spatial Layout and Architectural Integration**: analyzes the configuration of green spaces in relation to surrounding buildings and urban structure. This subgroup examines the size, shape, and positioning of green areas, as well as their relationship with building facades and architectural boundaries, highlighting how these spaces fit into and enhance the built environment.

The survey shows that groups of trees are the predominant green element, constituting 30% of the green space configuration, with other green forms remaining balanced across the study area. In the Ownership and Management Structure category, 65% of open spaces are under mixed-use ownership, providing these areas a semi-private character shaped by an 80% residential function that influences their usage patterns.

The survey also reveals a transparent urban block structure (35%), with buildings arranged discontinuously around shared courtyards, enhancing both visual and physical permeability. This layout, combined with strong public transport links, supports an 'intense-protracted' usage pattern in 40% of spaces, reflecting a high level of urban integration. Most open spaces are small (60%) and compact (65%), surrounded by tall facades (50%) that nonetheless provide ample sunlight, enhancing the quality and usability of these green areas. Collectively, these characteristics bolster the resilience and livability of the Ferencváros district, emphasizing the essential role of green infrastructure in fostering sustainable and adaptable urban environments.

Thesis 7: By performing the three scientific methods tested, Supervised Classification, Space Syntax analysis and Urban Green Typological Survey, in sequence and comparing the results, it sets an interdisciplinary methodological structure to examine the complexities of urban green morphology. By integrating quantitative and qualitative approaches, this methodology offers a comprehensive understanding of the spatial, functional, and morphological dynamics of green infrastructure within the urban fabric.

This synthesis aims to elucidate the complex interplay between urban fabric and green infrastructure, offering a robust toolset for comprehensive urban green morphology analysis.

- **Supervised Image Classification**: Acting as the foundation, this method quantifies changes in green space distribution over time. By mapping the evolution of vegetation and impermeable surfaces from a broad perspective, it establishes the **Environmental Baseline**. This baseline enables a data-driven analysis of how urban green spaces have developed over time, setting a clear foundation for further investigation into spatial and architectural relationships.
- **Space Syntax Analysis**: Building on the environmental data provided by Supervised Classification, Space Syntax examines the **Spatial Configuration** of green infrastructure within the urban grid. This method uncovers the relational aspects of green spaces—how they connect to and integrate with public spaces, how accessible they are, and how their layout supports or hinders urban interaction and cohesion. This goes beyond simple quantification, offering insights into the **connectivity and accessibility** of green infrastructure within the urban fabric.
- **Urban Green Typological Survey**: Moving to a more detailed level, Typological Studies focus on **Architectural Integration**. This analysis delves into the specific characteristics of individual green spaces, assessing their form, function, and socio-spatial dynamics. Typology examines how the physical features of these spaces either contribute to or detract from the effectiveness of green infrastructure, particularly how different green elements integrate within the architectural and social landscape of the city.

The convergence of these methodologies in a unified analytical framework underscores the complexity of urban green morphology and the necessity of a multifaceted approach to fully comprehend it. This integrative framework enhances our understanding of urban green spaces and is a valuable tool for urban planners and designers. It informs the creation of more resilient, ecologically rich, and socially engaging urban environments, highlighting the importance of interdisciplinary approaches in urban studies.

Therefore, this comprehensive methodological strategy emphasizes the synergy between different analytical lenses, each contributing essential dimensions to our understanding of urban green spaces. By weaving together quantitative data, spatial relationships, and qualitative analysis, this research offers a methodology for informed and sustainable urban development strategies.

Thesis 8: Ferencváros district in Budapest serves as a prime example of urban forms adaptation, demonstrating the essential mechanisms for successful urban renewal. The district's transitional character, situated near a low-density urban fringe, has facilitated experimentation with atypical renovation methods. This unique context, while preserving strong historical ties, presents a diverse urban fabric that requires careful articulation. The ability to reconcile historical preservation with contemporary transformation is particularly evident in the district's strategic approach to urban green spaces.

Post-socialist urban centers such as Budapest have undergone considerable political and social upheavals, significantly influencing the developmental strategies for transitional zones adjacent to low-density rings. These zones - commonly found in comparable historical European cities - articulate the dense urban core and the suburban peripheries. This research catalogs and examines the physical transformation of one of these intermediary areas, employing a set of analytical criteria developed to identify the predominant types - and consecutively the

characteristic elements of this urban morphology and, therefore, offering a critical examination of the urban renewal process.

The study develops a parametric methodology to analyze urban transformation in Budapest, providing a framework for replicating and comparing similar changes in other adapting urban areas. This approach helps understand the interconnections between urban form, social dynamics, and development policies. It also increases the generalizability of the findings and offers a scalable method for studying urban transformation across different landscapes.

The Typological Survey of the area discloses an urban environment marked by morphological continuity. The assessment of 206 buildings (seen as urban unities) evaluated in the first focus group found 10.19% of entirely new buildings, most of which were designed to be seamlessly articulated, with the large majority of 89.81% of historical buildings - spanning both restored and pending renovation urban unities. Amidst recent intense public and private (primarily residential or mixed-use) developments, the area largely preserves its remaining historical structures, with most buildings dating back to the 19th and 20th centuries, in addition to incorporating morphological features like modularity, form, and territorial configuration/layout in new developments. It demonstrates resilience transcending individual enduring elements and spaces, revealing the resilient nature of the area's comprehensive urban attributes.

8.1. Contributions to Science

The research develops and evaluates a new method combining different scientific tools to analyze urban morphology, particularly in regions undergoing urban renewal. This method identifies individual urban structural elements through a typological study, linking these elements to other data layers, such as green infrastructure networks and systems of public and semi-public spaces connected by green pedestrian pathways. The study explores the emergence of new networks within restructured territories, advancing to a detailed interpretation of morphological conditions, including the shape, design, layout, proportion, materiality, and connections of green and non-green elements.

The selection of study areas is closely tied to the noticeable scarcity of scientific research focusing on the adaptation and morphological integration of urban areas outside the frequently studied contexts of North America, Western Europe, and, more recently, Southeast Asia. There is a notable gap in the literature concerning successful case studies from large South American cities and post-socialist urban centers in Eastern Europe, highlighting a critical need for expanded geographical diversity in urban studies research. This underrepresentation highlights the importance of broadening the scope of urban research to include these less examined dense regions, enhancing the understanding of urban adaptation and integration across varied socio-political and historical contexts.

The typological research aims beyond understanding the spatial organization's connection to green elements for promoting vibrant, sustainable, and resilient urban centers. It also focuses on methodological experimentation. The questionary for local assessment was prepared using results obtained in the first stage of the research. Field investigations were conducted using two distinct focus groups at different times, initially examining different objects individually and later collectively on the same study object.

The analysis included critical comparisons that stimulated discussions about the anticipated versus actual outcomes, with the objective of reducing inconsistencies. This process ensured a thorough examination of the data, promoting a deeper understanding and validating the method's robustness. This comprehensive method enhances understanding of urban morphology and its connection to urban liveability and demonstrates a replicable approach in urban studies, offering insights into methodological strategies and the integration of various analytical tools for holistic urban analysis.

The research illustrates how strategic interventions in the urban environment can revitalize areas, boosting resilience and sustainability. It bridges the gap between quantitative and qualitative assessments, offering a comprehensive view that integrates historical development with contemporary urban challenges. The categorization of urban elements through this methodological approach aids in identifying areas that need improvement or revitalization, providing benchmarks for renewing and expanding urban territories. Moreover, the gathered data informs the proposal development phase, providing a foundation for crafting initiatives that either integrate with or deliberately diverge from their urban surroundings with informed intent. This approach enables the generation of contextually relevant and strategically grounded urban design proposals.

The study also highlights the social dimensions of physical transformations in urban environments, indicating trends like gentrification and their implications within the broader urban context. This analysis contributes valuable insights into urban planning and policy, emphasizing the importance of integrating green infrastructure and promoting sustainable urban development while assisting the local population in the transformative process.

9.SUMMARY

This dissertation explores how urban resilience can be strengthened through morphological transformations, focusing on the integration of Urban Green Infrastructure (UGI) within Budapest's IX District, Ferencváros. By examining the transformation of urban voids, underutilized and inefficient spaces, through morphological adaptation, into cohesive city spaces, the study highlights UGI's impact on enhancing ecological sustainability, socio-spatial cohesion, and resilience. Through a case study approach, this research aims to develop a methodology to understand and propose urban environments responsive to contemporary urban challenges.

Urban Morphology and Connectivity

Ferencváros demonstrates strong morphological continuity, with 89.81% of 206 assessed buildings being historic. Shared courtyards (56 units) highlight the resilience of historical layouts and semi-public configurations in renovated areas. A comparison with Vienna's III District reveals that both cities use green infrastructure to reconnect fragmented spaces, although cultural and administrative differences yield unique public space experiences. While Ferencváros prioritizes courtyards, accessibility is sometimes limited due to maintenance practices. This creates a varied cityscape but, at some points, threatens the previously established landscape character. Most buildings have 2 access points (126 units), highlighting good connectivity within the area. The presence of multiple access points likely improves circulation and accessibility, facilitating movement within and around the district.

Green Infrastructure and Typological Patterns

SIC analysis shows a 16.56% increase in vegetation over two decades, reducing urban voids and improving green connectivity while transforming largely unplanned green elements into a structured infrastructure. Typological surveys reveal that 30% of green elements are groups of trees, with 35% of buildings organized around transparent, shared courtyards, enhancing visual and physical permeability. However, open spaces are compact and bordered by tall facades. Public transport access and urban layout support a high integration level with "intense-protracted" usage in 40% of spaces.

Ownership, Accessibility, and Functional Diversity

About 65% of green spaces are mixed-use owned, with 80% mainly residential, granting semi-private characteristics but limiting functional diversity. While visually accessible, some areas lack practical accessibility and maintenance, highlighting the need for improved functionality and upkeep to support resilience.

Challenges and Adaptability

Despite the positive impacts of green infrastructure on connectivity, the renewal process raises challenges in heritage preservation, as some historic structures were partially or entirely modified. Adopting Kropf's (2017) concept of "configuration," the partial reconfiguration of courtyards, though challenging heritage preservation, reinforces spatial cohesion by revitalizing urban patterns. The methodology, especially SIC and typological surveys, proved effective for assessing green infrastructure and urban morphology.

Implications for Urban Resilience and Sustainable Development

Findings underscore that integrating green infrastructure within historical urban fabrics significantly enhances resilience, promoting connectivity, social cohesion, and environmental sustainability. Typological surveys effectively identify underutilized spaces and can guide renewal efforts, ensuring that green infrastructure meets both ecological needs and morphological parameters. For sustained resilience, future Ferencváros renewal projects should prioritize functional diversity and enhanced maintenance. Comparative insights from Vienna's III District underscore the importance of culturally informed policies and adaptive approaches in creating sustainable, livable urban environments that respect historical context.

Scholarly Contributions and Practical Implications

The dissertation advocates for an integrated approach to urban design that prioritizes the multifunctional benefits of green infrastructure. By categorizing urban elements, the research can be an instrument for identifying areas needing enhancement setting benchmarks for urban renewal. Data collected during the study inform the development of urban proposals, grounding them in context and strategy. The research also acknowledges the social impacts of urban transformations, such as gentrification, within the broader urban context, contributing valuable insights to urban planning and policy.

Conclusions and Future Directions

As urban areas continue to evolve, this research serves as a foundational reference for developing future urban strategies that balance human and environmental well-being, paving the way for further investigations into the nuanced dynamics between green infrastructure and urban morphology.

Community engagement models remain vital for sustainable development, especially in diverse socio-economic areas. Research into best practices for resident involvement in green infrastructure planning and maintenance could enhance ownership and sustainability. Finally, combined analysis of the overlapping methods could deliver deeper insights, supporting the development of a comprehensive urban database for informed planning.

References

[1] AKSÖZEN, M., HASSLER, U., KOHLER, N. (2017): Reconstitution of the dynamics of an urban building stock. In: *Build. Res. Inf.* 45, 239–258 pp.

[2] ACIOLY, C. JR., DAVIDSON, F. (1996): Density in urban development. In: *Building Issues*. 3 (8). Sweden: Lund Centre for Habitat Studies, Lund University.

[3] ALHASSAN, V., et al. (2020): A deep learning framework for land-use/land-cover mapping and analysis using multispectral satellite imagery. In: *Neural Comput. Appl.* 32, 8529–8544 pp. doi: https://doi.org/10.1007/s00521-019-04349-9

[4] ALSADATY, A. (2022): A typological approach to maintain character in historic urban areas. Urban Des Int. 27. 198–210 pp. https://doi.org/10.1057/s41289-022-00181-1

[5] ANDEXLINGER, W. (2015): Suburban processes of islandisation in Austria: The cases of Vienna and Tyrol. In: *Urban Island Studies*, 1 (2015), 118-133 pp.

[6] ANGUELOVSKI, I., et al. (2022): Green gentrification in European and North American cities. In: *Nat. Commun*. 13, 3816. doi: https://doi.org/10.1038/s41467-022-31572-1

[7] ARNFIELD, A. (2003): Two decades of urban climate research: A review of turbulence, exchanges of energy and water, and the urban heat island. In: *International Journal of Climatology*. 23 (1) 1-26 pp. doi: https://doi.org/10.1002/joc.859

[8] ASKAR, R., BRAGANÇA, L., GERVÁSIO, H. (2022): Design for Adaptability (DfA)—Frameworks and Assessment Models for Enhanced Circularity in Buildings. In: *Applied System Innovation* 5, (1) 24. doi: https://doi.org/10.3390/asi501002

[9] BAKAY, E. (2012): The role of housing estates' green surfaces in forming the city climate of Budapest. In: *Applied Ecology and Environmental Research*. 10. 1-16 pp. doi: 10.15666/aeer/1001_001016

[10] BALOGH, P.I., TAKÁCS, D. (2011): The significance of urban open spaces and green areas in urban property developments. In: *First International Conference Horticulture and Landscape Architecture in Transylvania* [Agriculture and Environment Supplement]. Romania: Sapientia Hungarian University of Transylvania. 110-121 pp.

[11] BARKE, M. (2018): The Importance of Urban Form as an Object of Study. 11-30 pp. In: OLIVEIRA, V., (Ed.): *Teaching Urban Morphology* [The Urban Book Series]. Cham, Switzerland: Springer.

[12] BARTON, H. et al. (2009): Healthy urban planning in European cities. In: *Health Promot. Int*. 24 (Suppl. 1), 191–199 pp.

[13] BATTY, M. (2003): The emergence of cities: complexity and urban dynamics. [CASA Working Paper Series 64]. London, UK: Centre for Advanced Spatial Analysis. 16 p. Retrieved from: https://discovery.ucl.ac.uk/id/eprint/231/

[14] BENKŐ, M. (2011): Budapest urban blocks and their sustainability. In: *A&U.* 45. 188-201 pp. Available at: https://www.researchgate.net/publication/293366684_Budapest_urban_ blocks _ and_their _sustainability. Accessed in 13 Sep. 2023.

[15] BENKŐ, M. (2015): Budapest's large prefab housing estates: Urban values of yesterday, today and tomorrow. In: *Hungarian Studies*. 29. 21-36 pp. doi: 10.1556/044.2015.29.1-2.2

[16] BENKŐ, M., GERMÁN, T. (2016): Crime prevention aspects of public space renewal in Budapest. In: *Journal of Place Management and Development*. 9. 191-209 pp. doi: 10.1108/JPMD-09-2015-0034

[17] BERG, M., et al. (2016): Visiting green space is associated with mental health and vitality: A cross-sectional study in four European cities. In: *Health & place*. 38. 8-15 pp. doi: 10.1016/j.healthplace.2016.01.003.

[18] BERTYÁK, Á. (2021): Urban Morphology: The Classical and Modern Research Methodologies. In: *Period. Polytech. Archit.* 52, 135–145 pp. doi: https://doi.org/10.3311/PPar.17988

[19] BIBRI, S. E., KROGSTIE, J., KÄRRHOLM, M.(2020): Compact City Planning and Development: Emerging Practices and Strategies for Achieving the Goals of Sustainability. In: *Developments in the Built Environment.* 4. doi: 100021.doi:10.1016/j.dibe.2020.100021

[20] BISHOP, P., WILLIAMS, L. (2012). The Temporary City. Oxon: Routledge. 256p.

[21] BOEING, G. (2018): Measuring the complexity of urban form and design. In: *Urban Des Int* 23, 281–292 pp. doi: https://doi.org/10.1057/s41289-018-0072-1

[22] BRAMLEY, G., POWER, S. (2009). Urban form and social sustainability: the role of density and housing type. Environment and Planning B: Planning and Design, 36 (1) 30–48 pp. doi:10.1068/b33129

[23] BUDA, A., et al. (2021): Conservation-Compatible Retrofit Solutions in Historic Buildings: An Integrated Approach. In: *Sustainability.* 13, 2927. doi: https://doi.org/10.3390/su13052927

[24] Budapest Municipality (2017): Budapest 2030 Long-Term Urban Development Concept. Retrieved from [https://budapest.hu/api/file/doc/BP%20ZÃ¶ldinra%20II.%20kÃ¶tet%20-%20KoncepciÃ³.pdf]

[25] CHEN, D., STOW, D. (2002): The effect of training strategies on supervised classification at different spatial resolutions. Photogramm. Eng. Remote Sens, 68, 1155–1162 pp.

[26] CHESHMEHZANGI, A. (2022): Green Infrastructure and Urban Sustainability: An Editorial. 1-17 pp. In: CHESHMEHZANGI, A. (Eds.): *Green Infrastructure in Chinese Cities. Urban Sustainability.* Singapore: Springer. https://doi.org/10.1007/978-981-16-9174-4_1

[27] CHILDS, M.C. (2010): Creating Vibrant Public Spaces: Streetscape Design in Commercial and Historic Districts. In: *J. Urban Des.* 15, 287–289 pp. doi: https://doi.org/10.1080/13574801003638103

[28] CHOLDIN, H. (1978). Urban Density and Pathology. Annual Review of Sociology. In: *Annual Reviews Sociology*. 4. 91-113 pp. Retrieved from: https://www.jstor.org/stable/2945966

[29] CIRIANNI, F. (2018): A Review Methodology of Sustainable Urban Mobility Plans: Objectives and Actions to Promote Cycling and Pedestrian Mobility. In: *Green Energy and Technology*. SSPCR 2017. 685–697 p. doi:10.1007/978-3-319-75774-2_46

[30] COHEN, G. B. (1987): Society and Culture in Prague, Vienna, and Budapest in the Late Nineteenth Century. In: *The East European Quarterly,* 20, 467-484 pp.

[31] CONNOP, S. et al., (2016). Renaturing cities using a regionally-focused biodiversity-led multifunctional benefits approach to urban green infrastructure. In: *Environmental Science & Policy*. 62. 99-111 pp. doi: https://doi.org/10.1016/j.envsci.2016.01.013

[32] COTELLA, G. (2019): Chapter 7—The Urban Dimension of EU Cohesion Policy. In: MEDEIROS, E. (Eds.): *Territorial Cohesion*. [The urban Dimension] Berlin/Heidelberg, Germany: Springer. 133–151 pp.

[33] DEKKER, K., et al. (2005): Restructuring large housing estates in European cities: an introduction. In: VAN KEMPEN, R., DEKKER, K., HALL, ST. AND TOSICS, I. (eds.) *Restructuring large housing estates in Europe*. Bristol: The Policy Press. 1-17 pp.

[34] DELSANTE, I., BERTOLINO, N. (2014): Urban analysis techniques and role of morphology in post crisis urban design: the case of Rubattino and Ortica districts in Milan. In: *ISUF 21st International Seminar on Urban Form: Our common future in Urban Morphology*, (3-6 July 2014) (Porto, Portugal). 1413-1421 pp.

[35] DI PALMA, F. et al. (2016): A SMAP supervised classification of landsat images for urban sprawl evaluation. In: *ISPRS Int. J. Geo-Inf.* 5 (7), 109. doi: https://doi.org/10.3390/ijgi5070109

[36] DRAHOKOUPIL, J. (2008): Globalization and the State in Central and Eastern Europe: The Politics of Foreign Direct Investment; Abingdon-on-Thames, UK: Routledge. 256 p.

[37] ELKINGTON, J. (1997): Cannibals with Forks: The Triple Bottom Line of 21st Century; Oxford: Capstone. 407 p.

[38] EPLÉNYI, A., FEKETE, A., KABAI, R. (2007): Örökségvédelmen alapuló vidékfejlesztés a Sztánai-völgy térségében. In: BALOGH, B., BODÓ, B., ILYÉS, Z., (Eds.): *Regionalitás, Közösségépítés, Szórványgondozás*. Jebuc, Romania: Zsobok.

[39] ERNSTSON, H., et al. (2010): Urban Transitions: On Urban Resilience and Human-Dominated Ecosystems. In: *Ambio*. 39. 531-45 pp. doi: 10.1007/s13280-010-0081-9.

[40] ESZTER, B.B. (2010): Történelmi Városrészek Átalakulásának Társadalomföldrajzi Vizsgálata Budapest Belvárosában. [Ph.D. Thesis]. Budapest, Hungary: Eötvös Loránd Tudományegyetem. 149 p. Available online: https://teo.elte.hu/minosites/ertekezes2010/berenyi_e.pdf. Accessed on 10 July 2023.

[41] European Environment Agency (2019): The European environment: state and outlook 2020: knowledge for transition to a sustainable Europe. Europe: Publications Office. 508 p. doi: https://data.europa.eu/doi/10.2800/96749

[42] FATIGUSO, F., et al. (2017): Resilience of Historic Built Environments: Inherent Qualities and Potential Strategies. In: *Procedia Eng.* 180, 1024–1033 pp. doi: https://doi.org/10.1016/j. proeng.2017.04.262

[43] FEKETE, A. (2022) Diseño Urbano a través de la Arquitectura del Paisaje. El caso de estudio de Budapest. In: *Anales del IAA*. Buenos Aires, Argentina: Universidad de Buenos Aires. 52. 1–18 pp.

[44] FEKETE, A., HODOR, K., DAI, D. (2021): Urban Sustainability through Innovative Open Space Design. A Novel Approach to the Regeneration of Historic Open Spaces in Some Eastern European Countries and China. In: *Earth.* 2, 405–423 pp. doi: https://doi.org/10.3390/earth2030024

[45] FORGET, Y., LINARD, C., GILBERT, M. (2018): Supervised classification of built-up areas in Sub-Saharan African cities using Landsat imagery and openstreetmap. In: *Remote Sens*. 10 (7) 1145. doi: https://doi.org/10.3390/rs10071145

[46] FUENTES, J.M. (2010): Methodological bases for documenting and reusing vernacular farm architecture. In: *J. Cult. Herit*. 11, 119–129 pp. doi: https://doi.org/10.1016 /j.culher.2009.03.004

[47] FÜRSTAND, A. (2007): Térszintaktika a településkutatásban. [Doctoral dissertation]. Budapest: Budapesti Corvinus Egyetem.

[48] GAUTHIER, H. L. (1973): Transportation and the Growth of the São Paulo Economy. 19-32 pp. In: HOYLE, B. S. (Ed.) *Transport and Development.* [The Geographical Readings Series]. London: Palgrave. doi: 10.1007/978-1-349-15506-4

[49] GAVRILIDIS, A., et al. (2017): Methodological framework for urban sprawl control through sustainable planning of urban green infrastructure. In: *Ecological Indicators*. 96. 67-78 pp. doi: 10.1016/j.ecolind.2017.10.054

[50] GERTEN, C.; BOYKO, D.; FINA, S. (2022): Patterns of Post-socialist Urban Development in Russia and Germany. In: *Front. Sustain. Cities.* 4, 846956. doi: https://doi.org/10.3389/frsc.2022.846956

[51] HALKOS, G.E., GKAMPOURA, E.-C. (2021): Evaluating the effect of economic crisis on energy poverty in Europe. In: *Renew. Sustain. Energy Rev.* 144, 110981. Doi: https://doi.org/10.1016/j.rser.2021.110981.

[52] HAMMERBERG, K., et al. (2018) Implications of employing detailed urban canopy parameters for mesoscale climate modelling: A comparison between WUDAPT and GIS databases over Vienna, Austria. In: *Int. J. Climatol.* 38, e1241–e1257 pp.

[53] HASANZADEH, K., KYTTÄ, M., BROWN, G. (2019): Beyond Housing Preferences: Urban Structure and Actualisation of Residential Area Preferences. In: *Urban Sci.* 3, 21. doi: https://doi.org/10.3390/urbansci3010021.

[54] HEIDT, V., & NEEF, M. (2008): Benefits of Urban Green Space for Improving Urban Climate. 84–96 pp. In: CARREIRO, M. M., et al. (eds.): *Ecology, Planning, and Management of Urban Forests*. Springer. doi:10.1007/978-0-387-71425-7_6

[55] HEPCAN, Ş. (2013): Analyzing the pattern and connectivity of urban green spaces: A case study of Izmir, Turkey. In: *Urban Ecosyst.* 16, 279–293 pp.

[56] HILLIER, B. et al. (1976): Space syntax. In: *Environment and Planning B: Planning and Design*, 3(2), 147–185 pp. doi:10.1068/b030147

[57] HIRT, S. (2014): The Post-Public City: Experiences from Post-socialist Europe. In: *102nd Annual Conference of the Association of Collegiate Schools of Architecture.* Washington, DC: Association of Collegiate Schools of Architecture.

[58] HIRT, S., STANILOV, K. (2009): Twenty Years of Transition: The Evolution of Urban Planning in Eastern Europe and the Former Soviet Union, 1989–2009. Nairobi, Kenya: United Nations Human Settlements Programme. 166 p.

[59] HOLM, A., SCHULZ, G. (2018): GentriMap: A Model for Measuring Gentrification and Displacement. 255-277 pp. In: HELBRECHT, I., (Ed.): *Gentrification and Resistance*. Wiesbaden, Germany: Springer. doi: https://doi.org/10.1007/978-3-658-20388-7_10

[60] HÖLSCHER, K., FRANTZESKAKI, N. (2021): Perspectives on urban transformation research: transformations in, of, and by cities. In: *Urban Transform* 3 (2) 2. doi: https://doi.org/10.1186/s42854-021-00019-z

[61] HORY, G. (2023): Az elsajátítás értelmezése 20. és 21. századi térelméletekben, és egy vizsgálati keretrendszerének megalapozása [Interpreting Appropriation in Space Theories of the 20th and 21st Centuries, and Proposing a Framework for Its Practical Investigation]. In: *Építés - Építészettudomány*, 51(3-4), 345-366 pp. doi: https://doi.org/10.1556/096.2023.00106

[62] IBGE, Brazilian Institute of Geography and Statistics. Housing. Retrieved from: https://brasilemsintese.ibge.gov.br/habitacao.html. Accessed: 04 jun. 2020.

