POLITECNICO
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"Reviving Urban Courtyards: Investigating the Socio-Cultural Potential of Greenery and Productive Landscapes for Community Resilience in Milan."

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Academic Year: **2021-2023**

Master of Science, Landscape Architecture Land Landscape Heritage

ABSTRACT

This comprehensive thesis navigates the intricate dynamics of Milan's urban landscape, specifically focusing on the transformative potential of the courtyard spaces. It engages in a detailed analysis of the city's existing fabric, highlighting the imperative of sustainable urban development and revealing the distinct characteristics of Milan's courtyard-centric environment.

The initial section establishes a contextual foundation emphasizing the unique qualities of three sample zones – the City Center, Intermediate Zone and Peripheral Area. This analysis serves as the bedrock for this innovative design proposal, emphasizing sustainability and community-centricity.

Extensive surveys capture community preferences and spatial nuances, resolving a refined understanding of diverse cultural and recreational needs in the courtyards across different zones. The importance of tailoring interventions to neighbourhood-specific preferences becomes apparent, forming the basis for the proposed design guidelines.

Differentiated design strategies are meticulously outlined for each zone, addressing spatial constraints, multifunctionality and the seamless integration of green elements. From vertical gardens in the City Center to multifunctional courtyards in Intermediate Zones and expansive cultural integrations in Peripheral Areas, this proposal reflects a profound understanding of Milan's unique urban dynamics.

A crucial link between analysis and the proposal is established, ensuring that each design strategy is a direct response to challenges and opportunities identified earlier. The proposal's universal theme of green integration aligns with the community desires, incorporating strategic tree placement, water elements and ecological corridors to enhance comfort, aesthetics and biodiversity.

Concluding with insightful recommendations, the thesis emphasizes continuous monitoring, comparative studies with other compact cities and the integration of technology for adaptive, universally applicable and technologically enhanced urban planning. This thesis serves as a comprehensive guide for urban planners, policymakers and community stakeholders offering a blueprint for a sustainable and vibrant urban future in Milan, specifically focusing on the unique potential of courtyard spaces.

Keywords: Milan, Courtyards, Community Cohesion, Green Integration, Urban Dynamics.

ABSTRACT IN ITALIAN

Questa tesi completa esplora le intricate dinamiche del paesaggio urbano di Milano, concentrandosi in particolare sul potenziale di trasformazione degli spazi del cortile. Si impegna in un'analisi dettagliata del tessuto esistente della città, evidenziando l'imperativo dello sviluppo urbano sostenibile e rivelando le caratteristiche distintive dell'ambiente incentrato sui cortili di Milano.

La sezione iniziale stabilisce una base contestuale sottolineando le qualità uniche di tre zone campione: il centro città, la zona intermedia e l'area periferica. Questa analisi funge da fondamento per questa proposta di design innovativa, sottolineando la sostenibilità e la centralità della comunità.

Sondaggi approfonditi catturano le preferenze della comunità e le sfumature spaziali, risolvendo una comprensione raffinata delle diverse esigenze culturali e ricreative nei cortili di diverse zone. Diventa evidente l'importanza di adattare gli interventi alle preferenze specifiche del quartiere, costituendo la base per le linee guida progettuali proposte.

Strategie di progettazione differenziate sono meticolosamente delineate per ciascuna zona, affrontando i vincoli spaziali, la multifunzionalità e la perfetta integrazione degli elementi verdi. Dai giardini verticali nel centro città ai cortili multifunzionali nelle zone intermedie e alle estese integrazioni culturali nelle aree periferiche, questa proposta riflette una profonda comprensione delle dinamiche urbane uniche di Milano.

Viene stabilito un collegamento cruciale tra analisi e proposta, garantendo che ogni strategia di progettazione sia una risposta diretta alle sfide e alle opportunità identificate in precedenza. Il tema universale dell'integrazione verde della proposta si allinea con i desideri della comunità, incorporando il posizionamento strategico degli alberi, elementi acquatici e corridoi ecologici per migliorare il comfort, l'estetica e la biodiversità.

Concludendo con raccomandazioni approfondite, la tesi enfatizza il monitoraggio continuo, gli studi comparativi con altre città compatte e l'integrazione della tecnologia per una pianificazione urbana adattiva, universalmente applicabile e tecnologicamente avanzata. Questa tesi funge da guida completa per pianificatori urbani, politici e stakeholder della comunità offrendo un progetto per un futuro urbano sostenibile e vivace a Milano, concentrandosi in particolare sul potenziale unico degli spazi cortili.

Parole chiave: Milano, Cortili, Coesione comunitaria, Integrazione verde, Dinamiche urbane.

TABLE OF CONTENTS

ACKNOWLEDGEMENT

I am profoundly grateful to my supervisor, Professor Julia Nerantzia Tzortzi and co-supervisor Maria Stella Lux for their unwavering support and guidance throughout my thesis. Their expertise and patience have been invaluable, playing a crucial role in the success of this endeavour. Professor Tzortzi's support through a consistent belief in me has provided unwavering confidence, guiding me throughout this journey.

A heartfelt thank you to Maria Stella Lux for going above and beyond to assist me with her expertise in mapping, analytical data and providing invaluable support and guidance throughout the thesis. Her dedication to the development of my project and belief in my abilities were the key motivators in reaching the project's completion.

I extend my deep thanks to my family and friends for their unwavering love and support during this challenging process. Their encouragement and motivation have been constant sources of strength throughout this journey and their belief in my abilities has been a driving force.

Finally, I want to express my sincere gratitude to everyone who has supported me, whether through encouragement, time or simply lending an ear. Your contributions have been invaluable and I am truly thankful for your time, insights and support.

This thesis stands as a testament to the collective efforts of all those who have played a part in its realization.

With profound appreciation and gratitude,
Kiran Ravindra Ranka

To the experiences never expected,

and the paths that were redirected.

To the friends like family found along the way.

Dedicated to my beloved dad,

who saw his dream come true through my master's journey.

CHAPTER 1

INTRODUCTION

1.1. Background and Significance of the Study

In the era of the 19th century and later, the urban landscape has become the central stage where we have lived our lives. As architects and planners we not only shape the city, but also the city shapes us affecting our way of life and social interactions. Urbanization has led to a huge disconnect between humans and the natural environment disrupting the balance within the biosphere and causing unsustainable consequences. In recent years an increasing awareness of the need to restore harmony between humanity and the natural environment especially in urban settings has emerged. The global pandemic has accelerated the urgency of adopting an ecological approach to urban development.

This thesis focuses on urban courtyards, often overlooked elements within the dense and individualistic fabric of modern cities. These courtyards, hidden within the city, serve as remnants of a shared urban landscape. The primary aim of this research is to explore the social and the cultural aspects of urban courtyards in comparison to other dominant urban open spaces like streets and squares. By doing so we seek to uncover unappreciated customs, untapped potentials and pathways to enhance community cohesion and resilience.

The city of Milan serves as the primary case study, although we remain open to considering comparative cases from other parts of the world. By examining the state of urban courtyards in Milan, we aim to reveal their cultural and social significance and contribute to the wider discourse on urban development.

In summary this thesis seeks to uncover the hidden potential within urban courtyards and their capacity to enhance community resilience and social cohesion. By doing so the aim is to not only enrich the understanding of urban environments but also provide a blueprint for the development of more sustainable and engaging cities.

Figure 1. City of Milan before Urbanisation

Figure 2. City of Milan after Urbanisation

1.2. Problem Statement

Urban courtyards once integral to the socio-cultural fabric of compact cities like Milan, have become fragmented features in the urban landscape. As urbanization progresses these courtyards are overshadowed by increasing population density and individualistic lifestyles. Consequently, the potential of these spaces to foster a sense of shared environment, community cohesion and resilience remains underutilized. This thesis aims to explore the cultural and social aspects of urban courtyards comparing them to other dominant urban open spaces such as streets and squares to identify overlooked habits, untapped potentials and avenues for enhancing community cohesion and resilience.

The central focus of this research lies in investigating the introduction of green elements including plants and trees into urban courtyards. By exploring the benefits associated with integrating greenery the study aims to understand how the presence of vegetation can influence social interactions and community cohesion within these courtyards. To gain valuable insights, surveys or interviews will be conducted with residents to gauge their attitudes towards the inclusion of greenery in courtyards. Additionally, observations will be made to assess the impact of vegetation on the way people utilize these spaces.

Although the city of Milan boasts a considerable number of urban courtyards, particularly in its central area, their prevalence diminishes towards the outskirts. Recognizing the importance of courtyards as elements of cultural identity and architectural heritage, this thesis seeks to address the challenge of their declining significance. In this regard, the research will explore possibilities for introducing productive landscapes, such as urban agriculture, into the existing courtyards of Milan. This approach not only aims to meet the city's food supply demands and reduce transportation costs but also considers the potential of utilizing agricultural bands at the outskirts for future development and construction.

By delving into the cultural and social dimensions of urban courtyards and investigating the introduction of greenery this thesis will provide valuable insights and recommendations for urban planners and policymakers. The goal is to propose strategies and guidelines for integrating productive landscapes into the existing courtyards of Milan, enhancing community resilience and fostering cohesive urban environments.

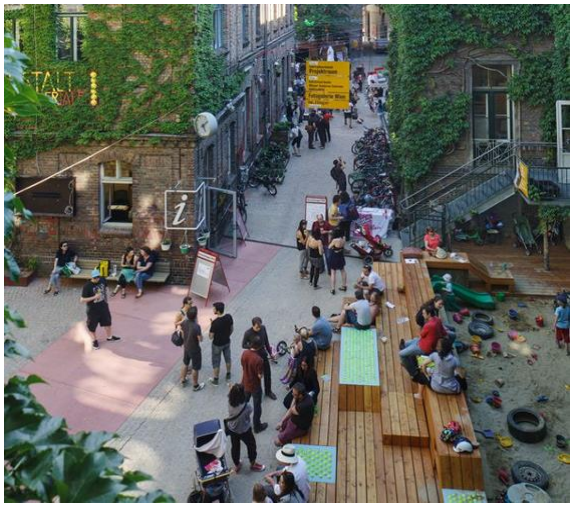


Figure 3. Overshadowed Courtyards: Population Density and Lifestyles.

1.3. Research Questions

How can the incorporation of green elements such as plants and trees and the integration of productive landscapes, such as urban agriculture, within urban courtyards contribute to enhancing community resilience and fostering social cohesion in the context of the compact city of Milan?

What are the potential benefits, challenges and strategies associated with introducing these elements and how do they impact social interactions and the overall liveability of courtyards?

1.4. Objectives of the Research

This research is guided by a set of interconnected objectives, categorized into three main sections: knowledge, current assessment and future scenario and guidelines. These objectives serve as the foundation for the structure and execution of the study.

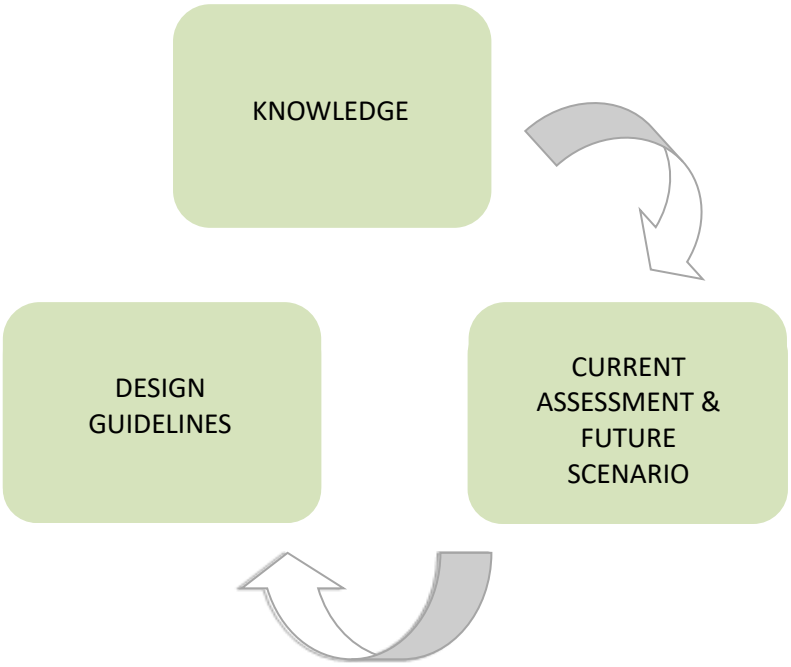


Figure 4. Sections of Objectives

Table 1. Objective Breakdown

Section 1: Knowledge (Theoretical)	**Section 2: Current Assessment and Future Scenario (Empirical)**	**Section 3: Guidelines (Design-Oriented)**
1. To Conduct a Comprehensive Literature Review	3. To Analyze Urban Courtyards in Milan	7. To Develop Design Guidelines
2. To Develop a Methodology for Courtyard Analysis	4. To Assess the Impact of Green Integration	8. To Enhance Community Resilience and Social Cohesion
	5. To Understand the Attitudes of Residents	9. To Evaluate Feasibility and Benefits
	6. To Examine the Possibility of Productive Landscapes	10. To Provide Recommendations for Future Research and Practical Applications.

Section 1: Knowledge (Theoretical)

1. To conduct a comprehensive literature review delving into existing literature on urban courtyards, socio-cultural significance and green element integration, including the examination of global case studies to identify overarching trends.
2. To establish a comprehensive methodology for the analysis of urban courtyards covering dimensions such as climate, morphology, social dynamics and historical context.

Section 2: Current Assessment and Future Scenario (Empirical)

1. To conduct an in-depth analysis of Milan's existing urban courtyards encompassing an understanding of their historical evolution, climate conditions, morphological characteristics and social dynamics.

2. To assess the impact of integrating green elements like plants and trees into urban courtyards with a focus on evaluating the benefits such as improved air quality, reduced urban heat island effects and enhanced biodiversity.
3. To understand resident's attitudes and perceptions regarding the incorporation of greenery in courtyards through surveys and interviews aiming to gain valuable insights into their perspectives.
3. To explore the potential of introducing productive landscapes like urban agriculture into Milan's existing courtyards, with a focus on assessing the practicality and benefits of this approach.

Section 3: Guidelines (Design-Oriented)

1. To develop design guidelines for introducing green elements and productive landscapes in urban courtyards, considering factors such as plant selection, irrigation systems and maintenance requirements.
2. To propose design interventions for selected courtyards in Milan based on the developed guidelines aiming to enhance community resilience and social cohesion.
3. To evaluate the feasibility and potential benefits of the proposed design interventions including their impact on sustainability, community engagement and other relevant factors.
4. To provide recommendations for future research and practical applications in the field of urban planning and design specifically regarding the integration of green elements and productive landscapes in urban courtyards.

These objectives collectively form a structured approach to investigating the socio-cultural significance of urban courtyards and their potential as spaces for community resilience and social cohesion, while integrating green elements and productive landscapes into the urban fabric.

1.5. Scope and Limitations

Scope:

1. The research will primarily focus on urban courtyards in the compact city of Milan with potential applicability to other compact urban environments and understanding their cultural, social and ecological features.
2. Comparative cases from other cities may be discussed to gain insights and to establish a comprehensive methodology for the understanding of urban courtyards, but the primary emphasis will be on the case study of Milan.
3. The research will specifically investigate the potential of introducing green elements and productive landscapes into urban courtyards and their impact on community resilience and cohesion.
4. Surveys or interviews will be conducted with residents of urban courtyards in Milan to understand their attitudes towards greenery and observations of certain selected areas will be made to study the effects of the addition of plants and trees on the use of these spaces.
5. Design guidelines and proposals will be developed for introducing green elements and productive landscapes in urban courtyards, focusing on selected courtyards in Milan.

Figure 5. Milan: Primary Case Study Map

Limitations:

1. The research will not extensively analyse the issues of food security and transportation costs related to the integration of productive landscapes in urban courtyards. These aspects will be acknowledged but will not be primary focus of the study.
2. The study's findings and recommendations may be specific to the socio-cultural context of Milan and may not be directly applicable to the other cities or regions.
3. The research will rely on responses and experiences of a limited number of residents in urban courtyards in Milan which in reality may not represent the entire population.
4. The implementation and long term sustainability of the proposed design interventions in urban courtyards will depend on various factors including the availability of resources, community support and policy considerations which are beyond the scope of this research.
5. The study will not address the economic viability or financial aspects associated with the integration of green elements and productive landscapes in urban courtyards.

CHAPTER 2

LITERATURE REVIEW

2.1. Definition and evolution of urban courtyards

2.1.1. Definition and Characteristics of Urban Courtyards:

A courtyard is a special place that opens to the sky and often to the earth, surrounded by rooms, trees, plants and flowers; it provides residents with daily contact with nature and is usually the liveliest place in a house [1].

Urban courtyards have been a significant element in the urban landscape offering unique spaces within the city that foster social interactions and provide respite from the bustling urban environment. To understand the concept of urban courtyards and their socio-cultural significance it is important to explore various definitions provided by researchers, architects and urban planners.

Urban courtyard is defined as a space between blocks of flats constituting an area adjacent to households and encircled by buildings or as a space between residential buildings [2][3]. It is also described as an example of a semi-public space which unlike the public spaces is characterized by restricted access to activities, the information and resources for outsiders and is primarily dedicated to a specific group of inhabitants [2][4]. It is a space that fills the gap between the public areas (e.g. streets, squares and parks) and private ones, to which access is limited (e.g. flats or private gardens) [2].

Courtyards are enclosed outdoor spaces but are normally open to the elements at their top; another definition of the courtyard is “An unroofed area that is completely or partially enclosed by walls or buildings, typically one forming part of a castle or large house” [5]. Edward (2006) reveals in his book The Past, Present and Future of the courtyard, that the Courtyard used in basic as a gathering place for house users’ and for daily particular purposes in another area it is used as encode [6].

Researchers have defined urban courtyards as enclosed or partially enclosed spaces located within the built fabric of the city. According to Zang, D (2020), the shared meaning of the

courtyard house is an earthly paradise, from which one may construe that the meaning of the world is a courtyard garden [2].

Architects and urban planners also emphasize the unique characteristics of urban courtyards. They highlight their role as private or semi-private spaces that provide a sense of community within the larger urban context.

In addition to their enclosed nature and intimate scale urban courtyards exhibit specific physical attributes that contribute to their distinctiveness. The spatial configuration of courtyards often involves a central open area surrounded by buildings on all sides creating a sense of enclosure and privacy. The presence of vegetation such as trees, shrubs and potted plants, adds to the aesthetic appeal and provides a connection to nature within the urban fabric. Furniture, seating arrangements and architectural features further enhance the usability and visual interest of urban courtyards.

To understand the historical evolution of urban courtyards, it is important to examine the works of Portaluppi and Semenza (1927), Reggiori (1947) and Vercelloni (1989) on the development and changes in the urban fabric of Milan [7][8][9]. These works provide insights into the architectural and urban planning decisions that have influenced the design and function of urban courtyards over time.

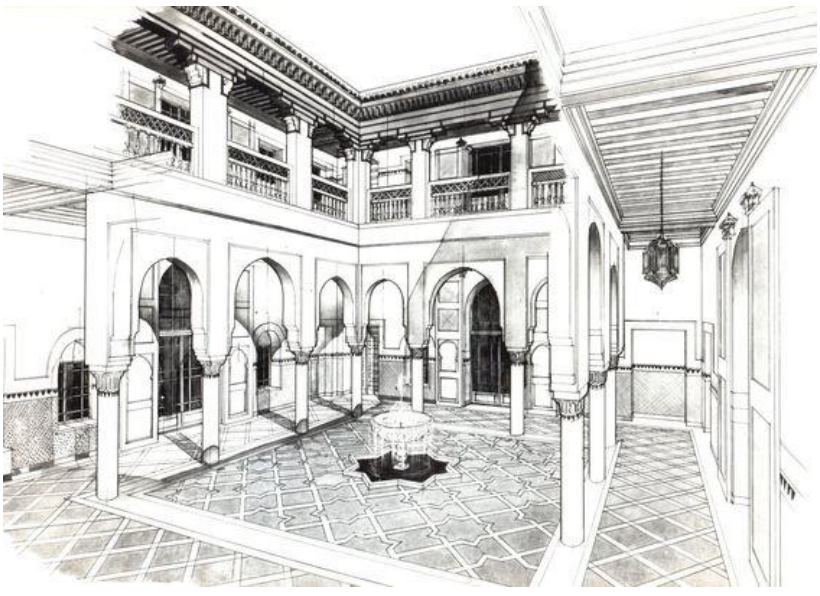


Figure 6. Typical Urban Courtyard

2.1.2. Historical Evolution of Urban Courtyards:

The concept of courtyard housing, one of the oldest and most enduring forms of residential architecture, has evolved over millennia, shaped by various cultures, environmental factors and social needs [6]. The historical evolution of courtyard houses is a testament to the adaptability and timelessness of this architectural typology. Tracing the roots of urban courtyards reveals their significance in various ancient civilizations and subsequent transformations throughout history. This section provides insights into their origins, development and the influences that have shaped their design over time.

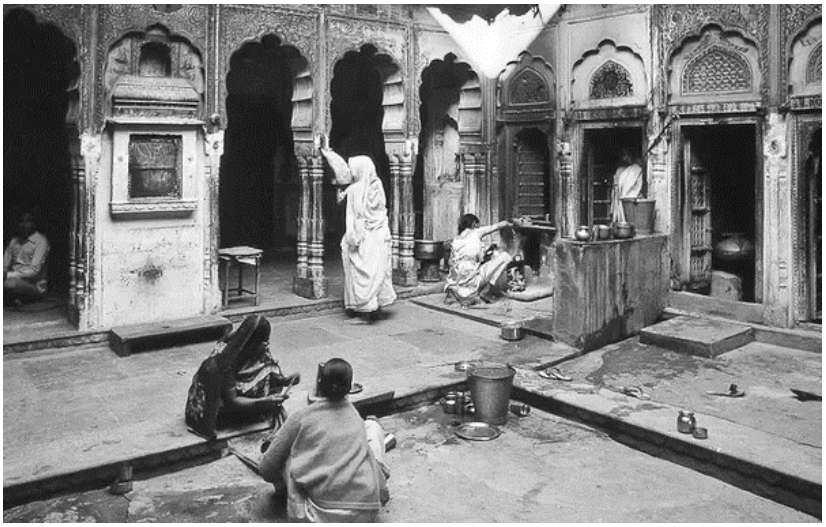


Figure 7. Ancient Courtyard House

Ancient Civilizations:

Courtyard housing has deep historical roots, dating back thousands of years to ancient civilizations. Excavations at Kahun in Egypt have unearthed courtyard houses that are approximately 5000 years old. Courtyards were also prominent in the Chaldean City of Ur, with examples dating back to before 2000 B.C. The characteristics of courtyard housing were influenced by the environment and culture of specific regions [5]. In Sumer and Pharaonic Egypt, the Middle East's oldest cultures, courtyard houses were a common architectural feature. These early courtyard houses served various purposes and were adapted to their respective climates and societal needs [5].

Figure 8. Excavated remains of Chaldean City of Ur

Classical Civilizations:

The evolution of courtyard housing continued in classical civilizations. In Italy around 700 B.C., a new design, known as the atrium house, emerged. Atrium houses featured a small courtyard enclosed by rooms and often included a container in the center for collecting rainwater. This design aimed to provide a private outdoor space for residents [5]. Around 275 B.C., Roman architecture blended elements from the Etruscans and the Greeks, leading to the atrium pre-style design, which combined the atrium and the pre-style (a courtyard enclosed by columns) [5].

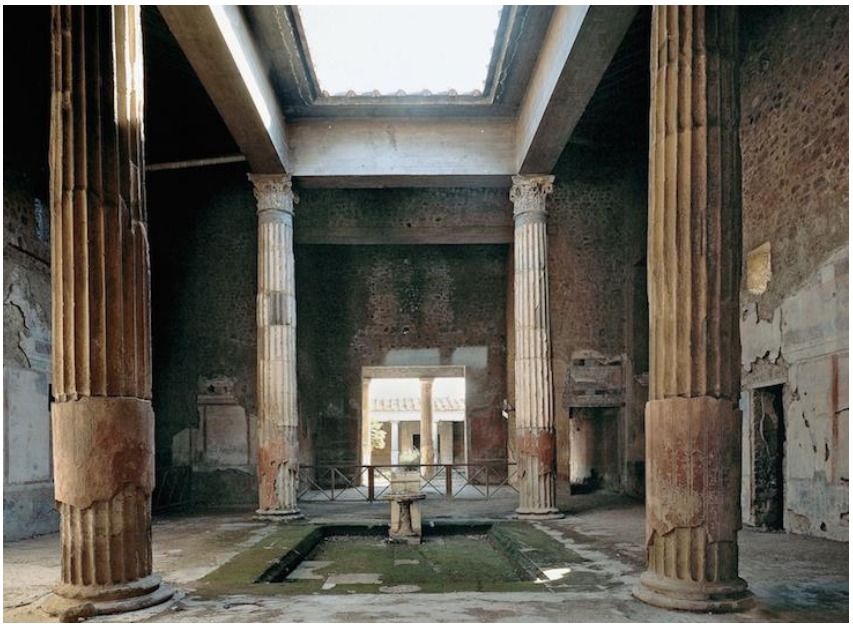


Figure 9. Atrium, House of the Silver Wedding, Pompeii.

Middle Ages and Renaissance Civilization:

After the fall of the Roman Empire, courtyard-style dwellings experienced a decline but persisted in Italian courtyards and monastic cloisters. During the early Christian era, atriums were common in early Christian churches and served as meeting places. In Islamic countries in North Africa and the Middle East, courtyards were designed to offer privacy and seclusion while providing a minimal display of the occupant's social status to the outside world [5]. Private courtyards often featured secluded spaces for relaxation, sheltered courtyard trees, pools and outdoor furniture. The addition of elements like the "serdab" further enhanced the functionality of these courtyards [5].

Figure 10. An Ancient Atrium Style Christian church

Continued Evolution:

The evolution of courtyard housing continued over the centuries. In the Maghreb and Andalusia, the courtyard type revealed a wealth of variants, demonstrating its adaptability to different cultural and environmental factors. Contrary to earlier notions of a strict dichotomy between open and closed courtyard models, the Arab-Islamic city exhibited a range of variations [5]. The idea of an elementary courtyard persisted in the cultural memory long after its physical use, leading to its replication and reuse in the same areas over time [5].

Figure 11. Courtyard inspired by Arabic-Islamic Architecture

Global Influences:

The evolution of courtyard housing was not limited to a specific region. For example, in Latin America, Spanish colonists introduced the patio design, which influenced dwelling houses in Mexico [5]. In Asia, particularly in Malaysia, traditional Malay houses integrated courtyard designs influenced by traditional Chinese houses, with inner courtyards. The arrangement of plants in Malay courtyards was influenced by the geographical distribution zones, resulting in different landscape typologies [5].

Figure 12. A typical Spanish Patio in Mexico

Modern Adaptations:

Courtyard housing, as an architectural typology, has continued to adapt and evolve. In Europe, single-story courtyard houses gained popularity, especially among low-income communities. The L-shaped courtyard plan, initially introduced by Hugo Haring in 1928, became widespread in England and Germany during the 1960s. Finally, this type of architecture is still in use almost all over the world [11][12].

In summary, the history and evolution of courtyards reflect their resilience and versatility as an architectural form. Over the centuries, they have adapted to various cultures, environmental conditions and societal needs, making them an enduring and integral part of architectural history [5].

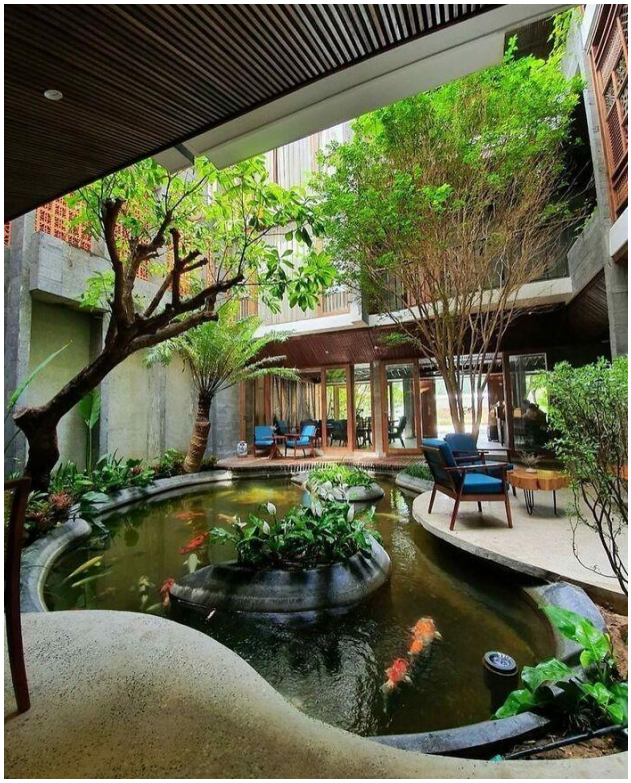


Figure 13. Evolution of courtyard in Modern day houses

2.1.3. Factors Influencing the Design and Function of Urban Courtyards

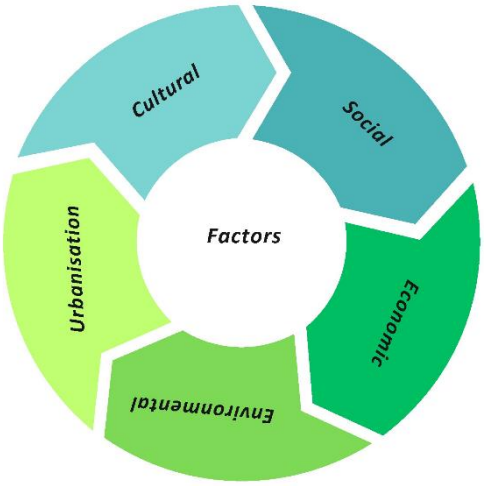


Figure 14. Factors affecting functions of Courtyards

The design and function of urban courtyards are shaped by a variety of factors that reflect the cultural, social, economic and environmental context of a city. Understanding these influencing factors provides valuable insights into the layout, size and the use of urban courtyards across different contexts.

Cultural factors play a significant role in the design of urban courtyards. Cultural preferences, traditions and architectural styles influence the spatial arrangement, materials and decorative elements incorporated in courtyards. For example, the works of De Biasi, Lopez and Palumbo (1990) explore the cultural significance of courtyards in Milan, highlighting their role in reflecting the local architectural heritage and cultural identity [10]. In Islamic countries, courtyards are often used to segregate public and private spaces within a house, with the inner courtyard serving as an outdoor area for family activities [5][13].

Social factors also shape the design and function of urban courtyards. The needs and preferences of residents and communities influence the use and programming of courtyards. Factors such as privacy, social interaction and community cohesion play a crucial role in determining the layout and amenities provided within courtyards. For instance, courtyards can serve as spaces for family interaction, gatherings and entertainment, promoting a sense of togetherness and social engagement [5][14]. In addition, they can offer a sense of enclosure and privacy, which is particularly important in regions with traditions of visual privacy [12][15].

Economic factors can influence the design of urban courtyards, especially in terms of available resources and investment. The allocation of financial resources, land values and development priorities impact the size, maintenance and accessibility of courtyards. Balancing economic considerations with the need for quality open spaces can be a challenge for urban planners and designers. Economic constraints may dictate the scale and complexity of courtyards, affecting the choice of materials and features included within them.

Environmental factors also come into play when designing urban courtyards. Considerations such as climate, solar orientation, natural ventilation and ecological sustainability influence the layout, planting choices and overall design approach. Courtyards have been recognized for their climatic benefits, serving as microclimate modifiers by mitigating high temperatures, channeling breezes and adjusting humidity [5][16]. The choice of green elements, such as trees and plants, can enhance environmental performance and aesthetics, contributing to cooling and air purification [12].

Urbanization, densification and modernization have had a significant impact on the design and role of urban courtyards in contemporary cities. Vercelloni and Balzani (1986) provide insights into how urban development and changing lifestyles have influenced the transformation of courtyards in Milan over time [17]. As cities grow and urban spaces become scarcer, the efficient use of courtyards becomes a critical consideration. Courtyards may evolve to accommodate new functions, such as providing communal spaces in high-density urban areas or integrating sustainable design features to address modern environmental concerns.

In conclusion, urban courtyards are multifaceted spaces that reflect interplay of the cultural, social, economic and the environmental factors. By considering these factors in the design and planning process, urban designers and architects can create courtyards that not only meet the functional needs of their communities but also contribute to the cultural identity and sustainability of their cities.

2.2. Socio-Cultural Significance of Urban Courtyards

Urban courtyards bear significant socio-cultural importance, transcending mere architectural elements and permeating the fabric of community life. These spaces act as communal nuclei, fostering social interactions, community engagement and a profound sense of belonging [20][21].

Beyond their role as social hubs, urban courtyards contribute significantly to the preservation of cultural heritage and architectural traditions. As Reynolds states, “Everyday repetitious acts benefit from the change of scene” the court is the heart of the house where different functions can take place during different parts of the day [24]. Often adorned with unique architectural features, materials and design elements, they serve as a reflection of the local culture and historical context. By preserving and incorporating these traditional architectural styles, courtyards contribute to the cultural identity of a place. Notably, Fathy (1973) and Rapoport (1969) emphasize the essential role of courtyards in preserving cultural heritage [22][23]

In addition to their cultural significance, urban courtyards offer psychological and emotional benefits to residents. These spaces provide a retreat from the bustling city environment, thus offering a serene and tranquil setting that can have a profound impact on well-being [19][21]. With greenery, seating areas and water features often present in courtyards, they become sanctuaries that contribute to stress reduction, improved well-being and an increased quality of life for the residents. Numerous studies have established the positive effects of access to green spaces like courtyards on mental health and overall satisfaction with the living environment [20][22]

Recognizing the socio-cultural significance of urban courtyards is very imperative for urban planners and designers. This understanding allows them to prioritize the creation and preservation of these spaces within urban settings thus promoting social cohesion, safeguarding cultural heritage and enhancing the well-being of residents. Urban courtyards emerge not merely as architectural elements but as vital components of vibrant urban life reflecting multi-dimensional aspects of their socio-cultural relevance.

Figure 15. Social Interaction in Urban Courtyards

2.3. Comparative analysis of urban open spaces

Urban open spaces play a crucial role in shaping the dynamics and quality of life in the cities. They serve various functions right from providing pathways for transportation to facilitating social interactions and the economic activities. In this chapter we will conduct a comparative analysis of four key types of urban open spaces i.e., urban courtyards, streets, squares and parks. These spaces have been integral to urban life throughout history from ancient civilizations to the modern metropolises [25].

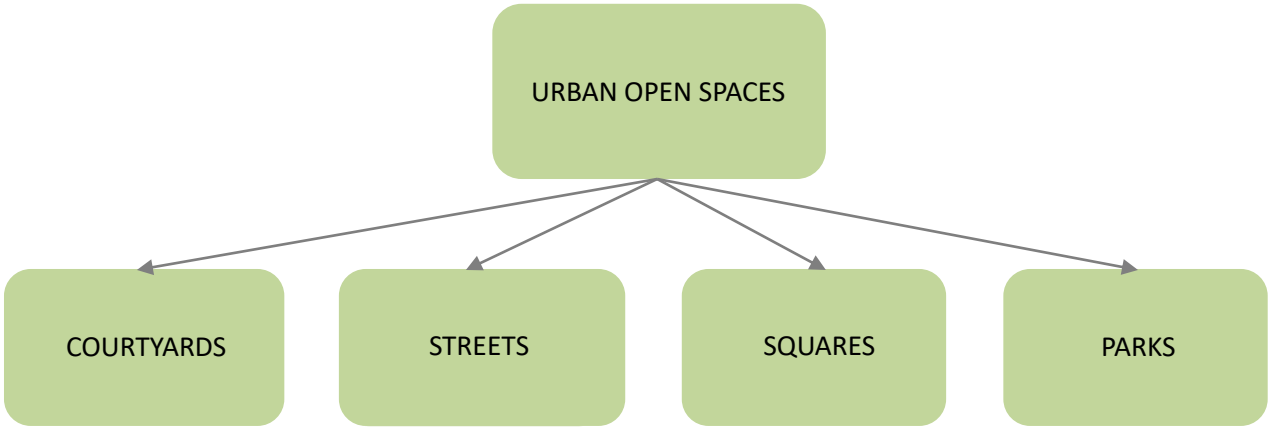


Figure 16. Classification of Urban Open Spaces

2.3.1 Urban Courtyards:

Urban courtyards are intimate, often semi-private spaces within the fabric of a city. They typically serve as transition zones between private residences and the public realm of the street. As noted by Madanipour, alleys and courtyards differ in scale and function, often becoming settings for intimate neighbourhood interactions, distinct from the bustling streets [26]. In Arab-Islamic cities, courtyards provide a critical space for social interaction within the same ethnicity or extended family [27][28].

Figure 17. Image illustrating the intimate and enclosed nature of urban courtyards fostering privacy and community engagement.

Advantages of an Urban courtyard:

- Privacy
- Community Engagement
- Tranquillity

Unique Characteristics of an Urban courtyard:

- Enclosed
- Inward Orientation
- Intimate Scale

2.3.2 Streets:

Streets are the arteries of urban life, facilitating both pedestrian and vehicular traffic. From ancient Babylonian classifications of "broad streets" and "narrow streets" [29] to their continued significance in modern cities, streets have remained essential for transportation and various urban activities. In modern times, streets have undergone significant transformations, with Haussmann's redevelopment in 19th-century Paris serving political and commercial motives alongside traffic and sanitary concerns [30][31].

Figure 18. Image illustrating the transportation corridors of a street fostering traffic management, pedestrian safety and a dynamic atmosphere.

Advantages of Streets:

- Transportation Corridors

Unique Characteristics of Streets:

- Traffic Management
- Pedestrian Safety
- Dynamic Atmosphere

2.3.3 Squares:

Squares, often found at the city level, are open spaces surrounded by buildings, offering versatile civic areas. They have historically symbolized political and civic significance. As exemplified by the central urban plaza in Ottoman Isfahan, squares have been historically diverse, accommodating a mix of functions, including cultural events, trade and political expressions [26]. The presence of monumental boulevards in modern cities, like those in Haussmann's Paris and contemporary Chinese urban centers [32], emphasizes the continuity of this urban form.

Figure 19. Image Illustrating social gatherings fostering focal points, architectural features and a lively atmosphere.

Advantages of Squares:

- Social Gatherings
- Civic Activities

Unique Characteristics of Squares:

- Focal Points
- Architectural Features
- Lively Atmosphere

2.3.4 Parks:

Parks are defined by their green and landscaped areas within urban settings, providing aesthetic and recreational value. The distinction between parks and gardens varies by country, as outlined in the text. Parks have often been established for specific cultural functions or have evolved from elite estates appropriated by authorities. The transformation of gardens in Japan and China from private or semi-public to fully public spaces illustrate historical changes in access [33][34]. Today, parks primarily result from municipal or state planning, often with specific intentions for aesthetic reflection and social practices.

Figure 20. Image illustrating greenery, landscape and recreational activities fostering recreation and relaxation.

Advantages of Parks:

- Recreation
- Relaxation
- Contact with Nature

Unique Characteristics of Parks:

- Greenery
- Landscaping
- Recreational Amenities

2.3.5 Summary:

The table below summarizes the social functions, design principles and user experiences associated with each urban open space:

Table 2. Characteristics of Urban open spaces

Urban Open Spaces	**Social Functions**	**Design Principles**	**User Experiences**
Urban Courtyards	Foster social interactions, community engagement and a sense of belonging	Enclosed, inward orientation, intimate scale	Privacy, tranquility, sense of belonging
Streets	Transportation corridors	Traffic management, pedestrian safety	Dynamic, vibrant, diverse experiences
Squares	Social gatherings, civic activities	Focal point, architectural features	Lively, bustling, sense of community
Parks	Recreation, relaxation, contact with nature	Greenery, landscaping, recreational amenities	Connection to nature, leisure, rejuvenation

By understanding the distinct characteristics of each urban open space, urban planners and designers can make informed decisions regarding their design, ensuring that they meet the diverse needs and preferences of communities.

