

Study of Green Space Morphology and Typology in Urban Landscape of Northern Nicosia

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ABSTRACT

As cities are growing rapidly and more than half of the world's population is living in urban areas, the quality of urban settlements has become a vital issue. The significant role of urban green spaces and vegetated areas have received attention from ecologists, environmentalists, and planners. Within this scope, one of the important issues that deal with green spaces is urban morphology in order to understand the morphology of green spaces. However, urban morphologists have only recently begun considering green space, and morphological analyses of green space are still rare. This study addresses this gap in historico-geographical and process typological approaches in order to examine the possibility of identifying "Green Space" as an individual element in urban structure. It proposes a systematic framework for assessing green space structure based on existing hierarchical theories in urban morphology introduced by M. R. G. Conzen, Caniggia, Kropf and Osmond. The framework is tested in the case of Northern Nicosia and particularly in three significant neighbourhoods, which are Köşklüçiftli, Çağlayan, and Yenişehir, to assess the opportunities provided by the framework, its limitations, and factors that played a role in its successful implementation.

Keywords: Urban Morphology, Green Space, Typology, Cyprus, Nicosia

ÖZ

Kentlerin hızla büyümesi ve dünya nüfusunun yarısından fazlasının kentsel alanlarda yaşaması, kentsel yerleşimlerin kalitesinin sorgulanması bağlamında önemli bir noktaya gelmiştir. Kentsel yeşil alanların ve bitkisel yeşil alanların rolü ve önemi, ekolojistlerin, çevrecilerin ve planlamacıların dikkatini çekmiştir. Bununla birlikte, kent içerisindeki yeşil alanların kentsel morfoloji kapsamında irdelenmesi yeni çalışılmaya başlanmıştır. Bu kapsamda, bu çalışma, kentsel yapıda morfolojik unsur olarak “Yeşil Alan” ın tanımlanması için *tarihsel-coğrafi* ve *tipolojik süreçler*deki boşluğu ele alarak morfolojik yeşil alanın bu tür çalışmalarındaki tanımını yapar. Bu tez, M. R. G. Conzen, G.F. Caniggia, K. Kropf ve P.Osmond tarafından tanımlanan kentsel morfolojideki mevcut hiyerarşik teorilere dayalı yeşil alan yapısını değerlendirmek için sistematik bir çerçeve önermektedir. Oluşturulan çerçeveye bağlı, Kuzey Lefkoşa'daki Çağlayan, Köşklüçiftlik ve Yenişehir bölgeleri örneklem olarak incelenerek, çalışmanın sağladığı fırsatlar, sınırlamalar ve başarıya ulaşması için rol oynayan faktörler ele alınarak tartışılmıştır.

Anahtar Kelimeler: Kentsel Morfoloji, Morfolojik Analiz, Yeşil Ağ, Kıbrıs, Kuzey Lefkoşa

To WOMEN of my county IRAN

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TABLE OF CONTENTS

ABSTRACT.....	iii
ÖZ	iv
ACKNOWLEDGMENT.....	vi
LIST OF TABLES	xi
LIST OF FIGURES	xii
1 INTRODUCTION	1
1.1 Introduction	1
1.2 Statement of the Problem	2
1.3 Aim and Objectives	4
1.4 Research Questions	4
1.5 Methodology and Data Collection	5
1.6 Thesis Limitation.....	7
1.7 Thesis Structure	8
2 URBAN FORM AND URBAN MORPHOLOGY	11
2.1 Introduction	11
2.2 Urban Morphology Definition	11
2.3 Urban Morphology Schools of Thought	15
2.3.1 The British School	16
2.3.2 Italian School	24
2.4 Urban Morphological Approaches	33
2.4.1 The Historico-Geographical Approach	35
2.4.1.1 Function.....	38
2.4.1.2 Social and Economic Context	38

2.4.1.3 Site.....	38
2.4.1.4 Development	39
2.4.1.5 Townscape.....	39
2.4.1.6 Land Utilization Pattern	41
2.4.1.7 Building Fabric.....	43
2.4.1.8 Town Plan	44
2.4.1.9 Plan-Unit	48
2.4.1.10 Morphological Period.....	49
2.4.1.11 Fringe Belt.....	51
2.4.2 The Process Typological Approach.....	55
2.4.2.1 Building.....	58
2.4.2.2 Urban Tissue	58
2.4.2.3 Urban Organisms	63
2.4.3 Configurational Approach	63
2.4.4 The Spatial Analytical Approach	68
2.4.4.1 Cellular Automata	69
2.4.4.2 Agent-Based Models.....	70
2.4.4.3 Fractals	72
2.4.4.4 . Parametric Design	74
2.5 Review of Various Urban Morphological Approaches	76
2.6 The Methodological Framework of Karl Kropf.....	77
2.7 The Methodological Framework of Paul Osmond.....	80
2.8 Chapter Summary	84
3 URBAN FORM AND GREEN SPACE.....	86
3.1 Introduction	86

3.2 Definition of Urban “Open” and “Green” Spaces.....	86
3.2.1 Open Space	87
3.2.1.1 Grey space	88
3.2.1.2 Green Space	88
3.2.1.3 Blue Space.....	89
3.3 Green Space Typologies.....	90
3.4 Green Space Elements and Characteristics	97
3.5 Classifications of Green Spaces for Present Study	99
3.6 Green Space as an Object of Study in Morphological Research.....	101
3.7 Chapter Summary.....	103
4 METHODOLOGY	104
4.1 Introduction	104
4.2 Research Strategy	105
4.3 Qualitative Research Method	105
4.4 Research Approach	107
4.5 Research Design	108
4.5.1 Macro-Level Analysis	109
4.5.2 Micro Level Analysis	111
4.6 Data Collection Method and Tools	117
4.7 Chapter Summary.....	118
5 APPLYING THE METHOD TO THE SELECTED CASE STUDY: NORTHERN NICOSIA	120
5.1 Introduction	120
5.2 Historical Background of Nicosia	120
5.3 The Urban Structure of Nicosia	125

5.4 Selection of Districts	126
5.5 Morphological Characteristics of Nicosia.....	127
5.5.1 Macro Level of Analysis	127
5.5.1.1 Fringe Belt.....	128
5.5.1.2 Townscape.....	138
5.5.2 Micro-Level of Analysis.....	146
5.5.2.1 Köşklüçiftlik Neighbourhood.....	147
5.5.2.2 Çağlayan Neighbourhood.....	166
5.5.2.3 Yenişehir District	181
5.6 Summary of Findings	203
CONCLUSION AND DISCUSSIONS	211
5.7 Discussion	211
5.8 Evaluation of the Proposed Framework	215
5.9 Further Study	216
REFERENCES.....	218

LIST OF TABLES

Table 1: Thesis structure and chapters' relations	10
Table 2: German geographers' contributions to urban morphology from the 1890s till 1932.....	16
Table 3: Urban morphology, urban form, and townscape studies in Britain	19
Table 4: Development of urban morphology research in Britain between the 1960s and 1970s	20
Table 5: Recent scholars' contributions to urban morphology	21
Table 6: Development of typological concepts by Italian and American scholar	33
Table 7: Classifications of parks by Byrne and Sipe (2010).....	92
Table 8: Urban green space by Rall et al. (2015).....	97
Table 9: Typology of green space used for the current study (Author 2022).....	100
Table 10: The proposed framework (Author, 2022)	114
Table 11: Data collection methods and tools	118

LIST OF FIGURES

Figure 1: Illustration of townscape (Cömert 2013).....	41
Figure 2: Illustration of land utilization (Cömert 2013).....	42
Figure 3: Illustration of building fabric (Cömert 2013).....	43
Figure 4: Illustrations of street, plot, and building pattern by Kropf (1996)	45
Figure 5: Illustration of plan unit (Cömert 2013).....	49
Figure 6: Illustration of morphological regions in Ludlow (Conzen, 1988).....	50
Figure 7: Illustration of fringe belts of Newcastle in 1965 (Whitehand, 1967).....	52
Figure 8: Illustration of a building according to Caniggia (Kristjánsdóttir, 2019)	58
Figure 9: Illustration of an urban tissue (Strappa,2020)	59
Figure 10: Illustration of lot division by Cömert (2013).....	60
Figure 11: Illustration of the pertinent strip (Cömert, 2013)	61
Figure 12: Illustration of the route (Cömert, 2013).....	62
Figure 13: Illustration of the block (Cömert, 2013).....	63
Figure 14: Illustration of an urban organism according to Caniggia (Kristjánsdóttir, 2019)	63
Figure 15: Basic conceptions in space syntax analysis (Yamu, 2021)	67
Figure 16: Three types of syntactic maps (Yamu, 2021).....	67
Figure 17: Cellular Automata of Mashad's night map (Talebian, 2020)	69
Figure 18: Example of Cellular Automata models (McGrath, 2017)	69
Figure 19: Example of Agent-Based Models (Cheliotis, 2020).....	72
Figure 20: Left: the Mandelbrot set, a mathematical fractal. Center: Venice's fractal urban fabric. Right: the Eiffel Tower's fractal architecture (Boeing, 2018).....	73

Figure 21: Comparison of elements identified by Conzen, and Caniggia and Maffei. (Kropf 2014).....	78
Figure 22: Developed diagrams for the position of the ‘area’ within the hierarchy (top) and the boundary between two types of voids or space (below). (Kropf 2014)	79
Figure 23: developed diagram for showing the position of street space and its relationship to plot series (Kropf. 2014)	80
Figure 24: Patterns of open space within an urban structural unit (Osmond 2010)...	82
Figure 25: Proposed hierarchy of open space (Osmond, 2010)	83
Figure 26: Decomposition of the urban structural unit. (Osmond, 2010).....	84
Figure 27: Definition of open space by Swanwick (2003)	88
Figure 28: Top left: Community park (https://www.crpd.org)- Top right: Pocket park (https://www.archdaily.com)- Down left: Neighbourhood park (https://landezine.com) - Down right: National park(https://www.strongtowns.org).....	93
Figure 29: Left: Sechseläuten Square in Zürich, Switzerland (https://www.juliusbaer.com/en/insights/future-cities/top-10-modern-city-squares-in-the-world/) Right: Rittenhouse Square, Philadelphia (https://www.cnu.org/publicsquare/2019/05/10/ten-great-public-squar	93
Figure 30: Greenways(https://www.tallahassee.com/story/life/causes/2020/06/15/blueprint-green-city-expands-trail-system/3174758001/)	94
Figure 31; Street in Sweden (https://aspiremetro.com/swedens-street-moves/).....	94
Figure 32: The typology of green and public spaces defined by Bell et al. (2007) ...	95
Figure 33: Typology of green spaces by Swanwick et. at. (2003).....	96
Figure 34: Research approach from macro to the micro level (Author, 2022).....	107
Figure 35: Research method at city level (Author, 2022).....	110

Figure 36: Research method at district level.....	113
Figure 37: Research method at block level.....	113
Figure 38: Research method at plot level.....	114
Figure 39: Map of cyprus (Alipor, 2011).....	121
Figure 40: From left to right: Kyrenia Gate, Paphos Gate, Famagusta Gate (https://en.wikipedia.org/wiki/Kyrenia_Gate (https://www.classic.com.cy/sights&landmarks).....	121
Figure 41: Left: Buyuk Han (Ottoman caravanserai architecture) (https://www.lonelyplanet.com/cyprus/north-cyprus/lefkosa-north-nicosia)	122
Figure 42: The British Colonial Law Courts (https://en.wikipedia.org/wiki/Law_Courts,_Nicosia).....	123
Figure 43: Diagram of the development of Nicosia and Buffer Zone. (Author, 2022)	125
Figure 44: Selected districts in city image	127
Figure 45: Nicosia's fringe belts (Author,2022).....	129
Figure 46: Nicosia's inner fringe belt (Author,2022)	130
Figure 47: Nicosia's inner fringe belt and green spaces.....	132
Figure 48: Nicosia's middle fringe belt (Author,2022)	134
Figure 49: Kuğulu Park- Right: Ankara Çağlayan Park (Author, 2019)	135
Figure 50: Nicosia's former railroad and Kumsal park (Author, 2019)	136
Figure 51: Lefkoşa Turkish High School (https://www.google.com).....	137
Figure 52: Turkish Maarif College (https://www.google.com)	137
Figure 53:Nicosia's outer fringe belt (Author, 2022)	138
Figure 54: Morphological regions (Author, 2022).....	140
Figure 55: Nicosia districts (Author, 2022)	143

Figure 56: Nicosia's land utilization (Author, 2022).....	145
Figure 57: Köşklüçiftlik neighbourhood.....	148
Figure 58: Köşklüçiftlik neighbourhood building pattern (Author, 2022)	150
Figure 59: Pine trees on plot head (Author, 2022).....	152
Figure 60: Typology of GSs(green spaces) on rectangular plots with a ratio 1.5:1 (Author, 2022).....	152
Figure 61:Locations of rectangle plots with a ratio of 1.5:1 and green spaces showing the neighbourhood's nucleus. (Author,2022)	153
Figure 62: Private land ownership and density of GSs (green spaces). (Author,2022)	154
Figure 63: Arrangement of green space on Köşklüçiftlik corner plots. (Author,2022)	155
Figure 64:Köşklüçiftlik street pattern. (Author, 2022)	157
Figure 65: Köşklüçiftlik street pattern based on the typology of GS (green space). (Author, 2022).....	158
Figure 66:Type A Street without green space (GS) on green space street space. (Author, 2022).....	159
Figure 67: Type B Street with GSs (green spaces) on the street space. (Author, 2022)	160
Figure 68: Köşklüçiftlik 's block typology and GSs (green spaces)-southern part .	162
Figure 69: Köşklüçiftlik 's block typology and GSs (green spaces)-the northern part	163
Figure 70: GS's land use and functional uses (green space). (Author, 2022)	165
Figure 71: Çağlayan neighbourhood. (Author, 2022).....	167
Figure 72: Çağlayan neighbourhood building and plot pattern. (Author, 2022)	168

Figure 73: Typology of GSs (green spaces) on rectangular plots. (Author, 2022)..	169
Figure 74: Locations of various typologies of GS(green space). (Author, 2022)....	170
Figure 75:Private land ownership and density of vegetation. (Author, 2022).....	171
Figure 76: Çağlayan street pattern. (Author,2022)	173
Figure 77: Çağlayan street pattern. based on the typology of GS (green space). (Author, 2022)	174
Figure 78: Type A Street without GS (green space). (Author, 2022).....	175
Figure 79: Type B Street with GS (green space). (Author, 2022)	175
Figure 80: Street typology and GSs (green space). (Author, 2022).....	176
Figure 81: Çağlayan ‘s block typology and GSs (green spaces)-northern part. (Author, 2022)	178
Figure 82: Block typology and GSs(green spaces). (Author, 2022).....	179
Figure 83: Land use and functional uses of GSs (green space). (Author, 2022)	181
Figure 84:Yenisehir neighbourhood. (Author, 2022)	182
Figure 85: Yenişehir plan units. (Author, 2022).....	184
Figure 86: Yenisehir building pattern. (Author, 2022)	185
Figure 87: Yenisehir plan unit 1. (Author, 2022).....	186
Figure 88: Yenisehir plan unit 2.....	187
Figure 89: Yenisehir plan unit 2 neighbourhood silhouettes. (Author, 2022)	188
Figure 90: Yenisehir plan unit 2 plot typologies. (Author, 2022).....	188
Figure 91: Yenisehir plan unit 3.....	189
Figure 92:Yenisehir plan unit 3 plot typologies. (Author, 2022).....	189
Figure 93: Yenisehir plan unit 4.....	190
Figure 94: Yenisehir plan unit 3 plot typologies. (Author, 2022).....	191
Figure 95: Yenisehir plan unit 5.....	192

Figure 96: Yenisehir private land ownership and density of vegetations. (Author, 2022)	192
Figure 97: Yenişehir street pattern	194
Figure 98:Yenişehir street typology and GSs (green spaces). (Author, 2022)	194
Figure 99: Yenişehir Type A street typology. (Author, 2022)	195
Figure 100: Yenişehir Type B Street typology (Author, 2022)	195
Figure 101:Yenisehir plan unit 1 block typology and GSs (green spaces). (Author,2022)	196
Figure 102: Yenisehir plan unit 2 block typology and GSs (green spaces). (Author, 2022)	197
Figure 103: Yenisehir plan unit 3 block typology and GSs (green spaces). (Author, 2022)	198
Figure 104: Yenisehir plan unit 4 block typology and GSs (green spaces). (Author, 2022)	199
Figure 105: Yenisehir plan unit 5 block typology and GSs (green spaces). (Author, 2022)	200
Figure 106: Yenisehir Land use and functional uses of GSs (green spaces). (Author, 2022)	202
Figure 107: Overall macro-level analysis	209
Figure 108: Overall micro-level analysis	210

Chapter 1

INTRODUCTION

1.1 Introduction

Urban morphology has become a significant part of urban studies for more than a decade due to the role of morphology studies in describing the physical form of the cities and explaining human actions. Urban morphology shows a city's anatomy and the pattern of formation and transformation of human habitats during history.

Urban greenery and green space may be considered as a part of the urban form, which is shaped as open space between masses in a designed and spontaneous form. Various types and shapes of green spaces have different impacts on human sensation and, simultaneously, on the formation of urban spaces. Therefore, considering location, form, size and type of green spaces in developing a city's structure may produce different results. For that reason, creating a systematic pattern or framework for developing green spaces in cities may help planners and urban designers to plan cities with sufficient green spaces.

Recently, green spaces have gained considerable attention due to their role in achieving sustainable urban form and new concepts of green spaces like vertical landscaping, green walls and green roofs are suggested to increase the amount of greenery in cities and get advantage from greeneries in urban structure. Green spaces can play significant roles in urban areas. The “Green Space” has several functions

relating to ecological, infrastructural, urban hygiene and public health perspectives and are living entities in themselves. Therefore, the connection between morphological and functional features of green space within the urban form context is crucial and can affect public health, well-being and quality of urban life. Urban morphological studies have usually focused on open space as a general term and have given less consideration to elements such as green space and its details. However, examining urban green space from the perspective of morphology is an important way to understand the physical structure of urban green space as a significant part of the urban environment that affects the function of urban natural habitats and maintains good spatial patterns of the urban ecological environment.

1.2 Statement of the Problem

Nowadays, more than half of the world's population lives in urban areas, and by 2050 almost 70 percent of the population will live in urban settlements (United Nations, 2016). Consequently, environmentalists and planners considered the vital role of urban green spaces and vegetation-covered areas in balancing humans and the environment. Although many scholars have studied the benefits of green space, the role of green space in the formation and transformation of the structure of new urban forms needs to be considered in different fields of urban studies, including urban morphology.

One of the significant dimensions of urban form is morphology; as Carmona (2010) mentioned, it is related to the city's physical characteristics systematically configuring urban form and space. Morphological studies focus on basic physical elements that help urban designers be aware of patterns of development and change processes. Physical features of urban form would include different types of urban patches in the cities, such as a market town, central business district or suburbs, or it would consist

of features like building material, facades organization, housing type, street type and their layout.

Generally, urban morphologists determined the form of cities in different periods using systematic methods. While these methods covered most urban features like land use, plot formation, streets, urban blocks, building structure and materials, the problem is that other elements like spaces between them, such as green spaces, are not taken into consideration as an element of urban morphology. One possible reason behind it might be that, in the early settlements, like Greek, Roman or medieval towns, green spaces were located outside of the city walls and were not considered in the structure of the urban environment. Consequently, former urban morphologists did not focus on these issues particularly.

However, after the nineteenth century, environmentalists considered greenery's positive role in improving the urban quality of life and emphasising green spaces within the urban form. But still, a limited consideration of the green dimension of urban form can be seen in the work of urban morphologists.

In addition, after the development of new concepts of urban forms, which added green space (Osmond, 2008; Hopkins, 2012; Whitehand, 2019; Zhang, 2018; Marcus, 2019; Zou & Wang, 2021) to the consideration, still different types of green elements such as private gardens, communal green spaces, local parks, city parks or fringe green lands in the urban morphological analysis are not considered intently. Emerging concepts of green spaces such as vertical surfaces, green walls and green roofs within the urban context can also be taken into consideration as physical elements that affect urban form in different dimensions. In summary, the main problem is the limited

studies on the urban green dimension in morphological studies and the application of morphological approaches in new concepts of urban forms such as compact cities, metropolitan, etc.

1.3 Aim and Objectives

As described above, morphology studies lead the researcher to understand humans' tangible and visible actions in their built environment. This study focuses on the morphological characteristics of urban green spaces in the urban environment. In this regard, the study's main aim is to develop a method for analysing the green dimension as a tool in morphological studies. In other words, this study aims to bring up the necessity and possibility of considering green spaces as a factor which affects urban form and patterns of formation and transformation of morphology of cities' by means of urban green spaces. Therefore, research is aimed to interpret historico-geographical and process typological methodology for redefining the urban green spaces as an element in morphological studies.

1.4 Research Questions

Upon the aim of the study, the main research question is; would it be possible to add 'Urban Green Spaces' as an element while analysing morphology of urban settlements?

Based on the problem definition, the main questions for this research may focus on:

- 1- How can urban green space be integrated into morphological studies, or can it be a part of urban morphological studies?
- 2- How the systematic method would be developed for analysing 'Urban Green Spaces' in morphological studies?
- 3- How can British and Italian schools' theoretical approaches be integrated and applied in urban green space analysis?

Following the main questions, there are sub-research questions that will help clarify the topic's objectives. For instance, when the approaches of British schools are the subject, various elements of the urban form need to be considered and asking about the role of green spaces will be unavoidable. The other question might be the possibility of adding green space as a new variable in urban morphological studies, together with street, block, plot and building. Besides, by focusing on Italian schools' approaches, the role of typology of green spaces brings up another secondary question; How various types of greenery might affect urban form. Answering these questions may provide a better understanding of the possible advantages of integrating green spaces in urban morphology studies.

1.5 Methodology and Data Collection

In order to answer the research questions and fulfil the objectives of the study, an integrated method will be used. This study applied qualitative methods complemented by a case study analysis. The study starts with qualitative research since the nature of the study is exploratory and descriptive. Then the case studies have been evaluated since the case study method supports theory building (Yin, 2009) and theory testing (Eisenhardt, 1989).

The research methodology is designed as “documentary research” and is based on a literature review of the primary and secondary sources written or gathered by other researchers related to urban morphology, urban form, and green spaces. Then collecting data was done by visiting the selected cases in Northern Nicosia.

The primary sources for urban morphology that have been studied are Conzen, M.R.G (1960) “Alnwick, Northumberland: a study in town-plan analysis”, “Architectural

Composition and Building Typology” by Caniggia and Maffei (2001), Karl Kropf ‘s thesis (1993) “The Definition of Built Form in Urban Morphology”, Paul Osmond’s thesis (2008) “an Enquiry into New Methodologies for Evaluating Sustainable Urban Form”. And the other sources that enhanced the learning of urban morphology are Vitor Oliveira’s (2016) “Urban morphology: an introduction to the study of the physical form of cities” and J.W.R. Whitehand’s (1981) “The Urban landscape: Historical development and management (papers by M.R.G. Conzen). For the definition of urban spaces, various sources were considered; however, the study focused on Matthew Carmona’s (2021) “Places Urban Spaces: The Dimensions of Urban Design”. For the urban green spaces and landscape design, this study selected the work Norman K. Booth’s (1990) “Basic Elements of Landscape Architectural Design”. However, the journals and sources from the SCI web of science and EBSCOP have been scanned. Deep research has been done on the publications on journal of urban morphology and ISUF conferences with the key words of urban morphology, urban form, historico-geographical approach, process typological approach, urban green spaces, and vegetation. 175 articles published in the Urban Morphology journal from 1997 to 2021 have been studied to bridge the gap in the approaches to urban morphology. and 100 articles from ISUF have been selected to study in addition to 250 article and sources from the field of urban open and green spaces.

The research is qualitative due to the characteristic of data which need to be analysed; that is impossible to measure them by numbers or any other quantitative technique. On the other hand, variables need to be identified, and the data need to be explored and described in detail.

The primary research techniques for collecting data are personal observation like site analysis and satellite images to understand the urban green dimension and its physical character and form. Besides, primary and secondary documents related to the urban green structure and form will be used to collect data.

1.6 Thesis Limitation

There are some limitations to this thesis to lead the author to realize in which ways the formulation of research aims, and objectives could be narrowed so that the level of focus of the study could be increased. This study focused on the morphological dimension of urban design, specifically on urban physical form. Other dimensions of urban design did not take into consideration in the study due to the fact that each dimension could be a research topic in itself.

This research selected multiple cases to explore the morphological characteristics of urban green spaces. Cases will be chosen from comparable neighbourhoods with similar characteristics to test the application of research questions in urban form and examine a suggested method for analyzing the morphology of green spaces. Another limitation of the study is in terms of the case study selection. This study selected Nicosia city, divided in 1974 due to the conflicts between Greek and Turkish Cypriots. The study focused on the whole of Nicosia regarding the level of understanding of the city's historical development; however, for further analysis, it focused on the North part of Nicosia. The study was limited to the North part of the city due to the unavailability of documents that the author could collect from the South of Nicosia. Although it attempted to examine the whole city, this was not fully possible due to the vast details of method, therefore, the analysis was limited to the distinct region of the city to examine the applicability of the designed framework and determine the

potential for further steps. The study was limited by selecting particular districts located in the area beyond the city walls and between inner and middle fringe belt of the city to recognize the physical characteristics, similarities, and differences to be comparable in detail.

1.7 Thesis Structure

This research is conducted in six chapters, as described below. Chapter 1 provides an overview of the background of the study with its main aims and objectives, research questions, and research approach. Chapter 2 focus on literature and document related to urban physical form, the morphological dimension of urban form, and morphologists' approaches and methods for evaluating the physical characteristics of the urban environment. The main approaches and findings of morphological studies developed by scholars such as MRG Conzen, Muratori, Cannigia, and Maffei will be considered in addition to new directions in urban morphology. Furthermore, the physical elements of urban structures based on morphological analysis, such as streets, blocks, and plots, will be investigated.

In Chapter 3, urban green space's definition and dimensions are identified and categorized. . Besides, the typology and classification of green spaces in various studies consider understanding different types and forms of urban green spaces. Later, basic elements of landscape design and its component present in order to use as a base for evaluating green space typology and its physical form.

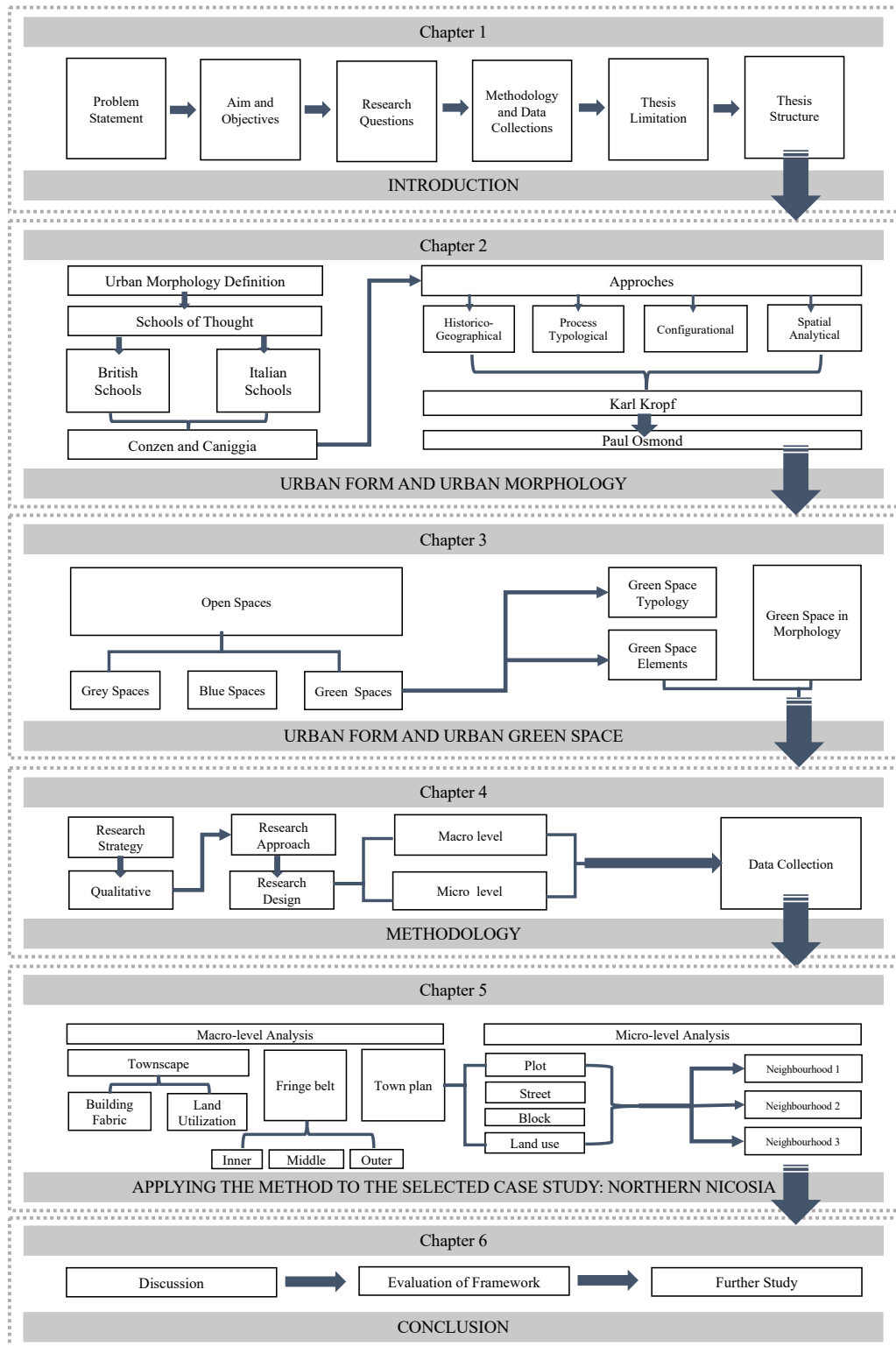
Chapter 4 focuses on the designing methodology and proposes the framework which provides a tool to assess the green space structure in urban form. It discusses the design

method's applicability at macro and micro levels and the details of the analysis needed on each level.

Chapter 5 applies the method in the Northern part of Nicosia, the last divided city in Europe. In this chapter, three selected neighbourhoods from the area between the inner and the middle fringe belt of Northern Nicosia have been evaluated through description and pictures, as well as maps and visual presentations that be a way to show the structure and typology of green spaces. Later findings will be categorised to evaluate the applicability of the designed methods and generalize the results to distinguish if the morphology of green spaces can be analysed by this method or not.

Chapter 6 concludes the research by evaluating the proposed framework, its limitations, and opportunities to be extended for future studies. The study's results made the discussion on whether the hypothesis was confirmed or disconfirmed. The following table (Table 1) presents chapters and their logical connection.

Table 1: Thesis structure and chapters' relations



Chapter 2

URBAN FORM AND URBAN MORPHOLOGY

2.1 Introduction

This chapter focused on introducing the urban morphology term and various approaches in the urban morphology field. The purpose of reviewing these approaches is to understand the basic definition of urban form and urban elements in morphological studies and to define the theoretical base for developing the methodology for the current study. The main schools of urban morphology have been introduced; however, this study emphasised the British and Italian schools of thought due to their geographical and architectural approaches.

2.2 Urban Morphology Definition

The origins of the term “morphology” back to the Mid-19th century, which is derived from the Greek word “morphe”, which means “form”, and refers to “the science of form”, particularly the “shape, form, external structure or arrangement, especially as an object of study or classification” (Shorter Oxford Dictionary, 1997).

The word morphology was first used by the famous German writer and thinker Johann Wolfgang Von Goethe (1749-1832), who spent part of his life working on biology. In Goethe’s works, “morphology” refers to the “science that deals with the essence of forms”. In biology science, it is discussed as the study “not only of shape and structure in plants, animals and micro-organisms, but also of the size, shape, structure, and relationships of their parts” (Encyclopaedia Britannica, 1984). The term morphology

has been used to examine the form and structure of various areas such as geology, geography, and linguistics. In any case, morphology can be considered the study of form or structure applicable to the subject in question; for instance, in geology and geography, it refers to the form of natural landscapes, and in linguistics, it refers to the elements and structure of language.

In the context of the built environment, the term morphology has been the subject of studies like other disciplines. Then, ‘urban morphology’ may be comprehended as the investigation of the form and structure of a settlement. Urban morphology first originated from the work of German-speaking geographers, and it might be argued that Otto Schlüter was the father of urban morphology. He figured out that the city could be realized as part of a more extensive landscape. At the same time, Gustavo Giovannoni was working on the city form and principles of urban growth and transition in Italy. Therefore, the term urban morphology expanded in the studies of German geographers and Italian architects in the first three decades of the twentieth century. Later M.R.G Conzen and Saverio Muratori developed various morphological studies and approaches in the fields of geography and architecture, which will discuss in the 2.3 section. The following paragraphs introduce the definition of urban morphology in several studies by authors from different fields.

Conzen (1960) has added aspects to the definition of urban morphology by giving a detailed description of the physical and spatial characteristics of an urban structure as the nature of urban morphology:

“... if urban form connotes a very general conception of the physical structure of cities, it may be useful to consider urban morphology as a term referring more precisely to the particular character of the urban landscape; the detailed interplay of land subdivision, buildings and their combined pattern of use”.
(p.143-144)

This definition showed that Conzen put more emphasis on urban elements that identified the characteristic of cities. In addition, this concept of urban morphology involves not only the study of physical form but also the study of socio-cultural forces, acknowledging the fact that the urban form has a physical and socio-cultural nature. In addition, an urban form and its socio-cultural context cannot be studied separately, according to some scholars' opinions.

“They are two aspects of the same phenomenon and relate dialectically; that is to say that socio-cultural context should not be considered as the cause for physical changes which would then be taken as the effects, but that changes at the physical level will facilitate and maybe even promote certain social processes” (Etcheberry, 1978, p.2).

Moudon (1997, p.3) also discussed urban morphology as “the study of the city as a human habitat”. Thus, this thought shows that the form of the city should not just be analyzed in the physical and material fields such as architecture, landscape architecture and urbanism; however, a result of the activities and support, human relationships and experiences that shape and construct a function their aspirations must be taken to the consideration. According to Moudon (2000), urban morphologists focus on the “city’s evolution from its formative years to its subsequent transformations, identifying and dissecting its various components”, and they established a link between the space elements, material, social, and economic forces of the city.

According to Smailes (1955), “urban morphology is not merely two-dimensional in scope. On the contrary, it is through the special importance which the third dimension assumes in the urban scene that much of its distinctiveness and variety arise”.

According to Gebauer and Samuels (1981), urban morphology is “a method of analysis which is basic to finding out principles or rules of urban design” (Gebauer and Samuels

1981, p.1). Lozano (1990) identified urban morphology as “the science of form or of various factors that govern and influence form”. Urban Morphology Research Group (1990) described it as “the study of the physical (or built) fabric of urban form, and the people and processes shaping it”.

Moreover, many scholars have emphasized city components, compositions, and complexities. Meyer (2005) explored that “morphology means form-lore or knowledge of the form”. Larkham’s (2006) definition of urban morphology refers to “an approach to conceptualizing the complexity of physical form. Understanding the physical complexities of various scales, from individual buildings, plots, street blocks, and the street patterns that make up the structure of towns, helps us understand how towns have grown and developed”. Scholars have discussed various definitions for urban morphology; however, in common, urban morphology has been defined as the systematic study of the form, shape, plan, structure, and functions of the built fabric of towns and cities and of the origin of the settlements and how this fabric has developed and transformed over time.

In addition to those discussions about urban morphology, it is also considered to use the term in philosophy. To develop a philosophical base for urban morphology, it is reasonable to refer to the works of Henri Lefebvre (1901-1991) and Michel Foucault (1926-1984). They are two predominant philosophical authors who have much to say that is relevant to urban morphology. Lefebvre, humanist, Marxist, and existentialist in the French tradition, is the most significant philosopher of urban morphology. His major work, “the production of space” (Lefebvre, 1991), discussed concepts relating to space, interaction with people, constructed environment and all aspects of social space created by people.

Foucault was a historian who focused on the built environment more broadly, particularly institutions and their settings. He placed considerable emphasis on “the site” of institutions and on the way buildings occupy sites. According to Foucault, “space itself has a history”, and “urban morphology” emphasises systematic description and analysis of relationships between the social and physical aspects of spaces/places over time. It would analyse their roots in social, cultural, and institutional change and relate this to changing historical and physical circumstances. (Foucault, M., and Miskowiec, J.,1986)

2.3 Urban Morphology Schools of Thought

The idea of urban morphology results from an evolutionary process that has developed since the nineteenth century in diverse cultural contexts. As architects, planners, geographers, historians, philosophers, or even archaeologists or social anthropologists, the authors wrote from different viewpoints that have proposed different disciplinary approaches over the last decades. Urban morphology mainly expanded in geography and architecture fields, and various perspectives led to a diverse range of methodological outputs. The roots of urban morphology lie in geography in Britain and Germany and architecture in Italy and France (Kristjánsdóttir, S., 2019). Anne Vernez Moudon (1997) categorised urban morphology studies in different schools of thought by the British, Italian, and French.

The British or Conzenian school originated from the works of German geographers Otto Schlüter (1899), father of urban morphology and M.R.G. Conzen (1932). The origin of the Italian school derived from the work of Italian architect Saverio Muratori (1910-1973). After Conzen and Muratori established the base for the British and Italian schools, a third school emerged in France. The French school, based principally at the

Versailles School of Architecture, has generated extensive methodological knowledge for analysing urbanisation processes and related architectural models and emphasises architectural and social aspects of urban morphology.

2.3.1 The British School

The British school approach is well summarised by the work of M. R. G. Conzen, which has its origin in the works of German-speaking geographers. Conzen's studies created the link between German and British cultures. To understand the evolution and history of British schools, it is fundamental to mention the studies done by German geographers between the 1890s and 1950s. (Table 2)

Table 2: German geographers' contributions to urban morphology from the 1890s till 1932

YEAR	SCHOLAR	SUBJECT OF STUDY
1894	Johannes Fritz	German city layouts
1899-1903	Otto Schlüter (father of urban morphology)	• Morphology of cultural landscape • Objects shaping the earth's surface
1903	Friedrich Ratzel	the geographical location of large cities
1907	Eugen Oberhummer	The town plan, its development and geographical relevance Underline the importance of historical town plans for tracing the original settlement layout
1910-1912	Hugo Hassinger	Art-historical Atlas of Vienna
1914-1916	Robert Gradmann	Publications on the towns in Wurttemberg and Swebia
1918-1924	Walter Geisler	• Monograph on Danzing • Comprehensive classifications of the sites, ground plans and building types of German towns
1925	Hans Dorries	Age and architectural style of the buildings
1927	Hans Bobek	Basic questions of urban geography / changing the direction of German studies /importance of the function of urban places
1928	Rudolf Martiny	The layout of German settlements/define a set of generic elements on German cities.
1932	M.R.G. Conzen	Conzen thesis (1932) focused on twelve cities located northwest of Berlin

In 1894, the geographer Johannes Fritz studied more than 300 German cities in his work '*Deutsche Stadtanlagen*' (German city layouts) by using the plan of the city and cartography and classified the cities based on the type of plan (Hofmeister, 2004). Five

years later, the geographer Otto Schlüter published two papers in 1899 and identified the city as part of the wider landscape (*Landschaft*) in his works (Schlüter, 1899a). One of his works was about settlement geography in general and urban landscapes in particular (Schlüter, 1899), and the second one was about the ground plan of towns (Schlüter, 1899b). Therefore, urban morphology from the beginning was about distinguishing, characterizing, and explaining urban landscapes. In his work on urban ground plans, Schlüter focused on the historical development of urban form in European, mostly German towns. He produced several simple maps of the layout of towns that this approach became a core feature of urban morphology in the next century and was later often referred to as morphogenetic. (Whitehand, 2007)

In the first decade of the twentieth century, Friedrich Ratzel in his work '*Die Geographische Lage der groben Städte*' (the geographical location of large cities, 1903) focused not only on the location of the cities but also on the reason for the selection of the original site for the foundation of human settlements. (Oliveira, 2016) Another significant publication was the work of Eugen Oberhummer (1907) on the town plan, its development and geographical relevance (*Der Stadt plan, seine Entwicklung und geographische Bedeutung*).

During the next decade, Robert Gradmann's publications on the towns in Wurttemberg (1914) and Swebia (1916) contributed to the morphology of urban places. In the following years, studies by Hugo Hassinger (Art-historical Atlas of Vienna, 1916) and Walter Geisler (Danzing, 1918) focused on a key feature of the morphogenetic approach, which was the mapping of the various physical forms within urban areas. The geographer Hugo Hassinger (1916) mapped the historical architectural styles in the city of Vienna, and Geisler represented land and building utilization and the

number of stories in residential buildings. In another work, Geisler worked on comprehensive classifications of the sites, ground plans and building types of German towns (Geisler, 1924).

In 1925, Hans Dorries followed Hassinger and Geisler by identifying the age and architectural style of buildings in the plan of several historic cities. Rudolf Martiny (1928) published a paper on the structure of German settlements and defined a set of generic elements of German cities. Hans Bobek's (1927) paper on '*Basic questions of urban geography*' was considered the starting point for changing German studies' direction, and urban functions' issues became significant concerning urban form.

The work of Geisler in Danzig influenced on work of M. R. G. Conzen, a German geographer who migrated to the United Kingdom in 1933. Conzen's studies considered the link between German and British cultures. In his thesis, Conzen (1932) focused on twelve cities located northwest of Berlin. He analyzed the plan and building fabric, mapped the building types by different colours and recorded the number of stories.

In 1936, one of the Conzen's mentors Herbert Louis, published a book on the geographical structure of the Grate Berlin and introduced the concept of an urban fringe belt (*Startrandzone*), the process of growth and transformation of the plot' size and form, at the edge of cities over the years.

Later results of Berlin studies by Conzen influenced his study of the English port town of Whitby (Conzen, 1958). In this study, priority has been given to historical periods, which are named morphological periods. In 1969 Conzen tried to explain the present

structure of a town plan by examining its development. The basic idea behind Conzen's study is that "the past provides the key to the future" (Whitehand, 1978, p.137). This was the beginning of the formation of the English school with Conzen's works.

During the Second World War and immediate post-war years in Britain, various studies have been done under the term an "indigenous British geographical tradition", which dealt with the concepts of 'urban morphology', 'urban form' and 'townscape'. (See Table 3 for relevant studies)

Table 3: Urban morphology, urban form, and townscape studies in Britain

Non-Conzenian Studies in Britain		
Year	Scholar	Subject of study
1934	R.E. Dickinson	East Anglian towns
1949	Gordon Cullen	Townscape
1953	Thurston, H.S.	Building fabric
1955	Smailes, A. E.	Characterizations the present townscapes in broad terms, based on rapid reconnaissance surveys
1955	House, J.W. and Fullerton, B.	Urban landscapes were seen in terms of the land uses
1958	Stedman, M.B.	Descriptive approach to Birmingham's urban landscape
1965	Johns, E.	British townscape: Townscape was used virtually as a synonym for 'urban landscape' (a geographical study but with artistic influence)
1968	Thomas Sharp	Used a different conception of 'townscape': it was 'a way of looking', a broader interconnected approach to urban landscape than Cullen's snapshots

In the later 1960s and early 1970s in Britain, various quantitative methods were developed, and research on the urban form was describing physical forms rather than analyzing their origins and development. Gradually, the number of researchers with a

historical perspective on urban form grew only very slowly. (See table 4 for relevant studies: Davies (1968), Carter (1970), Barley (1976), and Aston and Bond (1976)).

Table 4: Development of urban morphology research in Britain between the 1960s and 1970s

Conzenian tradition		
1960	Conzen	Alnwick
1962/1966/1975	Conzen	Historical townscape and historicity
1968	Darvies	Historical perspective on urban form/link form with changing land use.
1970	Carter	Urban morphology was characterized as having long been a 'barren outpost of urban geography' requiring rescue A decision-making approach to town plan analysis: a case study of Llandudno
1976	Barley	History and archeology
1976	Aston and Bond	Archeology

In the 1980s, Jeremy Whitehand progressively made a significant contribution to clarifying the subject of urban morphology through his definition, terminology, and principles. Whitehand worked on plan analysis, the fringe-belt, and cross-cultural studies and focused on Conzen's principles with actual developments such as the post-war period (Whitehand, 1981). Whitehand (2007) has continued the work of M.R.G. Conzen by adding an economic dimension and issues to the studies of city development, particularly the relationships between the city, its habitats, and the dynamics of the building industry (Pinho & Oliveira, 2009).

In 1994, Jeremy Whitehand established the Urban Morphology Research Group (UMRG) at the University of Birmingham. He is one of the important figures in expanding the Conzenian tradition and developing historico-geographical aspects of urban form. The UMRG plays a major role in coordinating international research in conjunction with the International Seminar on Urban Form (ISUF).

Several key British urban morphologists, notably Hall, Kropf, Lilley, Larkham, Samuels, Slater, and Susan Whitehand, subsequently became members of this research group (Table 5). The UMRG has two main focuses: the study of planning and management of medieval and pre-modern cities; and the analysis of the design processes of townscapes in the 19th and the 20th centuries. The following paragraphs introduce some scholars from different parts of the world in the field of urban morphology and their approaches.

Table 5: Recent scholars' contributions to urban morphology

1994	Urban Morphology Research Group	Research interest
1981	J.W.R. Whitehand	Historical development and planning of residential urban landscapes
1997	O'Brien	Form, function and sign: signifying the past in urban waterfront regeneration
1997	Anne Vernez Moudon	Urban morphology as an emerging interdisciplinary field
1998	Keith Lilley	Medieval urban landscapes in the British Isles
2001	Karl Kropf	Methods of describing and prescribing urban form
2001	M.P. Conzen	Urban landscape in United States
2003	Nigel Baker	The archaeology of the larger medieval towns.
2003	Michael Barke	Urban landscape regions and conservation
2004	Peter Larkham	Townscape conservation and planning
2004	Ivor Samuels	Urban morphology and planning practice
2005	Thomas Hall	Post war new town models
2005	Jason Gilliland and Pierre Gauthier	The study of urban form in Canada
2006	Peter J. Larkham	Townscape conservation and planning
2009	Terry Slater	Medieval town-plan analysis and urban landscape conservation
2011	Susan Whitehand	Urban landscape development and planning in China
2012	Michael I.W. Hopkins	Ecology and fringe belts
2013	Vitor Oliveira	Morpho: A methodology for assessing urban form The study of urban form in Portugal
2014	Gu, Kai	Conzenian and Caniggian ideas and the Chinese city
2016	Nicola Marzot	The study of urban form in the Netherlands
2017	Tolga Ünlü	Urban design, design control, urban morphology and planning, and urban history
2019	Yiting Zhang	Urban morphology and ecology

Anne Vernez Moudon's (1986) works on examining land-use change in the Alamo Square neighbourhood in San Francisco from 1899 to 1976 provides a North American context to the British School (Williamson, 2013). Moudon (1986) analyzed the number of buildings and lots per block, the extent of building coverage at the ground, and data points on habitation and business trends in the area over time. Moudon (1986) reveals structural patterns of change at the building and lot level, as well as the processes that affect these changes. (Williamson, 2013) Moudon (1997) argues that every urban morphological analysis is based on three fundamental components:

- Form: the urban form is defined by three physical elements –buildings and related open spaces, building lots/parcels and streets
- Resolution: urban form can be understood at four distinct levels corresponding to the building/lot, street/block, city, and region
- Time: urban forms can only be understood temporally because they comprise elements that undergo continuous transformation and replacement.

Karl Kropf (1993), in his thesis “the definition of built form in urban morphology”, established a theoretical basis for the definition and subdivision of built form. In other studies, Kropf (2001) focused on the conception of changes in the built environment and aspects of urban form (2009), and his intention was on methods of describing and prescribing the urban form.

Later, the group linked to international regions such as North America. The idea expanded the emerging school of thought by North American researchers such as M.P. Conzen (2001), who emphasizes the present-day urban landscape. He focused on historico geographical development and highlighted the cultural value of American society, which make American forms distinctive. His concentration was on the

evolution of town planning ideas in practice and emphasis on the systematic morphological structure and character of American cities.

Michael Barke (2003) is another urban morphologist who argued the applicability of urban morphology in planning practice, and he discussed the importance of urban morphology from three perspectives philosophical, cultural, and practical. Peter Larkham (2006) underlined the development of urban morphological studies in Britain. He identified the significance of urban morphology approaches, townscape conservation and planning. Michael I. W. Hopkins (2012) investigated the ecological characteristics of fringe belts. Besides, Yiting Zhang (2019) studied Urban Morphology and Ecosystem Services and considered the historico-geographical study of fringe belts and urban green spaces.

Vitor Oliveira (2013) introduced the term “Morpho”, which deals with elements of urban form, streets, plots, and buildings. He applied Morpho on the street scale in three streets of New York (2013). Consequently, it was applied on the city scale in Porto, addressing not only the present form of the city but also the evaluation of planning proposals for its future development. Later his methodology was applied to twenty Portuguese cities. He has various publications in the field of urban morphology, such as the book “*Urban morphology: an introduction to the study of the physical form of cities*” (2016), used as a textbook in courses in 10 universities in Portugal, Brazil, Spain, and China. He has published “*Teaching urban morphology*” (2018) book, which focuses on how to teach urban morphology through the contribution of international experts in urban morphology. Oliveira’s book “*JWR Whitehand and the historico-geographical approach to urban morphology*” focused on JWR Whitehand’s contribution to urban morphology research and the development of several dimensions

of the concepts of “fringe belt”, “morphological region”, “agents of change,” “comparative studies” and “research and practice”.

Ki Gu applied urban morphological approaches to East Asia. He focused on Conzenian and Caniggian ideas and expanded them to the Chinese cities. (Whitehand, J., & Gu, K., 2007). In addition, he contributed the morphological approaches to the conservation and management of historic urban landscapes and focused on the urban fringe belt, urban morphological regions, and urban landscape management. (See: Gu, K. (2010), Whitehand, J., Gu, K., Petruccioli, A., Stella, M., & Strappa, G. (2003), Whitehand, J. W. R., & Gu, K. (2010), Whitehand, J. W. R., & Gu, K. (2017)).