[63] IUNGMAN, T., et al. (2023): Cooling cities through urban green infrastructure: A health impact assessment of European cities. In: *Lancet.* 401, 577–589 pp. doi: https://doi.org/10.1016/S0140-6736(22)02585-5.

[64] JACOBS, A., APPLEYARD, D. (1987): Toward an Urban Design Manifesto. In: *J. Am. Plan. Assoc.* 53, 112–120 pp. doi: https://doi.org/10.1080/01944368708976642

[65] KAMAL-CHAOUI, L., ROBERT, A. (2009): Competitive Cities and Climate Change. OECD, Public Governance and Territorial Development Directorate, OECD Regional Development Working Papers. doi: https://doi.org/10.1787/218830433146

[66] KAPLAN, S. (1995): The Restorative Benefits of Nature: Toward an Integrative Framework. In: *Journal of Environmental Psychology*. 15. 169-182 pp. doi: 10.1016/0272-4944(95)90001-2

[67] KAZEPOV, Y. (2004): Cities of Europe: Changing Contexts, Local Arrangements, and the Challenge to Urban Cohesion. Hoboken, NJ, USA: Wiley-Blackwell. 344 p. doi: https://doi.org/10.1002/9780470694046.ch1

[68] KEUCHEL, J., et al. (2003): Automatic land cover analysis for Tenerife by supervised classification using remotely sensed data. In: *Remote Sens. Environ.* 86, 530–541 pp.

[69] KHADOUR, N., et al. (2021): Correlation between Land Use and the Transformation of Rural Housing Model in the Coastal Region of Syria. In: *Sustainability.* 13, 4357. doi: https://doi.org/10.3390/su13084357

[70] KHADOUR, N., FEKETE, A., SÁROSPATAKI, M. (2023): The Role of the Master Plan in City Development, Latakia Master Plan in an International Context. In: *Land*. 12, 1634. doi: https://doi.org/10.3390/land12081634

[71] KHAKZAND, M., YAZDANFAR, S. A., MIRZAEI, M. (2016). Mixed Use Development, A Solution For Improving Vitality Of Urban Space. In: *Comunicacoes Instituto De Investigacao Cientifica Tropical Serie Ciencias Biologicas*. 33 (1) 134-140 pp.

[72] KOCSIS, J. (2015): Patterns of urban development in Budapest after 1989. In: *Hungarian Studies*. 29. 3-20 pp. doi: 10.1556/044.2015.29.1-2.1

[73] KOLOKOTSA, D., et al. (2022): Analyzing the Impact of Urban Planning and Building Typologies in Urban Heat Island Mitigation. In: *Buildings.* 12, 537. doi: https://doi.org/10.3390/buildings12050537

[74] KONG, L., et al. (2022): The application of resilience theory in urban development: a literature review. In: *Environ Sci Pollut Res.* 29, 49651–49671 pp. doi: https://doi.org/10.1007/s11356-022-20891-x

[75] KORHONEN, J., HONKASALO, A., SEPPÄLÄ, J. (2018): Circular Economy: The Concept and its Limitations. In: *Ecological Economics.* 143. 37-46 pp. doi: 10.1016/j.ecolecon.2017.06.041

[76] KOVÁCS Z, WIESSNER R, ZISCHNER R. (2013): Urban Renewal in the Inner City of Budapest: Gentrification from a Post-socialist Perspective. In: *Urban Studies,* 50 (1) 22-38 pp. doi:10.1177/0042098012453856

[77] KOVÁCS, Z. (1998): Ghettoization or gentrification? Post-socialist scenarios for Budapest. In: *Neth. J. Hous. Built Environ*. 13, 63–81 pp. doi: https://doi.org/10.1007/BF02496934.

[78] KOVÁCS, Z., et al. (2019): Urban sprawl and land conversion in post-socialist cities: The case of metropolitan Budapest. In: *Cities.* 92, 71–81 pp. doi: https://doi.org/10.1016/j.cities.2019.03.018

[79] KOVÁCS, Z., SZIRMAI, V. (2006): Városrehabilitációs beavatkozások és a társadalmi fenntarthatóság kérdései Budapesten [Intervention of Urban Rehabilitation and the Challenges of Social Sustainability in Budapest]. In: *Tér és Társadalom*, 20(1), 1–19 pp.

[80] KOVACS, Z., WIESSNER, R., ZISCHNER, R. (2013): Urban Renewal in the Inner City of Budapest: Gentrification from a Post-socialist Perspective. In: *Urban Stud*. 50, 22–38 pp. doi: https://doi.org/10.1177/0042098012453856

[81] KROPF, K. (2017): The Handbook of Urban Morphology. Chichester, UK: Wiley. 240 p. doi: 10.1002/9781118747711

[82] LERNER, J. (2003): Acupuntura Urbana. Record, Rio de Janeiro, Brasil. 128 p.

[83] LEVY, A. (1999): Urban morphology and the problem of the modern urban fabric: Some questions for research. In: *Urban Morphol*. 3, 79–85 pp.

[84] LI, J., et al. (2023): Urban Resilience: A Systematic Review. 313–323 pp. In: LI, J., et al. (Eds.): *Proceedings of the 27th International Symposium on Advancement of Construction Management and Real Estate*. CRIOCM 2022. Lecture Notes in Operations Research. Springer, Singapore. doi: https://doi.org/10.1007/978-981-99-3626-7_25

[85] LICHTENBERGER, E. (1994): Urban decay and urban renewal in Budapest and Vienna, a comparison. In: *Acta Geograph*. Lovan. 34, 469–477 pp.

[86] LIU, X., et al. (2023): Identification of factors affecting public willingness to pay for heat mitigation and adaptation: Evidence from Guangzhou, China. In: *Urban Clim*. 48, 101405. Doi: https://doi.org/10.1016/j.uclim.2022.101405.

[87] LIU, Y., HUANG, TT. & ZHENG, X. (2022): A method of linking functional and structural connectivity analysis in urban green infrastructure network construction. In: *Urban Ecosyst* 25, 909–925 pp. doi: https://doi.org/10.1007/s11252-022-01201-2

[88] LOCSMÁNDI, G. (2001) Urban and housing renewal in Ferencváros, 9th district of Budapest, Hungary. 15 p. Retrieved from: https://urb.bme.hu/segedlet/angol/Locsmandi-Ferencvaros_ rehabilitation.pdf. Accessed on 08/08/2023.

[89] LOCSMÁNDI, G. (2005): Városmegújítás a Ferencvárosban. 201–228 pp. In: EGEDY, T., (Ed.): *Városrehabilitáció és Társadalom.* Budapest: MTA Földrajztudományi Kutató-Intézet. Budapest, Hungary.

[90] LOCSMÁNDI, G. (2008): Largescale restructuring processes in the urban space of Budapest. Technical University of Budapest. Faculty of Architecture. Department of Urban Design. 76 p. Retrieved from: http://www.urbanisztika.bme.hu/segedlet/angol/urban_space_of_Budapest.pdf

[91] LOCSMÁNDI, G. (2011). Large-Scale Restructuring Processes in the Urban Space of Budapest. In: DALLA LONGA, R. (Ed.): *Urban Models and Public-Private Partnership*. Berlin, Heidelberg: Springer. 131–212 pp. doi: https://doi.org/10.1007/978-3-540-70508-6_4

[92] MCMAHON, E.T., BENEDICT, M.A. (2000): Green infrastructure. In: *Plan. Comm*. J. 37, 4–7 pp.

[93] MEEROW, S., NEWELL, J.P., STULTS, M. (2016): Defining urban resilience: A review. In: *Landsc. Urban Plan*. 147, 38–49 pp.

[94] MICHAELA, P. (2008): The end of the viennese way? Changing strategies and spatial impacts of soft urban renewal in the austrian capital. In: *Investigación y Desarrollo.* 16 (1). 130-145 pp.

[95] MONCLÚS, J., DÍEZ MEDINA, C. (2018): Urban Voids and 'in-between' Landscapes. 247–256 pp. In: DÍEZ MEDINA, C., MONCLÚS, J. (Eds.): *Urban Visions.* Springer, Cham. doi: https://doi.org/10.1007/978-3-319-59047-9_24

[96] MURRAY, M. (2017): Spatial Restructuring on a Global Scale: Enclave Urbanism and the Fragmentation of Urban Space. In: MURRAY, M. (Ed.): *The Urbanism of Exception: The Dynamics of Global City Building in the Twenty-First Century*; Cambridge, UK: Cambridge University Press. pp. 93–146. doi:10.1017/9781316718438.005

[97] NIEMI, M. (2017): Breaking from and building on the past: Helsinki and Dublin after independence. In: *Ir. Hist. Stud*. 41, 238–255 pp.

[98] NILSSON, K., et al. (2014): Strategies for Sustainable Urban Development and Urban-Rural Linkages. In: *European Journal of Spatial Development*. 26 p. Retrieved from: https://research.manchester.ac.uk/en/publications/strategies-for-sustainable-urban-development-and-urban-rural-link. Accessed in: 25 Jun. 2022.

[99] NILSSON, K. et al. (Eds.) (2013): Peri-urban futures: Scenarios and models for land use change in Europe. Springer, 453 p.

[100] NORDH, H., et al. (2009): Components of small urban parks that predict the possibility for restoration. In: *Urban For. Urban Green*. 8, 225–235 pp.

[101] OLIVEIRA, G., et al. (2014): Classificação supervisionada como ferramenta para avaliação da dinâmica do uso e cobertura do solo. In: *Enciclopédia Biosfera*. 10 (18) 924-935 pp.

[102] OSTWALD, M.J.; LEE, J.H. (2023): Computational Analytical Methods for Buildings and Cities: Space Syntax and Shape Grammar. In: *Buildings*. 13, 1613. doi: https://doi.org/10.3390/ buildings13071613

[103] PAFI, M., et al., (2016): Measuring the Accessibility of Urban Green Areas: A Comparison of the Green ESM with Other Datasets in Four European Cities [JRC Technical Reports, European Commission]. Luxembourg: Publications Office of the European Union.

[104] PARK, S., et al., (2014): Influence of urban form on landscape pattern and connectivity in metropolitan regions: a comparative case study of Phoenix, AZ, USA, and Izmir, Turkey. In: *Environ Monit Assess* 186, 6301–6318 pp. doi: https://doi.org/10.1007/s10661-014-3855-x

[105] PASTERNAK, S. (2006): São Paulo e suas favelas. In: *Pós. Revista do Programa de Pós-Graduação em Arquitetura e Urbanismo da FAUUSP.* 19 .176-197 pp. doi: 10.11606/issn.2317-2762.v0i19p176-197

[106] PAULEIT, S., et al. (2017). Urban Landscapes and Green Infrastructure. Oxford Research Encyclopedia of Environmental Science. Retrieved from https://oxfordre.com/environmentalscience/view/10.1093/acrefore/9780199389414.001.0001/acrefore-9780199389414-e-23. Accessed in: 12 Mar. 2024.

[107] PAULEIT, S., et al. (2018): Advancing Urban Green Infrastructure in Europe: outcomes and reflections from the GREEN SURGE project. In: *Urban Forestry & Urban Greening*. 40. 4-16 pp. doi: 10.1016/j.ufug.2018.10.006

[108] PAULEIT, S., et al. (2019): Advancing Urban Green Infrastructure in Europe: Outcomes and reflections from the GREEN SURGE project. In: *Urban For. Urban Green*. 40, 4–16 pp. doi: https://doi.org/10.1016/j.ufug.2018.10.006

[109] PAULEIT, S., HANSEN, R., PRIBADI, D. O. (2021). Editorial: Transformative Urban Greening: Advancing Green Space Governance. In: *Frontiers in Sustainable Cities*, 3. 735918. doi: https://doi.org/10.3389/frsc.2021.735918

[110] PETROVIĆ, M., BACKOVIĆ, V., TOKOVIĆ, (2022):M. Rebuilding post-communist city identity: The case of Novi Pazar, Serbia. In: *Urbani* Izziv. 33, 91–102 pp.

[111] PIKE A., DAWLEY S., TOMANEY J. (2010): Resilience, adaptation and adaptability. In: *Cambridge Journal of Regions, Economy and Society*, 3 (1), 59–70 pp.

[112] PIRRUS, J., LEETMAA, K. (2023): Public space as a medium for emerging governance networks in post-privatised large housing estates in Tartu and Vilnius. In: *J Hous. and the Built Environ*. 38, 17–37 pp. doi: https://doi.org/10.1007/s10901-021-09864-7

[113] RANJHA, M. (2016). Green Infrastructure: Planning for Sustainable and Resilient Urban Environment. In: *United Nations Sustainable Development*. 5 p. Retrieved from: https://sustainabledevelopment.un.org/content/documents/95599_Ranjha_Green%20infrastructure_planning%20for%20sustainable%20and%20resilient%20urban%20environment.pdf. Accessed in: 15 Jan. 2022.

[114] REED, B. (2007): Shifting from "sustainability" to regeneration. In: *Building Research & Information*, 35 (6), 674–680 pp. doi:10.1080/09613210701475753

[115] RIBEIRO, P., GONÇALVES, L. A. J. (2019): Urban Resilience: a conceptual framework. In: *Sustainable Cities and Society.* 50. 101625. doi: 10.1016/j.scs.2019.101625.

[116] RICHARDS, D. R., PASSY, P., OH, R. R. Y. (2017): Impacts of population density and wealth on the quantity and structure of urban green space in tropical Southeast Asia. In: *Landscape and Urban Planning*, 157, 553–560 pp. doi:10.1016/j.landurbplan.2016

[117] RICHARDSON, H. W., BAE, C. H. C. (Eds.) (2005). Globalization and Urban Development; Springer Berlin/Heidelberg: Science & Business Media [Advances in Spatial Science The Regional Science Series]. 322 p.

[118] ROBERTS, B. R., WILSON, R.H. (Eds.) (2009): Urban segregation and governance in the Americas. New York, United States: Palgrave Macmillan. 231 p.

[119] ROBERTS, D. (2019): Superblocks: Barcelona's plan to free itself from cars. In: Kleinman Center for Energy Policy. Retrieved from https://kleinmanenergy.upenn.edu/research/publications/superblocks-barcelonas-plan-to-free-itself-from-cars/. Accessed in: 2 Jun. 2022.

[120] ROBERTS, P.; SYKES, H. (2008): Urban Regeneration: A Handbook. New York, NY, USA: SAGE Publications Ltd. doi: https://www.doi.org/10.4135/9781446219980

[121] RODRIGUES, M. I. R. P. R., FERREIRA, F. A. F., FERREIRA, N. C. M. Q. F. (2023): Constructing smarter and more sustainable urban ecosystems: a dynamic analysis of challenges and initiatives. In: *Annals of Operations Research.* doi: https://doi.org/10.1007/s10479-023-05406-2

[122] ROLNIK, R. (2015): The Program Minha Casa Minha Vida in the metropolitan regions of São Paulo and Campinas: socio-spatial aspects and segregation. In: *Artigos complementares Cad. Metropole São Paulo* 17 (33) 127-154 pp. doi: https://doi.org/10.1590/2236-9996.2015-3306

[123] RWANGA, S.S., NDAMBUKI, J.M. (2017): Accuracy assessment of land use/land cover classification using remote sensing and GIS. In: *Int. J. Geosci*. 8, 611–622 pp.

[124] São Paulo (2018) São Paulo Government. Development Plan and Evironmental Protection. Available on: https://www.infraestruturameioambiente.sp.gov.br/portalmananciais/pdpa/. Accessed in: 10 Jan. 2021.

[125] São Paulo (Municipality). Law No. 16.050, of July 31, 2014. Approves the Urban Development Policy and Strategic Master Plan of the Municipality of São Paulo and revokes Law No. 13.430/2002. São Paulo: Municipal Legislation, 2014. Accessed: 06 Jan. 2021.

[126] São Paulo (Municipality). Municipal Housing Department. Municipal Housing Plan of São Paulo (Bill No. 619/16). Available at: https://gestaourbana.prefeitura.sp.gov. Accessed: 04 Jan. 2021.

[127] São Paulo Municipality (2021): Dados Demográficos dos Distritos Pertencentes Às Subprefeituras, Secretaria Municipal De Subprefeituras, Prefeitura Da Cidade De São Paulo. Prefeitura.Sp.Gov.Br. https://www.prefeitura.sp.gov.br/cidade/secretarias/subprefeituras/subprefeituras/dados_demograficos/index.php?p=12758. Accessed 19 Jan 2021.

[128] São Paulo, Housing Secretary (n.a.): Municipal Housing Plan. Retrieved from: http://pmh.habitasampa.inf.br/. Accessed: 04 Jan. 2021.

[129] São Paulo. Law No. 9866 of November 28, 1997. Provides for guidelines and norms for the protection and recovery of springs of regional interest in the State of São Paulo and provides for related measures and other measures. 1997. Accessed: 10 Jan. 2021.

[130] SCHREIBER, F., CARIUS, A. (2016): The Inclusive City: Urban Planning for Diversity and Social Cohesion. 317–335 pp. In: Worldwatch Institute. *State of the World 2016, Can a City be Sustainable?* [State of the World book series]. Washington, DC: Island Press. doi: https://doi.org/10.5822/978-1-61091-756-8_27

[131] SERRAOS, K., ASPROGERAKAS, E. (2019): Typologies of Bottom-Up Planning in Southern Europe: The Case of Greek Urbanism during the Economic Crisis. In: AREFI, M., KICKERT, C., (Eds.): *The Palgrave Handbook of Bottom-Up Urbanism*. Cham, Switzerland: Palgrave Macmillan. doi: https://doi.org/10.1007/978-3-319-90131-2_11

[132] SETO, K. C. (2024): Achieving Sustainable Urban Growth on a Global Scale. Yale School of the Environment, Yale University. Retrieved from:environment.yale.edu/news /article/achieving-sustainable-urban-growth-on-a-global-scale. Accessed on: 25 Jan. 2024.

[133] SHARIFI, A., YAMAGATA, Y. (2018). Resilient Urban Form: A Conceptual Framework. In: YAMAGATA, Y., SHARIFI, A. (Eds.) *Resilience-Oriented Urban Planning*. Lecture Notes in Energy, vol 65. Springer, Cham. 167–179 pp. doi: https://doi.org/10.1007/978-3-319-75798-8_9

[134] SHEARMUR, R. (2011): What is an urban structure? The challenge of foreseeing 21st century spatial patterns of the urban economy. 95-142 pp. In: GARROCHO, C. (Ed.): *Advances in Commercial Geography: Prospects, Methods and Applications*. Toluca: El Colegio Mexiquense.

[135] SHUKLA, N., DAS, A., MAZUMDER, T. (2023): Assessment of urban form resilience: a review of literature in the context of the Global South. In: *Environ Dev Sustain*. doi: https://doi.org/10.1007/s10668-023-04058-3

[136] SILVA, H. M. B. (2000): Programas de Urbanização e Desenvolvimento do Mercado em Favelas Brasileiras. [Relatório de pesquisa feita para o Lincoln Institute of Land Policy].

[137] SIMON D., GRIFFITH C., NAGENDRA H. (2018): Rethinking Urban Sustainability and Resilience. In: ELMQVIST T, ET AL. (Eds.): *Urban Planet: Knowledge towards Sustainable Cities*. Cambridge University Press. 149-162 pp.

[138] STADDON, C., et al. (2018): Contributions of green infrastructure to enhancing urban resilience. In: *Environ. Syst. Decis.* 38, 330–338 pp. doi: https://doi.org/10.1007/s10669-018-9702-9

[139] STANILOV, K. (Ed.) (2007): The post-socialist city: urban form and space transformations in Central and Eastern Europe after socialism. [GEJL, volume 92]. Dorbrecht:Springer US. 496 p. doi: https://doi.org/10.1007/978-1-4020-6053-3

[140] SUGÁR, V., et al. (2017): Assessment of rehabilitation possibilities in case of budapest jewish quarter building stock. In: *Int. J. Archit. Environ. Eng*. 11, 386–392 pp.

[141] TAHERKHANI, R., HASHEMPOUR, N., LOTFI, M. (2020): Sustainable-resilient urban revitalization framework: Residential buildings renovation in a historic district. In: *J. Clean. Prod*. 286, 124952. doi: https://doi.org/10.1016/j.jclepro.2020.124952

[142] CSAPÓ, T., LENNER, T. (2016). Horizontal Homogeneity and Vertical Heterogeneity of Building Up in Budapest. In: TAMÁS, C., TIBOR, L. (Eds.) *Settlement Morphology of Budapest*. [Springer Geography]. Switzerland: Springer, Cham. doi: https://doi.org/10.1007/978-3-319-28364-7_4

[143] TARABA, J., FORGACI, C., ROMEIN, A. (2022): Creativity-driven urban regeneration in the post-socialist context - The case of Csepel Works, Budapest. In: *Journal of Urban Design*, 27 (2) 161-180 pp. doi: 10.1080/13574809.2021.1951604

[144] THEKKAN, A. F., et al. (2022). Understanding Blue-Green Infrastructure Through Spatial Maps: Contribution of Remote Sensing and GIS Technology. 123-138 pp. In: DHYANI, S., BASU, M., SANTHANAM, H., DASGUPTA, R. (Eds*): Blue-Green Infrastructure Across Asian Countries*. Singapore: Springer. doi: https://doi.org/10.1007/978-981-16-7128-9_6

[145] TIRYAKIAN, E.A. (1968): Typologies. In: *International Encyclopedia of the Social Sciences.* New York, NY, USA: Macmillan. Volume XVI, 177–185 pp.

[146] TOFILUK, A., KNYZIAK, P., KRENTOWSKI, J. (2019): Revitalization of Twentieth-Century Prefabricated Housing Estates as Interdisciplinary Issue. In*: IOP Conference Series Materials Science and Engineering*. 471 (1). 112096. doi: 10.1088/1757-899X/471/11/112096

[147] TOSICS, I. (2006): Spatial restructuring in post-socialist Budapest. In: TSENKOVA, S., NEDOVIĆ-BUDIĆ, Z. (Eds.) *The Urban Mosaic of Post-Socialist Europe. Contributions to Economics.* Heideberg: Physica-Verlag HD. doi: https://doi.org/10.1007/3-7908-1727-9_7

[148] TRANCOSO, U., et al. (2015): Parque Novo Santo Amaro V In São Paulo By Vigliecca & Associados - Architectural Review. In: *Architectural Review*. Available on: https://www.architectural-review.com/buildings/parque-novo-santo-amaro-v-in-sao-paulo-by-vigliecca-associados. Accessed 17 Jan 2021.

[149] TWEED, C., SUTHERLAND, M. (2007): Built Cultural Heritage and Sustainable Urban Development. In: *Landsc. Urban Plan.* 83, 62–69 pp.

[150] TZOULAS, K., et al. (2007): Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. In: *Landsc. Urban Plan*. 81, 167–178 pp.

[151] U.S. Green Building Council. (2014). LEED Reference Guide for Neighborhood Development, LEED v4 Edition. Washington, DC: U.S. Green Building Council. Retrieved from https://www.usgbc.org. Acessed 20 Jul 2022.

[152] UN-HABITAT (2020): United Nations Human Settlements Programme. World Cities Report 2020: The Value of Sustainable Urbanization. Nairobi, Kenya: UN-Habitat. Retrieved from: https://unhabitat.org/. Accessed: 17 May 2022.

[153] UNGERS, M., VIETHS, S. (1999): The Dialectic City. Milan: Skira. 120 p.

[154] Urban Ecology Agency of Barcelona. (2020). 20 years of the Urban Ecology Agency of Barcelona: Ecosystemic Urbanism & Superblocks. Barcelona City Council. Retrieved from: https://bcnroc.ajuntament.barcelona.cat/jspui/bitstream/11703/122999/3/BCNecologia_20%20years_ENG.pdf. Acessed: 10 Jul. 2021.

[155] VAN GENT, W., BOTERMAN, W. (2018): Gentrification Of The Changing State. In: *Tijdschrift Voor Economische En Sociale Geografie*, 110 (1), 35–46 pp. https://doi.org/10.1111/tesg.12331

[156] VAN KEMPEN, R., VERMEULEN, M., BAAN, A. (Eds.) (2005): Urban Issues and Urban Policies in the New EU Countries. Aldershot, UK: Ashgate.

[157] VAN NES, A., YAMU, C. (2021): Introduction to Space Syntax in Urban Studies. Cham, Switzerland: Springer. 250 p. doi: 10.1007/978-3-030-59140-3

[158] Viglecca. Vigliecca Arquitetos Associados. Available on: <http://www.vigliecca.com.br/?locale=pt-BR>. Accessed: 05 Jun. 2020.

[159] VILLAÇA, F. (2011) São Paulo: segregação urbana e desigualdade. Estudos Avançados. São Paulo, Brazil: USP. 37-58 pp.

[160] WANG, Y., SHEN, J., XIANG, W. (2018): Ecosystem service of green infrastructure for adaptation to urban growth: function and configuration. In: *Ecosystem Health and Sustainability*, 4 (5) 132-143 pp. doi: 10.1080/20964129.2018.1474721

[161] WEISZER, Á.; FEKETE, A. (2021): Landscape character and settlement identity. In: BENEDEK, K., DOMOKOS, E., VÁNYOLÓS, E. (Eds.): *Landscape, Garden and Man—Professional Challenges of the Present and of the Near Future*, [Proceedings of the 6th Conference on Horticulture and Landscape Architecture in Transylvania, Târgu Mureș, Romania, 28–29 May 202]. Targu Mures, Romania: Sapientia Hungarian University of Transylvania. 75–85 pp.

[162] WHEELER, S. M.; BEATLEY, T. (Eds.) (2004): The Sustainable Urban Development Reader. London: Routledge. 352 p.

[163] WHITEHAND, J. W. R. (2019): Green space in urban morphology: a historico-geographical approach. In: *Urban Morphology* 23 (1) 5-17 pp.

[164] WHITEHEAD, A. N. (1961): Introduction to Mathematics, New York: Barnes & Noble.

[165] WHO Regional Office for Europe (2002): Second Meeting of the WHO City Action Group on Healthy Urban Planning. Healthy Urban Planning and Transport. In: *Proceedings of the WHO Meeting*, Milan, Italy, 23–24 May 2002. Copenhagen, Denmark: WHO Regional Office for Europe.