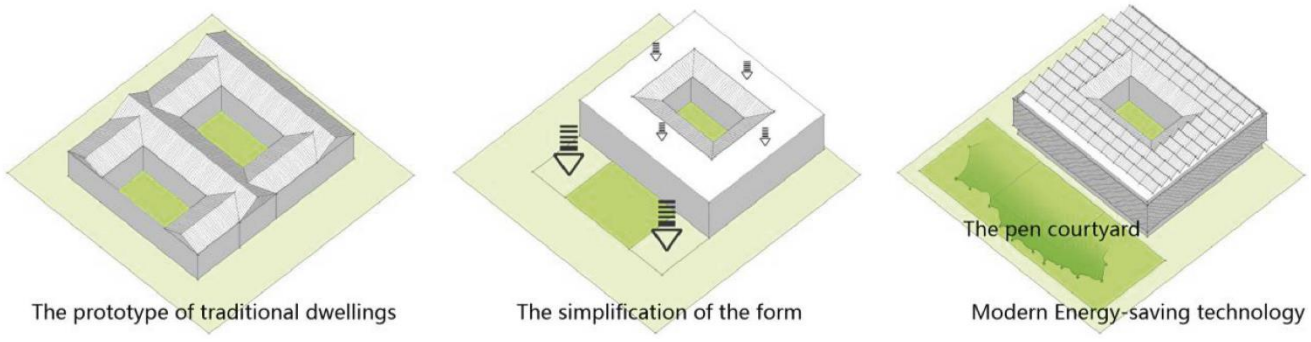


Figure 21.Extraction of the typologies of courtyards.

2.4. Review of Existing Studies on the Benefits of Green Elements and Productive Landscapes in Urban Courtyards

Urban courtyards, often regarded as small, enclosed spaces in densely populated urban areas, have garnered increasing attention due to their potential to accommodate green elements and productive landscapes. Various research studies have shed light on the multifaceted advantages of introducing greenery and productive elements within these compact environments:

Improved Air Quality: The presence of plants and trees in courtyards plays a pivotal role in enhancing air quality. By absorbing pollutants and releasing oxygen, these green elements contribute significantly to creating a healthier living environment [37].

Figure 22. Integration of green elements enhances air quality in the urban courtyards

Reduced Urban Heat Island Effect: Courtyards have the potential to mitigate the urban heat island effect, which is a common issue in densely built urban areas. They achieve this by incorporating green features like vegetation and permeable surfaces, which provide shade and lower surface temperatures. This, in turn, makes the courtyard area more comfortable and cooler during hot weather [37].

Figure 23. Green features create a cool and shaded environment, mitigating the urban heat island effects.

Increased Biodiversity: Urban courtyards can support a rich array of plant species, attracting various forms of wildlife, including birds and insects. As a result, these spaces contribute to urban biodiversity and fostering a more ecologically balanced environment within the city [35].

Psychological Well-being: Research has indicated that exposure to greenery in courtyards has positive impact on resident's psychological well-being. This effect extends to reducing stress levels and enhancing overall quality of life for those living near these green spaces [35].

Food Production: Urban agriculture within courtyards holds the potential to contribute to local food production. This localized approach can help reduce transportation costs, promote sustainability and increase the availability of fresh produce within the urban environment [37].

Community Engagement: Courtyards with productive landscapes create opportunities for community engagement. Activities like communal gardening foster a sense of ownership and cohesion among residents, resulting in stronger social bonds and a shared sense of purpose within the community [37].

Figure 24. Communal gardening fosters community engagement and a sense of ownership among the residents.

Enhanced Aesthetics: The introduction of green elements and productive landscapes significantly enhances the aesthetics of urban courtyards. The visual appeal of these spaces is improved, making them more inviting and enjoyable for residents and providing a visual respite from the urban surroundings [37].

Collectively, these findings from previous studies underscore the vast potential of integrating green elements and productive landscapes into urban courtyards. Not only do these interventions contribute to a more sustainable and environmentally friendly urban environment, but they also foster community resilience and cohesion, thus making them an asset for urban planners and residents alike.

2.5. Examination of the Relationship between Greenery, Community Resilience and Social Cohesion

The integration of green elements and productive landscapes within urban courtyards not only enhances the physical environment but also plays a pivotal role in fostering community resilience and social cohesion. This section explores the intricate relationship between greenery, community resilience and social cohesion:

1. **Strengthening Community Resilience:**
    - Green courtyards can serve as multifunctional spaces that provide opportunities for disaster preparedness, response and recovery. Community members can use these spaces as gathering points during emergencies, promoting a sense of security and collective resilience [45].
2. **Fostering Social Interaction:**
    - The presence of greenery in courtyards encourages residents to engage in communal activities such as gardening, which enhances social bonds and cooperation [5]. The act of tending to plants and trees fosters a shared sense of responsibility and resilience.
3. **Supporting Mental Health:**
    - Access to green spaces within courtyards has been linked to improved mental health outcomes, including reduced stress and anxiety. A mentally resilient community is better equipped to face challenges and adversity [46][47].
4. **Community-Based Decision Making:**
    - The design and management of green courtyards often involve community participation and decision-making. This process empowers residents, strengthens their bonds and builds resilience by collectively addressing local issues.
5. **Social Cohesion and Sense of Belonging:**
    - Green courtyards provide residents with a shared space to connect with neighbours fostering a sense of belonging and social cohesion. A cohesive community is more capable of responding to and recovering from crises [48].
6. **Enhancing Environmental Stewardship:**

- Green courtyards instill a sense of environmental responsibility and stewardship within communities. Residents become more aware of sustainability practices which contributes to long-term resilience [49].

The relationship between greenery, community resilience and social cohesion is complex and interdependent. Green courtyards act as catalyst, creating spaces where residents can strengthen their bonds, build resilience and collectively address challenges. This examination underscores the multifaceted benefits of integrating green elements into urban courtyards, thus making them vital components of sustainable and resilient urban environments.

Green courtyards serve as gathering points, enhancing community resilience during emergencies.

Communal gardening fosters social bonds and cooperation in urban courtyards.

Access to green spaces promotes improved mental health outcomes for residents.

Figure 25. Illustration of an Urban Courtyard

Residents connect and build a sense of belonging in social spaces within green courtyards.

Community participation in the design and management of green courtyards strengthens bonds and builds resilience.

Green courtyards promote environmental stewardship, contributing to long-term community resilience.

2.6. Case Studies from Different Cities Around the World

2.6.1. Case Study 1: Courtyard Houses of Cordoba, Spain

Figure 26. Traditional courtyard house in Cordoba, showcasing the city's architectural heritage.

- **City Name:** Cordoba, Spain

- **Number of Inhabitants-Population:** Approximately 345,000 people

- **Dimensions of the City (km square):** 1,254.25 km^2

- **Short History of the City:**

  Cordoba, located in southern Spain has a rich history dating back to Roman times. It became prominent center during the Muslim caliphate of Al-Andalus in the Iberian Peninsula with a population of half a million inhabitant during the 10th century.

- **Role of Courtyards:**

  The hot, dry Cordoban climate led to the development of houses centered around inner courtyards (patios). These courtyards often featured a fountain and plants to provide a sense of coolness and oasis in the desert-like environment.

- **Urban Agriculture/Landscape Practices in Courtyards:**

  The courtyards of Cordoba are known for their lush greenery, with plants like gitanillas (ivy geraniums), geraniums and carnations adorning the courtyards. The presence of plants in these courtyards helps create a sensation of freshness, making them ideal for coping with the warm climate.

- **Socio-Cultural Significance:**

  Courtyard houses in Cordoba are a vital part of the city's cultural heritage, reflecting the fusion of Roman and Muslim architectural influences. Every year in May, Cordoba celebrates the Cordoba Patio Festival, where proud patio owners decorate their courtyards with ornate iron grills and colourful flowers. This festival represents Andalusian folklore at its best and is open to the public during this time.

- **Design Strategies:**

  Courtyard houses in Cordoba are designed with the courtyard as the focal point, typically featuring arches, a clay-tiled or decorative pebbled floor and a central fountain. The design is oriented towards creating a sense of coolness and a private oasis within the home.

- **Community Engagement Approaches:**

  The Cordoba Patio Festival is a community-driven event where homeowners open their courtyards to the public, fostering a sense of community pride and interaction. The festival encourages collaboration among residents in decorating and maintaining their courtyards.

- **Management Models Employed:**

  Courtyards in Cordoba are privately owned by individuals, but during the Cordoba Patio Festival, they are open to public viewing. Homeowners take pride in maintaining and decorating their courtyards for the festival.

Figure 27. Lush greenery and vibrant plants contribute to the refreshing ambiance of Cordoba's courtyards.

- **References:**

1. Galán-Marín, C., López-Cabeza, V. P., Rivera-Gómez, C., & Rojas-Fernández, J. M. (2018, October). On the influence of shade in improving thermal comfort in courtyards. In *Proceedings* (Vol. 2, No. 22, p. 1390). MDPI.

2. de CANALES, C. P. G., BAENA, L. R. M., & BREUSTE, J. H. (2012). The courtyards of Cordoba in Spain. *Bavarian Academy for Nature Conservation and Landscape Management (ed.) Implementation of Landscape Ecological Knowledge in European Urban Practice. Laufener Special Contributions*, 67-72.

3. Reynolds, J. S., & Lowry, W. P. (1996). The Garden in the Building: Córdoba's Courtyards. *Landscape Journal*, *15*(2), 123-137.

2.6.2. Case Study 2: Courtyard Houses of Athens, Greece

Figure 28. Private courtyard house in Athens, maintained by residents and reflecting local Greek lifestyle.

- **City Name:** Athens, Greece

- **Number of Inhabitants-Population:** Approximately 3,154,463 people

- **Dimensions of the City (km square):** 2,928.717 km²

- **Short History of the City:**

  Athens, the capital of Greece has a history dating back to ancient times. It is renowned for its contributions to philosophy, democracy and art in classical antiquity.

- **Role of Courtyards:**

  Courtyard houses in Athens often serve as traditional Greek homes, featuring central courtyards with outdoor seating areas and plants. These courtyards offer a quiet escape from the bustling urban environment.

- **Urban Agriculture/Landscape Practices in Courtyards:**

  Courtyards in Athens may include potted plants, fruit trees and aromatic herbs. Urban agriculture is not as common but ornamental plants and greenery contribute to the aesthetics.

- **Socio-Cultural Significance:**

  Courtyard houses reflect the enduring Greek architectural tradition and are integral to the city's cultural heritage. They provide a connection to Greek domestic life and community.

- **Design Strategies:**

  Courtyard houses in Athens are designed with a focus on traditional Greek elements, including white-washed walls, blue accents and wooden pergolas. The design is oriented towards creating a serene and inviting atmosphere.

Figure 29. Design elements of Athens courtyard houses featuring white-washed walls.

- **Community Engagement Approaches:**

  Some courtyard houses in Athens are open for public viewing during cultural events and festivals. Community engagement may involve sharing knowledge about traditional Greek architecture and lifestyles.

- **Management Models Employed:**

  Courtyard houses are primarily privately owned and maintained by residents. Public access, when permitted is often coordinated through the local cultural organizations.

Figure 30. Restored courtyard in a 19th century Neo-classical architecture building

Note: The courtyards shown in the pictures are in the Plaka area of Athens (the older district of Athens around Akropolis-Parthenon) as the traditional style can be found only there.

- **References:**

1. NIKOLAOS, C., AGGELIKI, K., MARIA, L., MANOS, M., & MARIA, P. Traditional Environmental Architecture in re-use: The “Courtyard of Miracles” in Athens, Greece.

2. Bilge, E. (2019). *The “courtyard house”: a spatial reading of domestic architecture in ancient Anatolia and Greece* (Master's thesis, Middle East Technical University).

2.6.3. Case Study 3: Courtyard Houses of Copenhagen, Denmark

Figure 31. Copenhagen courtyard house, a harmonious blend of architectural styles from traditional to the modernist designs

- **City Name:** Copenhagen, Denmark

- **Number of Inhabitants-Population:** Approximately 1,381,005 people

- **Dimensions of the City (km square):** 2,561 km²

- **Short History of the City:**

  Copenhagen, the capital of Denmark has a very rich history and is known for its blend of historic and modern architecture.

- **Role of Courtyards:**

  Courtyard houses in Copenhagen are characteristic of the city's urban design which are offering private outdoor spaces within densely populated areas. These courtyards are often shared by multiple residents and serve as communal spaces.

- **Urban Agriculture/Landscape Practices in Courtyards:**

Courtyards in Copenhagen may feature a mix of landscaping and gardening, including flower beds, shrubs and small trees. Some courtyards support urban agriculture initiatives such as community gardens.

- **Socio-Cultural Significance:**

  Courtyard houses in Copenhagen represent a blend of historic and contemporary urban living. They contribute to the sense of community and neighbourhood identity.

- **Design Strategies:**

  Copenhagen's courtyard houses feature a mix of architectural styles from traditional to modernist designs. The design emphasizes functionality and adaptability to changing urban needs.

- **Community Engagement Approaches:**

  Many courtyard houses in Copenhagen encourage community engagement, with residents participating in gardening and maintenance. Some courtyards host neighbourhood events and gatherings.

- **Management Models Employed:**

  Courtyard houses in Copenhagen are often managed by homeowner associations or cooperatives. Residents collaborate on maintenance and use of communal spaces.

- **References:**

1. Woodward, C. (1998). *Copenhagen*. Manchester University Press.

2. Chiu, C. Y., Goad, P., Myers, P., & Yılgın, C. (2020). Ideas and ideals in Jørn Utzon's courtyard houses: dwelling, nature and Chinese architecture. *The Journal of Architecture*, *25*(5), 513-557

2.6.4 Case Study 4: Havelis of Rajasthan, India

Figure 32.Grand courtyard of a Rajasthan haveli, surrounded by the intricately decorated rooms.

- **City/Region Name:** Rajasthan, India

- **Number of Inhabitants-Population:** Varies by city and town

- **Dimensions of the Region (km square):** approximately 342,239 km²

- **Short History of the Region:**

  Rajasthan, located in northern India is known for its rich cultural heritage and historic cities. It was once home to princely states and its architecture reflects a blend of Rajput and Mughal influences.

- **Role of Courtyards:**

  Courtyard houses, often referred to as "havelis," are prevalent throughout Rajasthan. They are characterized by their grand courtyards surrounded by intricately decorated rooms. Havelis served as residences for wealthy merchants and aristocrats, designed to provide comfort in the arid desert climate.

- **Urban Agriculture/Landscape Practices in Courtyards:**

  Courtyards of havelis may include gardens with flowering plants, fruit trees and fountains. Some havelis have rooftop gardens for growing vegetables and herbs.

- **Socio-Cultural Significance:**

  Havelis are not only architectural marvels but also repositories of Rajasthan's cultural history. They showcase exquisite frescoes, carvings and traditional art forms. Some havelis have been converted into heritage hotels, providing guests with an immersive cultural experience.

- **Design Strategies:**

  Havelis in Rajasthan feature opulent architectural elements, including ornate facades, intricately carved wooden doors and jharokhas (overhanging balconies). The central courtyards are designed to provide shade and a sense of openness.

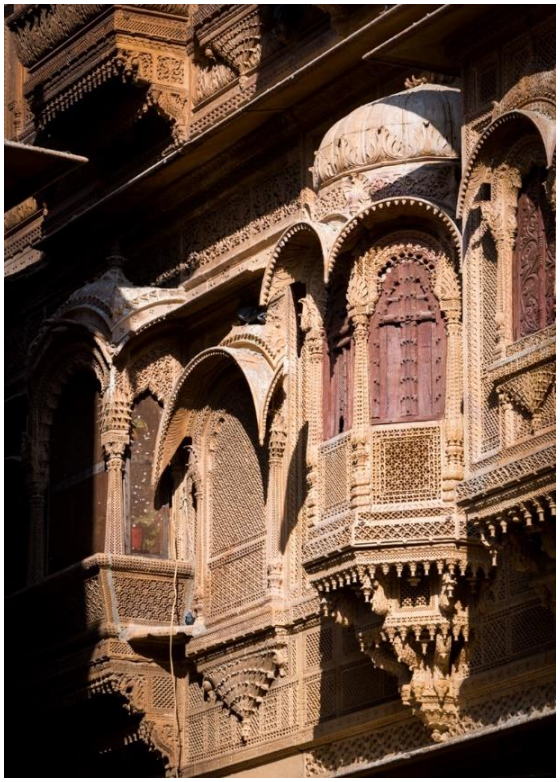


Figure 33.Exquisite frescoes and carvings on facades of a haveli reflecting its cultural significance.

- **Community Engagement Approaches:**

  Many havelis are open to tourists, offering guided tours that highlight the architecture and history. Local artisans conduct workshops in havelis, showcasing traditional crafts and art forms.

- **Management Models Employed:**

  Havelis are privately owned, family-run properties or managed by heritage preservation organizations. Access to courtyards and interiors is often regulated to protect the heritage

Figure 34. Intricately carved wooden doors and typical arches.

- **References:**

1. Verma, T., Kamal, M. A., & Brar, T. S. (2022). An Appraisal of Vernacular Architecture of Bikaner: Climatic Responsiveness and Thermal Comfort of Havelis. *International Society for the Study of Vernacular Settlements (ISVS e-Journal), University of Moratuwa, Sri Lanka*, *9*(2).

2. Upadhyaya, V. (2017). Transformation in Traditional Havelis: A case of walled city Jaipur, Rajasthan. *Imperial Journal of Interdisciplinary Research (IJIR)*, *3*(2), 1482-1492.

3. Upadhyaya, V., & Jakhanwal, M. P. (2015). Traditional walled cities of Rajasthan India: a sustainable planning concept. *Int. J. Eng. Res. Manag. Technol*, *2*(3), 204-217.

2.6.5 Case Study 5: Chettinad Courtyard Houses of Tamil Nadu, India

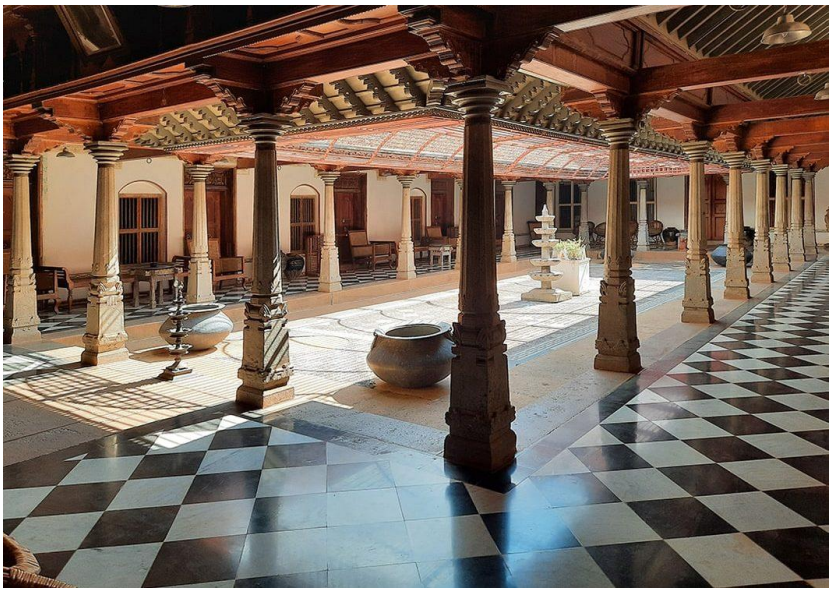


Figure 35. Spacious courtyard in a Chettinad mansionwith intricate wooden carving serving as a central gathering space.

- **City/Region Name:** Chettinad, Tamil Nadu, India

- **Number of Inhabitants-Population:** Varies by town and village

- **Dimensions of the Region (km square):** Chettinad comprises several villages covering an area of approximately 1,550 km²

- **Short History of the Region:**

  Chettinad, in the southern state of Tamil Nadu, is renowned for its unique Chettinad architecture and cuisine. The region was historically home to prosperous Chettiar merchant families.

- **Role of Courtyards:**

  Courtyard houses in Chettinad, known as "Chettinad mansions" or "Ayyanars," are prominent examples of Dravidian architecture. They are characterized by spacious courtyards ornate pillars and exquisite woodwork. Courtyards serve as central gathering spaces and provide natural ventilation in the tropical climate.

- **Urban Agriculture/Landscape Practices in Courtyards:**

  Chettinad courtyard houses often feature gardens with indigenous plants, including palms, jasmine and hibiscus. Some courtyards have traditional wells for rainwater harvesting and small vegetable gardens.

- **Socio-Cultural Significance:**

  Chettinad mansions are architectural gems that reflect the prosperity and artistic prowess of the Chettiar community. They host traditional ceremonies, family gatherings and cultural events, preserving the region's heritage.

- **Design Strategies:**

  Chettinad courtyard houses are designed with a focus on symmetry, intricacy and sustainability. The use of Athangudi tiles ornate wooden carvings and spacious courtyards is typical.

Figure 36.Symmetry, intricacy and sustainability in the Chettinad courtyards

- **Community Engagement Approaches:**

  Some Chettinad mansions offer guided tours to visitors, showcasing the unique architectural and cultural aspects. Local artisans may conduct workshops on traditional crafts and cuisine.

- **Management Models Employed:**

  Chettinad mansions are often family-owned and maintained, with some being converted into boutique hotels. Access to courtyards and interiors is regulated to protect the heritage.

Figure 37. A Chettinad courtyard used for rainwater harvesting and sustainable practices.

- **References:**

1. Myneni, K. K. (2013). Courtyard as a building component; its role and application in developing a traditional built form, creating comfort; a case of Athangudi Village, India. *International Journal of Chemical, Environmental & Biological Sciences*, *1*(4), 633-639.

2. Prakash, A. B. S., & Mahalakshmi, A. S. (2008). Traditional breathing spaces in built forms–Review and Comparison of courtyards in Athangudi village, Chettinad and Contemporary Context. *Int. Res. J. Eng. Technol*, *9001*, 361.

3. Narayanamurthy, A. (2023). *A Contemporary Approach in the Preservation of Chettinad Architecture* (Doctoral dissertation, Pratt Institute).

2.6.6. Comparative Analysis

The exploration of courtyard houses across different regions of the world, including Cordoba, Athens, Copenhagen, Rajasthan and Chettinad has provided valuable insights into the socio-cultural significance, design strategies and community engagement approaches associated with these architectural gems. As the urban landscape evolves and faces various challenges, the enduring presence of courtyard houses serves as a testament to their adaptability and enduring appeal.

These case studies have highlighted several common themes and unique characteristics as below:

Table 3. Comparison of Case studies

Aspect	**Cordoba, Spain**	**Athens, Greece**	**Copenhagen, Denmark**	**Rajasthan, India**	**Chettinad, India**
Historical Significance	Roman and Moorish influences	Ancient history with Greek influences	Blend of medieval and modern architecture	Blend of Rajput and Mughal architecture	Dravidian architectural heritage
Design Strategies	Moorish-influenced patios with presence of plants	Traditional Greek elements with potted plants	Varied styles, including modernist designs with greenery	Ornate facades and intricate carvings with gardens	Symmetrical layout with Athangudi tiles and indigenous plants
Community Engagement	Limited public access	Public access during cultural events	Engagement through neighbourhood associations	Guided tours and cultural events	Guided tours and artisan workshops
Urban Agriculture/Greenery	Courtyards with plants for freshness	Potted plants and small gardens	Gardens with flowerbeds and community gardens	Gardens with indigenous plants and rooftop gardens	Gardens with indigenous plants and small vegetable gardens

Presence of Landscape and Nature	Courtyards create an oasis with water features and greenery	Incorporation of plants provides a sense of freshness	Integration of greenery contributes to a balanced urban environment	Gardens, trees and well-maintained greenery enhance aesthetics	Courtyards filled with indigenous plants offer a natural ambiance
Management Models	Privately owned with controlled access	Varied, with public access during events	Homeowner associations or cooperatives	Privately owned with controlled access	Family-owned or boutique hotels

2.6.7. Findings of the Case studies

The study of courtyard houses from different parts of the world reveals their enduring cultural significance, adaptability and the vital role they play in connecting urban residents to the natural world. Whether they are the iconic patios of Cordoba, the tranquil courtyards of Rajasthan's havelis or the symmetrical layouts of Chettinad, these spaces continue to bridge the gap between tradition and modernity. They offer insights into the rich heritage of the regions they represent.

Moreover, the presence of landscape and nature within these courtyards not only enhances their visual appeal but also contributes to a profound sense of tranquility and balance in urban environments. This common thread across diverse courtyard houses highlights their unique ability to create oases of greenery and serenity within the bustling confines of urban living. These courtyards not only serve as architectural marvels but also as spaces that nurture a connection between residents and the natural world, underscoring their enduring importance in today's urban landscapes.

By comparing and analysing the variety and similarities between the different case studies, it gives an informed methodology for the case study of Milan by stressing the relevance of including social analysis like the public perception, attitude, morphology and climate.

CHAPTER 3

METHODOLOGY

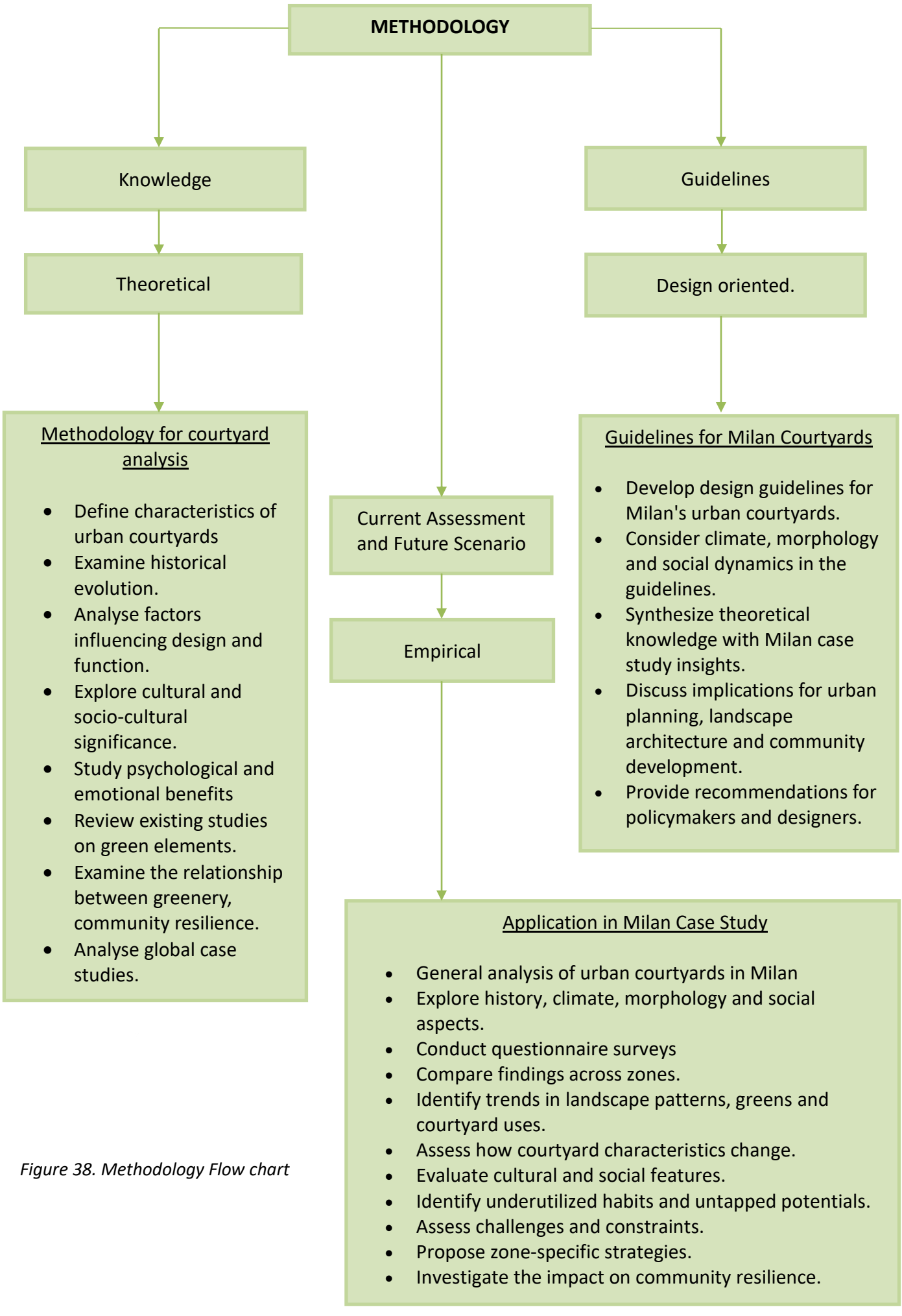


Figure 38. Methodology Flow chart

3.1. Research Design and Approach

The methodology of this thesis encompasses a multifaceted approach that combines empirical data collection, comparative analysis and a comprehensive literature review. This approach is structured as follows:

3.1.1 Literature Review: The study commences with an extensive literature review that not only serves as a theoretical framework but also functions as distinct methodological approach. This phase involves a systematic review and analysis of the existing studies related to urban courtyards, green elements, productive landscapes, community resilience and social cohesion. The methodology for this aspect includes sourcing academic papers, books and reports from reputable databases like Scopus and Google Scholar, which is followed by a critical analysis of these sources to derive key insights and trends in the field.

3.2. Data Collection Methods

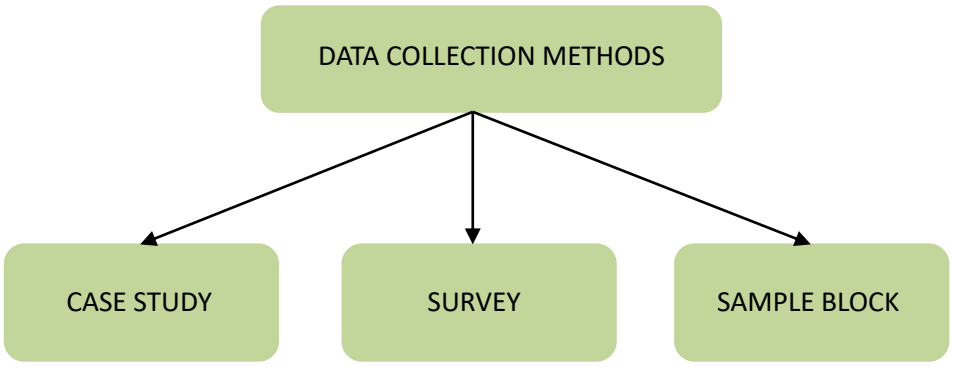


Figure 39. Data Collection methods

3.2.1 Case Studies: In addition to the survey, this research also involves the analysis of multiple case studies from various cities worldwide including Milan, Europe and India. These case studies serve as rich sources of qualitative data, providing insights into successful examples of urban courtyards with green and productive elements. Data collection for this aspect involved in-depth analysis of existing case study reports, architectural documents and interviews with relevant stakeholders where available.

3.2.2 Survey and Questionnaire: To understand the perspectives and the attitudes of Milan's residents towards the integration of green elements and productive landscapes in urban courtyards, a structured questionnaire survey was conducted. The survey aimed to capture data on resident's preferences, perceptions and expectations regarding these interventions. The survey was distributed among a diverse sample of residents residing in different areas of Milan, including the central, intermediate and peripheral areas.

3.2.3. Selection of Milanese Zones: To conduct a comparative analysis of urban courtyards, three distinct zones within the city of Milan are selected. These zones represent diverse urban contexts: central, intermediate and peripheral areas. The selection is based on considerations such as demographic diversity, architectural characteristics and presence of urban courtyards with the potential for green and productive interventions.

3.3. Data Analysis Techniques

3.3.1 Comparative Analysis: The data collected from surveys and case studies will undergo a comparative analysis. This analysis will entail the examination of trends, patterns and disparities in resident's preferences across different zones in Milan. Additionally, it will also involve the assessment of common design strategies, community engagement approaches and management models employed in successful case studies.

3.4. Criteria, Assumptions, Limitations and Novelty

3.3.2 Criteria for Investigation: The investigation is guided by criteria focused on understanding the socio-cultural significance of urban courtyards, the benefits of the green elements and productive landscapes and their potential impact on the community resilience and social cohesion.

3.3.3 Assumptions: The research assumes that the perspectives and attitudes of Milan's residents towards urban courtyards can be indicative of broader urban planning trends. It also assumes that successful case studies can provide valuable insights applicable to Milanese context.

3.3.4 Limitations: The study acknowledges limitations in terms of data acquisition, especially regarding the potential constraints on participant responses in the survey. Additionally, time and resource limitations influence the scope of the research.

3.3.5 Novelty of the Methodology: The novelty of this research methodology lies in its integrated approach, combining a large-scale resident survey along with the in-depth analysis of diverse case studies. This hybrid approach allows for a comprehensive exploration of the research objectives and the potential to generate nuanced insights into urban courtyard transformations.

This robust methodology is designed to provide a comprehensive understanding of the integration of green elements and productive landscapes in urban courtyards and its implications for community resilience and social cohesion in the city of Milan.

CHAPTER 4

ANALYSIS OF URBAN COURTYARDS IN MILAN

General analysis of the existing urban courtyards in Milan

Figure 40. Entrance of a typical Milanese Courtyard

4.1. History of Courtyards in Milan

The history of courtyards in Milan, Italy is closely intertwined with the city's architectural and urban development. Courtyards have played a significant role in Milan's urban fabric for centuries, serving various functions and evolving in style and purpose over the time. Here's a brief overview of the history of courtyards in Milan:

1. Ancient Origins:
    - In Italy around 700 B.C. a new courtyard design known as the "atrium house" emerged, marking a significant departure from previous courtyard styles. This design's primary purpose was to provide a private outdoor space.
    - The atrium house design in Italy featured a small courtyard surrounded by rooms and a central container to gather rainwater for drinking. This open-to-the-sky design emphasized the provision of a private outdoor space [13].

2. Medieval and Renaissance Periods:

- Milan has rich history dating back to Roman times, but the development of courtyards in the city as we know them today began to take shape during the Middle Ages and Renaissance.
- During the Middle Ages, many noble family built palaces and residences with internal courtyards. These courtyards often featured beautiful gardens and served as private retreats from the bustling city outside.

3. Baroque Era:
    - In the Baroque era, from the late 16th to the 18th century the city underwent significant architectural transformations. Courtyards were incorporated into the design of grand palaces and churches.
    - Many of these courtyards featured intricate decorations such as statues, fountains and frescoes. The famous Brera Palace is an example of a Baroque-style courtyard in Milan.

Figure 41. The courtyard of Brera Gallery.

4. Neoclassical Period:
    - The Neoclassical period, which followed the Baroque era, brought about a shift in architectural styles. Courtyards during this time often featured symmetrical and clean designs.
    - Public buildings such as the neoclassical Brera Gallery were constructed with grand courtyards that showcased the elegance of the era.

5. 19th and Early 20th Century:
    - During the 19th century, Milan underwent significant urbanization and industrialization. Many old courtyards were enclosed and integrated into larger buildings or demolished to make way for more modern structures.
    - Some of the grand courtyards in historic palaces and public buildings, however were preserved and continue to be important architectural features in the city.

6. Contemporary Courtyards:
    - In modern times, courtyards in Milan continue to serve various functions. Some are private residential courtyards, while others are public spaces, accessible to all.
    - Some historic courtyards have been repurposed into cafes, shops or galleries and others have been redesigned to accommodate new functions.

Figure 42. View of the courtyards of Palazzo Archinto , 1934

Milan is known for its mixture of historic and contemporary architecture and courtyards remain an integral part of city's urban landscape. While many traditional courtyards have been preserved and cherished new architectural developments continue to incorporate innovative courtyard designs, adding to city's charm and architectural diversity [9][10][38].

4.2. Climate

Milan, Italy, experiences a humid subtropical climate, characterized by hot and humid summers and, cold and foggy winters. Here's an overview of Milan's climate:

1. Summers (June to August):

- Summers in Milan are warm and humid. Average high temperature during this season are typically in the range from 27°C to 30°C (80°F to 86°F) but can often even exceed 30°C (86°F).
- Rainfall is relatively evenly distributed throughout the summer with occasional thunderstorms.
- Due to its inland location, Milan can occasionally experience heatwaves with temperatures reaching well into the 30s°C (over 90°F).
- Humidity levels are moderate making it feel warmer than the actual temperature.

2. Autumn (September to November):

- Autumn in Milan is a pleasant season with gradually decreasing temperatures. High temperature can range from 21°C to 26°C (70°F to 79°F) in September but it decreases to 13°C to 18°C (55°F to 64°F) in November.
- Rainfall increases as the season progresses.

3. Winters (December to February):

- Winters in Milan are cold and often foggy with occasional snowfall. High temperature typically ranges from 5°C to 8°C (41°F to 46°F).
- Night time temperatures can drop below freezing and the city occasionally experiences sub-zero temperatures particularly in January.
- Fog is a common feature during the winter months which can lead to reduced visibility and transportation disruptions.

4. Spring (March to May):

- Spring is a transition period with milder temperatures. High temperatures ranges from 12°C to 18°C (54°F to 64°F) in month of March and gradually increases to 18°C to 23°C (64°F to 73°F) in May.
- Rainfall remains relatively constant throughout the spring.

Milan's climate is influenced by its inland location and the surrounding mountains which can lead to temperature variations. The city experiences four distinct seasons with hot-humid summers and cold-foggy winters. While the climate is generally pleasant, Milan does encounter occasional weather extremes such as heatwaves in the summer and cold spells in the winter. It's advisable to check the weather forecast if you plan to visit Milan as the city's climate can influence your activities and clothing choices [39].

General analysis of Climate within courtyards in Milan:

The climate within courtyards in Milan can be different from the city's overall climate due to their enclosed or semi-enclosed nature. Courtyards create microclimates that are influenced by the architectural design the materials used and the immediate surroundings. Here are some ways in which the climate within courtyards may differ from the city's broader climate:

1. **Temperature:** Courtyards can experience temperature variations compared to the surrounding city. During the summer courtyards may be warmer due to reduced air circulation and heat-absorbing materials like stone or concrete. In contrast, during the winter courtyards can be cooler due to limited exposure to direct sunlight and the potential for cold air to become trapped within the enclosure.

2. **Wind:** Courtyards are often shielded from the strong winds by the surrounding buildings, which can make them more sheltered and less windy than the city at large. However, this can also result in reduced ventilation which may affect air quality and comfort.

3. **Humidity:** Courtyards can have different humidity levels from the surrounding city. They may trap moisture or experience reduced airflow making them more humid than the city streets or parks.

4. **Light:** Depending on the design, some courtyards may receive less direct sunlight, especially if they are surrounded by tall buildings. This can influence the amount of natural light and shadow within the courtyard.

5. **Noise:** Courtyards may be quieter than the city streets because they are sheltered from traffic and urban noise, thus providing a more tranquil environment.

6. **Vegetation:** Some courtyards feature gardens or greenery which can moderate temperatures and contribute to a more pleasant and comfortable microclimate.

7. **Pollution:** Enclosed courtyards may have less exposure to the air pollution than the streets hence contributing to a cleaner atmosphere.

It is important to note that the specific microclimate within a courtyard can vary widely based on its size orientation, design and the material used. Some courtyards are designed to maximize comfort and aesthetics while others may have a more functional or utilitarian purpose. Visitors and residents can experience different microclimates within Milan's courtyards and these microclimates are influenced by the architectural choices made in each space [14] [40].

Note: The climate data for milan is retrieved from climate-data.org

4.3. Morphology

Sample block analysis

Urban morphology is a dynamic field of study that seeks to understand how cities evolve over time, examining the structural elements and patterns that define their landscapes. Milan has an ever-changing urban landscape and hence provides a good backdrop for examining morphological changes of the urban residential landscapes within the city's different zones.

By employing a sample block method analysis, we aim to compare the courtyard hierarchy and the building hierarchy within the city's three different zones: the city center (central zone), the intermediate area (intermediate zone) and the outskirts (peripheral zone). It provides a comprehensive analysis of the changes in the shapes and areas of the courtyards, the density and height of buildings as one moves from the city center to the periphery of Milan.