Tolga Ünlü researched Turkish cities’ physical development and planning history, especially Mersin, and their morphological transformation. He has done significant research on fringe belt alienation of Turkish cities. (See; Ünlü, T., & Selvi Ünlü, T. (2012), Ünlü, T. (2013), Ünlü, T., & Baş, Y. (2016), Ünlü, T. (2021))

2.3.2 Italian School

In the first half of the twentieth century, the Italian morphological tradition was originated by Italian architect Saverio Muratori (1910-1973). It was the starting point for applying urban morphology to architecture, urban design, and planning. The Italian morphological tradition has been acknowledged for its close link between tradition and innovation, especially between pre-industrial and modern approaches to urban form, which is considered an important issue in the field of application in typological studies. The foundations of this approach can be found in Gustavo Giovannoni’s consideration of historical centres and Giuseppe Pagano’s studies of the politics of the development of rural settlements. (Marzot, 2002)

From the Italian point of view, the interpretation of urban form has mainly been tracked through an instrumental use of the concept of “type”. This interpretation follows the historical process involved in producing a particular form and determines a contextualized system of knowledge. (Marzot, 2002)

Gustavo Giovannoni is known as the father of the Italian urbanistic tradition. His most important work is ‘*Vecchie Citta ed edilizia nuova*’ which faced the problem of reconciling the city’s life and history. His idea started from a historical framework, which deals with the principles of urban growth and transformation. He proposed cooperating tradition and modernity within a concept of organicity and based his theories on the idea of the city as an organism.

The idea of Italian scholars was extended by Saverio Muratori. He studied architecture in Rome, where he absorbed the concept of contextualized architecture from his teachers Arnaldo Foschini, Enrico Calandra and in particular, Gustavo Giovannoni. After finishing university in 1933, he started to work on developing several plans and projects with the collaboration of Ludovico Quaroni and Francesco Fariello. During the war period, he published essays (1944-46) by Guido Marinucci that, for the first time, they discussed concepts of towns as living organisms and as collective works of art, also the idea of planning new buildings in continuity with the building culture of the place. During the post-war period, he was the group’s leader in the house plans of the *Istituto Nazionale delle Assicurazioni (INA)*.

Like his teachers, Muratori criticized the idea of the Modern Movement and instated that he believed in the systemization of a historical approach to architectural type. His analysis aimed to use types. For Muratori type was a tool for the historical analysis of

urban fabric. Muratori is best known for his approaches between the 1950s to the early 1960s when he worked on the historical fabric of Italian cities and employed the fundamental concepts of type, fabric, organism, and operative history. (Gauthiez, 2004)

In 1952, he started teaching in Venice, which was the beginning of the Italian school of building typology and urban morphology. Muratori extended his theory and practice during his years in Venice. His work *“Vita e Storia Della Citta”* presented the ideas that later characterized the school that originated from his teaching in Venice. The central idea of the school was historical understanding as the key to recovering the sense of continuity in architectural practice (Cataldi et al. 2002, Cataldi 2003). Muratori established the theoretical framework to explain the process of formation and transformation of urban forms throughout the centuries. According to Muratori, “typo-morphology is a dialectic relationship between complementary and reversible moments in historic typological research and stages of design developments” (Cataldi, 1999, p.35).

In the 1960s Muratori developed his method in various studies by support of his assistants such as Renato Bollati, Sergio Bollati, Gianfranco Caniggia, Guido Figus, Sandro Giannini, Romano Greco, Paolo Maretto and Guido Marinucci. (Gauthiez, 2004)

As Caniggia (2001) identified, Muratori’s approaches proposed analytical built environment concepts on various scales: “reading of building constituents, determining the shape, structure and various uses of buildings, just as readings that can be taken on the scale of clusters, towns, and territory enable to understand the

conforming rules at the root of the structuring of building fabrics, urban organism and territorial ranges”. (Caniggia, 2001, p.10)

Giancarlo Cataldi (2002) believed that the activities of Muratori have been divided into five different periods corresponding to five different decades. The first period (1930-1940) was years after he graduated and started working on various projects considered “professional experimentation”. Series of articles for the journal *Architettura*, his practice in planning and architecture, such as plans for *Aprilia* and *Cortogiana* and attending the competition of Italian squares, were the main approaches of that decade. In the second period, in the 1940s, he had his first teaching experience by assisting his mentors. And the main approach of this decade was developing the idea of towns as living organisms. In the third period, in the 1950s, he established a strong link between research and architectural and planning practice in the projects he worked on. He started his professional teaching in Venice and later continued in Rome. The main theme of this period was the city. His works in Venice were the starting point of a major step in interpreting urban phenomena within Italian architecture. In the 1960s, he developed the idea of territory and civilisation and focused on reflecting his theory on wider issues outside the specific disciplinary field of architecture. In his last years, he focused on teaching and mostly based his method on Synoptic charts and diagrams. In the research area, he established a universal classification of man-made structures on his proposal for projects of *Atlante territoriale* and *Tabelloni* that remain on paper only. Towards the end, he died in 1973 while surrounded by a few students and colleagues.

After Muratori’s death, some of his assistants, such as Guido Marinucci and Enzo Flamini, tried to work on unpublished lectures and papers, while most of his assistants

left Rome and started to teach in universities what they had learnt from him. As a result, his school in Rome started to lose its unity. Some of the assistants pursued a line of research focusing on Muratori's approaches. Sergio and Renato Bollati focused on architectural aspects and developed the concept of architectural organisms. They also worked on urban tissues with systematic research and architectural practice in Italian cities. Pablo Maretti (1931-1998) worked on aspects of interpretation of historical city centres, their restoration and conservation against the threat of modern architecture. Alessandro Giannini concentrated on Muratori's later territorial studies, the richest part of his studies.

Gianfranco Caniggia finished his study of the city of Como (his major contribution to urban morphology and building typology, 1963) under the supervision of Muratori. Caniggia continued the Muratorian tradition, which he called "procedural typology", which considers building types as the elemental root of urban form. He simplified Muratori's theory and concentrated on developing the potential in Muratori's definition of building type as a prior synthesis. Caniggia's approach is named "morphogenetic", which attempts to figure out the dynamics of urban form in its historical development through its constituent types and the evolution of these types (Noghsan-Mohammadi, 2001). These dynamics are called a typological process by considering the historical formation and transformation of the types and urban fabrics. (Levy, 1997) Caniggia classified types into two large categories: the basic or residential type- the most common- and the specialised type, which fulfils a diversity of functions (such as collective, religious, or civil functions). According to him, "building type was used in the past and still is today to indicate any group of buildings with some characteristics, or a series of characteristics, in common" (Caniggia, 2001, p.50). In his archaeological studies of urban fabrics, he does not hesitate to go as far back as

prehistory to understand a type's origin, which is the starting point of the typological process. He evaluated every single building as a product of modifications to previously existing buildings in a never-ending process of derivations. According to Caniggia, the story of each building does not start from its construction date but begins when the town starts. (Cataldi, 1999). He focuses on the ways buildings come together as cities and conceptualized his theories into four levels these are; "buildings emerge from nature as buildings' materials are mined and modified more or less by humans to produce shelter; building fabrics become buildings; buildings then make up the pieces of the urban fabric; settlements all fit together to make the city and settlements; cities themselves belong to a regional network of paths, all negotiating the constraints and opportunities of the larger landscape and the earth's surface". (Caniggia, 2001, p.21)

According to Cataldi (2003), Caniggia's approaches to the typological process are divided into six major themes: "(i) the examination and development of Muratori's concepts of type, typology, structure, tissue, series and seriality;(ii) the establishment of the method of procedural typology;(iii) the discovery and recognition of the *Domus* courtyard substratum as the matrix, within Roman planning, of all subsequent basic types;(iv) the distinction between basic and specialized building;(v) the theory of medievalization regarding the spontaneous utilization procedures of planned structures; and finally,(vi) the method of interpretation by phases of a city's history in connection with basic typological processes".(Oliveira, 2016, p.116)

Moreover, Caniggia, with the typological method, defined a scientific approach to building as a science of the built environment. In this regard, Caniggia's contribution was crucial due to putting Muratori's architectural thought into practice and providing the experimental support essential to uniting theory and practice. (Cataldi, 2003)

After he died in 1987, his research extended to several cities in Italy and North Africa, by an attempt by Giancarlo Cataldi, Gian Luigi Maffei, Maria Grazia Corsini, Paolo Maretto, Giuseppe Strappa, and others, who continued the Muratorian approaches and tradition in Florence, Rome, Genoa, and Sienna. Gian Luigi Maffei worked on last Caniggia's unfinished writings and published the volume *Ragionamenti di tipologia* one decade later.

The Muratorian idea spread out throughout the world through the works of different scholars. In the late 1950s, while the modern movement influenced cities development and linkage between new buildings and those of the past, a group of architects and scholars introduced the concept of "return to the city", attempting to set up a contextual authority for new development (Quaroni, 1983, Krier, 1978: 38-42, Vidler, 1978: 23-32). This new concept was derived from typo-morphological studies in Italy, which aimed to achieve continuity in the older architectural and urban traditions (Gosling, 1984). One of the concerns of the typo-morphological studies was restructuring and preserving the urban heritage against certain characteristics of modern architecture and planning. In this period, the main concept of the typo-morphological approach may be described in the works of Aldo Rossi in the 1980s, *The Architecture of the City*. He criticized modern architecture, which has demolished much of the historical continuity in our cities.

According to Rossi, the city is one of the most important manifestations of human society, which is the collective memory of its people (Rossi, 1982). He believed that the city develops with the passing the time and acts as a record of past events through its permanency. In this process, certain original themes persevered, and some others were modified. Thus, the continuity of the city comes from this permanency, which

Rossi defined “permanence” as a past we are still experiencing (Rossi, 1982). As a result, urban monuments, streets, and block plans were identified as the most meaningful elements of urban permanency in Rossi’s definitions. According to him every city “possesses a personal soul formed of old traditions and living feelings as well as an unresolved aspiration” (Rossi, 1982, p.162).

After Rossi, Aymonino worked on the effective definition of building typology, looked at the building type as a key element in studying the city, and defined it as “a part of a whole which can be isolated by analysis” (Aymonino, 1985, p.49-50). The study of types has become an essential subject in the processes of urban analysis, providing the tools to reconstruct the city. Parallel to that, the work of the Krier brothers in the USA extended. Rob Krier’s main hypothesis discussed that there are only two typomorphological elements, “streets” and “squares” (Krier 1979), for the recreation and preservation of the public realm. He expands the range of his exploration to include interior spaces, facades, building types by form, and the elements which define and modify these forms, such as corners, courtyards, staircases, etc. (Krier, 1983).

Leon Krier extends the issue by identifying “quarters”, “urban blocks”, and “distinct building typology” (Krier, 1978). In his work, consequently, the type provides a way of studying the city’s history. According to him, “The typomorphological approach is thus currently directed towards the study of spatial types, building form types and the elements of public space drawn from the past, particularly the nineteenth-century European city, which are seen as the major components of the urban morphology” (Krier, 1984, p.43). Krier brothers and Rossi (1984) expanded Caniggia’s typological process concept by focusing on form development throughout the typological process.

The third generation of Caniggia followers, such as Nicola Marzot and Marco Maretto, did not directly know Muratori and Caniggia, however, they continue to promote different aspects of their approaches. Marzot focused on Italian approaches and Aldo Rossi's theory, and Maretto focused on Saverio Muratori. Maretto (2012) highlighted Muratori's design and the integration of theory and practice, in addition to the interpretation of the urban form as a basis for urban design.

The recent development of the "process typological" was formed by two different organizations, CISPOT and ISUF. The *Centro Internazionale per lo Studio dei Processi Urbani e Territoriali* (CISPOT) was established in 1981 with Giancarlo Cataldi, Nicholas Adam, Lero Di Cristina, Fausto Formichi, Laura Marcucci and Henry Millon. The main aim was to provide the opportunity for architects and architectural historians to share and compare the various discipline and outcomes of Muratori's method. Later, during the 1990s, scholars such as Gian Luigi Maffei, Sylvain Malfroy, Bruno Marchand, Paolo Maretto, Anne Vernez Moudon and Jeremy Whitehand, international groups and scholars that dealing with towns and their transformation organized a gathering that was the starting point for founding ISUF. Table 6 shows the Italian and American researchers' studies on urban form and typological processes.

Table 6: Development of typological concepts by Italian and American scholar

YEAR	SCHOLAR	SUBJECT OF STUDY
	Gustavo Giovannoni (Father of Italian urbanistic tradition)	Vecchie città ed edilizia nuova Consideration of historical centers
	Giuseppe Pagano	Studies of the politics of the development of rural settlements
1930S	Savario Muratori	The professional experimentation
1940S	Savario Muratori	Developing the idea on towns as living organism
1950S	Savario Muratori	The historical fabric of Italian cities
1952	Savario Muratori	Italian school of building typology and urban morphology
1960S	Savario Muratori	The idea of territory and civilization
1970S		
1973	Guido Marinucci and Enzo Flamini	Unpublished lectures and papers of Muratori
	Sergio and Renato Bollati	architectural aspects and developed the concept of Architectural organism
	Pablo Maretti (1931-1998)	Aspects of interpretation of historical city centers
	Alessandro Giannini	Territorial studies
1970S	Gianfranco Caniggia	Morphogenetic
1980S	Aldo Rossi	Manifestations of human society
1981	CISPUT	
1984	Rob and Leon Krier	Form development throughout the typological process.
1985	Aymonino	Building typology
2001	Gian Luigi Maffei	Urban and building process classification
2002	Nicola Marzot	Italian approaches and Aldo Rossi's theory
2012	Marco Maretti	Savario Muratori's design Interpretation of the urban form as a basis for urban design

2.4 Urban Morphological Approaches

Apart from morphological schools of thought, new studies in terms of subject matter or approach or both have developed in this field. As discussed above, numerous scholars and urban morphologists focused on the definition and investigation of the physical form of cities. The results of those investigations provided dynamic approaches in terms of the systemization of data, theories, concepts, and methods. However, still, there are some debates and hesitation to offer a comparative meta-framework; choosing a specific method or approach to analyze a particular case study;

combining different approaches and using one particular approach under certain circumstances and criteria.

Based on the complexity and diversity of human settlements, the ways to read and understand this subject have become diverse and complex. According to Kropf (2009), human settlements are diverse and multifaceted; thus, in order to study urban form, the specious attraction of a single idea should not deceive researchers into focusing on a single method. (Kropf, 2009)

Kropf (2009) has considered four of the different approaches that have emerged within urban morphology. Most of them derive from older-established disciplines, such as archaeology, architectural history, geography, and history. He terms them historico-geographical, process typological(typo-morphological), configurational, and spatial analytical.

The British approaches are widely known as the Conzenian school (Moudon, 1997; Whitehand, 2001) or the “historico-geographical” approach (Kropf, 2009; Oliveira, 2016). The Italian approach is known as the Caniggian School (Cataldi, 2003), the ‘Muratorian tradition’ (Moudon, 1997), or the “process typological approach” (Kropf, 2009; Oliveira, 2016). However, the mathematically oriented “space syntax” approach was developed by Bill Hillier and Julienne Hanson (1984). In parallel, the various form of “spatial analysis” has been introduced by Michael Batty. Historico-geographical and spatial analytical have origins in the field of geography, and the typo-morphological and configurational approaches have come out of the field of architecture and urbanism.

This section introduced existing concepts that have evolved and are used to analyse urban morphological studies to identify common elements that can be used as a reference to coordinate further studies. The purpose of this section is to realize the findings of various urban morphological approaches in which way are working together and provide a framework and logical order for urban analysis.

In the end, it would help to find a working method and methodology employed within the present study to cover the similarities and find the gaps. The goal of the analysis is to identify a common element, defined consistently, that can be used as a reference key or registration mark to coordinate different descriptions. The following sections discuss current approaches, their origins, and their development process in detail.

2.4.1 The Historico-Geographical Approach

M.R.G. Conzen was born in 1907 in Berlin and graduated from the Geographical Institute at the University of Berlin in 1932. During his education in Berlin, he learned to look at the town as a physical entity with various disciplines such as geography, history, and architecture. Conzen's ideas about urban morphology began appearing in British publications after his emigration to Britain in 1933. He continued his education in the field of town and country planning at the University of Manchester between 1934 and 1936. His studies in town and country planning led him to work as a practising planner in northwest England. He had the opportunity to work on settlement pattern changes and the social or economic forces that create changes in urban planning. After Second World War, he joined the Research Group on Rural Planning at Manchester University. He started working on medieval German colonization and changes during that period. Besides, he got familiar with British towns by working on small towns plot-by-plot survey, which recorded land and building utilization, building type, building materials and a number of stories. The main results of that survey

prepared Conzen with a comparative view of basic aspects of the form of British towns.

In the 1950s, his interest in the link between geography and planning was reflected in his *Geographie und landesplanung in England* and in a *survey of Withby*, which has focused on building type and land and land utilization of the whole town. This study provided bases for a townscape conservation strategy. Apart from these works, Conzen's major contributions to urban morphology set out in *Alnwick, Northumberland: a study in town-plan analysis* in 1960.

In *Alnwick's* analysis, Conzen applied a systematic method to explain the geographical structure and character of the town by focusing on its basic elements and looking at their developments through time. He began by distinguishing the general aspects of *the site, function, social and economic context, development, and townscape*.

Within the townscape, he distinguishes three morphological aspects: town plan, building fabric and land utilization pattern. Conzen intended to treat all three aspects in equal detail but, in the end, concentrated on the town plan. Conzen defined a town plan "as the arrangement of an urban-built-up area in all its man-made features" (Conzen, 1969, p.4-5). The subdivision of the town plan for analytical purposes included: (i) the streets and their arrangement in a street system, (ii) plots and their arrangement in street blocks, (iii) and buildings, or more precisely, their blocks-plans.

In Conzen's (1969, p.50) own words:

"Examination of the town plan shows that the three-element complexes of streets, plots, and buildings enter into individualized combinations in different areas of the town. Each combination derives uniqueness from its site

circumstances and establishes a measure of morphological homogeneity or unity in some or all respects over its area. It represents a plan-unit, district from its neighbours.”

As mentioned above, certain combinations of streets, plots, and block plans represent plan units. The combinations of plan units are identified as plan divisions for the divisions of the town plan. A further distinction is morphogenetic regions, which are the combinations of town plan, building fabric, land utilization pattern and the site. According to Conzen, a town’s development is divided into morphological periods that are dependent on the variety and complexity of the arrangement of plan units, plan-divisions and morphogenetic regions. Morphological periods correspond to the periods of social and economic development which made significant changes in the town. Conzen also distinguished types of change such as burgage plot repletion and metamorphosis, redevelopment, and fringe-belt development.

According to Whitehand (1981, p.12), Conzen’s achievements in the study of Alnwick expanded into five heads:

“First, the establishment of a basic framework of principles for urban morphology; secondly, the adoption for the first time in the geographical literature in the English language of a thoroughgoing evolutionary approach; thirdly, the recognition of the individual plot as being the fundamental unit of analysis; fourthly, the use of detailed cartographic analysis in conjunction with field survey and documentary evidence and fifthly, the conceptualization of developments in the townscape”.

To find out some significant characteristics of this school of thought, it is beneficial to highlight some ideas emerging from morphological studies implemented by Conzen. He suggested that the geographical character of a settlement be functionally determined by economic and social significance within its regional context (Conzen, 1966). Nevertheless, his morphological study is clearly distinguished from a functional

one which intends to understand the perceptual aspects and social values of human beings in connection with the urban form. The following texts have described the general aspects of Conzen's approach to explaining the character of towns by their consistent elements and development through time.

2.4.1.1 Function

According to Conzen (1969), function, social and economic context are associated with the 'use' or 'activities' between humans and built form. However, Function is more limited and specific to particular classes of activities, for example, residential or commercial. The functional aspects of a town are more related to the human's interaction with other humans, or physical activity in a given part of the town (house, office, shop, factory etc.) or moving from one place to another.

2.4.1.2 Social and Economic Context

The social and economic context associated with human activity and interaction with the built environment can be considered a combination of different activities and functions. In this respect, any given 'function' is a part of the social and economic context (Kropf, 2009). Such as function definition, the relevant features defining this aspect are thus again the relations between humans and between humans and the environment, built and unbuilt within an area including the town and over an extended period. (Kropf, 1993)

2.4.1.3 Site

The site can be interpreted as the arrangement of natural features within the area of the town. (Kroft, 1993) A site is defined principally in terms of the spatial relations and distribution of natural physical features such as geology, topography, hydrology, and vegetation.

2.4.1.4 Development

According to Conzen (1969), every town has a history and life which has been lived in its development. The outline and fabric of the built-up area have been altered as changes appear in functional, social, cultural, economic, and morphological aspects over time, defined as “development” by Kropf (1993). Conzen described the town’s development as:

“When one period has achieved the manifestation of its requirements in the urban pattern of land use, streets, plots and buildings, another supersedes it in turn, and the built-up area, in its functional organisation as well as in its townscape, becomes the accumulated record of the town’s development.” (p.7)

Conzen further subdivides this aspect into periods. “Each period leaves its distinctive material residues in the landscape and, for the purpose of geographical analysis, can be viewed as a morphological period”. (Conzen, 1969, p.7) The related characteristics defining any period are the economic, social, spiritual, and material forms of human culture and its built environment.

2.4.1.5 Townscape

The term townscape was first used in the United Kingdom in the 1940s and 1950s. The term “townscape” was developed by Gordon Cullen first in his 1949’s study and then in the book “Townscape”, which has remained a classic text in urban design since 1961. Cullen analyzed the visual qualities of urban spaces for pedestrian observers through drawings in a very personal manner. Townscape refers to the art of the relationship. Cullen (1961) demonstrated that it is essential to “take all the elements that go to create the environment: buildings, trees, nature, water, traffic, advertisements and so on, and to weave them together in such a way that drama is released” (Cullen, 1961, p.9). Thomas Sharp used a different conception of

“townscape”: a way of looking, a broader interconnected approach to the urban landscape than Cullen’s snapshots (Sharp, 1968).

The definition of townscape is derived from the Roman “genius loci”, which translates as “the prevailing character or atmosphere of a place”. Townscape was used to explain how modern development could co-exist alongside historic buildings and areas, contributing positively to the evolution of a place. The townscape movement helped to raise the public profile of the conservation of built heritage, leading to the establishment of groups such as the Victorian Society and the 20th Century Society.

According to Conzen, cities and towns have a life history which he described in-town development and referred to historical periods, which are reflected in land use, streets, plots, and building patterns of each period. Therefore, the townscape is viewed as a manifestation of the values of every society in each historical period. Complexity arises from the coexistence and spatial arrangement in the townscape of features reflecting different cultural periods.

Conzen emphasizes the close relationship between a society’s socio-economic and political requirements in a particular period and the form taken by buildings constructed in that period. Besides, he emphasized the history of the towns. In this view, history is embodied in the townscape, which may be described in a city as evidence of different layers. Therefore, the townscape is the appropriate subject to investigate in seeking knowledge of the built environment within the time sequence. Townscape is “the physiognomy of the urban landscape, being the combination of the town plan, the pattern of building forms and pattern of urban land use” (Conzen, 1969, p.131). (Figure 1)

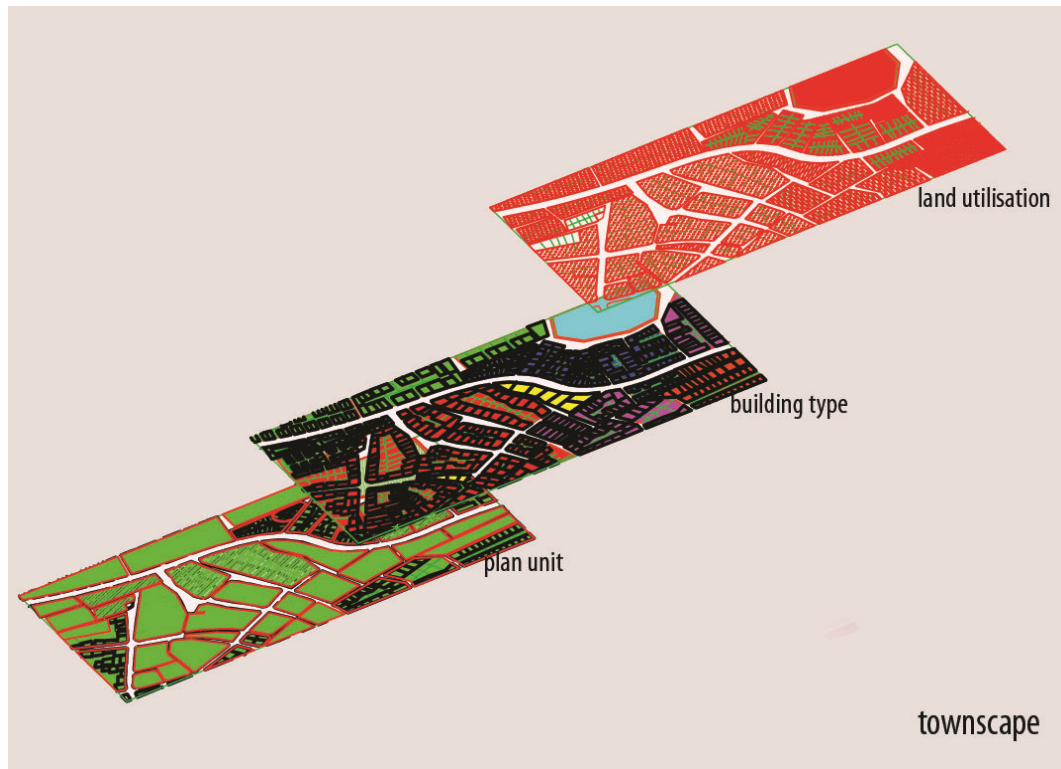


Figure 1: Illustration of townscape (Cömert 2013)

According to Marzot (1998), the Conzenian townscape is a heritage that refers to the physical combination of the town plan, building fabric and land utilization pattern. These components are hierarchical in which building forms are contained within plots or land-use units, which are set in the town plan framework.

The townscape cannot be comprehended in static terms. Still, it must be seen as the result of dynamic processes originating in urban society in its broader social and regional context and operating through time. Historical townscapes would seem to hold the best clue to such understanding. The following text will be considered elements of the townscape in greater detail.

2.4.1.6 Land Utilization Pattern

The urban land-use pattern is the arrangement of the spatial distribution of land use. The elements of the land utilization pattern are “the individual units of land utilization

occupying discrete plots”, which do not depend fundamentally on the period of origin. Classification of uses is “based on the single criterion of purpose”. Element complexes are represented by major functional categories such as residential, commercial, industrial, or community service functions, and their subdivision produces the detailed classification of actual land-use types. These classifications make up the functional structure of the townscape. (Whitehand, 1981) (Figure 2)



Figure 2: Illustration of land utilization (Cömert 2013)

While land utilization pattern is a matter of discussion, there is a distinction between elements and patterns, which is related to making a distinction between objects and their arrangement or order in space. According to Kropf (1993), the elements are defined as individual units of land use classified based on purpose. In this definition, there are three pertinent features. One concerns the unit occupied, a plot; another is the use of the plot, and the third is the relation between the two. (Kropf, 1993)

Moreover, according to Conzen, “use” refers to human activity and human interaction with the built and unbuilt environment. He classified “use” into different types; each type is a distinct combination of actions or interactions with other humans or the

environment. Different combinations define different types such as commercial, retail, business, professional, industrial, transport, residential etc. Further, Conzen identified groupings of element complexes within the land utilization pattern as residential premises; shops, business, and professional premises; public or community functions; industrial premises with builders' yards and warehouses; open spaces; and green space.

2.4.1.7 Building Fabric

The building fabric has individual buildings as its constituent form elements. The building fabric has been classified morphologically by the original function and period of building origin. (Figure 3) The original purpose of buildings has been grouped as dwelling houses, commercial buildings, industrial buildings, and community buildings. Within each complex period, divisions produce historical type groups, such as Georgian, the early and mid-Victorian, or the late Victorian and Edwardian in Britain. These are subdivided morphogenetical into actual building types designed for a particular purpose within a specific period context and architectural style. (Whitehand,1981)



Figure 3: Illustration of building fabric (Cömert 2013)

Like land utilization patterns, Conzen applied the same distinction between elements and patterns for building patterns, like the distinction between plot dominant and plot

accessory. A plot dominant is the site of greater use and is located on the frontage; the plot accessory is the site of lesser use and not on the frontage; the pertinent criteria for this distinction are thus the property of relative levels of human activity and the spatial relation of the building with the street. Various types of use and the position of the building within the plot and its relation to the street create a different pattern. In this definition, the elements are individual buildings without any more specific definition. Conzen distinguishes building types and groupings based on five criteria: the position relative to a street, the intensity of use, the user type, the period of origin and the internal and external form assuming a conventional definition of a building.

2.4.1.8 Town Plan

In Alnwick's study, Conzen (1969) defined a town plan as "the arrangement of an urban built-up area in all its man-made features" (Conzen, 1969, p.4). The town plan consists of four-element complexes: site, street system, plot pattern and building arrangement (Whitehand, 1981). (Figure 4) The site has been discussed earlier in this chapter and can be interpreted as the arrangement of natural features, particularly built and unbuilt elements, within the area of the town and the spatial relations between those features. (Whitehand, 1981). Other features are street and their arrangement in a street system; plots and their aggregation in street blocks; and buildings or, more precisely, their block plans (Conzen, 1969).

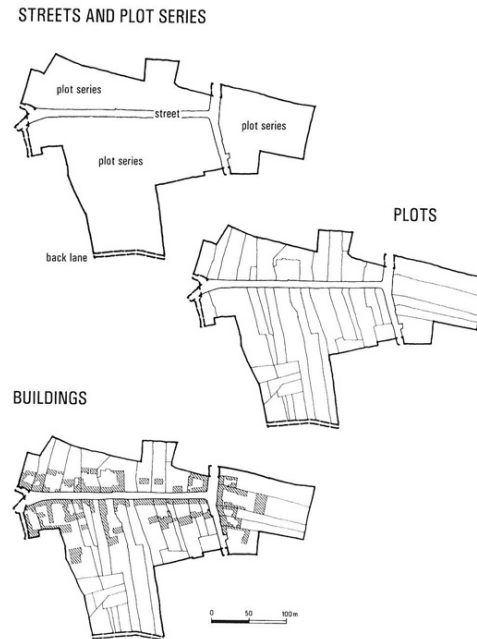


Figure 4: Illustrations of street, plot, and building pattern by Kropf (1996)

Street System

Streets are, in broad terms, the public and democratic space of the city, where people meet, with all their differences, and where they all interact in social terms. The street is defined as: “a space (street-space) in a built-up area bounded by street-line and reserved for the use of surface traffic”. Street space refers to an area or volume between particular boundaries and the relationship between boundaries. Street-line is “the boundary separating a street space from its adjoining street blocks”. And the street block is “a plot or group of contiguous plots bounded partly or wholly by street-lines...” (Conzen, 1969, p.130). (Figure 4)

Oliveira (2016) discussed various streets with different shapes and sizes, different ways of relating with the other streets in the surroundings, and different urban functions. Various elements of urban form, such as plots and buildings, and their characteristics, like height and location, influenced the character of a street. The plots influence this character on one or both sides of the street; by the buildings by their

height and by the relation between their height and the width of the street; by the way, buildings are located in plots, some near to the plot frontage, offering the street a higher sense of enclosure, some far from the plot frontage, offering greater openness to the street; or by the ‘doors’ of the buildings open to the street. In addition to those urban elements, another critical issue when analyzing the streets system is the relation of the space for pedestrians and the space for vehicles—public or private, motorized or non-motorized, soft (greeneries) and hard surfaces. To say that the street system is an arrangement of elements is thus challenging to support, and no relation can be specified between elements. (Oliveira, 2016)

Plot System

Conzen’s (1969) definition of a plot is “a parcel of land representing a land use unit defined by boundaries on the ground”. The plot pattern is “the arrangement of contiguous plots in a built up area viewed as a separate complex of the town plan and divided into street blocks” (Conzen, 1969, p.128). (Figure 4) The area within the town plan unoccupied by streets and bounded wholly or in part by street lines are street blocks. Each street blocks represents a group of contiguous plots or a single land parcel. Each parcel is a land use unit; it is physically defined by boundaries on or above ground and may be called a plot, whatever its size. The arrangement of contiguous plots is evident from the plot boundaries and, when considered separately from other elements of the town plan, may be called the plot pattern (Conzen, 1969).

These are discrete parts of the plot pattern referred to as the plot on the one hand and the street block and plot series on the other. The plot series is “a row of plots, each with its own frontage placed contiguously along the same street line” (Conzen, 1969, p.128).

As discussed in the street system, this street line is identified as the boundary between streets and street blocks based on forming the outer edge of plots in a block. The street block is recognized as an aggregate of plots and the street line as an aggregate of specific parts of plots taken together, but not necessarily forming a complete closed figure; the street line could not seem to create a component or determine the position of the street-block (Conzen, 1969).

The pertinent characteristic defining the plot is the spatial relation of boundary lines with the requirements that the boundaries form a closed figure; the boundary line refers to physical objects such as walls, level differences, paving etc.

Karl Kropf (1993) opened the discussion by examining the townscape defined by Conzen, which raises some ambiguities concerning the plot element. Despite function being identified as a distinct general aspect, the townscape includes the formed complex of land utilization patterns with the plot identified as a land use unit (Conzen, 1969). The town plan also includes the element complex of the plot pattern. The plot is thus defined in terms of land use and physical form.

In addition, Conzen emphasized ownership in the description and illustration of property holdings in his study of Alnwick, raising a further point of ambiguity associated with the plot. In common use, the plot refers to a unit of property. As with form and use, there is the tendency to conflate the physical form of plots and their status as an object of ownership or, more generally, control. While the physical boundaries of plots typically correspond to the boundaries of control, it is not always the case (Kropf, 1997). More fundamentally, the concept of ownership and other forms of control involves a socially defined relationship between the controller and the thing

controlled. One does not make sense without the other. As with use, however, control is a fundamental aspect of urban form and essential in understanding the development process. (Kropf, 2009)

Building Pattern

Conzen (1969) defined building pattern as “the arrangement of existing buildings, i.e., their block plans in a built up area viewed as a separate element complex of the town plan” (Conzen, 1969, p.123). Furthermore, the pertinent feature identifying the building pattern is the spatial relationships between elements. (Figure4)

The block plan of a building is “the area occupied by a building and defined on the ground by the lines of its containing walls” (Conzen, 1969, p.123). This means that the block plan is formed as a closed figure and consists of the ground surface within the boundaries. The boundaries are the lines of the building’s containing walls. The spatial relation of boundary lines which refer to specific material objects by convention defines the character of the block plan

2.4.1.9 Plan-Unit

The relations between objects characterize plan units as a combination of plan elements (streets, plots, and buildings) Conzen defined a plan unit as” any part of a town representing an individualized combination of streets, plots and buildings distinct from its neighbours, unique in its site circumstances and endowed with a measure of morphological unity and homogeneity” (Conzen, 1969, p.128). (Figure 5)



Figure 5: Illustration of plan unit (Cömert 2013)

Further, unlike the element complexes, the combination of elements in forming plan units is not “viewed as a separate element complex of the town” (Conzen, 1969, p.128). In this definition, “morphological unity” is integrated as a similarity of physical form. Specific plan units are the areas in which similar specific elements are arranged similarly. From this interpretation, the pertinent characteristic of the plan unit is the spatial relation of plan elements.

Conzen identifies plan divisions, which are combinations of plan units, to account for the larger-scale divisions of the town plan. Several orders of plan division are specified, each order being a combination of division of the next lower order.

2.4.1.10 Morphological Period

The plan units identified are the products of development processes. Their identification depends on the detailed examination in genetic terms of street and building lines, building block plans, and plots’ shape, size, orientation, and grouping. But plan units are only part of the townscape; as discussed by Conzen in the Whitby Survey, the building fabric and the pattern of land and building utilization can be

examined similarly. If these are viewed with one another and to the plan units, morphological regions can be recognized (Whitehand, 1981)

Therefore, according to Conzen, the identification of morphogenetic regions is made of the combinations of town plan, building fabric, land utilization pattern and the site. From the comparison of land use, building fabric, and town plan, the last emerges as the complex that contains the entire record of the town's physical development because it produces the complete collection of residual features. An evolutionary approach, tracing existing forms back to the underlying formative processes and interpreting them, would seem to provide the rational analysis method. (Figure 6) Therefore, the morphological changes are not random but correspond to periods of socio-economic and cultural history, manifesting themselves in the townscape as morphological periods, each with distinctive forms. (Conzen, 1975)

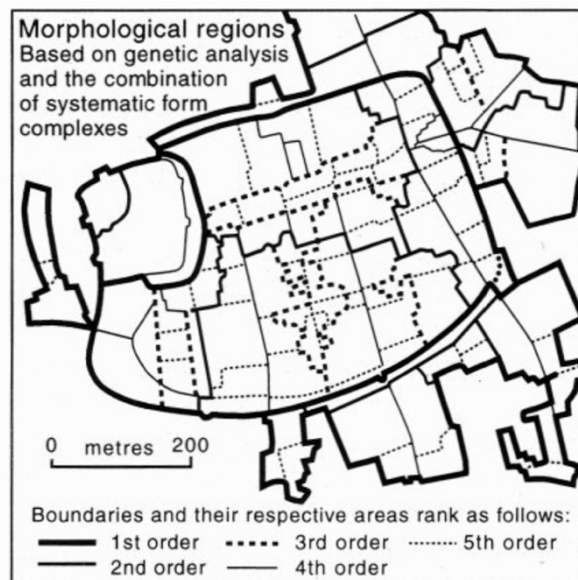


Figure 6: Illustration of morphological regions in Ludlow (Conzen, 1988)

As discussed above, the processes are those of economic and social development, as well as in materials and spiritual forms, therefore allowing the identification of distinct

cultural periods. Various regions have been developed in the sequence and contents of the cultural periods that affect them. Each period's distinctive character remains in the landscape and, for geographical analysis, can be viewed as a morphological period. In a townscape, any particular period expresses itself in the town plan and the fabric of buildings. Generally, the newer plan units in more peripheral situations show homogeneity because of the contemporaneous nature of streets, plots, and buildings. (Conzen, 1960)

In other words, the town's development, which leads to the variety and complexity of the arrangement of plan units, plan divisions, and morphogenetic regions, are divided into morphological periods. These correspond to the periods of social and economic development, which gave rise to specific changes in the town. Types of change are also distinguished, such as burgrave plot repletion and metamorphosis, redevelopment, and fringe-belt development. (Kropf, 1993)

2.4.1.11 Fringe Belt

The development of research on fringe belts followed three stages. The first stage started from 1936 to the mid-1960s, when European geographers identified the fringe belt phenomenon. Herbert Louis (1936) first applied fringe-belt research in the study of Berlin. He used the term *Stadtrandzone* (urban fringe belt) to explain the morphological structure of the city. This term has been used to describe the zone of expanding land use that developed at the urban fringe during various stages of urban growth. He identified urban fringe belts as the physical manifestations of periods of slow movement or actual standstill in the outward extension of the built-up area. They are characterized in the initial stages of their development by various extensive land users such as institutional and public utilities or country houses.

Conzen classified the fringe belt into intramural and extramural zones. The intramural zone consists of secondary development within the close-grained morphological phase of a traditional plot pattern. The extramural area consists of more open, dispersed development associated with the greater topographical freedom afforded by the large-grain rural field pattern. (Cömert, 2021)

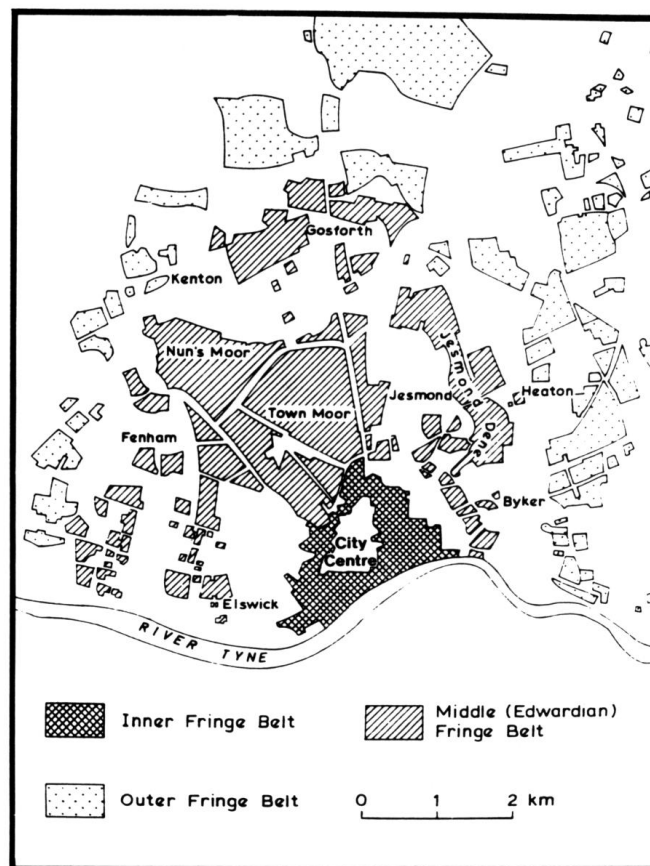


Figure 7: Illustration of fringe belts of Newcastle in 1965 (Whitehand, 1967)

M. R. G. Conzen (1960, 1962, 1966, and 1969) extended Louis's ideas, used the fringe-belt concept to establish a theoretical framework to explain urban growth and changes, and later investigated the town plans of Alnwick and Newcastle upon Tyne. Conzen defined an urban fringe belt as “a belt-like zone originating from the temporarily stationary or slowly advancing fringe of a town and composed of a

characteristic mixture of land use units initially seeking peripheral location” (Conzen, 1969, p.58). He found three fringe belts in Alnwick, an inner, a middle fringe belt, and an outer fringe belt. (Figure 7) An inner fringe belt defined the historical core and nucleus of the town surrounded by medieval walls, acting as a fixation line. A middle fringe belt was characterised by the development of residential areas outside the historic walls. An outer fringe belt at the edge of the town showed the city’s recent growth. These fringe belts have an essential role in the development of the morphological structure in the city.

The second stage of the development of the concept occurred between the mid-1960s and 1990. Slater (1978) augmented the fringe belt concept, especially in the conception of primarily economic terms, by examining the relationship between transformation, modification, and redevelopment of a single category of fringe belt land use and significant stage in the lifecycle of occupants. Whitehand (1967-1987) developed the studies of fringe belt research. Whitehand (1981a) grouped fringe belt studies under three categories, which are all traditional approaches that follow Conzen’s conceptions in his studies of Alnwick (1960) and Newcastle (1962). First, Whitehand considered the uses of the plot but also explored additive or formative development of the burgage/plot cycle and considered how this transformation comes over time. Secondly, he linked this traditional conception with urban rent theory; and thirdly, he explored the connections between fringe belts and the family life cycle and the evolution of social areas. Micheal Barke (1974,1990) discussed the formation and modification processes of fringe belts, and he focused on spatial and economic issues regarding the changes in fringe belts. Issues such as the relationship between the fringe belt and building cycles, land values and the bid-rent model have been discussed chiefly by geographers. They focused on the description and explanation of urban

form rather than its relation to planning (see Barke, 1976; Carter and Wheatley, 1979; M. P. Conzen, 1978; Slater, 1989, Whitehand, 1981b).

In the third stage of research, urban morphologists assessed fringe belts in relation to a range of topics. Whitehand and Morton (2003, 2006) integrated the discussion of the fringe belt idea into planning. Kropf (2001) and Whitehand (2005) studied the role of fringe belts in urban design management, and Hopkins (2003, 2012) focused on their importance for urban ecology and sustainable development. M. P. Conzen (2009) made a comparative assessment in which he searched for similarities and differences. M. P. Conzen extended the study of fringe belts from the spatial perspective to the American context in the analysis of Madison, Wisconsin. M. P. Conzen (2009) characterised the questions about fringe belt formation in two distinct groups: economic and functional specialisation and cultural and cross-cultural influence.

A strong tendency for fringe belt research has been formed and focused on Europeans, mainly the British. Consequently, studies of fringe belts increased as the concept was taken up in several other countries such as Catalonia (Vilagrassa, 1990), Germany (Dollen, 1990), Mexico (Rodrigo-Cervantes, 1999), France (Ducom, 2003, 2005, and 2008), and Italy (Conzen et al., 2012, and Karaulan & Kubat, 2018). In Turkey Kubat (2018) studied the Istanbul fringe belts (Hazar & Kubat, 2005; 2015; Kubat & Hazar, 2018; Kubat, 2018). And Ünlü (2013) categorised fringe belt formation like Conzen (2009) under spatial, economic, social, and planning levels, and he applied that methodology to Mersin (Turkey). In the last decade, research has been conducted in Auckland, and New Zealand (Gu, 2010). Finally, fringe belts have begun to be investigated in Eastern Asia (Kim, K. J., 2012; Whitehand et al., 2011; Whitehand, J. W. R., & Gu, K., 2017; Lihua et al., 2019).

Most recently, Whitehand (2019) discussed green space's role in urban morphology, particularly green spaces that occur in fringe belts. Zhang (2019) discussed urban green spaces in Birmingham's fringe belts and tested residential areas by evaluating the types of surfaces and green spaces. Scitaroci and Marić (2019) analysed 26 European towns and cities and identified green spaces in fortifications and inner fringe belts.

2.4.2 The Process Typological Approach

The process typological approach to urban morphology originated from the Italian school of urban morphology. In the 1950s, Italian architect Muratori started to analyze the typology of houses, their location in the city, and the active history of the town. Muratori attempts to create a concept for the design based on traditional procedures of urban construction (Moudon, 1998). Hence, Italians were the first who study the precise typology of urban morphology. However, the typo morphological approach is best represented by the work of the architect and urbanist Gianfranco Caniggia, who was an assistant of Muratori. Gianfranco Caniggia established the principles of the process-typological approach and, together with Maffei, wrote the most definitive work on process typology theory and methods: *Architectural composition and building typology; interpreting basic buildings* (Gauthiez, 2004).

The Italian school of thought attempts to establish a structural relationship between urban history and the future transformation of cities. According to Kropf (2009), the approach they developed seeks to inform their architectural and urban proposals with an understanding of the built environment by examining its detailed structure and the historical process of its formation. In the words of Gianfranco Caniggia, typo morphological studies present a “dynamic picture of the built world, whose production is the result of a dialectic [or active relationship] between human action and

‘environmental reaction’” (Caniggia and Maffei, 2001). According to Moudon (1989), typological studies generally make several direct contributions to design. Most obvious is the provision of a detailed historical context to facilitate design within the confines of a given city or region. The main fundamental issues in developing the typological method are the concepts of type, offering a tool to analyze large numbers of buildings, and process, allowing organizing the evolution of different types into a timeline. (Caniggia and Maffei, 2001)

Caniggia and Maffei thus identify the following distinct aspects of urban form:

- Physical form
- Function/use
- The idea of the building or form
- The act of construction/modification
- The cultural process of derivation and development/change.

Caniggia and Maffei (2001) defined type as:

“a system of integrated cognitions, assumed unitarily to satisfy the particular need to which [the] object has to correspond. These cognitions are already an organism as much as they are integrated, correlated, self-sufficient or complementary notions with a unitary aim. They are already a pre-projection of what the product will be, albeit prior to the object becoming a physical being”. (Caniggia and Maffei, 2001, p.50).

For Caniggia and Maffei, the forms found at the different levels are identified as *types*. In their definition, “*type*” is a cultural model or entity rooted in the local process of cultural development, carried mentally, and driven by former experiences which have been used for future transformation in the built environment. In the following, Caniggia and Maffei introduced the concept of “urban tissue”. According to Caniggia,

“tissue is the concept of the coexistence of several buildings existing in the minds of builders before the act of building, at the level of spontaneous consciousness as a civil result of the experience of putting together several buildings and summing up all interesting aspects” (Caniggia and Maffei, 2001). Urban tissue can be considered as an outline of “formative laws and categories that are as typological as the building type” (Caniggia and Maffei, 2001, p.118).

Like Conzen, Caniggia and Maffei developed the concept of compositional hierarchy, focusing on the specific aspect of built form. Kropf (2014) argued that Muratori, Caniggia and Maffei start from the aggregation principle as the basis for the hierarchy of elements stated as an abstract schema. The schema is a compositional hierarchy of elements, structures, systems, and organisms. This schema is first applied to building elements, with building materials such as bricks, timbers, tiles etc. The structures of elements are things such as walls, interior floors, roofs etc. Systems of structures are arrangements of rooms, stairs, and corridors, and the organism is the building. The same scheme is applied to towns, taking buildings as elements. The structure of elements is an association of buildings or an urban tissue. The system of structures is then a combination of tissues forming regions or districts, which, taken together, form the town’s organism (Caniggia and Maffei, 2001).

The following texts describe the general aspects of Caniggia and Maffei’s approach to explaining the character of urban form by their consistent elements and development through time. Since the present study focused on towns and cities, the hierarchical development has been focused on the city scale. Therefore, the text below presents the elements, structures of elements, systems of structures, and organisms of systems at the city level, such as buildings, urban tissues, districts, and organisms.

2.4.2.1 Building

Caniggia, and Muratori before him, consistently refer to the building as an “organism” that is integral to the whole human being’s body, mind, and spirit (Caniggia, 2001). Caniggia identified buildings as “those in which we live or in which we carry out a function” (Caniggia and Maffei, 2001, p.75).