[166] WINSLOW, J.F. (2021): Multifunctional green infrastructure: planning and design for long-term care. In: *Socio Ecol Pract Res* 3, 293–308 pp. doi: https://doi.org/10.1007/s42532-021-00088-1

[167] WITTMANN, M., KOPÁČIK, G., LEITMANNOVA, A. (2019): Closed Urban Blocks versus Open Housing Estate Structures: Sustainability Surveys in Brno, Czech Republic. In: *IOP Conference Series: Materials Science and Engineering*. 471. 102061. doi: 10.1088/1757-899X/471/10/102061

[168] WOLFF, M., WIECHMANN, T. (2018): Urban growth and decline: Europe's shrinking cities in a comparative perspective 1990–2010. In: *Eur. Urban Reg. Stud*. 25, 122–139 pp.

[169] YAMAGATA, Y., MARUYAMA, H. (2016): Urban Resilience: A Transformative Approach. [Advanced Sciences and Technologies for Security Applications Series]. Switzerland: Springer. 319 p.

[170] YAMU, C., VAN NES, A., GARAU, C. (2021): Bill Hillier's Legacy: Space Syntax—A Synopsis of Basic Concepts, Measures, and Empirical Application. In: *Sustainability. 13*(6), 3394. doi: https://doi.org/10.3390/su13063394

[171] ZHU, Y., AND LING, G. H. T. (2022): A Systematic Review of Morphological Transformation of Urban Open Spaces: Drivers, Trends, and Methods. In: *Sustainability* 14 (17) 10856. doi: https://doi.org/10.3390/su141710856

[172] ZUCARO A., MASELLI G., ULGIATI, S. (2022): Insights in Urban Resource Management: A Comprehensive Understanding of Unexplored Patterns. Frontiers in Sustainable Cities. 3. 87735. doi: https://doi.org/10.3389/frsc.2021.807735

ANNEXES

Annex 1. Glossary

The following glossary provides definitions and context for the key academic terms and concepts central to this thesis. As this research explores the complex intersections of urban resilience, sustainability, and morphological adaptations in urban environments, it employs a range of specialized terminology critical for understanding the discussions presented.

These terms have been selected based on their relevance to the thesis's core themes and methodologies, including the analysis of Urban Green Infrastructure (UGI), the assessment of urban forms through typological appraisal, and the examination of adaptive urban planning strategies. Each entry defines the term and indicates where it is most frequently discussed within the thesis, offering a roadmap to how these concepts are applied in the study of urban renewal in Budapest's 9th District and other comparative contexts.

Adaptive Urban Planning

A planning approach that focuses on flexibility and resilience, allowing urban areas to adapt to changing conditions and uncertainties.

- *Reference:* Wilkinson, Clare, Libby Porter, and Johan Colding. "Metropolitan Planning and Resilience Thinking: A Practitioner's Perspective." *Critical Planning*, vol. 17, 2010, pp. 24-45.
- **Found in:** Chapter 4 and Chapter 6, where discussions center around the need for urban plans that can respond dynamically to social, environmental, and economic changes, particularly in the context of sustainable development.

Circular Economy

An economic system aimed at eliminating waste and the continual use of resources through recycling, reusing, and sustainable design.

- *Reference: Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition.*Ellen MacArthur Foundation, 2013.
- **Found in:** Chapter 2 and Chapter 5, where the concept is integrated into discussions on sustainable urban development and the reconfiguration of urban centers to minimize environmental impact.

Ecological Infrastructure

Networks of natural and semi-natural features within urban areas that provide essential ecosystem services and enhance environmental resilience.

- *Reference:* Benedict, Mark A., and Edward T. McMahon. *Green Infrastructure: Linking Landscapes and Communities.* Island Press, 2006.
- **Found in:** Chapter 5, particularly in sections discussing Urban Green Infrastructure and its role in enhancing the environmental sustainability of urban areas.

Environmental Impact

The effect that urban development and human activities have on the natural environment, including ecosystems, air, and water quality.

- *Reference:* Glasson, John, Riki Therivel, and Andrew Chadwick. *Introduction to Environmental Impact Assessment.* Routledge, 2013.

- **Found in:** Chapter 4 and Chapter 6, where the analysis of urban renewal projects considers the ecological consequences of development practices and the importance of mitigating adverse effects.

Environmental Sustainability

The practice of developing urban areas in ways that ensure long-term ecological health and resource availability.

- *Reference:* McDonough, William, and Michael Braungart. *Cradle to Cradle: Remaking the Way We Make Things.*North Point Press, 2002.
- **Found in:** Throughout the thesis, especially in Chapters 2, 4, and 6, as a core principle guiding the strategies for urban renewal and morphological adaptations.

Gentrification

A process where urban neighborhoods experience increased investment and economic development, often leading to the displacement of lower-income residents.

- *Reference:* Lees, Loretta, Tom Slater, and Elvin Wyly. *Gentrification.* Routledge, 2008.
- **Found in:** Chapter 3 and Chapter 5, in discussions on the socio-economic consequences of urban renewal, particularly in the context of case studies like Ferencváros and São Paulo.

Green Spaces

Areas of vegetation in urban environments, such as parks and gardens, that provide ecological, social, and health benefits to urban populations.

- *Reference:* Tzoulas, K., et al. "Promoting Ecosystem and Human Health in Urban Areas Using Green Infrastructure: A Literature Review." *Landscape and Urban Planning*, vol. 81, no. 3, 2007, pp. 167-178.
- **Found in:** Chapter 5, where the implementation and benefits of green spaces in urban areas are explored as part of Urban Green Infrastructure strategies.

Morphological Analysis

A method used to study the form and structure of urban environments, focusing on patterns, shapes, and spatial relationships within cities.

- *Reference:* Kropf, Karl. *The Handbook of Urban Morphology*. Wiley-Blackwell, 2017.
- **Found in:** Chapter 4 and Chapter 5, which explore the methodology for evaluating urban forms and their resilience, particularly in the case study of Budapest's 9th District.

Public-Private Partnerships (PPP)

Collaborative agreements between government entities and private sector companies to finance, build, and operate urban infrastructure projects.

- *Reference:* Yescombe, E. R. *Public-Private Partnerships: Principles of Policy and Finance.* Butterworth-Heinemann, 2011.
- **Found in:** Chapter 3, where the role of PPPs in urban renewal projects is discussed, especially in the context of São Paulo and Budapest, highlighting their impact on the socio-economic landscape.

Regenerative Urban Strategies

Approaches to urban development that focus on revitalizing and renewing urban areas, often with an emphasis on sustainability and community well-being.

- *Reference:* Girardet, Herbert. *Creating Regenerative Cities.* Routledge, 2015.
- **Found in:** Chapter 6, which focuses on the long-term strategies for revitalizing urban areas, ensuring that development is sustainable and benefits the community as a whole.

Resource Management

The strategic planning and utilization of resources, such as land, water, and energy, in urban development to achieve sustainability and efficiency.

- *Reference:* Campbell, Heather. "Is 'Sustainability' an Obstacle to Climate Change Adaptation?" *Planning Theory & Practice*, vol. 7, no. 2, 1996, pp. 299-333.
- **Found in:** Chapter 4 and Chapter 5, where discussions revolve around how effective resource management contributes to urban sustainability and resilience.

Socio-Economic Dynamics

The interaction of social and economic factors within urban environments, influencing patterns of growth, development, and inequality.

- *Reference:* Harvey, David. *A Brief History of Neoliberalism.* Oxford University Press, 2007.
- **Found in:** Chapter 3 and Chapter 5, where socio-economic factors are analyzed in the context of urban renewal, particularly regarding the impact on different community segments.

Socio-Spatial Interaction

The relationship between social processes and spatial forms within urban environments that influences how people use and perceive space.

- *Reference:* Soja, Edward W. *Thirdspace: Journeys to Los Angeles and Other Real-and-Imagined Places.*Blackwell, 1996.
- **Found in:** Chapter 4 and Chapter 5, where the connection between social behavior and urban design is explored, especially in the context of creating inclusive and cohesive urban spaces.

Space Syntax

A theory and method for analyzing the spatial configurations of urban environments, focusing on the relationship between space and social behavior.

- *Reference:* Hillier, Bill, and Julienne Hanson. *The Social Logic of Space.* Cambridge University Press, 1984.
- **Found in:** Chapter 4 and Chapter 5, where Space Syntax is used as a tool to evaluate urban connectivity and integration, providing insights into how spatial arrangements influence social interactions.

Spatial Cohesion

The integration and connectivity of different areas within a city. Promotes social interaction, accessibility, and equitable distribution of resources.

- *Reference:* Faludi, Andreas. "Territorial Cohesion Policy and the European Model of Society." *European Planning Studies*, vol. 15, no. 4, 2007, pp. 567-583.
- **Found in:** Chapter 5, which discusses the role of spatial cohesion in enhancing urban resilience, particularly through the integration of green infrastructure.

Stakeholder Collaboration

The involvement and cooperation of multiple stakeholders, including government, private sector, and community groups, in urban development processes.

- *Reference:* Reed, Mark S. "Stakeholder Participation for Environmental Management: A Literature Review." *Biological Conservation*, vol. 141, no. 10, 2008, pp. 2417-2431.

• **Found in:** Chapter 6, where the importance of stakeholder engagement is emphasized in the planning and execution of urban renewal projects.

Supervised Image Classification

A remote sensing technique used to categorize pixels in satellite images into defined classes based on training data, often used for land-use and environmental studies.

• *Reference:* Lillesand, Thomas, Ralph W. Kiefer, and Jonathan Chipman. *Remote Sensing and Image Interpretation.* John Wiley & Sons, 2015.

• **Found in:** Chapter 5, which details the methodology for tracking urban green transformation and land-use changes through satellite imagery.

Sustainability

The practice of developing urban environments that meet current needs without compromising the ability of future generations to meet theirs, focusing on economic, social, and environmental health.

• *Reference:* Campbell, Scott. "Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development." *Journal of the American Planning Association*, vol. 62, no. 3, 1996, pp. 296-312.

• **Found in:** Throughout the thesis, particularly in Chapters 2, 4, and 6, as sustainability is a central theme in the analysis and proposed strategies for urban development.

Typological Appraisal

An evaluation method that classifies and assesses urban forms and architectural types to understand their role in the urban fabric and resilience.

• *Reference:* Moudon, Anne Vernez. "Getting to Know the Built Landscape: Typomorphology." *Journal of Urban Design*, vol. 1, no. 1, 1994, pp. 3-22.

• **Found in:** Chapter 4 and Chapter 5, where typological analysis is used to evaluate the resilience of urban forms, particularly in Budapest's 9th District.

Urban Density

The concentration of people, buildings, and activities within a specific urban area impacting infrastructure, environment, and social dynamics.

• *Reference:* Dovey, Kim, and Elvin Pafka. "The Urban Density Assemblage: Modelling Multiple Measures." *Urban Design International*, vol. 19, no. 1, 2014, pp. 66-76.

• **Found in:** Chapter 4 and Chapter 5, which discuss the implications of urban density on sustainability, social cohesion, and the effectiveness of green infrastructure.

Urban Fabric

The physical form of urban areas, including buildings, streets, and public spaces, that make up the city's structure.

• *Reference:* Marshall, Stephen. *Streets and Patterns.* Routledge, 2005.

• **Found in:** Chapter 4, where the existing urban fabric is analyzed to understand how historical patterns influence current and future urban development.

Urban Green Infrastructure (UGI)

A network of natural and semi-natural areas in urban settings that provide ecological, economic, and social benefits, including biodiversity support and climate resilience.

• *Reference:* Hansen, Rieke, and Stephan Pauleit. "From Multifunctionality to Multiple Ecosystem Services? A Conceptual Framework for Multifunctionality in Green Infrastructure Planning for Urban Areas." *Ambio*, vol. 43, no. 4, 2014, pp. 516-529.

- **Found in:** Chapter 5, as a key focus of the thesis, where the integration of UGI is explored as a strategy to enhance urban resilience and sustainability.

Urban Integration

The process of creating cohesive urban environments where different parts of the city are well-connected and function together harmoniously.

- *Reference:* LeGates, Richard T., and Frederic Stout. *The City Reader.* Routledge, 2015.
- **Found in:** Chapter 5, which emphasizes the importance of connectivity in achieving spatial cohesion and social equity in urban areas.

Urban Renewal

The process of revitalizing and upgrading urban areas that are in decline, often through redevelopment and infrastructure improvements.

- *Reference:* Roberts, Peter, and Hugh Sykes. *Urban Regeneration: A Handbook.* SAGE Publications, 2000.
- **Found in:** Chapter 3 and Chapter 5, where case studies of urban renewal in São Paulo and Budapest are analyzed to understand the processes and outcomes of revitalization efforts.

Urban Resilience

The capacity of urban systems to withstand, adapt to, and recover from adverse conditions while maintaining essential functions.

- *Reference:* Meerow, Sara, Joshua P. Newell, and Melissa Stults. "Defining Urban Resilience: A Review." *Landscape and Urban Planning*, vol. 147, 2016, pp. 38-49.
- **Found in:** Throughout the thesis, particularly in Chapters 2, 4, and 5, as the concept of resilience is central to the analysis of urban development strategies and the integration of green infrastructure.

Annex 2. Parque Novo Santo Amaro V, São Paulo

Because of the growing housing deficit of the city of São Paulo, Parque Novo Santo Amaro V is a pertinent example of governmental strategies for providing dwellings while also achieving environmental rehabilitation of fragile areas. Due to its economic power and relevance in the national and international context, the city's municipality has assumed an avant-garde role in experimenting with new opportunities in this field.

"São Paulo has the largest number of favelas in Brazil, with 1,715 locations registered by the Municipal Housing Secretariat (SEHAB). They are estimated to hold 391,000 households and more than two million residents, equivalent to 11% of the city's population" (IBGE, 2010).

Community-led housing concept was used as the foundation for most of the actions. Per definition, it is "(…) a housing project that is focused mostly on affordable homes for the benefit of the local community, either individually or in co-operation with a builder or other local housing provider (...) The community group will take a long-term formal role in the ownership, stewardship or management of the homes" (Benkö et al., 2020).

The policies of the city's Urban Development Plan determine the requalification of degraded urban areas (São Paulo Development Plan and Evironmental Protection, 2018). In the case of the study area, the strategy developed goes beyond the need to recondition the landscape and environmental state by implementing a Community-led housing estate. In this sense, the instruments found in environmental protection guidelines were considered priority factors in this process. On the map below (figure A1), it is possible to observe that the Parque Novo Santo Amaro is located in the "Macro zone of recovery and environmental protection" and the other urban areas of subnormal occupation inserted in zones of greater environmental relevance.

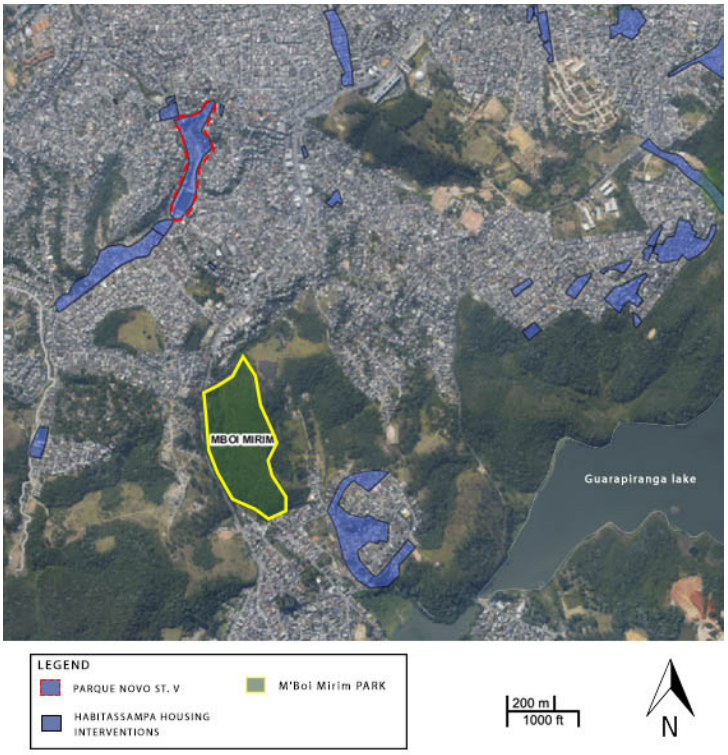


Figure A128: Parque Novo Santo Amaro V on the edge of Guarapiranga and M'Boi Mirim preservation areas. Source: São Paulo Development Plan, 2014 – edited by author.

The construction of the residential buildings and their surroundings began in 2009 and was completed in 2012, conceived under the requirements of the Alto Tietê Water Supply Environmental Sanitation Program. The intervention area has a total area of 21,900 m², with a built-in area of 14,600 m² (Villecca & Associados, 2012).

Figure A2: State of the local stream before and after the intervention.
Source: Viglieca & Associados, 2012

The housing density of Jandim Ângela, a neighborhood part of the district of M'Boi Mirim, in which Parque Novo Santo Amaro is located, is around 79 res/ha – below the average of 90 res/ha in the district. The Itaim Paulista district, located in the city's western periphery, has the highest population density among all the districts, with 171res/ha (Municipality of São Paulo, 2021). From this perspective, it is essential to highlight that the project density is approximately 405 res/ha, resulting from the growth of building height (see figures A2 and A3).

Figure A3: View from Coelho Lousada street in 2009 and 2021.
Source: Google Maps, 2022

The goal of this urban approach was to increase the density and simultaneously free up space to provide public spaces equipped with urban green elements - as visible in figure A4. Besides that, the built-up area is equivalent to slightly more than 2/3 of the total project area, and these results could be reached with a longitudinal building structure five to seven storeys high, which is also adapted to the local topographic conditions in terms of accessibility and landscape composition.

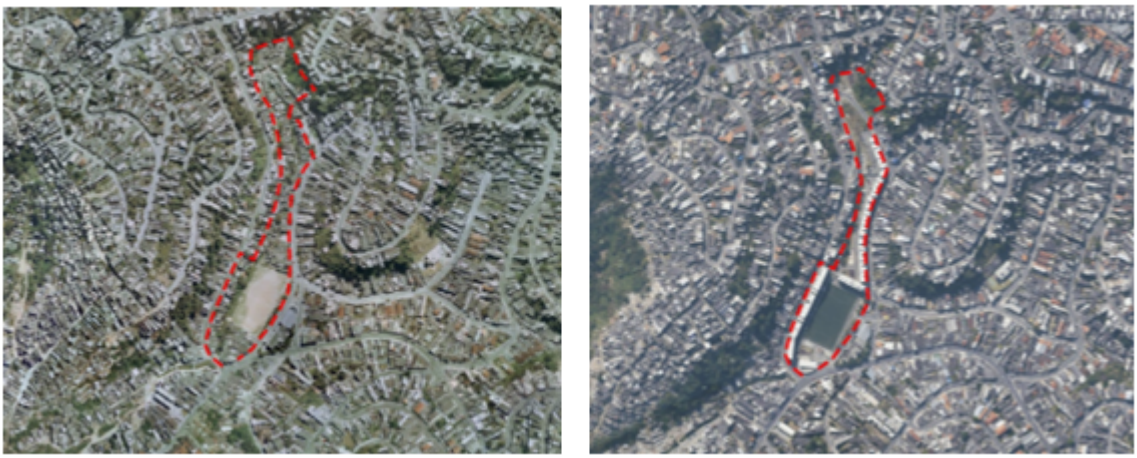


Figure A4: Aerial images - Before and after the Parque Santo Amaro intervention

Given that this is a zone of high density and low territorial permeability, a typical characteristic of this urban typology in Brazil, the priority, in terms of urban mobility, was to improve pedestrian traffic routes. Therefore, a new east-west axis was implemented, connecting the main public transport route to the inner portion of Parque Novo Santo Amaro (see figure A5).

The proposed axis crosses the new residential buildings, using its structure as a bridge to connect different levels, separated by the relief. This is a peculiar feature of the project, which had an impact on the organization of the building's layers of use and, at the landscape level, subdivided what could be a single visually continuous public space into two smaller ones - despite the direct physical connection that exists between them, since the ground level of this section of the building is completely open. The functions that involve physical activities were placed in the southern zone of the project, due to its favorable geometry. In contrast, the public functions related to contemplation were designed in the northern and most longitudinal zone.

For the rehabilitation process of Parque Novo Santo Amaro, professionals had to bear in mind the unique dynamics of the physical conditions that define the space. The character of the relief is the main aspect considered in the implantation of buildings and for the design of public spaces and their materials. The valley area where the project is located is susceptible to flooding during torrential rain periods. Therefore, it was essential to maintain the land's natural slope, despite the new paved, partially permeable, or unpaved surfaces distributed in the proposed plateau system.

The northernmost area of the project, separated by Zâbia Street, has more prominent vegetation, with a greater number of trees and consecutively more biologically active surface than the rest of the project, where there is a relatively high percentage of paved areas. As it is a stretch with a steeper slope (see figure A6), vegetation is used to promote soil retention and prevent landslides. This design decision minimized the costs with no need for implementation of another retaining wall, in addition to being ecologically suited to the urban context.

Another important element for the spatial definition was maintaining the 140x50m soccer field. This facility was kept precisely in its original position with the same dimensions. This decision is based on the fact that this element is a constituent part of the identity of the local population and their cultural expressions. Nevertheless, it is also an element that makes part of the neighborhood’s leisure infrastructure.

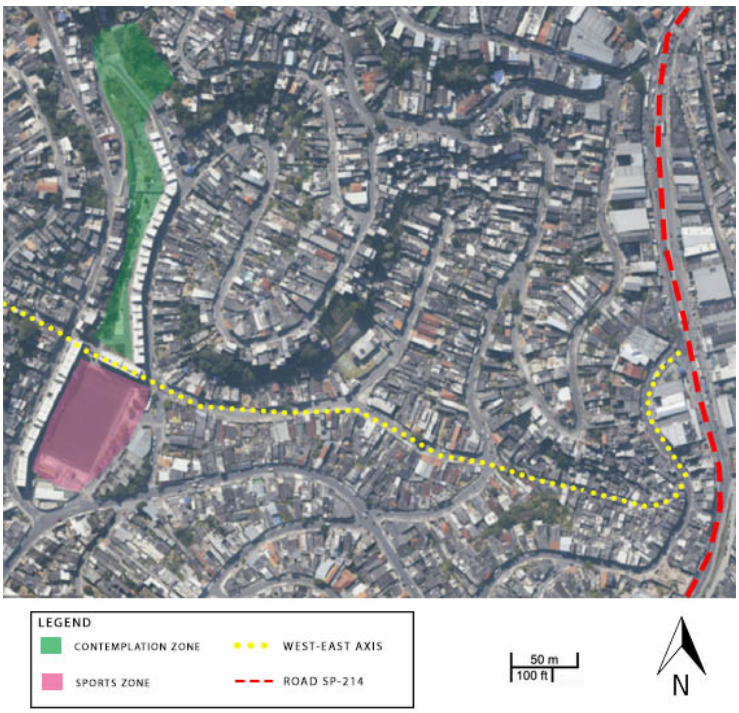


Figure A5: Parque Novo Santo Amaro V – zones of use and mobility axes.
Source: by the Author

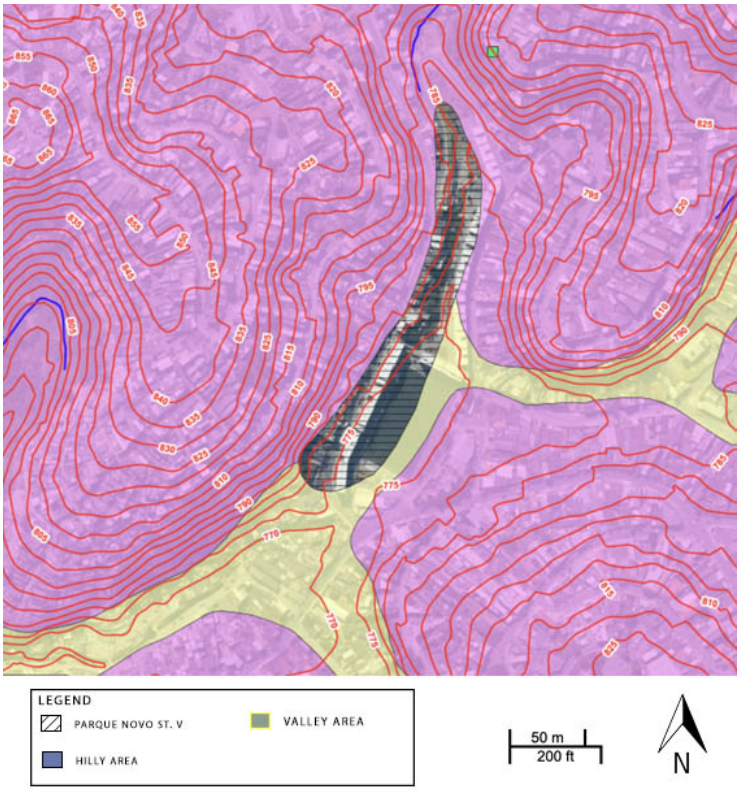


Figure A6: Topographic analysis - Parque Novo Santo Amaro V.
Source: by the Author

The building is divided into blocks to facilitate the implantation in the inclined terrain, avoiding earthworks and using this peculiar physical characteristics of the place as a design tool.

This technical decision defined criteria for accessing the blocks, making several seperate access points necessary and allowing the creation of public passages between the blocks. The project has a diversified program, including the primary residential function, skateboarding park, playground, water features, square, commercial spaces, a community center, and recreation areas (see figures A7, A8 and A9).

Figure A7: Parque Novo Santo Amaro housing estate.
Source: Viglieca & Associados, 2017

The increase in the percentage of permeable surfaces is one of the project's focal points, which follows the guidelines of the previously mentioned project to improve the environmental conditions of watershed areas in the region of São Paulo. Elements of public infrastructure were also implemented on the site, such as access ramps, pavements, and lighting on pedestrian roads and rainwater drainage system, as this is a flooded valley area.

After nine years of occupation, it is still possible to identify the improvements implemented through this project. However, some aspects indicate the vulnerability of the existing complex social situation. Due to the insecurity arising from the difficulties in managing the traffic of non-resident pedestrians and problems in the use of public spaces, such as large crowds of people on weekends generating disorder and noise pollution, the residents decided to request the closing of the space, configuring thus, a closed condominium. This decision weakens the original concept of urban mobility and territorial integration for social transformation.

In addition, the water feature designed to deliver clean spring water to the residents was disabled when the insufficient flow from the spring led to stagnant water, causing outbreaks of insects and disease (Trancoso et al., 2015).