Selection of Block Size : After a large scale dynamic urban analysis of Milan and considering various urban factors three different sample blocks were selected in three distinct zones of Milan. To ensure a consistent and meaningful analysis, a block size of 250 meters by 250 meters was chosen. Since this size allows the collection of detailed findings while ensuring that they are comparable across the three zones of Milan, this standard block size was decided upon.

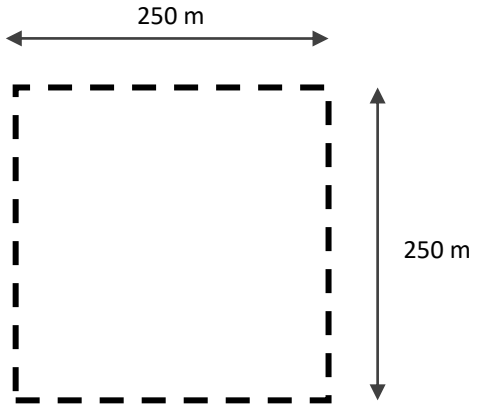


Figure 43. Sample Block Size

Method of analysing Courtyard hierarchy across the chosen samples:

The method of analysis employed in the courtyard analysis of the three chosen samples divides the courtyards into three distinct size categories based on their area in square meters: < 60 sq. m., 60-250 sq. m. and > 250 sq. m. This categorization approach was chosen because by dividing the courtyards into these categories we can gain insights into how different size ranges are distributed within the studied samples. This approach allows to identify trends, preferences and characteristics associated with small, medium and large courtyards.

Smaller courtyards (< 60 sq. m.) represent compact, space-efficient designs, while medium-sized courtyards (60-250 sq. m.) often serve as versatile spaces in urban environments. Larger courtyards (> 250 sq. m.) are typically associated with more spacious and potentially multifunctional areas.

Method of analysing Building hierarchy across the chosen samples:

For the method of analysis of the buildings, a classification of four distinct categories is made based on their height which is closely related to the number of floors in a building. This approach encompasses a range of real-world building heights in these categories which are commonly encountered in urban and suburban environments. The categories chosen are: < 9m (Short buildings), 9-15m (Medium buildings), 15-21m (Tall buildings) and >21m (Very tall buildings). The chosen categories simplify the classification process and provide a clear framework for analysing building heights.

After closely investigating the range of building heights in Milan we derived the categorization aspect for the analysis of building heights. We assume that short buildings (< 9 m.) are typically smaller in scale with single or a double storey, medium buildings (9-15 m.) are versatile ranging from 3 to 5 storeys, tall buildings (15-21 m.) are more imposing and they range from 5 to 7 storeys and very tall buildings (>21 m.) have a significant presence in city skylines and have buildings higher than 7 storeys.

URBAN LEVEL ANALYSIS: Soil equipped open areas of Milan

Figure 44. Soil equipped open areas of Milan

For the urban level analysis, to select the open areas of interest, the Regional Topographic Database (DBT) was used. The layer A020206 from the DBT, corresponds to the soil equipped open areas of Milan.

The NIL is the 'Local Identity Nuclei', which represents the areas defined as neighbourhoods of Milan. There are 88 Neighbourhoods in Milan.

URBAN LEVEL ANALYSIS: Residential areas of Milan

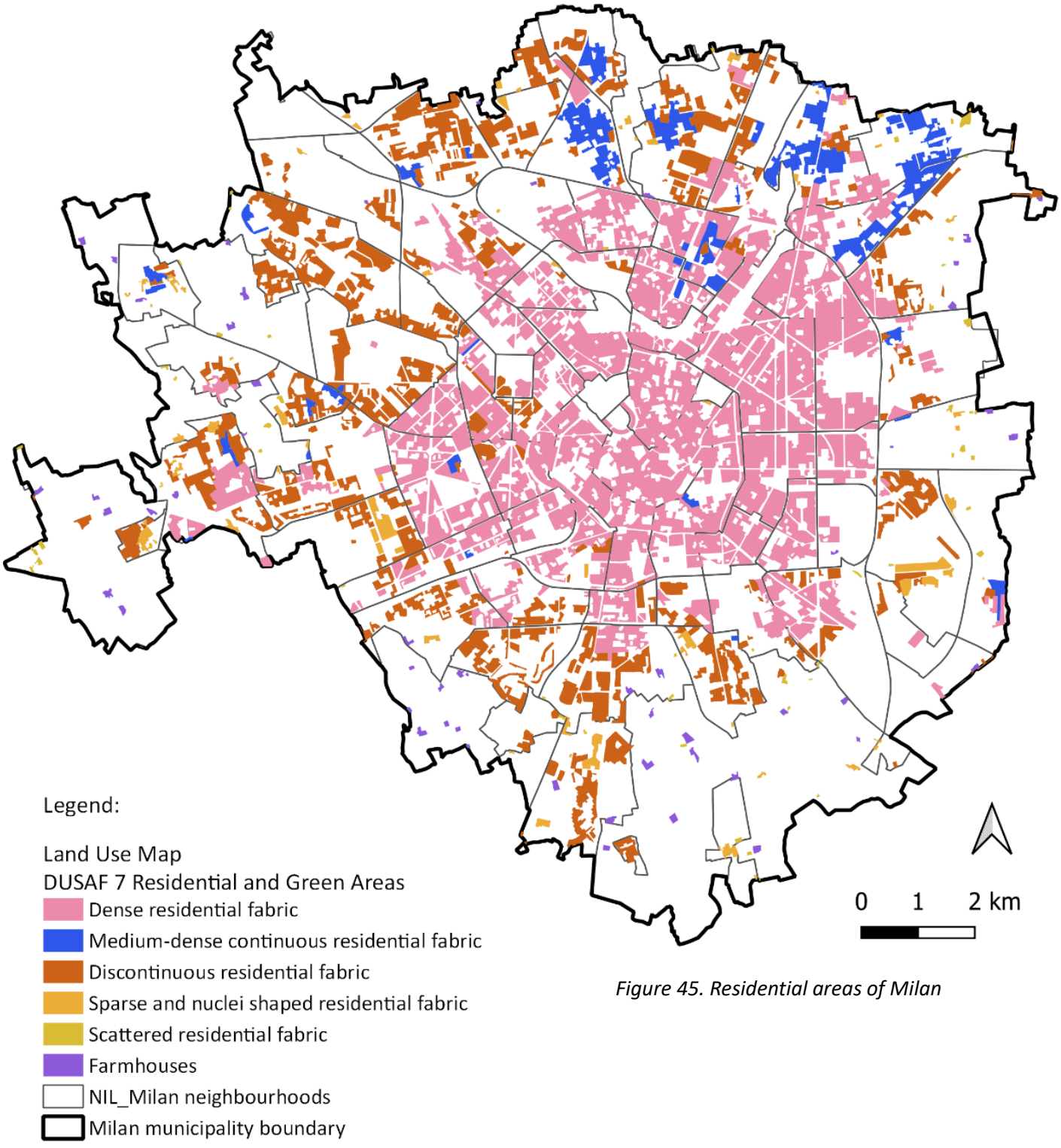


Figure 45. Residential areas of Milan

To get the mapped residential areas of Milan, DUSAF 7 (Land use Map) is used. We focus only on the layers related to the residential zones and discard the others. The entire residential fabric of Milan is mapped in this layer.

URBAN LEVEL ANALYSIS: Residential open areas of Milan (Courtyards)

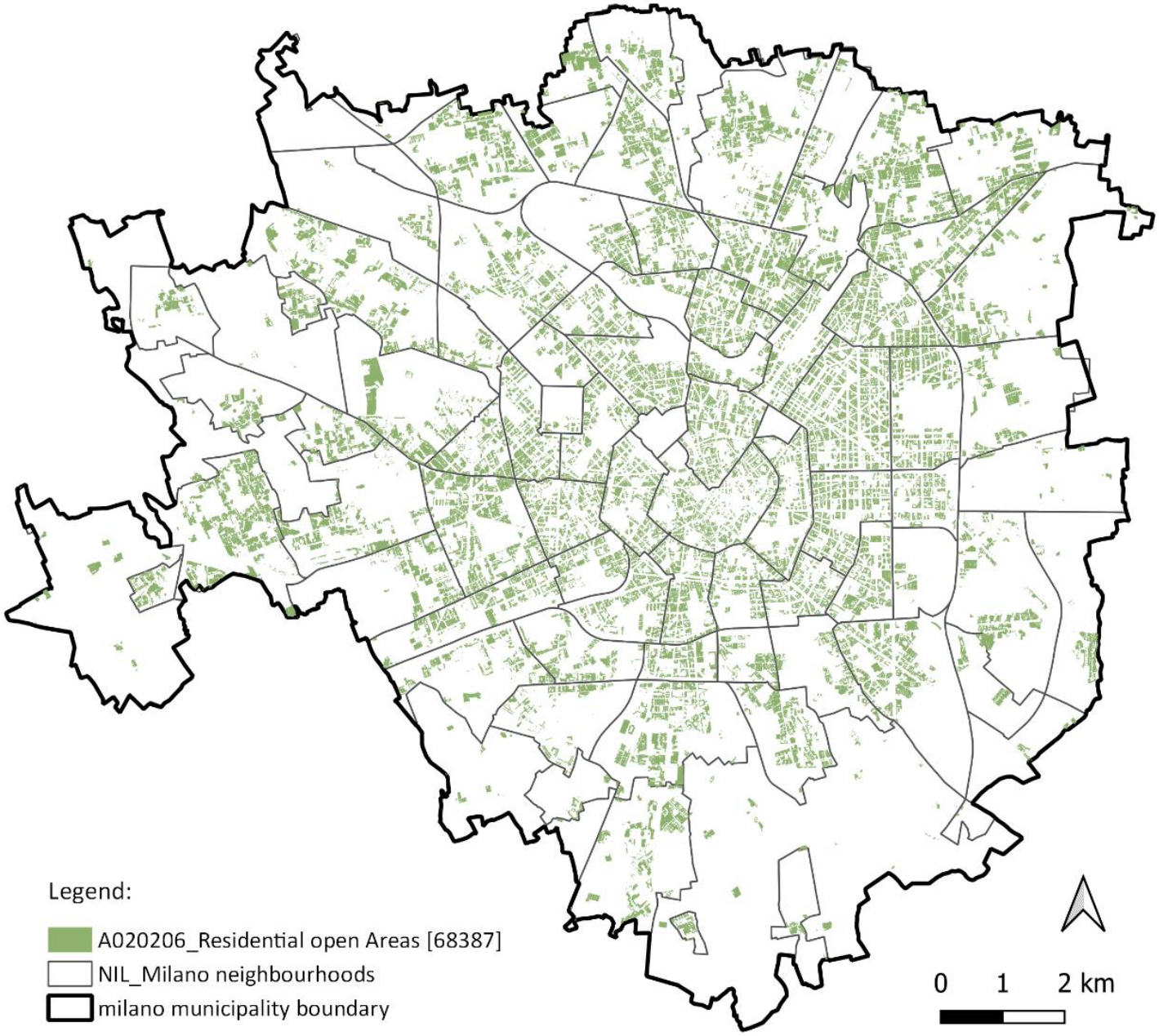


Figure 46. Residential Courtyards of Milan

To focus on the pure residential open areas that is courtyards, we need to categorise the soil equipped open area. So now for the individualisation of the areas into just the residential ones, DUSAF 7 (Land use Map) is used as a cutting mask. With this process, a lot of irrelevant layers are excluded and only the residential open areas are obtained. Hence, we have now mapped the residential open areas i.e. the courtyards of Milan.

URBAN LEVEL ANALYSIS: Percentage of residential open area w.r.t. NIL area

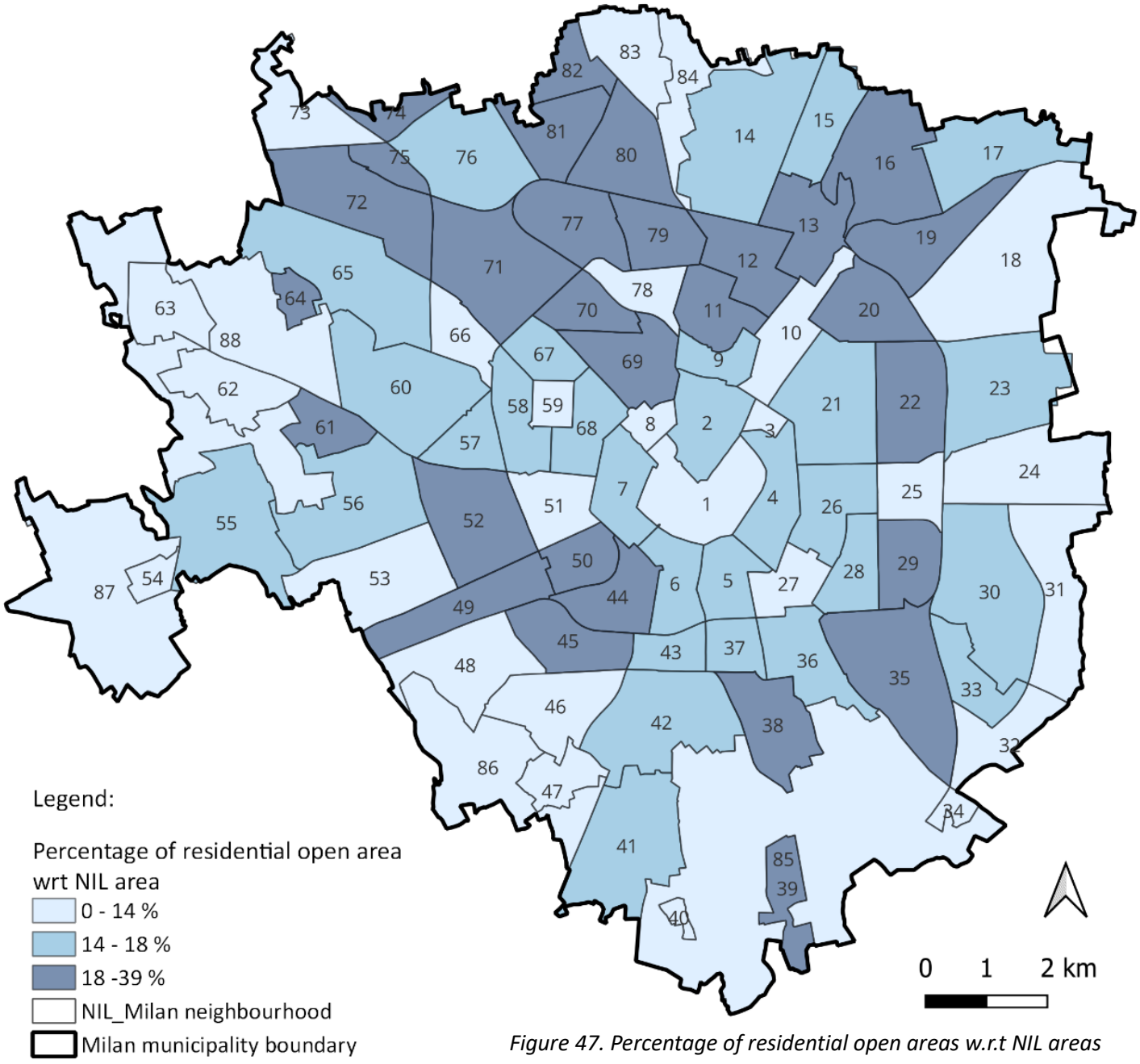


Figure 47. Percentage of residential open areas w.r.t NIL areas

All the 88 neighbourhoods of Milan are classified in percentage, where a neighbourhood having many residential open areas with respect to its entire area, has a higher percentage value and a neighbourhood with a few residential open areas have a smaller percentage value. So, the dark colour potrays the residential open areas representing a bigger percentage of the entire surface area of the neighbourhood and vice versa for the light colour. Hence, this map gives a base for the decidation of the placement of the three sample blocks, considering the areas having a higher percentage of residential open areas with respect to the entire neighbourhood.

URBAN LEVEL ANALYSIS: Residential open areas of Milan (Courtyards)

Below is a calculated data table showing statistics by category of the open areas and the residential open areas. We have a list of the 88 neighbourhoods with their individual areas in sq.km. The count of the number of individual elements registered as open areas and residential open areas in every neighbourhood are listed. The parks are excluded as there are no residential areas in those neighbourhoods.

Finally, the percentage of the open areas and the residential open areas are calculated with respect to the total area of the neighbourhood.

Table 4. Data for the open areas and residential open areas of Milan

			OPEN AREA				RESIDENTIAL AREA			
ID_NIL	NIL	AREA [SQKM]	COUNT	SUM	PERCENTAGE	MEAN	COUNT2	SUM2	PERCENTAGE	MEAN
1	DUOMO	2.344	2020	283926.656	12.12%	139.4531709	1746	211226.816	9.01%	120.0152364
2	BRERA	1.639	1659	266033.39	16.23%	158.6364878	1426	217357.767	13.26%	150.838145
3	GIARDINI PORTA VENEZIA	0.250	12	497.075	0.20%	41.42291667	1	51.447	0.02%	51.447
4	GUASTALLA	1.549	1104	232253.959	14.99%	209.4264734	949	151218.113	9.76%	158.6758793
5	VIGENTINA	1.136	1028	174018.269	15.32%	165.8896749	742	97024.988	8.54%	127.6644579
6	TICINESE	1.256	1403	219753.92	17.50%	154.7562817	1291	185583.301	14.78%	141.9918141
7	MAGENTA - S. VITTORE	1.391	1461	240742.529	17.30%	161.789334	1077	163616.076	11.76%	150.1064917
8	PARCO SEMPIONE	0.471	38	2047.926	0.43%	53.89278947			0.00%	
9	GARIBALDI REPUBBLICA	0.786	517	125720.202	15.99%	243.1725377	387	80238.236	10.20%	207.3339432
10	CENTRALE	1.557	899	167169.19	10.73%	184.1070374	775	146102.991	9.38%	186.5938582
11	ISOLA	1.324	1533	264558.326	19.98%	168.9389055	1349	232477.03	17.56%	168.5837781
12	MACIACHINI - MAGGIOLINA	1.676	1564	337698.885	20.15%	214.5482116	1415	376287.119	22.45%	264.8044469
13	GRECO	1.770	1270	379706.993	21.45%	294.803566	759	249502.373	14.10%	324.8728815
14	NIGUARDA - CA' GRANDA	4.255	1947	634494.303	14.91%	322.4056418	1347	452114.633	10.63%	332.9268284
15	BICOCCA	1.536	474	279199.7	18.18%	589.028903	205	63875.03	4.16%	311.5855122
16	VIALE MONZA	3.008	2112	755408.63	25.11%	355.8213048	1457	579242.19	19.26%	394.5791485
17	ADRIANO	2.433	761	429334.256	17.64%	561.9558325	516	286575.498	11.78%	552.1685896
18	PARCO LAMBRO - CIMIANO	4.976	1175	707584.444	14.22%	589.1627344	715	373086.888	7.50%	512.481989
19	PADOVA	2.064	1550	588286.657	28.51%	377.8334342	1118	440223.271	21.33%	392.0064746
20	LORETO	1.749	1461	377705.216	21.60%	257.1172335	1326	327212.35	18.71%	245.2866192
21	BUENOS AIRES - VENEZIA	2.880	3369	474052.404	16.46%	135.6761317	3191	455104.589	15.80%	137.4938335
22	CITTA' STUDI	2.209	2496	409997.596	18.56%	157.934359	1806	269818.383	12.21%	144.5972042
23	LAMBRATE	3.099	1804	550574.297	17.76%	295.6897406	810	180569.555	5.83%	214.1987604
24	PARCO FORLANINI - ORTICA	2.928	466	273136.97	9.33%	569.0353542	76	32333.821	1.10%	425.4450132
25	CORSICA	1.082	1062	132611.633	12.25%	118.4032438	893	88252.479	8.16%	92.99523604
26	XXII MARZO	1.639	1457	253226.137	15.45%	162.8463904	1374	240349.502	14.67%	163.3919116
27	PORTA ROMANA	1.004	977	133219.694	13.27%	134.9743607	796	100604.92	10.02%	125.75615
28	UMBRIA - MOLISE	1.193	1007	214327.739	17.96%	189.5028638	779	199962.724	16.76%	223.6719508
29	ORTOMERCATO	1.404	372	546577.828	38.94%	1434.587475	123	30165.479	2.15%	235.6678047
30	MECENATE	3.824	1306	578702.762	15.13%	422.7193294	490	264014.085	6.90%	515.6525098

Table continued from the previous page…

31	PARCO MONLUE' - PONTE LAMBRO	2.641	711	197257.663	7.47%	261.2684278	467	60106.413	2.28%	119.7338904
32	TRIULZO SUPERIORE	1.396	228	134731.677	9.65%	545.4723765	74	15468.446	1.11%	193.355575
33	ROGOREDO	1.201	924	199536.671	16.61%	184.9274059	323	75270.644	6.27%	173.4346636
34	CHIARAVALLE	0.312	101	19222.451	6.16%	183.0709619	7	1957.554	0.63%	279.6505714
35	LODI - CORVETTO	3.642	2315	709243.067	19.47%	292.3508108	1295	372717.973	10.23%	275.8830296
36	SCALO ROMANA	1.738	1288	271929.766	15.65%	206.4766636	506	80454.702	4.63%	152.6654687
37	EX OM - MORIVIONE	0.819	1009	147337.671	18.00%	141.9438064	692	91518.511	11.18%	129.2634336
38	RIPAMONTI	1.855	1465	368584.845	19.87%	209.9002534	901	226745.48	12.23%	197.858185
39	QUINTOSOLE	1.058	384	201545.423	19.04%	523.4946052	91	29740.896	2.81%	326.823033
40	RONCHETTO DELLE RANE	0.189	209	25145.389	13.30%	119.7399476	180	26268.439	13.90%	145.9357722
41	GRATOSOGLIO - TICINELLO	3.315	1351	601960.652	18.16%	407.8324201	924	282939.066	8.53%	273.1072066
42	STADERA	3.235	1601	514919.566	15.92%	318.44129	1138	415483.256	12.84%	361.6042263
43	TIBALDI	0.787	759	140688.521	17.88%	177.6370215	565	133110.317	16.92%	229.105537
44	NAVIGLI	1.485	1276	274667.78	18.50%	213.251382	908	162360.333	10.93%	177.4429869
45	S. CRISTOFORO	1.597	1558	342965.313	21.47%	216.7922332	707	144752.818	9.06%	200.4886676
46	BARONA	2.008	895	166894.899	8.31%	184.2107053	564	95297.841	4.75%	166.896394
47	CANTALUPA	0.927	255	26421.919	2.85%	101.2334061	228	14612.999	1.58%	62.44871368
48	RONCHETTO SUL NAVIGLIO	2.409	888	199173.834	8.27%	222.5405966	653	154479.219	6.41%	234.4145964
49	GIAMBELLINO	1.967	1798	407759.336	20.73%	220.5296571	1184	237470.022	12.07%	193.8530792
50	TORTONA	0.998	1048	201076.134	20.16%	176.6925606	806	108277.458	10.85%	121.3872848
51	WASHINGTON	1.307	1490	175877.758	13.45%	110.2681868	1373	154057.559	11.78%	104.5166615
52	BANDE NERE	2.666	3153	490838.01	18.41%	140.4400601	2311	395119.455	14.82%	155.8656627
53	LORENTEGGIO	2.637	1609	335801.433	12.73%	200.8381776	893	198601.386	7.53%	213.7797481
54	MUGGIANO	0.445	460	61358.991	13.80%	132.5248186	456	76193.097	17.14%	165.9980327
55	BAGGIO	3.481	2999	587282.084	16.87%	187.8100684	2438	546803.67	15.71%	215.3618236
56	FORZE ARMATE	3.209	1655	564611.715	17.59%	329.6040368	1079	288899.983	9.00%	259.5687179
57	SELINUNTE	0.986	1007	175515.559	17.81%	170.4034553	893	170056.969	17.25%	186.057953
58	DE ANGELI - MONTE ROSA	1.324	1465	226921.101	17.14%	150.6780219	1290	200271.28	15.12%	150.8066867
59	TRE TORRI	0.514	133	47462.73	9.24%	356.8626316	87	15741.894	3.06%	180.9413103
60	S. SIRO	3.438	1276	554486.599	16.13%	429.5016259	933	349342.283	10.16%	370.0659778
61	QUARTO CAGNINO	0.987	1038	251139.075	25.44%	236.7003534	660	176250.612	17.85%	264.6406586
62	QUINTO ROMANO	1.647	539	172335.706	10.46%	316.2123046	294	128965.267	7.83%	431.3219632
63	FIGINO	1.426	272	106462.993	7.47%	391.4080625	227	81126.105	5.69%	357.3837225
64	TRENNO	0.490	449	111515.168	22.75%	245.6281233	379	112383.012	22.93%	292.6640938
65	GALLARATESE	3.898	1470	681110.535	17.48%	438.0132058	808	537272.867	13.78%	611.2319306
66	QT 8	1.025	425	116510.825	11.36%	266.0064498	352	74777.954	7.29%	205.4339396
67	PORTELLO	0.910	537	152357.045	16.74%	277.5173862	327	91282.289	10.03%	270.0659438
68	PAGANO	1.291	1015	225478.327	17.47%	216.5978165	829	144859.32	11.22%	169.8233529
69	SARPI	1.813	2646	384025.805	21.18%	143.937708	1453	226792.685	12.51%	155.8712612
70	GHISOLFA	1.052	869	229634.455	21.82%	258.8889008	620	115274.085	10.95%	182.1075592
71	VILLAPIZZONE	3.430	2625	668834.34	19.50%	251.5360436	1302	282418.958	8.23%	214.4411222
72	MAGGIORE - MUSOCCO	3.033	1343	797709.648	26.30%	592.2120624	248	54195.053	1.79%	216.780212
73	CASCINA TRIULZA - EXPO	1.730	252	141594.162	8.18%	542.5063678			0.00%	
74	SACCO	0.709	394	142312.464	20.07%	361.1991472	24	4913.589	0.69%	204.732875
75	STEPHENSON	0.561	262	107735.139	19.22%	338.7897453			0.00%	
76	QUARTO OGGIARO	2.780	1097	459715.38	16.53%	398.021974	762	448549.53	16.13%	549.0202326
77	BOVISA	1.915	1339	390419.467	20.39%	289.4139859	686	106891.062	5.58%	154.4668526
78	FARINI	1.011	347	104343.669	10.32%	298.1247686	229	60720.59	6.01%	265.1554148
79	DERGANO	1.360	1488	300662.131	22.11%	199.7755023	978	167541.582	12.32%	169.9204686
80	AFFORI	2.073	1723	452889.654	21.85%	260.7309465	1200	272037.875	13.13%	225.1969164
81	BOVISASCA	1.578	952	437710.426	27.74%	458.8159602	571	159852.217	10.13%	279.4619178
82	COMASINA	0.927	357	245255.932	26.44%	683.164156	146	196731.116	21.21%	1329.264297
83	BRUZZANO	1.669	626	176506.941	10.58%	281.5102727	424	152227.203	9.12%	358.1816541
84	PARCO NORD	1.535	838	163363.68	10.64%	194.2493222	54	12059.718	0.79%	223.3281111
85	PARCO DELLE ABBAZIE	13.733	573	270005.204	1.97%	467.9466274	197	83353.676	0.61%	423.1151066
86	PARCO DEI NAVIGLI	3.621	251	101415.097	2.80%	402.4408611	113	34570.654	0.95%	305.9349912
87	PARCO AGRICOLO SUD	5.849	331	185572.293	3.17%	560.6413686	155	79109.458	1.35%	510.3836
88	PARCO BOSCO IN CITTÀ	7.844	552	317594.732	4.05%	574.3123544	191	51801.362	0.66%	271.2113194

URBAN LEVEL ANALYSIS: Placement of the three sample blocks

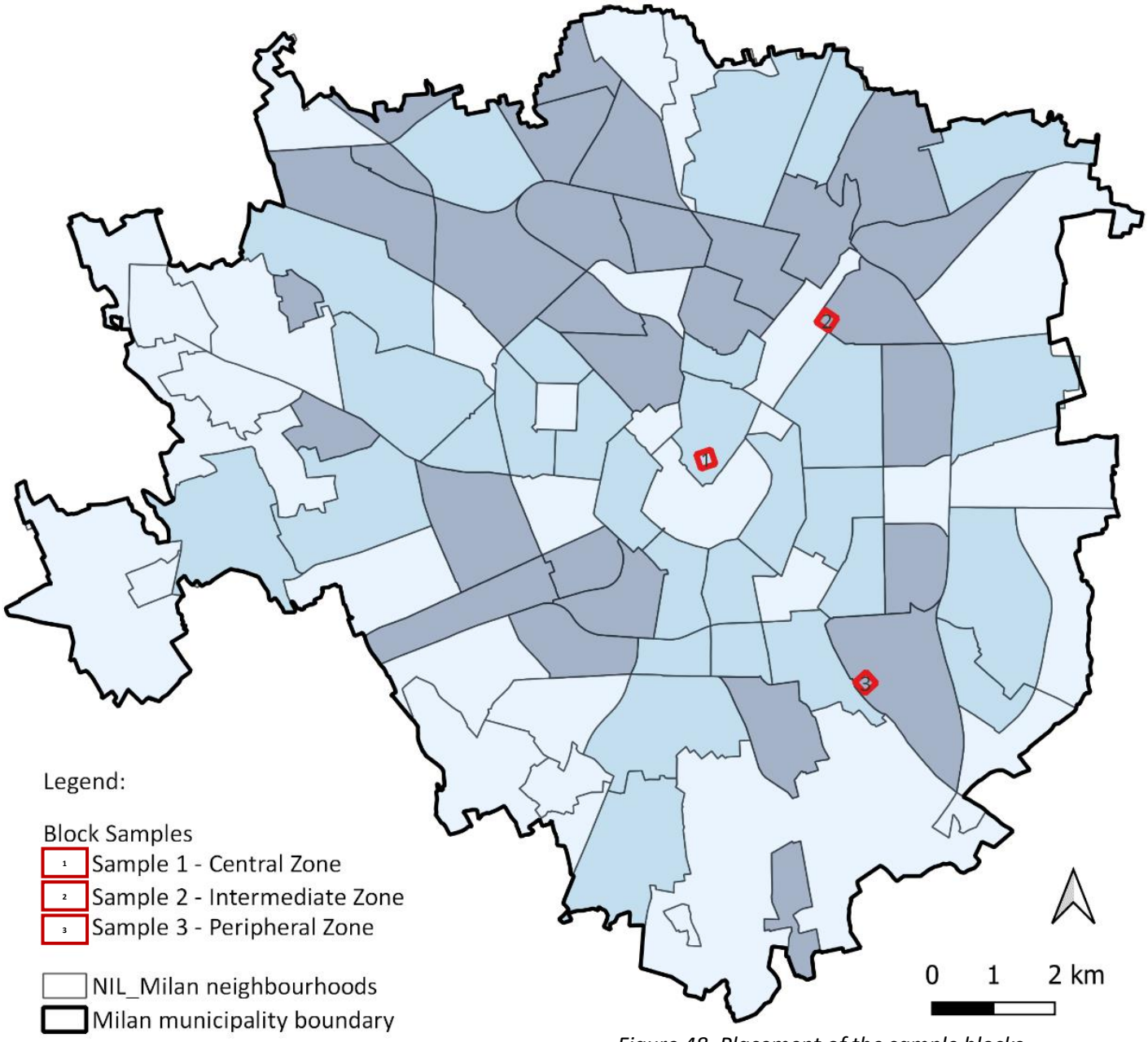


Figure 48. Placement of the sample blocks

Stratified sampling method is used by dividing the entire Milan in various percentages of the residential open areas in each neighbourhood. To select the samples in the central zone, Intermediate zone and the peripheral zone, one in each, the most densely populated neighbourhoods of Milan are taken into consideration. Since the selected blocks are a representative of the entire zone, the areas with pure residential zones are selected by using the DUSAF (land use map) layer. Hence, we have the samples in NIL 02,20 and 35.

SAMPLE BLOCK 1 : NIL 02 : BRERA

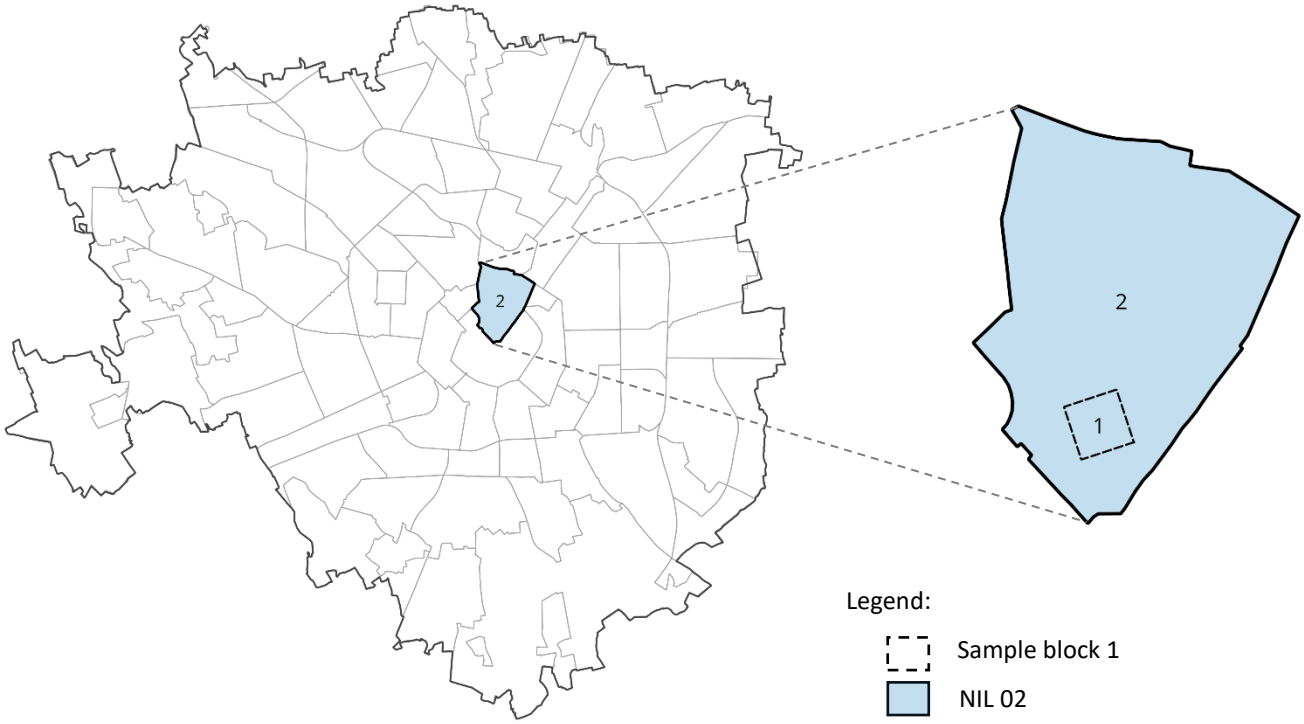


Figure 49. NIL 02 for Sample block 1

Table 5. Social demographic data of NIL 02 (Data Source: Schede di Nuclei di Identita' Locale)

Surface Area	1.6 km. Sq.
Percentage of surface of Milan	0.9%
Housing Density	11.558 ab/km. sq.
Number of families	10.568
Immigrant Population	14.9%
Total Population in 2020	18.492 (1.3% of total in Milan)

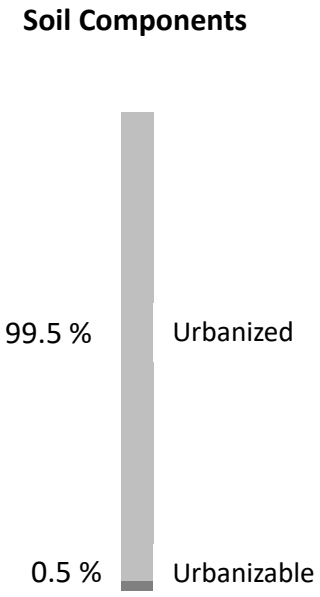


Figure 52. Soil Components NIL 02

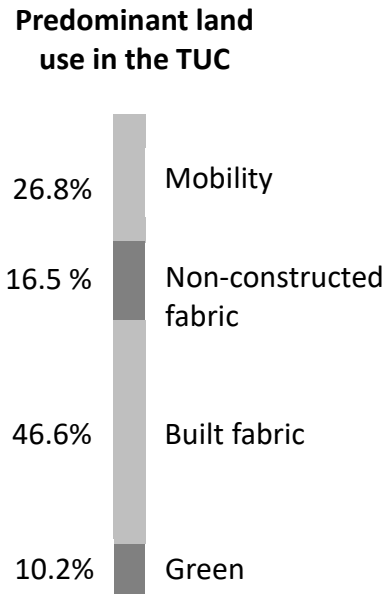


Figure 51. Land use of NIL 02

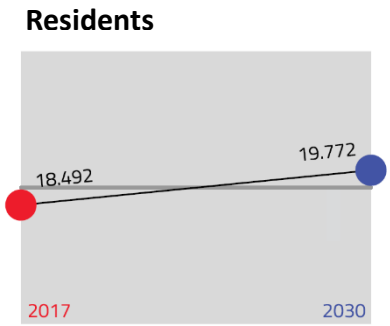


Figure 50. Population graph of NIL 02

The neighbourhood of Brera is densely urbanised with no space for further constructions. It is a very consolidated part of the city.

SAMPLE BLOCK 1 : Basic Statistics

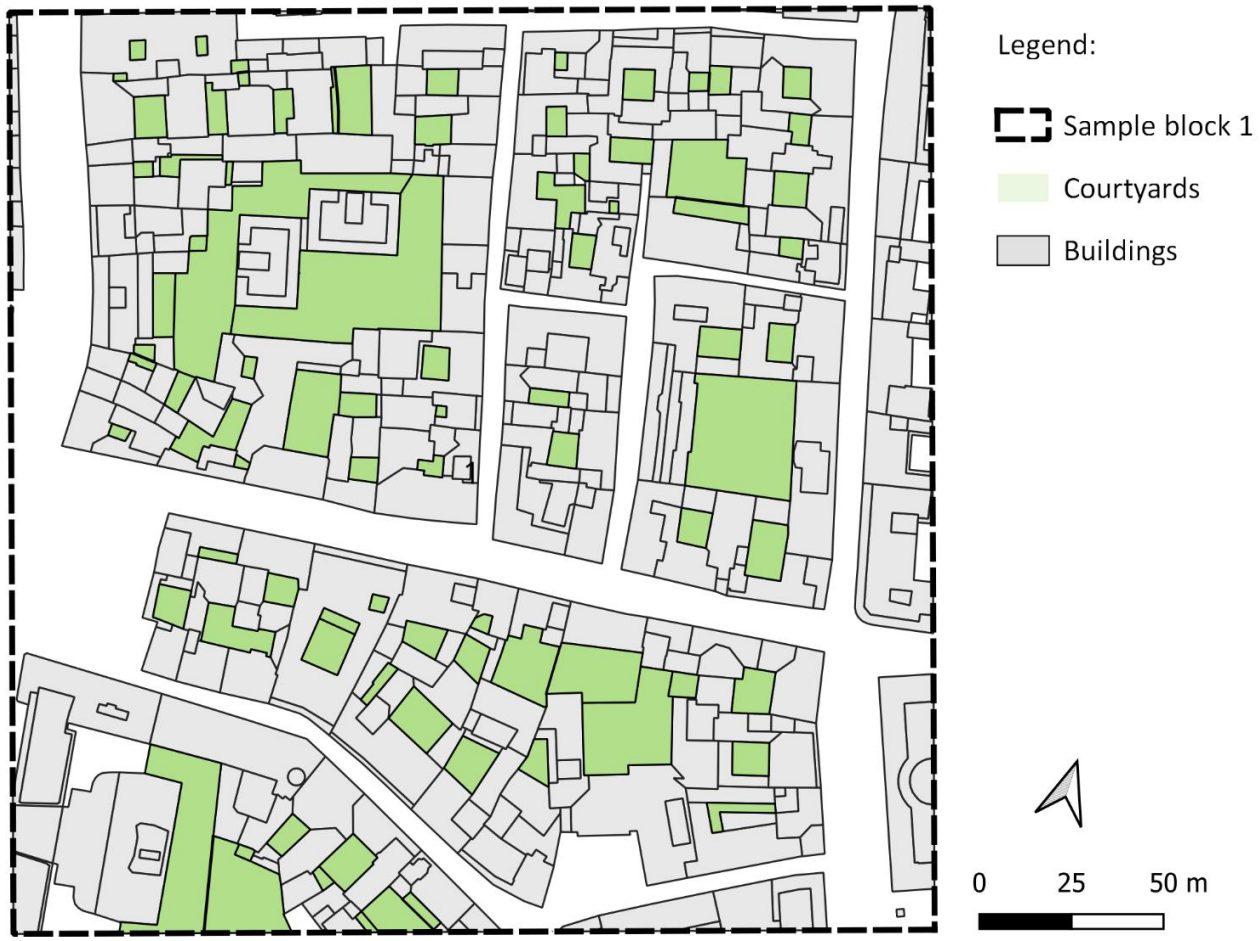


Figure 53. Plan of Sample block 1

Table 6. Basic Statistics of Sample block 1

COURTYARDS	BUILDINGS
Analysed Field : Area	Analysed Field : UN_VOL_AV
Count: 86	Count: 377
Unique values: 86	Unique values: 351
Minimum value: 2.554	Minimum value: 1.0
Maximum value: 1242.704	Maximum value: 36.139
Range: 1240.1499999999999	Range: 35.139
Sum: 9750.666999999998	Sum: 5890.048000000003
Mean value: 113.37984883720928	Mean value: 15.62346949602123
Median value: 61.7395	Median value: 15.593

NOTE : Some errors in the database are manually fixed hence the results might differ if the process is repeated with the original existing database.