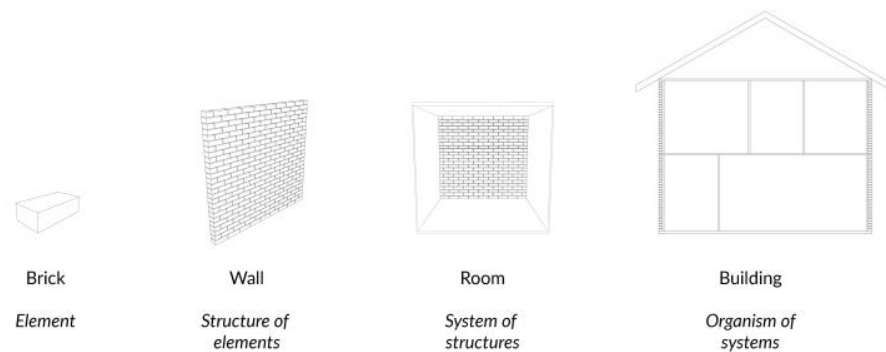


Figure 8: Illustration of a building according to Caniggia (Kristjánsdóttir, 2019)

As Caniggia and Maffei argued, “the term building type was used in the past and still today to indicate any group of buildings with some characteristics, or a series of characteristics, in common” (Caniggia and Maffei, 2001, p.50). Building type is a formation that gives information about its appropriate time. He mentioned that “the knowledge of type results from our observance and interpretation of existing building, therefore from our critical consciousness as an analytical recognition of the existence of types, their progressively changing system and the typological process”. The building type has been subdivided into specific types, rooms, stairs etc. The distinction is based on physical form and use. (Figure 8)

2.4.2.2 Urban Tissue

“A tissue is to an aggregate what building type is to build: tissue is the concept of the coexistence of several buildings existing in the minds of builders. It also refers to the level of spontaneous consciousness, as a civil result of the experience of putting together several buildings and summing up all interesting aspects, including aggregation....” (Caniggia and Maffie, 2001, p.119).

Urban tissue is defined generally as “associations of several elements” taking “building” like the elements or component parts. Another term that Caniggia used for a collection of buildings is *aggregates*. The distinction between aggregates and tissue is that tissue deals with the objects as types and covers the pertinent characteristic of a connection to other objects in a typological process. According to Caniggia and Maffei (2001), A tissue is identified under several headings: lot, pertinent strip, route, blocks, and tissue. (Figure 9)



Figure 9: Illustration of an urban tissue (Strappa,2020)

Caniggia and Maffie (2001) argued that a lot includes “the built area together with the pertinent area”. In other words, a lot identified as-built areas together with streets and routes. It deals with a regular piece of land for building use connected with a planned building route or street. The lot internally has been subdivided into a portion occupied by the house or different houses and a pertinent area. As Cömert (2013) mentioned, lot division during the time is an issue that presents a formation of the lot during the time. It affects the routes and street typology as well. (Figure 10)

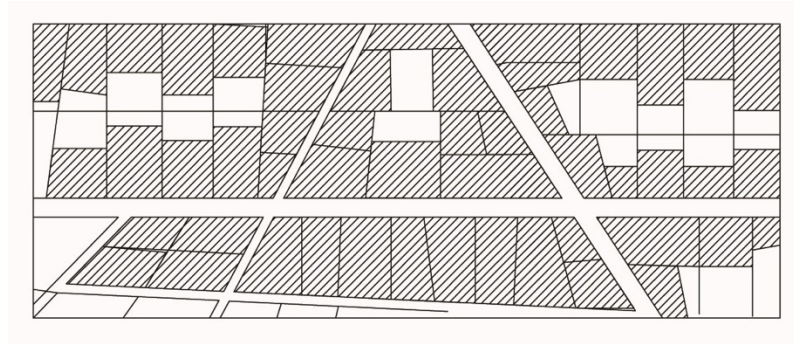


Figure 10: Illustration of lot division by Cömert (2013)

The Pertinent Strip

Caniggia and Maffie (2001) described the pertinent strip as the area which is connected to each building type. It refers to all the built lots on the same street front. The pertinent strip is an association of several elements. The pertinent characteristics identified in the definition are component parts(lots), arrangement of components, position relative to other entities and use. It deals with the relation of the building type and its lot, route and street surrounding it. All those relations give an overview of the pertinent strip definition at the plan level. On the facade level, the relations of the window and doors, entrances and garden walls present the character of the pertinent strip. (Cömert, 2013) (Figure 11)



Figure 11: Illustration of the pertinent strip (Cömert, 2013)

Route

Caniggia considered that “the route is, by definition, the structure which allows a place to be reached”. The route is defined primarily in terms of its use and position relative to other entities. Since he used the word “structure” in route definition like building type, “routes” could refer to an aggregate of materials such as gravel, stone, brick, asphalt, concrete etc., forming a continuous flat surface with certain width and length sitting in some specific relation to particular buildings.

On the other hand, the built route refers to a more general class of a lower level of specificity within the scale occupied by tissues. Caniggia strictly associates the concept of the route with the formation of the building tissue. He distinguishes several different kinds that can be subdivided into specific classifications (Figure 12), such:

1. Matrix routes exist both in the spontaneous and planned form in a territory before any construction takes place.
2. Planned building routes that follow the matrix routes.

3. Connecting routes, linking the first two categories.
4. Restructuring routes, intervening in mature tissues as conjunctions of new urban poles.

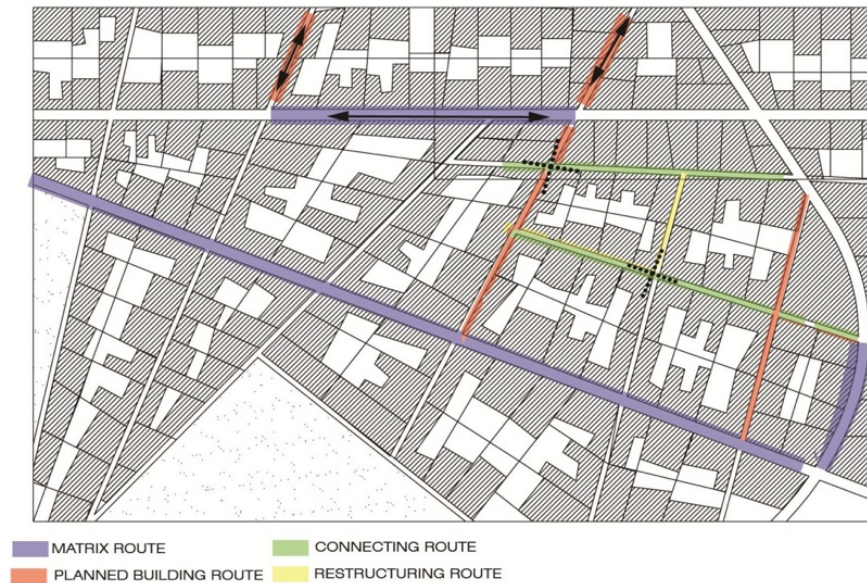


Figure 12: Illustration of the route (Cömert, 2013)

The Block

According to Canniga, the block can be described differently according to the scale. It is the result of the combination of a matrix route, two parallel planned building routes perpendicular to the matrix route and a connecting route parallel to the matrix route. (Figure 13) The block is then considered to be the combination of one of the pertinent strips of each of the four routes mentioned (Kropf, 1993)

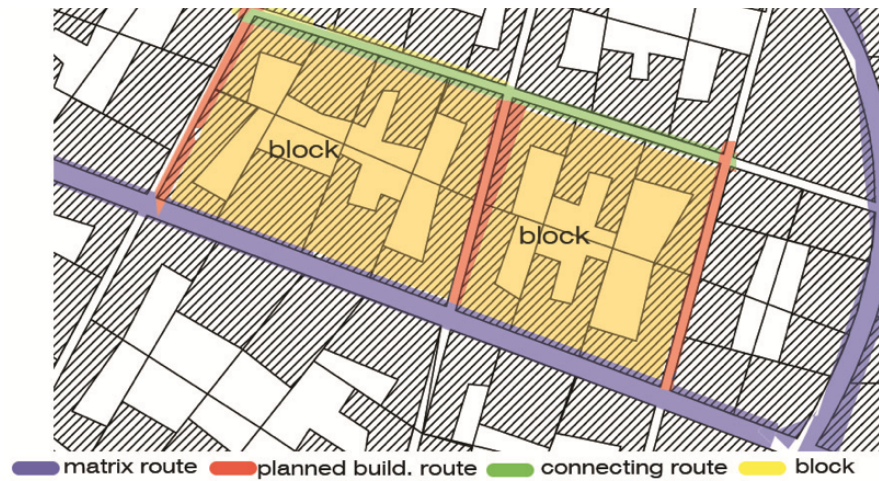


Figure 13: Illustration of the block (Cömert, 2013)

2.4.2.3 Urban Organisms

Caniggia and Maffei (2001, p.162) discussed the term aggregate, which is “a vague series of buildings and settlement, and urban organism are also series of the buildings”. Therefore, the urban organism is a system of a residential building, manufactory, craftsmen, and commercial activity. It is closely related to a territorial domain that is internally organised with its own centre, peripheries, boundaries, and axis. (Figure 14)

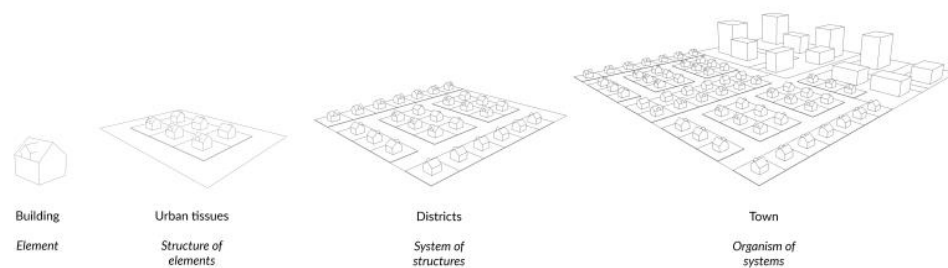


Figure 14: Illustration of an urban organism according to Caniggia (Kristjánsdóttir, 2019)

2.4.3 Configurational Approach

Urban morphological studies developed in another method by the work of Bill Hillier and Julienne Hanson in the 1980s. This configurational analysis is known as space

syntax, which is based on the fact that “an urban environment is an interconnected space where everywhere links to everywhere else” (Jiang, 1998, p.1). Space syntax is a social theory of space. In this theory, space is defined as inherent to human activity, and it is understood as configurational, meaning that it is influenced by network relationships. By analyzing the spatial layout of cities (or buildings), space syntax describes the potential human movement and its social and formal perceptions and interactions. (Monteiro & Pinho, 2021)

Three main books that Bill Hillier and Julienne Hanson have published must be highlighted as the primary represented source for space syntax in the 1980s, “*The Social Logic of Space*” (Hillier and Hanson 1984), “*Space is the Machine*” (Hillier, 1996) and “*Decoding Homes and Houses*” (Hanson 1998). According to Hillier:

“Space syntax is a research program within the morphological paradigm of built environment research. ... it aims to develop a theoretical understanding of how space works, and its strategy is to combine computer-driven formal descriptions of space patterns with empirical observation of how they are used, linking the two with simple statistics.” (Hillier & Hanson , 1984, p.108)

The space syntax approach focused only on public spaces, especially open spaces. (Jiang, 1998) In the space syntax approach, morphological explanation emphasizes identifying the characteristic configurational structures in road networks at different geographical scales. (Hillier, 1996) Space syntax research is separate from the Conzenian perspective in a way that its primary concern is not with historical morphological periods by itself but with the relationship between road networks, movement patterns and land-use distributions which are related to predicting human spatial behaviour in urban environments. (Hillier, 1999).

Akkelies van Nes and Claudia Yamu (2017) divided the space syntax demands into four elements in urban analyses based on Hillier's (2007) research.

“Firstly, space syntax means operating with a concise definition of urban space. Secondly, it offers a family of techniques for analysing cities as networks of space formed by buildings’ placing, grouping and orientation. Thirdly, it involves a set of techniques for observing how these space networks relate to functional patterns, such as movement, land use, area differentiation, migration patterns, and even social wellbeing and malaise. Fourthly, based on the empirical results arising from the first two aspects, space syntax makes it possible to develop a set of theories about how urban space networks relate in general to the social, economic, and cognitive factors which shape them and how they are affected by them” (Van Nes & Yamu, 2017, p.156).

Two fundamental aspects of the space syntax approach are space and the relationship between space and movement. Space syntax is considered a wider morphological variety to reflect the different relationships between space and society. This method can be applied to various scales and levels in research on built environments. It was initially used and tested in analyses of small settlements and buildings, which “results have contributed to theories and an understanding of how cities are spatially built as an effect of societal activities and how urban space functions as a generative power in relation to societal activities” (Van Nes & Yamu, 2017). Later on, computer programs could analyze complex spatial relationships within more prominent cities and regions.

Based on Kropf's (2009) discussion, space syntax is intended to understand the spatial structure of settlements through various analytical methods that characterize the configurational approach to urban morphology. At the scale of settlements, the theoretical basis of the approach is the relationship between spatial structure and the generic function of movement.

“The... fundamental correlate of the spatial configuration is movement. This is the case both in terms of the determination of spatial form, in that movement largely dictates the configuring of space in the city, and in terms of the effects

of spatial form, in that movement is largely determined by spatial configuration” (Hillier, 1996, p. 152).

Space syntax takes a distinct view because of its emphasis on space and spatial configuration, rooted in the analysis of buildings (Hillier and Hanson, 1984). The concepts and analytical methods focus almost entirely on the voids of a structure, principally the street spaces within a settlement. However, some consideration is given to the areas around buildings within a plot.

For Hillier, “spatial form” is the arrangement of spaces with explicit reference to the position of any given area within the structure of the configuration as a whole. This formulation necessarily implies or assumes the “solid” that defines the space or void.

In other words, space syntax is a method for describing and analyzing the relationships between spaces of urban areas and buildings. Architects commonly refer to these relationships as “the layout”. In Space Syntax, the spaces are understood as voids (streets, squares, rooms, fields, etc.) between walls, fences and other impediments or obstructions that restrain (pedestrian) traffic and the visual field. There are three fundamental conceptions in space syntax analysis (Figure 15):

- **Convex space** is a space where no line between any two of its points crosses the perimeter. A concave space has to be divided into the least possible number of convex spaces.
- **Axial space** or an axial line is a straight line (“sight line”), possible to follow on foot.
- **Isovist space** is the total area that can be viewed from a point.

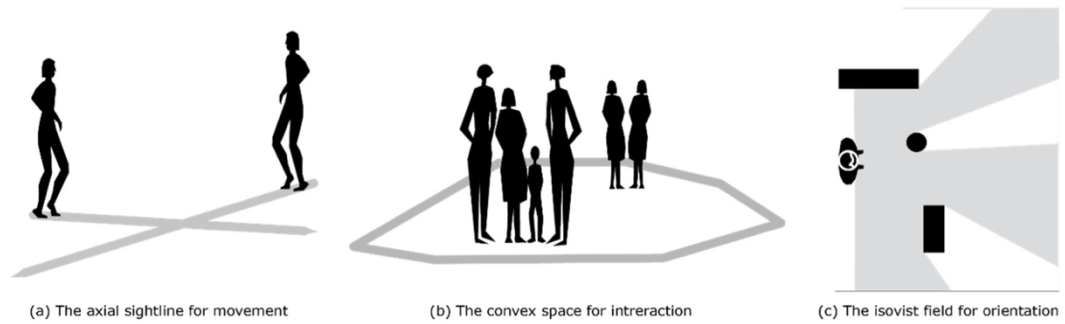


Figure 15: Basic conceptions in space syntax analysis (Yamu, 2021)

To analyse the spatial structure of a layout, three types of syntactic maps such as convex map, axial map, and isovist map, can be used. (Figure 16) All three types of maps can be transformed into graphs for the purpose of analysis. In the space syntax method, the “**graph**” is a figure representing the relationships of permeability between all the convex spaces or axial spaces of a layout.

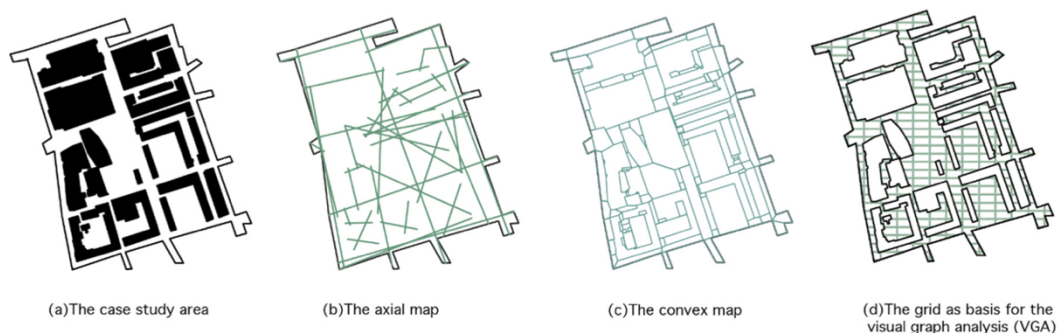


Figure 16: Three types of syntactic maps (Yamu, 2021)

The approach, therefore, implicitly includes the relation between humans and physical form, and it includes:

- **space/physical form**
- **use/occupation/movement**
- **perception.**

2.4.4 The Spatial Analytical Approach

Cities and settlements are constantly changing through time based on various factors such as geographical locations of activities and features, local movements, the development of lands, the migration of peoples over decades, cultures, and social and economic issues. Therefore, finding a way to record and analyze all the layers of information to find the structure of the development needs to create and sort a wide variety of types of geographic data. Various geographic phenomena can be represented digitally by applying various models and using computer software (such as GIS).

Nowadays, vast spatial analyses such as cellular automata, agent-based models, and fractals are available for morphological analysis. Michael Batty has been known as a critical researcher in promoting this approach. He studied Urban and Rural Planning at the University of Manchester and finished his PhD at Wales University. He became an editor of the journal “Environment and Planning B: Planning and Design” in 1983. He became a Center for Advanced Spatial Analysis (CASA) member at UCL. He focused on city systems by using various methods and computer models to “understand the spatial structure and dynamics of cities as complex, emergent phenomena, in which the global structure develops from local processes” (Oliveira, 2016, p. 125).

Jane Jacobs (1961) mentioned that Batty understands the city as a problem of organized complexity and applies the concepts of emergence and evolution in moving toward solving that problem. Spatial analysis is not a new concept; it is a way of applications of recent methods to identify the spatial structure of the city. Jack Dangermond (2003) determined it as a kind of data-mining technology to document

and analyze patterns and interpret them for decision-making purposes. The following text introduced different methods of spatial analysis in urban studies.

2.4.4.1 Cellular Automata

The history of Cellular Automata goes back to John von Neumann and Stanislaw Ulam, who worked with concepts of artificial life and idealizations of biological systems. Cellular Automata models are a tool for the dynamic modelling of urban phenomena that try to capture the complexity of spatial phenomena. (Figures 17 and 18)

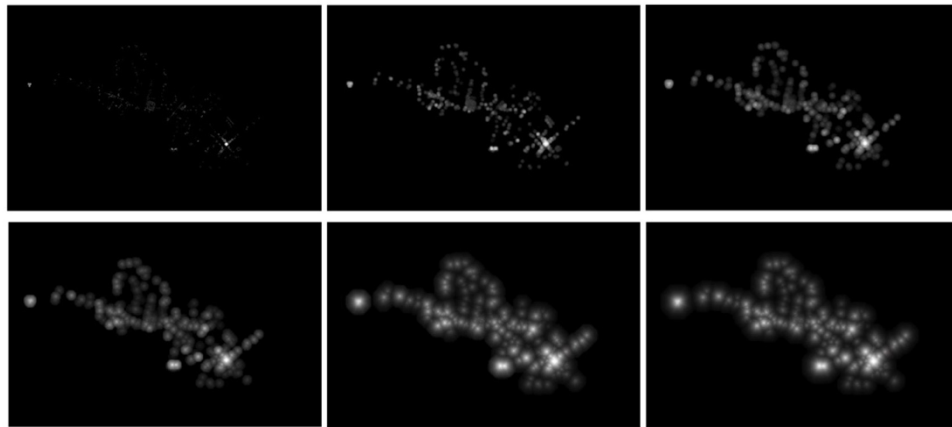


Figure 17: Cellular Automata of Mashad's night map (Talebian, 2020)

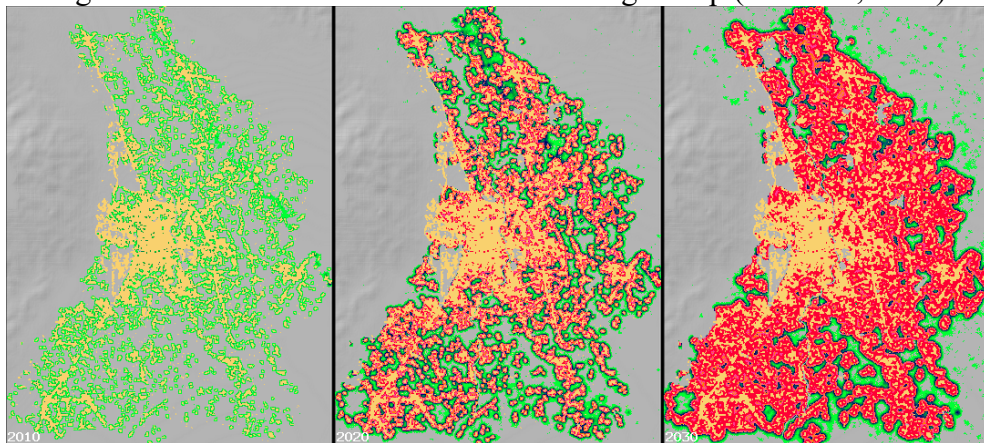


Figure 18: Example of Cellular Automata models (McGrath, 2017)

Oliviera (2016) described that Cellular Automata models have a straightforward formulation that makes its perception of the area of urban studies very easy. There are

essential live components: (i) the cells, (ii) the states of the cells (on or off), (iii) the neighbourhood (the adjacent cells), (iv) the transition rules (such as the number of neighbours required for turning the cell on), and, finally, (v) time.

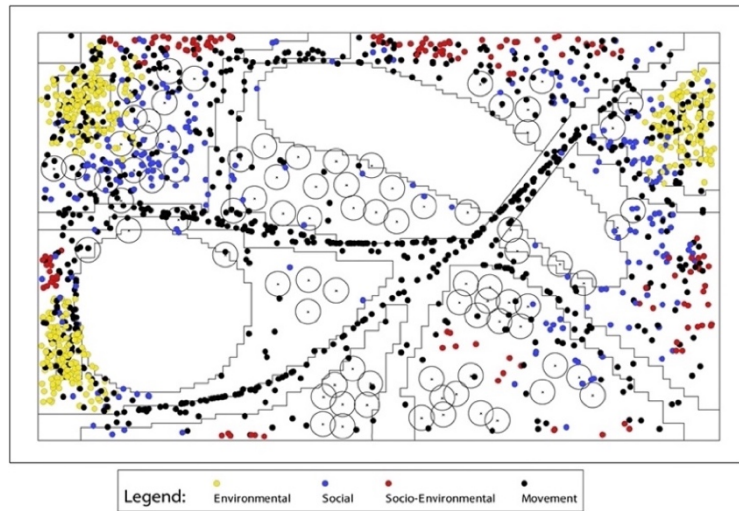
Cellular Automata models had very intense research in different areas of physics and mathematics, benefiting from the development of computing from the 1950s to the 1970s. In urban studies, Cellular Automata were applied by Waldo Tobler in his work “Cellular Geography” (1979). After that, several authors started to use Cellular Automata models in the simulation of urban phenomena (see: Helen Couclelis, 1985 and 1997; and White and Engelen, 1993)

2.4.4.2 Agent-Based Models

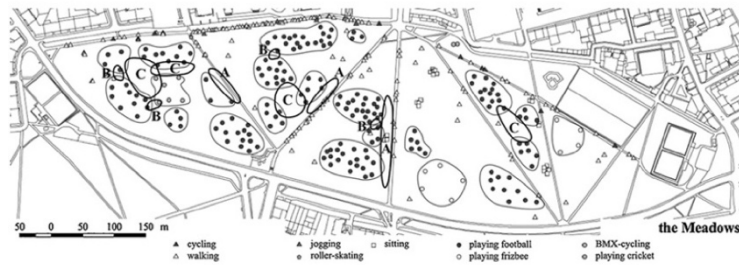
Agent-based modelling (ABM) is an emerging modelling approach. Recently, agent-based models have been increasingly adopted by social scientists, especially scientists in urban and geospatial studies, as a practical paradigm for framing the underlying problems of complex and dynamic processes (Chen, 2012). As Crooks et al. (2021) argued, with the growth of computational power and data, agent-based models have evolved into one of the main paradigms for urban modelling and understanding the various processes shaping our cities. Agent-based models have been developed to explore a vast range of urban phenomena, from micro-movement of pedestrians over seconds to urban growth over decades and many other issues in between. (Figure 19)

Gilbert and Troitzsch (2005) defined Agent-based modelling as a way to take the complexities of the real world and focus on the vital task at hand through abstraction, reductionism, and simplification. ABM models allow for the simulation of the individual actions of diverse agents and the measuring of the resulting system’s behaviour and outcomes over time. The agent-based modelling approach’s flexibility

has allowed such models to be used in a diverse set of applications. These range from archaeology (Axtell et al. 2002), agriculture (Hailegiorgis et al. 2018), basketball (Oldham and Crooks 2019), crime (Malleon et al. 2013), diseases (Perez and Dragicevic 2009), disasters (Jumadi et al. 2018), invasive species (Anderson and Dragićević 2018), to urban growth (Xie and Yang 2011), housing markets (Geanakoplos et al. 2012), gentrification (Jackson et al. 2008), slum formation (Patel et al. 2018), and traffic (Manley and Cheng 2018).



(a) Simulated



(b) Observed

Figure 19: Example of Agent-Based Models (Cheliotis, 2020).

2.4.4.3 Fractals

Fractal geometry is a powerful tool in geographic modelling and spatial analysis, and it has been applied to urban studies for a long time (see: Arlinghaus, 1985; Batty, 1996; De Keersmaecker et al., 2003; Thomas et al., 2010).



Figure 20: Left: the Mandelbrot set, a mathematical fractal. Center: Venice's fractal urban fabric. Right: the Eiffel Tower's fractal architecture (Boeing, 2018)

Fractal geometry was developed and became popular through the work of the mathematician Benoit Mandelbrot at the beginning of the 1950s; Mandelbrot launched a line of research in the book “The fractal geometry of nature”. He (1982) argued that many patterns of nature are so irregular and fragmented that, compared with Euclidian geometry, nature exhibits a higher degree and a rather different level of complexity. Mandelbrot proposes a new geometry of nature, arguing for its use in various fields based on the concept of “fractal”.

In the subsequent decades, fractal geometry has been progressively applied to the built environment. Two fundamental books on fractals were published in 1994. “*Fractal cities: a geometry of form and function*”, by Michael Batty and Paul Longley, is an initial attempt to apply fractal geometry to cities. Batty and Longley (1994) argue that cities are fractal in form and that much of the pre-existing urban theory is a theory of the fractal city. At the same time, Pierre Frankhauser published *La. fractalité des' structures urbaines*. Frankhauser (1994) sustains the existence of self-organising processes, or interior order principles, promoting the development of ‘irregular’ urban patterns. As in the case of Batty and Longley, the French author proposes using fractals to measure and characterize these irregular structures. (Figure 20)

As Tannier and Pumain (2005) discussed, the main advantage of fractal geometry is providing a model of reference that seems more adapted than Euclidean geometry to describe spatial forms created by societies. The most significant advantages of using fractal dimensions in urban geography have involved measuring the fractal dimensions of urban patterns to find new descriptions of the variety of urban morphologies. The morphology of urban patterns is analyzed to obtain: the verification of the hierarchical nature of the spatial structure and the characterization of this hierarchy; the identification of thresholds in the spatial organization of the city; and the determination of the number of different types of spatial organization. (Tannier & Pumain ,2005)

2.4.4.4 . Parametric Design

As mentioned above, computer-aided tools have been extraordinarily developed in the last decades. Therefore, various methods and technologies have been applied for urban design projects and the evaluation of urban forms. Parametric design is one of the approaches used in various disciplines, such as architecture, landscape design, urban design, and urban morphology. According to Kolarevic (2004), “parameters are more interesting and less the form; this means the parameters of a given object are declared and not its form”. Parametric tools can provide innovative design procedures by integrating strategies, solutions, and expressions in one system.

In architecture, parametric design is a mathematical method employed by Gaudí, Otto, Sutherland, and some engineers to be a regular part of architectural practice. In architecture, the term parametric is often accompanied by a utilitarian need to explore the possibilities of the model. In the 1920s, Walter Gropius defined formal parameters such as lighting, insulation, building orientation, the ratio of open space to build area, and numbers of floors for solving the housing problem in modern cities, as he called the rule of Heiligenthal. (Da Silva & do Eirado Amorim, 2010) Parametric modelling

is present, in some generated form, on most contemporary architect's projects such as Grey Lynn, Massimiliano Fuksas, Zaha Hadid, Frank Gehry, Patrik Schumacher, Kazuyo Sejima, Norman Foster, Herzog and De Meuron.

In recent years, parametric design techniques have been applied to town planning and urbanism. The parametric approach to urbanism has been defined by Stavric & Marina (2011) as “the ways in which associative design systems can control local dynamic information to affect and adjust larger urban life-processes by embedding intelligence into the formation, organization and performance of urban spaces, uses, activities, interfaces, structures and infrastructures”. Therefore, the objective of parametric design is linked to the urban scale. The initial concept of parametric urbanism has been developed gradually by Haggett & Chorley (1969).

Urban codes profoundly influence urban form, affecting the design and placement of buildings, streets, and public spaces. Stephen Marshall (2011), in his work “Urban Coding and Planning”, considers the nature and scope of coding, its purposes, the kinds of environments it creates, and its relationship to urban planning. Using urban codes established the relationship between urban elements. According to Baş(2003) and Ünlü (1999), urban codes in modern urban design operate as a tool to control the urban form. In the parametric morphology approach, a code index and code matrix were produced to provide the layout for the formation of the parametric language of the urban form and to define the urban codes with their expected performances, also developed by focusing on urban parameters. (Akman, S.D. 2017)

2.5 Review of Various Urban Morphological Approaches

The British and Italian approaches to urban morphology have been discussed to realize how each method looks at the urban elements from different perspectives and scales. Introducing these approaches might be due to the complexity and sensitivity of human settlements that are directly affected by the urban form. Therefore, the study discusses a wide range of studies to find their differences and similarities in the definition of urban form. The historico-geographical, process typological, configurational, and spatial analytical approaches are discussed. Upon those approaches, the works of MRG Conzen geographer and Gianfranco Caniggia architects have been argued in detail due to their comprehensive and exclusive points of view that are still applicable today.

Conzen's method of analysis explains the geographical structure of the town systematically. As discussed, he started with a definition of a site, function, townscape, social and economic context, and development. And by townscape, he refers to town plan, land utilization pattern and building pattern. Town plan analysis is subdivided into the street system, plot pattern and building pattern. He distinguished plan units as the combination of streets, plots, and blocks. In addition to this analysis, the morphological resign and fringe belt development has been determined.

Muratori and later Caniggia and Maffei developed their studies based on the definition of the type. They seek to examine the historical process and formation of the cities. Their approach was undertaking the towns as an organism and was hieratical; it consists of elements, the structure of elements, the system of structure and the organism. The method is applicable both to the building and the city level.

The configurational approach is mainly presented by space syntax. The space syntax analysis represents the relation between humans and physical form and primarily focuses on the void of a structure such as a street. The space syntax concentrates on what can be seen by a human within the space, and the analysis particularly emphasizes the space, use and movement and perceptual investigation.

The spatial analytical approach included various methods and techniques that resemble the spatial distribution of urban areas within a sub-region. The analytical methods focus on the variables and factors developed from local processes and change the global structure.

Various morphological studies have been introduced, which have been taken as a basis for the present study. However, the role of open space, particularly green space, has less consideration in the structure of the urban area. Therefore, the following sections introduce the most relevant studies of urban form, which were developed by integrating the discussed morphological approaches, which have been done by Karl Kropf and Paul Osmand. The reason for the selections of these two scholars can be their responsiveness to consider open space in their methodology- which is regarded as in none of the works of Conzen and Caniggia. However, some studies in space syntax and spatial analysis focus on open spaces, but their approach is related to the social aspect of urban form, which is not in the scope of this thesis.

2.6 The Methodological Framework of Karl Kropf

In his PhD thesis (1993), Kropf established a basis for a definition and subdivision of built form based on Conzen's and Caniggia's morphological approaches by differentiating between hierarchical levels based on part-to-part and part-to-whole

relationships of urban elements. He distinguished the similarities and differences between Conzen and Caniggia's urban elements. (Figure 21)

Conzen	Caniggia and Maffei
Streets	Streets
Plot series/blocks	Pertinent strips
Plots	Lots
Buildings	Buildings
	Rooms
	Structures
	Materials

Figure 21: Comparison of elements identified by Conzen, and Caniggia and Maffei. (Kropf 2014)

In his methodology, Kropf comprehends the conceptions of space, time and energy as essential aspects that contribute to a more profound description and understanding of the world. In his study, "Aspects of urban form", Karl Kropf compared the four approaches historico-geographical, process typological, configurational, and spatial analysis. He identified three aspects, first, the range of different phenomena that are the object of urban morphological enquiry; second, he recalls an aspect common to all the approaches which can be used as a reference key to coordinate different views rigorously; and third, he outlines a composite view which the different methods support each other to provide a better understanding of human settlements. (Kropf, 2009)

In addition, Kropf (2014) acknowledged ambiguity in the definition of urban form. According to him, by giving the distinction of different aspects of urban form, there is potential for ambiguity *between* and *within* aspects. There is ambiguity surrounding

“form” and “use” in what is represented. Also, the “plot”, can be identified as a physical form, a unit of land use and a unit of control (Kropf, 1997, 2009, 2014). Therefore, he argued that identifying aspects is not a means of denying overlaps but articulating them.

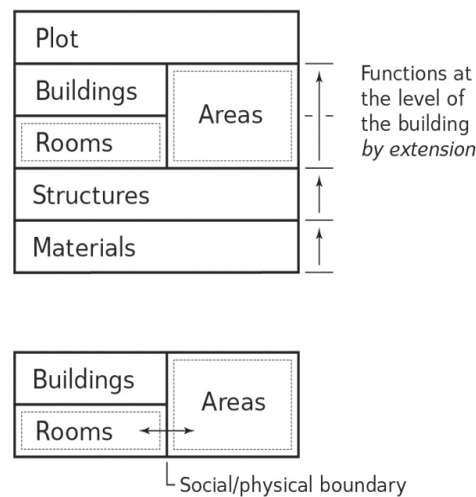


Figure 22: Developed diagrams for the position of the ‘area’ within the hierarchy (top) and the boundary between two types of voids or space (below). (Kropf 2014)

Kropf (2014) discussed the missing elements in Conzen and Caniggia hierarchical schemas. He identified that several levels are missing between the building and tissue. For instance, the “plot” as an individual urban element consists of the building, the area around it or private open space. Therefore, the open spaces entity in the plot definition was mistreated. At the urban scale, he discussed the similar concept between streets and plot series. Figure 22 represents the position of the area or open spaces in the hierarchical model.

He proposed the categories of ‘void’ or ‘area’ (space between buildings and plot boundaries) in the hierarchy of urban form. Kropf declared that each main urban element, building, plot, and street consists of a similar type of void or space. Rooms

in the buildings are the voids; a story is included the building and external areas; and a street consists of two plot series and public space (highway, square, etc.) (Figure 23)

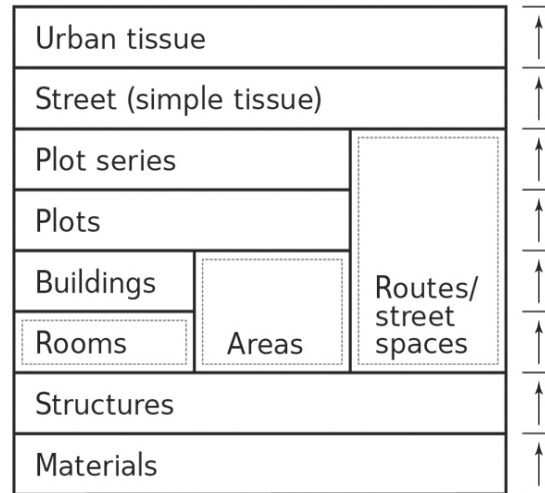


Figure 23: developed diagram for showing the position of street space and its relationship to plot series (Kropf. 2014)

Furthermore, in his discussions, the essential solid and void relationships in built form were articulated and identified with the various voids and their relative positions within the structure. The three defined types are the internal (private area), external (private-semiprivate) and public space. The horizontal and vertical relationships of different types of voids developed in the form of a diagram that integrated Conzen and Caniggia's elements. Therefore, as reviewed by Kropf, there is a possibility to consider the void and open spaces in the hierarchy of elements in three types: private, semi-private, and public space.

2.7 The Methodological Framework of Paul Osmond

Osmond (2008) took Kropf's definition and built-form subdivision as the starting point for his classification system. He integrated Kropf's hierarchical system and the concept of urban structural units (USUs: developed by Pauleit and Duhme, 1998) regarding open spaces. Pauleit and Duhme (1998, p. 66) defined USUs as "areas with

a physiognomically homogeneous character which are marked in the built-up area by a characteristic formation of buildings and open spaces”. Osmond investigated a parallel hierarchy of unbuilt space, which included civil infrastructure (water supply, electricity, and transport) and geophysical features in the description of the urban structural unit. Osmond’s approach generally made Kropf’s method applicable to open spaces and used built and unbuilt forms in urban area definitions. He explored the urban structural unit concept and discussed the consideration of unbuilt, or natural, elements to extend the hierarchy of open space. Therefore, Osmond developed a complementary technique to describe streets and infrastructure in terms of their network properties.

Osmond (2010) reviewed that Kropf’s framework specifies no consideration for parks, gardens, and related spaces between buildings. However, like other urban elements, unbuilt spaces can be considered components of the built form; a garden is part of a plot, and an urban park is part of a plan unit. He investigated that Kropf’s method of distinguishing form in terms of its pertinent characteristics is applicable to natural and built entities.

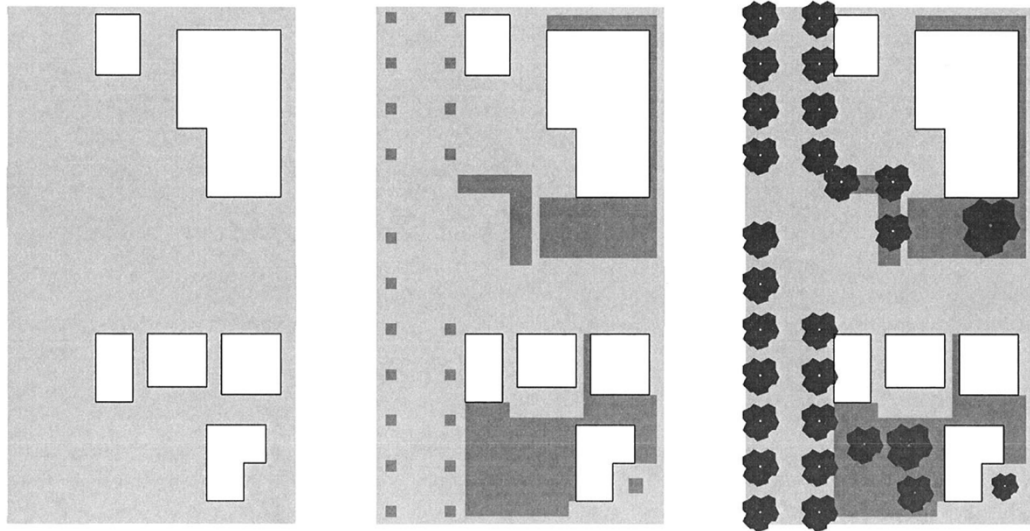


Figure 24: Patterns of open space within an urban structural unit (Osmond 2010)

Osmond (2010) demonstrated that the validity of his method is supported by the essential distinction between inside and outside. He referred to Hillier's opinion (1996) regarding inside and outside distinction as a logical way to enclose a space in which "one implies the other, and we cannot create a space inside without also making a space outside" (Hillier, 1995, p. 23). However, the type of "outside" (built or unbuilt) was not affecting this type of distinction. Therefore, Osmond proposed a hierarchy of open space as an additional device to support the subdivision of urban form, which covers both built (paved) and unbuilt elements. (Figure 24)

The structure of vegetation also has been discussed by Osmond as a hierarchical element. According to Fosberg (1961), the form, height and type of the space created by vegetation describe the vegetation structure. In addition, Osmond reviewed various vegetation classifications and structural types in the literature and proposed the structural type. He defined the vegetation structure of the urban structural unit by the number, size, arrangement and part-to-part relations of the proposed structural types.

However, in this approach, land use, such as “residential garden” or “urban park” for describing urban open space, has been disregarded. (Figure 25)

Level	Scope	Examples and comments
4	Building materials	Concrete, brick, timber
	Vegetation species	<i>Angophora costata</i> , <i>Wahlenbergia stricta</i>
3	Minor built elements	Street seating, street light, litter bin
	Vegetation structure	Trees, shrubs, lawn (see Table 3)
2	Paved surfaces	Street, path, parking lot
	Unpaved surfaces	Park, garden, vacant lot
	Water bodies	Ornamental pool, canal
1	Urban open space	Overall open space matrix

Figure 25: Proposed hierarchy of open space (Osmond, 2010)

Furthermore, Osmond differentiated urban structural units based on five principles: I) open space organisation, arrangement and its subdivisions on paved and unpaved surfaces and bodies of water; II) type, number, organisation and part-to-part relationship among blocks, street sections, intersections, and squares; III) vegetation structure; IV) dimensional limit of the building; and V) topography. His approach was also scale-independent, as it could be applied from the scale of the urban as a whole down to the scale of the plot (Osmond, 2008). Table 5 summarizes his proposed framework for describing urban space and form. (Figure 26)

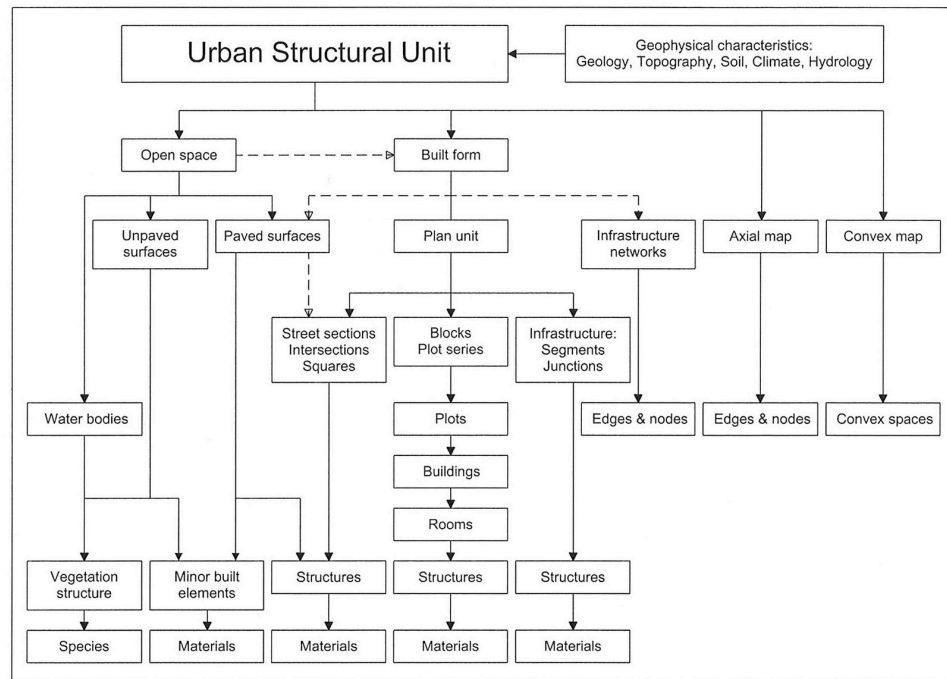


Figure 26: Decomposition of the urban structural unit. (Osmond, 2010)

2.8 Chapter Summary

Reviewing the literature showed that “urban morphology” is a broad and interdisciplinary subject in urban studies that has been the topic of several research all around the world. Scholars express their understanding in different ways and from various perspectives, theoretical and methodological points of view to understand the built form structure.

The results of reviewing literature show that there might be a common ground for the definition of urban morphology in a comprehensive way as ‘the study of the urban built and unbuilt environment’ that ‘examines the configuration of the urban form as well as the relationship between the individual forms and the city as a whole’. This chapter presented the theoretical framework on which the research problem is constructed. Among various valuable works and contributions, this chapter highlights the most relevant urban morphological approaches historico-geographical, process

typology, configurational, and spatial analytical. Conzen's and Caniggia's works have been taken as the starting point since their approaches to urban built form create ground traditions in aspects of geography and architecture. Their approaches are recognized as the Conzenian and Caniggian. In addition, the frameworks of Kropf and Osmond have been selected since they discussed open spaces in their definition and subdivision of urban built form and unbuilt form that provides the general context for this research. Chapter two reviewed the field as a whole and represented various approaches with particular reference to the complementarity of different methods. Recognition of this complementarity and developing new analytical tools are perceived as a requirement for greater expansion of the discussion on morphological elements and applications in other parts of the world. The next chapter will discuss the vegetation typology and characteristics. Also, it will present various classifications of urban green spaces to define variable "type" in urban green spaces to be applicable in the hierarchical framework of urban built and unbuilt forms.

Chapter 3

URBAN FORM AND GREEN SPACE

3.1 Introduction

This chapter is divided into three main sections. First, it explains open and green spaces definition in urban areas and their importance. Then, it reviewed the typology of green space in various studies and discussed the feature and characteristics of green space in addition to various elements of green space. Later, it considered the appearance of green spaces in morphological studies. In the end, it proposes the typology of green space for the current study. The purpose of this chapter is to review the literature to find the gap in morphological and typological studies, which may help to design the methodology for extending research in the urban morphology field.

3.2 Definition of Urban “Open” and “Green” Spaces

importance of green spaces in urban areas has increased the necessity of considering these spaces as an effective element in urban form. Various scholars from different fields of study, such as sociologists, psychologists, ecologists, environmentalists, planners, and urban designers, addressed the advantages of green spaces for cities and citizens and discussed human and nature relationships from different points of view (Seymour, 2016). The importance of ‘open space’ or ‘green space’ within urban areas has been recognised for over a hundred years; therefore, the following text determined the definition of these terms.

There is no strict and accepted definition of urban green space, and the term seems to be used loosely by different researchers. Before getting into details of urban green space, it needs to be addressed that urban green space is defined as part of urban open spaces. Therefore, the definition of “urban open space” has become a significant part of the research.

3.2.1 Open Space

Urban open spaces play an important role in creating healthier and more livable communities by providing positive environmental, social, and economic benefits. Scholars have defined “urban open space” in different ways. Open space includes some part of the external environment - the space outside buildings in urban areas. The term does, however, also have a formal meaning. According to Jan Gehl (1987), these types of spaces are defined by buildings, and he discussed them in his book *“The Life Between Buildings”*. The department of landscape at the University of Sheffield suggests that urban areas are made up of the built environment and the external environment between buildings. Open space is often described as any piece of land that is undeveloped and has no building structure on it. But since it is believed that plazas, playing fields, and urban squares contribute to improving public health and the environmental quality of the neighbourhood, they are often included in the definition as well (Olsson, 2012). Francis (2003) defined urban open space as publicly accessible open space such as parks, plazas, streets, community gardens and greenways. Urban open space includes all significant outdoor spaces, including not just land but also areas of water that offer sports and recreation activities and can act as a visual amenity. Al-Hagla (2008) classifies open space by physical form, defining “green space” as vegetated land and “grey space” as hard-surfaced. It has a vast meaning and covers green space and civic space. Some spaces may combine green and civic space elements, but one type or another will usually predominate

(PAN 65). Generally, open space has been divided into “grey space”, “green space” and “blue space”.

3.2.1.1 Grey space

Swanwick, C. et al. (2003) also presented similar definitions for open space as “a mixture of the public (or civic) and green space, where public spaces are mainly ‘hard’ spaces such as squares, street frontages and paved areas”. This part of the external environment or open space can be termed “grey space”, which is land that consists predominantly of sealed, impermeable, “hard” surfaces such as concrete, paving or tarmac. “Grey spaces” have been split into ‘functional spaces’ such as roads, pavements, and car parks; and ‘civic spaces’ referred to spaces such as squares and plazas. (Figure 32)

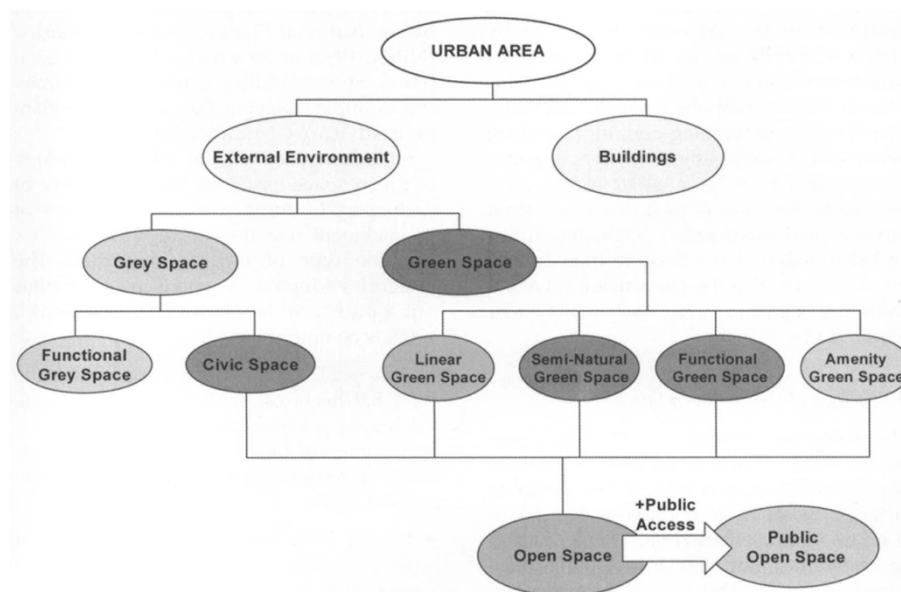


Figure 27: Definition of open space by Swanwick (2003)

3.2.1.2 Green Space

Definitions are particularly important as the terms green space and open space seem to be used loosely and interchangeably. Green space is usually, but not always, comprised of vegetation and associated with natural elements. Urban green space can be understood as an integrated area comprising natural, semi-natural, or artificial green land, providing

manifold benefits to different groups of people within the city extent (Tzoulas et al., 2007). Public urban green spaces comprise different types of green spaces, namely in degrees of naturalness, types of vegetation, recreational infrastructures, or social uses they can offer (Arnberger & Eder, 2015). It is further defined as “an open space situated within the city limits with a good vegetation cover planted deliberately or inherited from pre-urbanization vegetation and left by design or by default” (Jim and Chen, 2006, p. 338). Urban green space includes urban forests as well as other green areas (Helms, 1998; Wu, 2008); for example, public parks, sports fields, edges of roads, public or private gardens, and remnant patches of natural vegetation as well as individual street trees (Davies et al., 2008).