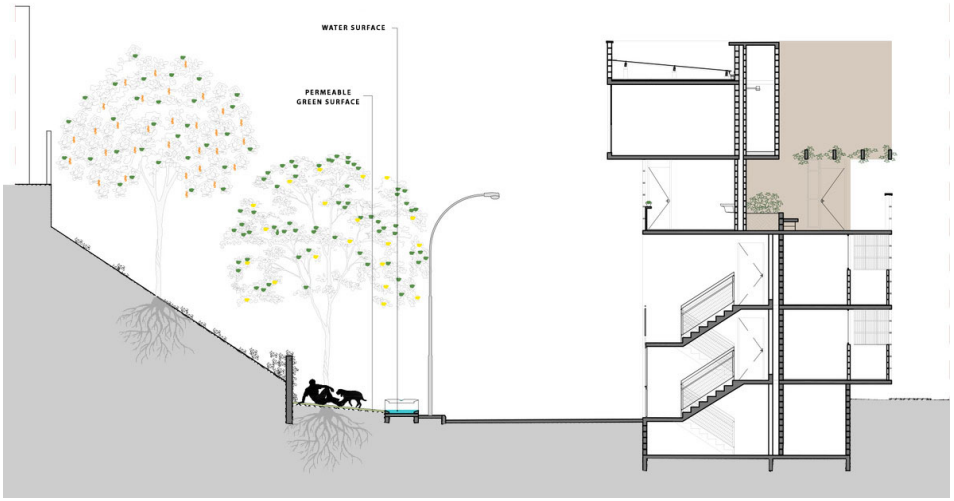


Figure A8: Parque Novo Santo Amaro housing estate – schematic section.
Source: Viglieca & Associados, 2017

Figure A929: Recreational area – schematic section.
Source: Viglieca & Associados, 2017

Annex 3. Data Compilation from Urban Typology Investigation Workshop

In autumn 2022, the Urbanism course at the Hungarian University of Agriculture and Life Sciences (MATE), tailored for master's students in Landscape Architecture, introduced an innovative series of hands-on workshops. This initiative was designed to bridge theoretical concepts with practical application, enabling students to employ Urban Typological Survey principles within the urban fabric of Budapest's IX district. The focus was strategically placed on areas that underwent significant urban renovation, particularly the urban blocks near József Boulevard, where the transformation processes were notably advanced.

This educational effort provided a platform for the focus group to explore and analyze the morphological and functional changes in urban spaces, facilitating a deeper understanding of urban dynamics in the context of Budapest's evolving landscape. The workshops were structured to encourage immersive learning, allowing students to directly observe, assess, and engage with the urban fabric, enhancing their analytical and empirical skills in landscape architecture and urbanism while collecting essential data for this research.

The teams, composed of approximately five members each on average. Independent field visits were encouraged to cultivate a free investigative approach. Subsequent sessions were dedicated to consolidating and critically discussing the assembled data, leveraging a shared online database as a pedagogical tool. This digital repository facilitated a collaborative learning environment, allowing students to input, compare, and evaluate their findings within the collective database.

For the experimental application of the methodology, each group was tasked with analyzing distinct urban blocks, approximating one block per group member. Figure A10 delineates the data collection and analysis framework employed by each group, correlating specific urban blocks with the typological inquiry. Tables Q1-Q16 synthesize the typological data compiled for each property within the designated blocks, illustrating the comprehensive documentation process:

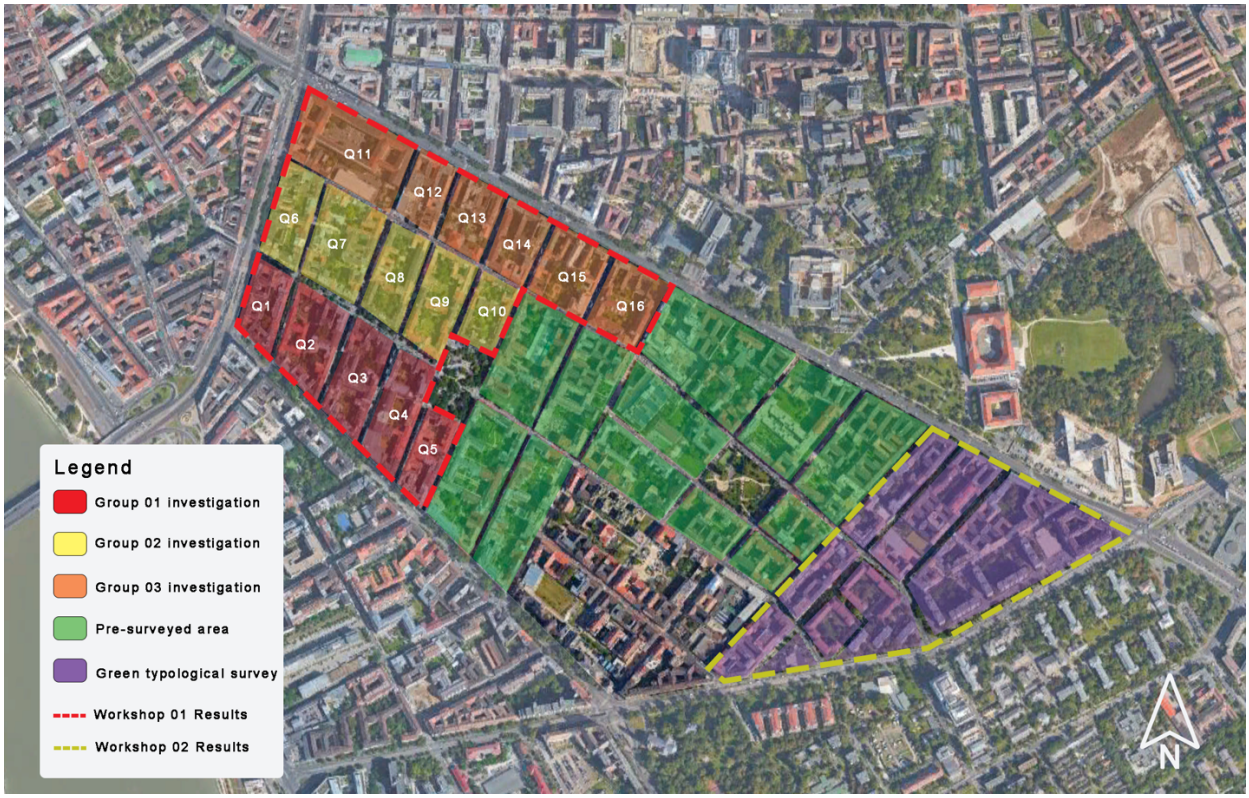


Figure A10: Urban Typological Survey administered in urban blocks Q1 to Q16. Source: by author.

Database – Results from workshop 1:

Urban Block 1 (Q1)	LAND USE								
	USE	RESIDENTIAL	2	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	11
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	11	06 TO 10 FLOORS	2
	COURTYARD	NOT APPLICABLE	13	COMMON	0	PRIVATE	0		
	FRONTAL SET BACK	NOT APPLICABLE	13	WITH GREEN ELEMENTS	0	WITH NO GREEN ELEMENTS	0		
	LATERAL SET BACK	NOT APPLICABLE	13	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	7	02 ACCESS	0	MORE THAN 02	5
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	11	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	10	TO PUBLIC STREET	1	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	10	PERMANENT	1	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	10	UP TO 02 PASSING UNITIES	1	ABOVE 02 PASSING UNITIES	0		
	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	0	50% - 80%	11	LESS THAN 50%	0
	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	11	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	13	ALLEY/COURTYARD	0	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	11	02 ACCESS	2	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	13	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	13	1970 TO 1990	0	1990 TO 2021	0
	GARAGE	NOT APPLICABLE	11	GROUND FLOOR	0	UNDERGROUND	2	COURTYARD	0
	BALCONIES	NOT APPLICABLE	9	TOWARDS STREET	4	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	12	<50%'	1	'>50%'	0		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	0	THROUGH RESIDENTIAL ACCESS	13	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	13	VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	13	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		0
	FRONTAL SET BACK	NOT APPLICABLE	13	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	0	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	13	YES	0	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	0	RENEWED	13	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	0

Urban Block 2 (Q2)	LAND USE								
	USE	RESIDENTIAL	5	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	15
	STOREY	01 FLOOR	0	02 FLOORS	2	03 TO 05 FLOORS	12	06 TO 10 FLOORS	7
	COURTYARD	NOT APPLICABLE	5	COMMON	1	PRIVATE	13		
	FRONTAL SET BACK	NOT APPLICABLE	19	WITH GREEN ELEMENTS	1	WITH NO GREEN ELEMENTS	0		
	LATERAL SET BACK	NOT APPLICABLE	19	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	2	02 ACCESS	2	MORE THAN 02	15
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	18	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	16	TO PUBLIC STREET	2	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	16	PERMANENT	2	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	18	UP TO 02 PASSING UNITIES	1	ABOVE 02 PASSING UNITIES	1		
	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	8	50% - 80%	3	LESS THAN 50%	3
	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	11	BELOW STREET LEVEL	1	ABOVE STREET LEVEL	5
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	19	ALLEY/COURTYARD	1	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	19	02 ACCESS	0	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	19	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	1	BEFORE 1970	0	1970 TO 1990	18	1990 TO 2021	0
	GARAGE	NOT APPLICABLE	15	GROUND FLOOR	4	UNDERGROUND	1	COURTYARD	0
	BALCONIES	NOT APPLICABLE	12	TOWARDS STREET	7	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	18	<50%'	2	'>50%'	0		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	1	THROUGH RESIDENTIAL ACCESS	18	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	19	VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	19	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	19	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	0	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	0	YES	19	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	0	RENEWED	19	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	0

Urban Block 3 (Q3)	LAND USE								
	USE	RESIDENTIAL	0	COM/INST/SERV	3	EMPTY PLOT	0	MIXED	13
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	9	06 TO 10 FLOORS	7
	COURTYARD	NOT APPLICABLE	8	COMMON	0	PRIVATE	8		
	FRONTAL SET BACK	NOT APPLICABLE	2	WITH GREEN ELEMENTS	6	WITH NO GREEN ELEMENTS	8		
	LATERAL SET BACK	NOT APPLICABLE	7	ONE SIDE	8	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	8	02 ACCESS	4	MORE THAN 02	4
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	15	GREEN ALLEY/COURTYARD	1	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	14	TO PUBLIC STREET	2	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	14	PERMANENT	0	SEASONAL	2		
	COVERED PROMENADE	NOT APPLICABLE	16	UP TO 02 PASSING UNITIES	0	ABOVE 02 PASSING UNITIES	0		
	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	4	50% - 80%	9	LESS THAN 50%	3
	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	16	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	2	PUBLIC STREET	14	ALLEY/COURTYARD	0	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	2	1 ACCESS	10	02 ACCESS	5	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	16	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	2	BEFORE 1970	0	1970 TO 1990	3	1990 TO 2021	12
	GARAGE	NOT APPLICABLE	11	GROUND FLOOR	5	UNDERGROUND	0	COURTYARD	0
	BALCONIES	NOT APPLICABLE	13	TOWARDS STREET	3	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	1	<50%'	4	'>50%'	11		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	1	COMMON CLOSED GATE FROM STREET	1	THROUGH RESIDENTIAL ACCESS	14	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	3	VISUALLY PERMEABLE	2	NOT VISUALLY PERMEABLE	10	NOT VISUALLY PERMEABLE (GREEN)	1
	SIDEWALK	TRADITIONAL	14	PERMEABLE/NOT LEVELED	1	SHARED PAVEMENT/PERMEABLE	1		
	FRONTAL SET BACK	NOT APPLICABLE	15	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	1	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	16	YES	0	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	3	RENEWED	11	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	2

Urban Block 4 (Q4)	LAND USE								
	USE	RESIDENTIAL	2	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	9
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	10	06 TO 10 FLOORS	3
	COURTYARD	NOT APPLICABLE	2	COMMON	2	PRIVATE	9		
	FRONTAL SET BACK	NOT APPLICABLE	0	WITH GREEN ELEMENTS	4	WITH NO GREEN ELEMENTS	9		
	LATERAL SET BACK	NOT APPLICABLE	0	ONE SIDE	9	BOTH SIDES	4		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	1	02 ACCESS	5	MORE THAN 02	5
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	10	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	1
	EXTENSION COMPONENT	NOT APPLICABLE	6	TO PUBLIC STREET	4	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	7	PERMANENT	3	SEASONAL	1		
	COVERED PROMENADE	NOT APPLICABLE	1	UP TO 02 PASSING UNITIES	4	ABOVE 02 PASSING UNITIES	6		
	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	2	50% - 80%	6	LESS THAN 50%	3
	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	11	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	9	ALLEY/COURTYARD	2	COMBINED	2
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	10	02 ACCESS	3	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	4	YES	7	COMMON USE	2		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	1	1970 TO 1990	7	1990 TO 2021	4
	GARAGE	NOT APPLICABLE	7	GROUND FLOOR	3	UNDERGROUND	3	COURTYARD	0
	BALCONIES	NOT APPLICABLE	0	TOWARDS STREET	12	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	1
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	0	<50%'	11	'>50%'	2		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	2	COMMON CLOSED GATE FROM STREET	4	THROUGH RESIDENTIAL ACCESS	7	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	1	VISUALLY PERMEABLE	4	NOT VISUALLY PERMEABLE	8	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	0	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	12		
	FRONTAL SET BACK	NOT APPLICABLE	0	IMPERMEABLE SURFACE	11	PERMEABLE SURFACE	0	WITH GARDEN	2
	PITCHED ROOF	NOT APPLICABLE	7	YES	2	COMBINED	4		
	MANTAINANCE STATUS	NOT RENEWED	1	RENEWED	9	UNDER RENIVATION	2	NEW (BUILT AFTER 200s)	1

Urban Block 5 (Q5)	LAND USE								
	USE	RESIDENTIAL	3	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	10
	STOREY	01 FLOOR	0	02 FLOORS	1	03 TO 05 FLOORS	10	06 TO 10 FLOORS	2
	COURTYARD	NOT APPLICABLE	0	COMMON	0	PRIVATE	13		
	FRONTAL SET BACK	NOT APPLICABLE	1	WITH GREEN ELEMENTS	8	WITH NO GREEN ELEMENTS	4		
	LATERAL SET BACK	NOT APPLICABLE	0	ONE SIDE	8	BOTH SIDES	4		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	3	1 ACCESS	8	02 ACCESS	2	MORE THAN 02	0
	TYPE OF ACCESS	NOT APPLICABLE	3	PUBLIC STREET	8	GREEN ALLEY/COURTYARD	2	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	12	TO PUBLIC STREET	1	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	12	PERMANENT	1	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	12	UP TO 02 PASSING UNITIES	1	ABOVE 02 PASSING UNITIES	0		
	GROUND FLOOR SERVICE	NOT APPLICABLE	3	80% - 100%	3	50% - 80%	3	LESS THAN 50%	4
	ACCESS LEVEL	NOT APPLICABLE	3	STREET LEVEL	8	BELOW STREET LEVEL	2	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	12	ALLEY/COURTYARD	1	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	8	02 ACCESS	5	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	13	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	1	1970 TO 1990	12	1990 TO 2021	0
	GARAGE	NOT APPLICABLE	0	GROUND FLOOR	10	UNDERGROUND	3	COURTYARD	0
	BALCONIES	NOT APPLICABLE	8	TOWARDS STREET	5	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	12	<50%'	1	'>50%'	0		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	0	THROUGH RESIDENTIAL ACCESS	13	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE	12	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	12	PERMEABLE/NOT LEVELED	1	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	0	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	13	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	11	YES	2	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	12	RENEWED	1	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	0

Urban Block 6 (Q6)	LAND USE								
	USE	RESIDENTIAL	8	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	13
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	15	06 TO 10 FLOORS	6
	COURTYARD	NOT APPLICABLE	0	COMMON	0	PRIVATE	21		
	FRONTAL SET BACK	NOT APPLICABLE	21	WITH GREEN ELEMENTS	0	WITH NO GREEN ELEMENTS	0		
	LATERAL SET BACK	NOT APPLICABLE	21	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	3	1 ACCESS	6	02 ACCESS	6	MORE THAN 02	1
	TYPE OF ACCESS	NOT APPLICABLE	3	PUBLIC STREET	13	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	15	TO PUBLIC STREET	1	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	15	PERMANENT	0	SEASONAL	1		
	COVERED PROMENADE	NOT APPLICABLE	15	UP TO 02 PASSING UNITIES	1	ABOVE 02 PASSING UNITIES	0		
	GROUND FLOOR SERVICE	NOT APPLICABLE	3	80% - 100%	4	50% - 80%	7	LESS THAN 50%	2
	ACCESS LEVEL	NOT APPLICABLE	3	STREET LEVEL	13	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	8	ALLEY/COURTYARD	4	COMBINED	9
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	17	02 ACCESS	5	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	18	YES	0	COMMON USE	3		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	13	1970 TO 1990	3	1990 TO 2021	5
	GARAGE	NOT APPLICABLE	18	GROUND FLOOR	3	UNDERGROUND	0	COURTYARD	0
	BALCONIES	NOT APPLICABLE	1	TOWARDS STREET	2	TOWARDS ALLEY/COURTYARD	13	STREET/ALLEY/COURTYARD	5
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	0	<50%'	4	'>50%'	17		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	1	THROUGH RESIDENTIAL ACCESS	20	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE	20	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	21	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	14	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	0	WITH GARDEN	7
	PITCHED ROOF	NOT APPLICABLE	2	YES	15	COMBINED	4		
	MANTAINANCE STATUS	NOT RENEWED	3	RENEWED	14	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	4

Urban Block 7 (Q7)	LAND USE								
	USE	RESIDENTIAL	5	COM/INST/SERV	3	EMPTY PLOT	0	MIXED	11
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	13	06 TO 10 FLOORS	6
	COURTYARD	NOT APPLICABLE	1	COMMON	5	PRIVATE	13		
	FRONTAL SET BACK	NOT APPLICABLE	13	WITH GREEN ELEMENTS	4	WITH NO GREEN ELEMENTS	2		
	LATERAL SET BACK	NOT APPLICABLE	16	ONE SIDE	3	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	4	1 ACCESS	9	02 ACCESS	3	MORE THAN 02	2
	TYPE OF ACCESS	NOT APPLICABLE	4	PUBLIC STREET	14	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	16	TO PUBLIC STREET	2	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	16	PERMANENT	2	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	15	UP TO 02 PASSING UNITIES	2	ABOVE 02 PASSING UNITIES	0		
	GROUND FLOOR SERVICE	NOT APPLICABLE	4	80% - 100%	5	50% - 80%	5	LESS THAN 50%	4
	ACCESS LEVEL	NOT APPLICABLE	4	STREET LEVEL	11	BELOW STREET LEVEL	2	ABOVE STREET LEVEL	1
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	3	PUBLIC STREET	2	ALLEY/COURTYARD	0	COMBINED	14
	NUMBER OF ACCESSES	NOT APPLICABLE	3	1 ACCESS	3	02 ACCESS	10	MORE THAN 02	3
	GREEN TERRACE	NOT APPLICABLE	16	YES	0	COMMON USE	2		
	BUILDING AGE	NOT APPLICABLE	4	BEFORE 1970	11	1970 TO 1990	4	1990 TO 2021	1
	GARAGE	NOT APPLICABLE	17	GROUND FLOOR	0	UNDERGROUND	2	COURTYARD	0
	BALCONIES	NOT APPLICABLE	3	TOWARDS STREET	2	TOWARDS ALLEY/COURTYARD	6	STREET/ALLEY/COURTYARD	8
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	0	<50%'	5	'>50%'	14		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	14	THROUGH RESIDENTIAL ACCESS	4	COMBINED	1
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	12	VISUALLY PERMEABLE	3	NOT VISUALLY PERMEABLE	4	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	17	PERMEABLE/NOT LEVELED	2	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	13	IMPERMEABLE SURFACE	4	PERMEABLE SURFACE	2	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	1	YES	16	COMBINED	2		
	MANTAINANCE STATUS	NOT RENEWED	5	RENEWED	11	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	3

Urban Block 8 (Q8)	LAND USE								
	USE	RESIDENTIAL	4	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	10
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	14	06 TO 10 FLOORS	0
	COURTYARD	NOT APPLICABLE	0	COMMON	0	PRIVATE	14		
	FRONTAL SET BACK	NOT APPLICABLE	10	WITH GREEN ELEMENTS	1	WITH NO GREEN ELEMENTS	3		
	LATERAL SET BACK	NOT APPLICABLE	14	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	4	1 ACCESS	4	02 ACCESS	0	MORE THAN 02	6
	TYPE OF ACCESS	NOT APPLICABLE	4	PUBLIC STREET	10	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	10	TO PUBLIC STREET	4	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	10	PERMANENT	3	SEASONAL	1		
	COVERED PROMENADE	NOT APPLICABLE	8	UP TO 02 PASSING UNITIES	4	ABOVE 02 PASSING UNITIES	2		
	GROUND FLOOR SERVICE	NOT APPLICABLE	4	80% - 100%	4	50% - 80%	3	LESS THAN 50%	3
	ACCESS LEVEL	NOT APPLICABLE	4	STREET LEVEL	6	BELOW STREET LEVEL	1	ABOVE STREET LEVEL	3
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	1	ALLEY/COURTYARD	1	COMBINED	12
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	0	02 ACCESS	9	MORE THAN 02	5
	GREEN TERRACE	NOT APPLICABLE	13	YES	0	COMMON USE	1		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	6	1970 TO 1990	5	1990 TO 2021	3
	GARAGE	NOT APPLICABLE	10	GROUND FLOOR	2	UNDERGROUND	2	COURTYARD	0
	BALCONIES	NOT APPLICABLE	6	TOWARDS STREET	3	TOWARDS ALLEY/COURTYARD	1	STREET/ALLEY/COURTYARD	4
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	0	<50%'	10	'>50%'	4		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	7	THROUGH RESIDENTIAL ACCESS	7	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	3	VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE	11	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	8	PERMEABLE/NOT LEVELED	6	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	5	IMPERMEABLE SURFACE	3	PERMEABLE SURFACE	3	WITH GARDEN	3
	PITCHED ROOF	NOT APPLICABLE	1	YES	11	COMBINED	2		
	MANTAINANCE STATUS	NOT RENEWED	2	RENEWED	9	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	3

Urban Block 9 (Q9)	LAND USE								
	USE	RESIDENTIAL	7	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	10
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	15	06 TO 10 FLOORS	2
	COURTYARD	NOT APPLICABLE	0	COMMON	0	PRIVATE	17		
	FRONTAL SET BACK	NOT APPLICABLE	10	WITH GREEN ELEMENTS	3	WITH NO GREEN ELEMENTS	4		
	LATERAL SET BACK	NOT APPLICABLE	17	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	4	02 ACCESS	3	MORE THAN 02	3
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	9	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	8	TO PUBLIC STREET	2	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	8	PERMANENT	0	SEASONAL	2		
	COVERED PROMENADE	NOT APPLICABLE	9	UP TO 02 PASSING UNITIES	0	ABOVE 02 PASSING UNITIES	1		
	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	3	50% - 80%	7	LESS THAN 50%	0
	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	10	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	2	PUBLIC STREET	2	ALLEY/COURTYARD	1	COMBINED	12
	NUMBER OF ACCESSES	NOT APPLICABLE	1	1 ACCESS	15	02 ACCESS	1	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	14	YES	1	COMMON USE	1		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	9	1970 TO 1990	8	1990 TO 2021	0
	GARAGE	NOT APPLICABLE	15	GROUND FLOOR	1	UNDERGROUND	1	COURTYARD	0
	BALCONIES	NOT APPLICABLE	1	TOWARDS STREET	0	TOWARDS ALLEY/COURTYARD	15	STREET/ALLEY/COURTYARD	1
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	0	<50%'	0	'>50%'	17		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	2	THROUGH RESIDENTIAL ACCESS	15	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE	16	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	17	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	16	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	0	WITH GARDEN	1
	PITCHED ROOF	NOT APPLICABLE	1	YES	16	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	0	RENEWED	17	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	0

Urban Block 10 (Q10)	LAND USE								
	USE	RESIDENTIAL	0	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	10
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	8	06 TO 10 FLOORS	2
	COURTYARD	NOT APPLICABLE	0	COMMON	0	PRIVATE	9		
	FRONTAL SET BACK	NOT APPLICABLE	6	WITH GREEN ELEMENTS	1	WITH NO GREEN ELEMENTS	3		
	LATERAL SET BACK	NOT APPLICABLE	10	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	2	02 ACCESS	4	MORE THAN 02	4
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	8	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	2
	EXTENSION COMPONENT	NOT APPLICABLE	8	TO PUBLIC STREET	2	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	8	PERMANENT	2	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	9	UP TO 02 PASSING UNITIES	1	ABOVE 02 PASSING UNITIES	0		
	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	5	50% - 80%	2	LESS THAN 50%	3
	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	7	BELOW STREET LEVEL	2	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	1	ALLEY/COURTYARD	1	COMBINED	9
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	2	02 ACCESS	5	MORE THAN 02	3
	GREEN TERRACE	NOT APPLICABLE	9	YES	0	COMMON USE	1		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	6	1970 TO 1990	1	1990 TO 2021	2
	GARAGE	NOT APPLICABLE	8	GROUND FLOOR	2	UNDERGROUND	0	COURTYARD	1
	BALCONIES	NOT APPLICABLE	2	TOWARDS STREET	0	TOWARDS ALLEY/COURTYARD	6	STREET/ALLEY/COURTYARD	2
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	1	<50%'	4	'>50%'	5		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	5	THROUGH RESIDENTIAL ACCESS	4	COMBINED	1
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	2	VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE	7	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	10	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	7	IMPERMEABLE SURFACE	1	PERMEABLE SURFACE	0	WITH GARDEN	1
	PITCHED ROOF	NOT APPLICABLE	0	YES	10	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	0	RENEWED	7	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	2