SAMPLE BLOCK 1 : Courtyards

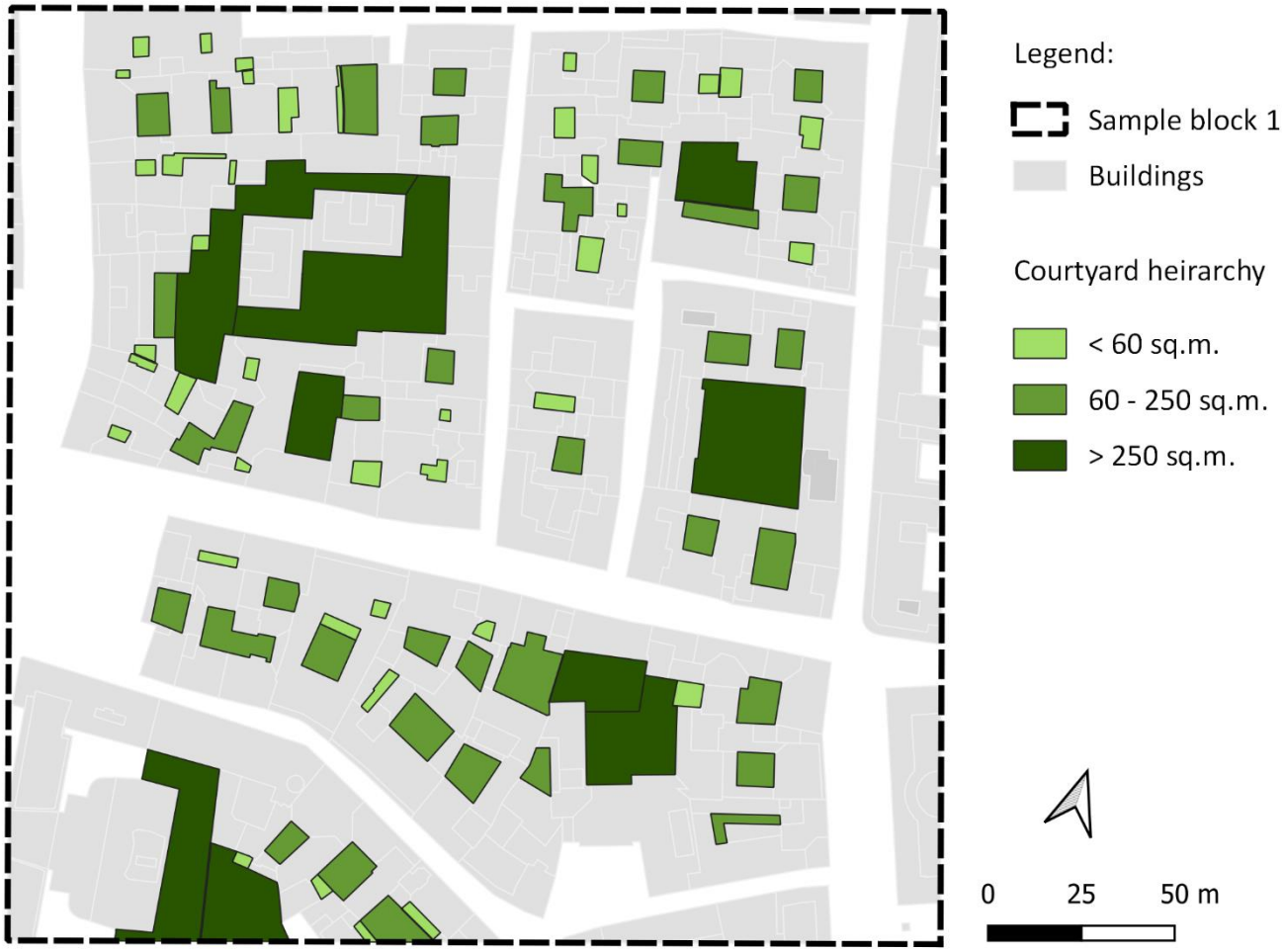


Figure 54. Plan of Sample 1 Courtyards

By observation, the above map of Sample 1 exhibits a diverse range of courtyard sizes with a substantial presence of both small and medium-sized courtyards. The architectural constraints and the demand for urban functionality often lead to the creation of compact yet essential, green spaces within the city center.

The count of the courtyards within this 250m x 250m of sample 1 is as follows:

Table 7. Courtyard Count as per area in Sample 1

Hierarchy	Area (sq. m.)	Count
Small	< 60	41
Medium	60-250	36
Large	>250	9

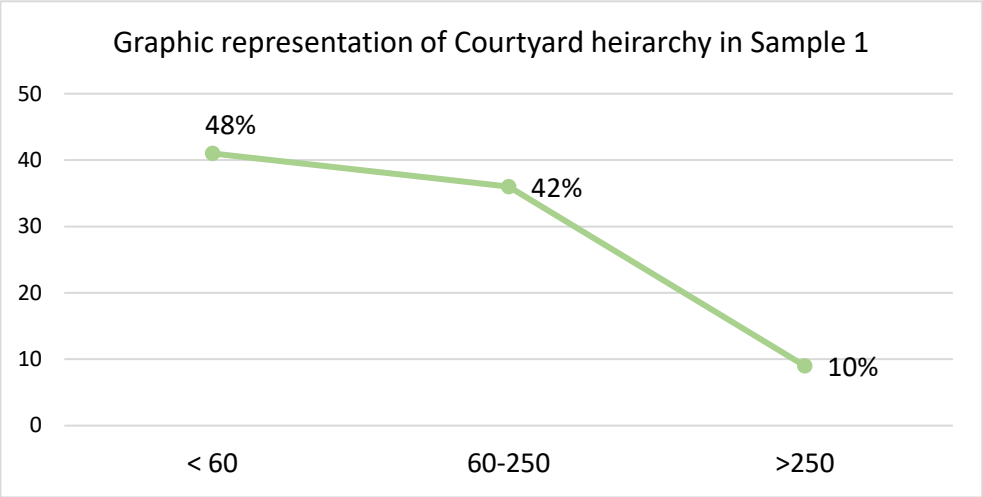


Figure 55. Graph showing courtyard heirarchy in Sample 1

Data Overview:

- There are a total of 86 courtyards in the sample area 1 of 250m x 250m.

Size Categories:

- Small Courtyards (< 60 sq. m.): There are 42 of these which accounts for 46% of the total courtyards in Sample 1.
- Medium Courtyards (60-250 sq. m.): There are 36 of these representing 40% of the total courtyards in Sample 1.
- Large Courtyards (>250 sq. m.): There are 10 of these making up 11% of the total courtyards in Sample 1.

Percentage Analysis:

- Small and medium courtyards together make up a significant portion of the total courtyards in the sample with 86% (46% small + 40% medium) of the courtyards falling into these two categories.
- Large courtyards, on the other hand account for only 11% of the total.

Interpretation:

- The majority of courtyards in the sample area 1 are Small and Medium in size.
- Small courtyards are the most common representing almost half of the sample area.
- From the dataset it is evident that the smaller and medium-sized courtyards are more prevalent compared to large ones.

SAMPLE BLOCK 1 : Buildings

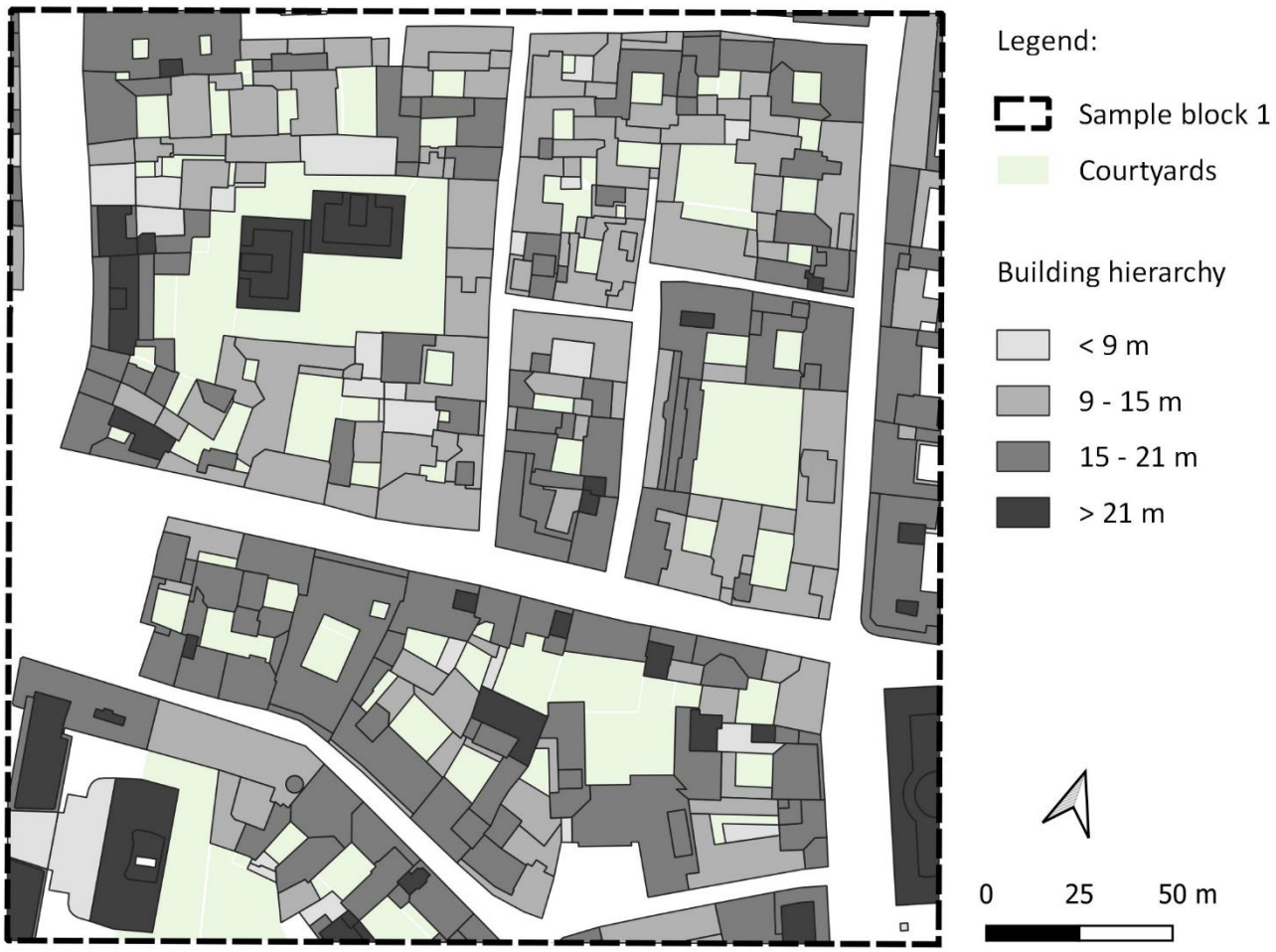


Figure 56. Plan of Sample 1 Buildings

By observation, the above map of buildings in Sample 1 reveals a rich tapestry of buildings featuring a diverse range of sizes. The distribution of buildings reflects the architectural complexities of a densely populated city center and a continuous band of uneven structures with not enough large open spaces in between them.

The count of the buildings within this 250m x 250m of sample 1 is as follows:

Table 8. Building count as per height in Sample 1

Hierarchy	Height (m.)	Count
Short	< 9	32
Medium	9-15	135
Tall	15-21	165
Very Tall	> 21	44

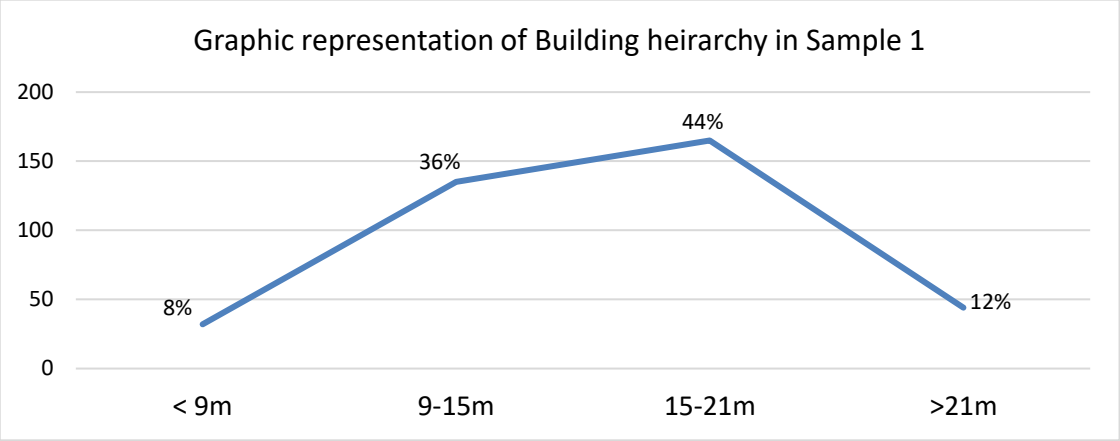


Figure 57. Graph showing Building heirarchy in Sample 1

Data Overview:

- Sample 1 in the central zone of Milan consists of a total of 377 buildings.

Height Categories:

- Short buildings (<9m): There are 32 buildings in this category which accounts for 8% of the total buildings in Sample 1.
- Medium buildings (9-15m): There are 135 buildings in this category representing 36% of the total in Sample 1.
- Tall buildings (15-21m): There are 165 buildings in this category making up 44% of the total in Sample 1.
- Very tall buildings (>21m): There are 44 buildings in this category accounting for 12% of the total in Sample 1.

Percentage Analysis:

- The distribution of buildings in Sample 1 indicates that the majority of buildings fall within the medium and tall height categories (36% and 44% respectively).
- The concentration of buildings in the medium and tall categories suggests a balanced mixture of urban architectural styles and spatial planning within the central zone of Milan.

Interpretation:

- The significant presence of medium and tall buildings is characteristic of central urban areas where there's a mix of residential and commercial structures.
- The relatively lower representation of short buildings might be due to the limited space and the desire to maximize land use efficiency in the city center.

SAMPLE BLOCK 2 : NIL 20 : LORETO, CASORETTO, NOLO

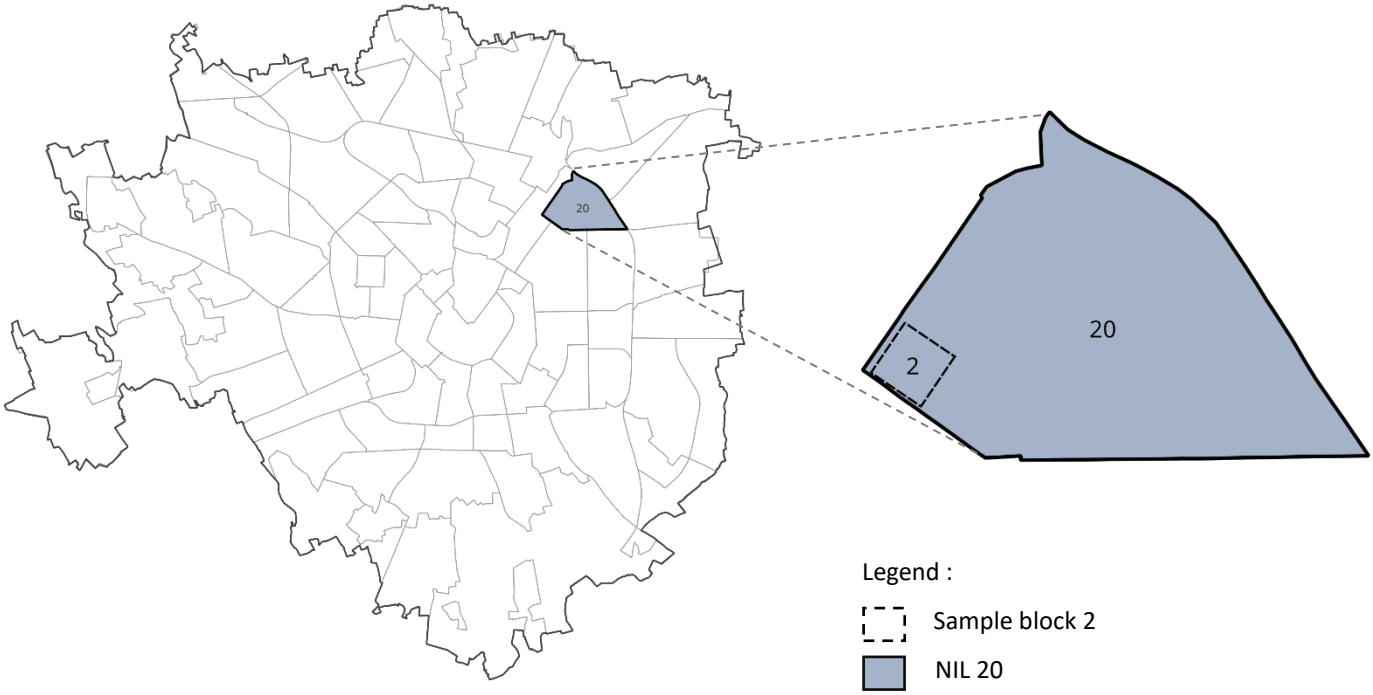


Figure 58. NIL 20 for Sample block 2

Table 9. Social demographic data of NIL 20 (Data Source: Schede di Nuclei di Identita' Locale)

Surface Area	1.7 km. Sq.
Percentage of surface of Milan	1.0 %
Housing Density	26.219 ab/km. sq.
Number of families	26.833
Immigrant Population	33.4 %
Total Population in 2020	44.572 (3.2 % of total in Milan)

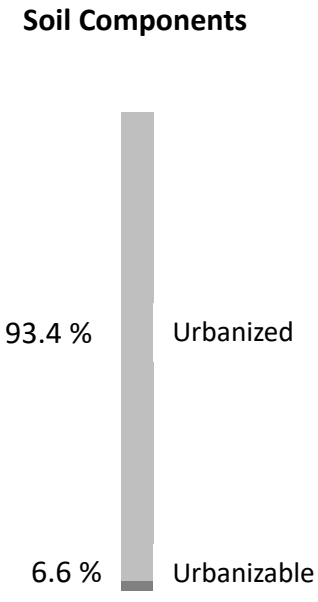


Figure 60. Soil components NIL 20

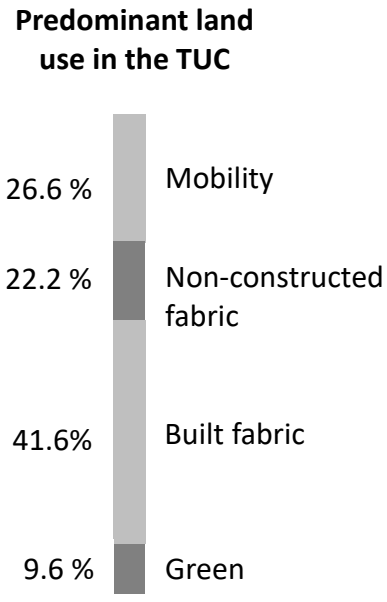


Figure 59. Land use of NIL 20

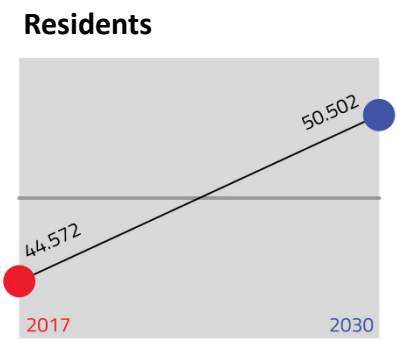


Figure 61. Population graph of NIL 20

The neighbourhood of Loreto is densely urbanised. It is known for its excellent transport connections and vibrant commercial offerings.

SAMPLE BLOCK 2 : Basic Statistics

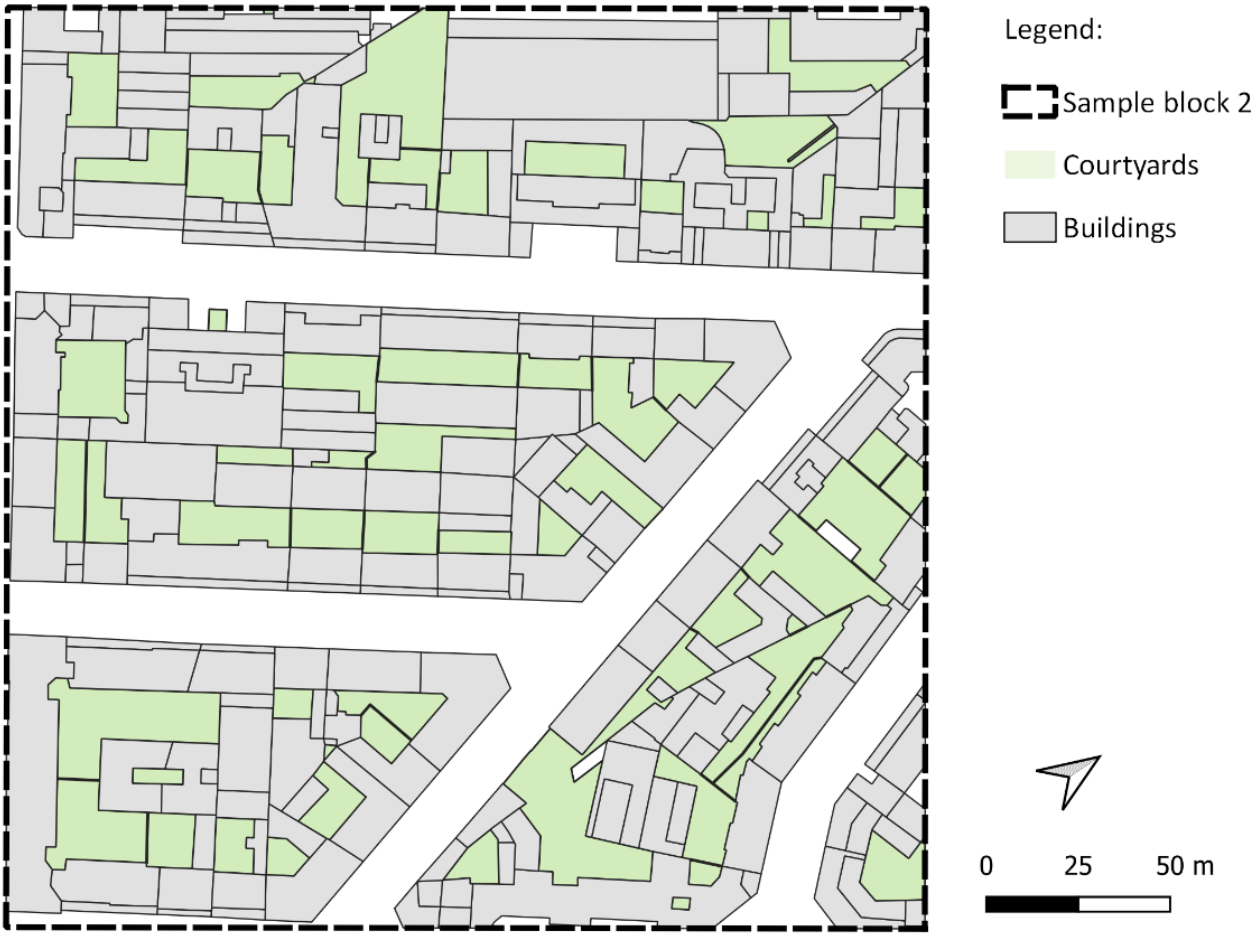


Figure 62. Plan of Sample block 2

Table 10. Basic Statistics of Sample block 2

COURTYARDS	BUILDINGS
Analysed Field : Area	Analysed Field : UN_VOL_AV
Count: 60	Count: 238
Unique values: 60	Unique values: 209
Minimum value: 4.480	Minimum value: 1.616
Maximum value: 1036.901	Maximum value: 33.901
Range: 1036.699	Range: 32.285000000000004
Sum: 13762.084000000003	Sum: 3696.782999999998
Mean value: 229.36806666666672	Mean value: 15.532701680672261
Median value: 194.0605	Median value: 16.79

NOTE : Some errors in the database are manually fixed hence the results might differ if the process is repeated with the original existing database.

SAMPLE BLOCK 2 : Courtyards

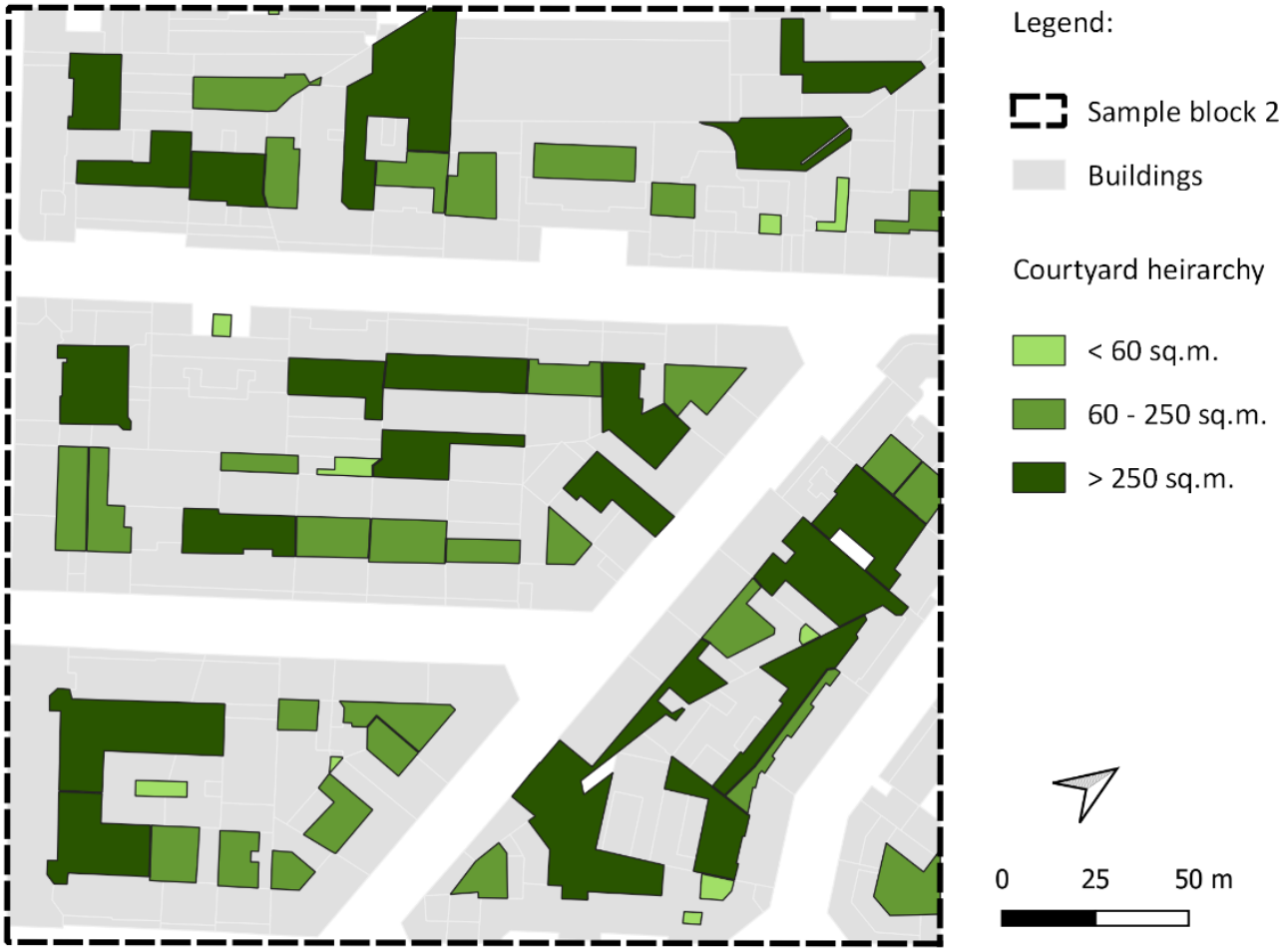


Figure 63. Plan of Sample 2 Courtyards

By observation, the above map of Sample 2 exhibits a significant representation of more balanced and medium-sized courtyards. This balance suggests an architectural compromise that caters to the transition from the city center's spatial constraints to the more spacious designs found in the peripheral areas.

The count of the courtyards within this 250m x 250m of sample 2 is as follows:

Table 11. Courtyard Count as per area in Sample 2

Hierarchy	Area (sq. m.)	Count
Small	< 60	11
Medium	60-250	29
Large	>250	20

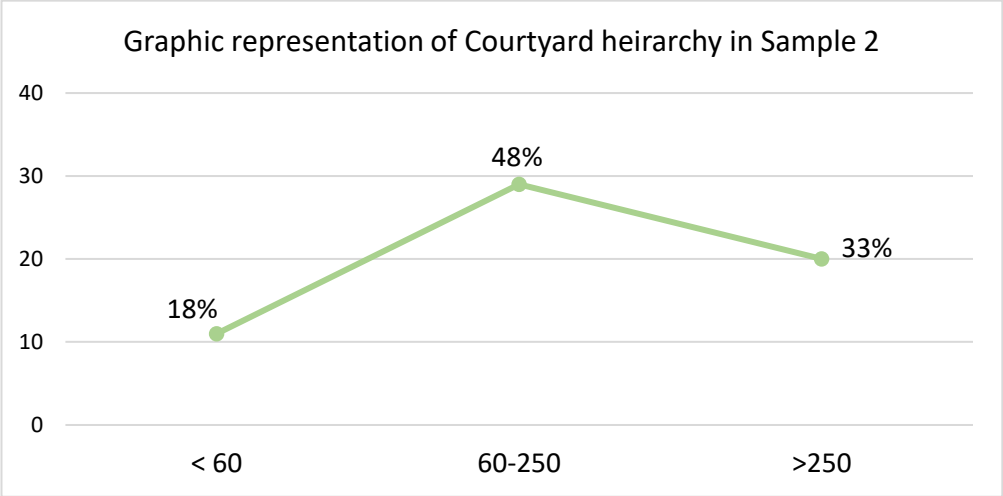


Figure 64. Graph showing Courtyard heirarchy in Sample 2

Data Overview:

- There are a total of 60 courtyards in the sample area 2 of 250m x 250m.

Size Categories:

- Small Courtyards (< 60 sq. m.): There are 11 of these accounting for 18% of the total courtyards in Sample 2.
- Medium Courtyards (60-250 sq. m.): There are 29 of these representing 48% of the total courtyards in Sample 2.
- Large Courtyards (>250 sq. m.): There are 20 of these making up 33% of the total courtyards in Sample 2.

Percentage Analysis:

- Medium-sized courtyards (60-250 sq. m.) are the most common in this sample with nearly half (48%) of the courtyards falling into this category.
- Large courtyards (>250 sq. m.) account for 33% of the total while small courtyards (< 60 sq. m.) make up 18%.

Interpretation:

- Unlike in Sample 1, Sample 2 has a higher percentage of medium-sized courtyards compared to both small and large courtyards.
- The distribution in this sample suggests that medium-sized courtyards are the most common followed by large courtyards, with small courtyards being the least common.

SAMPLE BLOCK 2 : Buildings

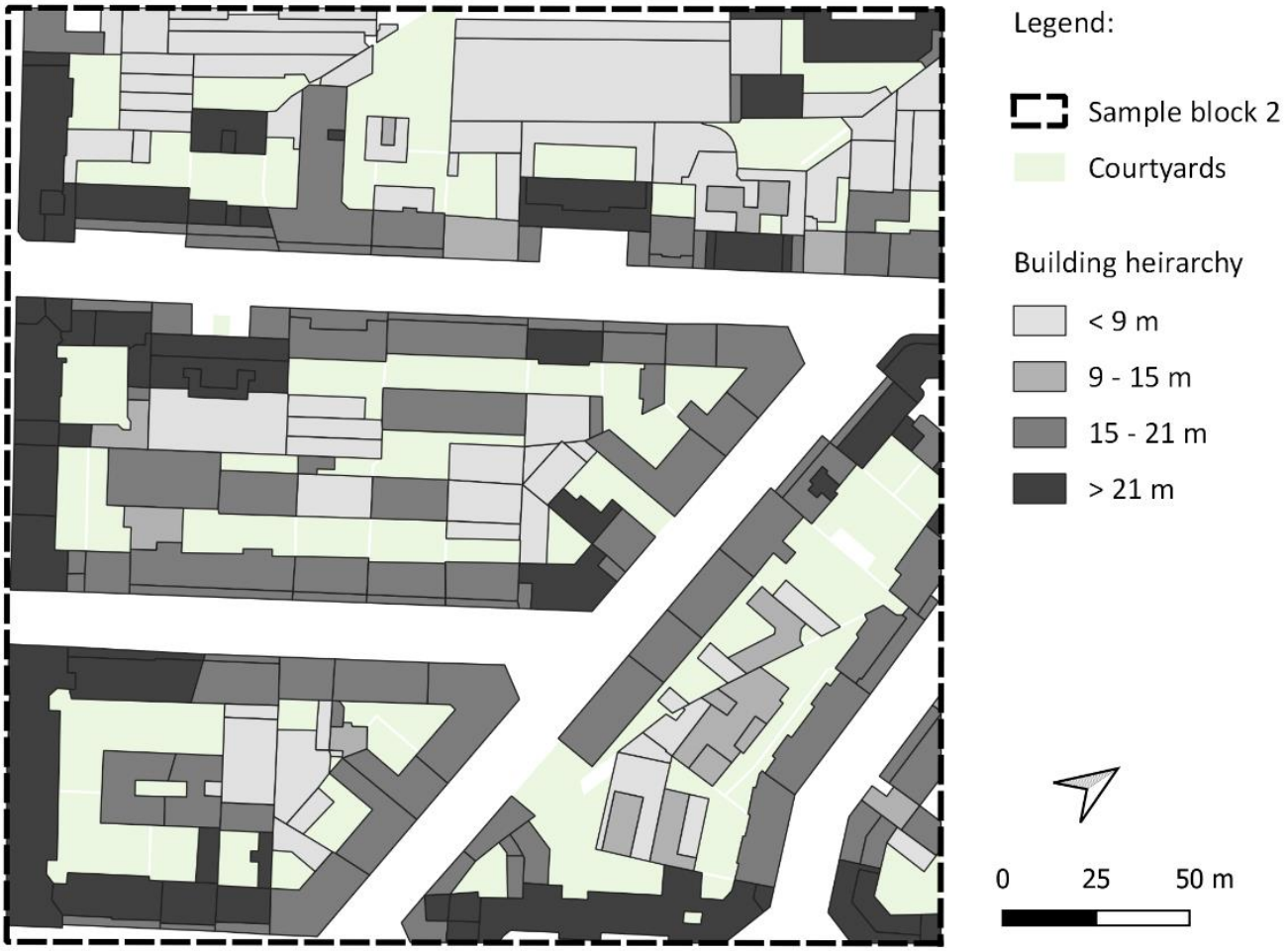


Figure 65. Plan of Sample 2 Buildings

The plan illustrates a balanced mixture of building heights, indicative of a zone that transitions between the city center and the periphery. Medium density of buildings create a suburban ambiance. The distribution of buildings in this zone is versatile, accommodating residential and commercial areas to balance the needs of the residents and businesses in this intermediate area.

The count of the buildings within this 250m x 250m of sample 2 is as follows:

Table 12. Building count as per height in Sample 2

Hierarchy	Height (m.)	Count
Short	< 9	66
Medium	9-15	16
Tall	15-21	97
Very Tall	> 21	59

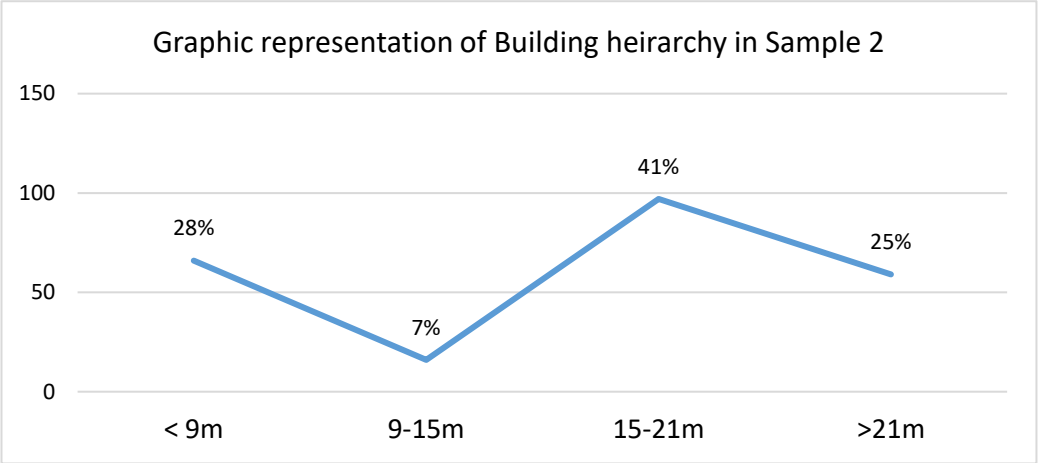


Figure 66. Graph showing Building heirarchy in Sample 2

Data Overview:

- Sample 2 in the intermediate zone of Milan consists of a total of 238 buildings.

Height Categories:

- Short buildings (<9m): There are 66 buildings in this category which accounts for 28% of the total buildings in Sample 2.
- Medium buildings (9-15m): There are 16 buildings in this category representing 7% of the total buildings in Sample 2.
- Tall buildings (15-21m): There are 97 buildings in this category making up 41% of the total buildings in Sample 2.
- Very tall buildings (>21m): There are 59 buildings in this category accounting for 25% of the total buildings in Sample 2.

Percentage Analysis:

- The distribution of buildings in Sample 2 indicates that the majority of buildings are concentrated in the height category of 15-21m which represents 41% of the total.
- Short buildings and very tall buildings each have a significant presence accounting for 28% and 25% respectively.
- The smallest portion of the sample is comprised of medium buildings at 7%.

Interpretation:

- Sample 2, in the intermediate zone of Milan, shows a more balanced distribution of building heights compared to the city center (Sample 1).
- The substantial representation of buildings in the 15-21m and >21m categories indicates a mix of both medium-rise and tall structures suggesting a dynamic urban environment with varied architectural styles.
- The presence of short buildings (<9m) suggests the inclusion of low-rise structures which can be associated with residential and commercial areas.