This study follows the definition suggested by Swanwick et al. (2003) that defined green space as “land that consists predominantly of unsealed, permeable, ‘soft’ surfaces such as soil, grass, shrubs, and trees”. It includes all areas of parks, play areas and other green spaces specifically intended for recreational use, as well as other green spaces with other origins. Urban green space is, therefore, an umbrella term for all areas of land covered by this definition of green space, whether publicly or privately owned. Stanwick’s definition of green space considered all types of spaces, including those covered with green elements and water bodies. According to him, the ‘urban green space’ essentially covers all public and private open space, consisting of any vegetated land or structure, water, or geological features in the urban environment.

3.2.1.3 Blue Space

Open space includes not only land but also water bodies such as lakes, canals, reservoirs, and rivers, improving visual amenities besides recreation and sport opportunities (Doyle, 2012). Therefore, “blue space” has been considered as water bodies that are accessioned with green spaces. In other words, “Blue space” includes water bodies and all types of green spaces near water bodies, such as lakeshores, riverbanks, seasonal wetlands, and

beaches (Swanwick et al., 2003). Therefore, any type of green space encompasses grey and blue spaces with their adjacent green (Rall et al., 2015).

3.3 Green Space Typologies

Green space in cities exists in a broad variety of types covering from parks and gardens to housing green spaces, city farms, grassland, private green areas, private green space belonging to corporate organizations (e.g., schools, hospitals, industrial parks), sports fields, and agricultural areas (see: Kong & Nakagoshi, 2006; Panduro & Veie, 2013; Pena-Salmon et al., 2014). Urban green spaces may have similar or different structures (e.g., size, shape, location) and functions (e.g., recreation, sports facilities, children's playground). This reflects that a multi-criteria approach must be considered to develop the classification system for urban green spaces. Classification of green space in the literature has, in most cases been treated as a uniform product (McConnells & Walls, 2005). Rare studies have treated green space as a more heterogonous product based on "objective" measures such as green space density, size, or vegetation concentration to introduce a standard quality that describes the character of each green space (Kong et al., 2007; Saphores & Li, 2012). There are various ways to classify urban open space and green space, such as their size, how people use them, their intended function, location, etc. Byrne and Sipe (2010) limited the typology of green spaces to parks, plazas, urban trails, and streets and focused on the size, naturalness, and activity types of green spaces.

Parks: Typically, parks are classified based on size, functions, geographic location, degree of naturalness, and the types of facilities present within the park. They can be categorized as urban parks, nature parks, pocket parks, district parks, community parks, neighbourhood parks, sporting fields, and urban forests. But they can classify by other factors such as the activities that occur within the park (e.g. skateboard park, bowling green), the agency responsible for managing the park (e.g. national park, state

park, city park), the history of the park (e.g. heritage rose garden or Bora RingIII park), the condition of the park, the land-use history of the area (e.g. Victorian-era park), the types of people who use the park (e.g. dog park, or bike park) and the philosophy behind the park's development (e.g. recreation reserve or civic square). (Figure 28)

Table 7 shows the classification of parks in Byrne and Sipe's (2010) study.

Plazas: Traditionally, Plazas were the civic focal point in Chinese, Italian, Spanish and Latin-American cities. They are referred to those spaces that are paved and located in between buildings and function as meeting places. Plazas often take the form of a public square. 'Squares' are similar to plazas and represent a sort of hybrid space between parks and plazas (Childs, 2006). Some plazas contain no vegetation, whereas others are richly planted. Like other parks, these spaces are also categorized according to factors such as size, function, location, visual complexity, ownership, ornamentation, activities, and degree of vegetation. (Figure 29)

Urban trails (Greenways): greenway term refers to linear space that links open and green spaces and is usually used for walking, cycling, jogging, skating, and even horseback riding. (Figure 30) Some trails are intentionally designed for this purpose, such as bikeways or hiking trails, whereas others have been converted from disused industrial areas and vacant land or constructed along abandoned railway lines or other infrastructure corridors. The greenways cover different spaces, including seaside, riverbank, lakefront, and woodland.

Streets: Most cities have a hierarchy of street types ranging from small alleys to large expressways. Many of these streets could not be considered green or open spaces as

they are major traffic arteries. But some, like boulevards, lanes and pedestrian-only streets, can perform functions other than acting as transport corridors. (Figure 31)

Table 7: Classifications of parks by Byrne and Sipe (2010)

Type	Size (ha)	Typical Densities	Visit Length	Facilities	Naturalness
Pocket park/ Playground/ Dog park	< 1	<50+ persons per ha	10 minutes – 1 hour	Few facilities typically just Play equipment (Booth, 1989) and maybe benches	Few natural features – just a small grassed area with a few shade trees.
Neighborhood park	0.11 – 4.9	40 – 100+ persons per ha	30 mins – 1.5 hours	Limited number of sports facilities. Play equipment, picnic sites, BBQ facilities & green-space set aside for organized sport.	Larger areas of lawn, a field or two for organized sports and plantings of ornamental vegetation with shade trees. Some areas of impermeable surface.
Community park	5 – 9.9	50 – 200+ persons per ha	30 minutes – 3 hours	Some active recreation or organized sports facilities. May include community center.	Large areas of managed landscape, abundant lawn, shade trees and ornamental vegetation. Larger areas of impermeable surface.
District park	5 – 9.9	50 – 200+ persons per ha	30 minutes – 3 hours	Some active recreation or Organized sports facilities. May Include community center.	Large areas of managed landscape, abundant lawn, shade trees and ornamental Vegetation. Larger areas of impermeable surface.
District park	10 – 24.9	50 – 1,000+ persons per ha	1 hour – 5 hours	Many sports facilities. Community center, sports fields for football, soccer basketball courts, tennis courts etc.	Generous areas of managed landscape abundant lawn, shade trees and ornamental vegetation. Several grassed areas dedicated to organized sports. Several areas of impermeable surface.
Regional park	25 – 500+	<150+ persons per ha	2 hours to 1 day	Range of facilities e.g. large scale recreational activities –field sports, archery, canoeing, nature trails etc.	Abundant natural features, mixture of managed landscapes and endemic vegetation. Much lower percentage of park is comprised of impermeable surfaces.
Nature/ wilderness park/ National Park	25 – 1000+	<10 persons per ha	½ day to 1 week +	Few if any active recreation or Organized sports facilities.	Few managed features and largely dedicated to preservation of endemic species. May include a landscape feature such as a Wetland, hills or canyon(s). May contain interpretative signage.



Figure 28: Top left: Community park (<https://www.crpdp.org>)- Top right: Pocket park (<https://www.archdaily.com>)- Down left: Neighbourhood park (<https://landezine.com>) - Down right: National park(<https://www.strongtowns.org>)



Figure 29: Left: Sechseläuten Square in Zürich, Switzerland (<https://www.juliusbaer.com/en/insights/future-cities/top-10-modern-city-squares-in-the-world/>) Right: Rittenhouse Square, Philadelphia (<https://www.cnu.org/publicsquare/2019/05/10/ten-great-public-squar>)



Figure 30:

Greenways(<https://www.tallahassee.com/story/life/causes/2020/06/15/blueprint-green-city-expands-trail-system/3174758001/>)



Figure 31; Street in Sweden (<https://aspiremetro.com/swedens-street-moves/>)

Scholars in various studies proposed several inventories of the classification and typology of green spaces. For example, Bell et al. (2007) differentiated between parks and gardens; natural and semi-natural spaces; green corridors; allotments, community gardens and urban farms; outdoor sports facilities; amenity green spaces; provision for children and young people; cemeteries, disused churchyards, and other burial grounds; other public spaces. (Figure 32)

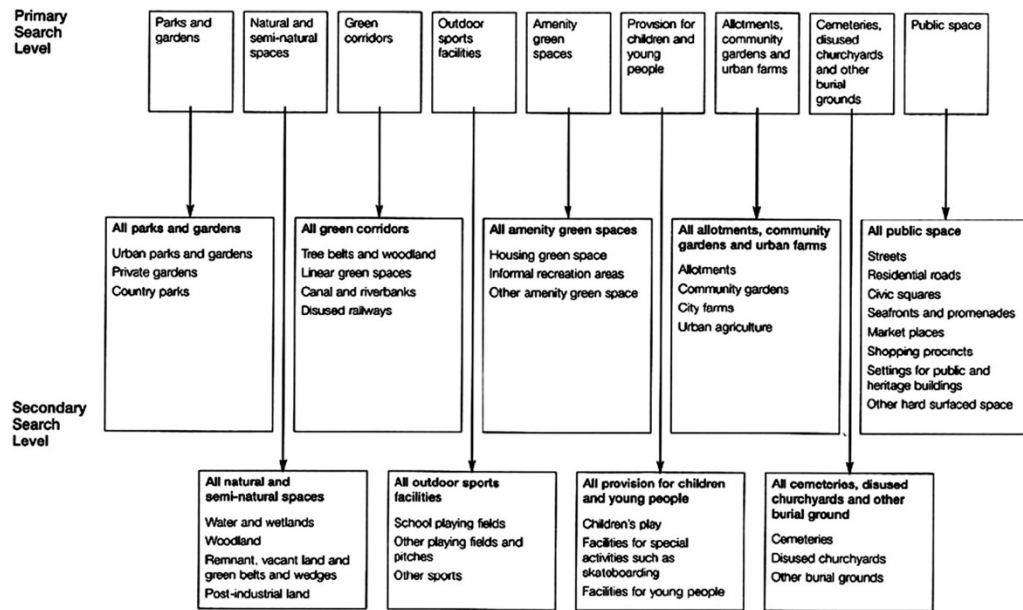


Figure 32: The typology of green and public spaces defined by Bell et al. (2007)

Swanwick et al. (2003) produced an inventory of 25 urban green space types, falling into 10 subgroups and four main groups (amenity green space, functional green space, semi-natural habitats, and linear green space). (Figure33)

Other inventories are grouped based on usage (Hofmann and Gerstenberg, 2014), based mainly on the scale (Byrne and Sipe, 2010), or cover informal urban green space (Rupprecht & Byrne, 2014). Some typologies combine urban green spaces with other open spaces such as squares, pedestrian areas, and cycling areas (DTLR, 2002). Panduro (2013) classified green spaces into eight types inspired by the classifications of green spaces by Bell, Montarzino, and Travlou (2007). According to him, the different types of green space can be characterized as follows: a)Parks: the park has a high maintenance level with well-kept vegetation and a wide range of recreational possibilities; b)Lakes: Some green space in cities is characterized primarily by the presence of water bodies such as lakes; c)Nature: On the edge of the city, large areas of green space can be found which often contain open fields of grass, tree cover, and

lakes; d) Churchyards: These are often open to the public during daytime and have a high level of maintenance with flowers and hedges; e) Sports fields: Schools and institutions often have access to green space, which facilitates sports activities and playground for the pupils (Sports facilities connected to sports clubs often have similar characteristics); f) Common areas: Communities of houses or apartment buildings in on occasion have shared “common green space” which is maintained by the property owner association or landlord; g) Agriculture fields: These areas are usually relatively large and homogeneous; h) Green buffers: Green space can be found in connection to infrastructure such as highway, larger roads, and railways, industrial areas.

ALL URBAN GREEN SPACE									
Linear Green Space	Semi-natural habitats			Functional Green Space			Amenity Green Space		
	Other Habitats	Woodland	Wetland	Institutional Grounds	Burial Grounds	Productive Green Space	Private Green Space	Incidental Green Space	Recreation Green Space
									Parks and gardens Informal recreation areas Outdoor sports areas Play areas Housing green space Other incidental space
River and canal banks Transport corridors (road, rail, cycleways and walking routes) Other linear features (e.g. cliffs)	Disturbed ground	Mixed woodland Coniferous woodland Moor/heath Grassland	Open/runing water Marsh, fen Deciduous woodland	School grounds (including school farms and growing areas) Other institutional grounds	Churchyards Cemeteries	Remnant farmland City farms Allotments	Domestic gardens		

Figure 33: Typology of green spaces by Swanwick et. at. (2003)

In another study, Farinha-Marques et al 2013 categorize green space in Porto city as river banks, watercourses, beaches / coastal zones, cliffs, public parks and gardens, public squares, green spaces associated with civic buildings, cemeteries, tree-lined streets, green spaces associated with main roads, green spaces associated with apartment blocks, urban yards (private green spaces within blocks), private gardens

(green spaces associated with private buildings), agricultural areas, urban woodlands, and wastelands / vacant lots.

Rall et al. (2015) recorded that forty-four urban green space elements were identified as Urban green space elements inventory and grouped into eight broad categories (see, e.g., Table 8). This categorisation is not a typology in a strict sense, and alternative ways of grouping the urban green space elements are possible and legitimate.

Table 8: Urban green space by Rall et al. (2015)

<i>Category</i>	<i>Green space element</i>
Building greens	1 balcony green
	2 ground based green wall
	3 facade-bound green wall
	4 extensive green roof
	5 intensive green roof
	6 atrium
private, commercial, industrial, institutional UGS and UGS connected to grey infrastructure	7 bios wale
	8 tree alley and street tree, hedge
	9 street green and green verge
	10 house garden
	11 railroad bank
	12 green playground, school ground
riverbank green	13 riverbank green
parks and recreation	14 large urban park
	15 historical park/garden
	16 pocket park
	17 botanical garden/arboreta
	18 zoological garden
	19 neighborhood green space
	20 institutional green space
	21 cemetery and churchyard
	22 green sport facility
	23 camping area
allotments and community gardens	24 allotment
	25 community garden
agricultural land	26 arable land
	27 grassland
	28 tree meadow / orchard
	29 biofuel production / agroforestry
	30 horticulture
natural, semi-natural and feral areas	31 forest (remnant woodland, managed forests, mixed forms)
	32 scrubland
	33 abandoned, ruderal and derelict area

3.4 Green Space Elements and Characteristics

Apart from the typology of green spaces, the characteristics of green spaces have been investigated by many scholars. Norman Booth identified different characteristics of

landscape elements such as landforms, plants, space organisations, pavements and surfaces, site structures and water elements. (Booth, 1983)

By landform definition, he concentrated on the form of land and various types and their significance in aesthetic, spatial sensation, views, microclimate etc. Further, the functional uses of landform have been reflected in spatial definition, control views, influence movement, affecting microclimate and aesthetic benefit. (Booth, 1983, p: 7-65)

By plant material definition, Booth first emphasises the functional use of plants, creating outdoor rooms, solving environmental problems, and contributing to the real state and value of buildings and sites. Second, architectural use such; as the creation of space, screening and controlling privacy. Third, visual plant characteristics take consideration into the plant size, plant form, plant colour, foliage type and plant texture. And fourth, aesthetic uses of plants that aimed to look at the plants as elements like complementary, unifiers, emphasize, acknowledgers, softeners and view enframement. (Booth, 1983, p: 69-114)

In Booth's identification, building clusters and types of spaces refers to various arrangements and space organizations that green spaces might produce on-site such as; central open spaces, focused open spaces, channel linear space, and organic linear space. (Booth, 1983, p: 141)

Moreover, Booth divided the site structure into the elements such as steps, ramps, walls, and fences. In addition, the materials and use of each part of these components have been discussed in detail. (Booth, 1983, p: 212-227)

3.5 Classifications of Green Spaces for Present Study

As discussed above, various scholars classified green space in different ways; however, to a varying degree, their definitions referred to the natural and man-made green space within the built environment. Results of classifications and typologies in various studies show that the typologies might be different based on the nature of the study and the geographical location of the research. However, general categories represented public and private, natural, and semi-natural, functional use of green spaces and green space characteristics.

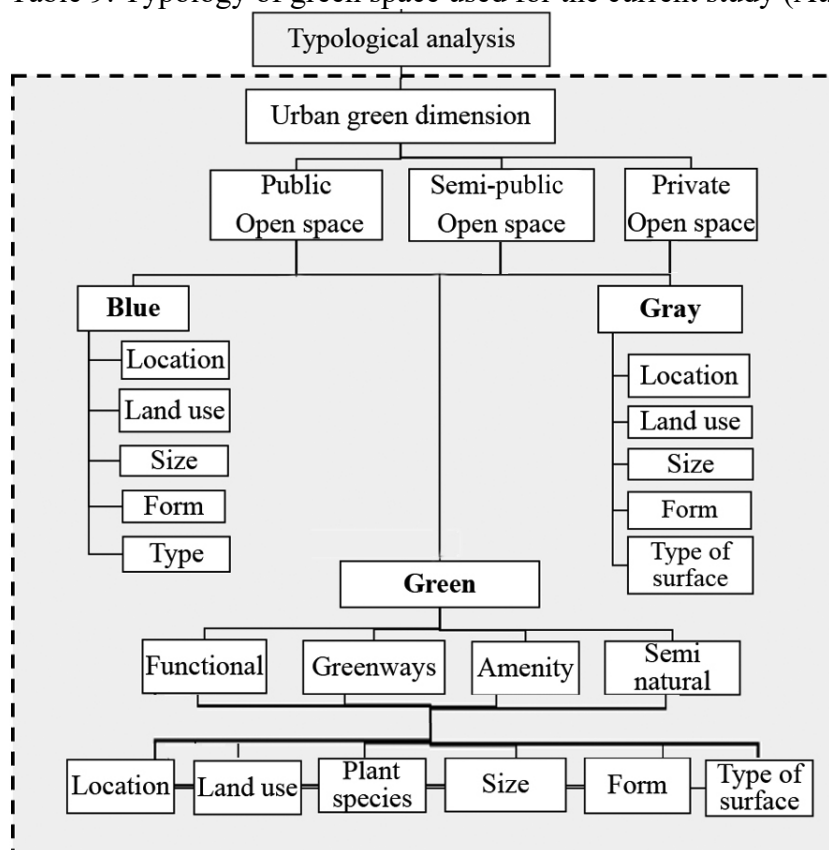
As the current study focused on green space in Nicosia's built environment and its formation and transformation, the typology and classification have been defined based on existing green spaces and inventories in the literature reviewed above. Thus, urban green space is divided into two main categories: open space related to buildings and open spaces, which also refer to the public and private use of spaces. Therefore, urban green spaces include public, semi-public and private spaces, each consisting of gray, green, and blue spaces (waters, wetlands).

The green space inventory includes a) functional green spaces such as parks (pocket parks, playgrounds, neighbourhood parks, community parks, district parks, regional parks, and national parks), and zoo lands; b) greenways or linear green spaces such as green corridors, walking or cycling paths; c) amenity space like common areas and; d) semi-natural areas such as burial ground (churchyards, and cemeteries). Additionally, it contains the green space within the city, which is associated with private and semi-public buildings such as dwellings (front yard, courtyard, and backyard); apartments (green balconies, roof gardens, green walls); and institutional buildings like

commercial, schools, gardens, and sports fields. Gray spaces contain streets and plazas; blue spaces consist of lakes, riverbanks, seasonal wetlands, and beaches.

This research will now progress towards a more improved analysis of urban green spaces based on the typological and morphological description. The results aim at contributing to the definition of a methodology and a set of recommendations for urban morphology studies in terms of green spaces and analyzing urban form. Besides provides a framework for planning, design, and management procedures for the city's green spaces. Therefore, in this study, "green space" refers to all types of green spaces within the open spaces, including grey and blue spaces, and for every kind of green space, the study focused on their features in terms of location, land use, plant species, size, form, and type of space that created. (Table 9)

Table 9: Typology of green space used for the current study (Author 2022)



3.6 Green Space as an Object of Study in Morphological Research

Examining urban green space from the perspective of morphology is an essential way to comprehend the physical structure of urban green space as a significant part of the urban environment that affects the function of urban natural habitats and maintains good spatial patterns of the urban ecological environment.

As it discussed in Chapter two, elements of urban form such as buildings, plots and streets patterns have generally received the most attention from urban morphologists however, the space around these elements received little consideration. In section 2.6 Karl Kropf's framework and diagrams of urban structure has been reviewed. As it clarified by him, there is a possibility to consider the void and open spaces in the hierarchy of elements in three types: private, semi-private, and public space. Osmond's approach generally made Kropf's method applicable to open spaces and used built and unbuilt forms in urban area definitions. He investigated that Kropf's method of distinguishing form in terms of its pertinent characteristics is applicable to natural and built entities. Progressively, scholars in the field of urban morphology have been motivated by the character of urban green space in the urban environment. For instance, Hopkins (2012, 2018) focused on the importance of the ecological and amenity value of the green space that forms part of the Edwardian fringe belt in Birmingham. He distinguished that green spaces in fringe belt areas provide several ecosystem benefits, as well as many cultural assets. Kolnberger (2018) studied specific types of green space and concentrated on cemeteries as significant places in the formation of urban environments by using the historico-geographical approach. He emphasized the urban fringe belts and the spatial order of grave fields, graveyards, churchyards, cemeteries, and other burial grounds that plays a central role in any

archaeological analysis because, in one way or another, it reflects the settlements of the living. According to him, the places for the dead are an integral part of any human settlement. They are involved in – sometimes even the driver of – their formation and transformation. Whitehand (2019) analyzed the green spaces in urban fringe belts and its effects on urban planning. He underlined the integration of green space development into historico-geographical thinking and its value in research and practice. Zhang (2018), in his PhD thesis, worked on urban morphology and ecosystem services and focused on a historico-geographical study of fringe belts and urban green spaces in Birmingham city. Zhang (2018), in his PhD thesis, worked on urban morphology and ecosystem services and focused on a historico-geographical study. In 2019 he discussed urban green spaces in Birmingham's fringe belts and tested residential areas by evaluating the types of surfaces and green spaces. Scitaroci and Maric (2019) studied the characteristics of green spaces in twenty-six fortified European towns and cities. They focused on inner fringe belts and the importance of the functionality of green spaces. They studied the various types of green space and their places within the system of fortifications. Marcus, et.al. (2019) study integrated landscape ecology and urban morphology by proposing a socio-ecological system described as configurations of patches. Their approach comprises a geometric abstraction of plots, streets, and buildings, as well as patches, corridors, and matrices – central elements in urban morphology and landscape ecology. In 2020 they discussed how to capture the relation between such configurations and the processes of formations and transformation over time. (Marcus, 2020)

Zou and Wang (2021) reviewed the literature related to urban green spaces in morphological studies and considered that morphology includes two important approaches. One is the analytical process taken from parts to the whole, and the other

is to emphasize the transformation of objective matters and understanding of the sequential relationship of matters with respect to time. Therefore, the “morphology” of urban green space can be comprehended from the basic levels of “form”, “distribution”, and “pattern” and their correlations.

3.7 Chapter Summary

Chapter three broadly defined urban green spaces as any vegetation found in the urban environment, including parks, open spaces, residential gardens, or street trees, provide important ecological, psychological, social, cultural, environmental, and economic benefits. Urban green spaces can increase the aesthetic appeal, amenity, and value of the urban environment. They afford social benefits by providing places for community interaction, providing places for playing, spaces for formal and informal sport and recreation as well as environmental benefits through protecting local biodiversity and visual landscapes, retaining ecological systems and linkages, and management of urban water. Economic benefits can be gained by the provision of services supporting visitation for sport, recreation, and tourism.

Furthermore, it discussed various typologies of green spaces in different sources. The reviewing literature created the basis for the definition and classification of green space for the current study. In addition to the classification of green spaces, the discussion on general characteristics of green space helped the author to develop the framework for assessing green space structure in urban areas. Chapter four introduced the designed framework based on the findings and gaps that have been discussed in chapters two and three.

Chapter 4

METHODOLOGY

4.1 Introduction

Reviewing the literature in the last two chapters provides an extensive vision of two fundamental concepts urban morphology and urban green spaces. Chapter two pointed out the urban form and main urban elements in various studies. Discussion on various morphological approaches has shown that except few recent studies, urban green spaces got less consideration in morphological studies. Chapter three clarified the definition of urban green spaces and pointed out the different typological definitions by scholars. Hence, this chapter is dedicated to creating a practical framework for further investigation of the morphological structure of urban green spaces. The thesis methodology is defined based on two main phases: urban morphology theoretical background and case study analysis. In the phase of theoretical background, the approaches of Historico-geographical, and Process typological have been selected to create a strong base for the development of the framework due to their definition of urban structural elements. Investigation of the case starts with taking into consideration the urban fringe belt development pattern (Middle fringe belt) and the urban green structural elements. In analyzing the case study, the weather condition (Mediterranean climate) and seasons (fall and spring) have been considered by observation and documentation of maps, photos, and frequent visits. This chapter Firstly, the discussion focuses on the research strategy, design, and approach to analyzing green space patterns in urban areas. After that, the selection of the case study

has been discussed with the research process and the type of data analysis. The last part discussed the research limitations.

4.2 Research Strategy

This research is an analytical one based on results of existing morphological approaches in the literature, however, the method for investigating the structure of green space has been not tested in previous approaches. This study tried to integrate numerous pieces of previous academic research regarding the structure of urban form in the field of urban morphology to propose an analytical framework for studying the pattern of green space in urban areas in every place and city of the world. As such, the proposed research took the form of new research based on an existing research approach by integrating Conzen, Caniggia, Kropf and Osmond's methods on analyzing the structure of the urban form.

4.3 Qualitative Research Method

The research is epistemological, and it is Empiricism within the field of epistemology study. Empiricism accepts personal experiences associated with observation, feelings, and senses as valid source of knowledge. To fulfil the aims of the dissertation, the research used a method or combination of methods that advance specific research in the best possible manner. Under the umbrella of epistemology study, the pragmatism research philosophy can integrate more than one research approach and research strategies within the same study. However, the current research selected qualitative research. The main principle of qualitative research is that it is mostly applicable to small samples, while its results are not quantifiable or measurable. One of the fundamental advantages of the qualitative method is that it offers a complete description and analysis of a research topic, without limiting the scope of the research and the nature of participants' responses. (Collis & Hussey, 2003) Qualitative research

methods are typically categorized into five groups: ethnography, narrative, phenomenological, grounded theory, and case study. (Creswell, J.W., 2009, pp. 176)

Case study methodology has been selected to provide tools to study this complex phenomenon within the close context. According to Creswell 2009, case study research is a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes.

Based on the nature of the research, this study selected the case study method for analyzing and surveying the pattern of green space formation and transformation in selected districts of Nicosia, based on their morphological characters and the stages of developments, and findings from those regions will be presented. This research is an exploratory study that takes a broad look at the towns from macro to micro levels. (Figure 34)

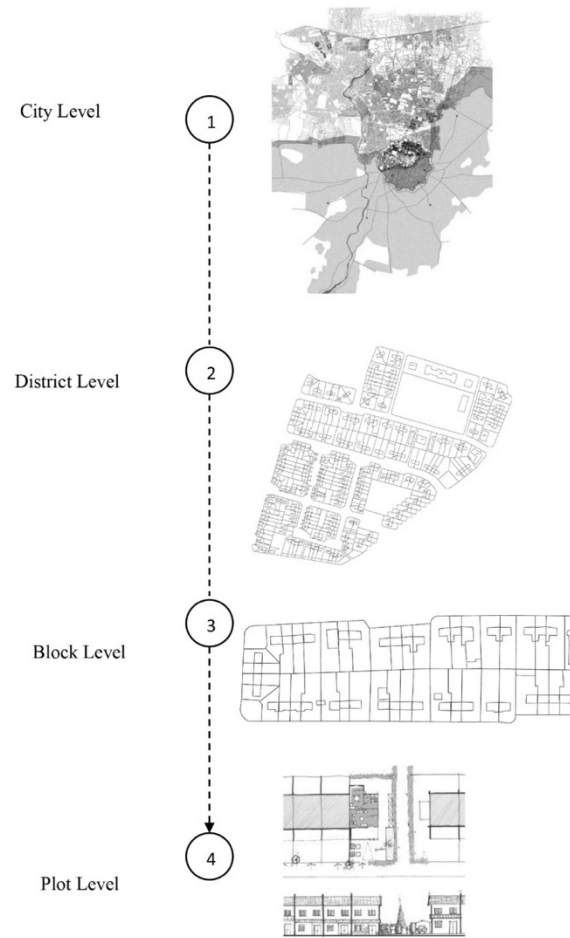


Figure 34: Research approach from macro to the micro level (Author, 2022)

4.4 Research Approach

The research approach was the inductive one. As indicated by this methodology, the study started with specific observation and perception of the town's structure, which is used to produce a generalized overview of the morphology of the urban area. The reason behind the inductive methodology was that it is appropriate for small samples with qualitative data. Based on the nature of the study, the research started with a set of observations of the selected case study and mainly focused on selected districts and then it moved from those particular experiences to a more general set of propositions on their similarities and differences in terms of urban form and structures to recognize the plan units and morphological regions. In other words, it moves from data to theory,

or from the specific to the general, which is expected to guide the author to develop a particular approach for analyzing urban green dimensions using morphological analysis.

4.5 Research Design

As discussed above, this research is primarily theoretical and methodological in nature. The methodology is highly dependent on the concepts, selected methods, and available data. Concepts are based on understanding the spatial structure of urban form and the information requirement of urban morphology. The study followed certain morphological factors and components of green spaces, which are determined as variables. These variables can take the shape of more than one structure in detail.

The derived primary sources, as mentioned previously, are Conzen (1960), Caniggia and Maiffe (2001), Karl Kropf (1993) and Pual Osmond (2010). Mainly, the study was designed to set the information related to urban morphology using Conzen and Caniggia for analysing urban structure. As a basis, it applied the hierarchy of the basic elements of built form, which Conzen presents as streets, plots, buildings, and Cannigia's compositional hierarchy, which comprises elements, structures, systems, and organisms. Caniggia extends the hierarchy upward by taking the building as the element, urban tissue as structure, urban quarter as a system and settlement as the organism to identify the further levels of urban form. The basic relationship between the levels is, therefore, part to whole.

On the other hand, as Kropf mentioned in his works, in both approaches the open space and the space around the building are dismissed in terms of its physical structures and areas defined. In addition to Kropf's concept of built form, Osmond (2010) proposed

to add vegetation to the hierarchy of urban form however the current study aimed to cover the disregarding land use and function of green spaces in Osmond's approach such as "residential garden" or "urban park" in addition to proposing a method for investigating green space's structure. Therefore, this research intended to add a layer of information related to the open space structures, particularly green space, in each level of the hierarchy.

The first aim of the research was to consider the importance of green spaces in urban morphological analyses and to create a systematic framework for analysing green spaces in the urban structure. The second aim is to test the proposed framework in a particular case study. The main concern for applying the framework is understanding the structure of green spaces and tracing their changes over time.

4.5.1 Macro-Level Analysis

Based on the designed framework, a macro-scale analysis was conducted at the city level. The purpose of this was first to investigate the history and background of the city and, secondly, to review green spaces within the scope of fringe belt and townscape analysis. In this framework, the macro level of analysis illustrates the general arrangement of green space and its typical structure at the city level. (Figure 35) Therefore, the detail of the analysis is less than micro-level analysis, which focuses on more information related to the structure of green space at the district, block, and plot levels. The first layer of analysis will show historical development, urban fringe belts, and reading the major physical features of the urban form. The second layer of analysis will focus on the characteristics and typologies of green spaces in urban fringe belts.

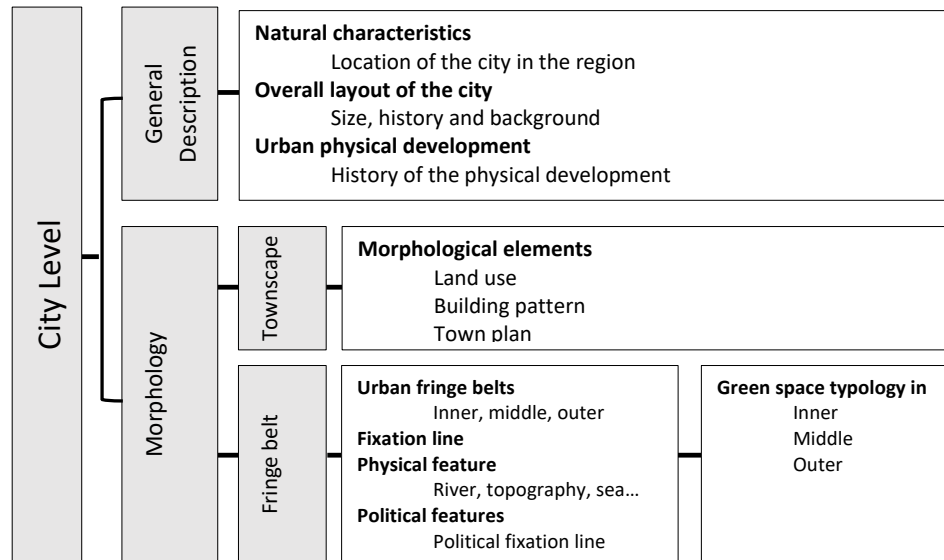


Figure 35: Research method at city level (Author, 2022)

Apart from identifying green spaces in urban fringe belts, the townscape analysis is a critical aspect of the framework to understand the general arrangement of green spaces at this scale. In townscape analysis, the arrangement of green spaces can be highlighted by analysing the building patterns and green spaces associated with them, the functional analysis of green spaces, and land utilization. The proposed framework was designed to be applicable both at the macro, and micro levels. Macro scale analysis has been reviewed under two fields: fringe belt and townscape of Nicosia, by evaluating the green dimension of urban morphology. The study started from the macro level by analyzing Nicosia's historical map of formation and transformations in various periods of time. The reason for choosing Northern Nicosia was that this city has significant urban characteristics that developed from the medieval period until now. Various physical, natural, social and political factors affect the city structure. Besides, the author was familiar with the environment and had an opportunity to visit the selected neighbourhoods regularly during the last five years.

Fringe belt: The study focused on the definition of the urban fringe belts of North Nicosia and reading the major physical features of the city. By looking at the historical maps, the study determined the pattern of developments to identify the inner, middle, and outer fringes of North Nicosia and understand how the various issues like physical borders or city wall (fixation line), the political zone and fixation lines, and natural features such as river shaped the structure and development of the city. The study mainly focused on the green space land uses, typologies, and characteristics in Nicosia's inner, middle, and other fringes.

Townscape: the study analyzed Nicosia's townscape by referring to land use maps, building forms and town plan to understand the complete morphological development of the urban area. Town plan analysis identifies the various *plan units* and *morphological regions* of Nicosia, which guide the author to select the specific morphological regions based on their similarities for further research. The pattern of streets, plots and buildings in selected morphological regions or districts have been identified in more detail.

4.5.2 Micro Level Analysis

At the micro level, the framework aims to enable the identification of the pattern of green space in each morphological region or plan unit (depending on the focus of the study). (Figures 36 to 38) Therefore, the morphological regions/plan units first need to be defined; then, the micro-level analysis is applied to each morphological region/plan unit. In this regard, the morphological elements are streets, blocks, and plot patterns, particularly the study will concentrate on the green spaces associated with these morphological elements.

For the detailed analysis, this study focused on districts between inner fringe and middle fringe belts of Northern Nicosia. The first reason for this type of selection was the general characteristics of the medieval towns. Typically, in medieval towns, green spaces were located outside the walls, and limited public greenery developed within the city. Since Nicosia's walled city has the main characteristics of medieval towns, most green spaces developed outside the walls. The study focused on the area close to the middle fringe belt and the regions where the first settlements were developed outside the walled city. In this regard, the selected districts Köşklüçiflik, Çağlayan, and Yenişehir will be examined in chapter five.

Each morphological element is investigated through its general typology and features; its relationship with vegetation is considered accordingly. The green space patterns and physical characteristics in relation to buildings and open spaces were assessed by considering their land ownership (public, semi-public and private), location, land uses (functional use of green space), plant species, size, forms, and types of surfaces (hard/soft). (Table 10) All characteristics were assessed in relation to all morphological elements. At micro level and in addition to those layers of morphological analysis, this study determined the green space patterns and physical features in relation to buildings and open spaces within the selected areas.

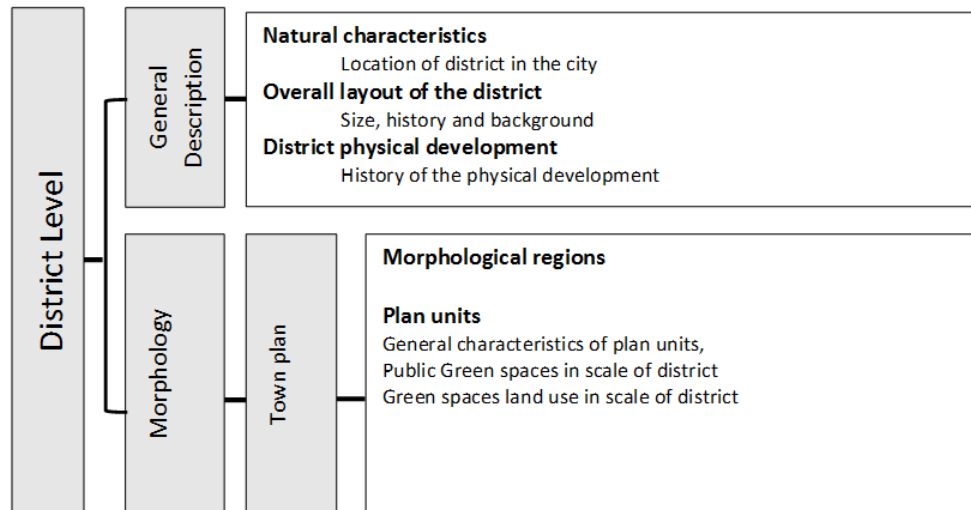


Figure 36: Research method at district level

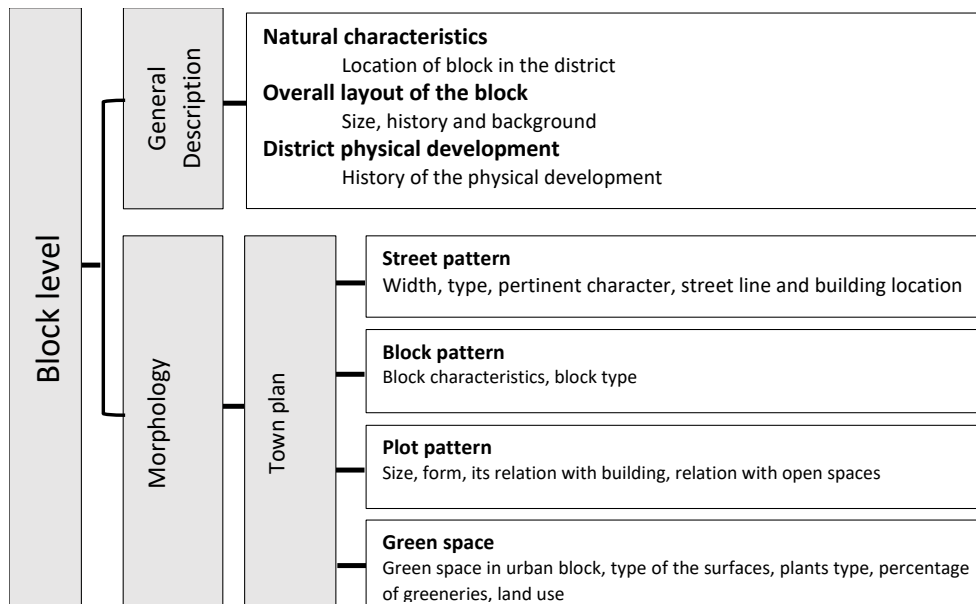


Figure 37: Research method at block level

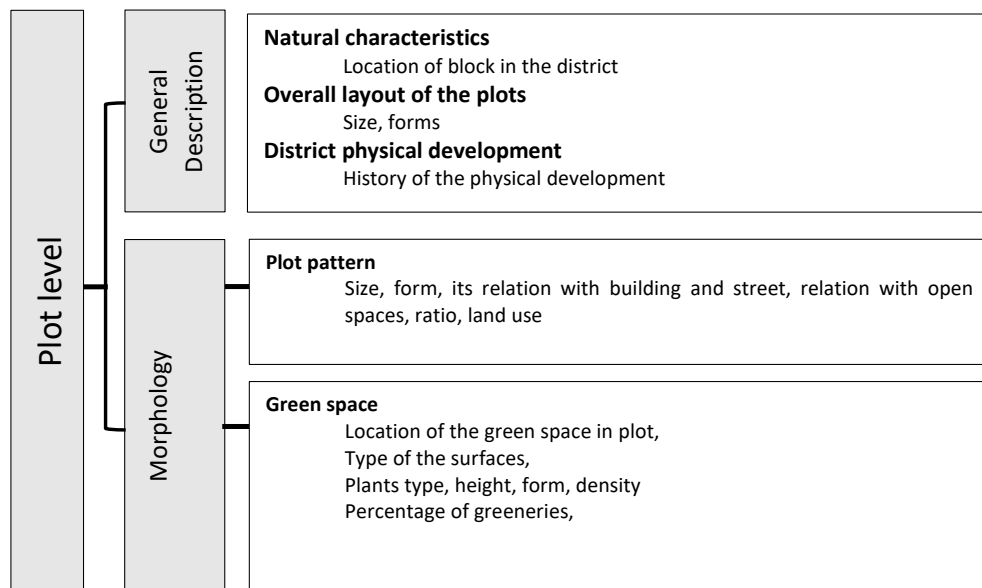
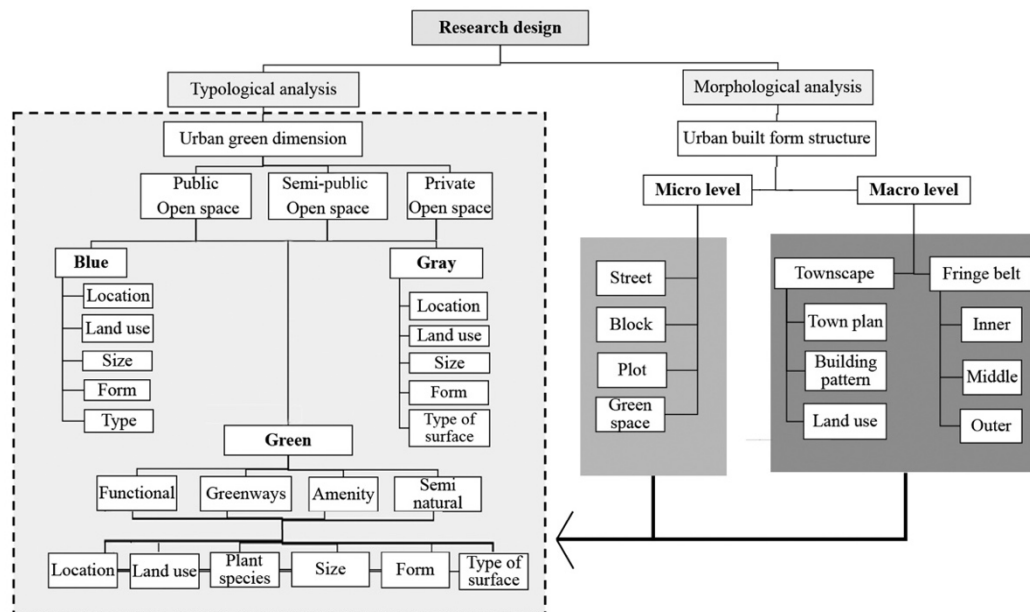


Figure 38: Research method at plot level

Table 10: The proposed framework (Author, 2022)



Green space: green spaces are identified by analyzing their *locations, sizes, forms, land uses, and types of surfaces* in relation to each morphological element, such as *streets, blocks and plots* and the results are categorized into morphological regions and plan units. In this conception, the green space is categorized into three types of green, blue, and gray surfaces, each of which has been examined based on its general

characteristics. Subsequently, it emphasizes the details and components of green spaces. It refers to the basic elements of landscape architecture to systematically investigate the layers of green space analysis. In this regard, the variables for analyzing green space characteristics are:

- types of landforms based on the position of green space on flat or topography lands
- size of the green space
- its positions in plot, block, and street
- plants characteristics such as height, size, form, density, and types
- types of space created by green spaces
- hard surface types and pavements
- Site structures, steps, ramps, walls, and fences
- Water bodies.

Apart from the general character of green spaces, the land use analysis has been done to investigate the various uses. It categorized functions based on public, semi public and private ownerships of the land and uses of green spaces such as a park, common area, greenways, semi-natural area, institutional, commercial, sports field and residential.

Plots: The main issue in studying the plot characteristic was its size, form, its relationship to the buildings on the plot and, most important part its relation to the open and green spaces. The ratio of the plot and the percentage of green space to the plot would be evaluated accordingly. The plot typology and the form of green spaces within the plot are studied according to the dimensions and types of the spaces that

green spaces have created. The types of plants and their characteristics, such as height, size, form, and density, have been investigated. This type of analysis contributes to understanding the green space typology in general. Finally, the typology of the green spaces on the plots is identified.

Streets: the street typology has been determined based on the street width, building and street relationship, and pertinent strip characteristics. The most important part of the street analysis is the relationship between the street line and the building location within the plots to investigate the pattern of formations of the street line. Therefore, the open spaces between streets and buildings have varied based on the location of the building within the plot. The plot head (building on the frontage) and plot tail (the garden/open area to the rear, with or without additional buildings) are created whether buildings are attached or detached from the street line. Other typologies might take place if the buildings are continuous along the street or create a niche. Another issue is determining the street typologies according to green spaces within the street, pedestrian paths, their surfaces, types of plants, forms, heights, and densities. This leads to determining the character of the green specs related to the street and categorizing them based on the street typology.

Blocks: This analysis aimed to examine the urban block characteristic based on the general components such as plot characteristics, pertinent strip characters, street types, and block types. In addition, it investigated the green space's position within the urban block and the green space typology in the urban context. Types of surfaces, plants and spaces have been investigated in relation to the urban block. This part of the analysis has marked the green space's locations and ratios to the urban block to understand the

percentage of the green spaces in the urban context. In addition, it aimed to distinguish the green spaces typologies based on the various purposes of the uses.

The factors and variables are determined as mentioned to assess the proposed method and research questions. The factors are the historical backgrounds of the towns, which will be discussed in the following texts. The variables are tested through desk work, literature review and sample study. The variables are the research's tools and elements, which will be measured through fieldwork and site analysis. The relevant morphological elements are plot, street, urban block, townscape, and fringe belt. The components are green spaces typology and percentage, plot typology and ratio, pertinent strip and street typology, urban green block and block formation, urban context, plan unit, building pattern and morphological region.

This study's elements and components are dynamic variables because they emphasize the physical changes over time. Although the physical changes happen gradually, the green spaces' physical features change rapidly and are seasonal. In addition to the seasonal changes, the social, cultural, and economic factors and human lifestyles directly affect the physical environment. However, this study does not focus on these factors, which are not in the scope of the thesis.

4.6 Data Collection Method and Tools

For this research, various tools have been used. The town's historical background has been analyzed through historical maps, documents, and literature survey. Apart from recorded documents, other tools like drawings, illustrations, photographs, map survey, tables and graphs help support the analysis visually for investigating morphological characteristics of the selected regions and studying the typology of green spaces. A

map survey is fulfilled for analyzing the plots, blocks and streets patterns, and their relationship with the surroundings; for fringe belt analysis historical map survey needs to be prepared. The land use map helped to understand the distribution of functions in the city and read the development patterns. For analyzing the position of green spaces in each plot, block and street, the observation technique of outdoor spaces during the site survey is taken into the consideration. Apart from that, the position of green spaces needed to be displayed by the satellite images from google earth. Graphs and tables helped to categorise related data.

Auto Cad program has been used to document data related to the fringe belts maps, town plan, plan units and green spaces form and position. In addition, the Photoshop program helps to illustrate the information in a more analytical form. Toward the end, these tools support the author in determining the components and elements' characteristics and simplify the layers of information into a more understanding visual form. This method of collecting data is intended to develop the research structure for the study, and it describes how the case is analyzed systematically. (Table 11)

Table 11: Data collection methods and tools

Method	Literature Survey Desk Work Field survey Site Survey				
Variables	Fringe Belt	Townscape	Plot	Street	Block
Method of Measurements	Field survey map survey	Field survey, map survey, documentary search	Site survey map survey physical analysis documentary search	Site survey map survey physical analysis	Site survey field work map survey physical analysis

4.7 Chapter Summary

Chapter four introduced the strategy, approach, design, and methodology of the thesis. it introduced the designed framework for assessing green spaces in morphological

studies. Variables, methods of collecting data, and tools have been discussed. The following chapter will present the selected case study in detail.

Chapter 5

APPLYING THE METHOD TO THE SELECTED CASE STUDY: NORTHERN NICOSIA

5.1 Introduction

This chapter aims to test the application of the proposed methodology in Nicosia. It targeted to introduce the selected case and discuss the method of choosing the specific districts to be discussed in detail. Besides, it considered the limitation and boundaries of investigation. It intends to argue the factors and variables of morphology in Nicosia. Firstly, it started with the historical background of the city and a discussion of the historical, natural, physical, and political factors that affected the city's structure. Then it examined the variables: plots, blocks, streets, green spaces (GSs), fringe belts (FBs) and townscape.