	LAND USE								
	USE	RESIDENTIAL	4	COM/INST/SERV	3	EMPTY PLOT	0	MIXED	5
	STOREY	01 FLOOR	2	02 FLOORS	0	03 TO 05 FLOORS	8	06 TO 10 FLOORS	0
	COURTYARD	NOT APPLICABLE	7	COMMON	1	PRIVATE	2		
	FRONTAL SET BACK	NOT APPLICABLE	0	WITH GREEN ELEMENTS	1	WITH NO GREEN ELEMENTS	9		
	LATERAL SET BACK	NOT APPLICABLE	2	ONE SIDE	3	BOTH SIDES	5		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	1	02 ACCESS	2	MORE THAN 02	2
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	5	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	0	TO PUBLIC STREET	4	TO ALLEY/COURTYARD	2		
	EXTENSION CHARACTER	NOT APPLICABLE	1	PERMANENT	4	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	1	UP TO 02 PASSING UNITIES	3	ABOVE 02 PASSING UNITIES	1		
Urban Block 11	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	0	50% - 80%	4	LESS THAN 50%	1
(Q11)	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	5	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	7	ALLEY/COURTYARD	0	COMBINED	1
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	5	02 ACCESS	0	MORE THAN 02	3
	GREEN TERRACE	NOT APPLICABLE	8	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	6	1970 TO 1990	0	1990 TO 2021	0
	GARAGE	NOT APPLICABLE	7	GROUND FLOOR	1	UNDERGROUND	0	COURTYARD	0
	BALCONIES	NOT APPLICABLE	5	TOWARDS STREET	3	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	0	<50%'	3	'>50%'	1		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	2	COMMON CLOSED GATE FROM STREET	2	THROUGH RESIDENTIAL ACCESS	0	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE	3	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	1	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	3		
	FRONTAL SET BACK	NOT APPLICABLE	3	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	1	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	3	YES	1	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	3	RENEWED	0	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	1

	LAND USE								
	USE	RESIDENTIAL	4	COM/INST/SERV	3	EMPTY PLOT	0	MIXED	4
	STOREY	01 FLOOR	1	02 FLOORS	2	03 TO 05 FLOORS	5	06 TO 10 FLOORS	3
	COURTYARD	NOT APPLICABLE	2	COMMON	0	PRIVATE	9		
	FRONTAL SET BACK	NOT APPLICABLE	9	WITH GREEN ELEMENTS	0	WITH NO GREEN ELEMENTS	2		
	LATERAL SET BACK	NOT APPLICABLE	11	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	8	02 ACCESS	2	MORE THAN 02	1
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	11	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	11	TO PUBLIC STREET	0	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	11	PERMANENT	0	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	0	UP TO 02 PASSING UNITIES	8	ABOVE 02 PASSING UNITIES	3		
Urban Block 12	GROUND FLOOR SERVICE	NOT APPLICABLE	5	80% - 100%	5	50% - 80%	1	LESS THAN 50%	0
(Q12)	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	11	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	11	ALLEY/COURTYARD	0	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	8	02 ACCESS	2	MORE THAN 02	1
	GREEN TERRACE	NOT APPLICABLE	9	YES	1	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	5	1970 TO 1990	5	1990 TO 2021	1
	GARAGE	NOT APPLICABLE	9	GROUND FLOOR	1	UNDERGROUND	0	COURTYARD	0
	BALCONIES	NOT APPLICABLE	4	TOWARDS STREET	6	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	6	<50%'	5	'>50%'	0		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	0	THROUGH RESIDENTIAL ACCESS	9	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	9	NOT VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE (GREEN)	2
	SIDEWALK	TRADITIONAL	11	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	9	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	2	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	5	YES	6	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	8	RENEWED	2	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	1

	LAND USE								
	USE	RESIDENTIAL	3	COM/INST/SERV	2	EMPTY PLOT	0	MIXED	5
	STOREY	01 FLOOR	0	02 FLOORS	2	03 TO 05 FLOORS	6	06 TO 10 FLOORS	2
	COURTYARD	NOT APPLICABLE	2	COMMON	0	PRIVATE	7		
	FRONTAL SET BACK	NOT APPLICABLE	9	WITH GREEN ELEMENTS	1	WITH NO GREEN ELEMENTS	0		
	LATERAL SET BACK	NOT APPLICABLE	10	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	3	1 ACCESS	2	02 ACCESS	3	MORE THAN 02	2
	TYPE OF ACCESS	NOT APPLICABLE	3	PUBLIC STREET	7	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	10	TO PUBLIC STREET	0	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	10	PERMANENT	0	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	10	UP TO 02 PASSING UNITIES	0	ABOVE 02 PASSING UNITIES	0		
Urban Block 13	GROUND FLOOR SERVICE	NOT APPLICABLE	5	80% - 100%	3	50% - 80%	1	LESS THAN 50%	1
(Q13)	ACCESS LEVEL	NOT APPLICABLE	3	STREET LEVEL	7	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	2	PUBLIC STREET	8	ALLEY/COURTYARD	0	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	3	1 ACCESS	6	02 ACCESS	1	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	10	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	3	BEFORE 1970	5	1970 TO 1990	1	1990 TO 2021	1
	GARAGE	NOT APPLICABLE	9	GROUND FLOOR	0	UNDERGROUND	1	COURTYARD	0
	BALCONIES	NOT APPLICABLE	4	TOWARDS STREET	6	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	3	<50%'	7	'>50%'	0		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	0	THROUGH RESIDENTIAL ACCESS	8	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	2	VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE	8	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	5	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	5		
	FRONTAL SET BACK	NOT APPLICABLE	9	IMPERMEABLE SURFACE	0	PERMEABLE SURFACE	0	WITH GARDEN	1
	PITCHED ROOF	NOT APPLICABLE	3	YES	7	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	6	RENEWED	2	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	2

	LAND USE								
	USE	RESIDENTIAL	0	COM/INST/SERV	0	EMPTY PLOT	0	MIXED	7
	STOREY	01 FLOOR	0	02 FLOORS	0	03 TO 05 FLOORS	5	06 TO 10 FLOORS	2
	COURTYARD	NOT APPLICABLE	1	COMMON	0	PRIVATE	6		
	FRONTAL SET BACK	NOT APPLICABLE	6	WITH GREEN ELEMENTS	1	WITH NO GREEN ELEMENTS	0		
	LATERAL SET BACK	NOT APPLICABLE	7	ONE SIDE	0	BOTH SIDES	0		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	0	02 ACCESS	3	MORE THAN 02	3
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	7	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	7	TO PUBLIC STREET	0	TO ALLEY/COURTYARD	0		
	EXTENSION CHARACTER	NOT APPLICABLE	7	PERMANENT	0	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	6	UP TO 02 PASSING UNITIES	1	ABOVE 02 PASSING UNITIES	0		
Urban Block 14	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	4	50% - 80%	1	LESS THAN 50%	2
(Q14)	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	5	BELOW STREET LEVEL	1	ABOVE STREET LEVEL	1
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	7	ALLEY/COURTYARD	0	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	6	02 ACCESS	0	MORE THAN 02	1
	GREEN TERRACE	NOT APPLICABLE	6	YES	1	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	3	1970 TO 1990	3	1990 TO 2021	1
	GARAGE	NOT APPLICABLE	5	GROUND FLOOR	1	UNDERGROUND	2	COURTYARD	0
	BALCONIES	NOT APPLICABLE	3	TOWARDS STREET	4	TOWARDS ALLEY/COURTYARD	0	STREET/ALLEY/COURTYARD	0
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	2	<50%'	4	'>50%'	1		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	1	THROUGH RESIDENTIAL ACCESS	6	COMBINED	0
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	0	VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE	6	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	3	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	4		
	FRONTAL SET BACK	NOT APPLICABLE	5	IMPERMEABLE SURFACE	1	PERMEABLE SURFACE	0	WITH GARDEN	1
	PITCHED ROOF	NOT APPLICABLE	1	YES	5	COMBINED	1		
	MANTAINANCE STATUS	NOT RENEWED	3	RENEWED	2	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	2

	LAND USE								
	USE	RESIDENTIAL	6	COM/INST/SERV	3	EMPTY PLOT	0	MIXED	3
	STOREY	01 FLOOR	0	02 FLOORS	4	03 TO 05 FLOORS	7	06 TO 10 FLOORS	1
	COURTYARD	NOT APPLICABLE	0	COMMON	2	PRIVATE	10		
	FRONTAL SET BACK	NOT APPLICABLE	11	WITH GREEN ELEMENTS	0	WITH NO GREEN ELEMENTS	1		
	LATERAL SET BACK	NOT APPLICABLE	5	ONE SIDE	6	BOTH SIDES	1		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	6	02 ACCESS	2	MORE THAN 02	4
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	11	GREEN ALLEY/COURTYARD	1	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	11	TO PUBLIC STREET	0	TO ALLEY/COURTYARD	1		
	EXTENSION CHARACTER	NOT APPLICABLE	11	PERMANENT	1	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	2	UP TO 02 PASSING UNITIES	8	ABOVE 02 PASSING UNITIES	1		
Urban Block 15	GROUND FLOOR SERVICE	NOT APPLICABLE	8	80% - 100%	1	50% - 80%	2	LESS THAN 50%	1
(Q15)	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	12	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	12	ALLEY/COURTYARD	0	COMBINED	0
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	6	02 ACCESS	2	MORE THAN 02	4
	GREEN TERRACE	NOT APPLICABLE	12	YES	0	COMMON USE	0		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	3	1970 TO 1990	5	1990 TO 2021	4
	GARAGE	NOT APPLICABLE	11	GROUND FLOOR	0	UNDERGROUND	1	COURTYARD	0
	BALCONIES	NOT APPLICABLE	6	TOWARDS STREET	3	TOWARDS ALLEY/COURTYARD	2	STREET/ALLEY/COURTYARD	1
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	6	<50%'	3	'>50%'	3		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	0	COMMON CLOSED GATE FROM STREET	3	THROUGH RESIDENTIAL ACCESS	8	COMBINED	1
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	2	VISUALLY PERMEABLE	10	NOT VISUALLY PERMEABLE	0	NOT VISUALLY PERMEABLE (GREEN)	4
	SIDEWALK	TRADITIONAL	12	PERMEABLE/NOT LEVELED	0	SHARED PAVEMENT/PERMEABLE	0		
	FRONTAL SET BACK	NOT APPLICABLE	11	IMPERMEABLE SURFACE	1	PERMEABLE SURFACE	0	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	0	YES	11	COMBINED	1		
	MANTAINANCE STATUS	NOT RENEWED	11	RENEWED	1	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	0

	LAND USE								
	USE	RESIDENTIAL	4	COM/INST/SERV	3	EMPTY PLOT	0	MIXED	3
	STOREY	01 FLOOR	1	02 FLOORS	1	03 TO 05 FLOORS	5	06 TO 10 FLOORS	1
	COURTYARD	NOT APPLICABLE	1	COMMON	2	PRIVATE	5		
	FRONTAL SET BACK	NOT APPLICABLE	2	WITH GREEN ELEMENTS	1	WITH NO GREEN ELEMENTS	4		
	LATERAL SET BACK	NOT APPLICABLE	0	ONE SIDE	4	BOTH SIDES	4		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	1	02 ACCESS	6	MORE THAN 02	0
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	7	GREEN ALLEY/COURTYARD	0	STREET AND ALLEY/COURTYARD	0
	EXTENSION COMPONENT	NOT APPLICABLE	0	TO PUBLIC STREET	6	TO ALLEY/COURTYARD	1		
	EXTENSION CHARACTER	NOT APPLICABLE	0	PERMANENT	7	SEASONAL	0		
	COVERED PROMENADE	NOT APPLICABLE	0	UP TO 02 PASSING UNITIES	2	ABOVE 02 PASSING UNITIES	5		
Urban Block 16	GROUND FLOOR SERVICE	NOT APPLICABLE	0	80% - 100%	0	50% - 80%	2	LESS THAN 50%	5
(Q16)	ACCESS LEVEL	NOT APPLICABLE	0	STREET LEVEL	7	BELOW STREET LEVEL	0	ABOVE STREET LEVEL	0
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	0	PUBLIC STREET	8	ALLEY/COURTYARD	0	COMBINED	1
	NUMBER OF ACCESSES	NOT APPLICABLE	0	1 ACCESS	6	02 ACCESS	2	MORE THAN 02	0
	GREEN TERRACE	NOT APPLICABLE	4	YES	2	COMMON USE	2		
	BUILDING AGE	NOT APPLICABLE	0	BEFORE 1970	1	1970 TO 1990	4	1990 TO 2021	3
	GARAGE	NOT APPLICABLE	4	GROUND FLOOR	4	UNDERGROUND	0	COURTYARD	0
	BALCONIES	NOT APPLICABLE	1	TOWARDS STREET	5	TOWARDS ALLEY/COURTYARD	1	STREET/ALLEY/COURTYARD	2
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	1	<50%'	5	'>50%'	2		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	2	COMMON CLOSED GATE FROM STREET	4	THROUGH RESIDENTIAL ACCESS	1	COMBINED	1
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	1	VISUALLY PERMEABLE	1	NOT VISUALLY PERMEABLE	6	NOT VISUALLY PERMEABLE (GREEN)	0
	SIDEWALK	TRADITIONAL	5	PERMEABLE/NOT LEVELED	1	SHARED PAVEMENT/PERMEABLE	2		
	FRONTAL SET BACK	NOT APPLICABLE	0	IMPERMEABLE SURFACE	5	PERMEABLE SURFACE	3	WITH GARDEN	0
	PITCHED ROOF	NOT APPLICABLE	1	YES	7	COMBINED	0		
	MANTAINANCE STATUS	NOT RENEWED	4	RENEWED	3	UNDER RENIVATION	0	NEW (BUILT AFTER 200s)	1

SUMMARY	LAND USE								
	USE	RESIDENTIAL	53	COM/INST/SERV	17	EMPTY PLOT	0	MIXED	136
	STOREY	01 FLOOR	3	02 FLOORS	11	03 TO 05 FLOORS	148	06 TO 10 FLOORS	45
	COURTYARD	NOT APPLICABLE	41	COMMON	11	PRIVATE	151		
	FRONTAL SET BACK	NOT APPLICABLE	130	WITH GREEN ELEMENTS	31	WITH NO GREEN ELEMENTS	45		
	LATERAL SET BACK	NOT APPLICABLE	152	ONE SIDE	37	BOTH SIDES	14		
	COMMERCE/SERVICE UNITY								
	NUMBER OF ACCESSES	NOT APPLICABLE	17	1 ACCESS	68	02 ACCESS	41	MORE THAN 02	57
	TYPE OF ACCESS	NOT APPLICABLE	17	PUBLIC STREET	157	GREEN ALLEY/COURTYARD	4	STREET AND ALLEY/COURTYARD	3
	EXTENSION COMPONENT	NOT APPLICABLE	154	TO PUBLIC STREET	25	TO ALLEY/COURTYARD	3		
	EXTENSION CHARACTER	NOT APPLICABLE	156	PERMANENT	19	SEASONAL	7		
	COVERED PROMENADE	NOT APPLICABLE	132	UP TO 02 PASSING UNITIES	35	ABOVE 02 PASSING UNITIES	15		
	GROUND FLOOR SERVICE	NOT APPLICABLE	32	80% - 100%	51	50% - 80%	65	LESS THAN 50%	30
	ACCESS LEVEL	NOT APPLICABLE	17	STREET LEVEL	144	BELOW STREET LEVEL	9	ABOVE STREET LEVEL	10
	RESIDENTIAL								
	TYPE OF ACCESS	NOT APPLICABLE	9	PUBLIC STREET	126	ALLEY/COURTYARD	11	COMBINED	59
	NUMBER OF ACCESSES	NOT APPLICABLE	9	1 ACCESS	126	02 ACCESS	50	MORE THAN 02	20
	GREEN TERRACE	NOT APPLICABLE	180	YES	10	COMMON USE	10		
	BUILDING AGE	NOT APPLICABLE	10	BEFORE 1970	82	1970 TO 1990	75	1990 TO 2021	34
	GARAGE	NOT APPLICABLE	153	GROUND FLOOR	33	UNDERGROUND	18	COURTYARD	1
	BALCONIES	NOT APPLICABLE	77	TOWARDS STREET	60	TOWARDS ALLEY/COURTYARD	43	STREET/ALLEY/COURTYARD	22
	URBAN LANDSCAPE/GREENSCAPE								
	FACADE OPENINGS	<30%'	61	<50%'	64	'>50%'	75		
	ACCESS TO COURTYARD	COMMON OPEN GATE FROM STREET	5	COMMON CLOSED GATE FROM STREET	41	THROUGH RESIDENTIAL ACCESS	146	COMBINED	3
	PHISICAL BARRIER TO COURTYARD	NOT APPLICABLE	57	VISUALLY PERMEABLE	33	NOT VISUALLY PERMEABLE	105	NOT VISUALLY PERMEABLE (GREEN)	7
	SIDEWALK	TRADITIONAL	163	PERMEABLE/NOT LEVELED	10	SHARED PAVEMENT/PERMEABLE	25		
	FRONTAL SET BACK	NOT APPLICABLE	139	IMPERMEABLE SURFACE	21	PERMEABLE SURFACE	22	WITH GARDEN	16
	PITCHED ROOF	NOT APPLICABLE	64	YES	121	COMBINED	14		
	MANTAINANCE STATUS	NOT RENEWED	57	RENEWED	118	UNDER RENIVATION	2	NEW (BUILT AFTER 200s)	21

The urban morphological analysis conducted within the specified study zone has delineated an architectural panorama characterized by remarkable morphological preservation. Amidst the contemporary wave of urban redevelopment, the district remains anchored in its historical roots, predominantly showcasing structures from the 19th and early 20th centuries.

This architectural stock is systematically categorized into two distinct typologies: Traditional Historic Buildings, which are further segmented into renovated units (T2) and those awaiting such interventions (T3), as well as Institutional Buildings (T4). The analytical process highlights the intricate interplay between historic preservation and urban modernization, accentuating the strategic management of architectural heritage within urban development processes.

Annex 4. Data Compilation from UGI Typology Investigation Workshop

In the spring semester of 2023, a second round of hands-on workshops was incorporated into the Urbanism course at the Hungarian University of Agriculture and Life Sciences (MATE), designed for master's students in Landscape Architecture. This collaborative effort allowed students to apply the principles of Urban Green Typological Survey in a real-world context, focusing on the public green spaces of Budapest's IX district.

An in-depth curriculum was crafted to blend theoretical knowledge with practical experience, further enriched by technically guided visits to the survey site. These visits were pivotal in producing relevant content, and the structured environment fostered a rigorous standard for data collection and interpretation.

Comprising six groups with approximately five students each, the teams embarked on two faculty-supervised field trips. These sessions provided a live platform for inquiry and peer learning, allowing students to conduct their research under expert guidance and directly engage with the space. Additional visits were organized independently, fostering a sense of autonomy in the learning process.

The analysis continued in the classroom as the collected data were collated and deliberated. An important aspect of this research phase was the use of a shared online database. This dynamic tool enabled students to not only input their findings but also to juxtapose and scrutinize their data with the collective intelligence of their peers' contributions.

The six groups systematically examined all nine selected urban blocks in this structured analytical exercise. This was part of a cohesive approach to ensure that the resulting analyses could be precisely compared and validated against each other. The goal was to critically assess the effectiveness of different evaluation parameters and their ability to measure and interpret the urban green infrastructure within the District while rectifying essential concepts of urban morphology from the students' side.

By cross-referencing the outcomes from each group, the workshop facilitated a scientific discussion focused on the reliability and accuracy of the data collected. This collective examination served to identify any discrepancies and biases in the methodologies applied, promoting a constructive critique of the evaluation parameters. The process also aimed to detect patterns or anomalies in the urban green infrastructure distribution and typology, which could contribute to a more empirical understanding of the subject.

This comparative analysis was essential in developing a framework for urban green space assessment, ultimately leading to an evidence-based discussion on landscape architecture and urban planning practices. This pedagogical approach facilitated a rich educational experience and contributed significantly to the fieldwork, embodying a collaborative learning and research model.

See below the combined results of the research conducted per urban block analyzed. The data is presented graphically to facilitate identifying the typological characteristics prevalent within each block, as per indicated in figure A11.

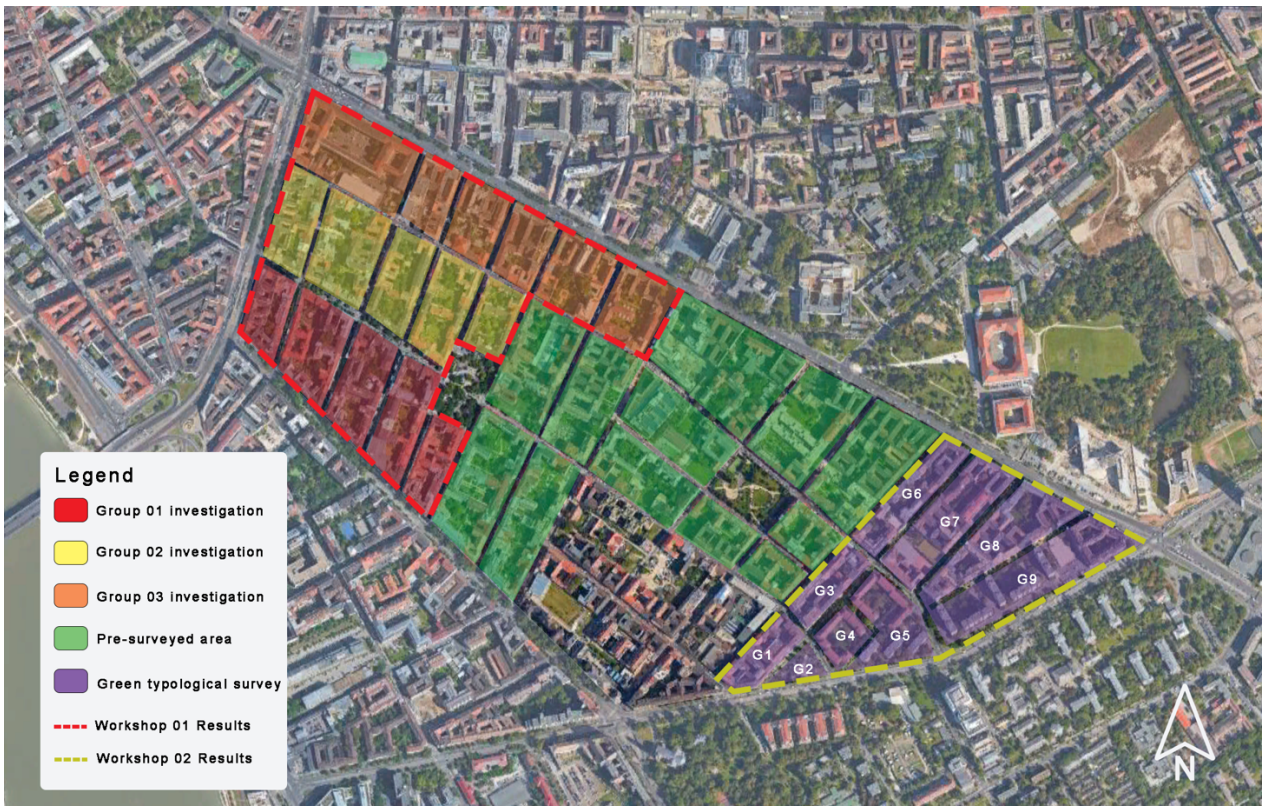
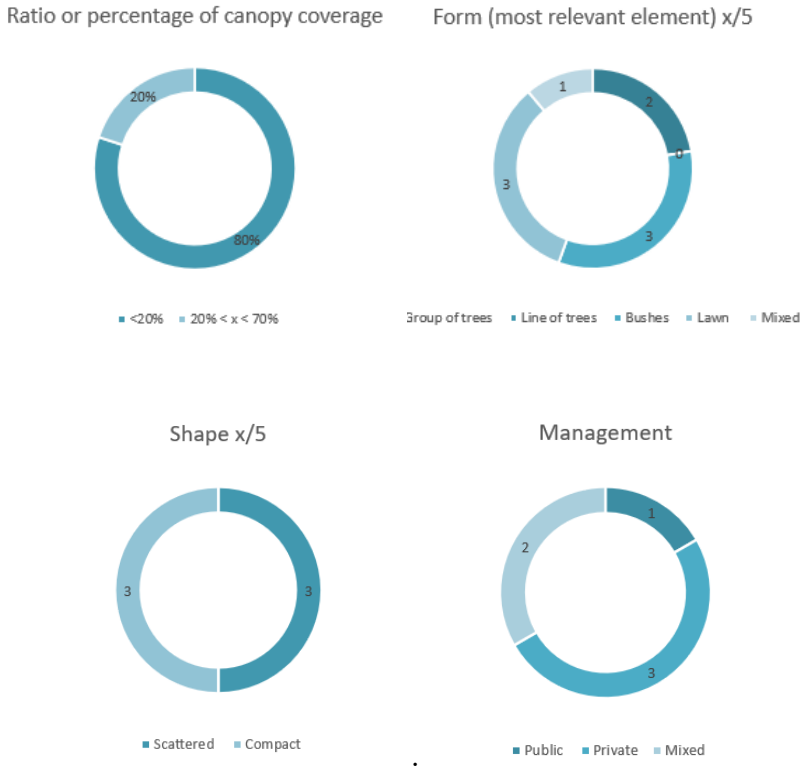
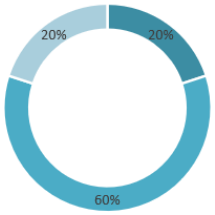


Figure A11: Urban Green Typological Survey administered in urban blocks G1 to G9. Source: by author.