Sample 3 : NIL 35 : LODI, CORVETTO

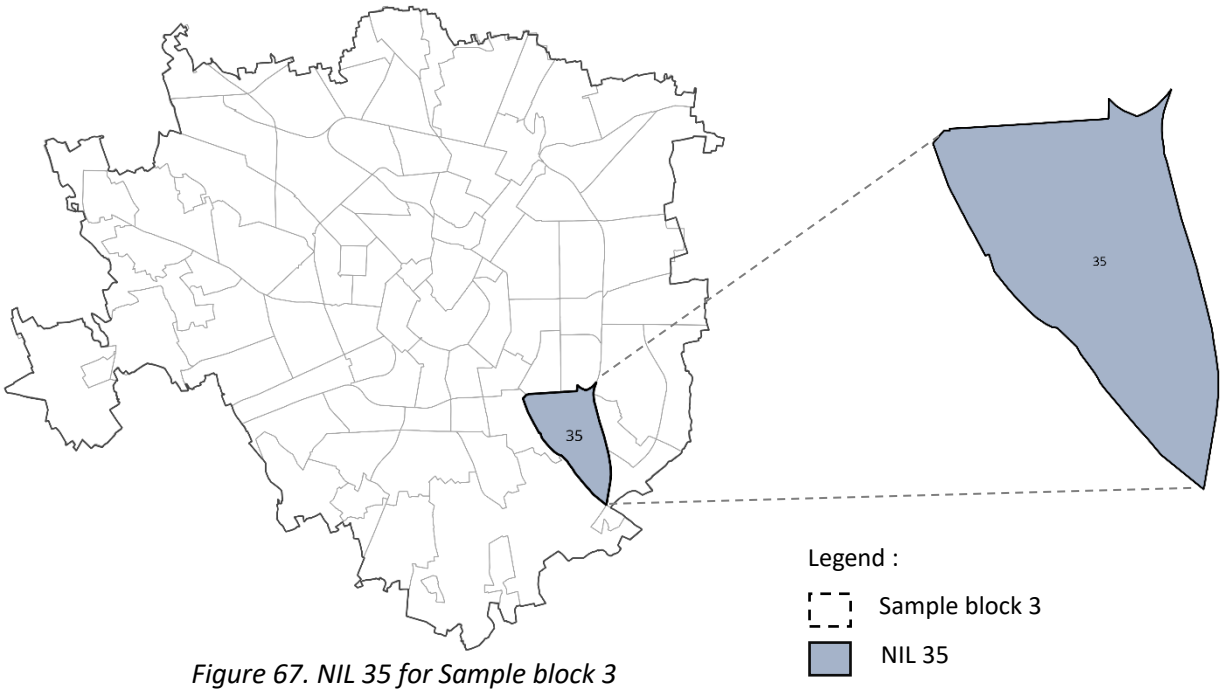


Figure 67. NIL 35 for Sample block 3

Table 13. Social demographic data of NIL 35 (Data Source: Schede di Nuclei di Identita' Locale)

Surface Area	3.6 km. Sq.
Percentage of surface of Milan	2.0 %
Housing Density	10.036 ab/km. sq.
Number of families	19.980
Immigrant Population	27.0%
Total Population in 2020	36.129 (2.6 % of total in Milan)

Soil Components

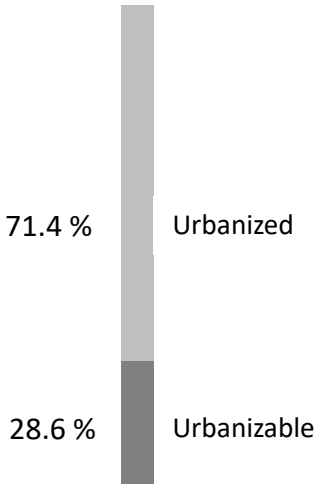


Figure 70. Soil Components NIL 35

Predominant land use in the TUC

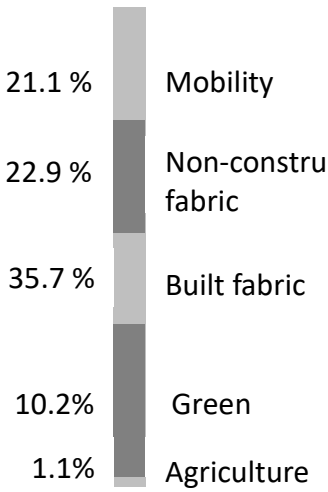


Figure 69. Land use of NIL 35

Residents

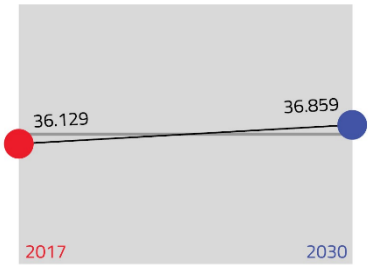


Figure 68. Population graph of NIL 35

The neighbourhood of Lodi, Corvetto is an evolving urban area with commercial and residential spaces having a blend of community living and modernity.

SAMPLE BLOCK 3 : Basic Statistics

Figure 71. Plan of Sample block 3

Table 14. Basic Statistics of Sample Block 3

COURTYARDS	BUILDINGS
Analysed Field : Area	Analysed Field : UN_VOL_AV
Count: 18	Count: 86
Unique values: 18	Unique values: 70
Minimum value: 90.149	Minimum value: 1.0
Maximum value: 2364.782	Maximum value: 21.651
Range: 2274.6330000000003	Range: 20.651
Sum: 15049.257000000001	Sum: 1276.3119999999997
Mean value: 836.0698333333335	Mean value: 14.840837209302322
Median value: 843.9535	Median value: 15.84

NOTE : Some errors in the database are manually fixed hence the results might differ if the process is repeated with the original existing database.

SAMPLE BLOCK 3 : Courtyards

Figure 72. Plan of Sample 3 Courtyards

By observation, the above map of Sample 3 exhibits a intriguing trend with an overwhelming majority of large courtyards while small courtyards are notably absent. This highlights a preference for generous green spaces and aligns with the more residential and suburban nature of the peripheral zone.

The count of the courtyards within this 250m x 250m of sample 3 is as follows:

Table 15. Courtyard count as per area in Sample 3

Hierarchy	Area (sq. m.)	Count
Small	< 60	0
Medium	60-250	3
Large	>250	15

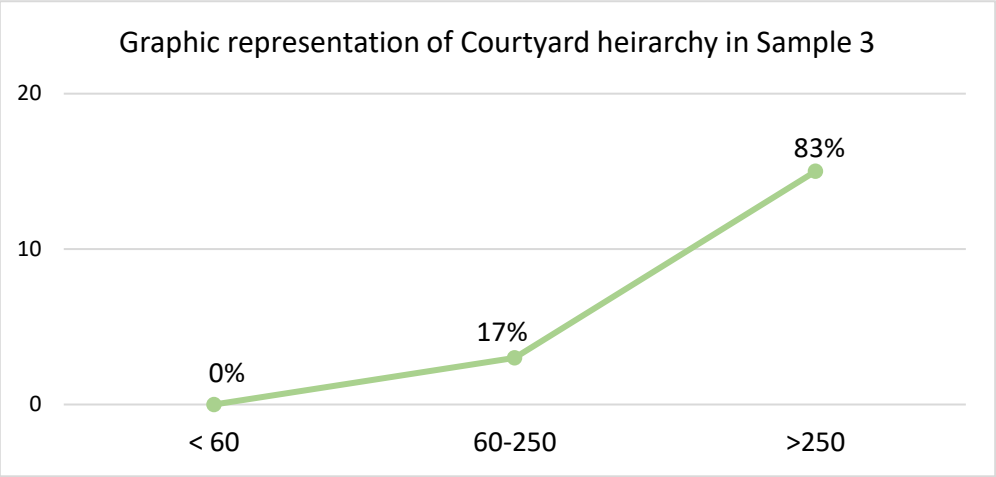


Figure 73. Graph showing Courtyard heirarchy in Sample 3

Data Overview:

- There are a total of 18 courtyards in the sample area 3 of 250m x 250m..

Size Categories:

- Small Courtyards (< 60 sq. m.): There are no courtyards in this size category resulting in 0%.
- Medium Courtyards (60-250 sq. m.): There are 3 courtyards in this category accounting for 17% of the total courtyards in Sample 3.
- Large Courtyards (>250 sq. m.): There are 15 courtyards in this category making up 83% of the total courtyards in Sample 3

Percentage Analysis:

- In Sample 3, large courtyards (>250 sq. m.) are the most prevalent representing a significant majority at 83%.
- Medium-sized courtyards (60-250 sq. m.) are the second most common making up 17% of the total.
- Small courtyards (< 60 sq. m.) are not present in this sample.

Interpretation:

- Sample 3 has a distinct distribution, with the overwhelming majority of courtyards being large and no small courtyards in the dataset.
- This indicates a very different pattern compared to both Sample 1 and Sample 2.

SAMPLE BLOCK 3 : Buildings

Figure 74. Plan of Sample 3 Buildings

The plan highlights the dominance of large open spaces with scattered residential areas, complementing the suburban and residential nature of this zone. There is a preference for medium-rise residential structures demonstrating the significance of land use efficiency and residential comfort in the peripheral areas of Milan.

The count of the buildings within this 250m x 250m of sample 3 is as follows:

Table 16. Building count as per height in Sample 3

Hierarchy	Height (m.)	Count
Short	< 9	16
Medium	9-15	5
Tall	15-21	62
Very Tall	> 21	3

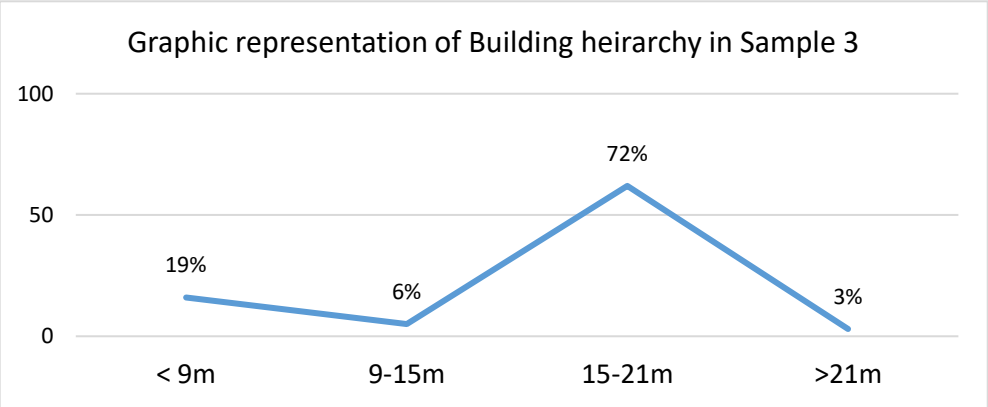


Figure 75. Graph showing Building heirarchy in Sample 3

Data Overview:

- Sample 3 in the peripheral zone of Milan consists of a total of 86 buildings.

Height Categories:

- Short buildings (<9m): There are 16 buildings in this category which accounts for 19% of the total buildings.
- Medium buildings (9-15m): There are 5 buildings in this category representing 6% of the total.
- Tall buildings (15-21m): There are 62 buildings in this category making up a significant 72% of the total.
- Very tall buildings (>21m): There are 3 buildings in this category accounting for 3% of the total.

Percentage Analysis:

- The distribution of buildings in Sample 3 highlights that the majority of buildings fall within the height category of 15-21m representing 72% of the total.
- Short buildings (<9m) also have a notable presence making up 19% of the sample.
- Medium buildings (9-15m) account for a relatively small portion at 6%.
- The category of very tall buildings (>21m) is the least represented at 3%.

Interpretation:

- Sample 3, situated in the peripheral zone of Milan demonstrates a distinct distribution of building heights.
- The significant concentration of buildings in the 15-21m category suggests a preference for medium-rise structures in this zone.
- The limited representation of medium buildings and very tall buildings suggests a focus on a specific height range that aligns with the residential and suburban nature of the peripheral zone.

COMPARISON OF THE THREE SAMPLE AREAS

1. COURTYARDS:

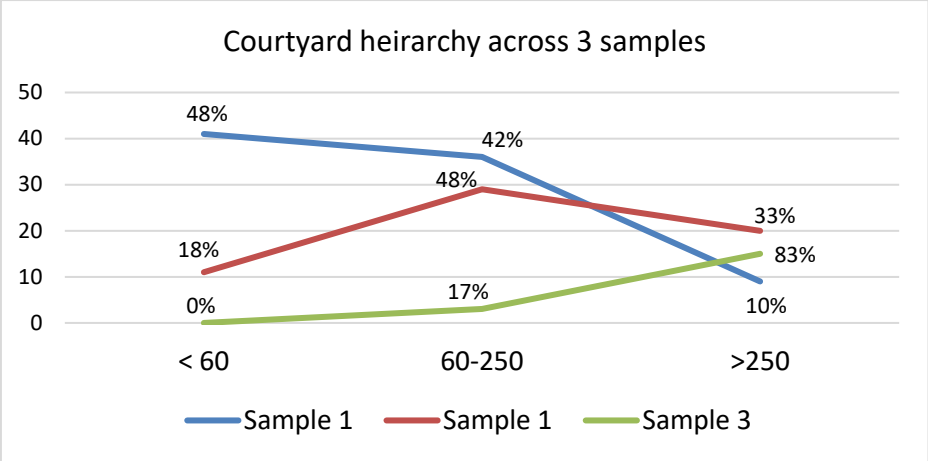


Figure 76. Graph showing variation in courtyard areas of the 3 samples.

Trends observed in courtyards from the city center to the peripheral area:

- In the city center, where space is at a premium there is a diverse mix of small and medium-sized courtyards reflecting the need for efficient use of available space in densely populated urban areas.
- In the intermediate zone a balance between urban and suburban characteristics is evident with a more even distribution of medium-sized courtyards. This suggests a transition zone where the architectural and spatial preferences accommodate a broader range of courtyard sizes.
- In the peripheral area the trend shifts towards larger courtyards with an emphasis on spacious and potentially recreational spaces. This likely aligns with the more residential and less densely populated nature of the peripheral zone where residents may have more space to allocate to larger courtyards.
- The number of courtyards decrease as we move from the center to the periphery.

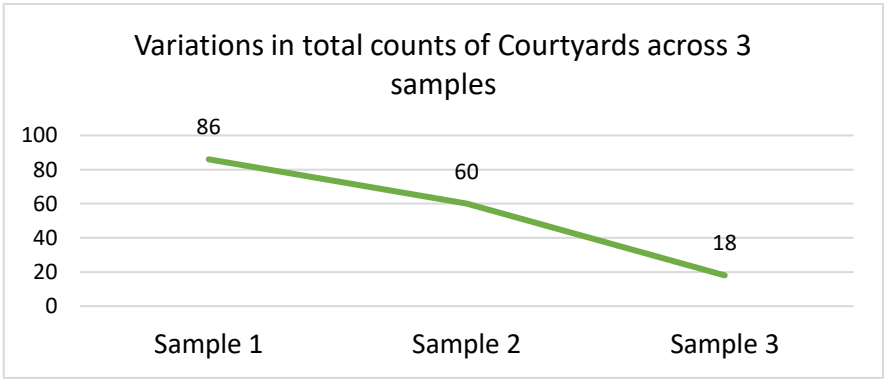
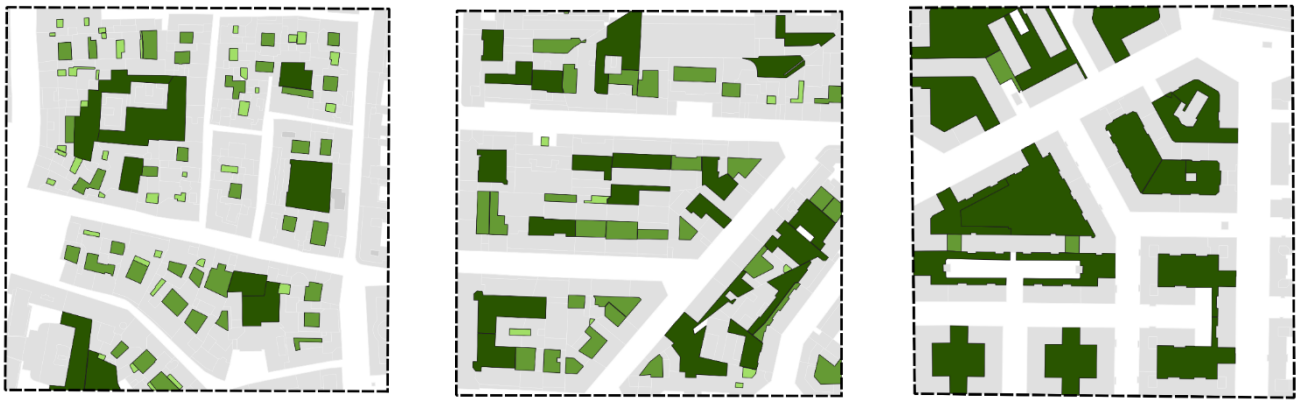


Figure 77. Graph showing variation in total courtyard count of the 3 samples.



SAMPLE 1 SAMPLE 2 SAMPLE 3

Figure 78. Courtyards across the 3 samples

City Center (Sample 1):

- In the city center, Sample 1, there is a relatively higher number of courtyards (86) reflecting the densely populated and urban nature of this area.
- The distribution of courtyard sizes in this sample is diverse, with a notable presence of small and medium-sized courtyards (46% and 40%, respectively). This diversity could be attributed to architectural constraints and the need for the efficient space utilization in a densely built environment.

Intermediate Zone (Sample 2):

- In the intermediate zone, Sample 2, there is a moderate number of courtyards (60) suggesting a blend of urban and suburban characteristics.
- The distribution of courtyard sizes in this sample is relatively balanced with a significant representation of medium-sized courtyards (48%). This balance indicates a mix of urban and residential spaces possibly reflecting the transition from the city center to the peripheral area.

Peripheral Zone (Sample 3):

- In the peripheral zone, Sample 3, there are fewer courtyards (18) which aligns with the lower population density and more residential nature of this area.
- The distribution of courtyard sizes in this sample is distinct with an overwhelming majority of large courtyards (83%). The absence of small courtyards suggests a preference for more spacious and potentially recreational courtyards in the peripheral zone.

2. BUILDINGS:

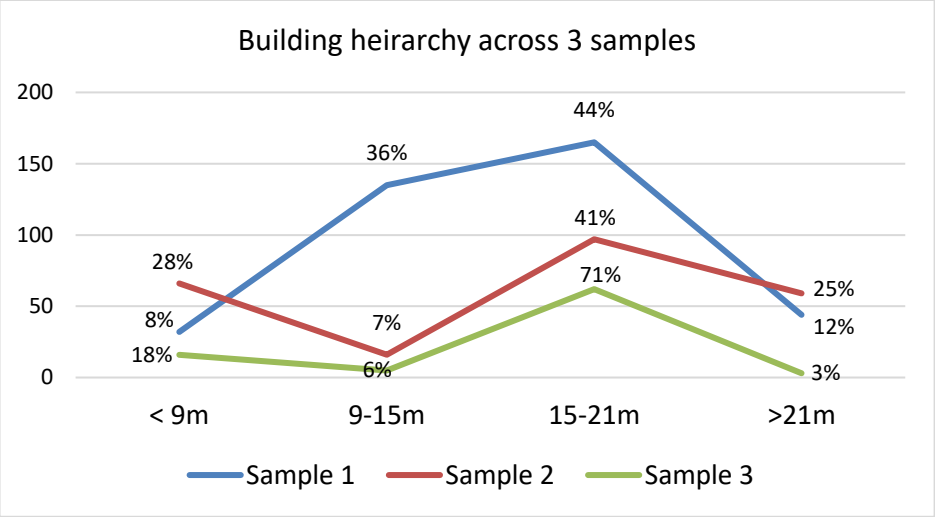


Figure 79. Graph showing variation in Building height of the 3 samples.

Trends observed in buildings from the city center to the peripheral area:

- In the city center, the trend is marked by architectural diversity, where a mix of short, medium, tall and very tall buildings coexists, contributing to a vibrant and iconic urban landscape.
- In the intermediate zone, there is a balanced distribution of medium and tall buildings, demonstrating the transitional nature of this zone, which harmonizes elements of both the city center and the periphery.
- In the peripheral zone, there is a strong preference for medium-rise structures, creating a suburban atmosphere with an emphasis on residential comfort and space efficiency. Very tall buildings are less prominent in this area.
- The number of buildings decrease as we move from the center to the periphery.

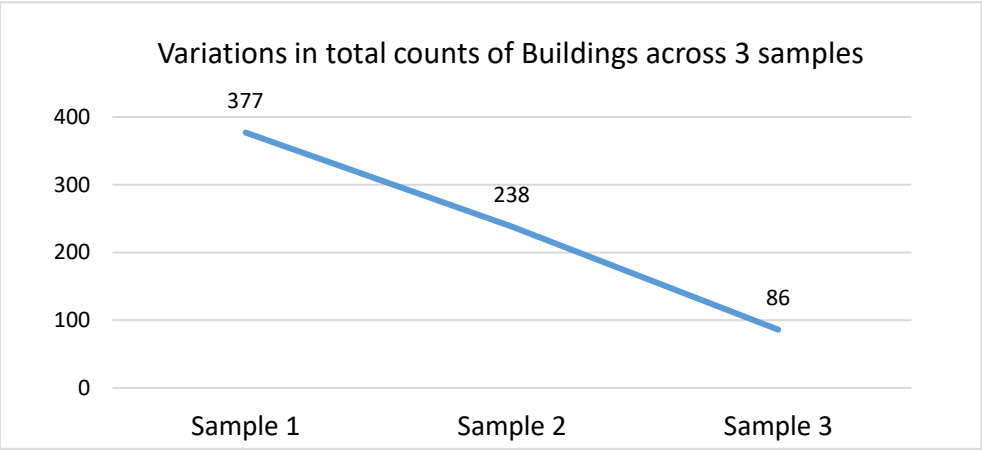
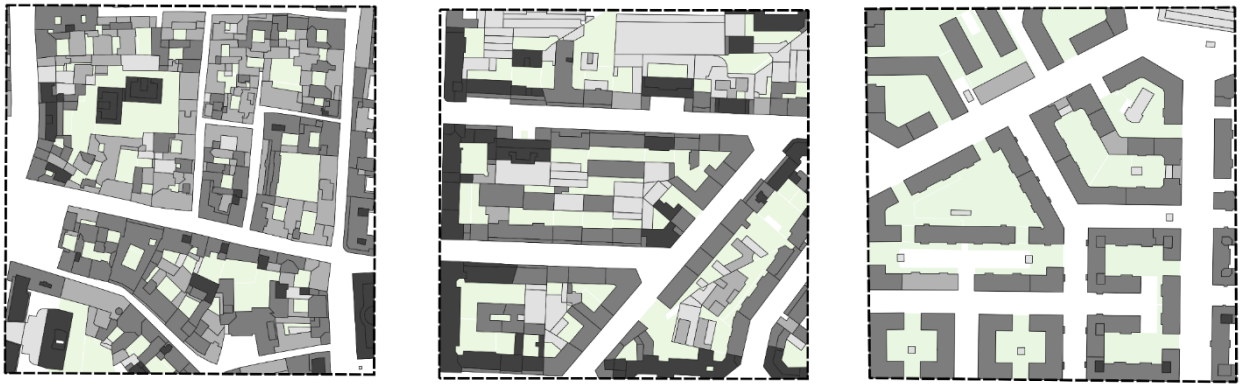


Figure 80. Graph showing variation in total Building count of the 3 samples.



SAMPLE 1 SAMPLE 2 SAMPLE 3

Figure 81. Buildings across the 3 samples.

City Center (Sample 1):

- In the city center, Sample 1, there's a multifaceted mix of building heights reflective of a densely populated and diverse urban environment.
- The distribution of buildings demonstrates an equilibrium between short, medium, tall and very tall structures reflecting the architectural complexities of a bustling central zone.
- This trend underscores the city center's role as a dynamic hub where historical landmarks, modern skyscrapers and lower-rise buildings coexist harmoniously.

Intermediate Zone (Sample 2):

- In the intermediate zone, Sample 2, the distribution of building heights shows a balanced blend of medium and tall buildings, indicating a transition from the city center to the suburban outskirts.
- Medium-rise buildings are predominant, reflecting a versatile urban environment that accommodates both residential and commercial structures.
- This balance emphasizes the intermediate zone's role in bridging the architectural styles and functions of the central and peripheral areas.

Peripheral Zone (Sample 3):

- In the peripheral zone, Sample 3, a distinct preference for medium-rise structures is evident, symbolizing a tranquil suburban atmosphere.
- The significant concentration of buildings in the 15-21m height category illustrates a focus on efficient land use and residential comfort.
- Very tall buildings are notably rare, aligning with the suburban and residential nature of the peripheral areas.

4.4. Social Analysis

Survey Questionnaire and Analysis

A survey on 'The Ecological and Social Value of Urban Courtyards in Milan' was conducted through a questionnaire. The data was collected anonymously. The respondents were the domiciled people of Milan including the people from municipalities as well.

The questionnaire consists of 19 questions, divided into 3 sections such as the General Information, Courtyards in Milan and the Transformation Scenarios.

The first section is more about the general information of the respondents like the age group of the people who have answered the survey, their gender, their location in terms of the zone and the district of Milan.

The second section is focused on the survey of general information about the courtyards of Milano like the type of houses, presence of courtyards, location with respect to the house, current functions, utilization, presence of greenery, etc.

In the third section the respondents were asked to imagine a transformation scenario of their courtyard and give their opinions with respect to: possible interventions to be implemented, priorities to be followed and the possible problems. While expressing their opinions, the respondents were asked to keep in mind the actual characteristics of their courtyard like the size, current state, etc while not limiting their imagination.

In the questionnaire reference is made to the administrative division into 88 neighbourhoods and 9 zones in Milan. So, for a deeper analysis of the survey, some of the responses are more deeply analysed by categorising them into two parts, one comprising of the central zone and the other part comprising of all the other 8 zones of Milan. By this distinction, a better idea of the differences in the responses of the respondents from central area vs the peripheral area of Milan is analysed.

SECTION 1 – GENERAL INFORMATION

Q1. In which district of Milan do you live?

1 - Centro storico

2 - Stazione Centrale, Gorla, Turro, Greco, Crescenzago

3 - Città Studi, Lambrate, Venezia

4 - Vittoria, Forlanini

5 - Vigentino, Chiaravalle, Gratosoglio

6 - Barona, Lorenteggio

7 - Baggio, De Angeli, San Siro

8 - Fiera, Gallaratese, Quarto Oggiaro

9 - Stazione Garibaldi, Niguarda

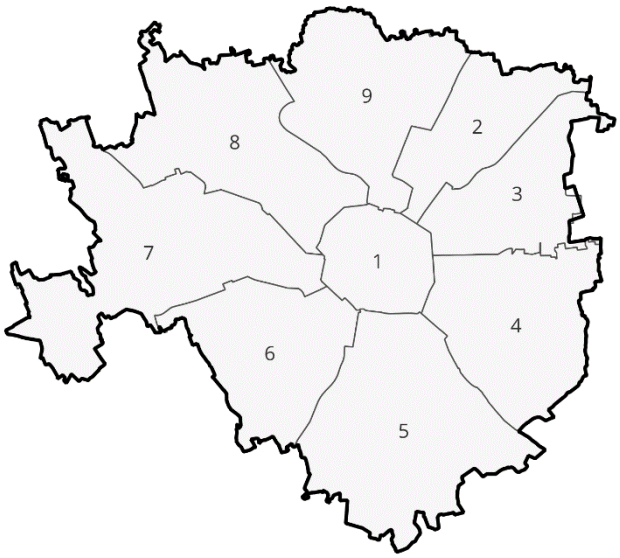


Figure 82. Districts of Milan

A17.

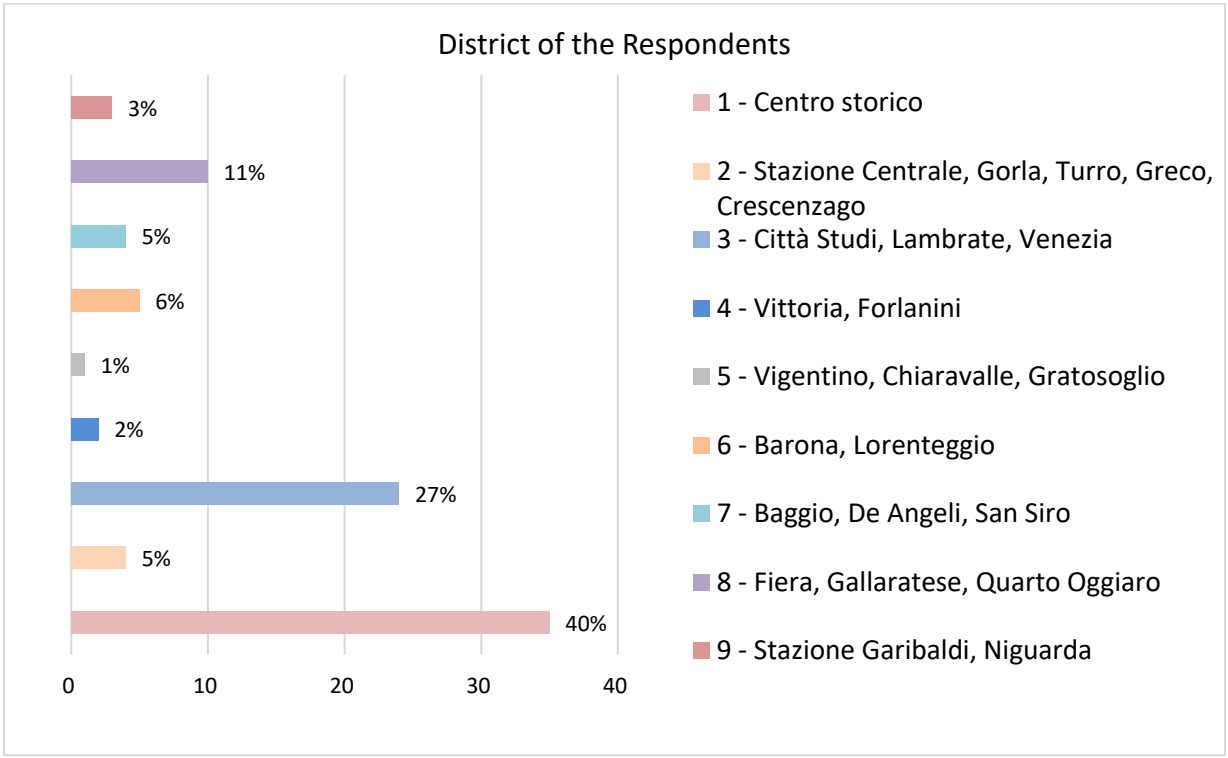


Figure 83. A Bar graph depicting the percentage of respondents in each district.

From here on the distinction between the center and the other neighbourhoods is kept for comparing the trends between the central zone and the peripheral. Also, no distinction is kept between the nine neighbourhoods but just between the center and the rest of the other zones because of the lack of data.

The further analysis between the distinction of the number of respondents from the central zone of Milan and the rest of the other zones of Milan are as follows:

A1.1

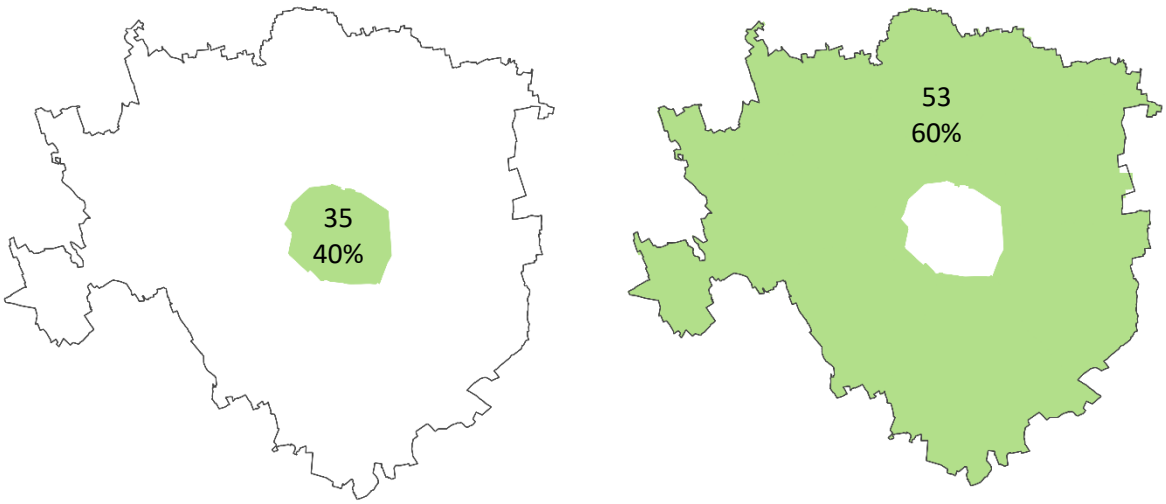


Figure 84. Map depicting the percentage of respondents in the central zone vs other zones.

Analysis:

- The number of people who answered the survey from the central zone of Milan are 35, which is 40% of the total number of respondents.

- The number of people who answered the survey from the other zones of Milan (excluding the central zone) are 53, which is 60% of the total number of respondents.

Q2. What is your age?

a. 18-25
b. 26-35
c. 36-50
d. 50-65
e. >65

A2.

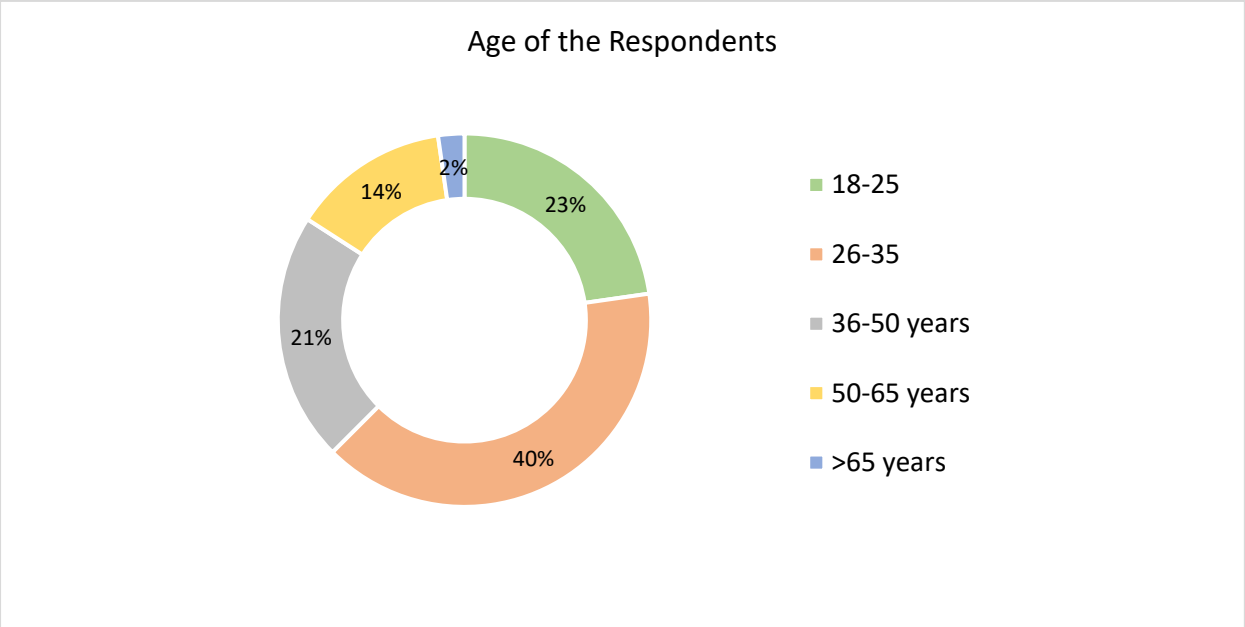


Figure 85. Pie chart depicting the percentage of respondents in each age group

.

Analysis:

The respondents are from a relatively diverse age group with a fairly even distribution between the categories of all the ages. Most of the respondents, almost 40% of the total people who responded, fall in the 26-35 age group followed by the 18-25 age group.

Q3. What gender do you identify with?

a. Male
b. Female
c. Non-binary
d. Prefer not to say

A3.

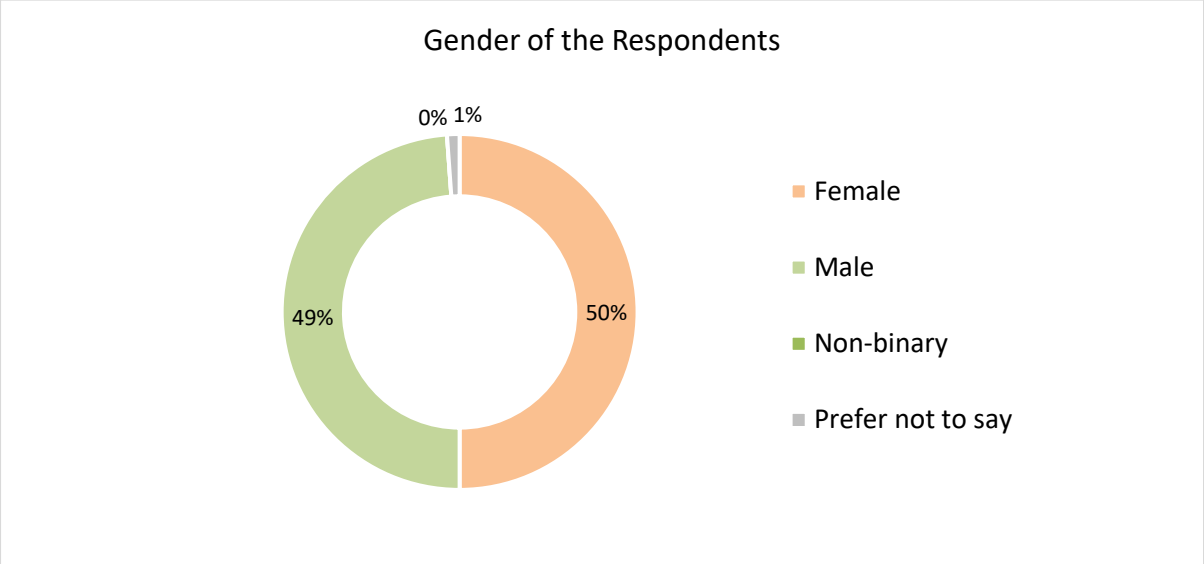


Figure 86. Pie chart depicting the gender of respondents in percentage.

Analysis:

The respondents are diverse, showing nearly an equal split between the male and female respondents where 44 of them identified themselves as female and 43 as male.

SECTION 2 – COURTYARDS IN MILAN

Q4. What type of housing do you live in?

a. Single-family house
b. Duplex house
c. Apartment in a residential building
d. Other

A4.