5.2 Historical Background of Nicosia

For over nine centuries, Nicosia acted as the capital of Cyprus and remained the island's largest city, political, and administrative centre due to its central location. (Figure 39) Nicosia has a historic core, fortified during the Lusignan period (1192–1489). During this period, various buildings such as a palace, houses, churches, and monasteries were constructed. The walls were replaced in 1567 during the Venetian period (1489-1571). The new walls took the shape of a star with eleven bastions and three gates, the North Kyrenia Gate, the west Paphos Gate, and the east Famagusta Gate. (Figure 40)

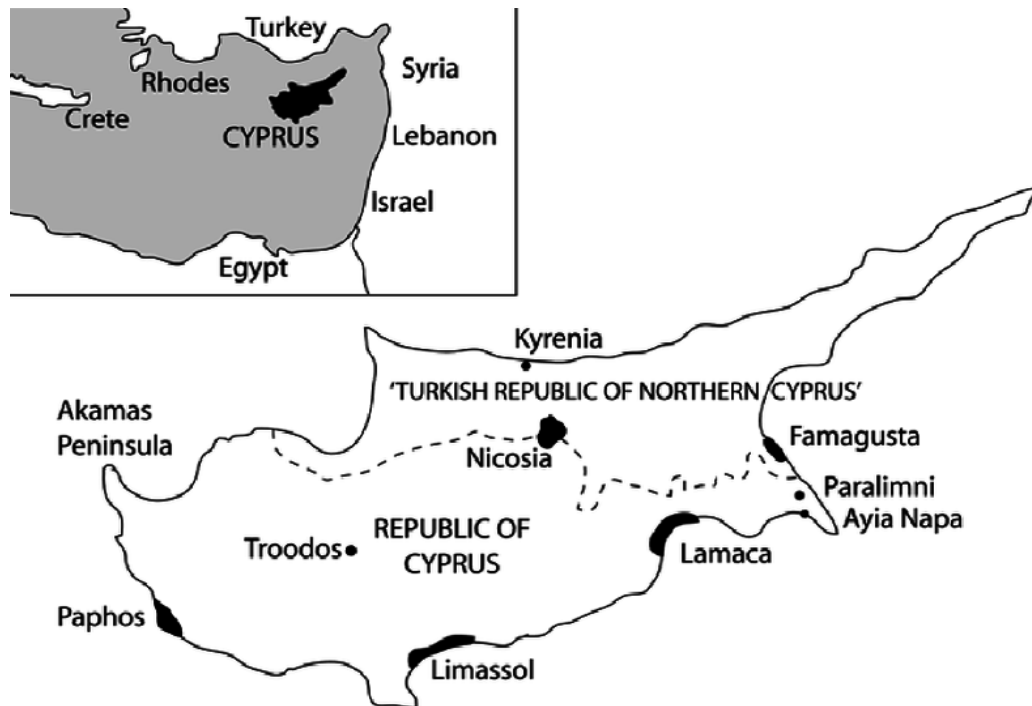


Figure 39: Map of cyprus (Alipor, 2011)

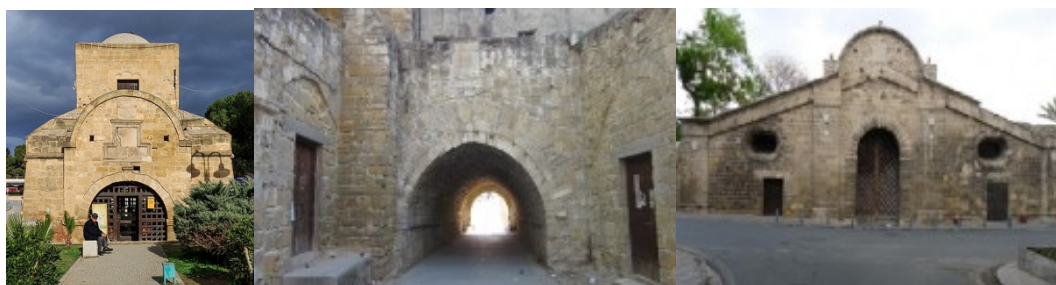


Figure 40: From left to right: Kyrenia Gate, Paphos Gate, Famagusta Gate
https://en.wikipedia.org/wiki/Kyrenia_Gate)
<https://www.classic.com.cy/sights&landmarks>)

The Venetian fortifications remain in place today and are still perhaps the most recognizable feature of the contemporary city. During this period, some buildings were destroyed, and some construction materials were reused in the construction of new buildings (Gürkan, 1996). The physical structure of the city walls and the Pedieos River were the main features shaping the physical structure of Nicosia. The river

flowed through the middle of the city before the Venetian period, along with the route corresponding to the present Buffer Zone. In 1567, it was diverted outside onto the newly built moat for strategic reasons due to the expected Ottoman attacks. In 1570 the city was captured by the Ottoman Empire, and its character of the city was maintained for a long time (Demi, 1990). During this period, the existing religious buildings were reorganized for the needs of the Muslim religion worship. The city started to grow by constructing various buildings such as caravanserais, inns, Turkish baths, covered bazaars, tombs, a library, and a covered market and residential area formed a large part city. (Figure 41)



Figure 41: Left: Buyuk Han (Ottoman caravanserai architecture)
(<https://www.lonelyplanet.com/cyprus/north-cyprus/lefkosa-north-nicosia>)

On July 5, 1878, Nicosia came under the rule of the United Kingdom. During the British occupation, the city was still limited completely within its Venetian Walls. The city was full of private gardens and courtyard houses, but the streets remained unpaved and wide enough to transport material with pack animals. In 1881, the paved roads were completed to create access and connection between coastal towns and Nicosia. The first roads were asphalted after World War I. Education and administrative structures were built during the British period (19th -20th Century) (Çavulu & Öngül, 2011). (Figure 42)



Figure 42: The British Colonial Law Courts
(https://en.wikipedia.org/wiki/Law_Courts,_Nicosia)

During the British colonial period (1878- 1960), urban density in Nicosia increased, which caused the building of empty lands within the walled city and the completion of the city structure (Demi, 1990). Consequently, a series of openings in the Walls provided direct access to areas beyond the Walls as they grew in importance. In 1879, the Paphos Gate opened; however, the most famous opening was across a wooden bridge at the top of Ledra Street, which linked the city to government offices in 1882. British ideas and practices started to influence the Cyprus planning system only some years or decades later. Therefore, the British rules led to expanding administrative, commercial, marketing and service functions into developing the suburban outside the city walls and along the main roads (Zetter, 1985). After the Second World War, between 1946 and 1965, Nicosia 's population grew rapidly, the city expanded, and new residential districts were developed outside the city walls by the major communities (Greek and Turkish).

After establishing the Republic of Cyprus in 1960, the two major communities established independent local authorities, who worked together until 1963. Southern and northern Nicosia went through a process of rapid urbanization, and suburban

growth continues in the peri-urban fringes of the city. The “Green Line” divided the city in 1963 due to the political conflict between the two communities.

After a post-conflict time, the Buffer Zone cut the Walled City from the middle, forming a lifeless corridor, disrupting the city’s cohesion. The Buffer Zone has become one of the major determinants in the town's physical development. Along with political, demographic, and socio-economic changes, the Buffer Zone also created a ‘political’ fixation line. The Buffer Zone also caused the city's development outside of the Walled City. The inhabitants moved to the new neighbourhoods outside the walls to achieve a proper place to live. The physical and political separation of the island led the two sectors of the Walled City to develop in their social contexts. A physical feature (historic walls), a natural feature (Pedieos River), and a political feature (buffer zone) are key determinants in the overall image of the city, which can be identified as tangible barriers and fixation lines. (Figure 43)

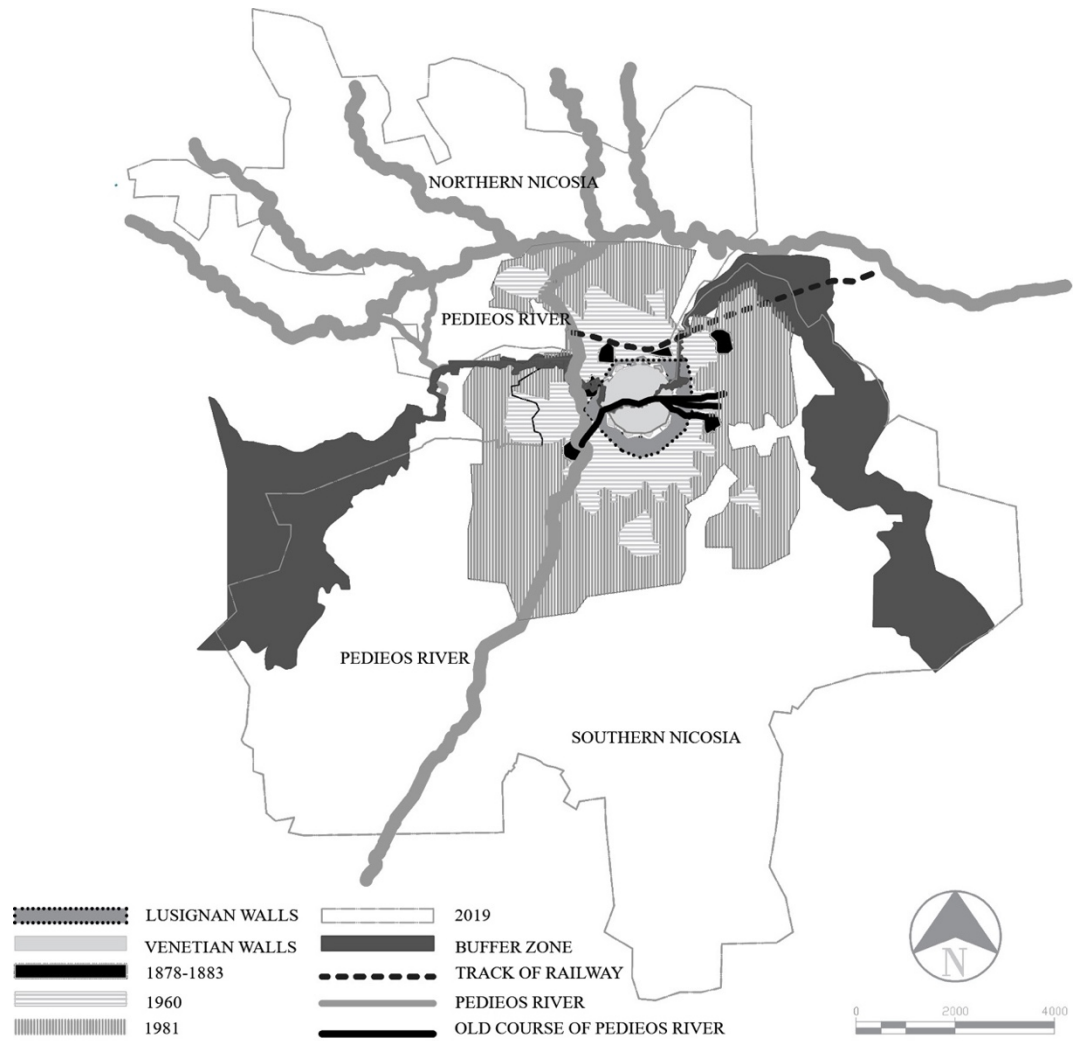


Figure 43: Diagram of the development of Nicosia and Buffer Zone. (Author, 2022)

5.3 The Urban Structure of Nicosia

The urban structure of Nicosia can be defined in four parts. 1) The Walled City, the geometric centre of Nicosia where the north-south axis intersects the "Buffer Zone" along the east-west axis. 2) The Buffer Zone cuts across the Walled City in an east-west direction. 3) The Core Business Area, which extends to the north and the south of the Walled City. The 'CBD-North' comprises the area located on the northern part of the Kyrenia Gate, where four high schools, a library, governmental buildings, several public buildings, and the residential area of Yenişehir are located, extending towards the Nicosia Bus Terminal to the east. On the other side, the 'CBD-South'

consists of Makarios Avenue, Stasikratous Street, and the surrounding areas. 4) Residential areas around the CBDs developed in different periods. Köşklüçiftlik, Çağlayan, and Yenişehir in the north, and Ayios Dhometios, Ayios Constantinos and Ayios Nikoladis in the south were all built before 1974 and surround the central core of both sides, reflecting some established character. In the last 40 years, new housing areas have been added, and the city's boundaries have been widened significantly (Oktay, 2007).

5.4 Selection of Districts

For the detailed analysis, this study focused on districts where the first settlements have been developed outside of the walled city. In this regard, the selected districts are Köşklüçiftlik, Çağlayan, and Yenişehir. (Figure44). The similarities and differences of the selected region will be discussed in detail. These districts were analysed in depth to address detailed information related to morphological elements, particularly green dimensions. This analysis aimed to systematize the findings and establish a principally inductive approach by analysing the city from macro to micro-scale. Generally, 2D surveys have been applied to the whole town, and 3D searches have been applied to the selected regions in detail. However, to measure the developmental process, the entire town should be analysed to facilitate further research.

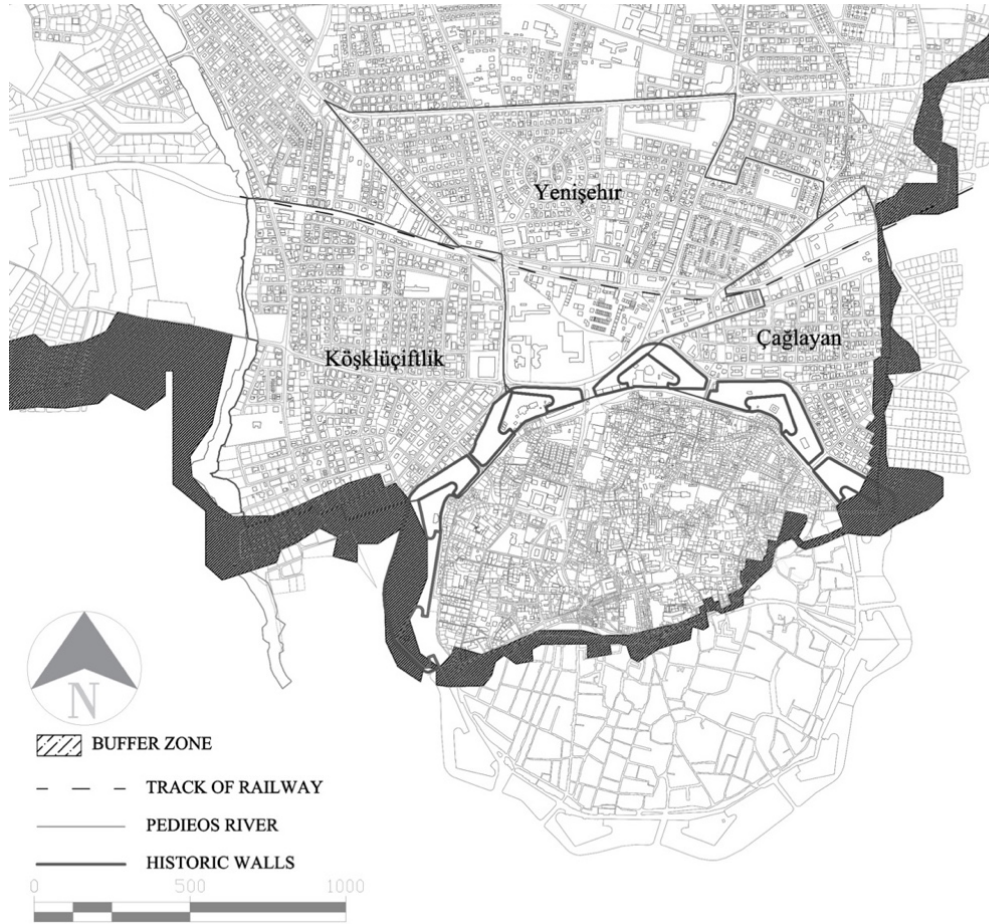


Figure 44: Selected districts in city image

5.5 Morphological Characteristics of Nicosia

This part of the study aimed to analyse the physical structure of Nicosia by applying the designed framework, presented in chapter 4, under the two-level macro and micro and generally discussed on four defined scales city level, district level, block-level, and plot level. The main criteria that will analysis are (a) Morphological Region, (b) Fringe Belt, (c) Townscape, (d)Town plan, (e) Plots, (f) Streets, (g) Block, and (h) research for the green space typology.

5.5.1 Macro Level of Analysis

Nicosia city in Cyprus has been chosen as a case study to illustrate the concept of green space in morphological research. Numerous information needed to be documented on the level of macro-scale analysis. The study focused on the fringe belt analyses due to

the direct relationship between the fringe belt concept and green spaces on the urban scale. In addition, townscape evaluations have been done by describing the various morphological region based on the variation of building pattern, land utilization and town plan. Therefore, this section of the study partially focuses on the macro level and discusses Nicosia's morphological characters, in general, to create a holistic image of the city later; it will concentrate on the micro-scale of analysis, particularly town plan and plan unit analysis on each selected neighbourhood.

5.5.1.1 Fringe Belt

Based on the definition of fringe belts in chapter two and due to the crucial ecological, environmental, and physical role of green spaces with urban fringe belts, fringe belt analyses for Nicosia have been discussed in this section. Conzen's concept (1960) for determining the Inner Fringe belt (IFB), Middle Fringe belt (MFB) and Outer Fringe Belt (OFB) has been used as a method for understanding the urban fringes of Nicosia. In this section, the general characteristics of Northern Nicosia have been explored, and the political, natural, and physical features that influenced the city's development have been discussed. After that, it intended to analyse the green spaces in the fringe belts to understand the changes in green spaces in a different stage of the city's growth. (figure 45)

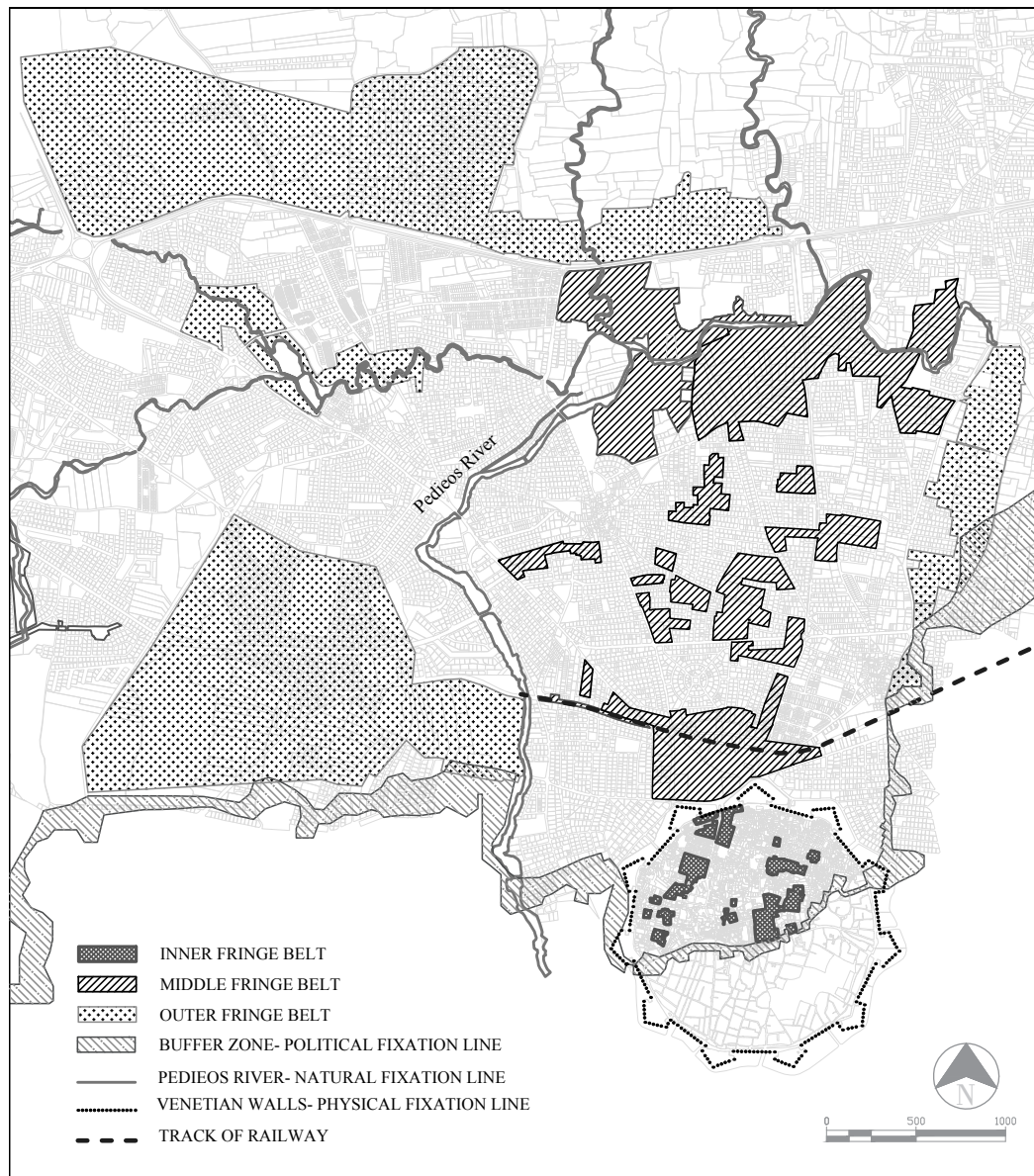


Figure 45: Nicosia's fringe belts (Author,2022)

Nicosia's Inner Fringe Belt

Nicosia's historic core has been fortified by stone walls and surrounded by a moat. The moat is one of the important elements that have survived until today, together with fortifications and bastions, to maintain its character. The fortifications represent a separate major plan type forming a closed fringe belt, which M. R. G. Conzen (1960) termed a fixation line. By this strong physical feature, Nicosia's old town is completely separated from the subsequent zones of residential and other developments outside the

walls. However, a series of openings in the walls and gates provided direct access to areas beyond the walls. Therefore, Nicosia's inner fringe belt can be recognized as a 'closed fringe belt' as Conzen (1969, p. 59) termed it. (Figure 46)

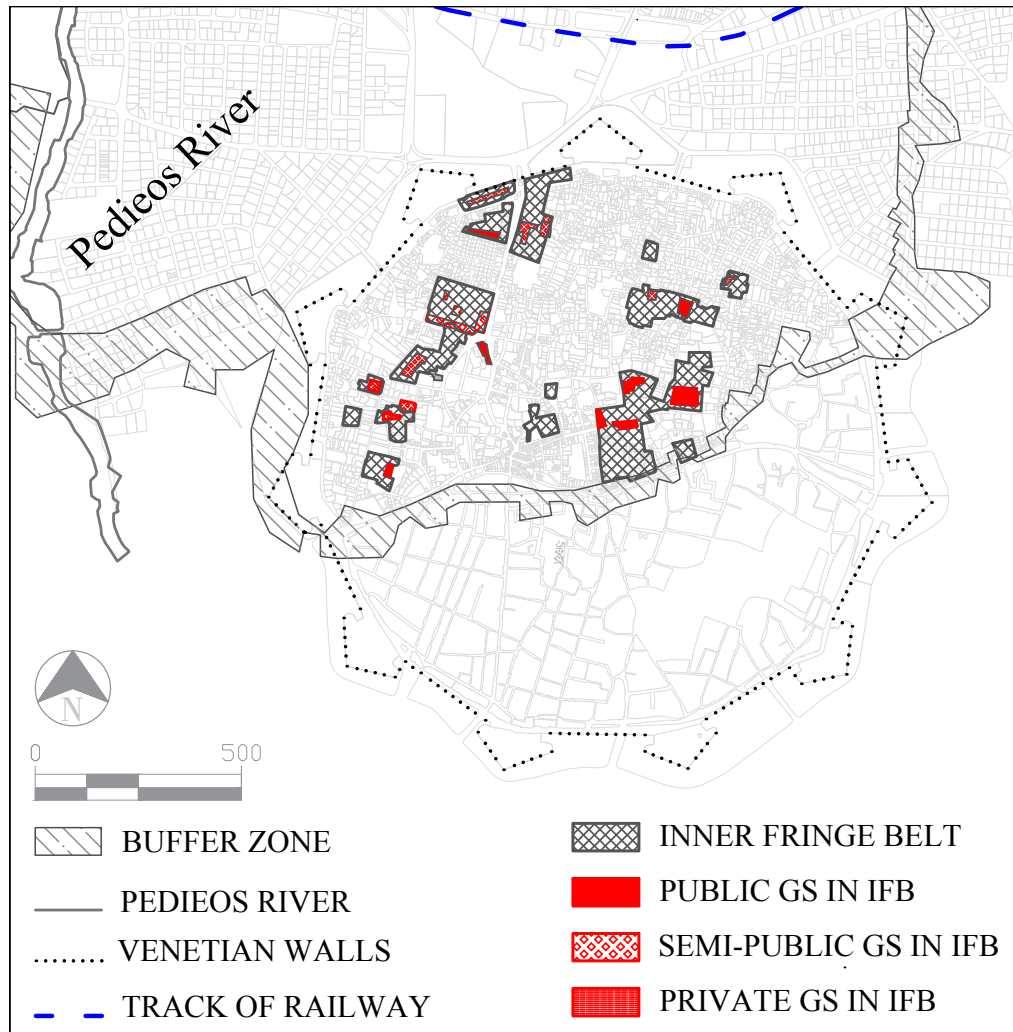


Figure 46: Nicosia's inner fringe belt (Author,2022)

Another significant feature of Nicosia's old town is the Buffer zone, which divides the city's historic core into two parts. This barrier is distinct from the other fixation line that can be termed a political fixation line. The inner fringe belt of Nicosia is highlighted in Figure 46, which shows the development of the old town's governmental, religious, and institutional buildings and public facilities.

Public green spaces in the inner fringe belt are limited, due to the compact layout of the walled city. The most unique vegetation within the old town can be found within the political fixation line (the Buffer Zone). The area has been inaccessible since 1974, which has led to the growth of natural habitats over and between the abandoned buildings, thus creating a linear green space through the middle of the old city. Therefore, the vegetation typology has been changed to natural greeneries with linear form.

Public, functional green spaces are rarely found in the city's inner fringe belt: a small number surround or line the main squares and public spaces. However, along the physical border of the old town, on top of the fortification and the bastions, there are some green spaces in the form of a park, soccer fields and sports clubs. The Yiğitler Burcu in the west part of the walled city, now used as a park, is one of the distinguished public green spaces on fortification walls and bastions. Çetinkaya Sports Club and Taksim Soccer Field are the other important public functional green spaces in the inner fringe of Nicosia. Other public green spaces are associated with the Prime Ministry Garden.

Semi-public green spaces in the inner fringe belt are primarily associated with religious or institutional buildings such as Nicosia's court, Tekke Garden Cemetery, and post office. The plot typologies of institutional buildings, religious buildings, and schools showed that the historical town was divided from the east to the west. The institutional plots were located in the centre, while religious and school plots were situated along the eastern and western sides of the fortifications. The religious plots were larger than other plots in the fringe belt. The green spaces in those plots cover approximately 30 per cent of the area.

Private green spaces are common and belong to courtyard houses. Nicosia's old town is full of courtyard houses; however, they are varied in size and space organization; Danilo (1997) identified four types of Nicosia's courtyard houses: 1) Original Courtyard-House Type (a large inner courtyard and the buildings are organized around it), 2) Minimal Courtyard-House Type (similar to the previous category, but it is much more modest in size), 3) Planned Serial-House Type (the courtyard is moved to the back of the house, and it becomes smaller), 4) New Courtyard-House Type (combination of the two previous types, part of the plot facing the street and it is larger). The arrangement of courtyard houses in each block and the combination of courtyards in the middle of the block created large compact green spaces that are not perceivable from the street level. However, they created a microclimate for a group of houses in relation. These green spaces can be noticed in Figure 47.



Figure 47: Nicosia's inner fringe belt and green spaces

Nicosia's Middle Fringe Belt

Nicosia's middle fringe belt can be recognized by following the city's development pattern outside of the walls. In northern Nicosia, between 1946 and 1965, new

residential neighbourhoods such as Çağlayan and Köşklüçiftlik were developed outside of the walls. Consequently, facilities such as schools, administrative offices, and institutional buildings supported the new development, and the city expanded toward the northwest. In addition to that, the physical barrier of Pedieos River limited the city's expansion from the Westside, and the continuation of the Buffer Zone restricted it from the East. Military zones on the west and east sides of the new development area and other institutional plots defined the second stage of the development, as shown in Figure 48.

In the middle fringe belt, public green spaces developed inside the moat, along the riverbed (in southern Nicosia) and along the railway track (in northern Nicosia); these include parks, sports fields, and cycling greenways. The major functional green spaces (parks, playgrounds, and sports clubs) developed in the moat provide citizens with facilities for public activities. Two important parts of the moat next to the Kyrenia s Gate were converted into Kuğulu Park and Ankara Çağlayan Park (Figure 49), creating a green line around the historical walls. These public spaces support most of the city's national festivals and social activities.

In northern Nicosia, the riverbed was used as a leisure active green space in the past but, now due to the expansion of the development very close to this area, it is not acting for such a purpose. The areas next to the branches of the Pedieos river also defined the edges of the middle fringe belt that controlled the development of the city on the riverbed's lands. These green spaces have been selected to be transferred in close future to the National and City Park by northern Nicosia's Municipality.

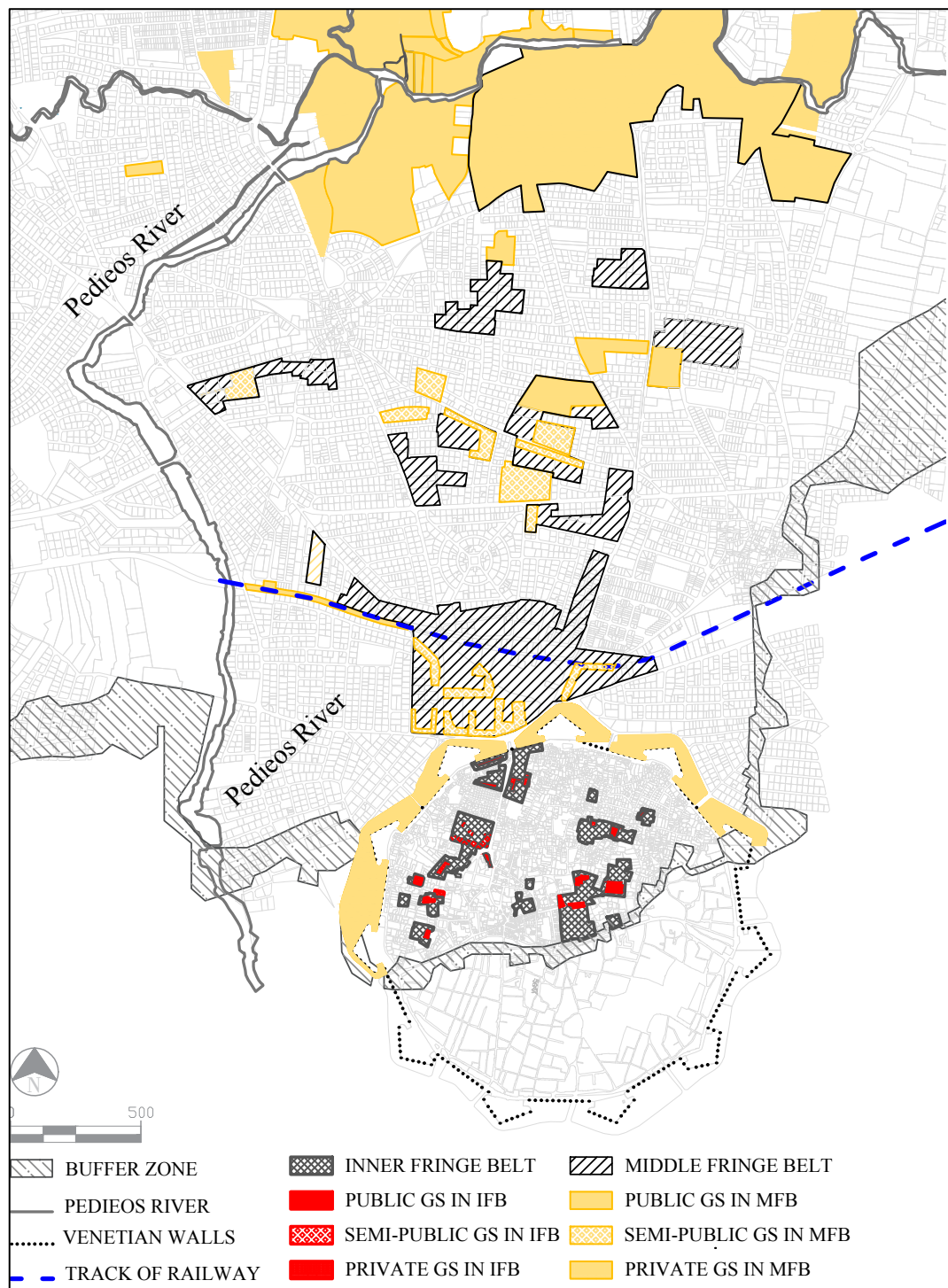


Figure 48: Nicosia's middle fringe belt (Author,2022)



Figure 49: Kuğulu Park- Right: Ankara Çağlayan Park (Author, 2019)

The significant public green space in the middle fringe belt of Nicosia has been built on a brownfield site on top of the tracks of the railroad. Kumsal Park is located on tracks of the train line between Nicosia and Famagusta, which was established in 1905 and closed in 1951 due to economic issues. (Turner, 1979) There is a row of trees along the tracks of the railroad, which can be easily followed on the map. Creating a public green space and revitalizing this brownfield site kept the identity and memory of the place. Greenways and green streets mostly can be distinguished on the track of the railroad in the Yenişehir and Çağlayan districts. (Figure 50)



Figure 50: Nicosia's former railroad and Kumsal park (Author, 2019)

Apart from the Kumsal park, located at the edge of the middle fringe belt, other green spaces are associated with institutional and administrative buildings. The most noticeable green spaces developed through the north part of the Kyrenia Gate along Gazeteci Kemal Aşık Road as green spaces associated with Lefkoşa Turkish High School (Figure 51), 20 Temmuz High School, Şehit Hüseyin Ruso Secondary School and Atatürk Cultural Centre. Besides those schools on the edge of the middle fringe belt the green space of Turkish Maarif College (Figure 52), Küçük Kaymaklı Şehit Hüseyin Ruso Stadium and the old Turkish cemetery defined other green zones of the city. However, green spaces associated with administrative and institutional buildings are demarcated as semi-public green spaces in the middle fringe belt of Nicosia.



Figure 51: Lefkoşa Turkish High School (<https://www.google.com>)



Figure 52: Turkish Maarif College (<https://www.google.com>)

Nicosia's Outer Fringe Belt

Nicosia's development has been restricted from the eastern side by a Buffer Zone, agricultural lands, and a military zone on the western side. Therefore, the city has been developed mainly in the northwest. The industrial zone, sports field, and Near East University Campus mainly defined the outer fringe belt in a north direction.

Significant green spaces in relation to the outer fringe belt are defined by seasonal lakes, sports facilities, open spaces of universities, industrial zones, military grounds, agricultural lands, and the Buffer Zone. Notable green spaces are associated with Near East University Campus and Nicosia cemetery. Additionally, agricultural land can be

classified as a natural fixation line of Northern Nicosia in both the east and west. (Figure 53)

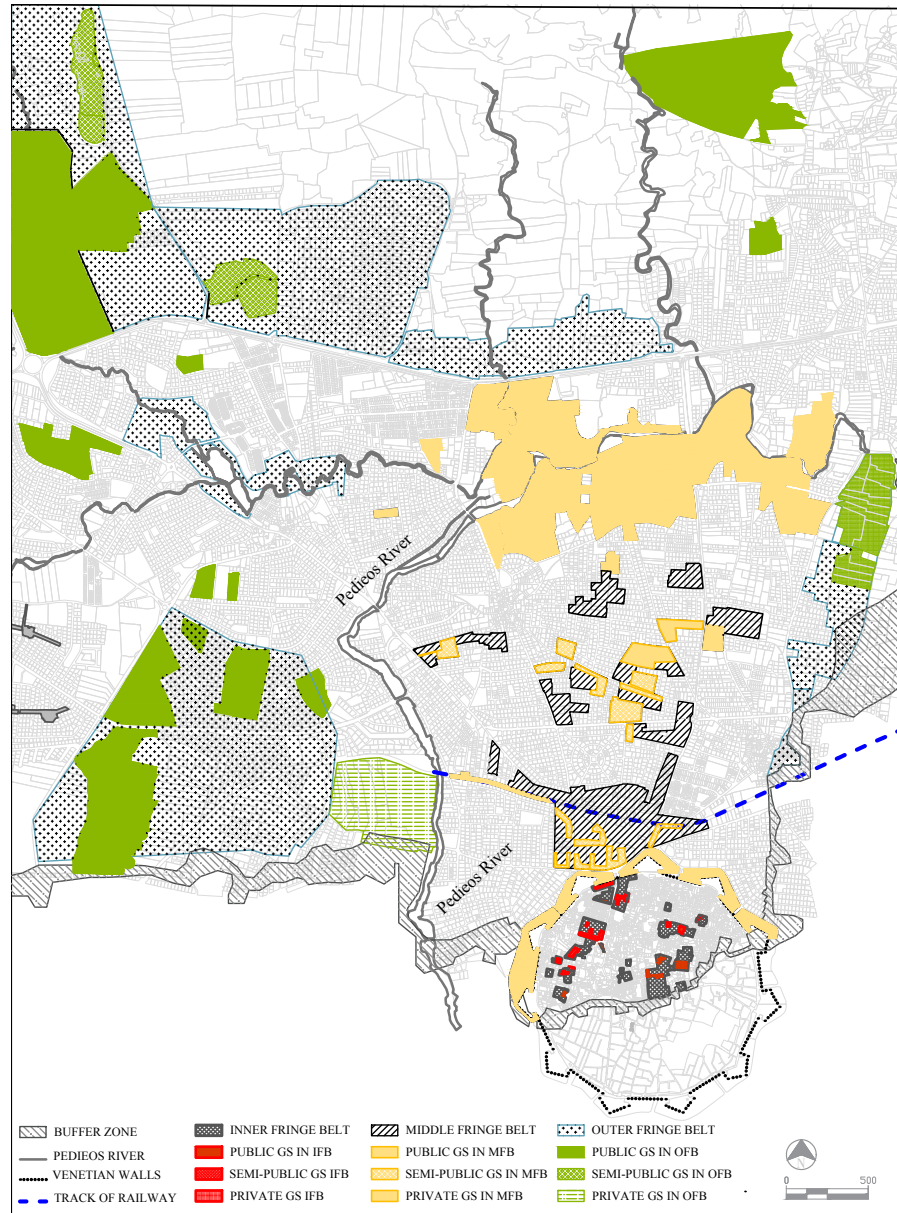


Figure 53:Nicosia's outer fringe belt (Author, 2022)

5.5.1.2 Townscape

Townscape analyses determine the historical development of the city. It can be done by distinguishing various morphological regions and stages of development through the evaluation of their morphological components. According to Conzen 1988, a

morphological region is an area that has unity in respect of its form and is a distinguishable pattern from surrounding areas (Conzen, 1988, p.257). The building patterns, land utilization, and town plan combination clarified the townscape and historical formation of the city. Building patterns have been evaluated based on the building construction period and their construction type with materials. Land utilization has been presented as the functional distribution in various regions. The town plan has been analysed by referring to the relations of plots, streets, and building formation in each plan unit. Figure 54 shows the morphological regions of northern Nicosia.

Northern Nicosia has been developed in seven morphological periods, Medieval period-(Latin), Ottoman or late Medieval period (1571-1878), British or pre-modern period (1878-1960), Republic of Cyprus-Modern period (1960-1974), post-conflict period KTFD period (1974-1983), TRNC period (1983) and new development. The figure showed the morphological regions of northern Nicosia. (Figure 55)

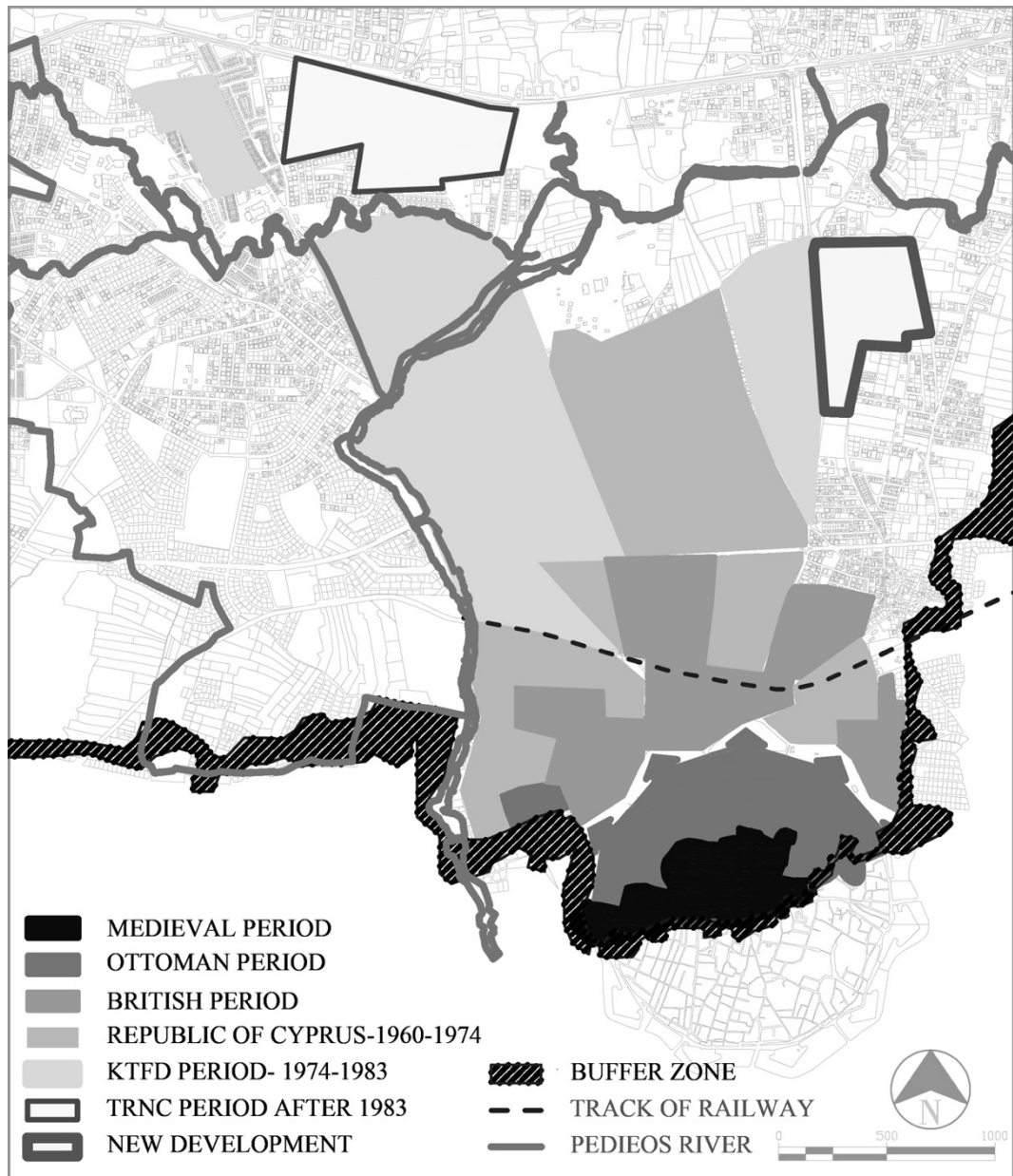


Figure 54: Morphological regions (Author, 2022)

Building Pattern

In Nicosia, building pattern has been classified under seven periods: the Medieval Period, Ottoman Period, British Period, Republic of Cyprus-Modern period (1960-1974), KTFD period, TRNC period and recent development. Mostly the buildings in the old town of Nicosia have remained from the Medieval, Ottoman and British periods. The existing buildings, such as churches, mosques and courtyard houses,

present the architectural characteristics of each period; however, the general layout of the old town followed the same organic form.

During the Medieval period, especially in the Roman (50 BC-395 AD) and Byzantine (395-1191 AD) periods, Nicosia became an important administrative and business centre of the island. In 1191 Lusignan came to the island. They built fortified walls and towers, churches, and a cathedral, that still survives as important architectural works of the period. During the Venetian period from 1489 to 1570, numerous Lusignan buildings and walls were replaced. (Demi, 1990) The new fortification walls thus made the city smaller to protect the city from the threat of the Ottomans. The new walls had the shape of a star with eleven bastions and three gates. In 1570 the city was captured by Ottoman. In Ottoman times, main Latin churches were converted into mosques in addition to the religious buildings and mosques that had been constructed. They filled the empty plots around the centre. In 1878 British gained control of the island; still, Nicosia's development was limited inside the walls, and the city kept its physical and architectural characteristics. Eventually series of openings in the walls provided direct access to areas beyond the walls, and the city started to expand outside the walls. The first development of the town outside the city walls happened in the British period in Köşklüçiftlik area. The area's initial nucleus was settled in the Ottoman period; however, the first residential development occurred in the 1910s. The first (the 1910s) and the second (1930s) stages of neighbourhood development happened both in the British period, although the development periods and typologies of plots, streets, and buildings are different. Mainly large and magnificent houses were constructed on large plots with yellow stone material, which still characterize the area. Çağlayan is the second neighbourhood that was developed in the British period. The neighbourhood is full of detached houses with yellow stone façades on large plots.

After that, the Yenişehir district developed in different stages and various plan units with varying building typologies. The first settlement in the area was made between 1930 and 1945; the social houses were constructed mostly with yellow stone material on smaller plots. The second stage of the district's development happened between 1960 and 1974. Multi-storey buildings, been built with contemporary materials and a modern architectural style, contradict the walled city's historical texture. This district is occupied by most of the administrative and intuitional buildings of North Nicosia, such as Nicosia Bus Terminal, Nicosia Police Headquarters, Şehit Hüseyin Ruso Stadium, Northern Cyprus State Theatre, Nicosia Municipal Theatre, and the old railway station of Nicosia.

Kumsal, Gelibolu and Marmara districts developed after 1974. Each generated different morphological regions due to the building's pattern, street typology, and land use. The building patterns are varied as their construction periods were varied, and the streets' development happened in different ways in each district. Mainly, apartment buildings developed in these areas. (Figure 55)

After 1983 various types of residential buildings were constructed in Taşkınıköy districts, such as social houses in two stories semi-detached forms and apartment buildings. Recently, various types of residential buildings, mostly high-rise buildings and detached houses, have been developed in different parts of the city.

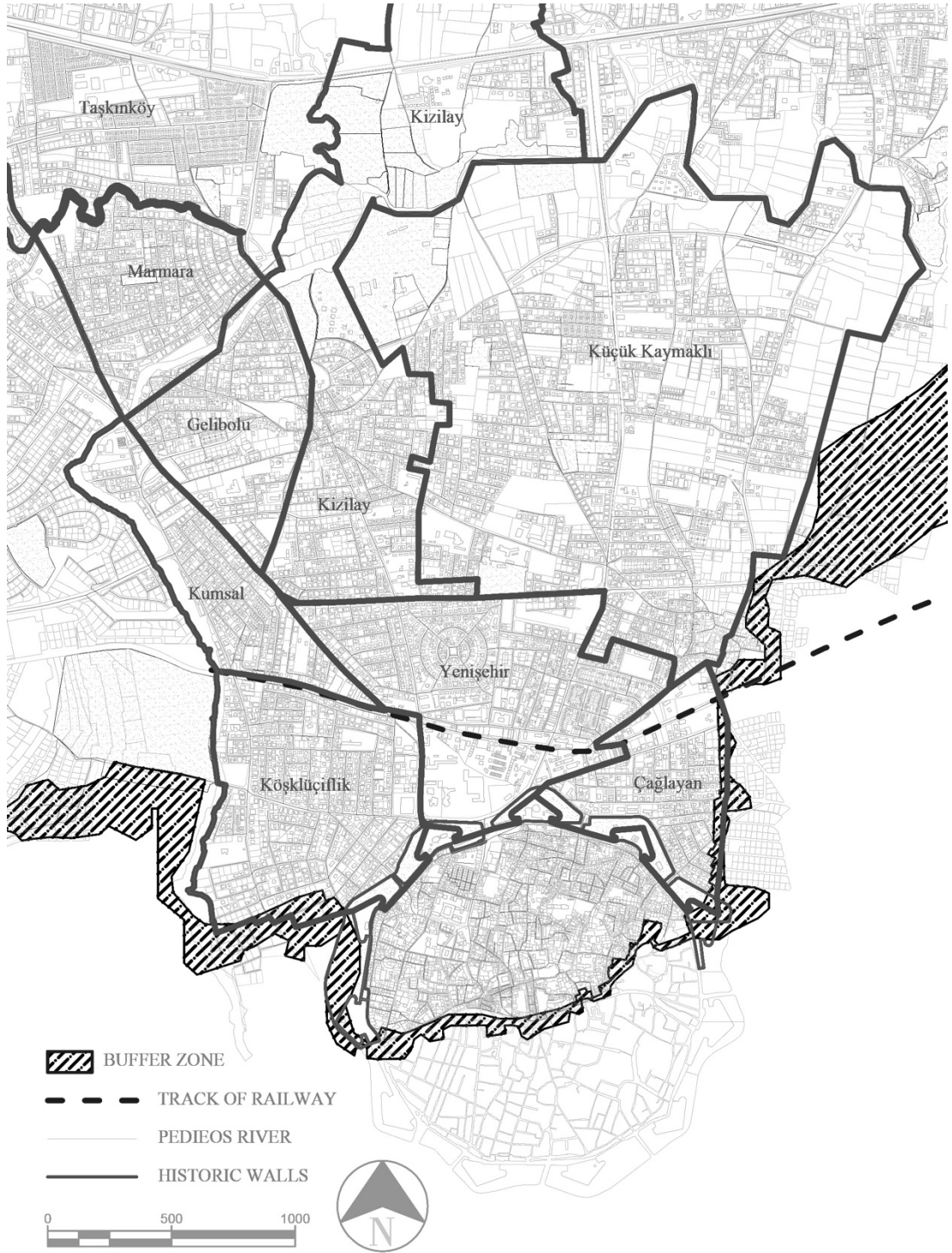


Figure 55: Nicosia districts (Author, 2022)

Land Utilization

Land utilization analyses have been done in detail based on MRG Conzen's analysis, and definition of land uses, which are generalized under five main categories as: 1) Residential premises; 2) shops, business, and professional premises with or without

residence;3) Open spaces;4) Industrial premises with builder yards and warehouses;
5) Premises with public or community functions.