Results Urban block 1

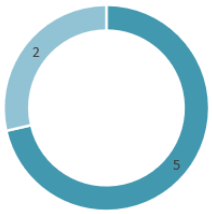


Ownership



Public Private Public with private appropriation

Maintanance Status x/5

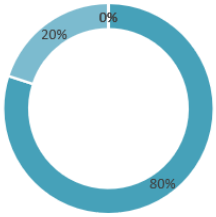


Extensivly Main Lack of care

Pattern of use x/5

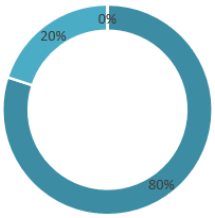
Intense-protacted use Light - protacted use Light - connection path

Function



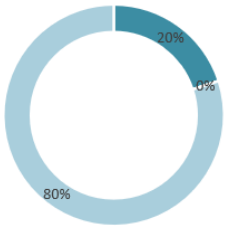
Leisure Urban residential Connection Other functions

Ratio or percentage of green area



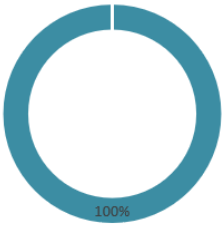
<20% 20% < x <70% >70%

Dominant pavement



Predominantly green cover Water permeable paving Non permeable paving

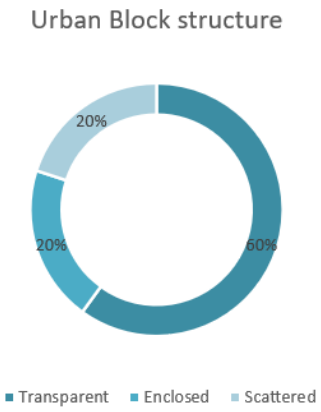
Outdoor Furnishing

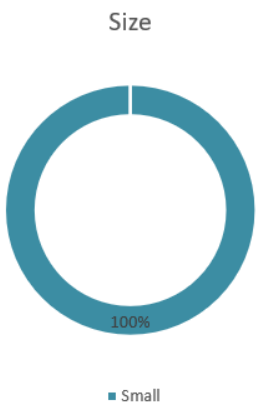


Not applicable existing, insuficient exinting, sufficient

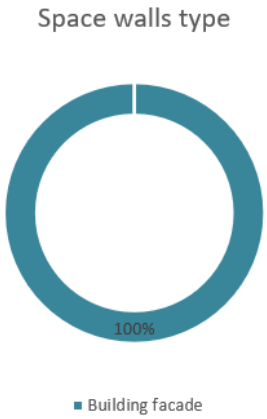
Building layout x/5

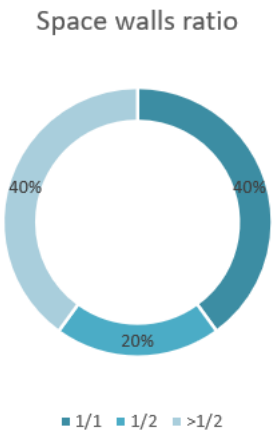
Not applicable Unified Courtyard Individual coutyard Not applicable

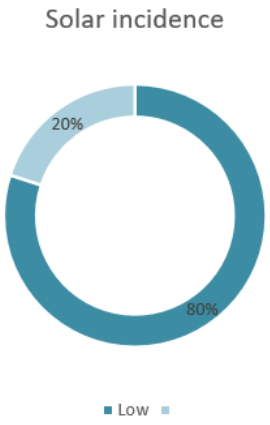

Urban Block structure
20%
20%
60%
Transparent
Enclosed
Scattered


Size
100%
Small

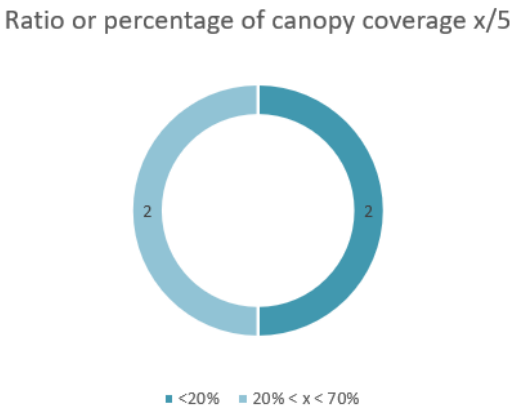

Shape
1
1
4
linear
rectangular
Triangular

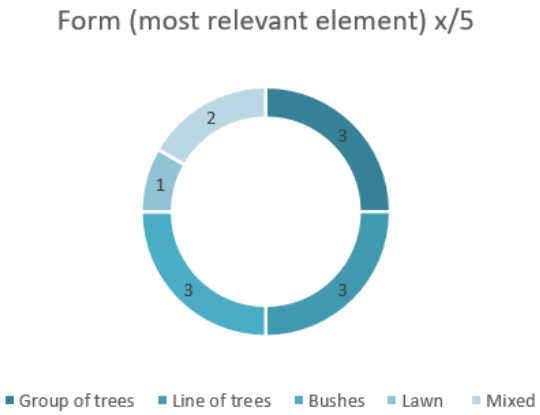

Space walls type
100%
Building facade

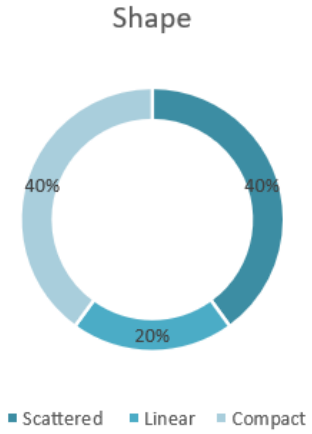

Space walls ratio
40%
40%
20%
1/1
1/2
>1/2

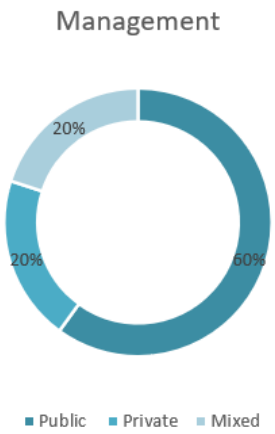

Solar incidence
20%
80%
Low

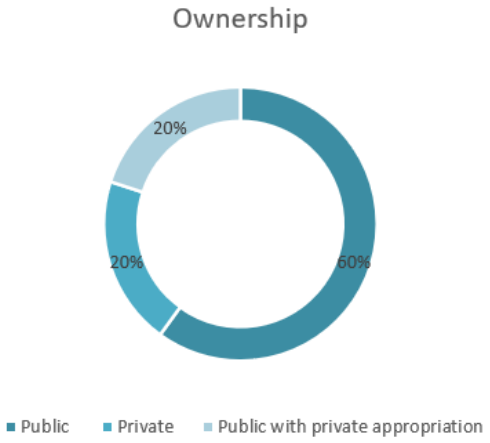
Results Urban block 2

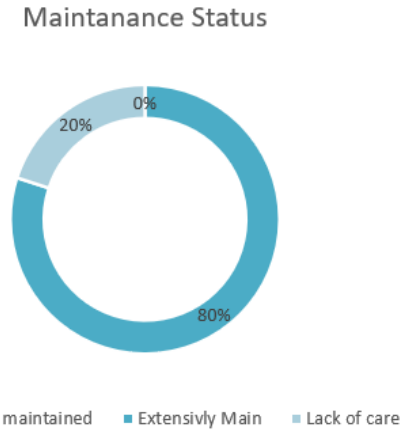








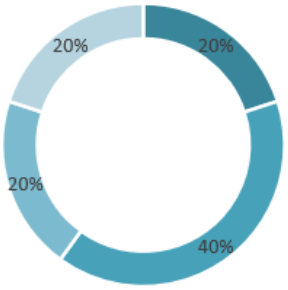




Pattern of use x/5

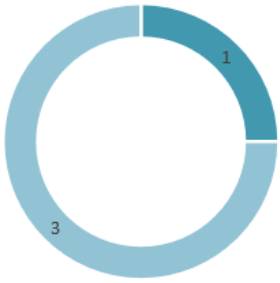
Intense-protacted use Intense - connection path
Light - protacted use Light - connection path

Function



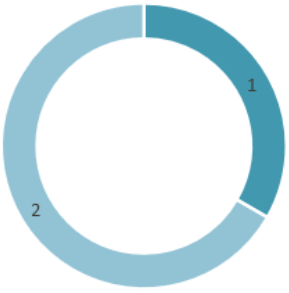
Leisure Urban residential Connection Other functions

Ratio or percentage of green area x/5



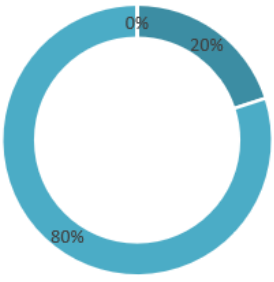
<20% 20% < x <70%

Dominant pavement x/5



Predominantly green cover Non permeable paving

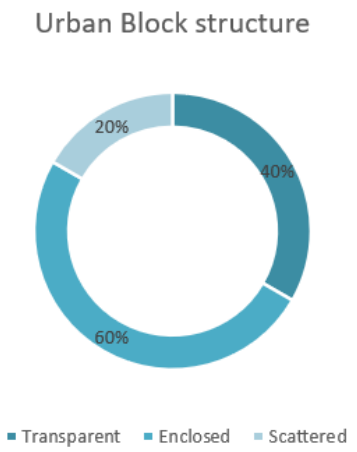
Outdoor Furnishing

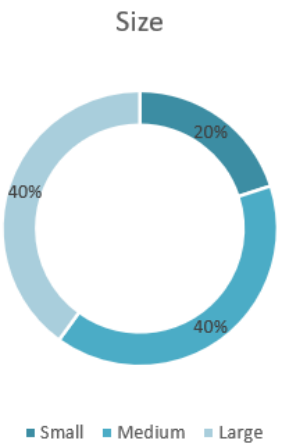


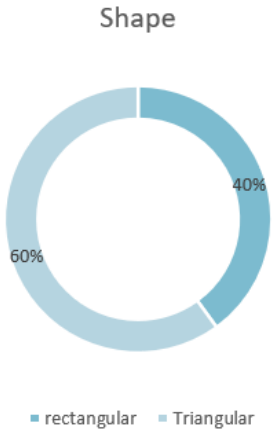
Not applicable existing, insuficient exinting, sufficient

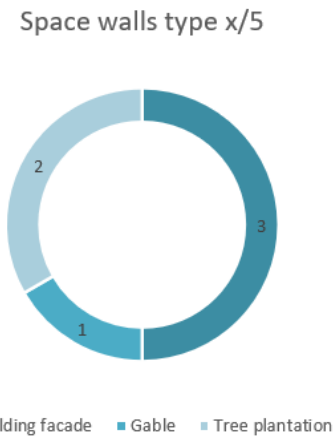
Building layout x/5

Not applicable Unified Courtyard Detatched Building

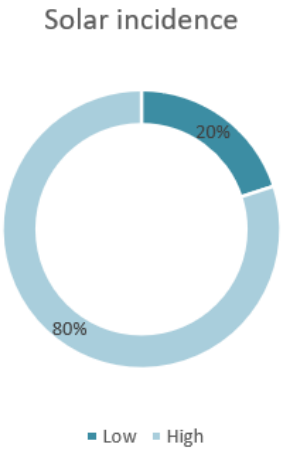

Urban Block structure
20%
40%
60%
Transparent
Enclosed
Scattered


Size
20%
40%
40%
Small
Medium
Large

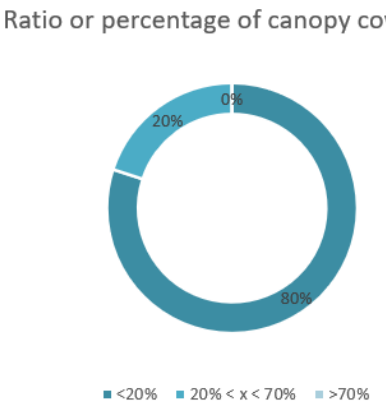

Shape
40%
60%
rectangular
Triangular

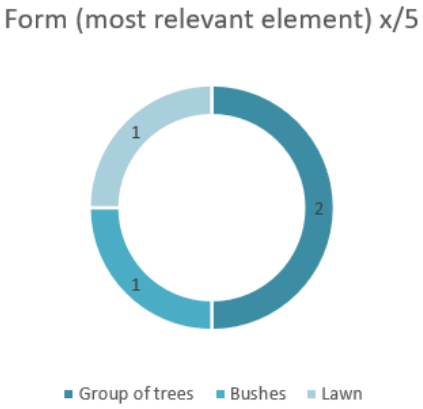

Space walls type x/5
2
3
1
Building facade
Gable
Tree plantation

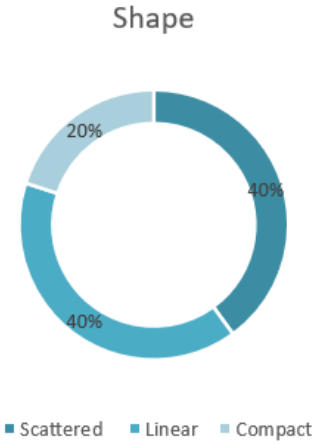

Space walls ratio x/5
1
1
4
1/1
1/2
>1/2

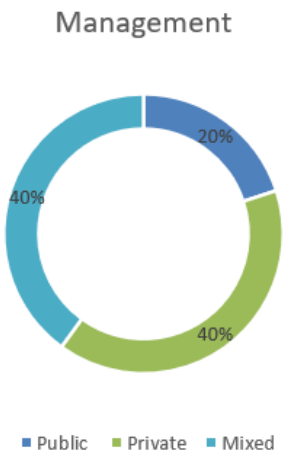

Solar incidence
20%
80%
Low
High

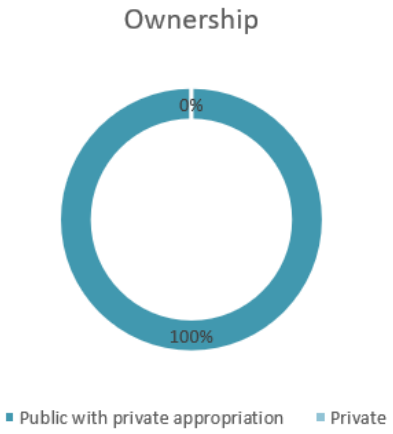
Results urban block 3

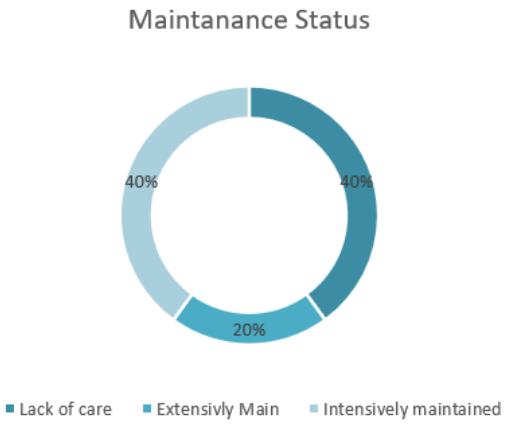


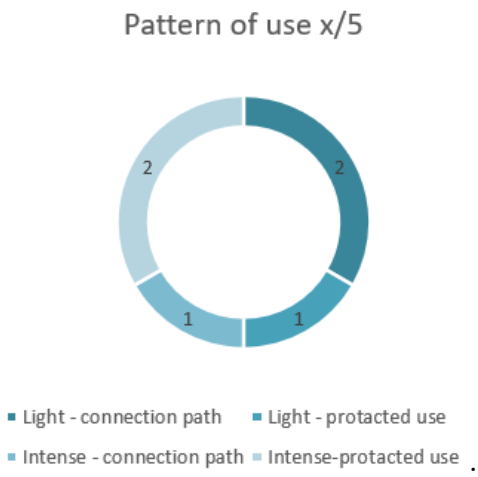


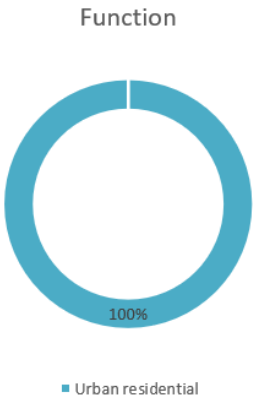


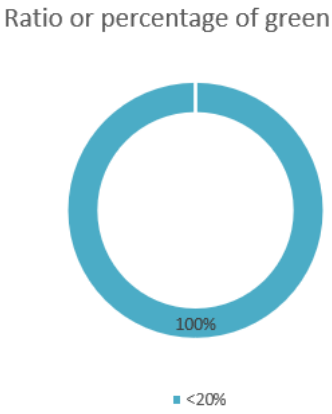


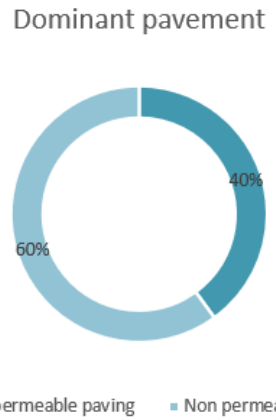


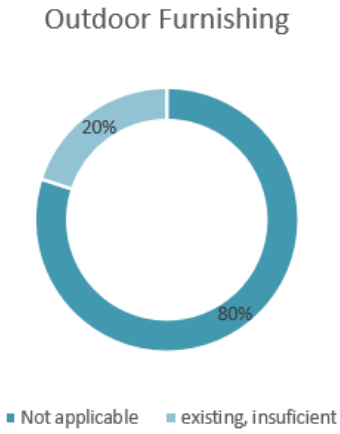


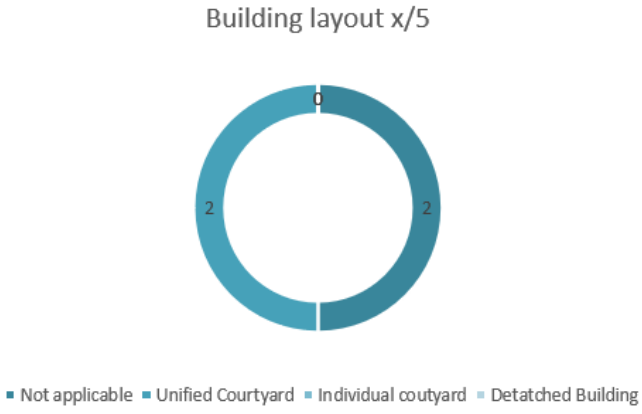

Pattern of use x/5
2
2
1
1
Light - connection path
Light - protacted use
Intense - connection path
Intense-protacted use


Function
100%
Urban residential


Ratio or percentage of green area
100%
<20%

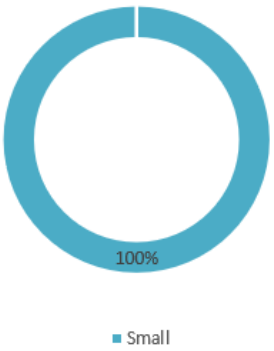

Dominant pavement
40%
60%
Water permeable paving
Non permeable paving


Outdoor Furnishing
20%
80%
Not applicable
existing, insuficient

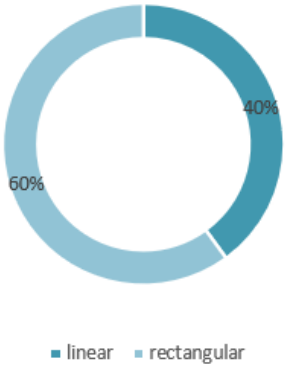

Building layout x/5
0
2
2
Not applicable
Unified Courtyard
Individual coutyard
Detatched Building

Solar incidence x/5

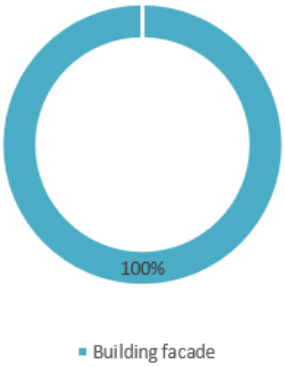
Size



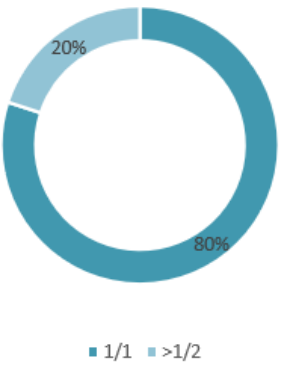
Shape



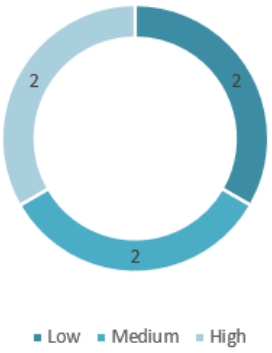
Space walls type



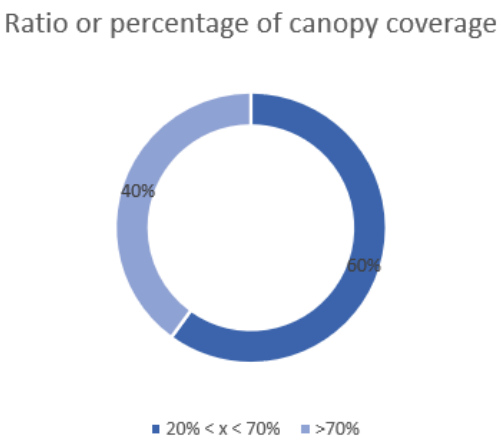
Space walls ratio

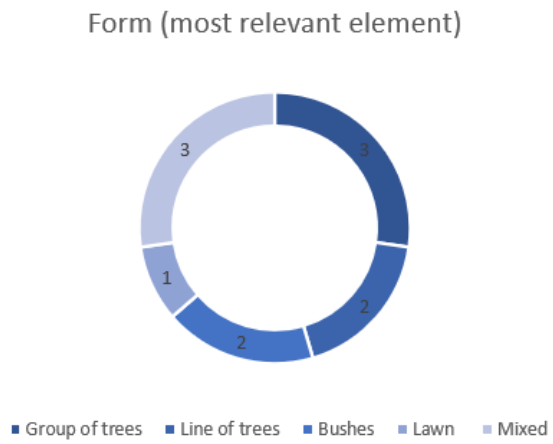


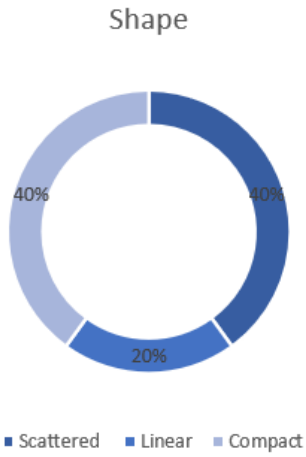
Solar incidence

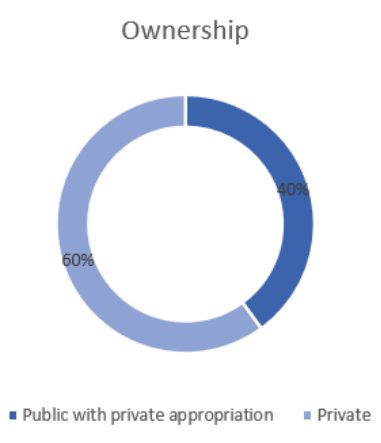


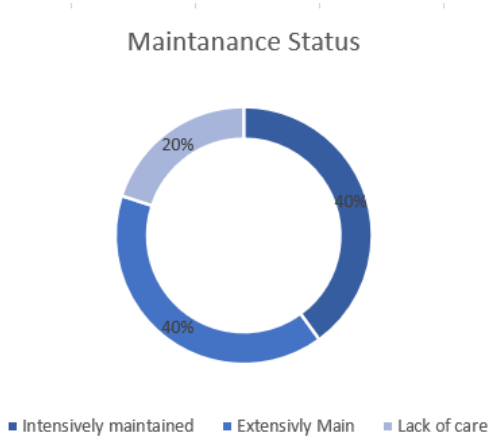
Results urban block 4

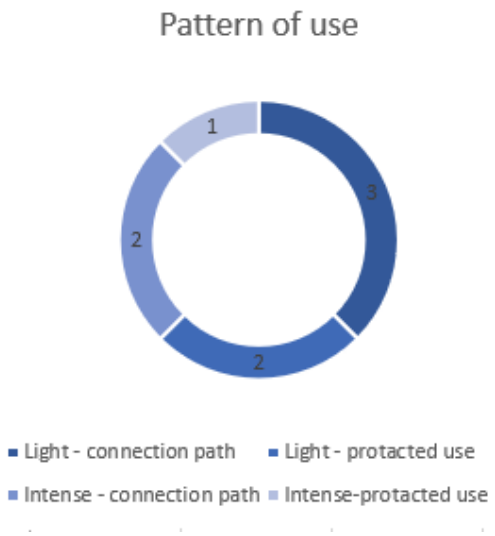


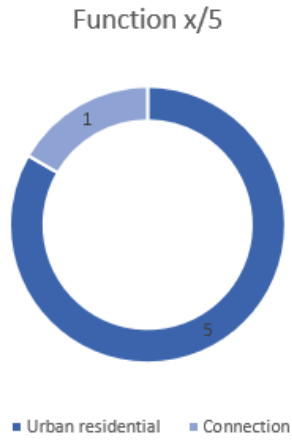


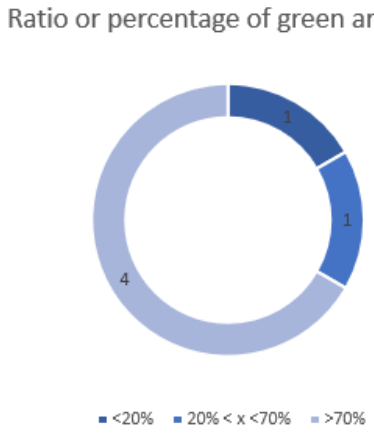


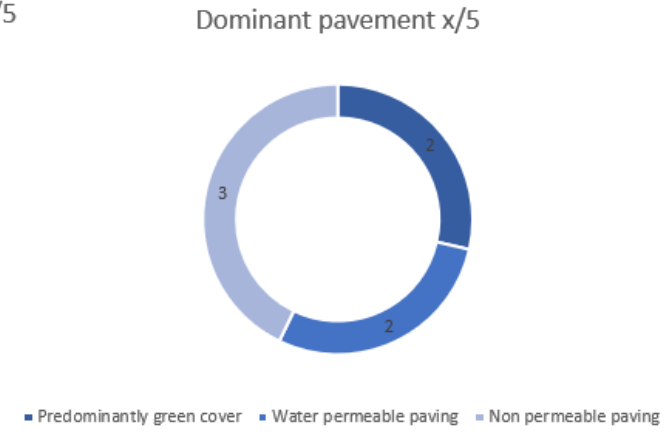


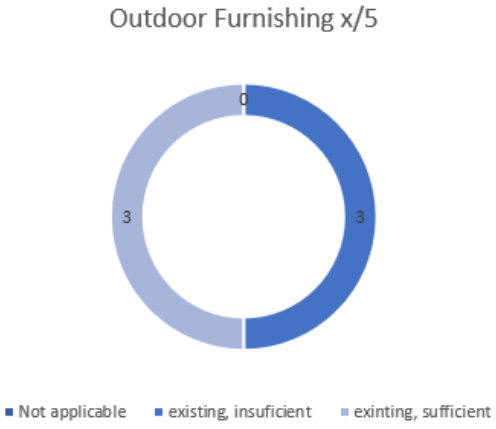


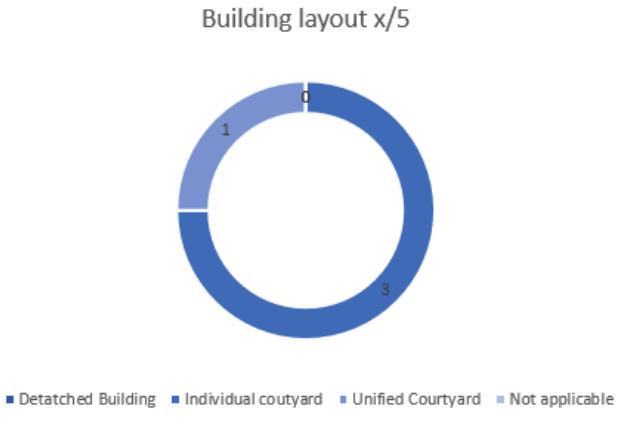

Pattern of use
3
2
2
1
Light - connection path
Light - protacted use
Intense - connection path
Intense-protacted use