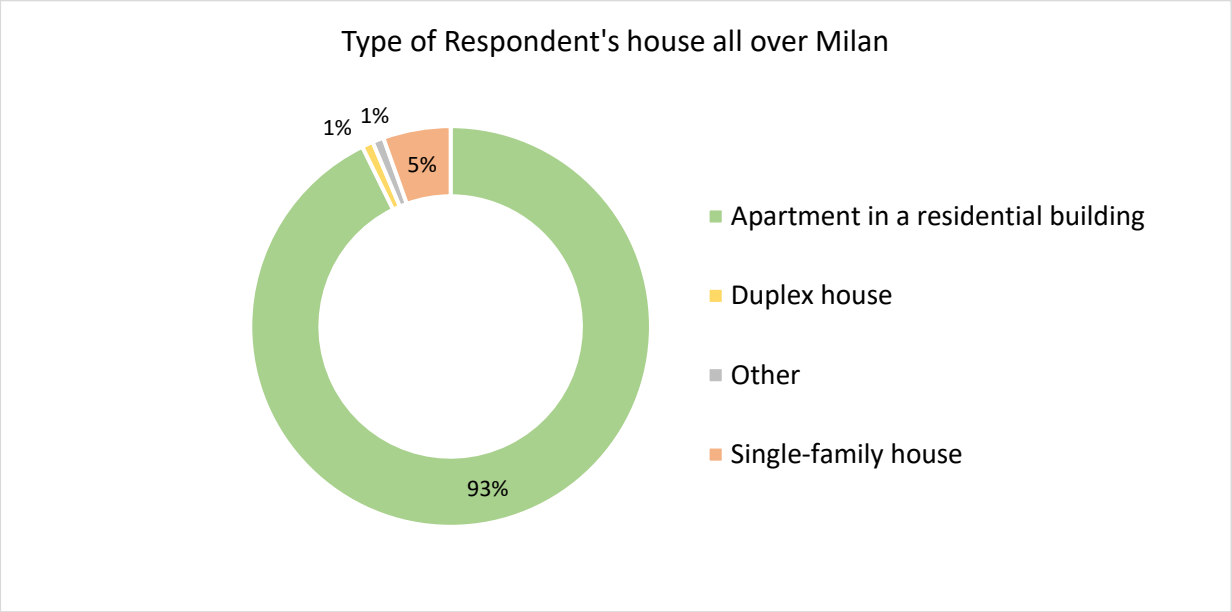


Figure 87. Pie chart depicting the percentage of each housing type all over Milan.

Analysis:

The majority of the total respondents that is 93% of them live in an apartment in a residential building.

A4.1.

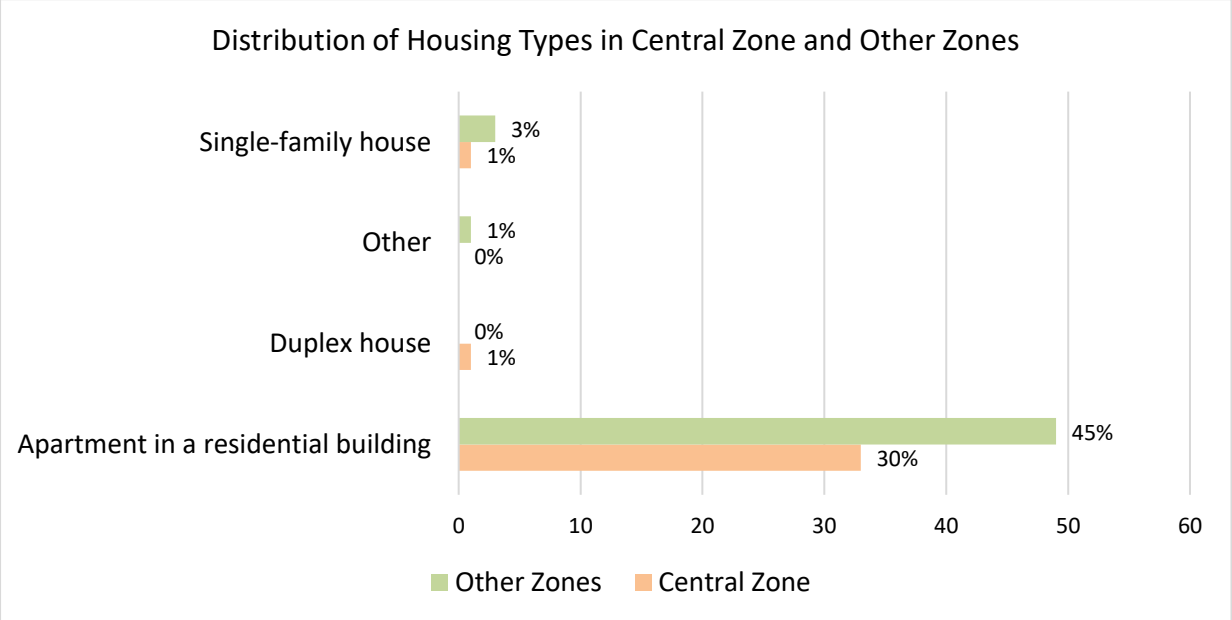


Figure 88. Bar graph depicting the distribution of each housing type in central vs other zones.

Analysis:

Majority of the respondents from the Central zone and the other zones live in an apartment of a residential building, with 30% and 40% of the total respondents. The graph indicates that the apartment in a residential building is the most common type of housing for the respondents living in central zone and other zones of Milan.

Q5. Does your house have a courtyard/garden/open space (private or shared)?

a. yes
b. no

A5.

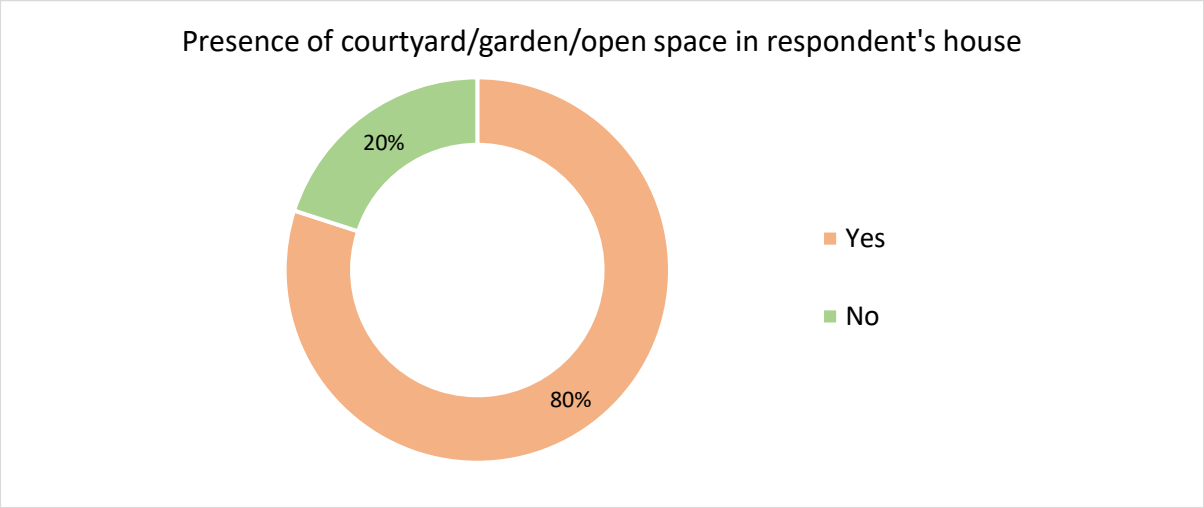


Figure 89. Pie chart depicting the percentage of the number of respondents having presence of green space in their house.

Analysis:

Almost 80% people that is majority of the respondent have a courtyard/garden/open space which is either private or shared, in their houses. Out of which 80% also own an Apartment in a residential building. Hence suggesting a common presence of outdoor spaces in them.

Q6. Where is the courtyard/garden/open space place with respect to the building?

a. in front of the building
b. around the building
c. within the block, accessible through a vehicle entrance
d. within the block, accessible through the building

A6.

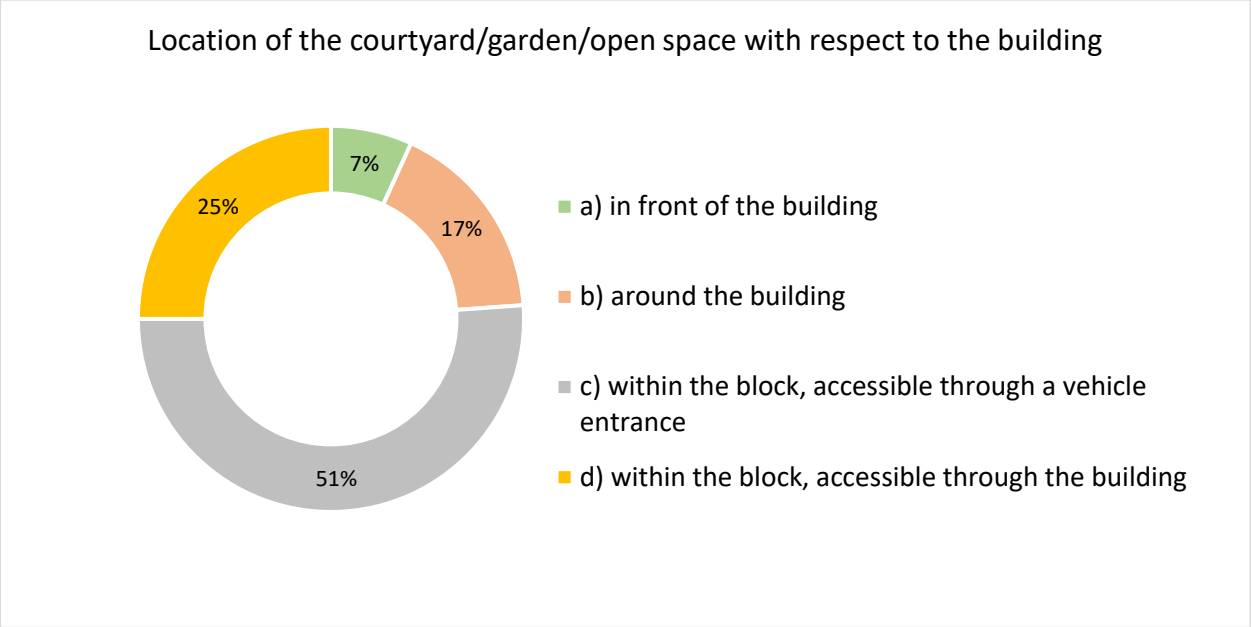


Figure 90. Pie chart depicting the percentage of each location of the green space with respect to the building.

Analysis:

From the above Pie chart, almost 76% of the respondents have the presence of courtyard/ garden/open space, within the block- accessible through a vehicle entrance and the building (option c and d). Hence, we can conclude that the presence of the residential courtyards is in a large number.

Q7. What functions are present within your courtyard? (can select multiple answers)

a. car parking
b. bike parking
c. waste collection
d. benches, tables or other furniture
e. children playground
f. dehors or other extensions of private activities

A7.

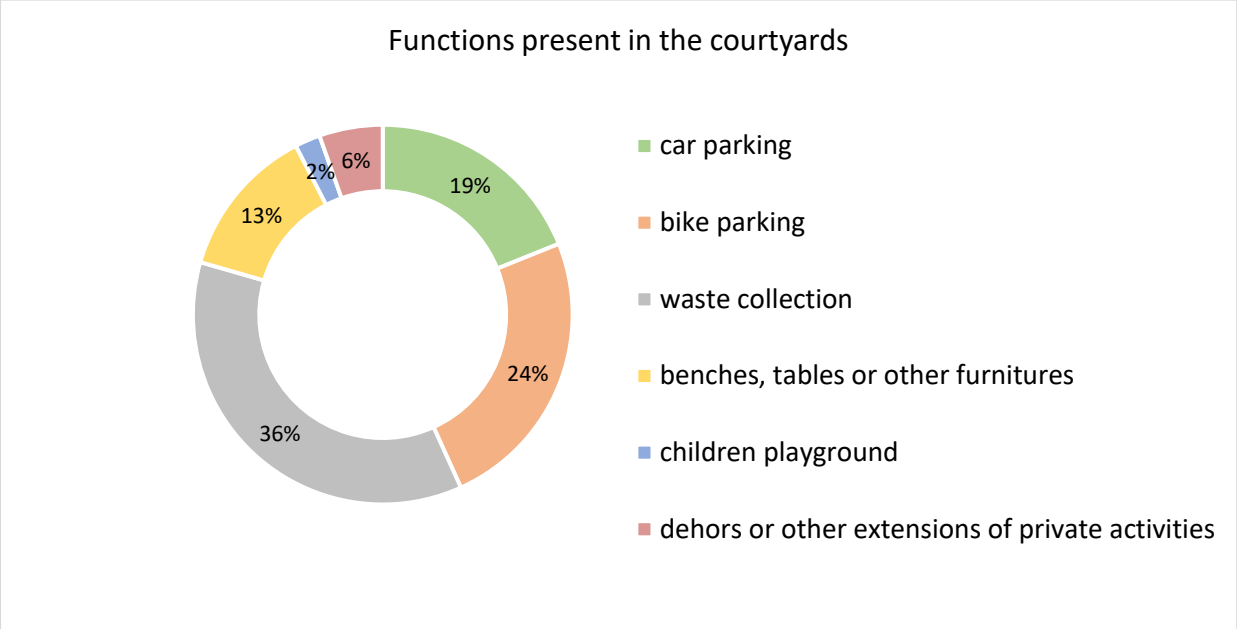


Figure 91. Pie chart depicting the percentage of each function present in the courtyards.

Analysis:

Majority of the courtyards are used as waste collection spaces and bike parking areas and hence making those courtyards not being used in their true potentials.

A7.1.

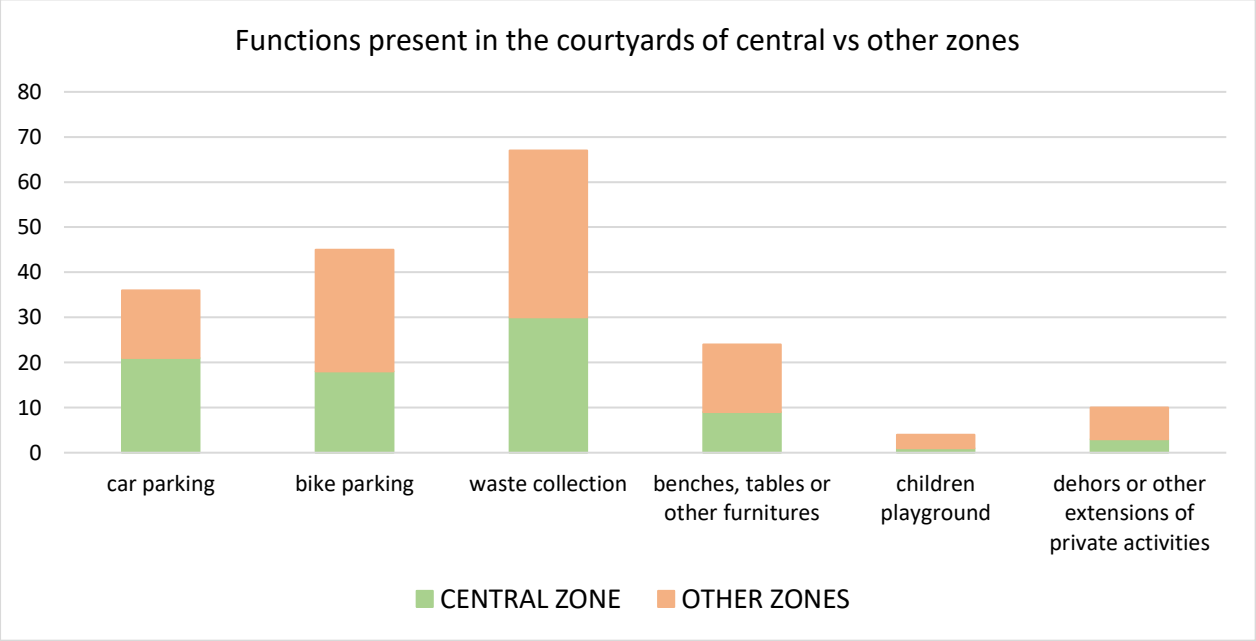


Figure 92. Pie chart depicting functions present in the courtyards of central vs other zones.

Analysis:

The Central Zone prioritizes car parking and has fewer bike spaces hence prioritizes vehicular infrastructure while the Other Zones emphasize sustainable transport, waste management and family-friendly amenities. Differences in public furniture and spaces for the private activities suggest a thoughtful zoning strategy tailored to specific needs and characteristics of each zone.

Q8. How do you use the courtyard space?

a. just passing through
b. to spend time outside
c. to meet other people
d. to park my car
e. other

A8.

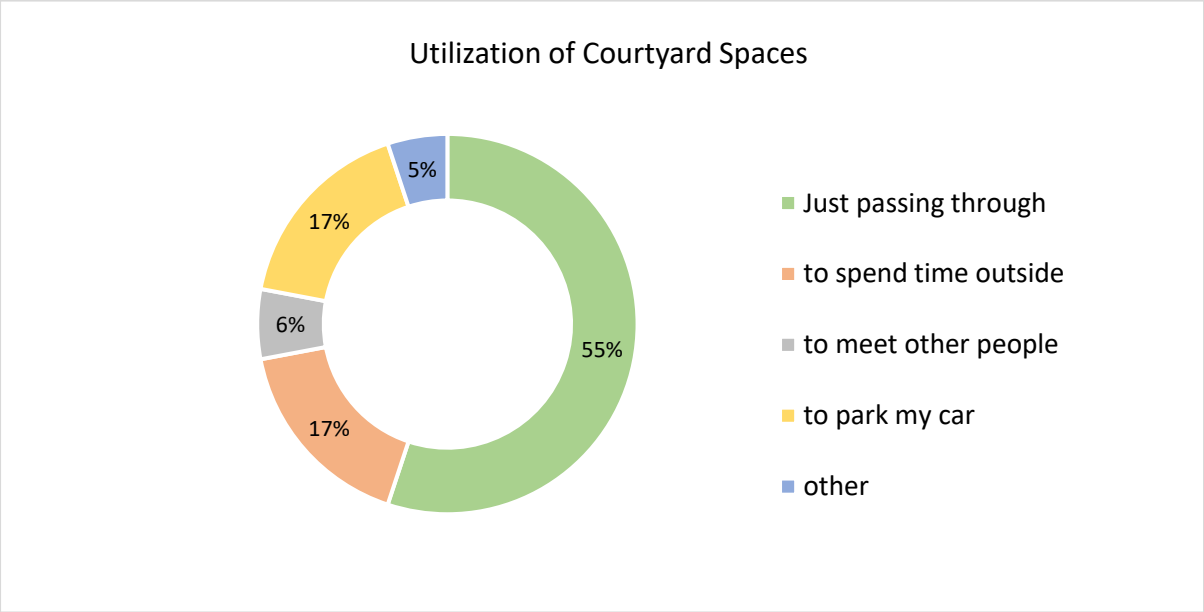


Figure 93. Pie chart depicting the percentage of utilization of the courtyard spaces by the respondents.

Analysis:

The courtyards in Milan are primarily used as a functional space for just passing through. Also the diversity in the responses from the end users suggest that courtyards play a multifaceted role in their lives.

A8.1.

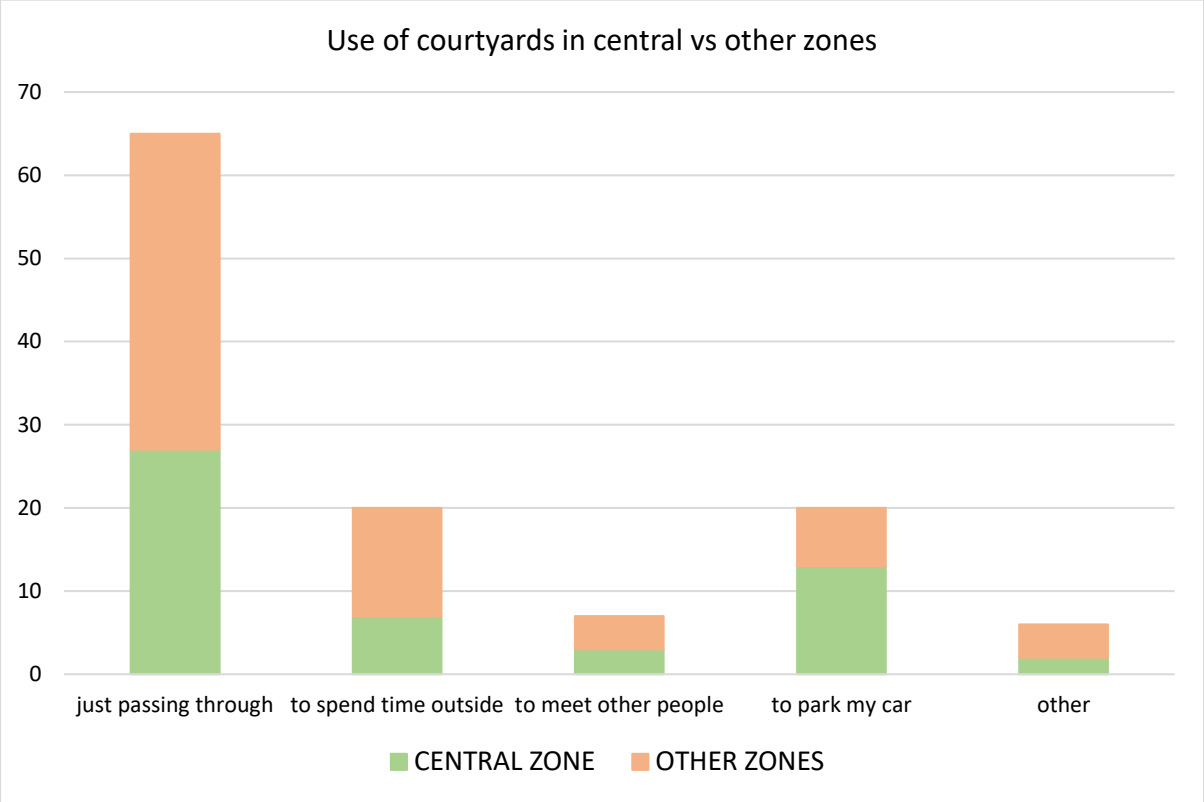


Figure 94. Bar graph depicting the use of courtyards in the central vs other zones.

Analysis:

The data highlights distinct preferences in the Central Zone and Other Zones. Other Zones experience higher foot traffic, emphasize outdoor activities and exhibit a slightly greater inclination for social interactions. In contrast, the Central Zone sees a higher demand for parking.

Q9. How often do you use the space of the courtyard?

a. Daily
b. Sometimes a week
c. Sporadically
d. Rarely or never

A9.

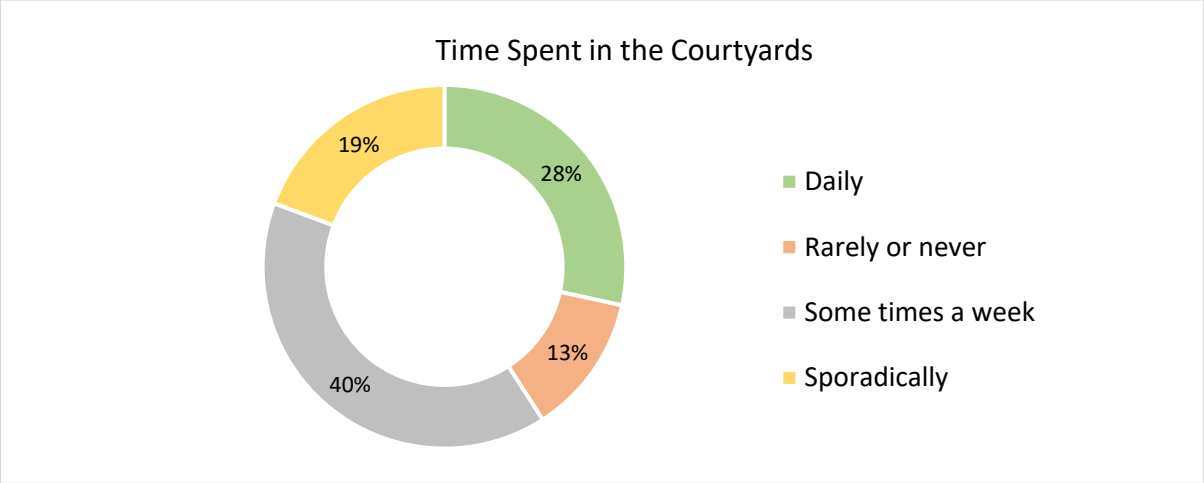


Figure 95. Pie chart depicting the percentage of time spent in the courtyards by the respondents.

Analysis:

The responses reflect the different patterns of the courtyard usage, where 40% showcase a semi-regular engagement by using it sometimes a week and 28% showcase courtyards as an important integral part of their lives by using it daily.

Q10. How much do you think the presence of greenery within an urban courtyard is important (regardless of whether your courtyard has it or not)?

1: not important at all - 5: very important

A10.

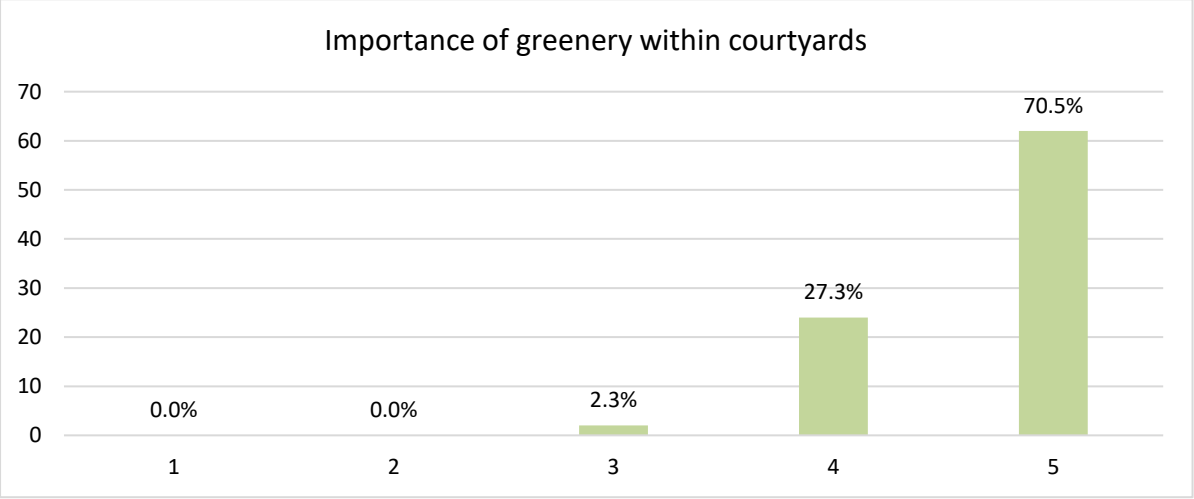


Figure 96. Bar graph depicting the percentage of the importance of greenery within courtyards for the respondents.

Analysis:

The average rating is 4.68, 98% rated between 4-5. Evidently, majority of the respondents think that the presence of greenery within the urban courtyards is important.

Q11. Is there any greenery in your courtyard? Consider any kind of greenery (potted plants, trees, flower beds...)

A11.

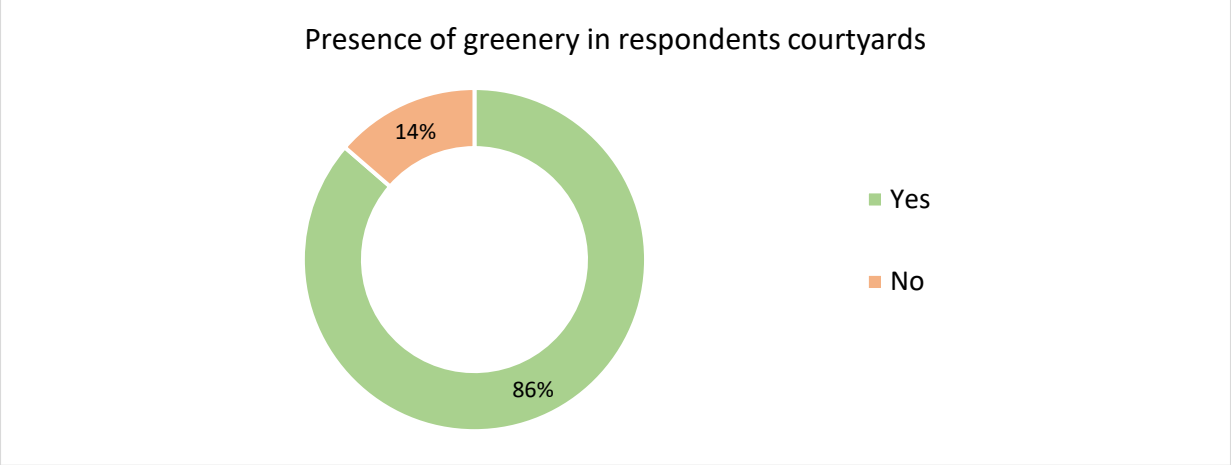


Figure 97. Pie chart depicting the percentage of the number of respondents having presence of greenery in their courtyards.

Analysis:

86% respondents have the presence of greenery in their courtyards in the form of potted plants, trees or flower beds.

A11.1.

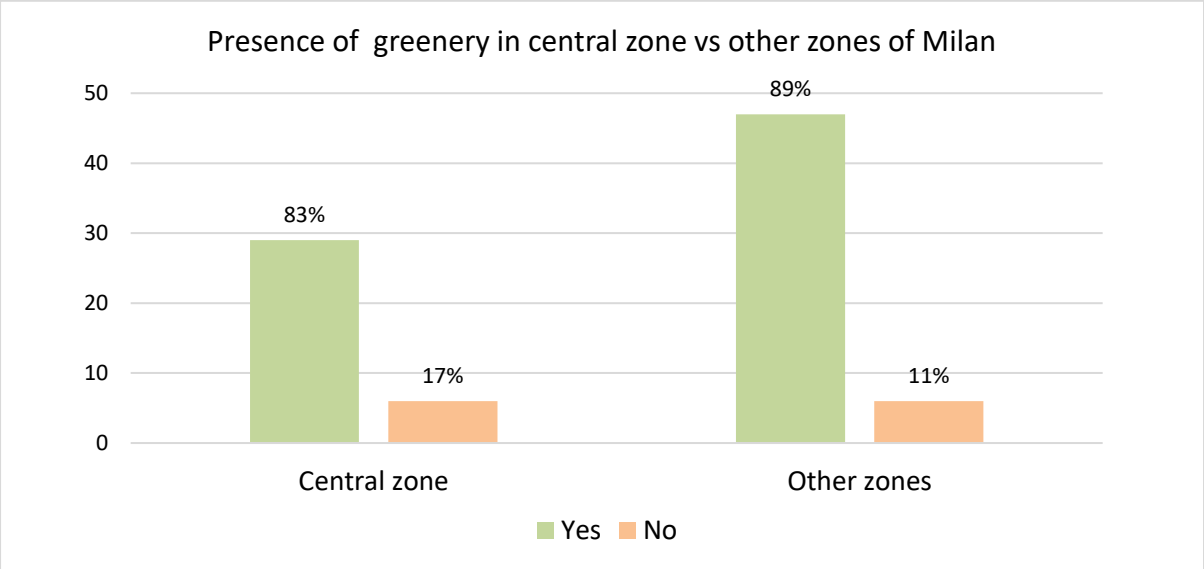


Figure 98. Bar graph depicting the presence of courtyard greenery in central vs other zones.

Analysis:

Majority of the respondents agree having more greenery in the courtyards with 83% in the center and 89% in the other zones, which indicate a significant presence of greens in the courtyards of Milan.

Q12. What kind of greenery? (can select multiple answers)

a. potted plants
b. one or more trees
c. natural surfaces (flowerbeds, grass...)
d. other

A12.

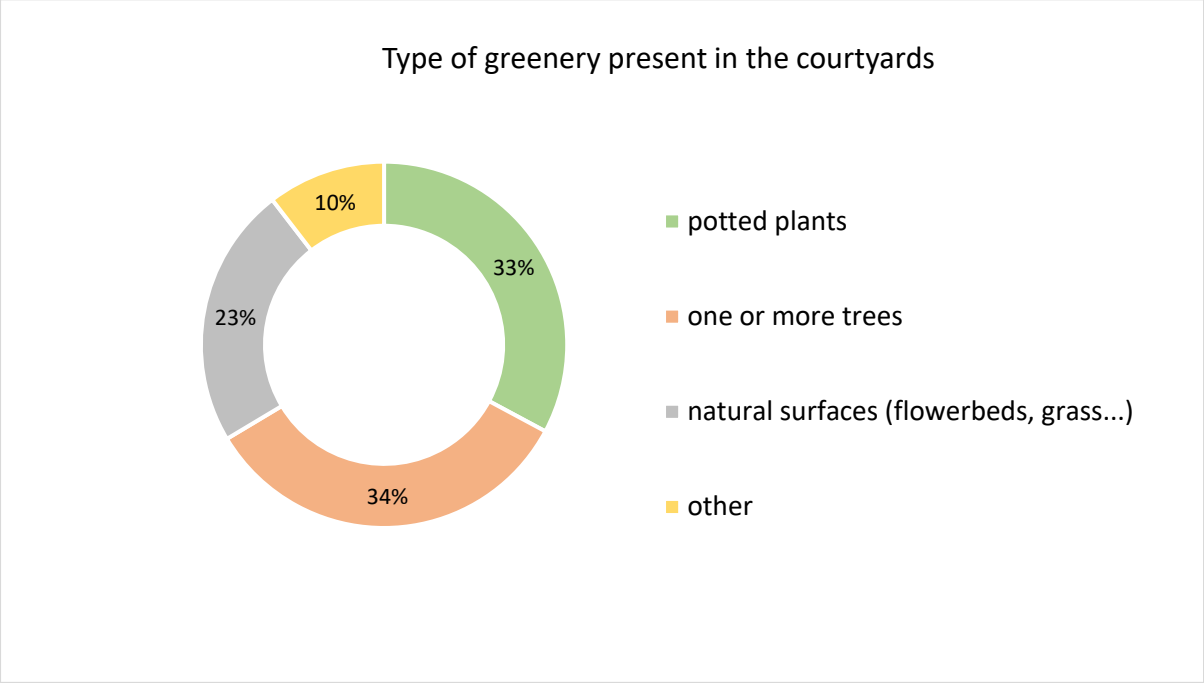


Figure 99. Pie chart depicting percentage of the type of greenery present in the respondents courtyards

Analysis:

There is an equally distributed diverse range of greens in the courtyards of Milan.

A12.1.

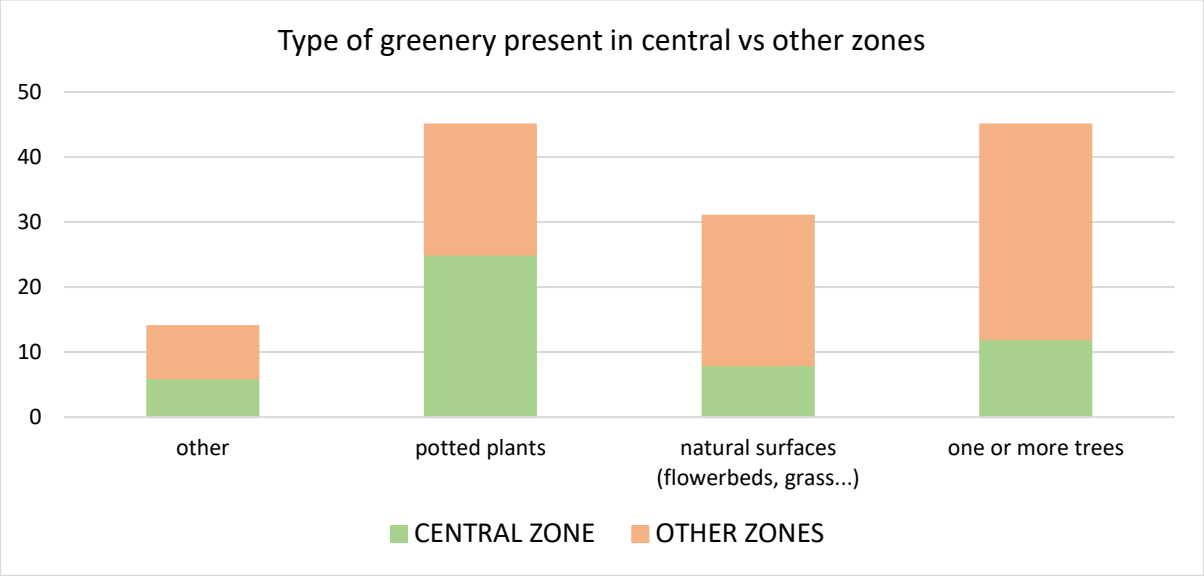


Figure 100. Bar graph depicting the type of greenery present in the courtyards of central vs other zones.

Analysis:

The Central Zone exhibits a higher concentration of potted plants, suggesting an inclination towards indoor or container gardening. In contrast, the Other Zones prioritize outdoor greenery, particularly with a significant preference for one or more trees and natural surfaces like flowerbeds and grass.

Q13. How do you evaluate the presence of greenery within your yard?

(can select multiple answers)

- **quantity**: the amount of greenery present is adequate for the space available.
- **quality**: the types of greenery present are appropriate for the space available (potted plants, flower beds, trees)
- **impact**: the greenery present enhances the perception of the courtyard space.
- **accessibility**: the greenery present is easily and directly accessible.

a. Strongly disagree

b. Disagree

c. Neutral

d. Agree

e. Strongly Agree

A13.1.

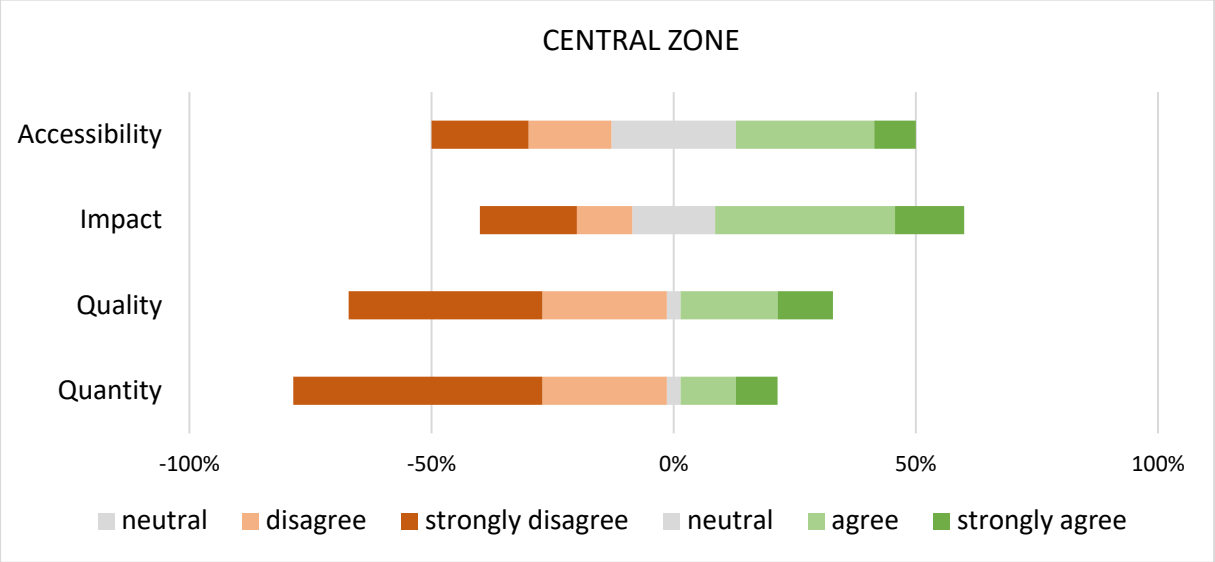


Figure 101. Stacked bar graph depicting the evaluation of the presence of greenery in central zone.

Analysis:

A significant number of respondents are less satisfied in terms of the quantity of greenery and have a negative opinion ranging from disagree to strongly disagree. Whereas the respondents are more satisfied with the quality, impact and accessibility of the greenery within their yard.

A13.2.