Residential premises are developed in different areas of the city, and their range is more comprehensive than other functions. However, they are more expanded throughout the northeast and northwest of the city. Branches of the Pedieos river created a kind of barrier that affected the development pattern to expand through the northwest and northeast. Nicosia's old town also included a variety of residential neighbourhoods.

Shops, business, and professional premises with or without residential functions have been distributed generally along the main roads that shaped the structure of the city and axial developments such as Dereboyu in the northwest, Osmanpaşa street on the west side, Gazeteci Kemal Aşık towards the northeast and Atatürk Street from east to west.

Historical plazas and squares in the old town are recognized as public spaces, and most public activities are happening in those places. This study added functional green space as an individual element to Conzen's category. Green spaces mainly surrounded the fortification walls in addition to those spaces next to the branches of the Pedieos river toward the north. The Kumsal park is also recognized as a green space in the west part of the city. Moreover, green spaces are shaped along the Buffer zone area in the old town from east to west. Outside the historical town, the buffer zone defined the agricultural lands on the east side, and green space belonging to the military zone on the city's west side defined another green zone. A distinctive natural green space is

located in a linear shape next to the Pedieos River. The riverbed in the Kizilay district created a major green area in the city.

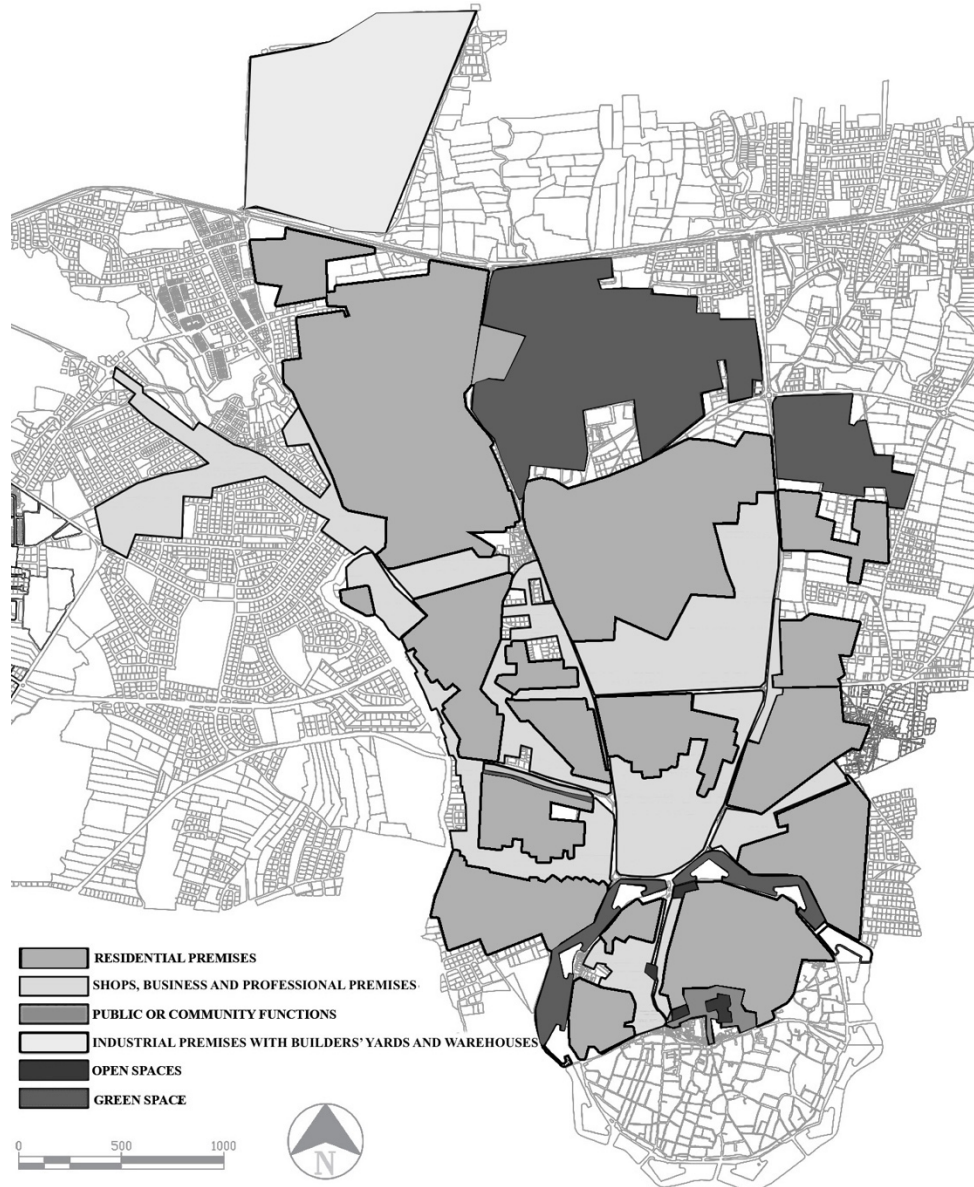


Figure 56: Nicosia's land utilization (Author, 2022)

In Nicosia, the industrial zone is in the north part of the city and separated by a highway from the other part of the city. Public and community functions are shaped almost in the area next to the edges of the middle fringe belt in the Yenişehir area. (Figure 56)

In addition to those five headings that were defined by MRG Conzen (1960), this study discussed the green spaces' land utilization to discover the structure of green spaces in the city. As discussed above, morphological elements such as fringe belts, morphological regions and townscapes of Nicosia have been presented at the macro-level to understand the general characteristics of the city. The following sections focused on micro-level analysis and presented town plan analyses on the selected districts.

5.5.2 Micro-Level of Analysis

At the micro-level and in addition to those layers of macro-scale analyses, the morphological characteristics and town plan analysis for each selected neighbourhood have been discussed, and the focus was mainly on green space. Districts are analysed based on morphological characteristics and divided into plan units. For each region, the discussion will focus on morphological elements. In this regard, the selected areas have been analysed by considering the streets, blocks, and plot patterns, particularly the green spaces associated with these urban elements. The green space patterns and physical features of buildings and open spaces have been documented by considering their locations, sizes, forms, types of surfaces, land uses and land ownership with each morphological element such as streets, blocks, and plots.

Generally, in Nicosia, the “Streets and Buildings Regulations, Cap 96” was legislated in 1946, and the “Nicosia master plan” determined rules and regulations to control the development. Regulations such as building setbacks(front and lateral setbacks to be a minimum of 3 meters wide- minimum setback at rear 5 meters wide), plot coverage (up to 60%), and plot ratio(up to 4.5:1) that impact the configuration of the city. The following sections discuss the micro-level analysis in Köşklüçiftlik, Çağlayan, and Yenişehir; three selected neighbourhoods.

5.5.2.1 Köşklüçiftlik Neighbourhood

The Köşklüçiftlik neighbourhood is located in the west part of Nicosia and is limited between the city wall on the east side, the Buffer Zone on the south side, Pedieos River on the west side and Kumsal park on the north. Köşklüçiftlik neighbourhood is one of the first neighbourhoods of Nicosia to be built outside the walls. In the 1910s, the first structures of the three mansions were constructed in the area for holiday purposes, and the name of the neighbourhood (Köşklüçiftlik) has taken from the most prominent building, “Big mansion”. The area started to develop after 1923, simultaneously with the establishment of the Dianellos cigarette factory. Houses were built on large plots with roses, flowers, and all kinds of fruit trees in the garden. In particular, pine trees have been planted in front of those houses that still exist and have become part of the significant characteristics of the neighbourhood. (Gürkan, 1996) The Nicosia train line defined the northern border of the area. In 1952 the rails were dismantled, and the axis green space, which reached the stopping point in the east, was left and altered as a park (Kumsal Park) today. During the 1950s, the neighbourhood grew rapidly, and apartment-type buildings began to be built on new plots besides detached houses in the garden. Recent developments on the island affected the construction industry regarding building materials and techniques. The yellow stone, baked brick and reinforced concrete construction system began to be used in the area (Numan et al. 1, 2002). The area was developed under the influence of the British in the continuation of the Ottoman period, which determines the neighbourhood's dominant characteristic. (Figure 57)

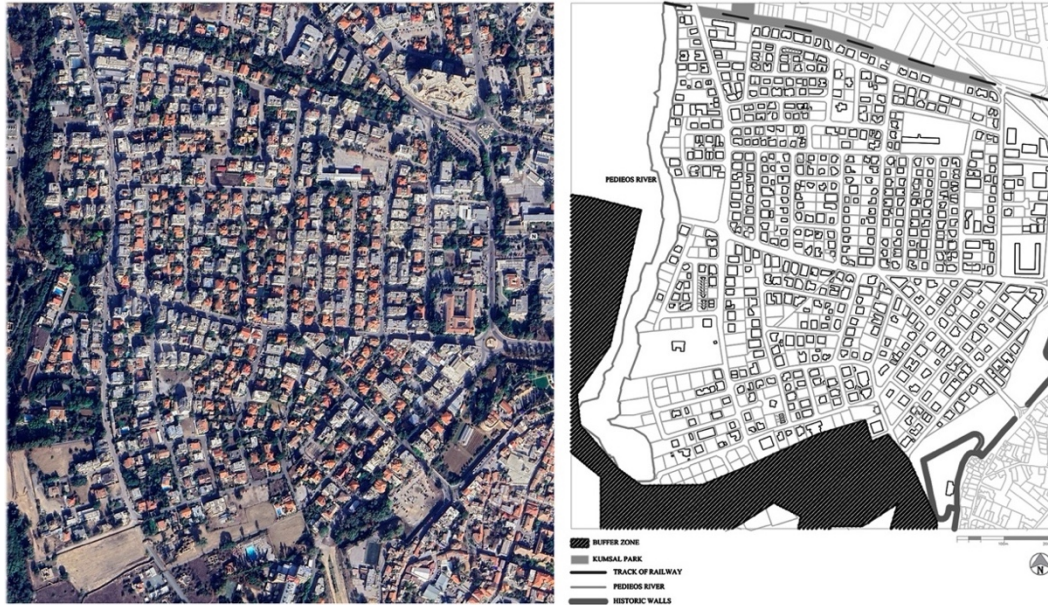


Figure 57: Köşklüçiftlik neighbourhood

In the 1970s, housing demands raised (Atun & Pulhan, 2009), and a series of changes happened in the neighbourhood, such as the housing typology, architectural style, construction material and technique, which gradually neighbourhood missed its old quality. One- and two-storey buildings with yellow stone material replaced with reinforced concrete and aluminium glass piles apartments. The commercial function takes place on the ground floor of the apartment-type building, and the residential function of the neighbourhood changed to a commercial function. In the same period, the cigarette factory was converted into a parliament, increasing the area's importance. Therefore, the neighbourhood began to host official state buildings gradually. Today most of the stylish buildings from the British period have been converted into business, and commercial buildings, and the neighbourhood kept the style relatively.

Plots Typology of Köşklüçiftlik

In this study, plots have been analysed under three components: (a) plot typology that gives an idea about the evolution of the plot, and plot form, (b) the ratio of the plot

(according to depth and width), and (c) plot's typology concerning open and green spaces.

The main issue in plot analysis is its size, form, relationship to the buildings on the plot and, most importantly, its relation to open and green spaces. Therefore, the ratio of the plot and the percentage of green space to the plot shows the balance, harmony, or domination of spaces in terms of proportions. The dimensions of the plot and plot shape (type) have clarified the plot typology. However, the vital aim of plot type analysis is to realize the form and type of spaces created by green spaces within the plot. The types of plants and their characteristics, such as height, size, shape, and density, have been investigated. This type of analysis contributes to understanding the green space typology in general and identifying the typology of the green spaces in the plot scale. To enrich the level of understanding of the structure of green spaces and the relationship between plot typology and green space, the study focused on the plot size, form and density of green spaces compared to plot size.

Overall, the neighbourhood layout shows that the buildings sat three metres back from street lines and plot edges. The building pattern of the neighbourhood indicates that various building typologies exist in Köşklüçiftlik (Figure 58).

Nevertheless, various plot and building typologies created a different organisation of green spaces. The plots within the Köşklüçiftlik neighbourhood have characteristic shapes and sizes. Trapezoidal plots are mostly located on the corners of blocks with defined green space that creates green walls to provide privacy and define the borders and territory. Moreover, as shown in Figure 59, the most common plot shape is a

rectangle, rectangular plots with different sizes with ratios of 2:1, 1.5:1 and 1.2:1. The rectangular plot has various ratios of plot-to-green space between 2:1 and 3:1.



Figure 58: Köşklüçiftlik neighbourhood building pattern (Author, 2022)

The space around the building was used as a garden in a larger rectangular plot with one- or two-storey buildings. Green space was arranged in a U-shaped form around

the building in these cases. The green space created a tall green wall on the plot head and distinguished these plots from other plots in the area. A smaller rectangular plot with a ratio of 1.5:1 is common in the neighbourhood with one and two-storey buildings. In these plots, green spaces organised one plot head or tail or on both plot head and tail in U-shaped, L-shaped, and linear forms. In most cases, from these categories, the percentage of green spaces located on the plot tail is more than the plot's head. Besides, the typology of plant species differs in plot, tail and head.

As mentioned before, the pine and cypress trees had been planted on the plot's head in the gardens of one and two-storey buildings in the British period that still exist (Figure 58). Those trees and green spaces' density are recognisable in an aerial map which determined the first nucleus of the neighbourhood as well. Moreover, the olive, citrus, palm, and fig trees are the plant species that have been planted on the plot's tail. (Figures 60 and 61)



Figure 59: Pine trees on plot head (Author, 2022)

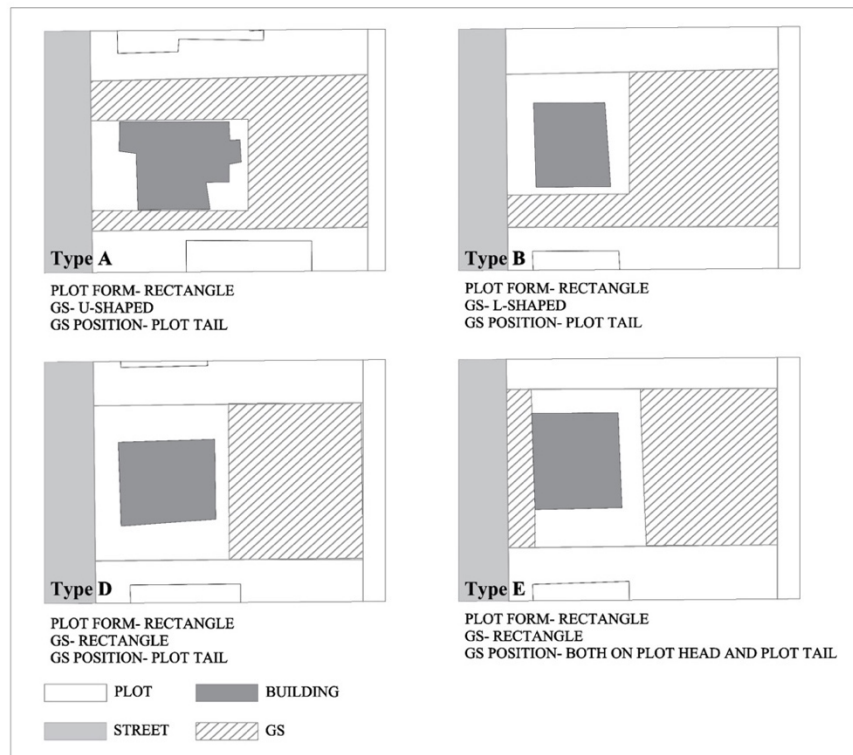


Figure 60: Typology of GSs(green spaces) on rectangular plots with a ratio 1.5:1 (Author, 2022)



Figure 61: Locations of rectangle plots with a ratio of 1.5:1 and green spaces showing the neighbourhood's nucleus. (Author,2022)

In addition, the green space on the corner plots on the southern side of the Köşklüçiftlik neighbourhood has a distinctive pattern. Most corner plots are bigger and surrounded by high bushes that create green walls. This type of plantation defined the territory and made privacy simultaneously. However, the corner plots on the northern part of the neighbourhood do not follow that particular pattern for green spaces plantation. In these plots, 25 to 30 per cent of the plot area was covered by green elements. Citrus, olive, palm, pine and eucalyptus trees, cacti, tall shrubs, and hedges are typically planted to define property boundaries and provide privacy. (Figure 63)

In the case of large plots containing apartment blocks, organised green spaces were less than one or two-storey buildings. However, the amount of green spaces was more than in other neighbourhoods which developed in the same period. Hence the pattern

of the green spaces was altered through a change in the pattern of building typology. There is an increase in the footprint of taller blocks and a decrease of green space around taller blocks. As the number of floors increased, the amount of green space decreased. (Figure 62)

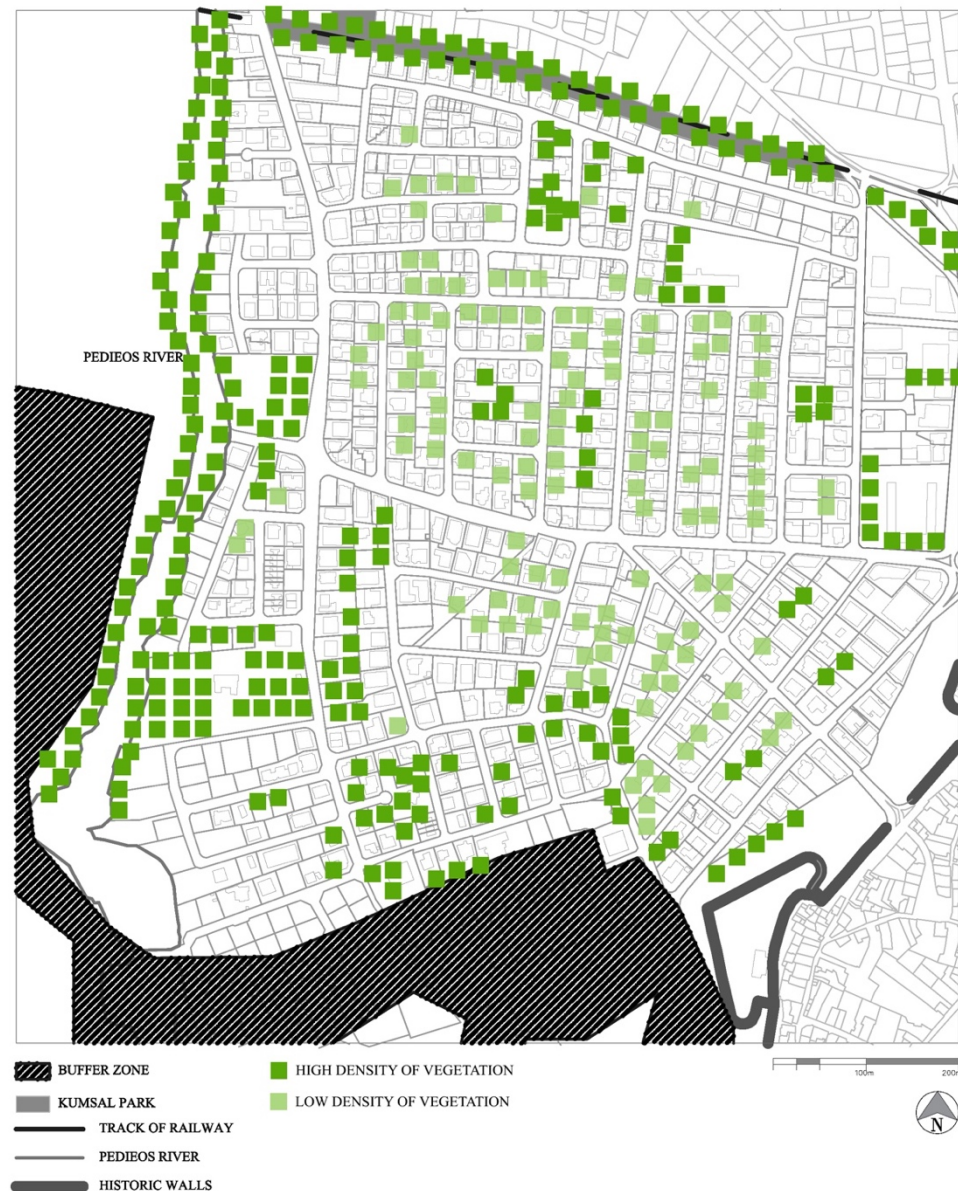


Figure 62: Private land ownership and density of GSs (green spaces). (Author,2022)



Figure 63: Arrangement of green space on Köşklüçiftlik corner plots. (Author,2022)

Street Typology of Köşklüçiftlik

The street typology analysis items are the street's width, the relationship between the street and plot, and pertinent strip characteristics. The most important part of the street analysis is the relationship between the green spaces located on the street space. Street block also completes the street typology based on the variation of open spaces and the location of the buildings in the plot series. The plot head (usually occupied by a building on the street frontage) and plot tail (the garden/open area to the rear, with or

without additional buildings) defined the physical overview of the street (solid-void relationship). In contrast, the vegetation described the soft, three-dimensional effect and character. Moreover, the types of surfaces (paved/unpaved, soft /hard), plants and their forms, heights, and densities defined the street typologies. This leads to determining the character of the green specs related to the street and categorising them based on the street typology.

In the case of Köşklüçiftlik, based on Caniggia's definition (2001), the street can be defined as a matrix route (main road), building route, connecting route and reconstructed route. (Figure 64)

On the other hand, street types can be differentiated by considering hard and soft surfaces and organising green space along the street. In Köşklüçiftlik, the streets were defined only by hard surfaces, and rarely can soft spaces be found in streets spaces. Therefore, two types of streets are determined based on the green space organisation: streets without (type A) and those with green space (GS) (type B) (Figure 65).

In the type(A) street typology, 100% of street space is covered by hard surfaces. Although the green space does not exist in the street space, the rich green spaces in the plot series shape continuous green façades. Since the buildings sat 3 meters back from the street line, the green spaces between street lines and buildings created a three-dimensional structure in the streetscape. (Figure 66)

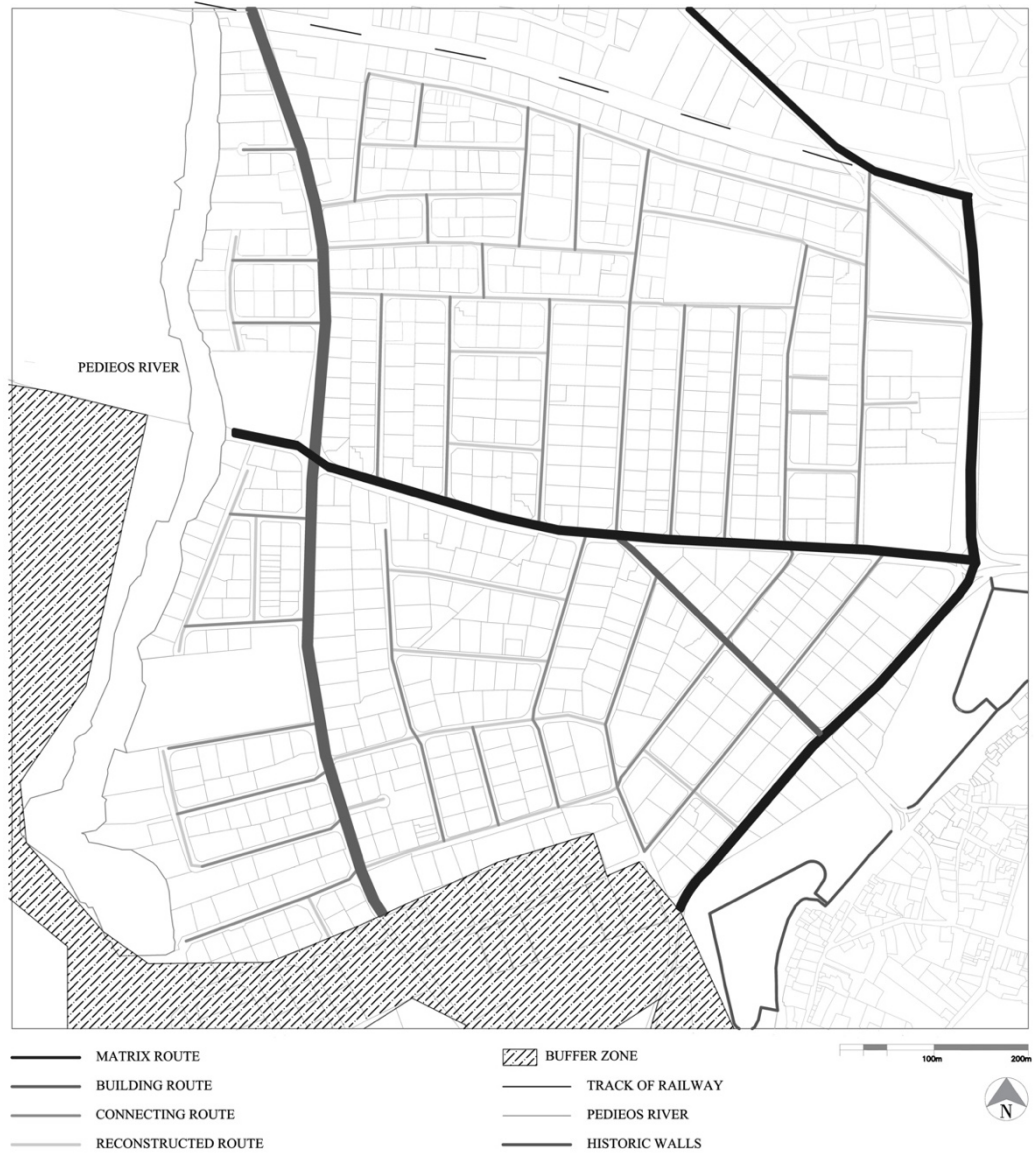


Figure 64:Köşklüçiftlik street pattern. (Author, 2022)

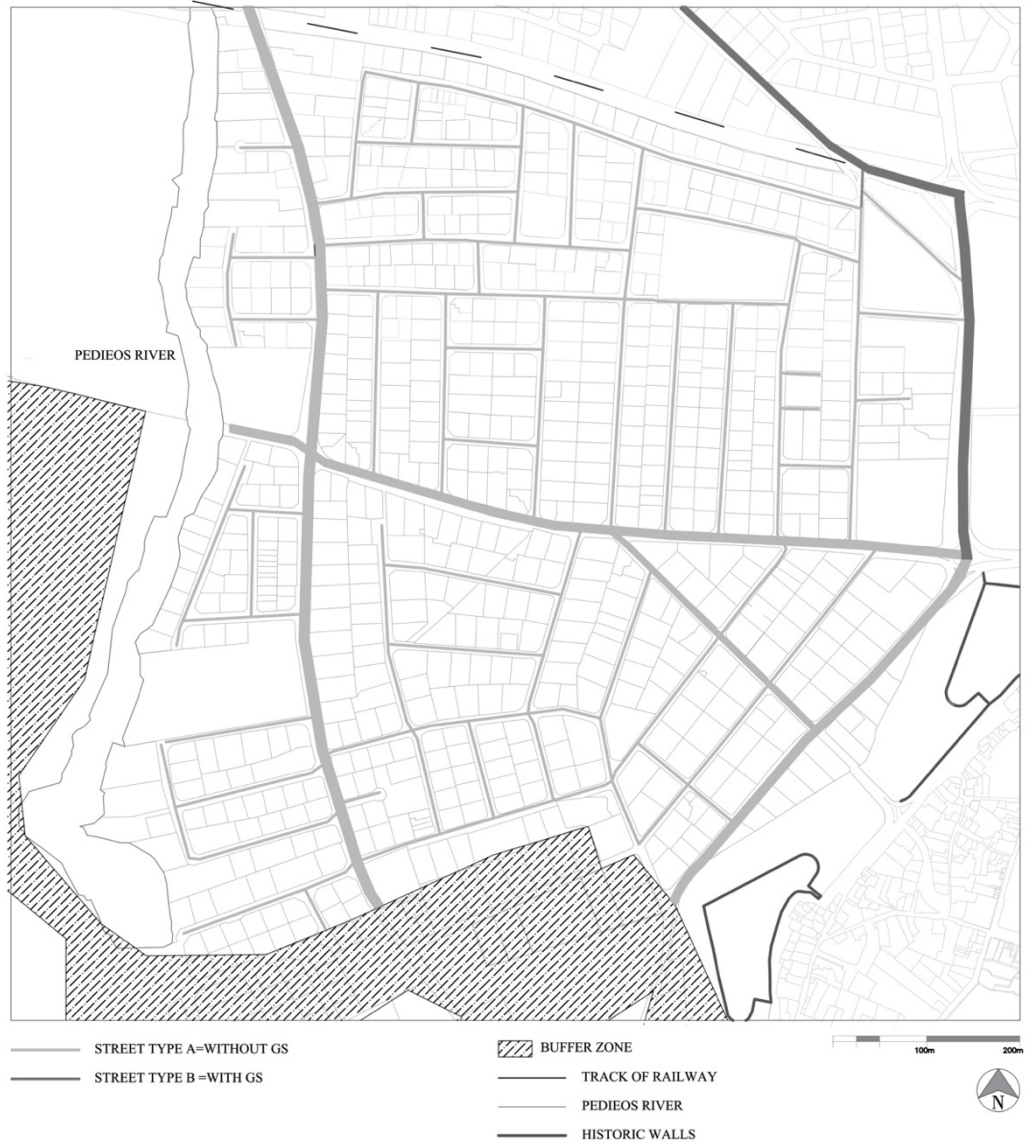


Figure 65: Köşklüçiftlik street pattern based on the typology of GS (green space).
(Author, 2022)



Figure 66: Type A Street without green space (GS) on green space street space.
(Author, 2022)

In the streets with green space, the street space was covered by a combination of green surfaces (soft) and hard surfaces and only one street in the whole neighbourhood was distinguished by the characteristics of this typology. In Type B Street, mainly trees are planted on one side of the street and one-fifth of street space is covered by green surfaces. (Figure 67)



Figure 67: Type B Street with GSs (green spaces) on the street space. (Author, 2022)

Block Typology of Köşklüçiftlik

Urban block characteristics are examined based on the components such as plot characteristics, pertinent strip character, street types, and block types. Investigating green space typology in the urban block would be possible by considering their positions, types of surfaces, plants, and spaces. The method provides a base for measuring the ratio and percentage of green space on the scale of the urban block. In addition, it aimed to distinguish the green spaces typologies based on the various purposes of the uses.

The block pattern of the neighbourhood varied due to the periods of development and various existent physical features such as the river and historic walls that limited the neighbourhood borders. The initial settlement developed on the neighbourhood's south side, and blocks were arranged in a grid way. The Köşklüçiftlik neighbourhood consists of fifty urban blocks of various sizes and shapes. Blocks in Köşklüçiftlik were classified into four shapes: triangular, trapezoid, rectangular and irregular. Some triangular blocks formed due to the intersection of Memduh Asaf street, which is directly connected to the old city, and Osmanpaşa street, which passes through the

middle of the neighbourhood. The trapezoid blocks are mostly located in the southeast of the neighbourhood near the historic walls and marked the transition between the medieval character of the old city and the grid system. The rectangular blocks are varied in size and number of consisting plots. And the irregular blocks bordered the edges of the neighbourhood from the west due to the proximity to Pedieos River. Although the block pattern of the neighbourhood is categorised into four, the layout of green space is varied due to the other factors related to the pattern of development, building typology and land use (function of the plot). The block analysis showed that the pattern of the green spaces in blocks is different on the southern rather than on the northern side of the neighbourhood. In the south part of the neighbourhood, green spaces are located on the corners of every single block, as also discussed in the street pattern part. The green spaces were developed on the blocks that were part of the original nucleus of the neighbourhood and were mostly associated with single- or two-storey buildings. Thus, two types of block patterns were identified based on the positions of the green spaces: blocks with green space positioned in the middle (mostly associated with single- and two-storey buildings), and blocks with green space on the edges and middle (Figures 68 and 69).

The building typology has been changed from single and two-storey to multi-story buildings by expansion and development of the neighbourhood toward the northwest. With such changes, the amount of vegetation decreased, and in the recently developed areas, the multi-storey buildings in the northwest blocks of the neighbourhood almost have slightly vegetation.

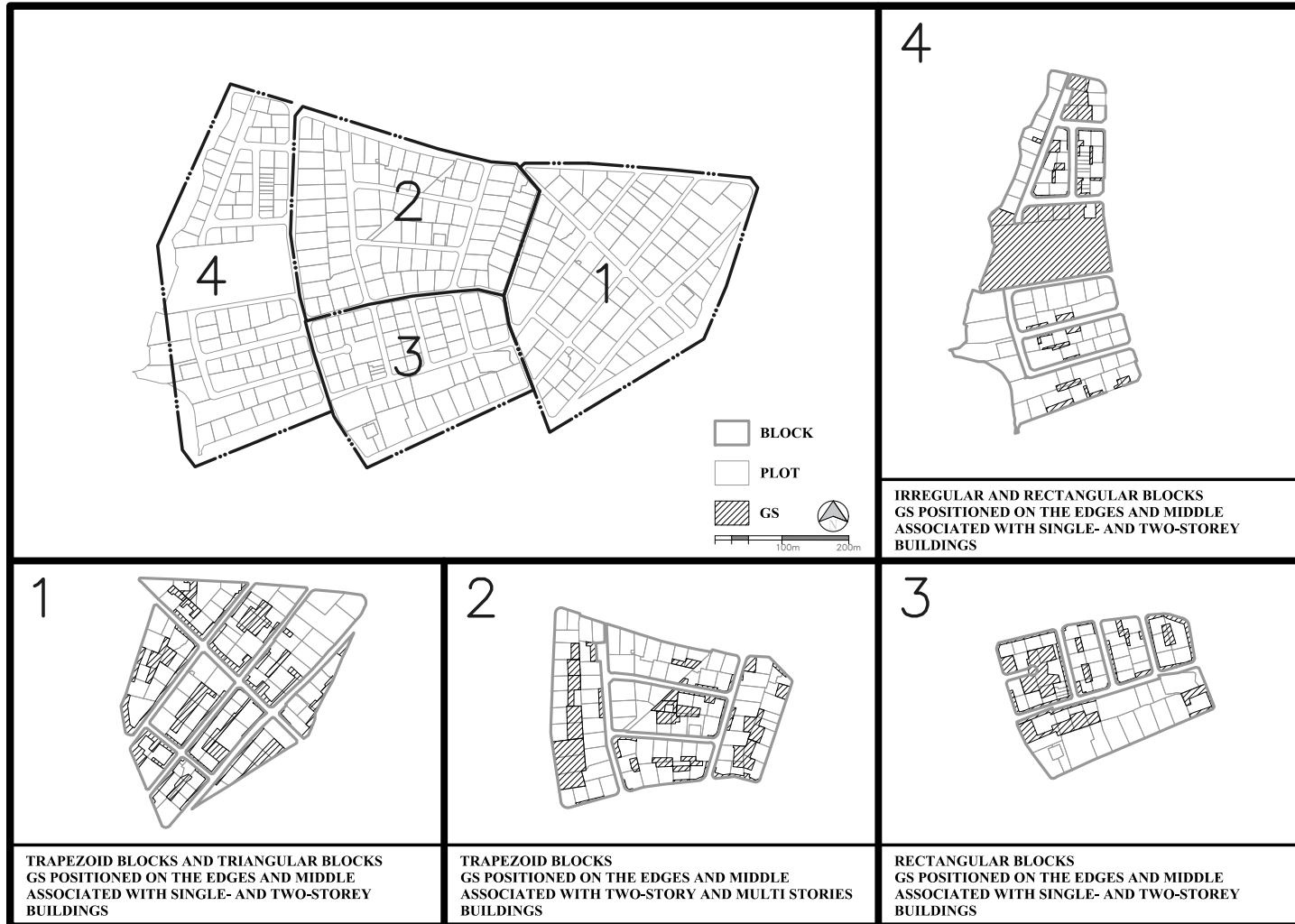


Figure 68: Köşklüçiftlik 's block typology and GSs (green spaces)-southern part

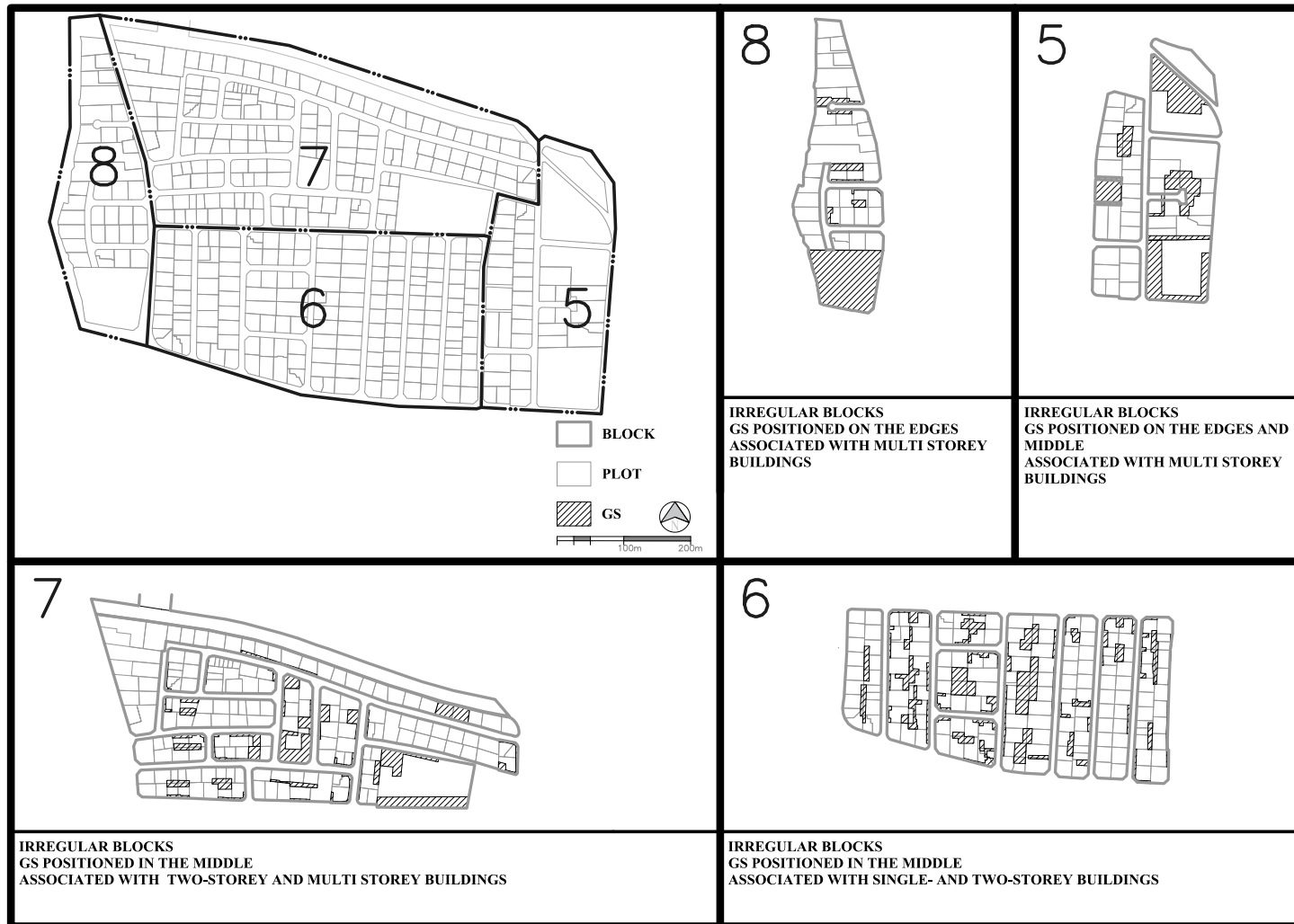


Figure 69: Köşklüçiftlik 's block typology and GSs (green spaces)-the northern part

Land Use and Land Ownership

On top of those layers of morphological investigation, the land uses analysis needed to be done to examine the various types of uses. Categorization of the function of green spaces done based on public, semi-private and private ownership of the land, and uses of green spaces such as parks, communal areas, greenways, public sports fields, cemeteries, semi-natural, semi-public greeneries associated with institutional, commercial, educational, and industrial zones; and private gardens associated to residential and offices.

The land use analysis shows that the Köşklüçiftlik neighbourhood is a mix used neighbourhood which is hosted residential, commercial, and public functions. The neighbourhood is limited from the north by Kumsal Park, a linear functional green space constructed on the track of the former railway. The row of the pain trees created linear access that remained from the British period. Another functional green space is Nilüfer park, located on the neighbourhood's east side. These two public spaces are the only communal green spaces in the neighbourhood open to the public.

On the neighbourhood's west side, Mehmet Akif Street is surrounded by various shops, businesses, and commercial functions. However, this street is covered only by hard surfaces and green spaces are excluded totally from the streetscape. On the east side, Bedrettin Demirel street contains different institutional and public functions. Most of the green spaces are associated with those institutional and public buildings. On the south side of the neighbourhood, some of the single- and two-storey houses from the British period were converted to business functions; therefore, those gardens and green spaces are part of the semi-private spaces. And gardens of the residential buildings are the private green spaces in the neighbourhood (Figure 70).

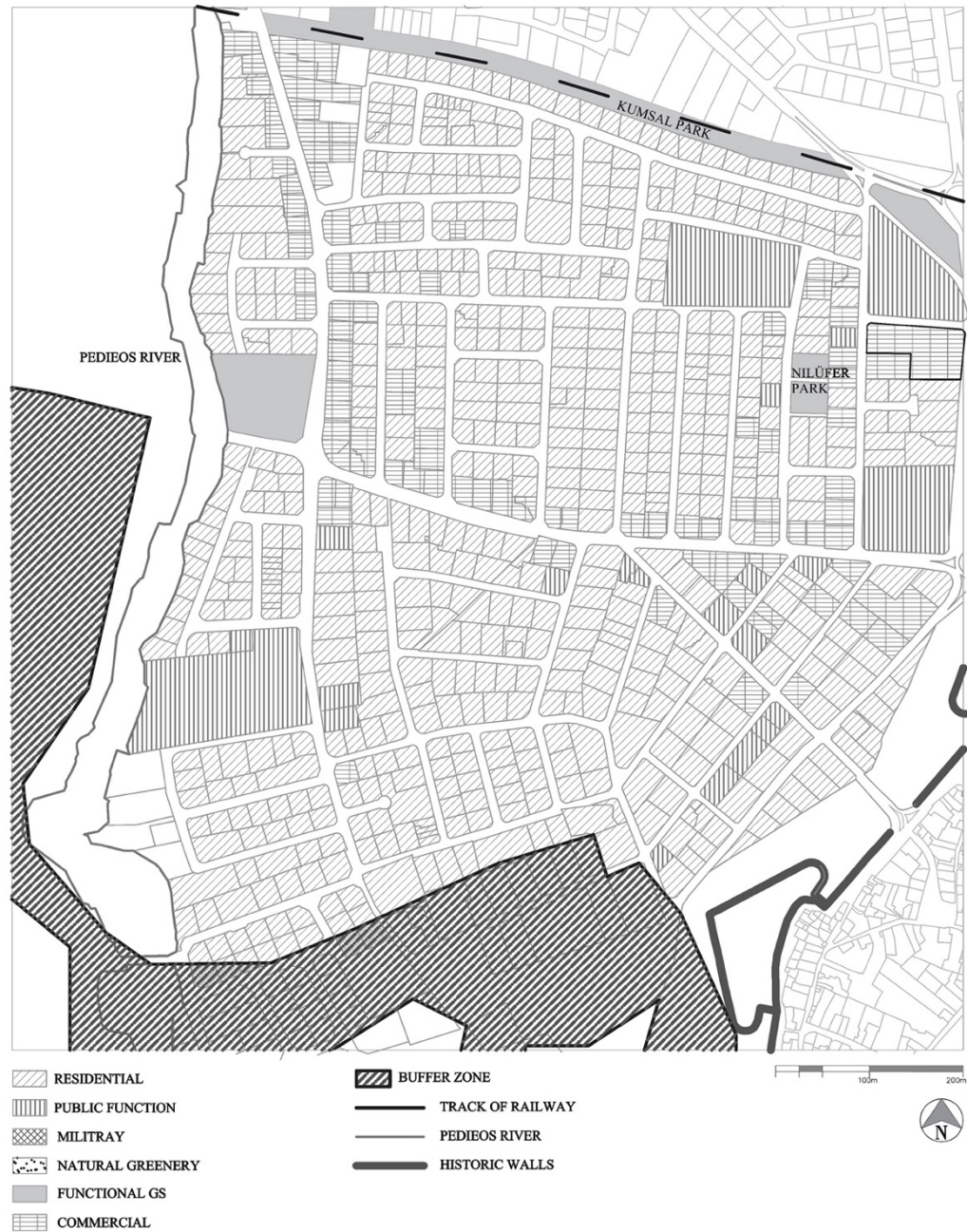


Figure 70: GS's land use and functional uses (green space). (Author, 2022)

Analysis of the neighbourhood has shown the pattern of formation of blocks, streets, plots, and particularly green space typologies in the Köşklüçiftlik neighbourhood. The general layout of the neighbourhood indicates that the existing green elements, such as trees, especially pine, palm, and cypress trees, originated at the same time as the first nucleus of the neighbourhood. Those green spaces are kept in their plots, although

the typology of the buildings has been changed on plots eventually. The recent neighbourhood developments in terms of the block, street and plot patterns have given less consideration to green spaces and, in most cases, eliminated them. However, the limited public green spaces and functions in the neighbourhood is noticeable in comparison to the size and dispersal of the neighbourhood.

5.5.2.2 Çağlayan Neighbourhood

The selected neighbourhood is in the East part of Nicosia and is limited between the city wall from one side and the Buffer Zone from the other side. Çağlayan neighbourhood used to be a rich environment after the city's development outside the historic walls. Mainly the high social class started to build large houses and villas with yellow stone façades outside of the city walls in this region. Bypassing through the neighbourhood, the particular architectural style can be recognized by its specific features, which are influenced by the British architectural style and later on by the modern style. Plan and façade analysis demonstrated that mainly one-story, two stories and apartment blocks defined typologies of buildings in the neighbourhood. Two stories of detached houses can be distinguished by the material and architectural style constructed during the British period between 1930 and 1960. Today the neighbourhood kept the style more or less, however the overall condition of those stylish buildings and the whole neighbourhood is in decline. (Figure 71)

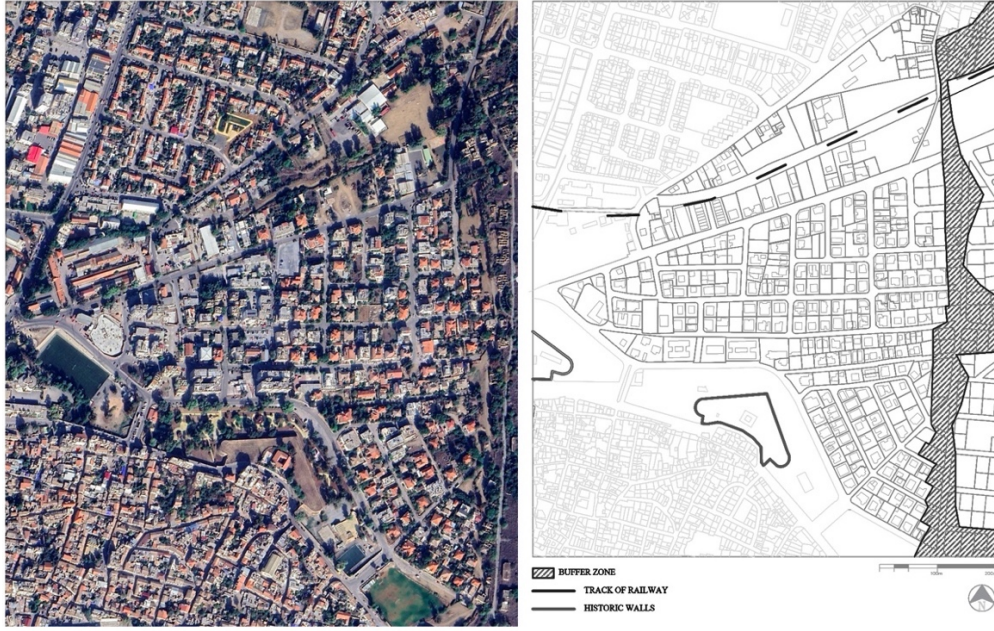


Figure 71: Çağlayan neighbourhood. (Author, 2022)

Plots Typology of Çağlayan

Generally, the neighbourhood layout shows that the buildings sat three metres back from street lines and plot edges. Figure 72 shows the building pattern in the Çağlayan neighbourhood and the location of the first nucleus of the neighbourhood. However, the organization of green spaces was varied based on the plot and building typologies. The plots within the Çağlayan neighbourhood have characteristic shapes and sizes. There are few trapezoidal plots with rear green space, and the most common plot shape is a rectangle; large rectangular plots were created by merging smaller plots for constructing apartment blocks. The small rectangular plot mostly has a ratio of plot-to-green space between 2:1 and 3:1.

In rectangular plots with one- or two-storey buildings, the buildings were located in the middle of the plot, and the space around them was used as a garden. In these cases, green space was arranged around the building in six common types. Type A encompasses plots with a U-shaped green space arrangement on the plot head. The L-

shaped arrangements of green spaces on plot tails and heads are categorized as types B and C, respectively. Types D and E have linear green space on plot tails and heads. Type F has linear green space both on the plot tail and head (Figures 73 and 74).