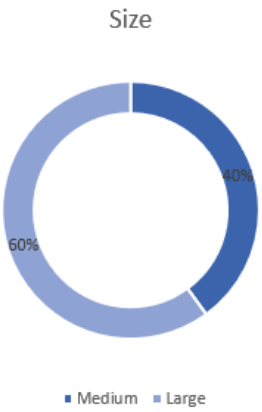

Function x/5
1
5
Urban residential
Connection

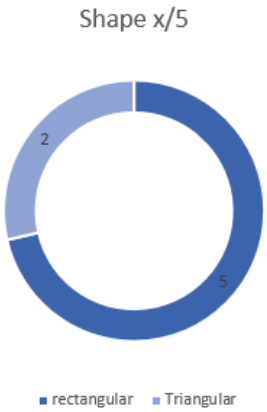

Ratio or percentage of green area x/5
1
1
4
<20%
20% < x <70%
>70%

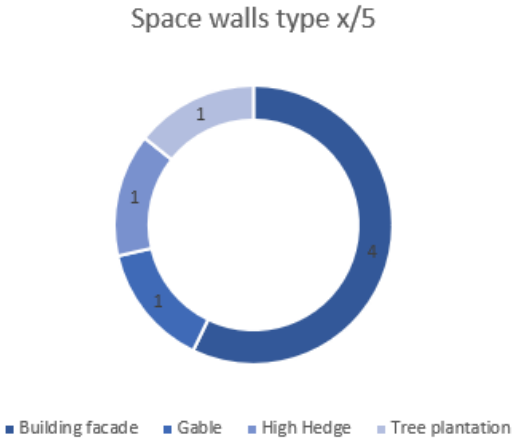

Dominant pavement x/5
2
2
3
Predominantly green cover
Water permeable paving
Non permeable paving

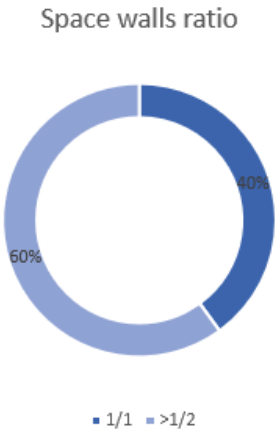

Outdoor Furnishing x/5
0
3
3
Not applicable
existing, insuficient
exinting, sufficient

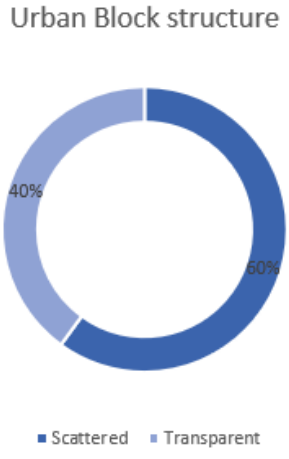

Building layout x/5
0
1
3
Detatched Building
Individual coutyard
Unified Courtyard
Not applicable

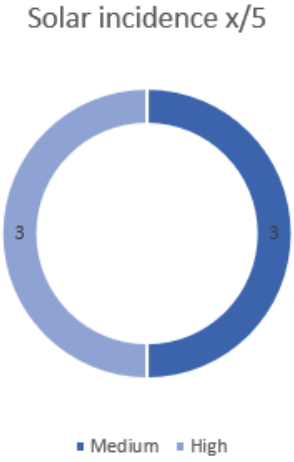

Size
40%
60%
Medium
Large


Shape x/5
2
5
rectangular
Triangular

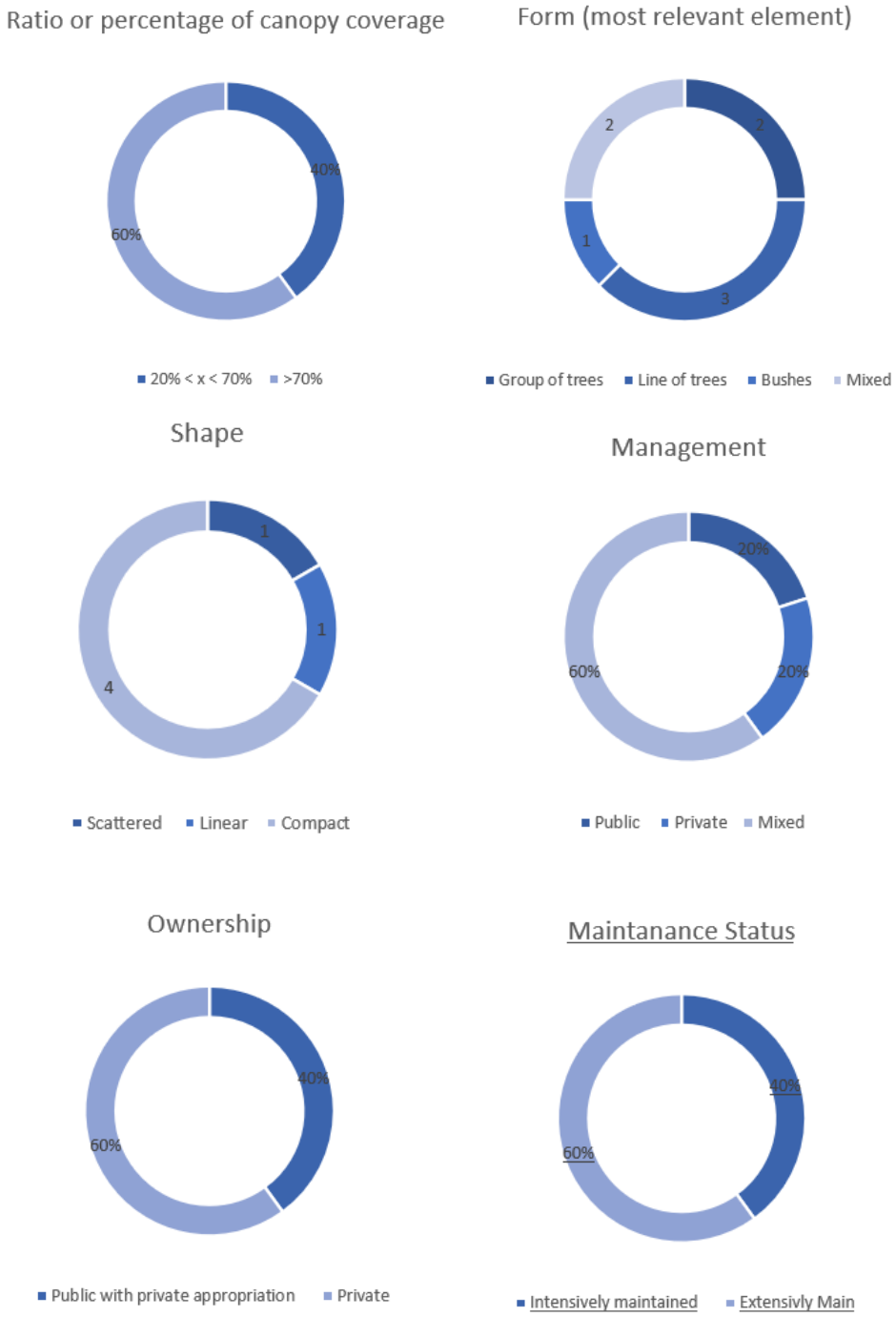

Space walls type x/5
1
1
1
4
Building facade
Gable
High Hedge
Tree plantation

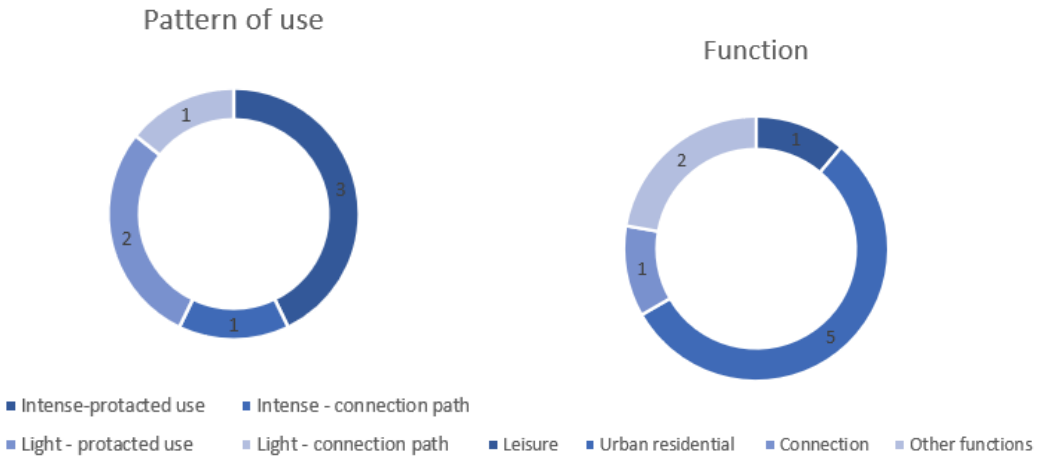

Space walls ratio
40%
60%
1/1
>1/2

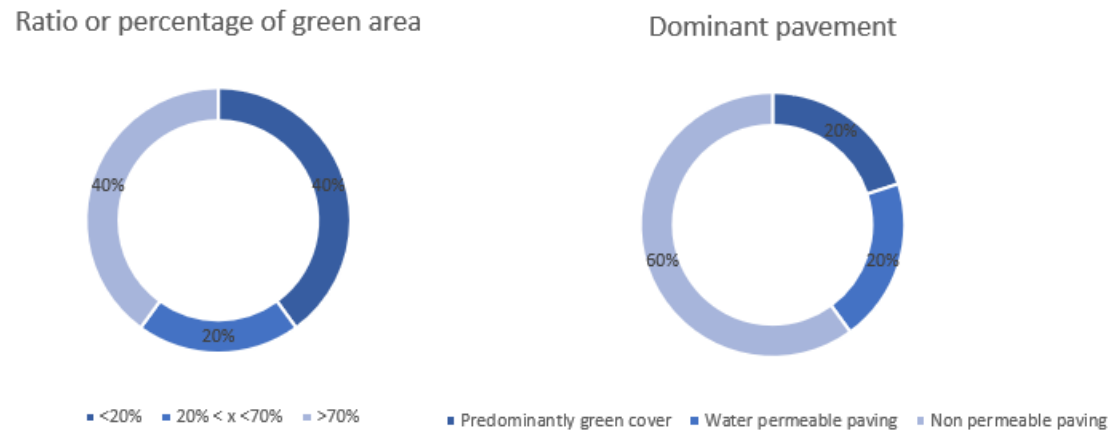

Urban Block structure
40%
60%
Scattered
Transparent

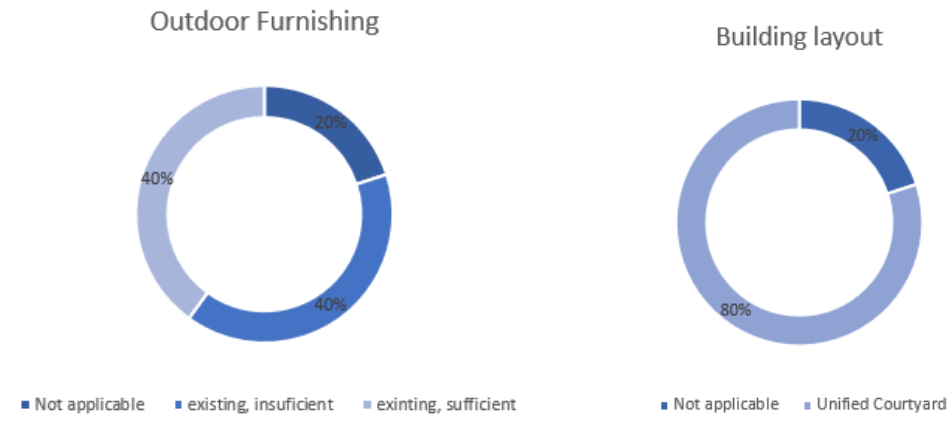

Solar incidence x/5
3
3
Medium
High

Results urban block 5

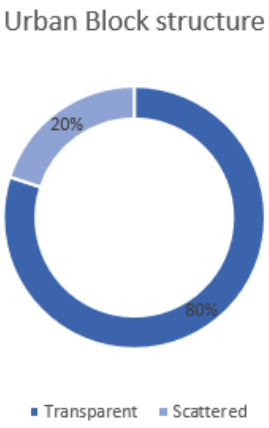


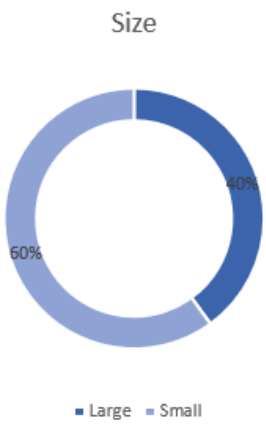

Pattern of use
3
1
2
1
Intense-protacted use
Intense - connection path
Light - protacted use
Light - connection path
Function
1
2
1
5
Leisure
Urban residential
Connection
Other functions


Ratio or percentage of green area
40%
40%
20%
<20%
20% < x <70%
>70%
Dominant pavement
20%
20%
60%
Predominantly green cover
Water permeable paving
Non permeable paving

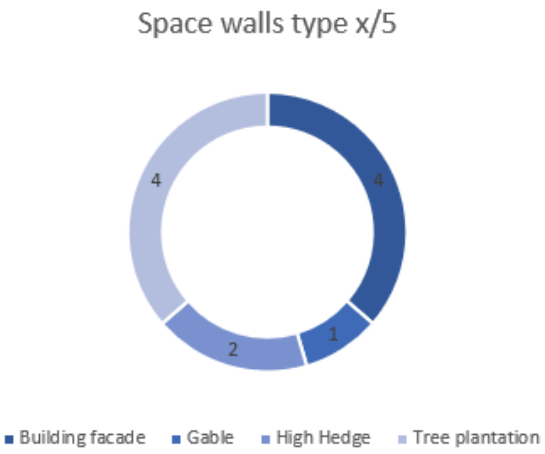

Outdoor Furnishing
20%
40%
40%
Not applicable
existing, insuficient
exinting, sufficient
Building layout
20%
80%
Not applicable
Unified Courtyard

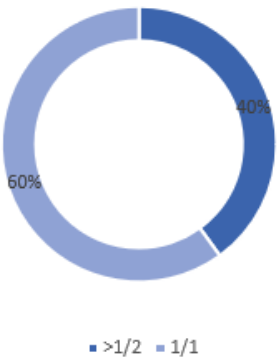
.