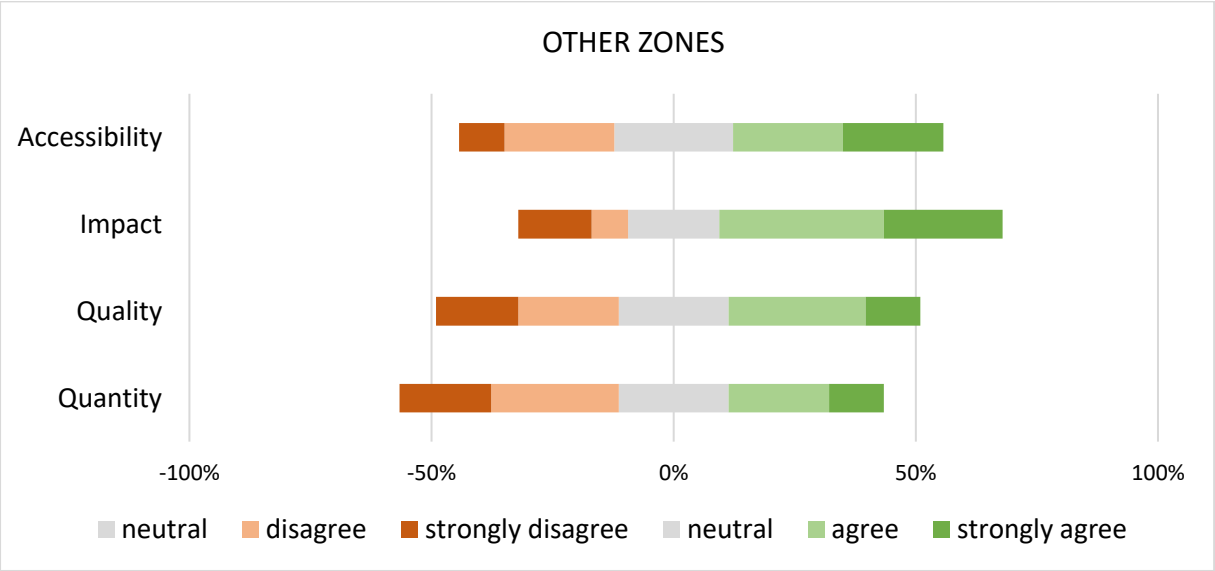


Figure 102. Stacked bar graph depicting the evaluation of the presence of greenery in other zones.

Analysis:

Respondents have more positive opinions about the all the factors that is the quantity, quality, impact and accessibility of the greenery with a significant number of opinions ranging from agree to strongly agree.

SECTION 3 - TRANSFORMATION SCENARIOS

Q14. Which of the interventions listed below would you like to carry out in your courtyard?

- Medium to tall trees for shading
- Accessible and usable green surfaces (grass and flower beds)
- Water elements for cooling (fountains, water ponds...)
- Vegetable gardens
- Green walls on the facades of buildings surrounding the courtyard
- Furniture for the usability of the space (chairs, tables, benches...)
- Children's playground
- Outdoor sports equipment

a. Strongly disagree

b. Disagree

c. Neutral

d. Agree

e. Strongly Agree

A14.1.

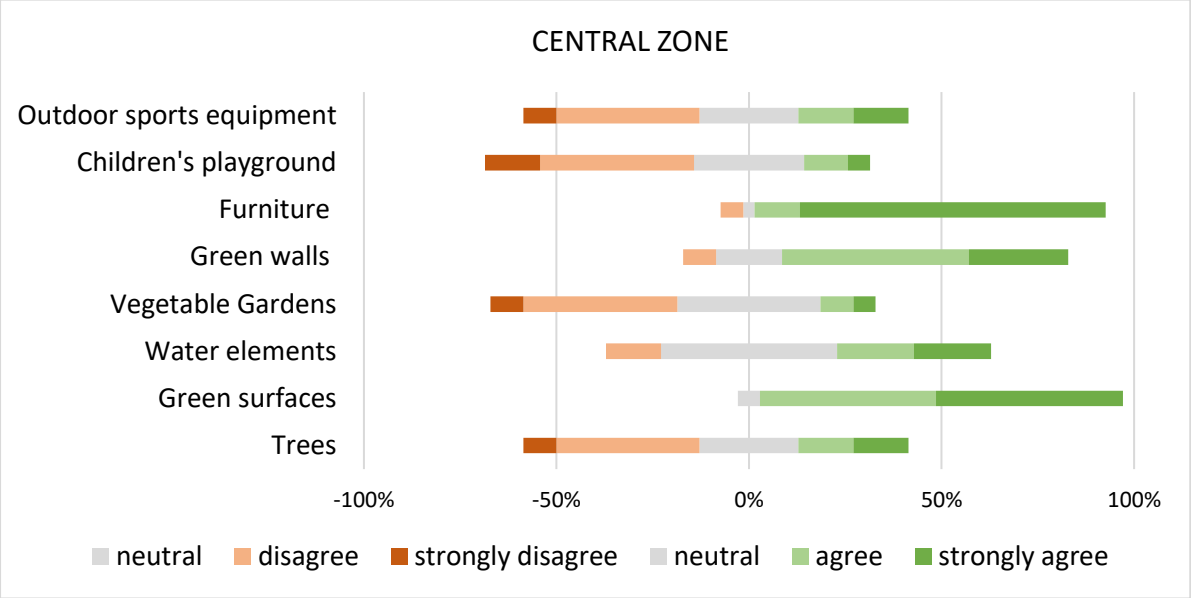


Figure 103. Stacked bar graph depicting the suggested interventions in the central zone.

Analysis:

The majority of the respondents have a positive approach for the green surfaces, green walls, furniture and water elements whereas there is more uncertainty regarding the playground, community gardens, trees and outdoor sports.

A14.2.

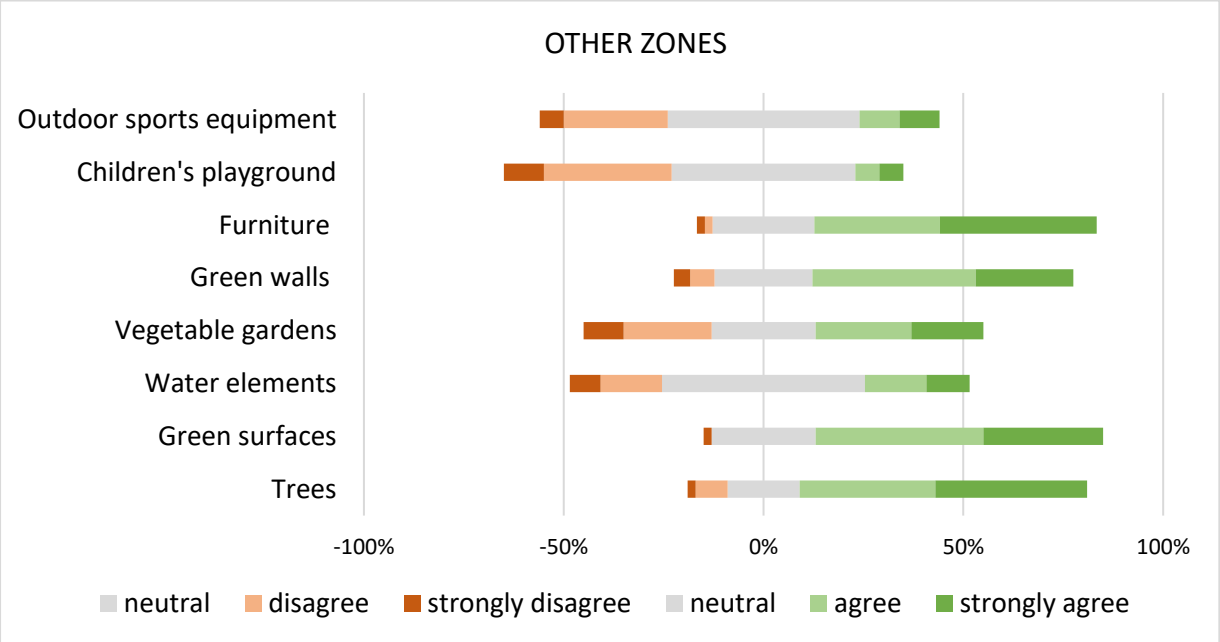


Figure 104. Stacked bar graph depicting the suggested interventions in other zones.

Analysis:

Overall, there are more positive opinions and less negative ones. Green surfaces have the strongest support followed by the furniture, trees and green walls. The playground, outdoor sports are more towards negative side. But overall, the respondents from the other parts of Milan are more positive about the ecological interventions in their courtyards.

Q15. Which of the following criteria do you consider a priority?

- Absorption of pollutants and improvement of air quality
- Aesthetic improvement of the courtyard
- Microclimate regulation (mainly mitigation of heat peak)
- Enhancement of biodiversity
- Fostering social interactions and strengthening a sense of community
- Support for food self-production

a. Strongly disagree

b. Disagree

c. Neutral

d. Agree

e. Strongly Agree

A15.1.

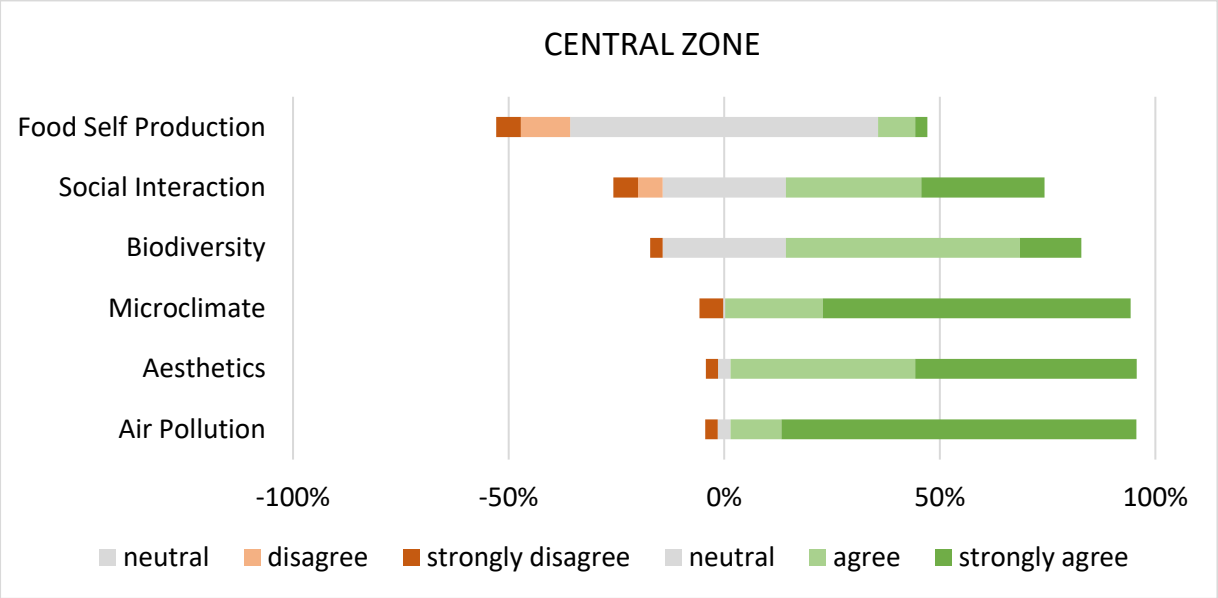


Figure 105. Stacked bar graph depicting the priority of criterias for interventions in central zone.

Analysis:

The respondents show a strong emphasis on almost all the given factors. Due to the concern for the air quality, the absorption of pollutants is highly prioritised followed by microclimate regulation. The support for the food self production is seen as the lowest priority of the respondents.

A15.2.

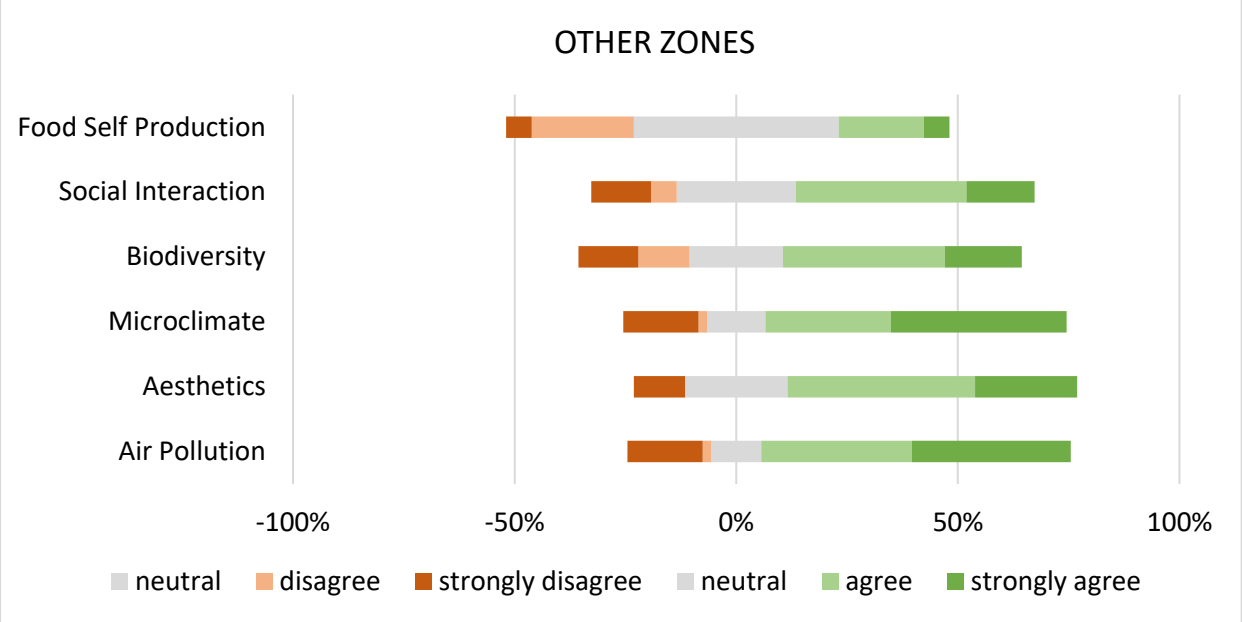


Figure 106. Stacked bar graph depicting the priority of criterias for interventions in other zones.

Analysis:

The respondents have a high consent with common opinions for most factors. However, there are more disagreements as compared to the central zone, with absorption of pollutants and improvement of air quality being the least priority. Other zones overall exhibit a uniform set of preferences.

Q16. Which of the aspects listed below do you think might be a problem for you?

- Discomfort related to courtyard transformation work (noise, dust), even if for a limited period of time
- Increased noise from new activities in the courtyard (recreational activities, children's games...)

- Loss of private parking spaces
- Increase in insects and other animals due to the increased presence of vegetation.
- Increased condominium expenses for the maintenance and care of the common space

a. Strongly disagree

b. Disagree

c. Neutral

d. Agree

e. Strongly Agree

A16.1.

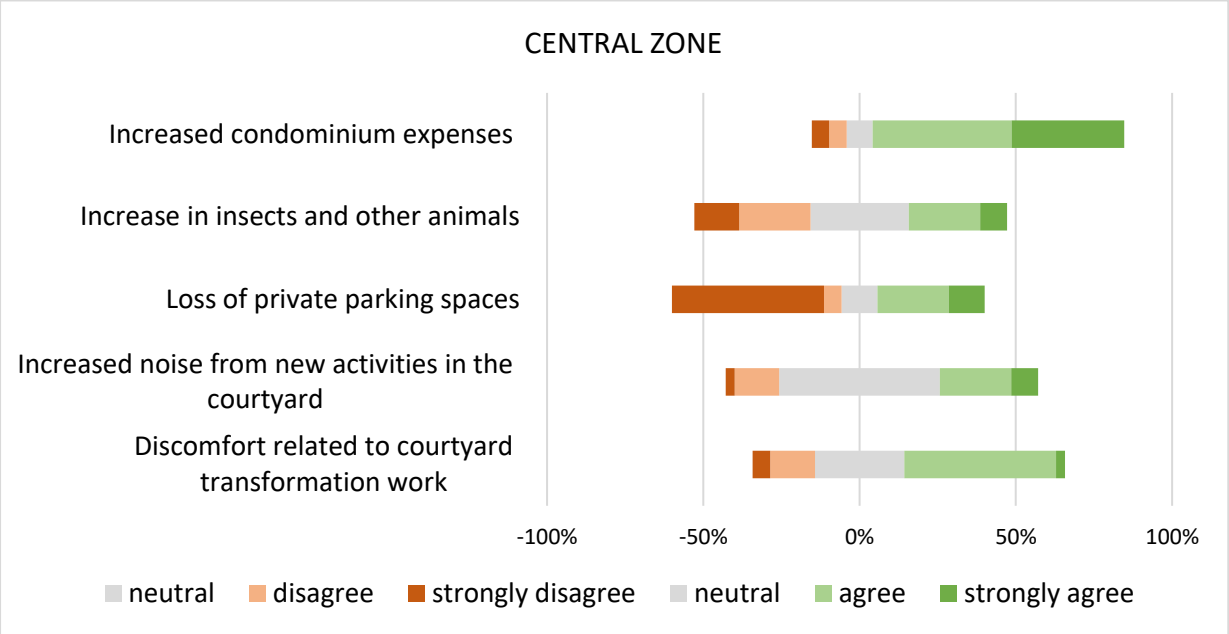


Figure 107. Stacked bar graph depicting the problems during the interventions in the courtyards of central zone.

Analysis:

The respondents show a significant concern over increased condominium expenses for the maintenance and care of the common space whereas they are least concerned about the loss of the parking spaces. Noise due to new activities is also a concern but comparatively less significant.

A16.2.

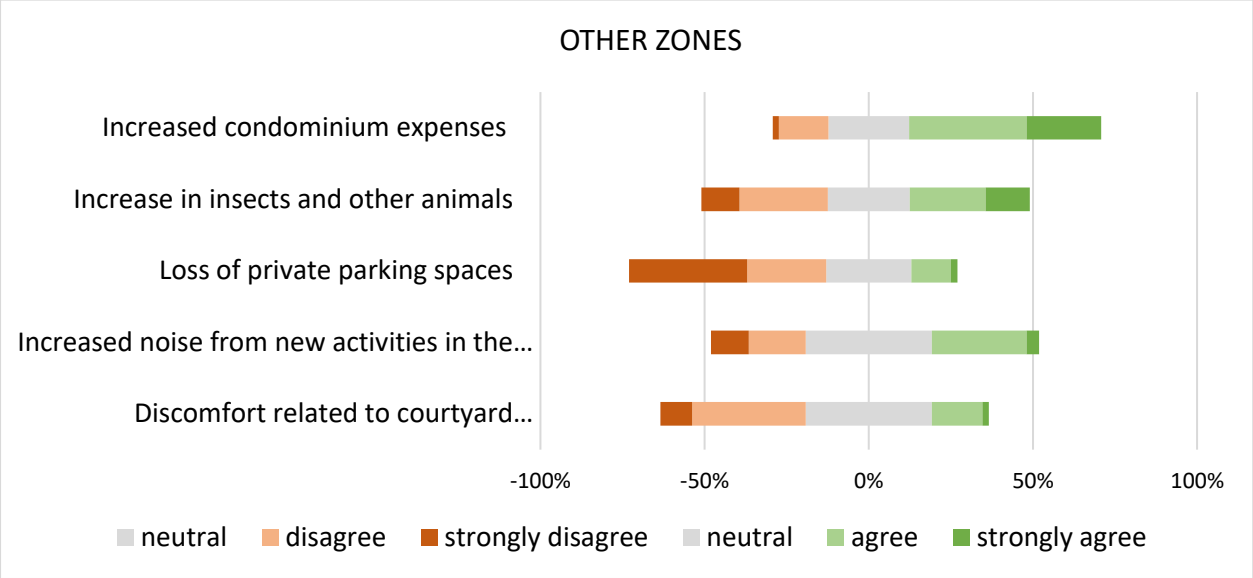


Figure 108. Stacked bar graph depicting the problems during the interventions in the courtyards of other zones.

Analysis:

There is high concern over the increased condominium expenses which indicate a strong point of financial implication. Loss of private parking space and discomfort due to transformation work are the least concerned factors by the respondents.

Q17. Would you be willing to participate in community initiatives aimed at greening urban courtyards (e.g. volunteering for gardening, maintenance or planting activities)?

A17.

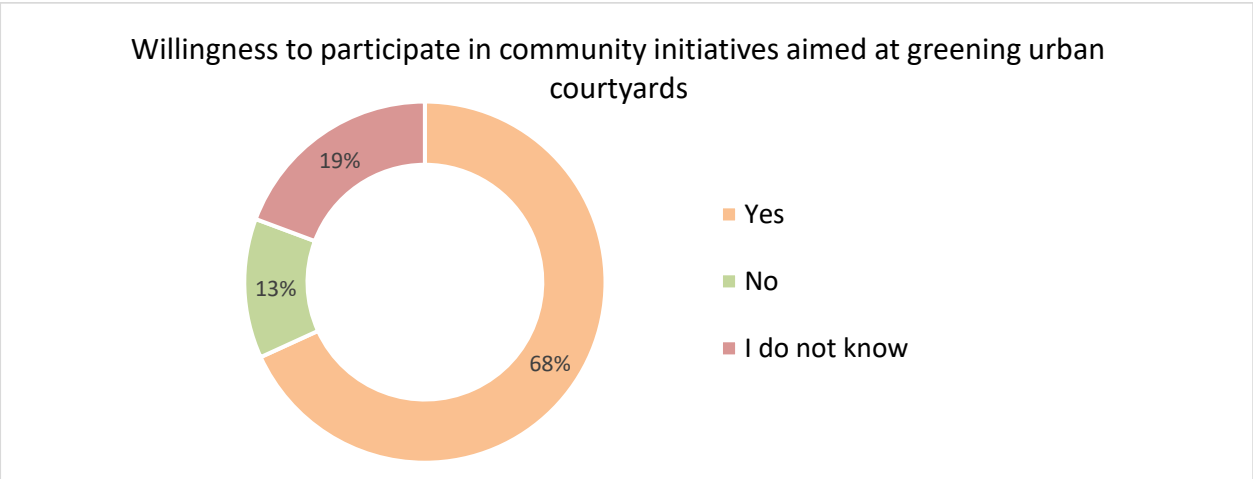


Figure 109. Pie chart depicting the willingness of the respondents to participate in community activities aimed at greening courtyards.

Analysis:

68% of people show willingness to participate in community initiatives aimed at greening urban courtyards indicating their interest in improving these spaces. Also, it is important to address the concerns of the people who are not willing to participate since it is almost 13%.

Q18. Would you support the regulated opening of your home's courtyard to people not domiciled in the surrounding buildings? (Regulated opening means that use by outside users is limited to certain time slots)

A18.

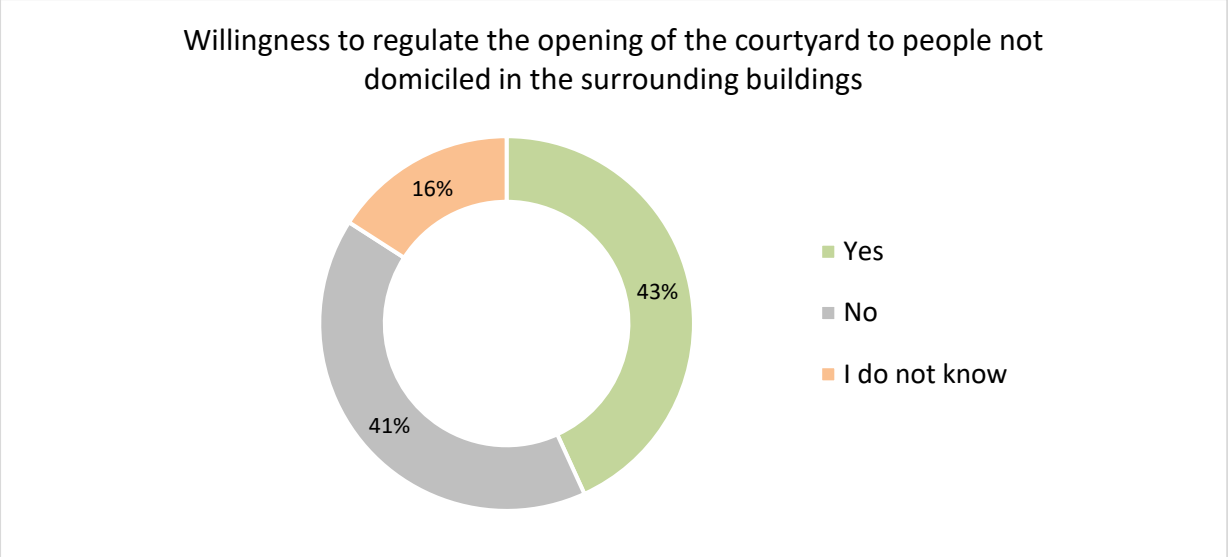


Figure 110. Pie chart depicting the willingness of the respondents to regulate the opening of the courtyard to the people from surrounding areas.

Analysis:

There is a substantial balance between the number of people willing to open their courtyards to outsiders and the number of people not willing to do it. This highlights the complex nature of this response where the people are willing to support but are also concerned about their privacy and security.

CHAPTER 5

DISCUSSION OF OBSERVATIONS AND RESULTS

5.0. General Overview

Urban courtyards are integral components of Milan's urban landscape, providing spaces for social interactions, leisure and potential for greenery. To comprehensively understand these courtyards, we employed a two-fold research approach: a city-wide survey and a zoning-based sample block analysis. This combined methodology offers a nuanced perspective on the current state of urban courtyards in Milan.

Table 17. Research Methodology overview

Research Approach	Methods Employed
City-Wide Survey	(Q1-Q18) Questionnaire
Zoning-Based Sample Block	Analysis of Courtyards in 3 Zones

5.0.1. Survey-Based Insights: The survey responses gathered from residents across different zones within Milan illuminate their perceptions and utilization of urban courtyards. Key findings include:

- **Greenery and Its Significance:**

  One prevailing theme across all zones is the profound significance of greenery within urban courtyards. An overwhelming majority of respondents expressed a strong preference for the presence of green elements, such as plants and trees, in these spaces (Q11) (A11.1). This underscores the universal recognition of greenery as a vital component in enhancing the quality of urban life.

- **Diverse Courtyard Functions:**

  Courtyard’s functions vary significantly across different zones. In the city center, they tend to be relatively smaller in size, primarily serving as spaces for relaxation. In contrast, courtyards in the intermediate and peripheral zones exhibit greater diversity in functionality, accommodating parking, recreation and social interaction (Q7) (A7.1). These variations in use reflect the differing needs and lifestyles of residents in these zones.

- **Community Engagement:**

  Encouragingly, respondents from all zones showed a willingness to participate in community initiatives aimed at greening urban courtyards (Q17). This highlights a shared sense of responsibility and a desire to actively contribute to enhancing these spaces.

Table 18. Survey Insights Matrix

Aspect	Survey Question	Key Findings
Importance of Greenery	(Q10)	Strong consensus on the significance of green elements
Presence of Greenery	(Q11)	Strong presence of greenery recorded
Greenery Preferences	(Q14)	High preference for green elements
Courtyard Functions by Zone	(Q7)	Varied functions based on zone
Courtyard Usage by Zone	(Q8)	Varied usage patterns across different zones
Willingness for Community Initiatives	(Q17)	High willingness to engage in community initiatives
Community Engagement	(Q18)	Regulated opening of courtyards

5.0.2. Sample Block Analysis:

The research further examined courtyards within three distinct zones of Milan:

City Centre Zone (Central Milan):

(Sample 1)

- Typically characterized by smaller courtyards with limited facilities.
- Prioritizes aesthetics and greenery to create visually appealing and relaxing environments.
- Courtyard usage predominantly revolves around leisure activities.
- There is unanimous support for introducing more greenery, emphasizing the importance of enhancing these spaces' ecological and aesthetic qualities.

Intermediate Zone (Suburban Milan):

(Sample 2)

- Offers a diverse range of courtyards, both in terms of size and functionality.
- Presents a mix of facilities, including parking spaces and green areas.
- Courtyard usage in this zone spans a wider spectrum, catering to various resident needs.
- Residents here also express a desire for more greenery, indicating a shared aspiration for courtyards to provide ecological benefits alongside functional diversity.

Periphery Zone (Outskirts of Milan):

(Sample 3)

- Features spacious and versatile courtyards, often comprising larger green spaces, parking lots and recreational areas.
- Courtyard usage exhibits a broad diversity, ranging from recreational activities to social interactions.
- Similar to other zones, residents express a strong preference for the introduction of additional green elements, signifying the desire to integrate urban courtyards with productive landscapes.

Table 19. Zone Characteristics

Zone	Courtyard Size	Dominant Features
City Centre	Small	Aesthetics and limited facilities
Intermediate	Varied	Mix of facilities, diverse functions
Periphery	Spacious	Larger green spaces, versatile usage

5.0.3. Cross-Zonal Trends: While the analysis highlighted differences across zones, several common trends emerged:

- **Collective Desire for Greenery:** Irrespective of their location within Milan, respondents consistently emphasized the importance of introducing greenery within urban courtyards.

- **Alignment with Sustainability Goals:** There's a noticeable convergence of views regarding the potential introduction of productive landscapes and urban agriculture. This alignment reflects a broader commitment to sustainability objectives and enhancing the ecological footprint of courtyards.

- **Shared Priorities:** Across zones, residents prioritize enhancing air quality, regulating microclimates, fostering biodiversity and encouraging social interactions within courtyards.

Table 20. Common trends across zones

Common Trends	Linked to Survey Question	Linked to Sample Block Observation
Desire for Greenery	(Q10)	City-wide support, emphasized in all zones
Alignment with Sustainability	(Q14)	Consistent interest in productive landscapes
Prioritization of Objectives	(Q15)	Common priorities: air quality, biodiversity, social interactions

Conclusion:

The combined survey and sample block analysis offer a comprehensive understanding of urban courtyards in Milan. They underscore the unanimous significance of greenery within these spaces, regardless of their location. Moreover, the findings emphasize resident's willingness to actively engage in enhancing these courtyards, supporting the overarching goal of bolstering community resilience and social cohesion throughout the city. The subsequent phases of this research will involve the development of design guidelines and a comparative analysis with international case studies, providing valuable insights for future urban planning practices in Milan.

5.1. Evaluation of Cultural and Social Features of Urban Courtyards in Milan

Urban courtyards in Milan serve as vibrant microcosms within the city, reflecting the cultural and social dynamics of their respective zones. This evaluation delves into the cultural and social aspects of these courtyards, drawing insights from this survey data and the sample block analysis conducted in Milan's central, intermediate and peripheral zones.

5.1.1. Cultural Significance

- **Historical Context:** Courtyards, particularly in the city center, often bear historical significance, preserving architectural elements and design characteristics from bygone eras. These spaces act as living testimonials to Milan's rich history, fostering a sense of continuity and connection with the past.

- **Heritage Preservation:** In the city center, the presence of courtyards helps protect Milan's architectural heritage. Residents and authorities alike recognize their importance in safeguarding the city's cultural identity, leading to efforts to maintain and restore historical courtyards.

- **Cultural Preservation:** In the intermediate and peripheral zones, courtyards continue to play a role in preserving cultural traditions and fostering a sense of belonging among diverse communities. They often serve as venues for cultural events, reflecting the city's multicultural character.

5.1.2. Social Significance

- **Community Interaction:** Respondents from all zones underscored the pivotal role of courtyards in facilitating social interactions. These spaces offer residents opportunities to connect, fostering a sense of belonging and neighbourly camaraderie.

- **Meeting Points:** Courtyards in the intermediate and peripheral zones function as informal meeting points. They host gatherings, picnics and celebrations, allowing residents to strengthen bonds and share their cultural heritages.

- **Social Inclusivity:** This analysis reveals courtyard's potential to promote social inclusivity, transcending demographic and socio-economic barriers. In many cases, courtyards in peripheral areas serve as vital spaces for new residents and immigrants to integrate into the local social fabric.

5.1.3. Cross-Zonal Trends:

- **Historical Significance**: The city center predominantly emphasizes the cultural heritage aspects of courtyards, reflecting the area's historical significance. In contrast, the intermediate and peripheral zones prioritize social inclusivity and community interactions, given their multicultural demographics.

- **Community Cohesion**: Across all zones, courtyards consistently contribute to community cohesion by offering spaces for shared activities and informal gatherings. This fosters stronger social bonds and enriches the quality of life for residents.

- **Integration of Culture and Nature**: The desire for introducing greenery within courtyards is seen to harmonize culture and nature, creating aesthetically pleasing and culturally rich environments.

Table 21. Cultural and Social Features by Zone

Zone	Historical Significance	Social Inclusivity	Community Interaction	Integration of Culture and Nature
City Centre	Emphasis on heritage	Limited	Primarily leisure	Harmonizing greenery and culture
Intermediate	Cultural events venue	Growing inclusivity	Informal meeting points	Potential for cultural exchange
Periphery	Community-building	Vital spaces	Diverse interactions	Integration of cultural festivals

***Conclusion**:*

Urban courtyards in Milan play a multifaceted role, preserving cultural heritage and fostering social bonds. These spaces are not merely physical entities. They are repositories of Milan's historical and cultural identity. Moreover, courtyards act as hubs for community interactions where residents from diverse backgrounds come together to celebrate traditions and build relationships. Understanding the cultural and social features of these courtyards is essential for further enhancing their role in bolstering community resilience and social cohesion. In the subsequent phases of this research, we will explore design strategies and community engagement approaches to leverage these features effectively.

5.2. Identification of Underutilized Habits and Untapped Potentials in Milan's Urban Courtyards

Urban courtyards, scattered throughout Milan's various zones, possess untapped potential and underutilized habits that, if harnessed effectively, can enhance the socio-cultural fabric of the city. In this section, we delve into the behaviours and latent opportunities within these courtyards, drawing from survey responses and the sample block analysis.

5.2.1. Underutilized Habits:

- **Limited Multifunctionality:** Respondents from all zones indicated that courtyards are predominantly used for basic functions such as passing through or parking. These underutilized habits suggest a lack of recognition regarding the diverse role's courtyards can play within urban living.

- **Neglected Green Spaces:** The survey highlighted that the presence of greenery within courtyards is not uniformly appreciated. In some cases, respondents showed indifference or undervalued the role of greenery in their courtyards. This underutilization of green spaces signifies a gap in understanding their benefits.

- **Inadequate Cultural Activation:** Despite the potential for courtyards to serve as cultural spaces, they are often underused for this purpose. Cultural activities, performances and exhibitions remain limited, particularly in the intermediate and peripheral zones, where such initiatives could bridge cultural divides.

5.2.2. Untapped Potentials:

- **Community Gardens:** The desire for introducing productive landscapes, including community gardens, emerged as a significant potential across all zones. Residents in the central zone expressed interest in green walls and outdoor sports equipment. These green interventions can serve as a bridge between underutilized spaces and community engagement.

- **Multifunctional Design:** Courtyards, especially in intermediate and peripheral zones, hold untapped potential for multifunctional design. Incorporating elements such as playgrounds, outdoor fitness equipment and seating areas could transform these spaces into vibrant community hubs.

- **Cultural Exchange:** The intermediate and peripheral zones have a unique opportunity to foster cultural exchange within their courtyards. These spaces can host cultural festivals, food fairs and art exhibitions that celebrate the diverse backgrounds of residents, bridging the cultural gap and promoting social cohesion.

5.2.3. Cross-Zonal Trends:

- **Central Zone**: Residents here often underutilize courtyards for activities other than parking or passing through. However, the potential for enhancing greenery is recognized. Multifunctional design and community gardens can infuse vibrancy into these spaces.

- **Intermediate Zone**: Courtyards in this zone have the potential to become cultural melting pots. There's a growing appetite for community gardens and outdoor fitness

equipment. Cultural exchanges and collaborative art projects can unlock their latent potential.

- **Peripheral Zone**: These courtyards are rich in untapped potential for creating inclusive spaces. Their multifunctional design can combine community gardens, children's playgrounds and cultural festivals to foster social cohesion.

Table 22. Habits and Potential Matrix

Aspect	Survey Question	Key Insights
Underutilized Habits	Limited Multifunctionality (Q9)	Lack of recognition for diverse roles
Untapped Potentials	Community Gardens (Q14)	Potential for community engagement

Conclusion:

Identifying underutilized habits and untapped potentials in Milan's urban courtyards is vital for realizing their full socio-cultural significance. The recognition of courtyards as multifunctional spaces and the desire for greening and cultural activation underscore the resident’s willingness to transform these areas into vibrant community hubs. This subsequent research phases will explore design strategies and community engagement approaches that align with these identified potentials to enhance community resilience and social cohesion.

5.3. Strategies for Introducing Green Elements and Productive Landscapes

Realizing the potential identified in the previous sections requires a systematic approach. This section outlines strategies for introducing green elements and productive landscapes within Milan's urban courtyards, considering plant selection, irrigation systems and maintenance requirements. These strategies draw insights from both survey responses and the cross-zonal sample observation.

5.3.1. Plant Selection

- **Survey Insights:** Survey respondents expressed varying preferences for greenery in courtyards. Many favoured a combination of potted plants, trees and natural surfaces (Q12). This diversity suggests that plant selection should cater to different preferences and courtyard characteristics.

- **Biodiversity Promotion:** Incorporating a variety of plant species, including native and drought-resistant ones, can enhance biodiversity (Q15). This aligns with the priority of enhancing biodiversity and microclimate regulation expressed by respondents.

Cross-Zonal Sample Approach:

- **Zone-Specific Plant Selection:** Observations across different zones revealed distinct microclimates. Plant selection should consider these variations. For instance, drought-resistant plants might be more suitable in peripheral areas, while shade-loving plants could thrive in the city centre.

- **Vertical Gardening and Green Walls:** Compact courtyards in the city centre might benefit from vertical gardening or green walls to maximize greenery within limited space.

5.3.2. Irrigation Systems

- **Survey Insights:** Respondents indicated that accessibility to greenery is vital (Q13). Efficient irrigation systems are essential to maintain the quality and appeal of the green elements.

- **Sustainable Watering Methods:** Implementing sustainable watering methods, such as drip irrigation or rainwater harvesting, aligns with the priorities of air quality improvement and environmental sustainability expressed in the survey (Q15).

Cross-Zonal Sample Approach:

- **Zone-Specific Irrigation:** Irrigation systems should be tailored to the specific needs of each zone. For instance, peripheral courtyards may require less frequent irrigation due to higher soil moisture retention.

- **Rainwater Utilization:** In zones where water scarcity is a concern, rainwater harvesting systems can be incorporated into courtyards to reduce dependence on external water sources.

5.3.3. Maintenance Requirements

- **Survey Insights:** Respondents highlighted the importance of accessibility (Q8). Maintenance activities should be planned to ensure that green elements do not hinder courtyard use.

- **Community Engagement in Maintenance:** The survey indicated a willingness among residents to participate in gardening and maintenance activities (Q17). Involving the community in upkeep fosters a sense of ownership and enhances social cohesion.

Cross-Zonal Sample Approach:

- **Diverse Maintenance Needs:** Courtyards with a higher density of green elements may require more frequent maintenance. This should be considered when designing maintenance schedules.

- **Professional Support:** In some cases, professional maintenance services might be required, especially for complex green installations like green walls.

Table 23. Strategy Connection

Strategy	Linked to Survey Insights	Linked to Sample Block Characteristics	Linked to Community Engagement (Q14)
Plant Selection	(Q9, Q12, Q15)	Zone-specific variations	Biodiversity promotion, aesthetics
Irrigation Systems	(Q10, Q14, Q15)	Zone-specific considerations	Sustainable watering methods
Maintenance Requirements	(Q8, Q17)	Diverse maintenance needs	Community engagement in upkeep

Conclusion:

Strategically introducing green elements and productive landscapes within urban courtyards in Milan necessitates a flexible approach that considers plant selection, irrigation systems and maintenance requirements. These strategies should be tailored to the specific characteristics and needs of each courtyard, with an emphasis on community engagement and sustainability.

5.4. Impact on community resilience and social cohesion

This section explores the impact of introducing green elements and productive landscapes on social interactions within Milan's urban courtyards. The evaluation is based on data collected from surveys, interviews and observations, as well as insights from the cross-zonal sample approach.

5.4.1. Influence on Social Interactions

Enhanced Social Interactions

- **Survey Insights:** The survey revealed that some residents use courtyards as spaces to meet other people (Q8). The introduction of green elements could create attractive, inviting environments that encourage social interactions, aligning with the survey's emphasis on fostering community resilience and cohesion (Q15).

- **Observations:** Across the sampled zones, courtyards with green elements tended to have more residents engaging in conversations or communal activities. The presence of seating areas, shaded by trees or surrounded by greenery, facilitated spontaneous gatherings.

Strengthened Sense of Community

- **Survey Insights:** Residents expressed a desire for their courtyards to support a sense of community (Q15). Green spaces have the potential to act as focal points, providing common ground for residents to connect and build relationships.

- **Observations:** In zones where green elements were more prevalent, residents appeared more inclined to engage with one another. Activities like communal gardening or shared maintenance tasks fostered a sense of collective responsibility and belonging.