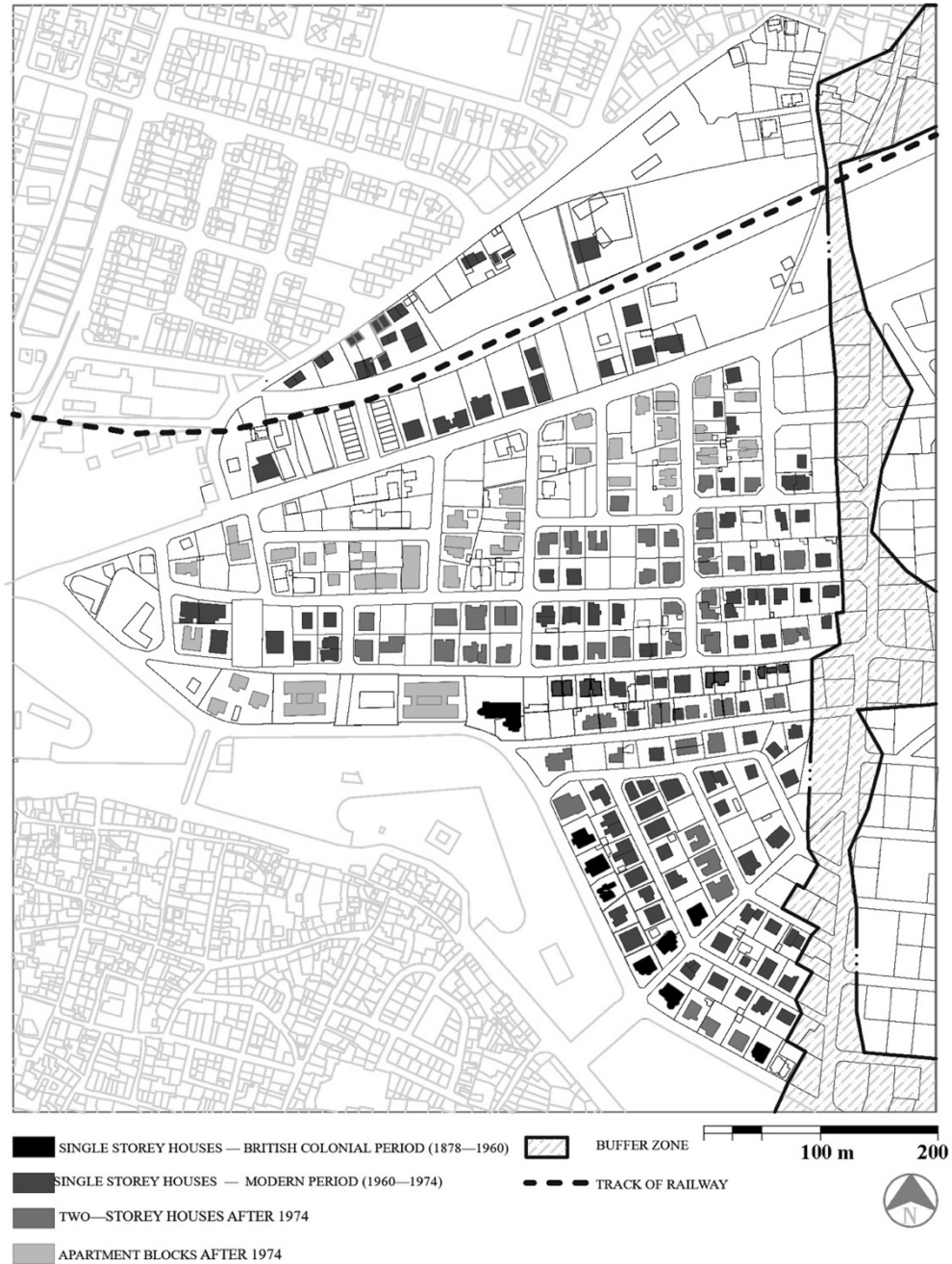


Figure 72: Çağlayan neighbourhood building and plot pattern. (Author, 2022)

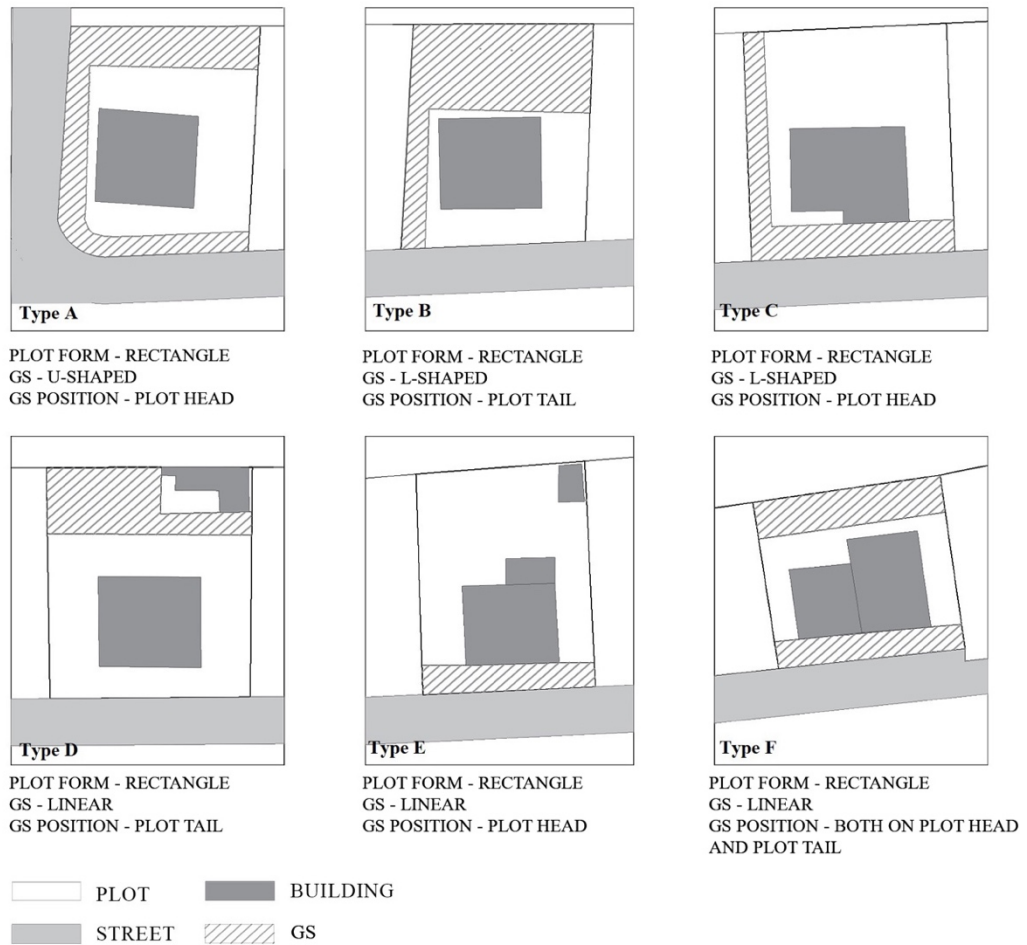


Figure 73: Typology of GSs (green spaces) on rectangular plots. (Author, 2022)

In addition to the form of green space, the percentage and density of vegetation were examined (Figure 75). In these plots, 25 to 30 per cent of the plot area was covered by green elements. Citrus, olive, palm, pine and eucalyptus trees, cacti, tall shrubs, and hedges are typically planted to define property boundaries and provide privacy.

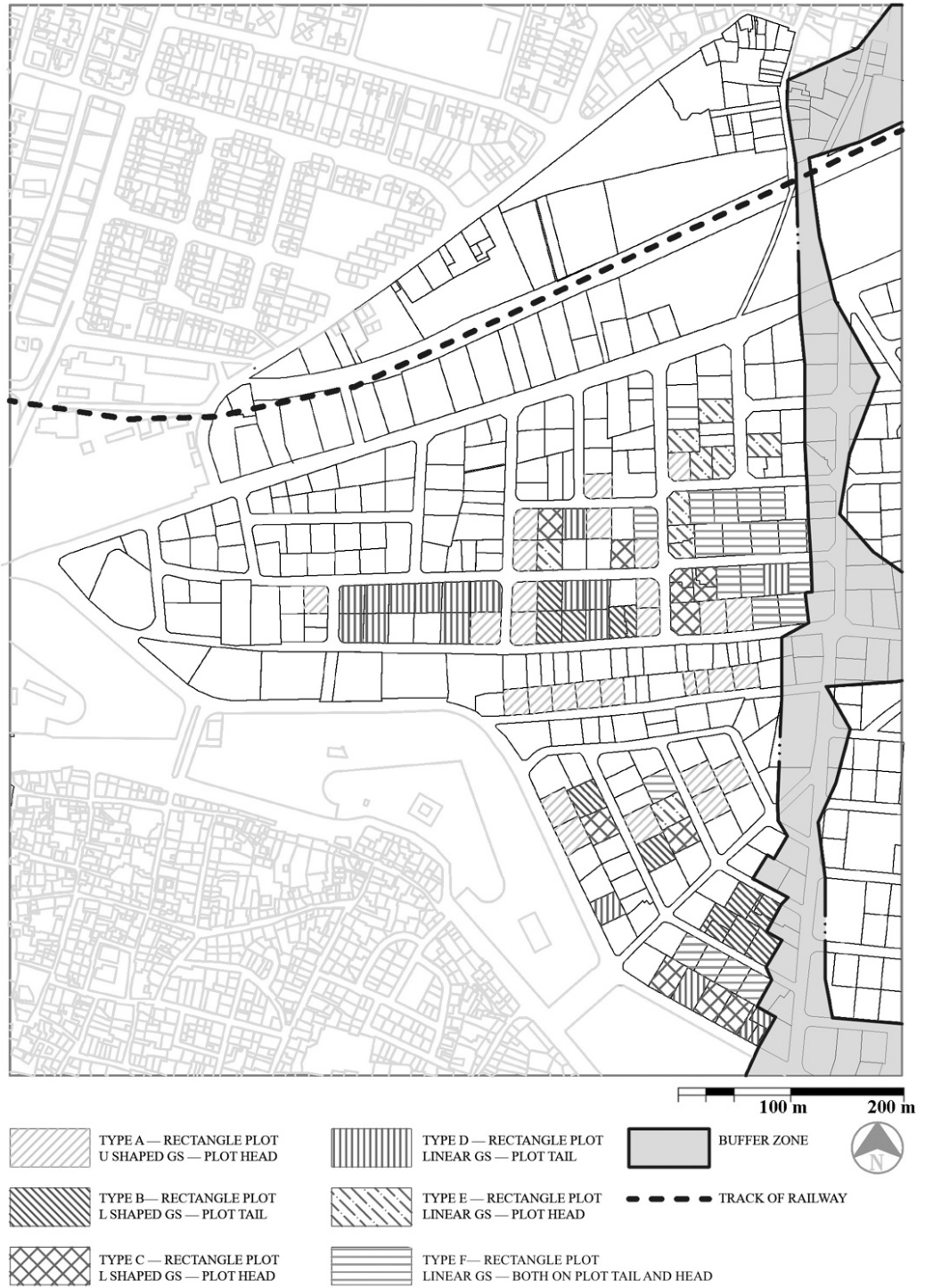


Figure 74: Locations of various typologies of GS(green space). (Author, 2022)

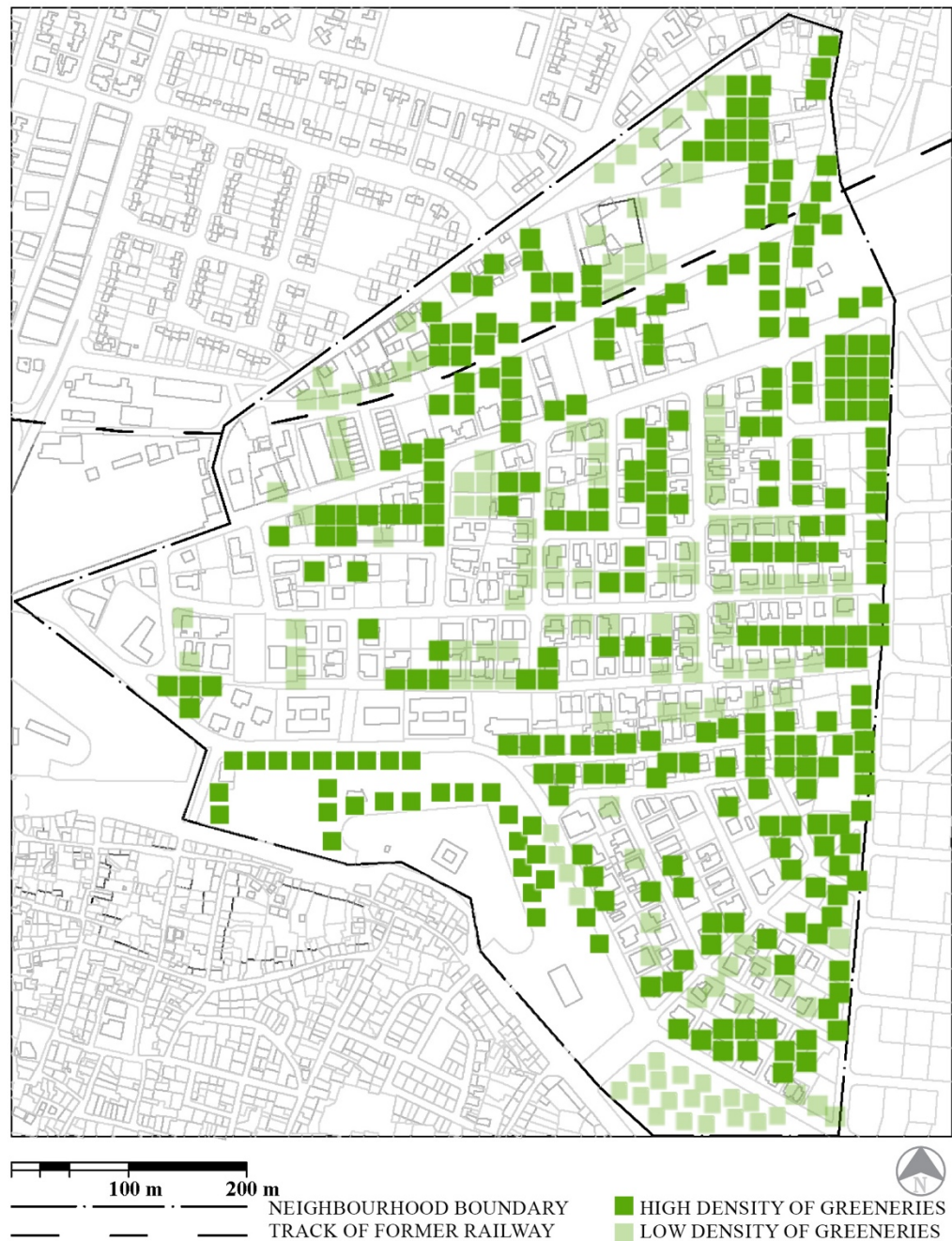


Figure 75: Private land ownership and density of vegetation. (Author, 2022)

In the case of large plots containing apartment blocks, organized green spaces were rare. Hence the pattern of the green spaces was altered through a change in the pattern of building typology. There is an increase in the footprint of taller blocks and a decrease in green space around taller blocks. As the number of floors increased, the amount of green space decreased.

Street Typology of Çağlayan

As mentioned before, the street analysis included the various street elements and spaces. However, the typology of the streets has been classified based on the morphological characteristic of various streets within the neighbourhood. In the case of Çağlayan based on Caniggia's definition (2001), the street can be defined as a matrix route (main road), building route and connecting route and reconstructed route. (Figure 76) However, street types can be differentiated by considering hard and soft surfaces and the organization of green space along the street. In Çağlayan, the limited street elements and planned street structure caused a problem in completing the detailed analysis of street typologies that could not be considered as contributing factors in defining the street character. (Figure 77)

Consequently, the existing conditions led to the definition of two types of streets based on the green space organization: streets without (type A) and those with GS (type B). In the streets with GS (type B), the street space was covered by a combination of green surfaces (soft) and hard surfaces (Figure 78). However, Type A, green spaces are excluded from the street and, therefore, the street space is covered exclusively by hard surfaces (Figure 79).

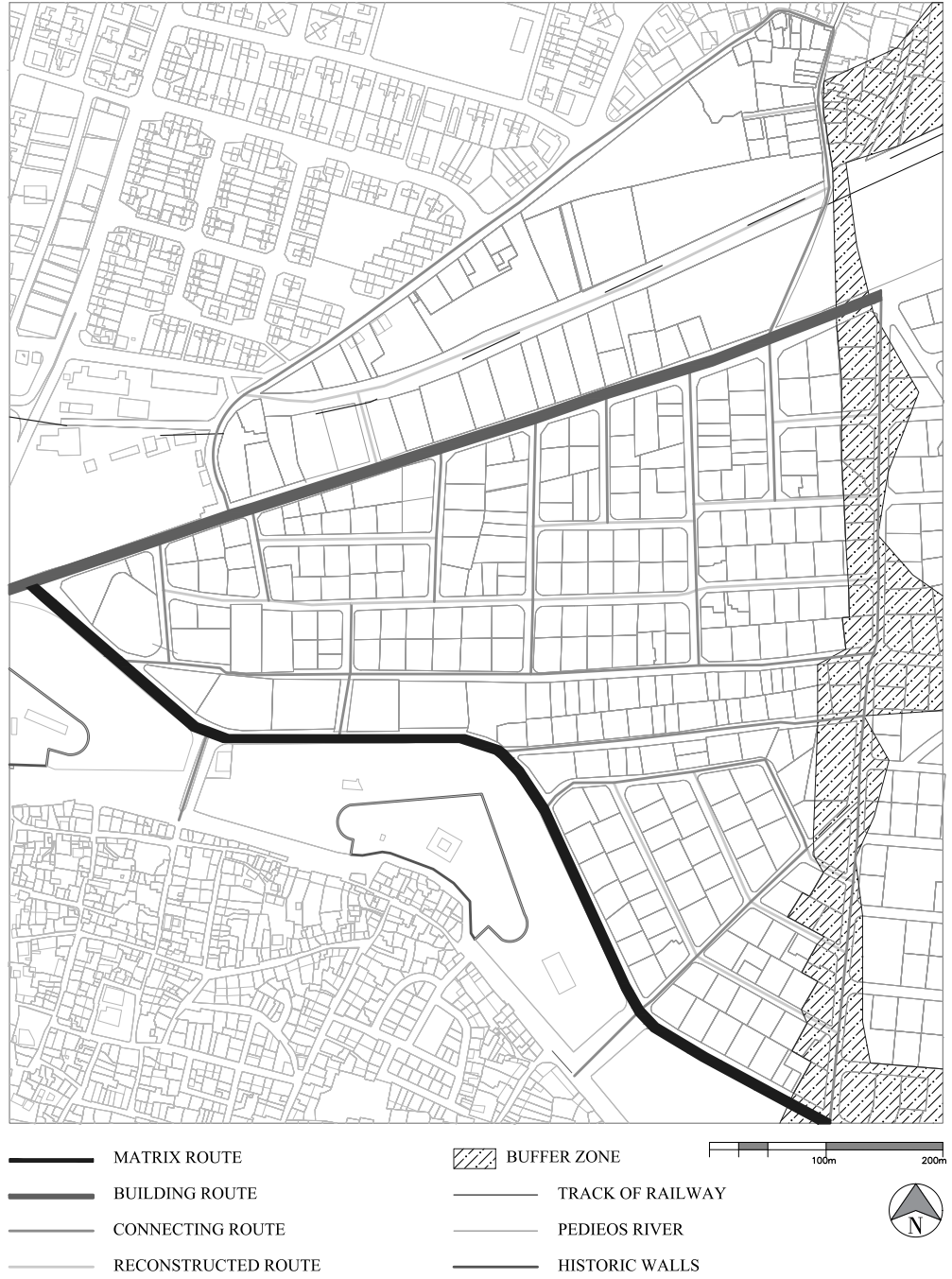


Figure 76: Çağlayan street pattern. (Author,2022)



Figure 77: Çağlayan street pattern. based on the typology of GS (green space).
(Author, 2022)



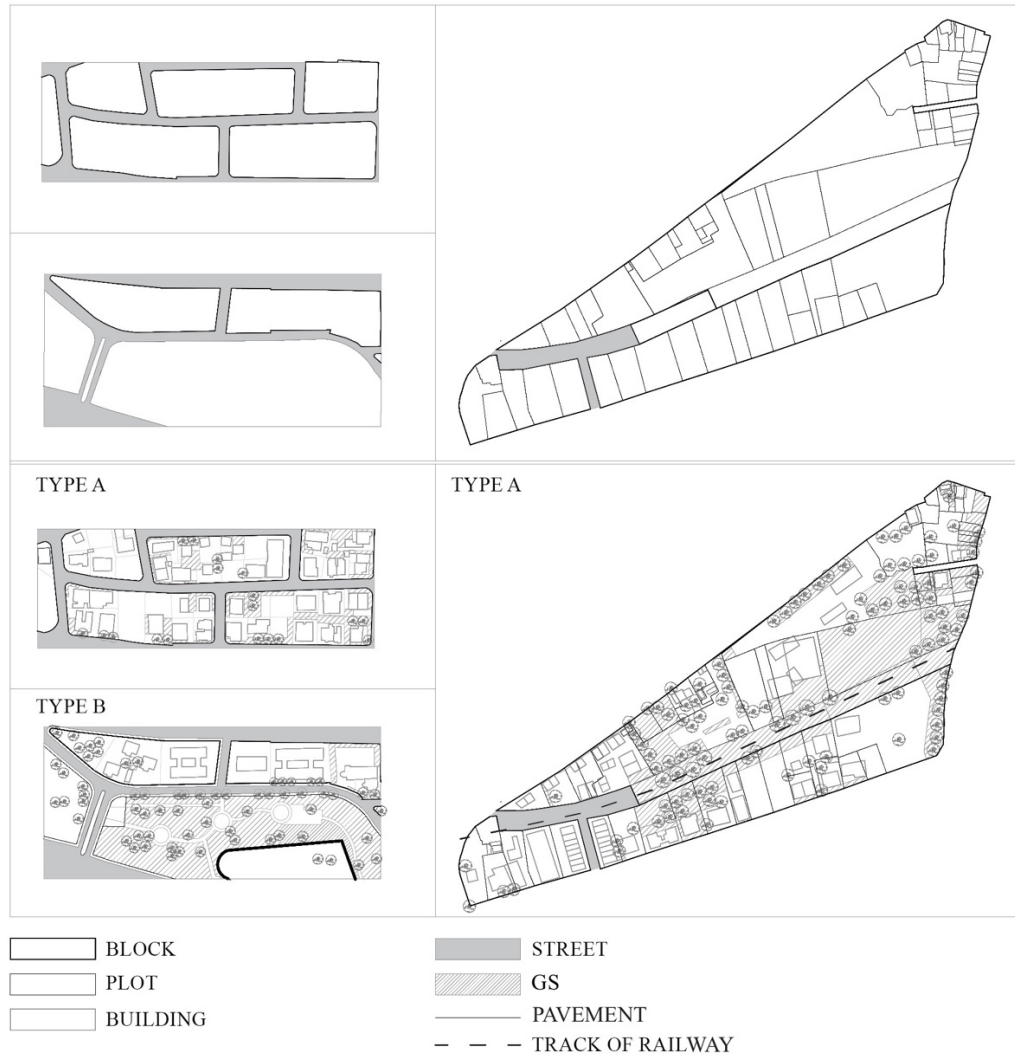
Figure 78: Type A Street without GS (green space). (Author, 2022)



Figure 79: Type B Street with GS (green space). (Author, 2022)

The matrix routes are characterized by organized street space in terms of differentiation of street-level, pavement, and greeneries. Mainly pine trees that have been planted in the British period are the common types of plants on one side of the street. This type of plantation refers to a certain period defined as a morphological plantation in the current study. In that typology, only one-fourth of street space is covered by green surfaces. However, in other street typologies, green spaces are excluded from street space, and 100% of street space is covered by hard surfaces. The street block also completes the street typology based on the variation of open spaces and the location of the building in the plot series. As mentioned in the plot analysis, buildings set back 3 meters and green spaces located between street lines and buildings created the three-dimensional structure in the streetscape. Although green space does not exist in street space, rich green spaces in plot series shaped continuous green façades. In some cases,

even the density of greenery covered all the physical features and elements of the plot, building and street line. (Figure 80)



Type A: streets without GS, **Type B:** streets with GS

Figure 80: Street typology and GSs (green space). (Author, 2022)

Block Typology of Çağlayan

The block pattern of the neighbourhood varied due to the proximity to the historical walls and moat, which fundamentally affected the pattern of adjacent streets and urban blocks. The existing block pattern strongly kept the identity and character of the initial one. Generally, Çağlayan consists of twenty-seven urban blocks of various sizes and

shapes. Blocks in Çağlayan were classified into three shapes: trapezoid, rectangular and irregular. The irregular blocks bordered the edges of the neighbourhood and marked the transition between the medieval character of the old city and the grid system of the later expansion. The small rectangular blocks comprised 12 to 14 plots. However, the trapezoid blocks varied greatly regarding the number of plots (five to six plots). Although the block pattern of the neighbourhood is categorized into three, the layout of green space is varied due to the other factors related to the pattern of development, building typology and land use (function of the plot). As discussed in the street and plot pattern, the number of green spaces on plots is decreasing by increasing the number of floors and building size. The block analysis showed that the green spaces were developed on the blocks that were part of the original nucleus of the neighbourhood and were mostly associated with single-storey buildings. Thus, three types of block patterns were identified based on the positions of the green spaces: blocks with green space positioned in the middle (mostly associated with one-storey buildings), blocks with green space on the edges (associated with two-storey buildings), and blocks without any green space (apartment blocks or industrial functions) (Figure 81 and 82)

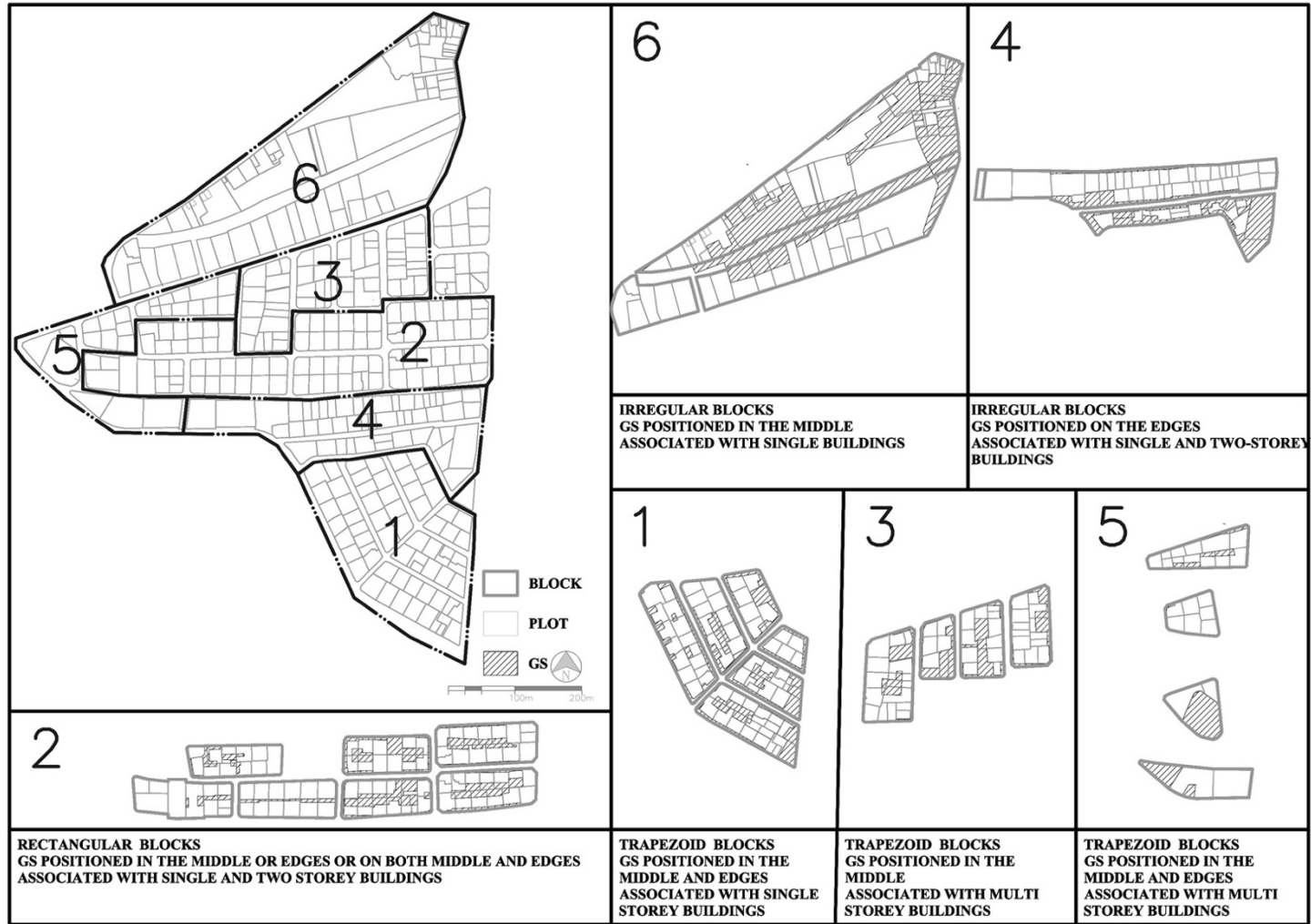


Figure 81: Çağlayan 's block typology and GSs (green spaces)-northern part. (Author, 2022)

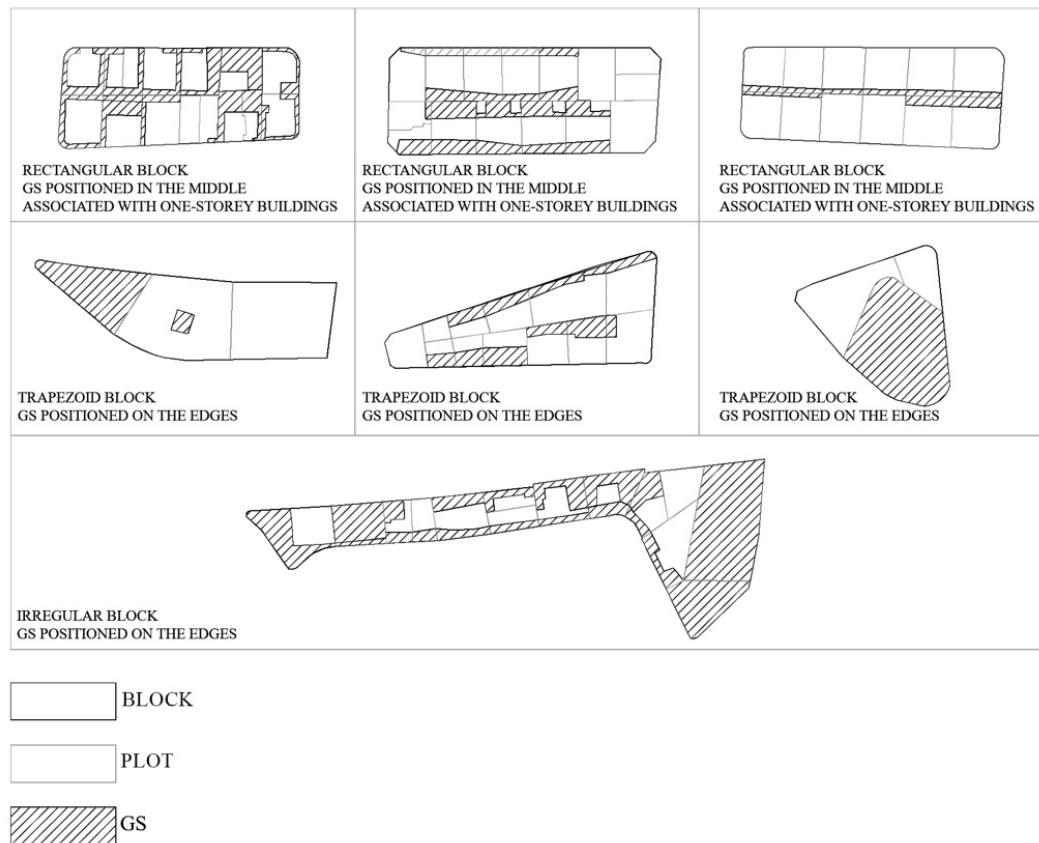


Figure 82: Block typology and GSs(green spaces). (Author, 2022)

Although social, cultural, and economic factors changed the image of the neighbourhood other factors, such as seasonal changes and mainly political factors, affect the physical characteristics of green spaces and affect the whole image of the neighbourhood correspondingly. The neighbourhood had a rich architectural style, an urban planning system and high social status. However, due to the limited commercial and business activities and the proximity to the Military and the Buffer zone, most of the valuable buildings are abounded and forbidden to be tough or renovated. Therefore, green spaces naturally grew around them and affected the characteristics and identity of the neighbourhood.

Land Use and Land Ownership

Three green spaces, important in terms of their size and physical characteristics, were located at the edges of the Çağlayan neighbourhood and defined its boundaries. These comprised Çağlayan Park, which includes a playground, sports clubs and fields located in the historical moat next to the medieval town; a natural green zone formed as a result of political conflict creating the buffer zone between the two community groups; and natural greenery located on the track of the railway that connected Nicosia to the port cities, passing along the north part of the neighbourhood: this is currently used for public activities, sports facilities, and sports clubs. (Figure 83).

The pattern of formation of blocks, streets, plot distributions and particularly green spaces typologies in the Çağlayan neighbourhood allows plan units to be identified by considering similarities and periods of origin. The general layout of the neighbourhood shows that green spaces existing in blocks, streets, and plots originated at the same time as the first nucleus of the neighbourhood. The recent neighbourhood developments in terms of the block, street and plot patterns have given less consideration to green spaces. On the other hand, due to the proximity to historical walls and by conversion the moat to Public Park and sports facilities in 2008, the neighbourhood has been supported by rich green spaces. However, accessibility and permeability to those spaces also need to be discussed.

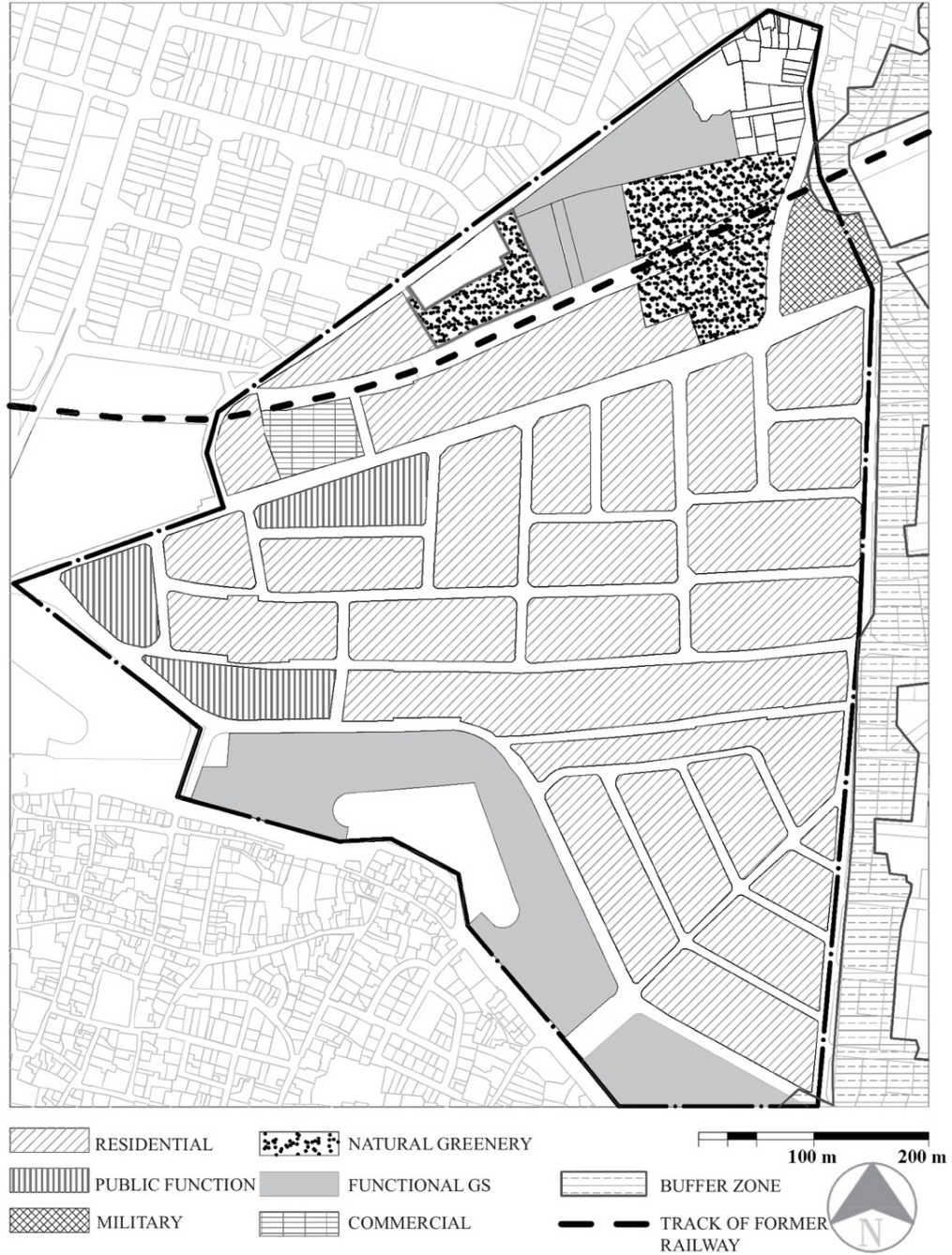


Figure 83: Land use and functional uses of GSs (green space). (Author, 2022)

5.5.2.3 Yenışehir District

Yenışehir district is the area which developed outside of Nicosia's old town toward the north. The neighbourhood is limited from the west side by Köşklüçiftlik and Kızılay neighbourhoods, and the east is bounded by the Çağlayan neighbourhood. The Yenışehir district developed in different periods; the area consists of various urban

planning, architectural style, material, and construction technique. Therefore, the district involves various morphological periods, which will be a detailed exploration in the following headings and plan units with different morphological characteristics.

(Figure 84)

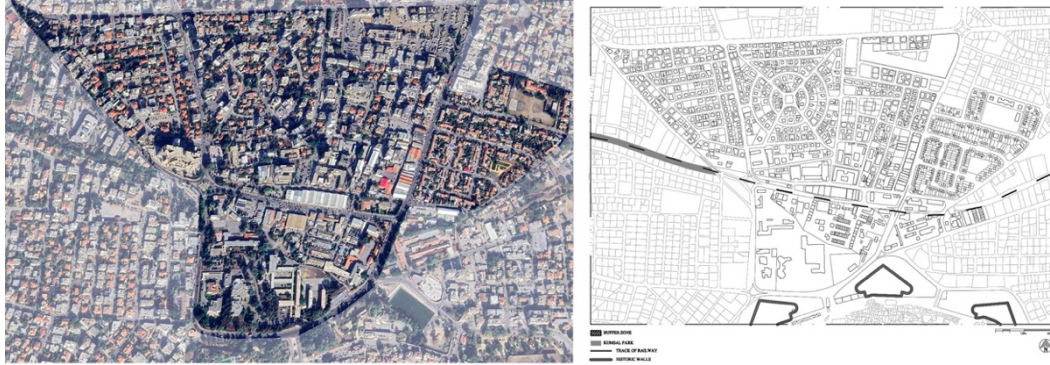


Figure 84:Yenisehir neighbourhood. (Author, 2022)

In the late British Colonial period (1925- 1960), new settlements started to develop in Nicosia due to the migration of people from rural to urban areas. (Atun & Pulhan, 2009) In this period, modernization and westernization processes influenced the development and urban pattern. The first stage and the nucleus of the Yenisehir neighbourhood is a distinguishable example of such planning and designing attempts of the period. The initial settlement of the Yenisehir neighbourhood was developed between 1930 and 1945. It is a typical old suburban quarter with a radial pattern and a small square in the centre as a focusing point. This specific part of the neighbourhood presents a unique case throughout the whole island as a reflection of the garden city image. The predominant typology of the building was one storey detached house with a pitched roof. However, gradually the two-storey and multi-storey buildings were replaced by those initial buildings and nowadays, high-rise buildings are constructed in the neighbourhood. (Figure 85, plan unit 2)

Later, the demand for the housing needs of the increasing population was resolved by establishing social housing, which was developed and implemented by the Public Works Department, such as Standard Houses. The Standard Houses were built in 1946 on the east side of the district. The project was consisting of semi-detached houses with gardens, pitched roofs, and yellow stone as high-quality materials designed for the working class. (Figure 85, plan unit 4)

The west side of the neighbourhood has been developed in the modern period with different morphological characteristics due to the various planning strategies, the architectural style and construction technology of the period. This part of the neighbourhood is distinguishable due to its triangular form. In this part of the neighbourhood, the building typology consists of mostly multi-storey buildings that have been built after 1974. ((Figure 85, plan unit 3)

In the Yenişehir district, plan analysis shows various types of buildings that have been developed in this district during the British period from 1930 till now. The Yenisehir district is the area that included the most important institutional buildings of Northern Nicosia such as the Nicosia Bus Terminal, Nicosia Municipal Theatre, Nicosia Police Headquarters, Northern Cyprus State Theatre, and the old railway station of Nicosia. (Figure 85, plan unit 1)

Various types of commercial, educational, quasi public institutions and administrative buildings shaped the district from the south. Most residential buildings were built and extended to the edges of the Kizilay district throughout the north direction. As discussed earlier, the district development patterns are varied in the area. Therefore, the district has been analysed based on five plan units. This study evaluated the

morphological characteristics of each plan unit as the structure and period of their origins are varied; consequently, the structure of the green space might be altered. (Figure 85)

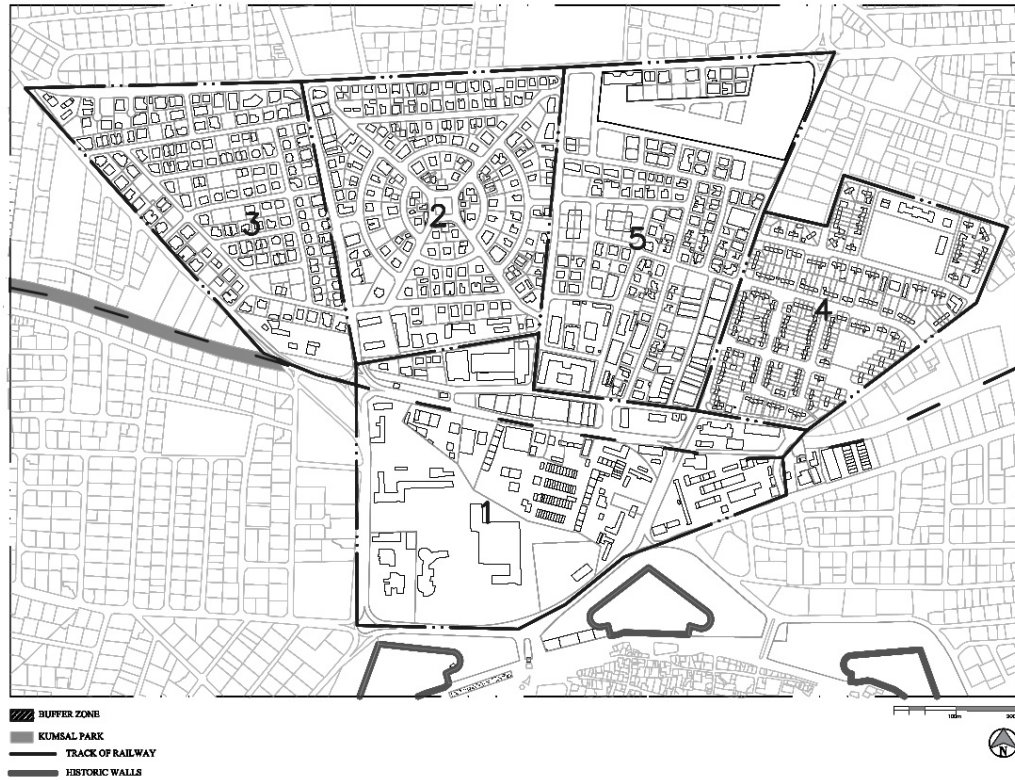


Figure 85: Yenışehir plan units. (Author, 2022)

Plots Typology of Yenışehir

The neighbourhood layout displays that the Yenışehir's buildings are set back from the street's edges by three to five meters. The building pattern of the district is shown in Figure 86, which demonstrates that buildings in this district were constructed in different periods and typologies. Common typologies are one-storey detached, two-storey semi-detached, two-storey detached, Multi-storey, and high-rise buildings.

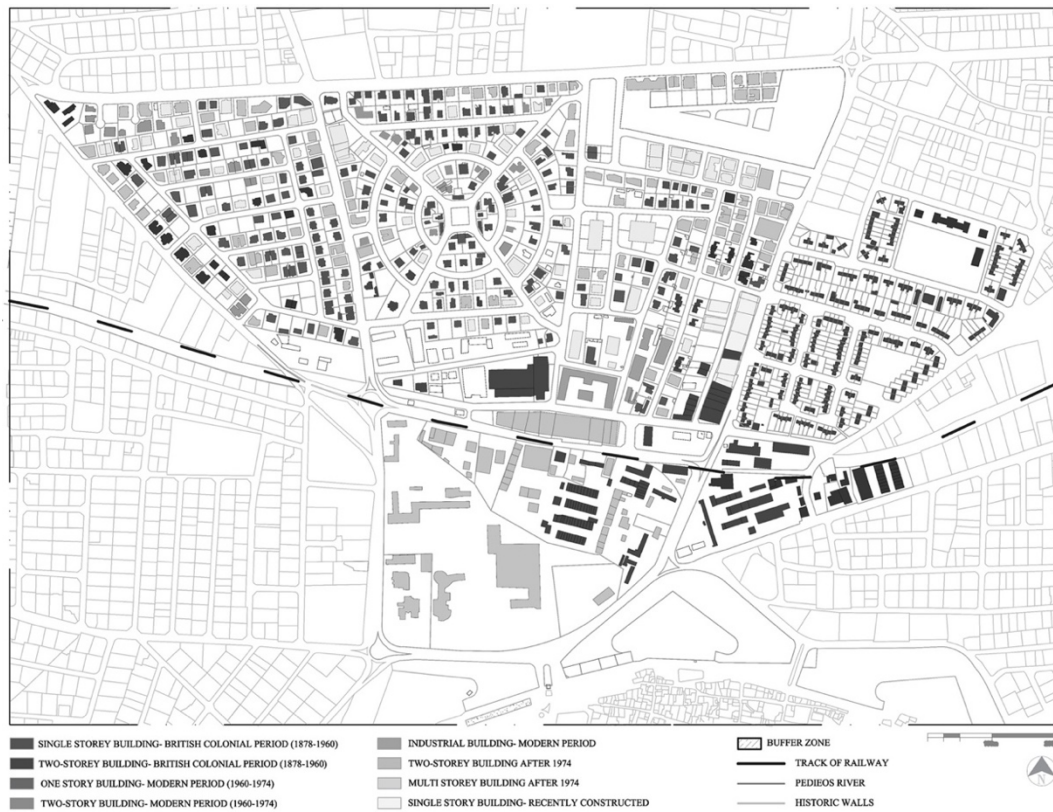


Figure 86: Yenisehir building pattern. (Author, 2022)

The first Plan Unit of Yenisehir hosted the institutional, industrial, and public functions located in the middle fringe belt of Nicosia. The analysis shows that the plots have unique and distinctive shapes and sizes. In terms of size, the plots are bigger than other parts of the districts due to their functional needs. Mostly, the smaller plots are rectangular with various ratios. However, the bigger size plots are irregular in shape. (Figure 87) The organization of green spaces was varied on these plots and did not follow a certain pattern based on the building location or typology. However, the plots belonging to the schools and educational functions have more green spaces than those belonging to institutional and industrial functions.

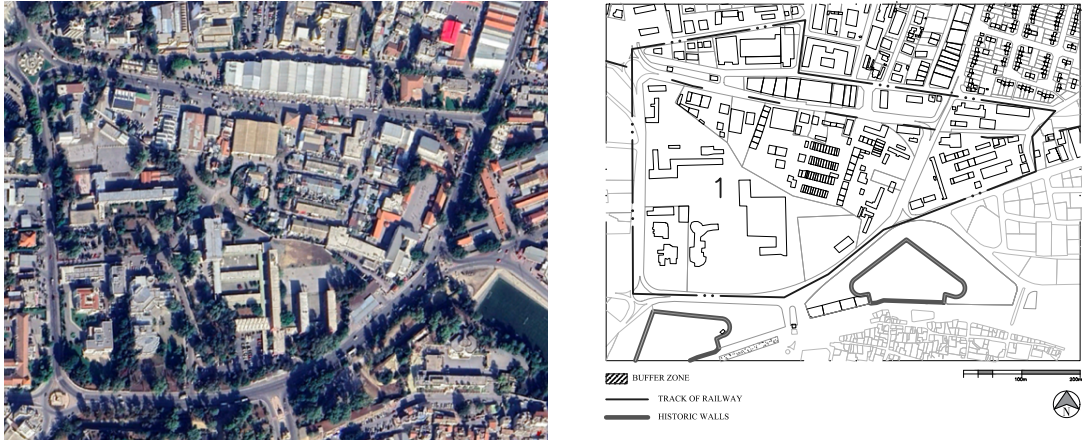


Figure 87: Yenisehir plan unit 1. (Author, 2022)

The second plan unit of the district originated during the British period in the form of the garden city. The radial organization creates a unique character for the neighbourhood. The plots within the neighbourhood have characteristic shapes and sizes. Common plot shapes are square, rectangular, and trapezoidal. There are trapezoidal plots with U-shaped, L-shaped, and linear green spaces positioned on the plot tail or plot head. (Figure 88).