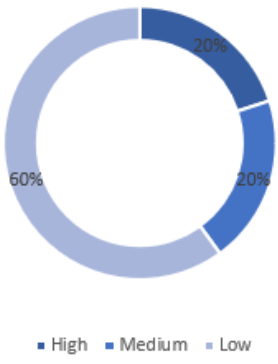

Urban Block structure
20%
80%
Transparent
Scattered


Size
40%
60%
Large
Small

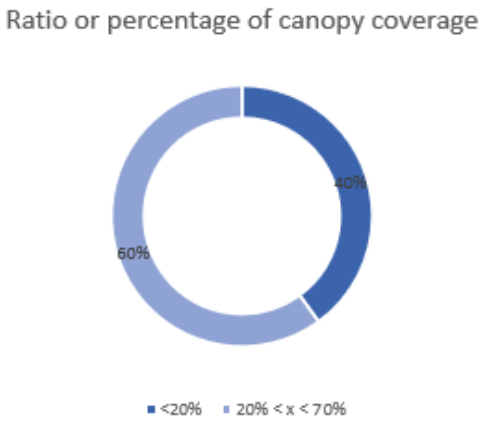

Shape x/5
1
2
4
linear
rectangular
Triangular

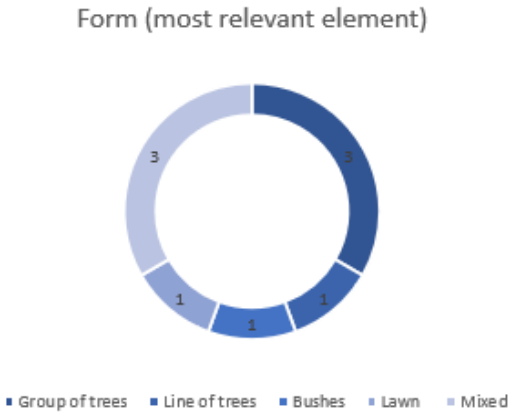

Space walls type x/5
4
4
1
2
Building facade
Gable
High Hedge
Tree plantation

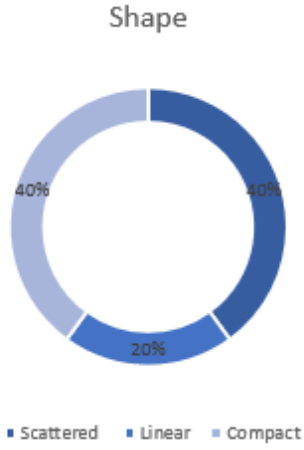

Space walls ratio
40%
60%
>1/2
1/1

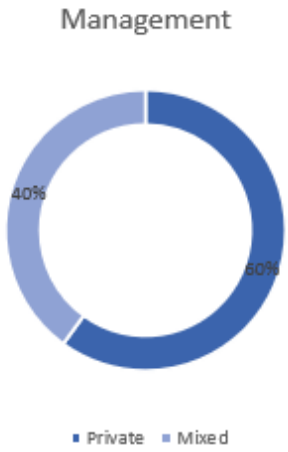

Solar incidence
20%
20%
60%
High
Medium
Low

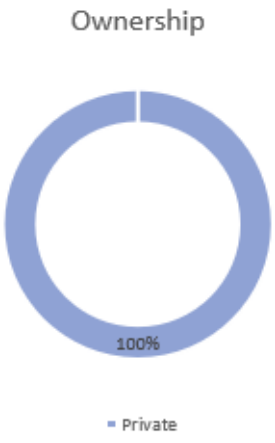
Results urban block 6

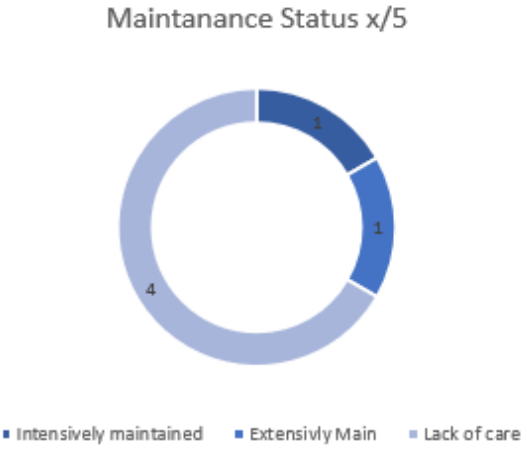






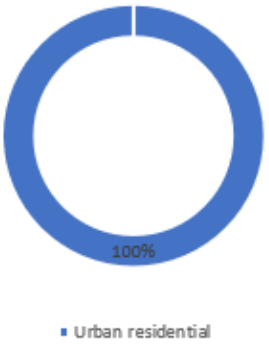




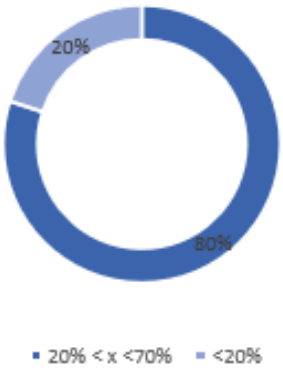


Pattern of use x/5

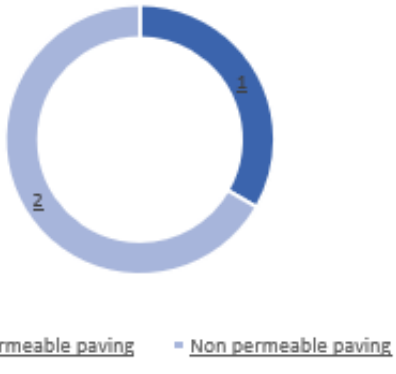
Function



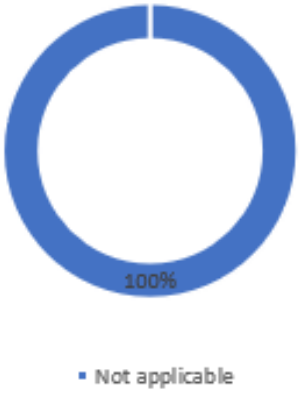
Ratio or percentage of green area



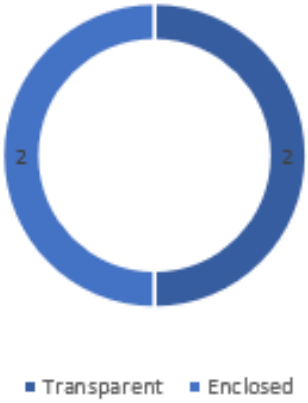
Dominant pavement

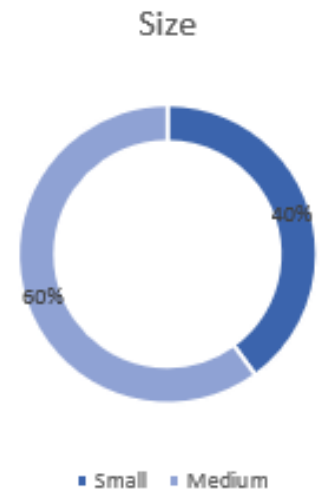


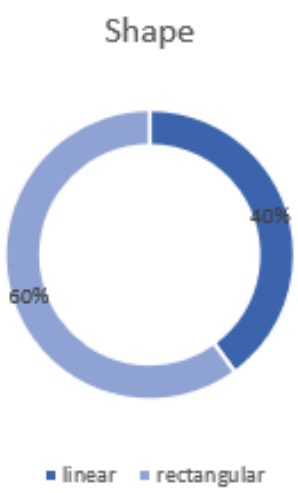
Building layout

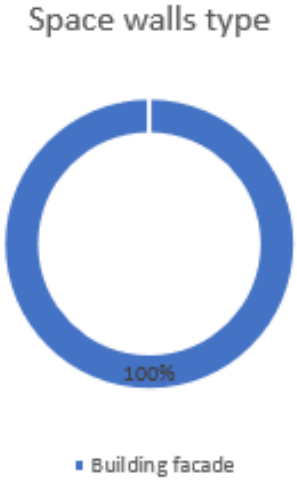


Urban Block structure x/5

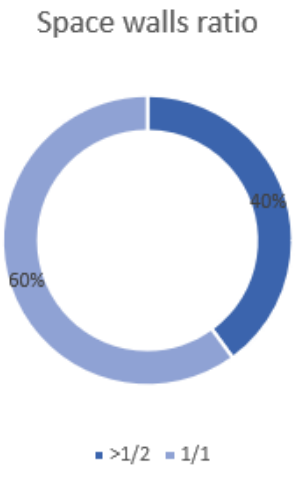



Size
40%
60%
Small
Medium


Shape
40%
60%
linear
rectangular

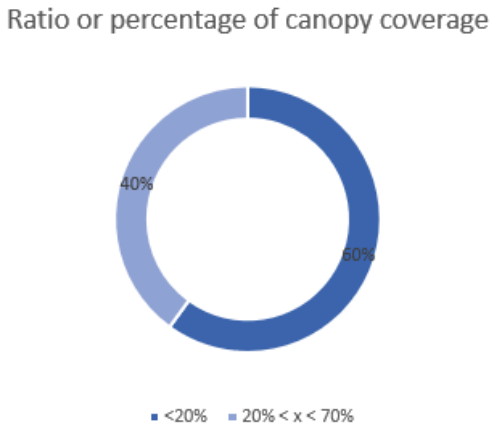

Space walls type
100%
Building facade

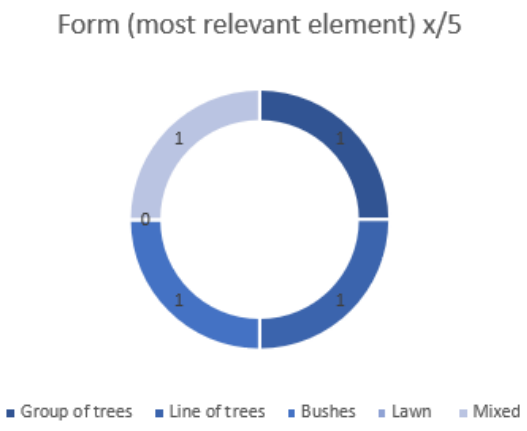

Space walls ratio
1
2
1/1
>1/2

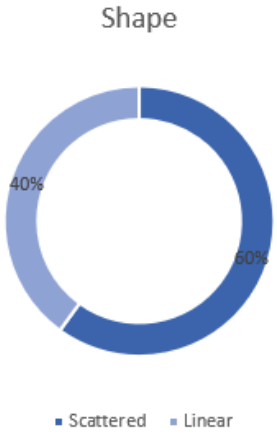

Space walls ratio
40%
60%
>1/2
1/1

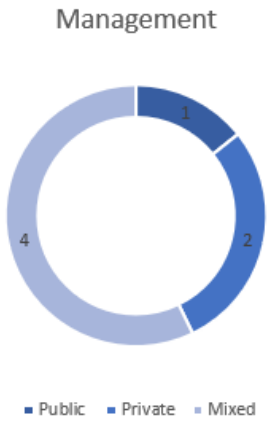

Solar incidence
2
4
Medium
High

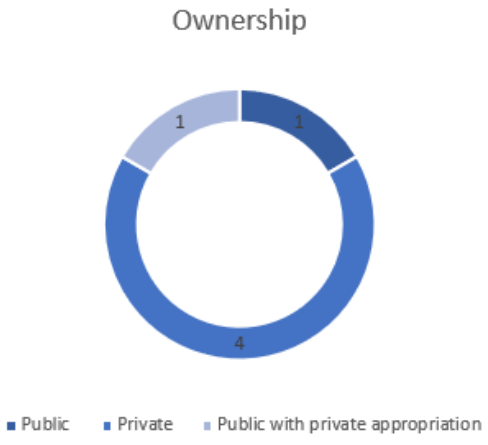
Results urban block 7

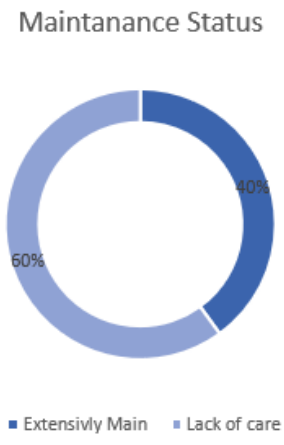


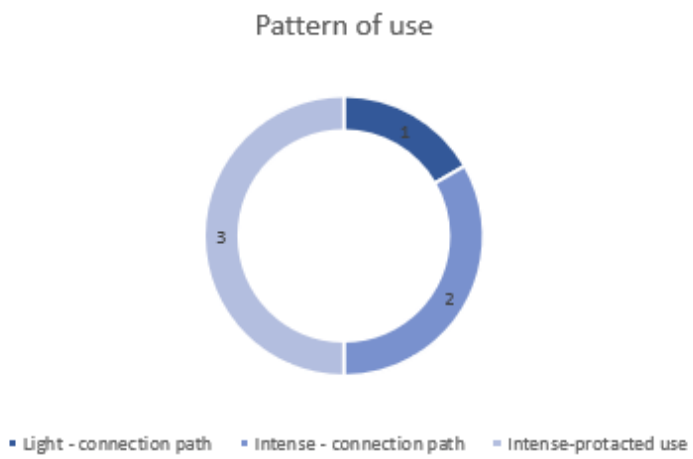




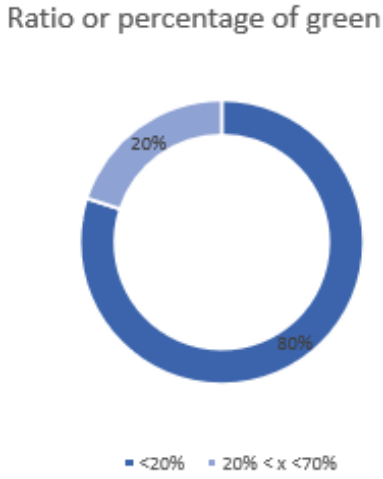


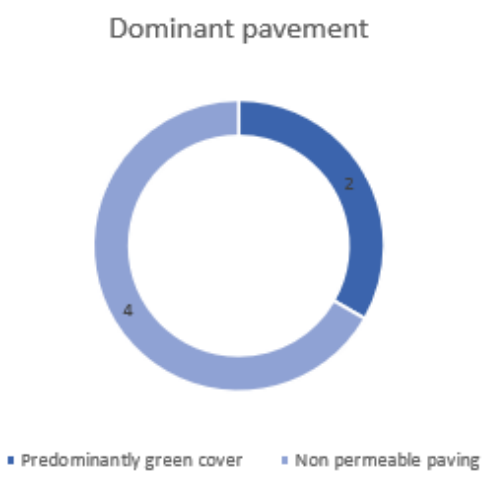


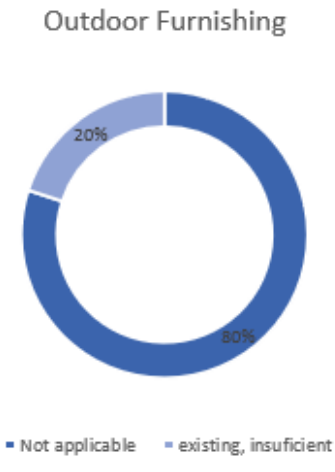


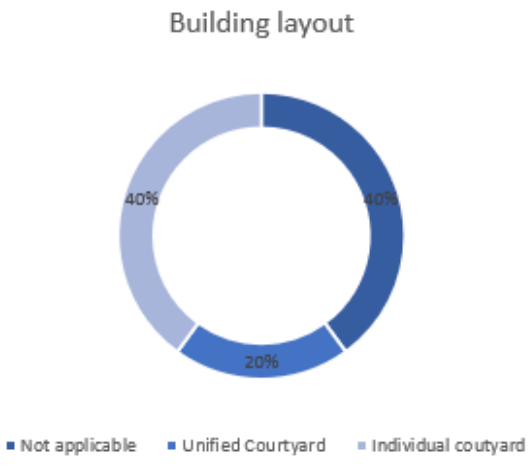

Pattern of use
1
2
3
Light - connection path
Intense - connection path
Intense-protacted use

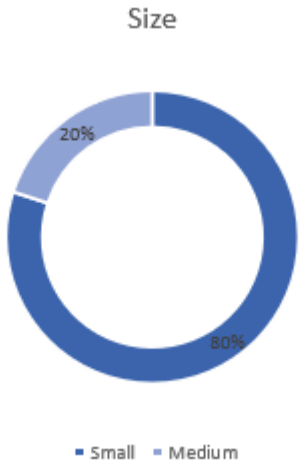

Function
1
5
Leisure
Urban residential

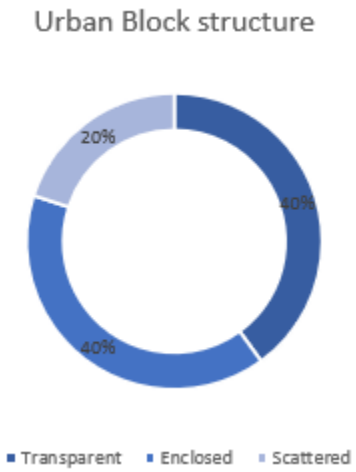

Ratio or percentage of green area
20%
80%
<20%
20% < x <70%

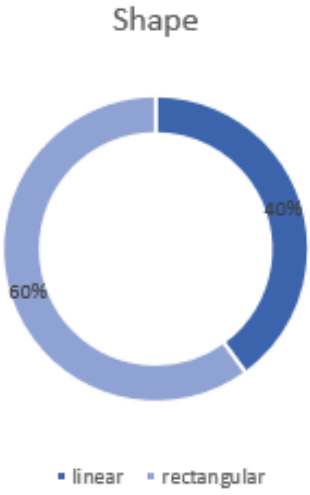

Dominant pavement
2
4
Predominantly green cover
Non permeable paving

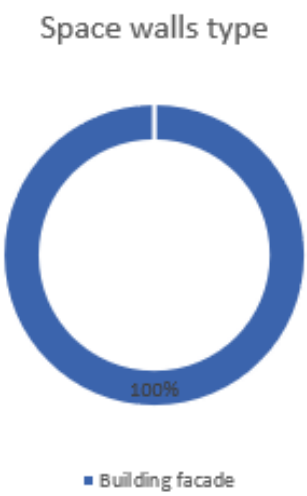

Outdoor Furnishing
20%
80%
Not applicable
existing, insuficient

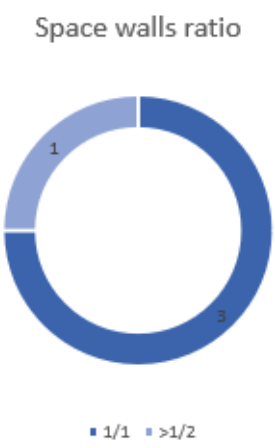

Building layout
40%
40%
20%
Not applicable
Unified Courtyard
Individual coutyard

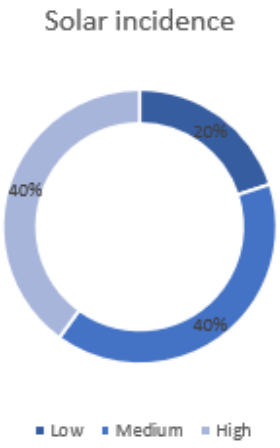

Size
20%
80%
Small
Medium


Urban Block structure
20%
40%
40%
Transparent
Enclosed
Scattered

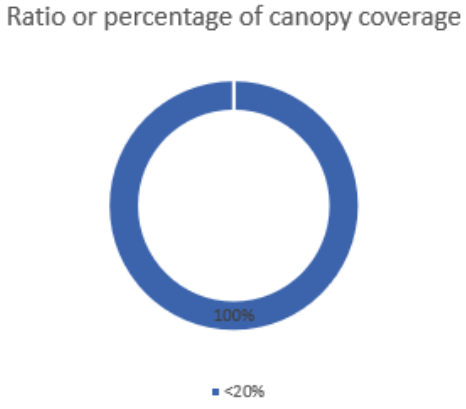

Shape
40%
60%
linear
rectangular

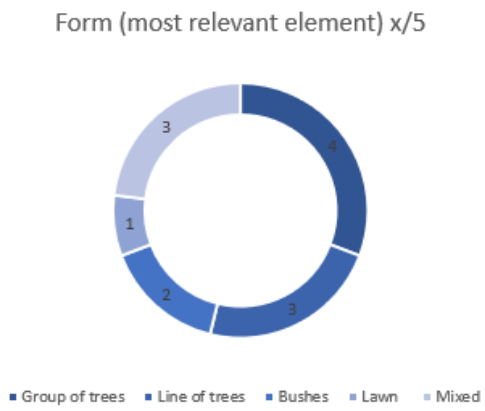

Space walls type
100%
Building facade

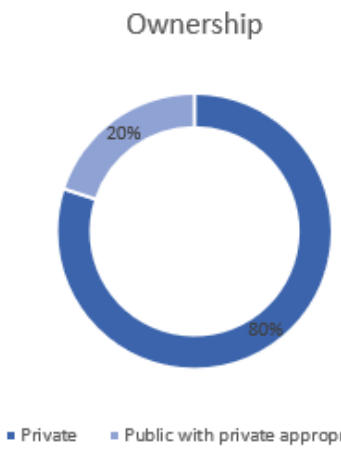

Space walls ratio
1
3
1/1
>1/2

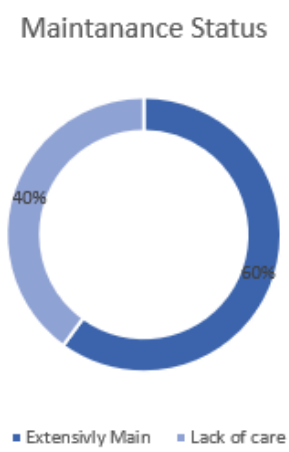

Solar incidence
20%
40%
40%
Low
Medium
High

Results urban block 8

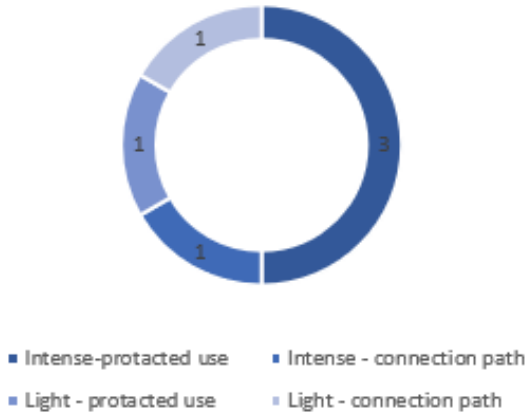




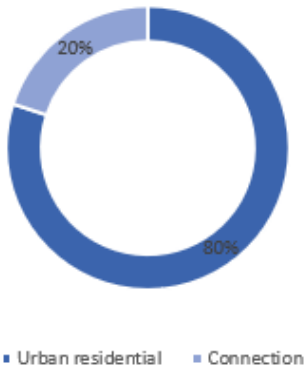




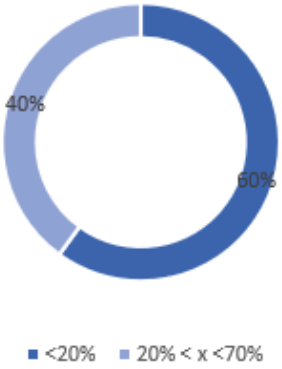
Pattern of use x/5



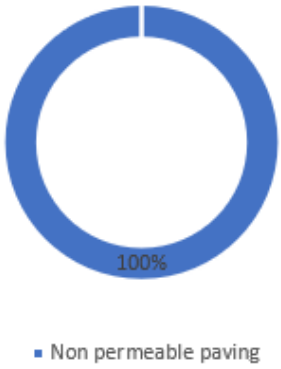
Function



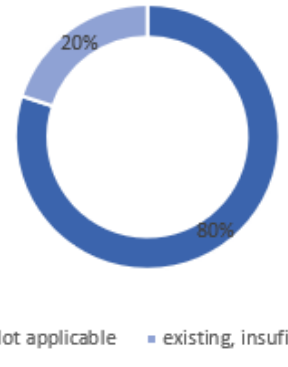
Ratio or percentage of green area



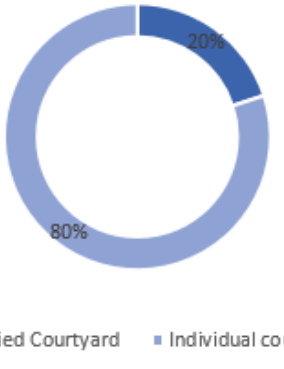
Dominant pavement

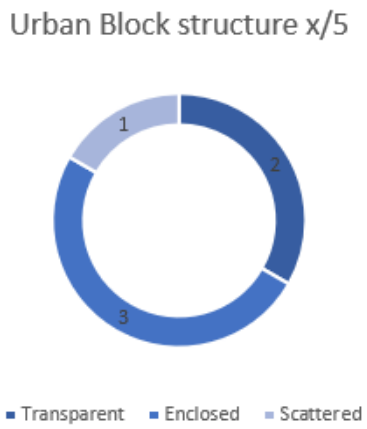


Outdoor Furnishing

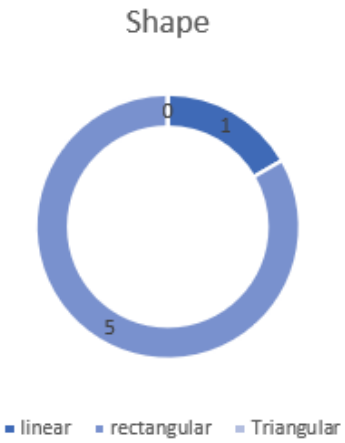


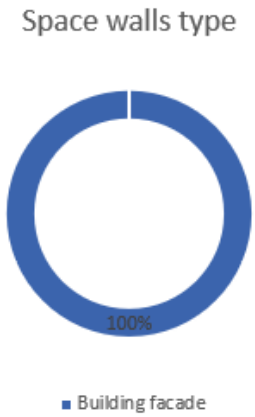
Building layout

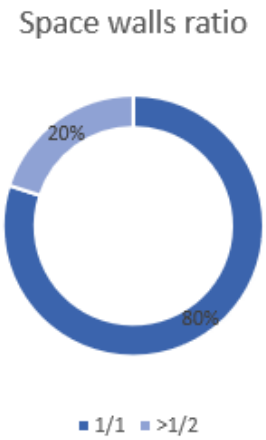



Urban Block structure x/5
1
2
3
Transparent
Enclosed
Scattered


Size
1
5
Small
Medium

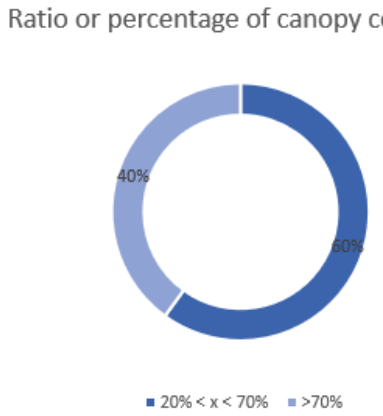

Shape
0
1
5
linear
rectangular
Triangular

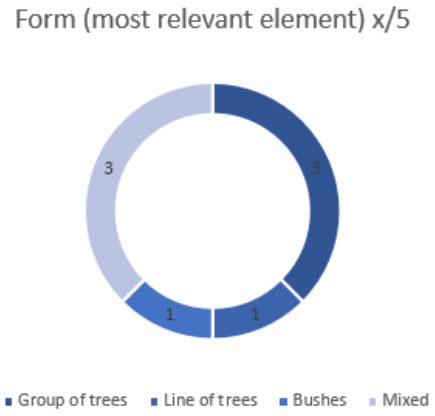

Space walls type
100%
Building facade

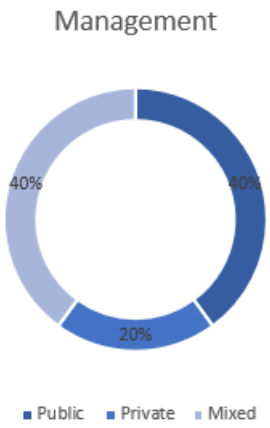

Space walls ratio
20%
80%
1/1
>1/2

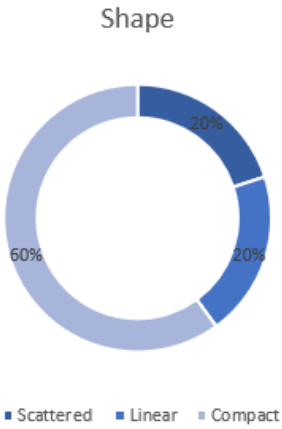

Solar incidence x/5
1
5
Low
Medium

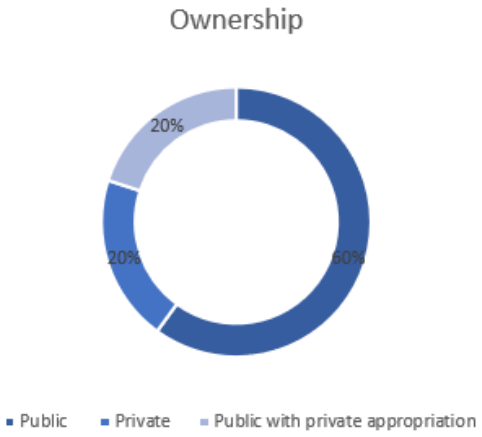
Results urban block 9

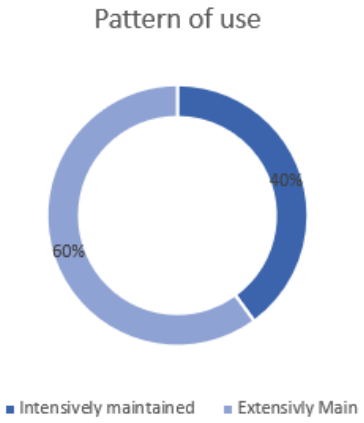


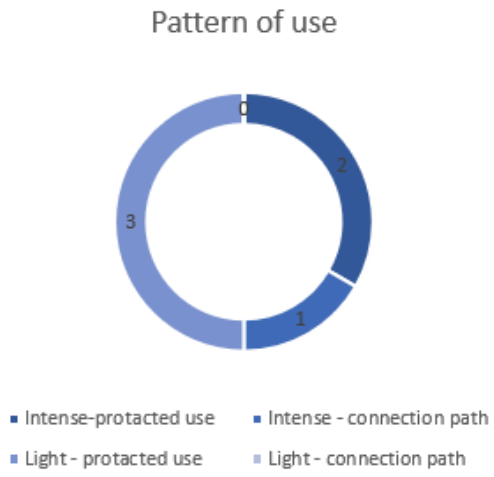


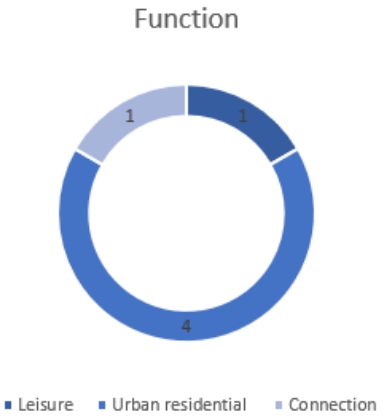


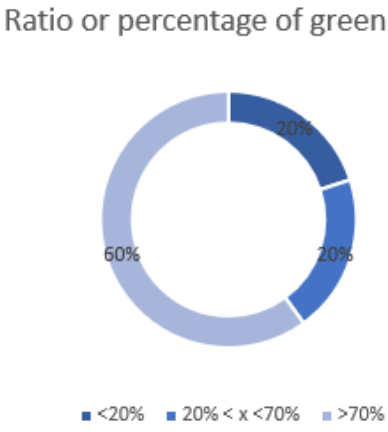


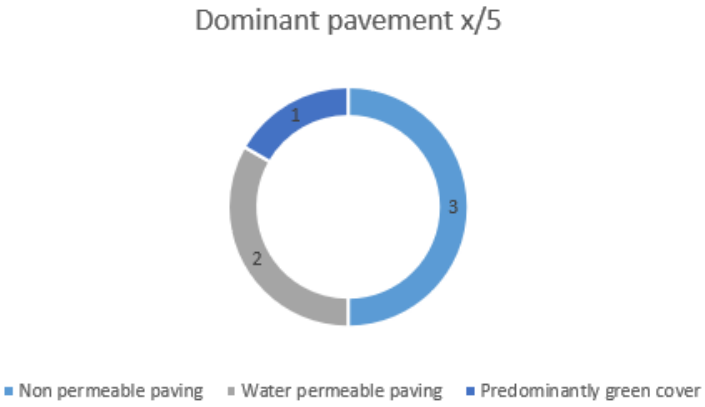


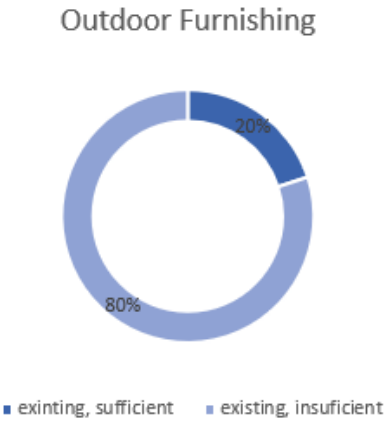


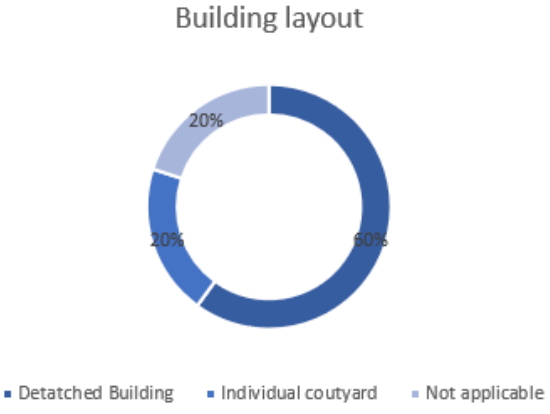

Pattern of use
0
2
3
1
Intense-protacted use
Intense - connection path
Light - protacted use
Light - connection path

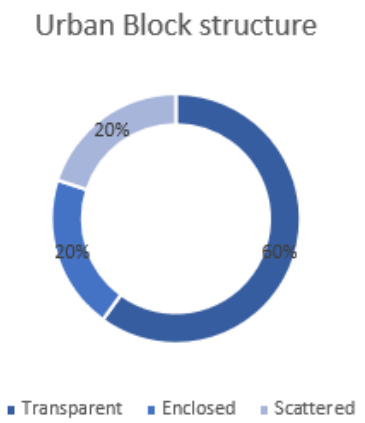

Function
1
1
4
Leisure
Urban residential
Connection

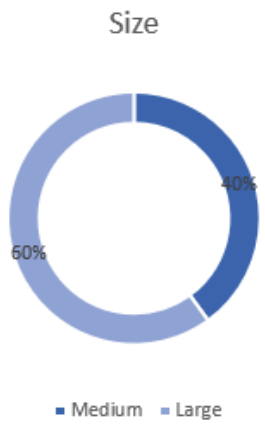

Ratio or percentage of green area
20%
20%
60%
<20%
20% < x <70%
>70%

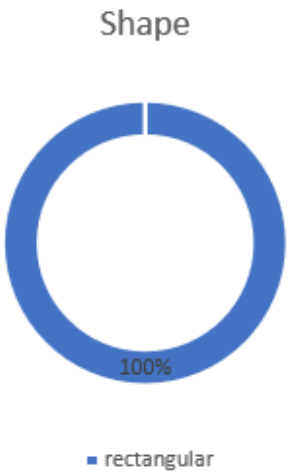

Dominant pavement x/5
1
3
2
Non permeable paving
Water permeable paving
Predominantly green cover

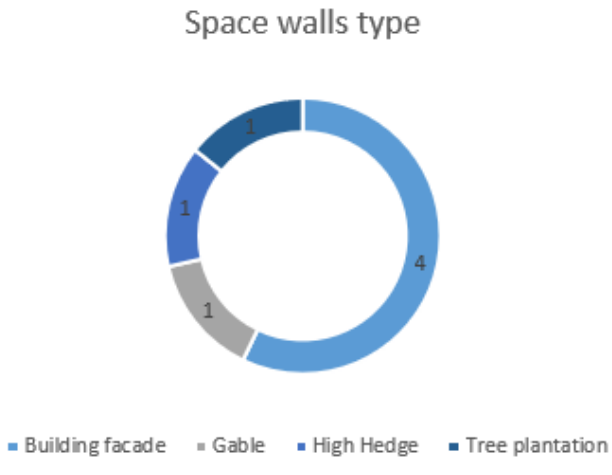

Outdoor Furnishing
20%
80%
exinting, sufficient
existing, insuficient

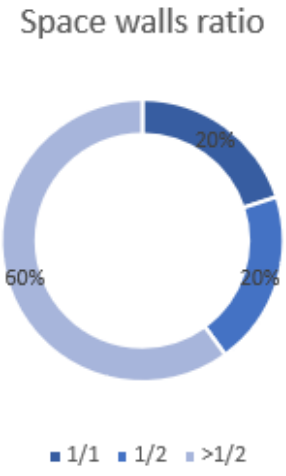

Building layout
20%
20%
60%
Detatched Building
Individual coutyard
Not applicable

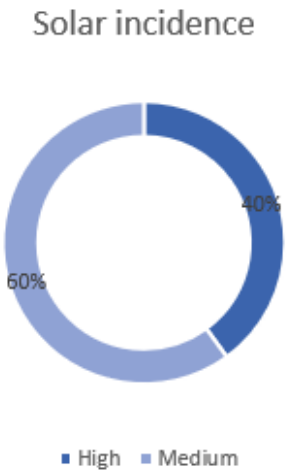

Urban Block structure
20%
20%
60%
Transparent
Enclosed
Scattered


Size
40%
60%
Medium
Large


Shape
100%
rectangular


Space walls type
1
1
4
1
Building facade
Gable
High Hedge
Tree plantation


Space walls ratio
20%
60%
20%
1/1
1/2
>1/2


Solar incidence
40%
60%
High
Medium

Acknowledgements

First and foremost, I would like to extend my heartfelt appreciation to the MATE Doctoral School of Landscape Architecture and Landscape Ecology for hosting my research and supporting my academic pursuits.

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