Inclusivity and Accessibility

- **Survey Insights:** Survey respondents indicated varying levels of comfort with the idea of opening their courtyards to people from surrounding buildings (Q18). This suggests that while green elements can encourage inclusivity, privacy concerns need to be addressed.

- **Observations:** Inclusive spaces, where open courtyards or community gardens were accessible to neighbouring buildings, tended to have a more diverse mix of residents. However, clear guidelines and regulations for usage were essential to mitigate potential conflicts.

Impact on Frequency of Use

- **Survey Insights:** The survey revealed that many residents use their courtyards daily or several times a week (Q9). The introduction of green elements can further incentivize frequent use, as it transforms courtyards into attractive leisure spaces.

- **Observations:** Courtyards with green elements, such as vegetable gardens or seating areas, saw increased daily use. Residents were more likely to visit these spaces for relaxation, socializing or participating in gardening activities.

Table 24. Impact on Social Interactions

Aspect	Linked to Survey Responses	Linked to Sample Block Observations
Enhanced Social Interactions	(Q8, Q15)	More interactions in green spaces
Strengthened Sense of Community	(Q15)	Shared activities foster unity
Inclusivity and Accessibility	(Q18)	Balanced approach to open spaces
Impact on Frequency of Use	(Q9)	Increased daily use with greenery

Conclusion:

The introduction of green elements and productive landscapes within urban courtyards in Milan has a positive influence on social interactions and community cohesion. These spaces provide residents with attractive, inclusive environments that encourage a frequent use, strengthen the sense of community and foster the social interactions. However, careful planning is required to address privacy concerns and ensure that these spaces remain accessible and welcoming to all the residents.

5.4.2. Community Attitudes towards Greenery in Courtyards

This section examines community attitudes towards the presence of greenery in urban courtyards in Milan. The assessment is based on survey responses and the interviews conducted with residents, providing valuable insights into their perceptions and preferences.

Importance of Greenery

- **Survey Insights:** The survey asked residents to rate the importance of greenery within urban courtyards, regardless of whether their own courtyard had it (Q10). The average rating indicated a strong consensus among respondents about the significance of green elements.

- **Interview Findings:** In interviews with residents, participants consistently emphasized the importance of greenery for creating a pleasant living environment. Many associated greenery with improved air quality, aesthetics and overall well-being.

Evaluation of Existing Greenery

- **Survey Insights:** Residents were asked to evaluate the presence of greenery within their courtyards (Q13). Responses ranged from "strongly disagree" to "strongly agree" on criteria such as quantity, quality, impact and accessibility of green elements.

- **Interview Findings:** Interviews provided nuanced perspectives on the existing greenery. Residents praised well-maintained gardens and shaded seating areas but also highlighted the need for regular maintenance to ensure green spaces remained attractive and accessible.

Preferred Interventions

- **Survey Insights:** Respondents were asked about their willingness to carry out various interventions to enhance greenery in their courtyards (Q14). Participants could express levels of agreement or disagreement with different proposals.

- **Interview Findings:** In interviews, residents expressed interest in specific interventions, such as planting medium to tall trees for shading or creating accessible and usable green surfaces. Their preferences aligned with the survey results, emphasizing practical and aesthetic improvements.

Priority Criteria

- **Survey Insights:** Residents were asked to prioritize criteria related to greenery interventions (Q15). This helped identify their preferences concerning factors like air quality improvement, aesthetic enhancement, microclimate regulation and fostering community interactions.

- **Interview Findings:** Interviews highlighted those residents often considered aesthetics and community interactions as their primary priorities. They saw greenery not only as a functional asset but also as an essential element for creating appealing, communal spaces.

Willingness to Participate

- **Survey Insights:** The survey explored resident's willingness to participate in community initiatives related to greening urban courtyards (Q17). This provided insights into their potential engagement in collaborative efforts.

- **Interview Findings:** In interviews, residents expressed varying degrees of interest in participating in gardening, maintenance or planting activities. Some were enthusiastic about contributing to greening initiatives, while others were more reserved.

Table 25. Community Attitudes and Linkages

Aspect	Linked to Survey Responses	Linked to Sample block observations
Importance of Greenery	(Q10) Collective acknowledgment	City Centre: Emphasis on heritage, aesthetics
Evaluation of Existing Greenery	(Q13) Nuanced perspectives	Intermediate: Cultural events venue, growing inclusivity
Preferred Interventions	(Q14) Practical and aesthetic	Periphery: Community-building, vital spaces
Priority Criteria	(Q15) Aesthetics and interactions	City-wide: Desire for greenery, alignment with sustainability
Willingness to Participate	(Q17) Varying degrees of interest	Intermediate: Growing interest in community gardens

Conclusion:

The assessment of community attitudes towards greenery in courtyards indicates a collective acknowledgment of its importance. Residents value green elements for their role in enhancing living environments, fostering community interactions and improving well-being. Understanding resident's preferences and priorities regarding greenery is crucial for designing interventions that align with their needs and aspirations.

5.4.3. Enhancing Community Resilience and Social Cohesion

This section explores the potential of integrating green elements and productive landscapes in urban courtyards to enhance community resilience and social cohesion. It combines insights from survey responses and observations in sampled courtyards.

Strengthening Social Bonds

- **Survey Insights:** Survey results indicated that the presence of greenery within courtyards has the potential to strengthen social bonds (Q15). Respondents recognized that green spaces encourage social interactions and a sense of community.

- **Observations from Sample Blocks:** In courtyards with green elements, residents often engaged in conversations, group activities and collaborative gardening efforts. These interactions contributed to a stronger sense of community within these spaces.

Promoting Shared Responsibilities

- **Survey Insights:** Survey responses revealed that residents were willing to participate in community initiatives aimed at greening urban courtyards (Q17). This willingness to engage in communal efforts suggests the potential for shared responsibilities in maintaining and improving these spaces.

- **Observations from Sample Blocks:** In courtyards with community gardens or green spaces maintained collectively, residents were observed participating in gardening and maintenance activities. This shared responsibility promoted a sense of ownership and unity among neighbours.

Building Resilience to Climate Change

- **Observations from Sample Blocks:** Courtyards with greenery, especially those featuring trees, demonstrated improved microclimates (Q15). These spaces offered natural cooling during hot weather, which can contribute to community resilience by providing a cool refuge during heatwaves.

Supporting Local Food Production

- **Survey Insights:** Respondents recognized the potential benefit of introducing vegetable gardens in courtyards (Q14). This suggests an acknowledgment of the role these spaces can play in supporting local food production.

- **Observations from Sample Blocks:** Courtyards with vegetable gardens were observed yielding fresh produce. Residents participating in gardening activities appreciated the convenience of growing their own food.

Table 26. Enhancing Community Resilience and Social Cohesion

Aspect	Linked to Survey Responses	Linked to Sample Block Observations
Strengthening Social Bonds	Residents recognize green spaces as catalysts for social interactions and community (Q15)	Courtyards with green elements observed to foster spontaneous gatherings and group activities
Promoting Shared Responsibilities	Willingness of residents to engage in community initiatives for greening (Q17)	Courtyards with shared green spaces demonstrate collective gardening and maintenance activities
Building Resilience to Climate Change	Recognition of improved microclimates in green courtyards (Q15)	Observations show green courtyards providing natural cooling during hot weather
Supporting Local Food Production	Acknowledgment of potential for vegetable gardens in courtyards (Q14)	Vegetable gardens in sampled courtyards yield fresh produce, supporting local food production

Conclusion:

The integration of green elements and productive landscapes in urban courtyards has the potential to enhance community resilience and social cohesion. This can be achieved by strengthening social bonds, promoting the shared responsibilities, mitigating the effects of climate change and supporting local food production. These interventions align with the growing awareness of the importance of sustainable, resilient urban communities.

5.5. Summary: Survey vs. Sample Block Analysis

This matrix provides a concise comparison between survey insights and sample block analysis, highlighting key findings and relationships between different aspects of urban courtyards in Milan.

Table 27. Comparative Matrix: Survey vs. Sample Block Analysis

Aspects	Survey Insights	Sample Block Analysis
Greenery Importance	Strong consensus on the significance of green elements	Varied courtyard sizes and functions across different zones
Courtyard Usage	Diverse patterns: daily or weekly use emphasized	Varied usage based on zone characteristics
Community Engagement	High willingness for community initiatives	Observed community participation in maintenance and gardening
Desire for Greenery	Consistent desire for greenery across all zones	Zone-specific preferences for more green elements
Cultural Significance	Recognized historical and cultural roles of courtyards	Varied emphasis on heritage and cultural events in different zones
Social Inclusivity	Acknowledgment of courtyards as potential meeting points	Growing inclusivity in intermediate and peripheral zones
Underutilized Habits	Limited awareness of multifunctional roles of courtyards	Potential for multifunctional design in intermediate zones
Untapped Potentials	Desire for community gardens and multifunctional design	Identified potential for community gardens and cultural events

Plant Selection Strategies	Preference for diverse green elements including trees	Zone-specific plant selection considering microclimates
Irrigation Systems Consideration	Emphasis on sustainable watering methods	Zone-specific irrigation considering water availability
Maintenance Involvement	Willingness for community engagement in upkeep	Observed community participation in maintenance activities
Impact on Social Interactions	Positive correlation between greenery and social interactions	More interactions observed in courtyards with green elements
Sense of Community Strength	Desire for courtyards to support a sense of community	Shared activities fostering a sense of collective responsibility
Inclusivity and Accessibility	Varying comfort levels with opening courtyards to neighbours	Inclusive spaces observed with clear guidelines for usage
Frequency of Courtyard Use	Frequent daily or weekly use of courtyards	Increased daily use observed in courtyards with green elements
Impact on Resilience and Cohesion	Recognition of potential to strengthen social bonds	Observed positive impact on community resilience and cohesion

CHAPTER 6

PROPOSAL: DESIGN GUIDELINES

Proposal: Comprehensive Design Guidelines for Milan's Urban Zones

In this detailed design proposal, Milan's cityscape is analysed thoroughly, conducting strong surveys and thinking about various aspects. An overarching plan that is finely tuned to the unique characteristics of different parts of Milan: the City Center, Intermediate Zones and Peripheral Areas is proposed.

The proposal takes into account the varied requirements of these areas. Specific design strategies for each along with shared measures for incorporating green spaces have been developed. Additionally, the main focus was on actions that center around neighbourhoods and provided in-depth strategies for integrating green elements into the overall design.

In simpler terms, by studying Milan's urban layout, the needs of different parts of the city were studied and a plan that caters to those specific needs has been crafted. Whether it's the bustling City Center, the quieter Intermediate Zones or the Peripheral Areas, this proposal has targeted strategies. There is also a strong emphasis on the importance of green spaces and the practical steps for incorporating them seamlessly into the urban landscape have been outlined.

6.1. Differentiated Design Strategies

City Center: Maximizing Greenery in Constrained Spaces

Design Essence: The primary focus is on the crucial task of establishing rich, small-scale ecosystems within the confines of the City Center. This endeavour entails the strategic augmentation of green elements in restricted spaces, achieved through the deliberate incorporation of vertical gardens and compact design strategies. The intention is to create lush microenvironments that contribute to the aesthetic appeal and ecological sustainability of urban core, transforming constrained areas into vibrant and green spaces.

Figure 111. Schematic sketch vividly showcasing the envisioned vertical greenery and compact seating areas with an emphasis on aesthetics for heightened visual appeal.

Strategies:

- **Implement Vertical Gardens:** Building facades serve as canvases for vertical greenery, responding directly to the spatial constraints identified in the analysis (Chapters 2 and 4).

- **Compact Seating Areas:** Thoughtfully integrated seating areas provide spaces for leisure and relaxation, acknowledging the need for multifunctionality in limited spaces.

- **Aesthetic Prioritization:** Aesthetic considerations take precedence, aligning with survey responses that highlighted the community's desire for visually appealing urban spaces.

Reasoning from Thesis: Chapters 2 and 4 laid bare the concentration of compact spaces in the City Center. Respondents emphasized the need for greenery influencing the proposal to maximize green spaces within the limited available areas.

Intermediate Zones: Balancing Functionality and Ecology for Harmonious Living

Design Essence: For the Intermediate Zones the key idea is to strike a balance between practicality and the environment, aiming for a living experience that feels harmonious. A visual represention of this concept is made by carefully combining parking spaces with green areas. The design emphasizes the seamless integration of functional elements, like parking, with ecological features, creating a landscape where both aspects work together to enhance the overall living environment.

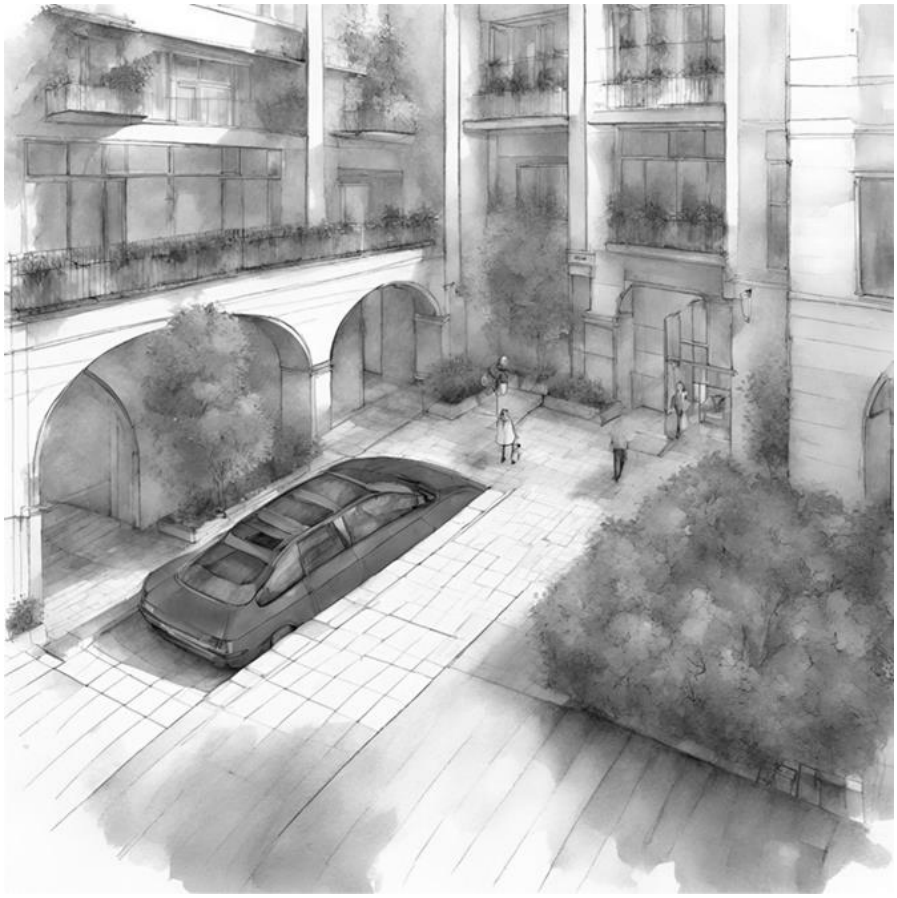


Figure 112. Schematic sketch showing seamlessly blended parking space with green elements, providing a snapshot of the proposed multifunctional courtyard and ecological integration.

Strategies:

- **Multifunctional Courtyards:** Diverse resident needs drive the development of multifunctional courtyards that cater to various activities, promoting both functionality and ecological sustainability.

- **Ecological Integration:** The proposal promotes ecological benefits alongside functional diversity, aligning with the survey findings that underscored the importance of multifunctional spaces.

- **Community Engagement Areas:** Outdoor fitness equipment and seating areas are strategically integrated to enhance community engagement, responding directly to survey preferences.

Reasoning from Thesis: Intermediate zone survey responses highlighted the importance of multifunctional spaces. The proposal integrates these insights by creating courtyards that serve various purposes, aligning with the preferences expressed by intermediate zone residents.

Peripheral Areas: Fostering Versatility in Spacious Courtyards

Design Essence: The design approach for the Peripheral Areas centers on promoting adaptability in large courtyards, placing a strong emphasis on encouraging social interactions. The visual schemes created showcase a variety of uses for these spaces and highlight the incorporation of green elements throughout. The strategy is to make these areas versatile, allowing for different activities while ensuring a prominent role for social engagement and the presence of greenery.

Figure 113. Schematic sketch depicting expansive courtyard accommodating recreational and social activities, strategically placing native trees and community gardens and encouraging cultural events.

Strategies:

- **Expansive Courtyards:** A primary emphasis is placed on creating expansive courtyards, aligning with the spacious nature identified in the analysis (Chapter 4).

- **Green Elements:** Native trees and community gardens take center stage to promote ecological sustainability and community engagement.

- **Cultural Integration:** Cultural events become integral, celebrating the diversity of residents and fostering a sense of community.

Reasoning from Thesis: The analysis in Chapter 4 highlighted the spacious nature of peripheral areas. The proposal leverages this by focusing on expansive courtyards and cultural integration, aligning with the preferences and characteristics of residents in these zones.

6.2. Common Actions for Green Integration

Community Gardens: Establishing Hubs for Ecological and Social Engagement

Design Essence: There are designated community gardens as central points that serve both ecological and social purposes. These spaces are intended to be hubs where the people come together not only to engage with nature but also to connect with each other. The idea is to create environment that promotes both ecological awareness and social interactions making these community gardens vibrant spaces for the community to gather and enjoy.

Figure 114. Schematic sketch depicting community gardens seamlessly integrated with seating areas emphasizing the symbiotic relationship between ecological and social elements

Strategies:

- **Focal Points for Interaction:** Community gardens are designed as focal points for communal interaction, aligning with the analysis (Chapter 2) that underscored the desire for community engagement.

- **Integrated Seating Areas:** Seating areas are thoughtfully integrated with gardening spaces, promoting social engagement and shared responsibilities.

- **Promoting Shared Responsibilities:** Communal gardening initiatives are championed, responding directly to the identified need for shared spaces that promote social interaction.

Reasoning from Thesis: Chapter 2's analysis underscored the desire for community engagement. The proposal incorporates community gardens, responding directly to the identified need for shared spaces that promote social interaction.

Multifunctional Spaces: Vibrant, Diverse and Inclusive

Design Essence: The multifunctional spaces are imagined to be lively and varied, encouraging a range of activities for community involvement. The idea of these spaces is to have features like playgrounds, fitness equipment and communal areas, creating an environment where people can engage in different activities and enjoy a vibrant and diverse community experience.

Figure 115. Schematic sketch highlighting the inclusivity of spaces designed to accommodate various community activities fostering social cohesion and a sense of community.

Strategies:

- **Diverse Activity Spaces:** The design caters to diverse interests by providing spaces accommodating various activities, directly aligned with the multifaceted nature of community life emphasized in the thesis.

- **Fostering Social Cohesion:** Shared spaces for activities promote social cohesion, aligning with the findings that underscored the importance of multifunctional spaces.

- **Importance of Inclusive Design:** Emphasis is placed on the importance of multifunctional design for inclusive environments, responding directly to the thesis's insights into the varied interests and needs of residents.

Reasoning from Thesis: The thesis findings emphasized the multifaceted nature of community activities. The proposal aligns with these findings by creating spaces that cater to diverse interests, promoting inclusivity and social cohesion.

Universal Interventions: Greenery as a Common Thread

Design Essence: The core theme that runs through this proposal is the universal integration of greenery, which plays a central role in enriching both ecological aspects and social connections across all zones. Visual elements are consistently used to emphasize this green integration in various contexts, showcasing how it becomes a unifying factor, contributing to a more sustainable and interconnected urban environment.

Figure 116. Schematic sketch showcasing green integration in various contexts, reinforcing the role of greenery as a common thread weaving through urban spaces.

Strategies:

- **Universal Green Integration:** Green elements are integrated universally to enhance ecology and social connections, validating the importance of greenery identified in Chapters 2, 3 and 4.

- **Introduction of Seating Areas:** Seating areas become integral across zones, promoting community gatherings and reinforcing the connection between greenery and social interactions.

- **Greenery for Ecology and Social Connectivity:** The proposal consistently highlights the dual impact of greenery, emphasizing its role in enhancing both ecology and social connections.

Reasoning from Thesis: Chapters 2, 3 and 4 collectively emphasized the universal role of greenery. The proposal integrates this insight by making greenery a central theme across all zones, emphasizing its dual impact on ecology and social connections.

6.3. Neighbourhood-Centric Design Actions

Recreational Priorities: Tailoring Spaces to Neighbourhood Preferences

Design Essence: The guiding principle is to customize recreational spaces based on what each neighbourhood prefers. The tailored visuals represent these recreational zones, showcasing how they are designed to suit the specific preferences of each neighbourhood. The idea is to make sure that recreational areas are uniquely crafted to reflect and enhance the character of the communities they serve.

Figure 117. Schematic sketch showcasing recreational zones tailored to specific neighbourhoods reflecting a nuanced approach to design based on identified preferences.

Strategies:

- **Identifying Recreational Priorities:** Neighbourhoods with a preference for recreational spaces are identified and prioritized, ensuring a targeted approach.

- **Leisure-Focused Environments:** Designing leisure-focused environments in alignment with specific neighbourhood preferences ensures relevance and resonance.

- **Customizing Elements:** Incorporating elements like outdoor sports equipment based on recreational priorities establishes a tailored approach, directly in line with Chapter 5's emphasis on neighbourhood-centric interventions.

Reasoning from Thesis: Chapter 5 highlighted the importance of tailoring interventions to specific neighbourhood preferences. The proposal integrates this by customizing recreational spaces based on identified neighbourhood priorities, ensuring a more targeted and effective approach.

Biodiversity Focus: Enhancing Natural Elements Based on Neighbourhood Characteristics

Design Essence: A central focus is to boost biodiversity by tailoring interventions to suit the characteristics of each neighbourhood. Visual representations highlight the biodiversity focused strategies in various zones illustrating how the designed interventions enhance and support the unique natural features of each area. The goal is to create a more diverse and resilient urban ecosystem that aligns with the distinctive qualities of each neighbourhood.

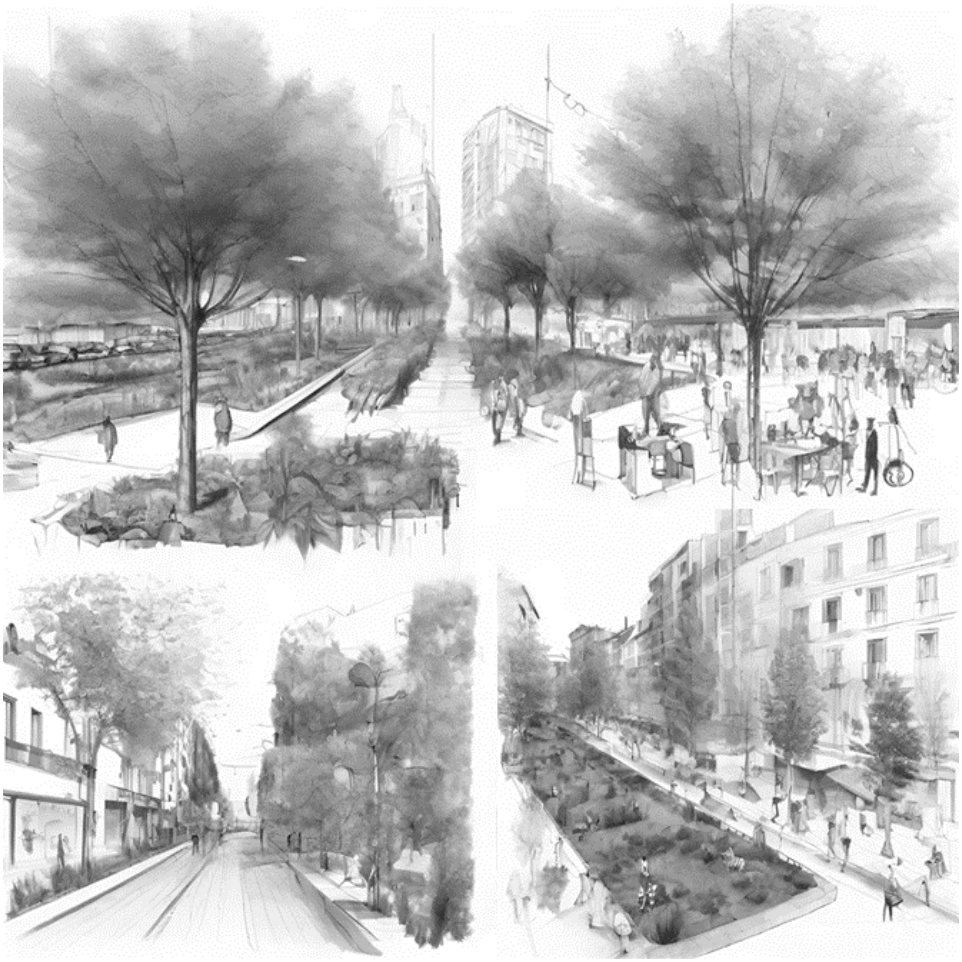


Figure 118. Schematic sketch depicting biodiversity-focused interventions, illustrating a commitment to enhancing natural elements based on specific neighbourhood characteristics.

Strategies:

- **Identifying Biodiversity Inclinations:** Neighbourhoods with a strong inclination towards biodiversity enhancement are identified, forming the basis for tailored green interventions.

- **Tailoring Green Interventions:** Design interventions are tailored to specific neighbourhood characteristics, ensuring maximum impact on biodiversity.

- **Variety of Plant Species:** Enhancing biodiversity by introducing a variety of native and drought-resistant plant species aligns with the findings in Chapter 3, emphasizing varying biodiversity preferences.

Reasoning from Thesis: Analysis in Chapter 3 emphasized the varying biodiversity preferences. The proposal acknowledges this by tailoring interventions to each neighbourhood, aligning with their unique characteristics and preferences.

Cultural Integration: Celebrating Diversity Through Design Elements

Design Essence: The design philosophy places a crucial emphasis on celebrating cultural diversity through carefully selected design elements. Visual concepts vividly portray how there is an integration of diverse cultural influences into the intermediate and peripheral zones. The intention is to create spaces that reflect and honour richness of different cultures fostering inclusivity and a sense of identity in these areas.

*Figure 119. Schematic sketch showcas*ing *design elements that celebrate cultural diversity, fostering inclusivity and cultural richness in specific zones.*

Strategies:

- **Recognizing Cultural Heritage:** Neighbourhoods with a rich cultural heritage are recognized, forming the basis for culturally integrated design elements.

- **Incorporating Cultural Diversity:** Design elements that celebrate cultural diversity are incorporated, aligning with the cultural richness emphasized in Chapter 5.

- **Promoting Inclusivity:** Cultural aspects are seamlessly integrated into the design, promoting inclusivity and fostering a sense of community.

Reasoning from Thesis: Chapter 5 emphasized the cultural richness of certain neighbourhoods. The proposal responds by incorporating cultural elements, aligning with the identified cultural diversity of specific zones.

6.4. Green Integration Strategies

Strategic Tree Placement: Enhancing Comfort and Aesthetic Appeal

Design Essence: Strategic tree placement is adopted to enhance comfort and aesthetic appeal. The visuals highlight these well-placed trees in courtyards, emphasizing how they create shaded areas. This not only enhances comfort but also adds to the visual charm, contributing to an aesthetically appealing environment.

Figure 120. Schematic sketch emphasizing the strategic placement of trees, creating shaded areas for enhanced comfort and aesthetic appeal.

Strategies:

- **Prioritizing Shaded Areas:** The introduction of trees in areas with limited greenery takes precedence, ensuring shaded spaces for enhanced comfort.

- **Creating Shaded Areas:** Shaded areas are strategically designed, considering courtyard dimensions and solar exposure, directly addressing the need highlighted in Chapter 2.

Reasoning from Thesis: Chapter 2 highlighted the importance of shaded areas. The proposal strategically places trees to address this need, ensuring that each courtyard maximizes comfort and aesthetic appeal.

Water Elements: Microclimate Regulation and Aesthetic Enhancement

Design Essence: There are incorporated water elements for multiple benefits including cooling, regulating the microclimate and adding to the overall beauty. Schematic representations highlight the strategic placement of fountains and water ponds in design. These elements not only serve practical purposes like cooling but also contribute to visual appeal creating a more pleasant and aesthetically pleasing environment.

Figure 121. Schematic sketch highlighting fountains and water ponds strategically integrated to enhance visual and auditory appeal and contribute to microclimate regulation.

Strategies:

- **Exploring Water Features:** The proposal explores the use of fountains and water ponds, enhancing both visual and auditory appeal.

- **Microclimate Regulation:** Water elements are strategically used for microclimate regulation and cooling effects, aligning with the desire for cooling elements identified in Chapters 2 and 4.

Reasoning from Thesis: Chapters 2 and 4 highlighted the desire for cooling elements. The proposal integrates water features strategically, aligning with the identified need for microclimate regulation and enhanced visual aesthetics.

Ecological Corridors: Connecting Green Spaces Across Neighbourhoods

Design Essence: By creating the ecological corridors we can connect green spaces seamlessly across neighbourhoods. The conceptual visuals illustrate these interconnected green corridors demonstrating how the nature can flow through different areas providing a continuous and harmonious connection between various green spaces. This approach aims to enhance the ecological balance and create a more unified and interconnected urban landscape.

Figure 122. Schematic sketch depicting interconnected green corridors, emphasizing the importance of seamless connections between green areas for ecological balance.

Strategies:

- **Identifying Pathways:** Pathways for ecological corridors are identified, connecting different zones and fostering biodiversity.

- **Importance of Interconnected Spaces:** Emphasis is placed on the importance of interconnected green spaces for ecological balance, responding directly to the potential for ecological connections highlighted in Chapter 4.

- **Promoting Biodiversity:** Seamless connections between green areas are promoted, contributing to biodiversity enhancement across the urban fabric.

Reasoning from Thesis: Chapter 4 highlighted the potential for ecological connections. The proposal establishes ecological corridors, responding to the identified need for interconnected green spaces, contributing to ecological balance and biodiversity.

6.5. Discussion of connection between analysis and proposal

The proposed comprehensive design guidelines for Milan's urban zones emerge as a natural extension of the in-depth analysis conducted on the city's existing urban fabric. The connection between the analysis findings and the subsequent proposal guidelines is integral to understanding the rationale behind the suggested interventions. This discussion aims to illuminate the seamless link between the analytical insights gained from Chapters 2 to 5 and the design strategies outlined in the proposal.

6.5.1. Compact Spaces in the City Center:

Analysis (Chapters 2 and 3): The analysis revealed a concentration of compact spaces in Milan's City Center, necessitating innovative solutions to maximize greenery within spatial constraints.

Proposal (Differentiated Design Strategies): The proposal responds by advocating for vertical gardens and compact seating areas, aligning with the identified need to create lush microenvironments within confined spaces. The emphasis on aesthetic prioritization resonates with survey responses, addressing the community's desire for visually appealing urban spaces in the City Center.

6.5.2. Multifunctional Spaces in Intermediate Zones:

Analysis (Survey Findings): Intermediate zone survey responses highlighted the importance of multifunctional spaces that balance functionality and ecological sustainability.

Proposal (Differentiated Design Strategies): The proposal translates these insights into the creation of multifunctional courtyards, promoting ecological integration and catering to diverse resident needs. The incorporation of outdoor fitness equipment and seating areas aligns with the survey preferences, enhancing community engagement in intermediate zones.

6.5.3. Versatility in Peripheral Areas:

Analysis (Chapter 4): Peripheral areas were identified for their spacious nature, indicating the potential for versatile design interventions.

Proposal (Differentiated Design Strategies): The proposal capitalizes on the spaciousness of peripheral areas by focusing on expansive courtyards and cultural integration. This aligns with the identified characteristics and preferences of residents in these zones, fostering a sense of community and accommodating diverse recreational and cultural activities.

6.5.4. Universal Green Integration:

Analysis (Chapters 2 and 4): The analysis collectively emphasized the universal role of greenery in enhancing both ecology and social connections.

Proposal (Common Actions for Green Integration): The proposal makes greenery a central theme across all zones, introducing universal green integration strategies. The integration of seating areas and the consistent emphasis on the dual impact of greenery on ecology and social connectivity align with the identified importance of green elements in urban spaces.

6.5.5. Neighbourhood-Centric Tailoring:

Analysis (Chapter 5): The analysis highlighted the importance of tailoring interventions to specific neighbourhood preferences.

Proposal (Neighbourhood-Centric Design Actions): The proposal operationalizes this insight by customizing recreational spaces, enhancing biodiversity and celebrating cultural diversity based on identified neighbourhood priorities. This ensures a targeted and effective approach that resonates with the unique characteristics of each area.

6.5.6. Green Integration Strategies:

Analysis (Chapters 2 and 4): The analysis provided insights into the preferences and needs related to green elements, shaded areas, water features and ecological connections.

Proposal (Green Integration Strategies): The proposal responds to these insights by strategically placing trees for enhanced comfort, integrating water elements for microclimate regulation and aesthetic enhancement and establishing ecological corridors to connect green spaces. Each strategy addresses specific needs identified in the analysis, ensuring a holistic approach to green integration.

In essence, the proposal is a direct outcome of the meticulous analysis conducted on Milan's urban zones. It bridges the gap between understanding the existing urban fabric and envisioning a sustainable, vibrant and community-centric future. The proposed design guidelines act as a strategic response to the identified challenges and opportunities, aligning closely with the preferences and characteristics revealed through the comprehensive analysis. This connection ensures that the proposed interventions are not arbitrary but are grounded in a deep understanding of Milan's unique urban dynamics.

CHAPTER 7

CONCLUSION

In the pursuit of reimagining the courtyard spaces within Milan, this comprehensive study delved into the intricacies of the existing urban fabric, aiming to weave a tapestry of sustainable, vibrant and community-centric environments. This exploration has traversed through the analysis of compact spaces in the City Center, multifunctional spaces in Intermediate Zones and the versatile expanses of Peripheral Areas. Rooted in this analysis, the proposal unfolds as a strategic response to the challenges and opportunities embedded in Milan's courtyard spaces.

7.1. Main Findings

The exploration commenced with a meticulous analysis of three sample zones, each presenting unique characteristics that mirror the diversity within Milan's urban landscape. The concentrated examination of these zones, coupled with an in-depth survey, has enabled to distill key insights into the preferences, needs and dynamics of the residents.

Compact Spaces in the City Center:

- The City Center, characterized by its compact spaces, necessitates innovative solutions. The proposal, with its focus on vertical gardens and compact seating areas, aligns with the identified need to create lush microenvironments within spatial constraints.

Multifunctional Spaces in Intermediate Zones:

- Intermediate zone residents expressed the importance of multifunctional spaces. This proposal responds with the creation of courtyards that balance functionality and ecological sustainability, incorporating outdoor fitness equipment and seating areas to enhance community engagement.

Versatility in Peripheral Areas:

- The spacious nature of Peripheral Areas opens avenues for versatile design interventions. The proposal capitalizes on this by focusing on expansive courtyards and cultural integration, aligning with the characteristics and preferences of residents in these zones.

Universal Green Integration:

- The universal role of greenery emerged as a common thread across zones. The proposal integrates green elements universally, emphasizing their dual impact on ecology and social connections.

Neighbourhood-Centric Tailoring:

- The importance of tailoring interventions to specific neighbourhood preferences is highlighted. The proposal operationalizes this insight by customizing recreational spaces, enhancing biodiversity and celebrating cultural diversity based on identified neighbourhood priorities.

Green Integration Strategies:

- Strategic tree placement, water elements and ecological corridors emerged as pivotal strategies. The proposal strategically places trees for enhanced comfort, integrates water elements for microclimate regulation and aesthetic enhancement and establishes ecological corridors to connect green spaces seamlessly.

7.2. Conclusions: Unveiling the Essence of Milan's Courtyard Spaces

As the curtains are drawn on the exploration into the intricate tapestry of Milan's courtyard spaces, a profound narrative unfolds—a narrative intricately woven with threads of analysis, community insights and visionary proposals. This concluding chapter aims to unravel the essence of the findings and the transformative potential encapsulated within the proposed design guidelines.

7.2.1. A Nuanced Understanding:

This journey commenced with a meticulous examination of three distinct sample zones, symbolizing microcosms of Milan's urban diversity. From the bustling compact spaces of the City Center to the multifunctional landscapes of Suburban Zones and the expansive versatility of Peripheral Areas, each zone bore its unique characteristics and challenges.

Through this granular analysis, the nuanced intricacies that define the soul of Milan's courtyard spaces were unearthed.

7.2.2. Designing for Specificity:

The main focus of this study lies in the understanding that one size does not fit all. As revealed by the community engagement initiatives and surveys, the importance of tailoring interventions to the specific needs and preferences of each neighbourhood was recognised. The City Center demanded a focus on microenvironments, the Intermediate Zones sought a harmonious blend of functionality and ecology and the Peripheral Areas yearned for versatile, culturally rich hubs. The design guidelines put forth are not generic solutions but rather tailored responses to the unique identity of each zone.

7.2.3. Universal Green Integration:

An overarching theme emerged through the veins of this analysis—greenery as a unifying force. From the compact spaces of the City Center to the sprawling expanses of Peripheral Areas, green elements manifested as vital contributors to ecological balance and social connectivity. This universal integration of greenery serves as a common thread weaving through the fabric of Milan's urban zones, providing not only aesthetic appeal but also fostering a sense of community and environmental sustainability.

7.2.4. Beyond Physical Spaces:

These conclusions transcend the mere physicality of spaces. They resonate with the pulse of communities, recognizing the cultural richness, recreational priorities and biodiversity inclinations unique to each neighbourhood. Milan's courtyard spaces, as envisaged in this proposal, cease to be static entities; they become living, evolving entities that embody the collective aspirations of the residents.

7.2.5. A Catalyst for Transformative Change:

In essence, this thesis is not a mere academic exercise but a call to action—a catalyst for transformative change. It beckons urban planners, architects and communities to engage in a collaborative initiative, shaping Milan's courtyards into vibrant, resilient and inclusive spaces. It serves as a guidebook, a source of inspiration and a testament to the potential of conscious and community-centric urban design.

7.2.6. Shaping the Future:

As Milan's courtyard spaces evolve guided by these design principles, a future where sustainability, culture and community are seamlessly interwoven is envisioned. These spaces become catalysts for social interactions, biodiversity conservation and cultural celebrations. The harmonious coexistence of nature and humanity, diversity and unity, echoes through the labyrinth of courtyards, fostering a city that thrives on the principles of interconnectedness and resilience.

7.3. Future Research and Improvements

7.3.1. Continuous Monitoring and Adaptation

Key Emphasis: The proposal advocates for the establishment of a continuous monitoring system to adapt the design guidelines to evolving community needs and changing environmental conditions.

Explanation: Recognizing the dynamic nature of community preferences highlighted in Chapter 5, a system of continuous monitoring becomes essential. This adaptive approach ensures that the proposed interventions remain responsive and effective over time. Regular feedback loops and data collection mechanisms should be integrated into the urban planning process to facilitate ongoing adjustments.

7.3.2. Comparative Studies

Key Emphasis: The recommendation for conducting comparative studies with other compact cities aims to identify universally applicable design principles while respecting context-specific nuances.

Explanation: While the proposal provides tailored strategies for Milan, there's acknowledgment of the uniqueness of each urban context. Comparative studies with other compact cities can reveal shared principles and best practices, contributing to a broader understanding of urban design. This approach encourages a cross-cultural exchange of ideas and experiences, fostering a more comprehensive and adaptable set of guidelines.

7.3.3. Technology Integration

Key Emphasis: The proposal suggests the integration of technology to enhance sustainability, community engagement and maintenance efficiency.

Explanation: Building upon the insights from Chapter 5, which hinted at the potential of technology, the proposal recommends incorporating smart technologies. These could include IoT (Internet of Things) devices for real-time environmental monitoring, community engagement platforms and sustainable maintenance practices. The goal is to leverage technology as a tool for optimizing the long-term impact of green interventions.

LIST OF FIGURES

SOURCES FOR BELOW FIGURES: Author (2023)

LIST OF TABLES

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POLITECNICO
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Academic year: 2021-2023

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