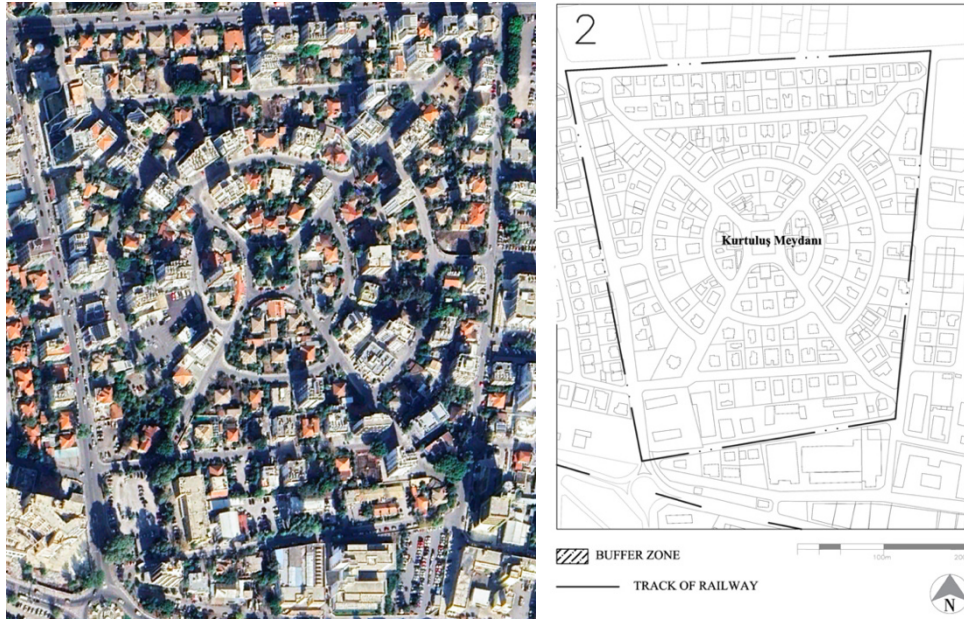


Figure 88: Yenisehir plan unit 2

Most corner plots belong to this category; thus, green spaces are typically positioned on the plot head in a U-shaped form. The one-storey buildings with green spaces are mostly located on square plots, and buildings being surrounded by vegetation. In this plot typology, green spaces located only on the plot tail and vegetation created the outdoor spaces in the forms of L-shaped or U-shaped. (Type I and J) However, recently some of the one-storey buildings on square plots have been replaced by multi-storey buildings and green spaces are excluded from the plots. Rectangular plots accommodated two-storey and multi-storey buildings, and green spaces were organized around the buildings in four different ways, as illustrated in Figure 90. (Figures 89 and 90)

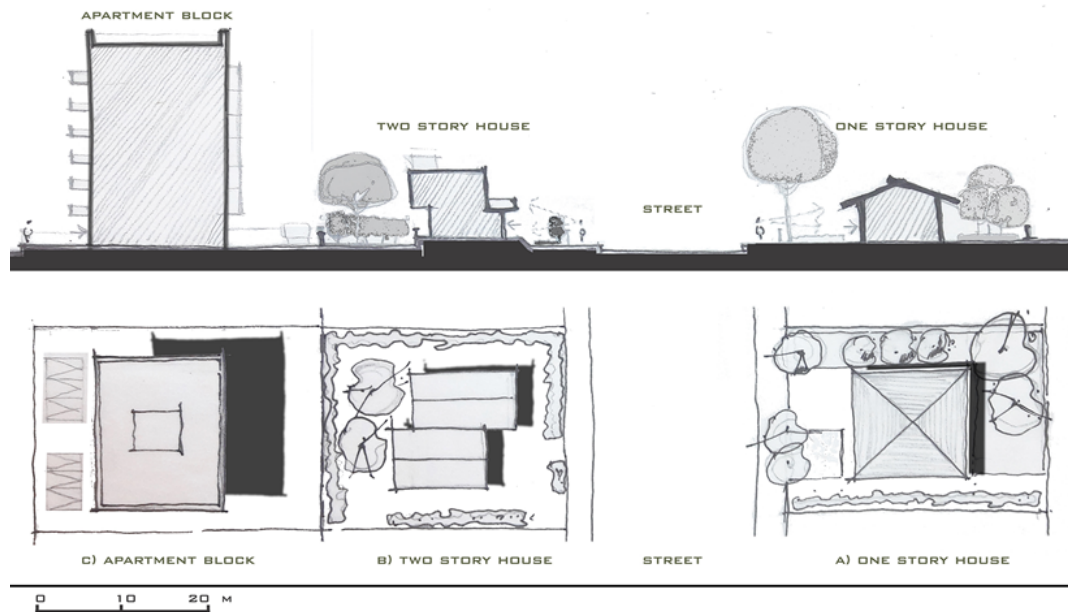


Figure 89: Yenisehir plan unit 2 neighbourhood silhouettes. (Author, 2022)

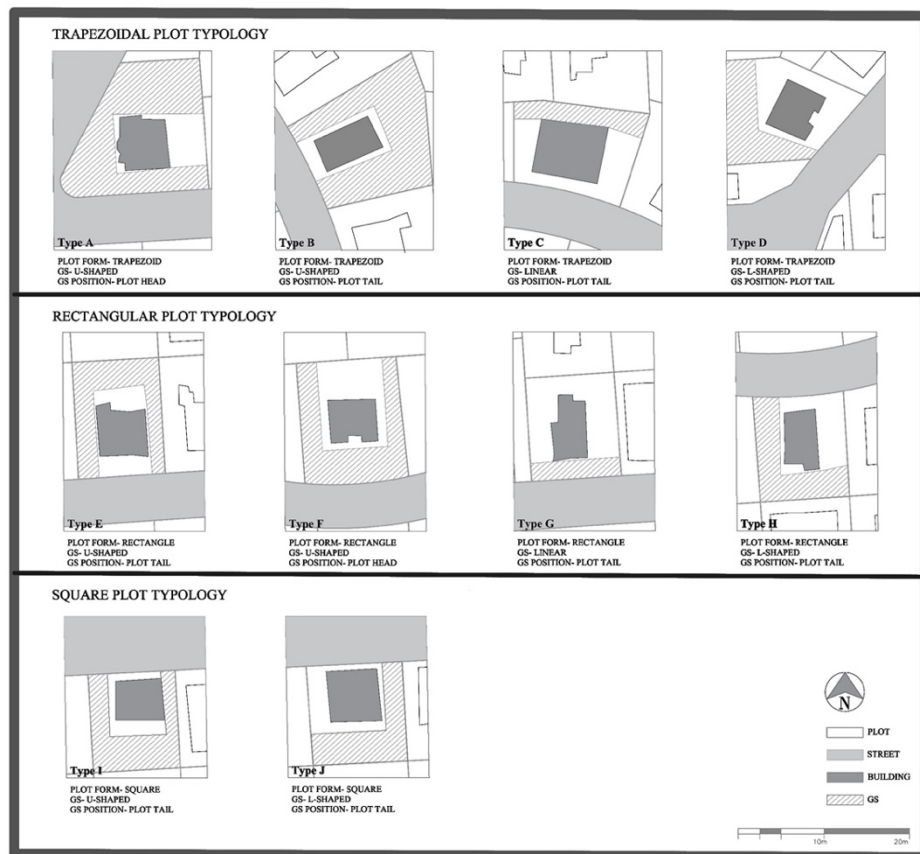


Figure 90: Yenisehir plan unit 2 plot typologies. (Author, 2022)

In plan unit three (Figure 91), plot analysis demonstrated that square plots mostly have linear green space both on the plot head and plot tail. Rectangular plots also follow the same organisational pattern as green spaces. And for corner plots, the plot shapes are varied; however, the arrangement of green spaces is the same as U-shaped on the plot head. (Figure 92)



Figure 91: Yenisehir plan unit 3

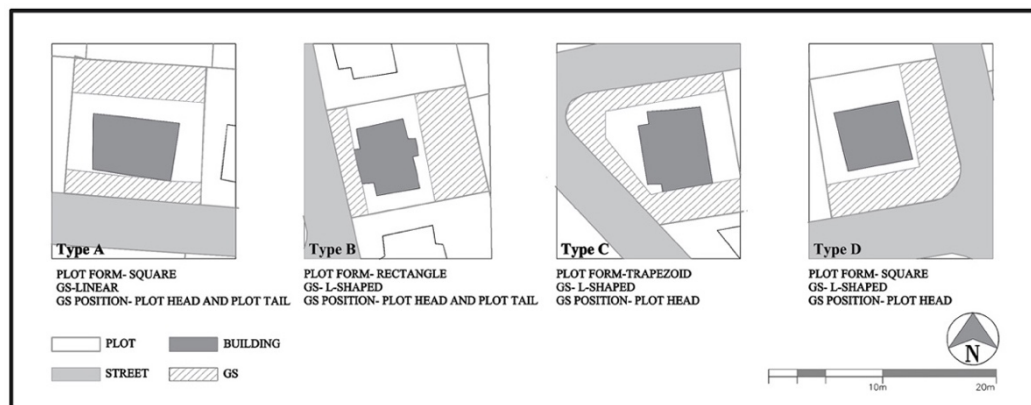


Figure 92:Yenisehir plan unit 3 plot typologies. (Author, 2022)

As discussed earlier, the standard housing project was built during the British period. The buildings are organized in two-storey semi-detached row forms that set back seven to ten meters from the street's edges. (Figure 93) Therefore, the arrangements of the

buildings provided a wide area for plantation and the creation of outdoor spaces, specifically on the plot head.

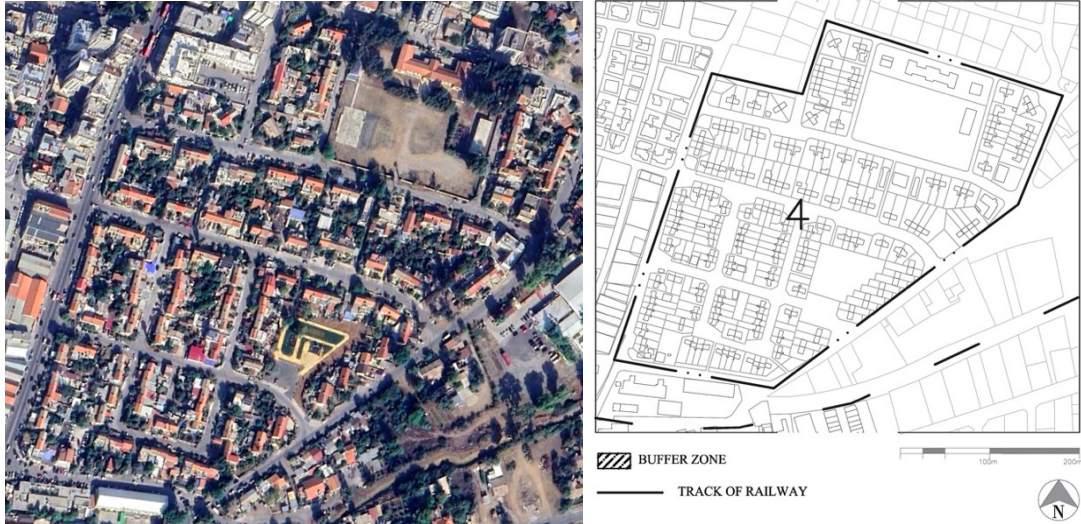


Figure 93: Yenisehir plan unit 4

The plots are typically rectangles with ratios of 1.14: 1, 1.4:1 and 4:1, with green spaces organized on both plot head and plot tile. (Figure 93 Type A and Type B). Apart from rectangular plots, the corner plots also follow the certain organization pattern of green spaces. The corner plots are varied in shape and size; however, green spaces are linear, L-shaped, or U-shaped, mainly positioned on the plot head. (Figure 94)

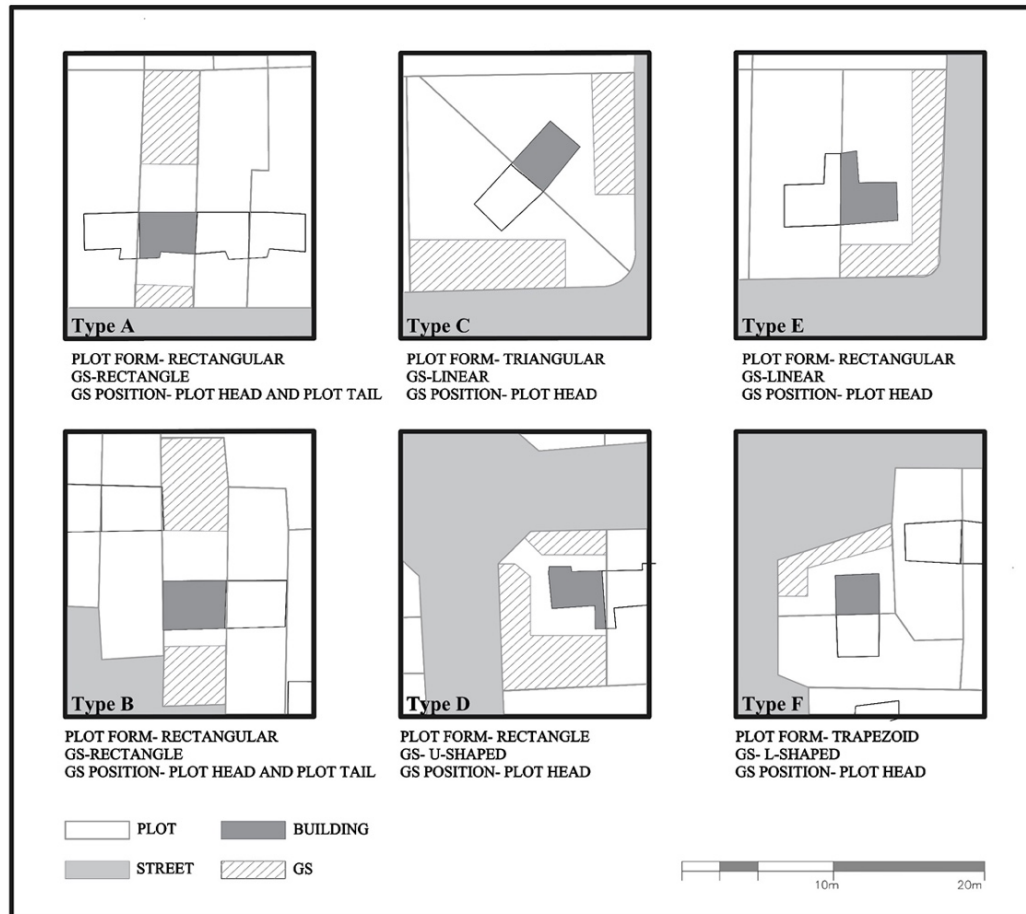


Figure 94: Yenisehir plan unit 3 plot typologies. (Author, 2022)

The plan unit five has mostly public functions such as institution building, terminal, hotel, and industrial building. Therefore, the green spaces are excluded from the plots due to the size of the buildings and rarely seen green spaces in this plan unit. In the cases of residential function, the buildings are organized in multi-storey forms and green spaces are excluded from the plots. (Figure 95) In addition to the form of green space, the percentage and density of vegetation were illustrated. In these neighbourhoods, 25 to 30 percentage of the plot area was covered by green elements. (Figure 96)



Figure 95: Yenisehir plan unit 5



Figure 96: Yenisehir private land ownership and density of vegetations. (Author, 2022)

Street Typology of Yenişehir

In this district, the streets are defined as a matrix route (main road), building route, connecting route, and reconstructed route. (Figure 97) As it is recognisable, the Yenişehir district consists of main roads that were initially structured right after the city's development outside the historic walls. Those streets connect the city's historic part to the latest development areas.

Such as previous case studies, the street typology analysis has been done based on the existence of green space and types of plantations. Therefore, the existing conditions in the Yenişehir district lead us to define two types of streets based on the green space (GS) organization: streets without (type A) and those with GS (type B). In the streets with GS (type B), the street space was covered by a combination of green surfaces (soft) and hard surfaces (Figure 98). However, in Type A, green spaces are excluded from the street; therefore, the street space is covered exclusively by hard surfaces.

Type A street typology refers to those streets where green spaces are excluded from street space, and hard surfaces cover 100% of street space. As mentioned in the plot analysis, buildings set back from the street edges between three to ten meters in different plan units. However, in most plots, green spaces are located between street lines and buildings on the plot head. Such as in the two previous cases in Yenişehir, the green spaces do not exist in street space; however, the rich green spaces in the plot series shaped continuous green façades. (Figure 99)

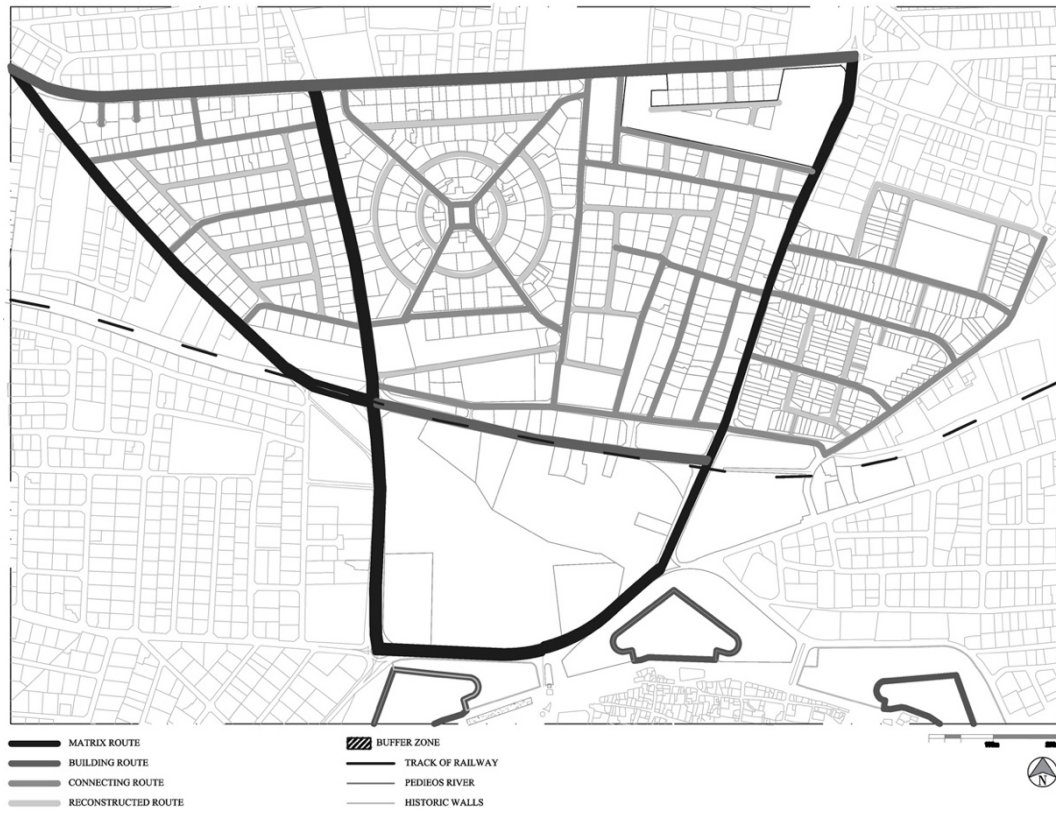


Figure 97: Yenışehir street pattern

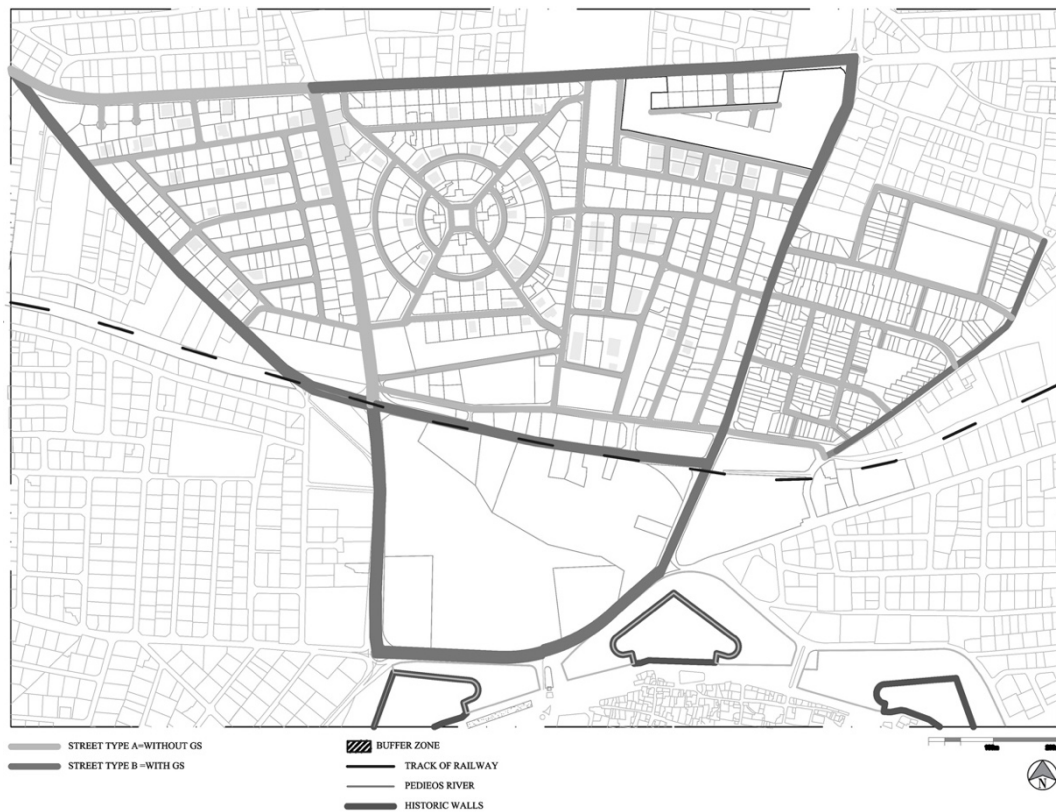


Figure 98:Yenışehir street typology and GSs (green spaces). (Author, 2022)



Figure 99: Yenişehir Type A street typology. (Author, 2022)



Figure 100: Yenişehir Type B Street typology (Author, 2022)

Type B streets are generally those matrix routes that developed earlier, and palm, pine, and eucalyptus trees are the common types of plantations. Vegetation is located on one side or two sides of the streets. In this typology, one-third of the street space is covered by green surfaces. (Figure 100)

Block Typology of Yenişehir

The block pattern of the district varied due to the different morphological periods, which fundamentally affected the development pattern in different plan units and urban blocks. In Yenişehir, the blocks have different shapes such as rectangular, curvilinear, triangular, trapezoidal, and irregular. Apart from the form of the blocks, the various factors affected the form and pattern of the green spaces. In Yenişehir, the

functional use of the land and development stages have a significant effect on green space formation. The following figures show the block typology and green space positions in every plan unit of the Yenisehir district. (Figures 101 to 105). The block analysis showed that the green spaces were developed on the residential blocks mostly.

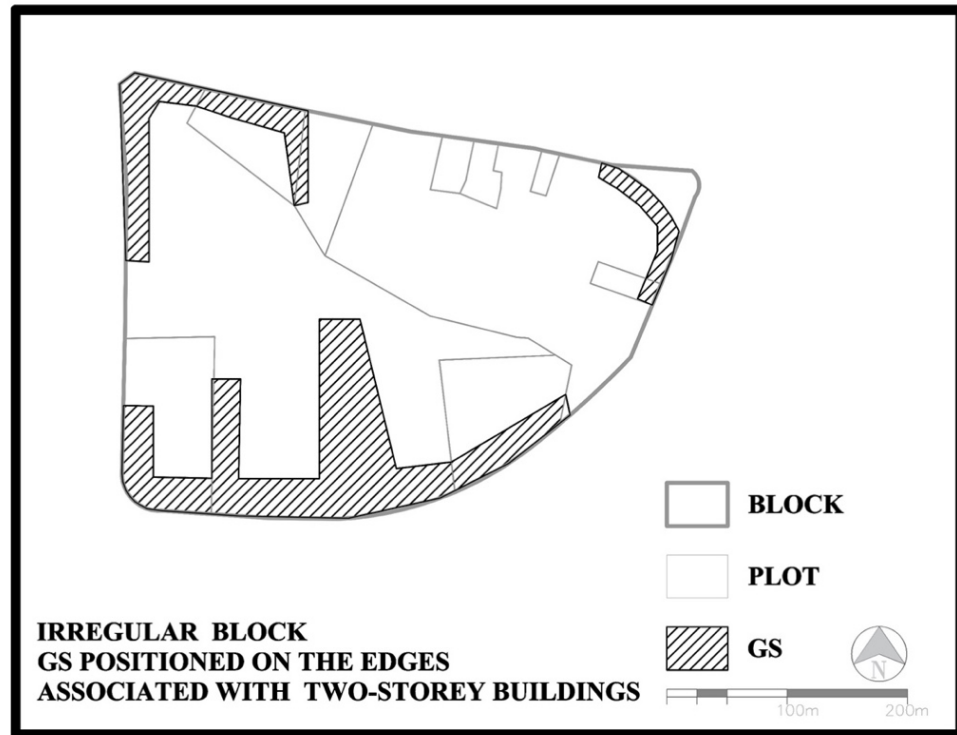


Figure 101:Yenisehir plan unit 1 block typology and GSs (green spaces).
(Author,2022

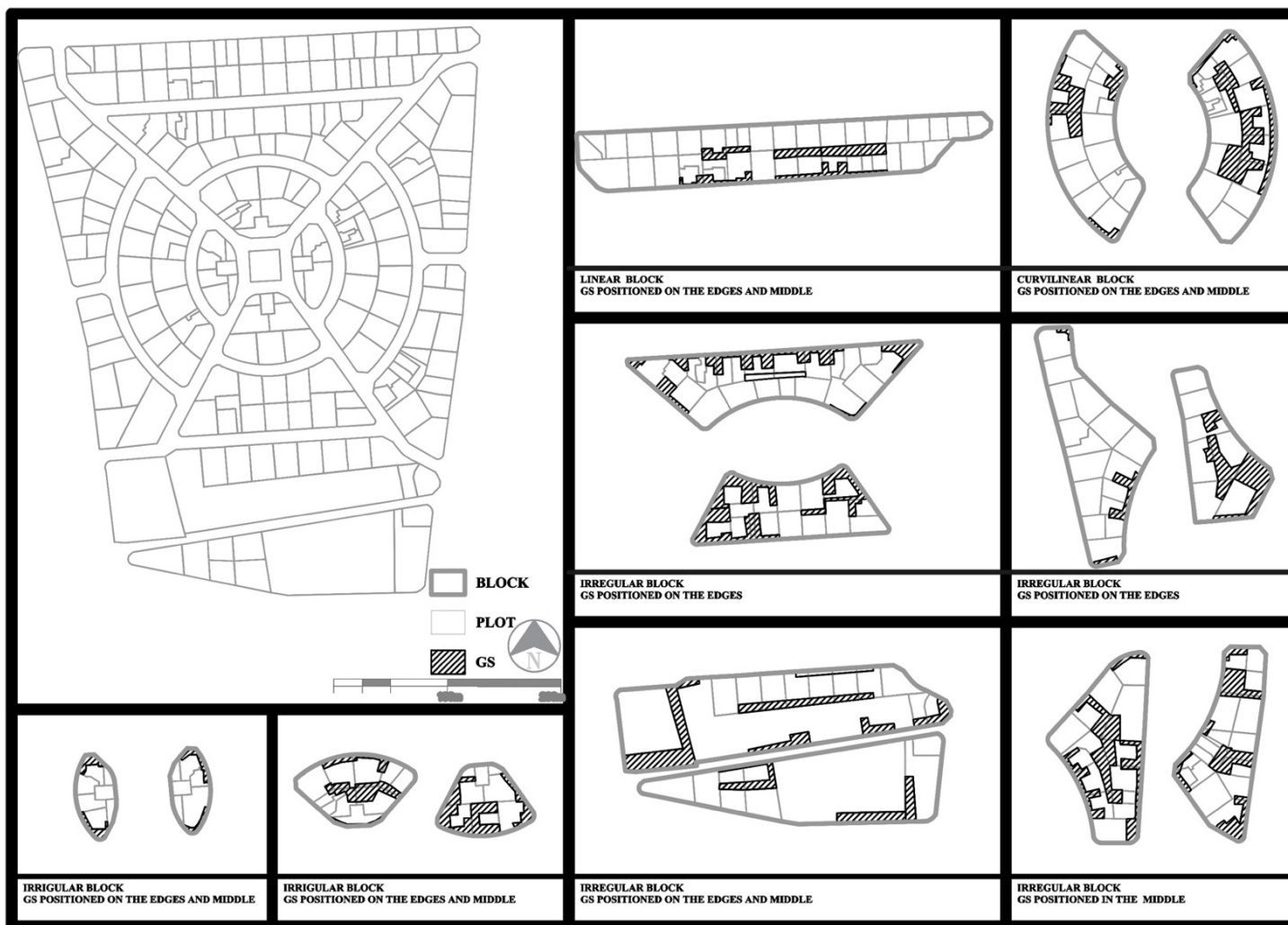


Figure 102: Yenisehir plan unit 2 block typology and GSs (green spaces). (Author, 2022)

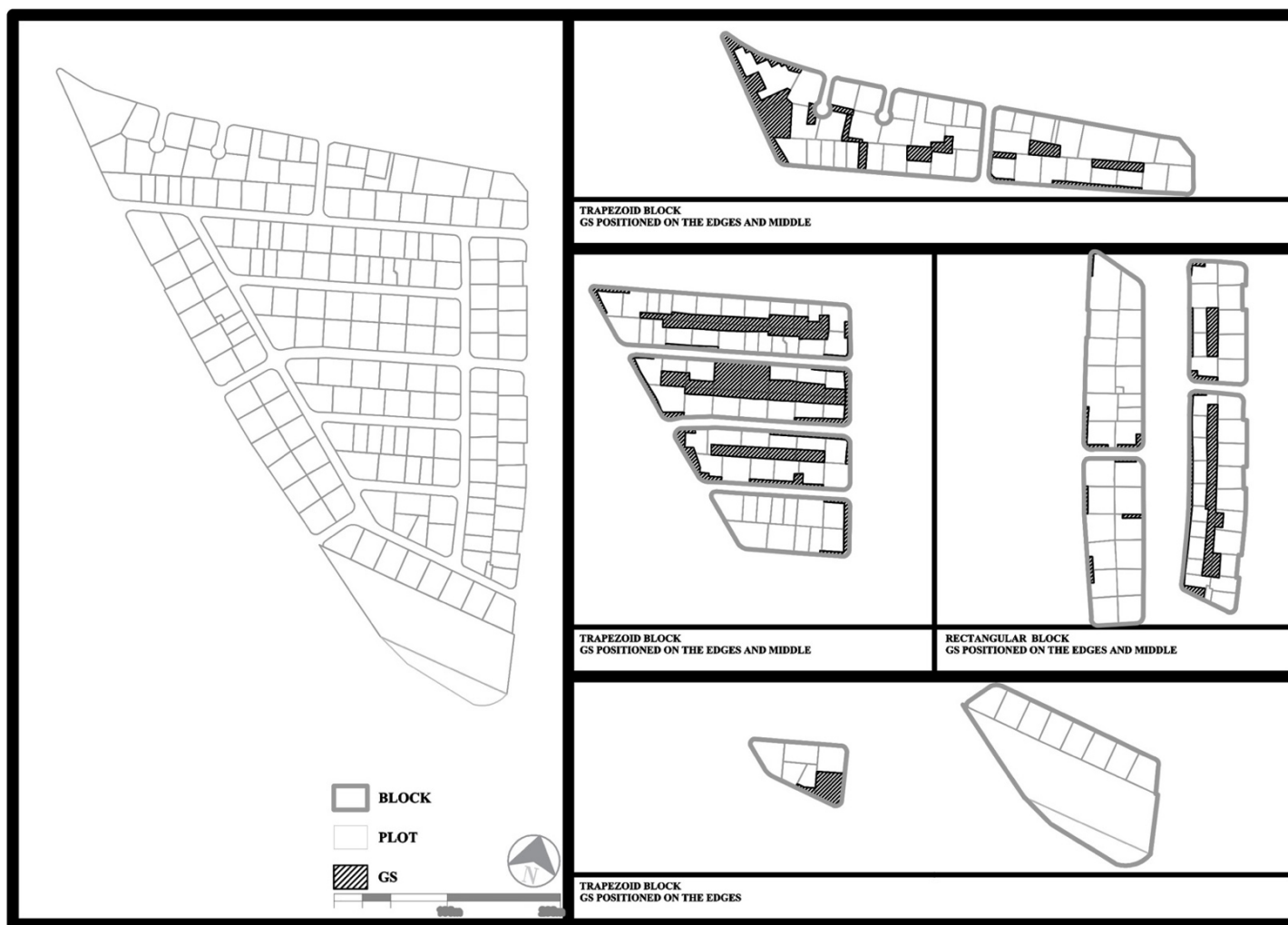


Figure 103: Yenisehir plan unit 3 block typology and GSs (green spaces). (Author, 20

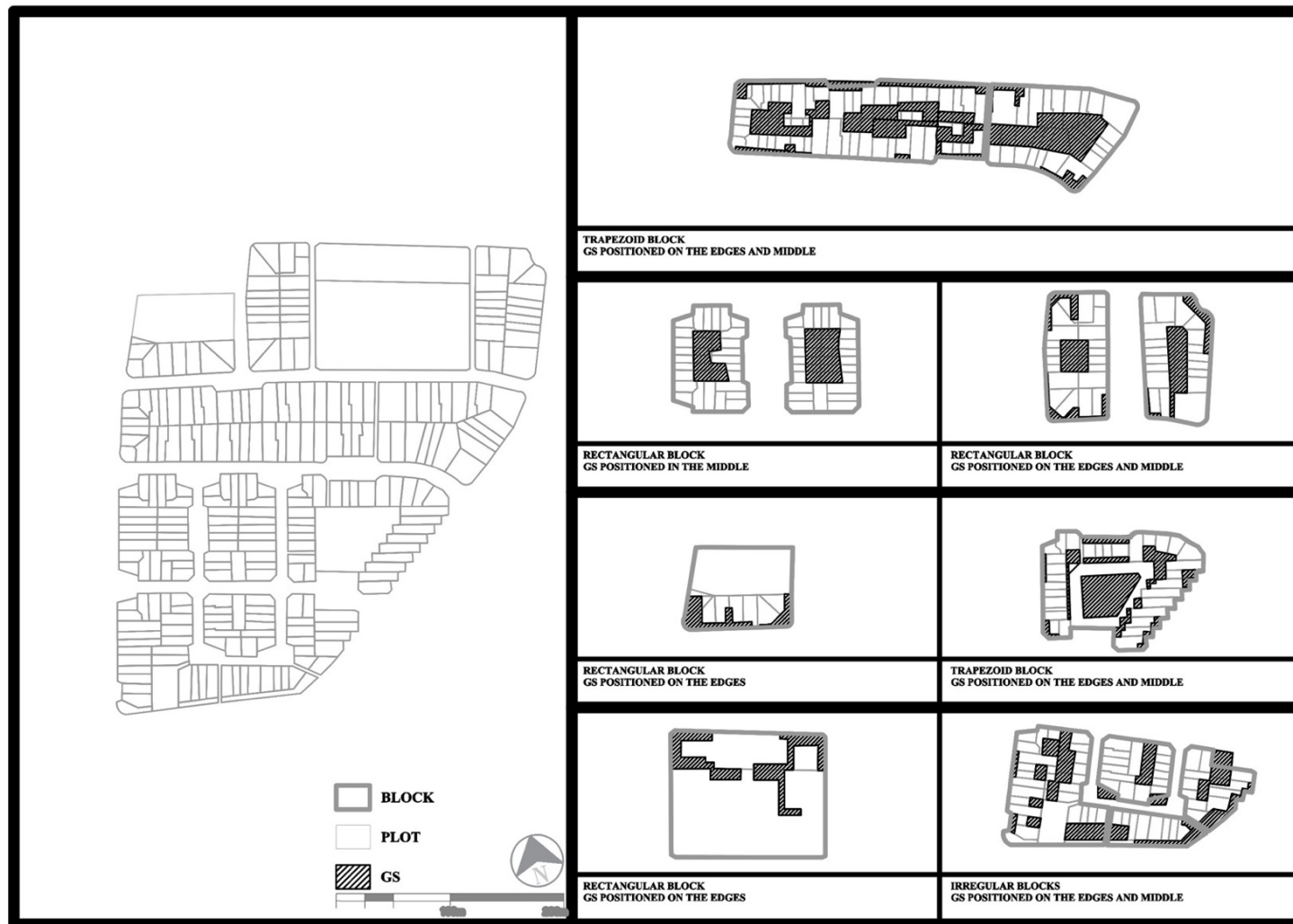


Figure 104: Yenisehir plan unit 4 block typology and GSs (green spaces). (Author, 2022)

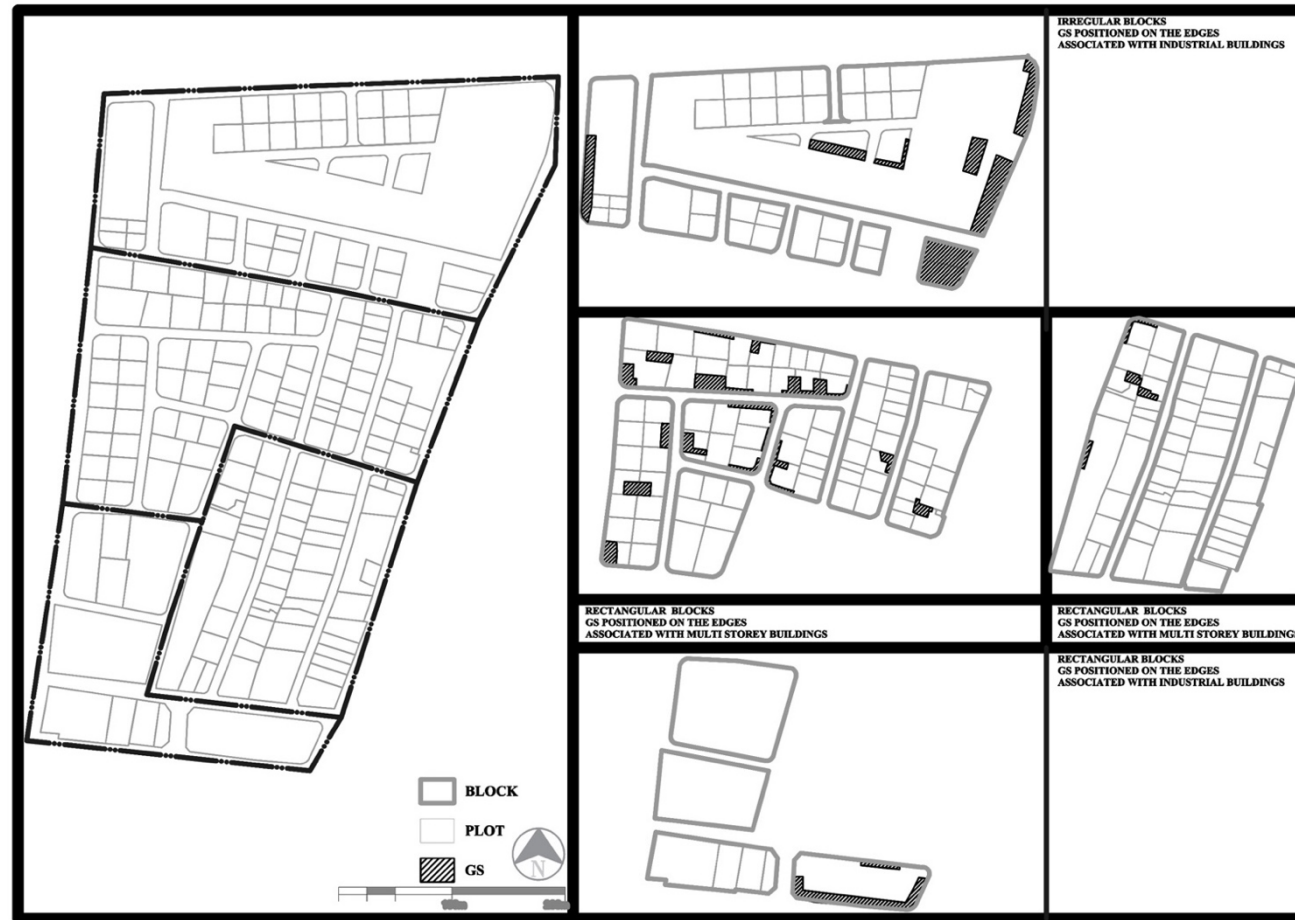


Figure 105: Yenisehir plan unit 5 block typology and GSs (green spaces). (Author, 2022)

Land Use and Land Ownership

The Yenışehir is a mixed-used district with various factions such as residential, commercial, educational, industrial, military, and public functions. Land use analysis illustrated that the southern part of the district consists of public, educational and industrial functions, which were developed right after the city's expansion outside of the walled city. And by passing through the north, east and west, the residential neighbourhoods started to appear in the second stage of the development of the district. In terms of green space land utilization, although the district's scale and the population are vast, the developed green spaces are limited in this district. There are only two functional green spaces in the whole district, one on plan unit two in the middle of the Yenışehir neighbourhood (Kurtuluş square) originated in the British period. The second functional green space is located in the middle of the standard housing project on the east side of the district. The district is in very close proximity to the Kumsal park from the west side, which is defined as the border of the Köşklüçiftlik and Kızılay districts. (Figure 106).

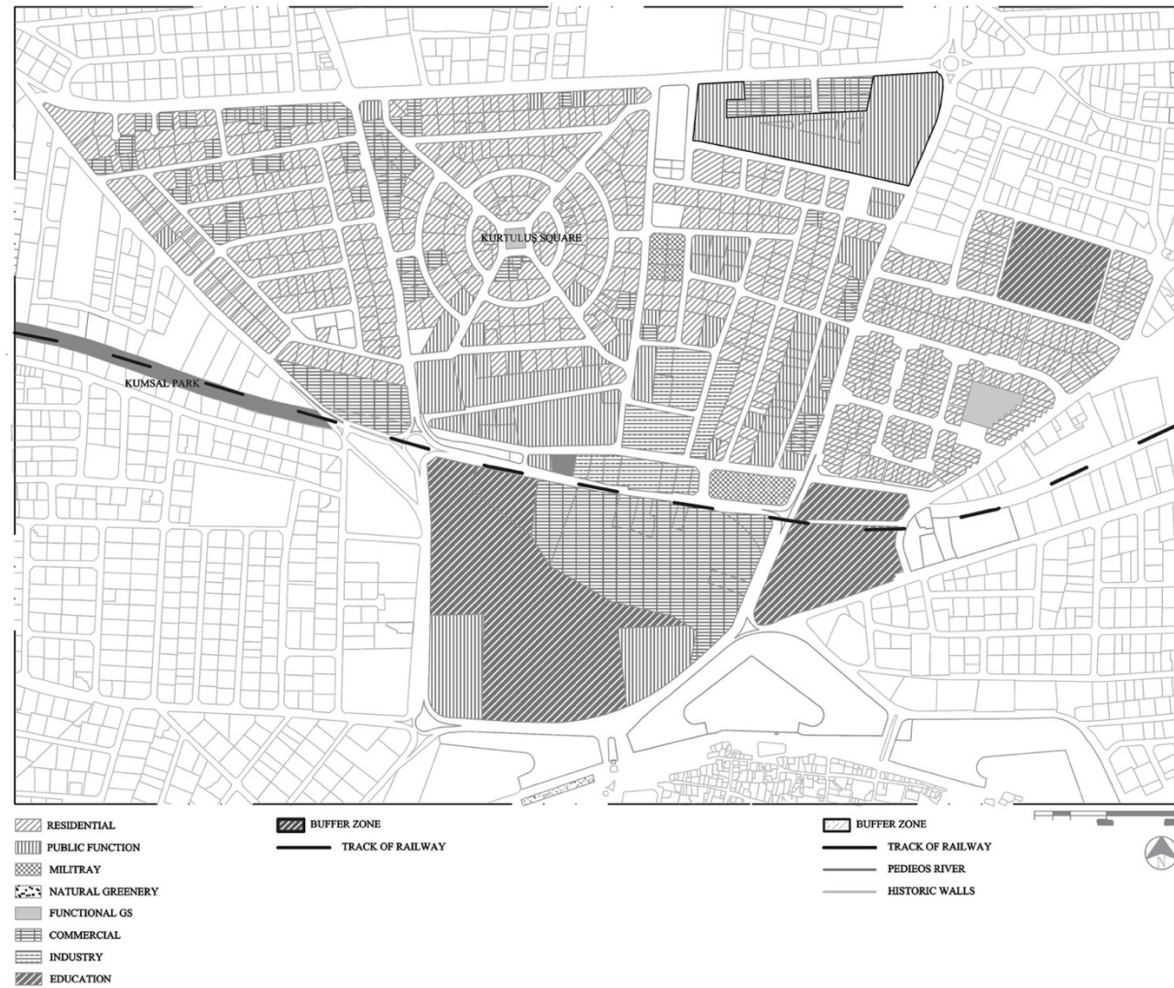


Figure 106: Yenisehir Land use and functional uses of GSs (green spaces). (Author, 2022)

5.6 Summary of Findings

The analysis has been divided into two-part macro and micro levels. The macro-level analysis focused on the general character of the city to understand the pattern and structure of the city. Therefore, the fringe belt (FB) and townscape analysis has been done in detail. (Figure 107)

Nicosia has a rich historical background in terms of the physical characteristics of the initial settlement and elaborating the architectural characteristics of the various historical period. The city developed eventually with a historical core during the medieval period and expanded later in the modern period. The historical analysis of the city identifies that for a long time, the city was limited by historic walls, and the organic development pattern completed the urban tissues. However, by increasing the population and modernization of the city, the organic form of the development, materials, and construction methods within the walls was replaced by a new pattern of development with new construction techniques and materials outside the walls. Therefore, the analysis of the morphological regions illustrated the city development periods.

The fringe belt analysis indicated the development stages of the city. The current study focused on the green space developments in urban fringe belts of Nicosia. The physical (historical walls), natural (Pedieos river), and political (Buffer zone) features that shaped the development pattern have been discussed. The analysis explained that most of the green spaces in the inner fringe belt of Nicosia belong to semi-public institutional buildings. Rarely public green space can be marked in the walled city of Nicosia.

Nevertheless, it is inevitable to consider Buffer Zone as a remarkable naturally grown vegetation within the city walls. The analysis displayed that the public green spaces have been developed in the middle fringe belt of Nicosia to support the social needs of the citizens right after the development of the city outside the walls. Consequently, various public green spaces were created in a historical moat and on the track of the former railway, which was planted by a row of trees in the British period. However, in the recent development areas, green spaces have been disregarded in the urban planning system, as discussed earlier. Significant natural green spaces remained near the branches of the Pedieos river and defined the outer fringe belt of the city from the northern and western sides. The continuation of the Buffer zone, the location of the military zones and agricultural lands created the natural green spaces along the eastern side of the city. And from the northern part ,outer fringe belt of the city is defined by the sessional lakes and university green spaces.

Land use analysis demonstrated the functional zones and showed the pattern of the distributing functions in the city. The analysis illustrated the location of the city's central business districts, residential neighbourhoods, and industrial and public functions.

Town plan analysis has been done under the micro-level analysis title, and various morphological elements of selected neighbourhoods have been discussed. The building, plot, street, and block patterns of each selected case have been analysed in addition to the land utilization consideration. (Figure 108)

The building pattern analysis identified that the initial settlements of the Köşklüçiftlik and Çağlayan neighbourhoods originated in the early British period; however, the

Yenişehir initiated later in the 1930s. Therefore, the building analysis identified that the single and two-storey buildings in the Köşklüçiftlik and Çağlayan neighbourhoods were designed in the same period with similar architectural style, material, and construction techniques. However, in the Yenişehir neighbourhood, the initial settlement was created by the one-storey buildings in the form of the garden city development and later, the two-storey semi-detached row houses were developed in the Standard housing project with the same yellow stone materials that were used in Köşklüçiftlik and Çağlayan neighbourhoods. Later in the modern period, multi-storey buildings developed in all the neighbourhood and gradually, the number of floors increased. The general finding in building pattern analysis is that the buildings are set back from the street edges in all the cases three to ten meters and located in the middle of the plots.

The plot analysis clarified that the plot typologies vary in different neighbourhoods; however, the rectangular shape is a similar plot shape repeated in all the neighbourhoods. Nevertheless, the plots' size and ratios are altered based on the building typology. In terms of the position and typology of the green space, the study identified three patterns that have been repeated in all cases. The linear, L-shaped, and U-shaped organization of the green spaces is formed due to the position of the buildings within the plot. However, the location of the green spaces on plot head or plot tail or both plot head and plot tail depended on various factors. It was different due to the proximity of the building to the street edge and the size of the building, and the ratio of the plot. Generally, plots with multi-story buildings in all three neighbourhoods slightly have green space or, in most cases, without green space. Plot amalgamation for constructing mass buildings might be the reason for demolishing green space in those plots. Another reason might be the need to provide parking areas

that caused disappearing soft spaces and replace them with hard surfaces. For that reason, the analysis could not generalize a specific pattern of apartment blocks regarding the green space structure.

The street typology analysis showed that the street pattern was the same in all three cases due to the general development pattern of streets in Nicosia. As clarified, street typologies are divided into two parts, streets with green spaces and streets without green spaces. The analysis illustrated that most of the matrix routes in the cases followed the same street typology (street with GSs). Nevertheless, the connecting and reconstructed routes within the neighbourhood belong to the second typology, streets without green spaces. The streets typology in the designed framework was invented to analyse all the elements of the streets, such as types of surfaces (hard or soft), plants and their forms, heights, and densities. The streets in Nicosia do not include all the elements in the designed framework. Therefore, the street analysis was limited to the location of the trees, types of the trees and hard surfaces in street space. The analysis could not be completed in Nicosia based on the limited street elements.

The block pattern analysis revealed the blocks' shapes and types of green spaces organized in urban blocks. The shapes of the blocks are altered in the three selected neighbourhoods. The urban blocks are unique in these three neighbourhoods due to the different physical, natural, and political features that affect the initial structure of the neighbourhood. For instance, in Köşklüçiftlik and Çağlayan neighbourhoods, proximity to the city walls, river, and the streets orientations caused the creation of the various blocks' shapes. However, the building typology and the functional uses were the effective factors in the formation and presence of the green spaces on the urban blocks. Residential blocks associated with one- and two-storey buildings had more

green spaces rather than those with multi-storey buildings. In addition, the commercial, institutional, and industrial urban blocks had fewer green spaces. Generally, the blocks in Köşklüçiftlik and Çağlayan neighbourhoods had more density of green spaces than the Yenişehir neighbourhood due to the various public functions in this neighbourhood.

The land use and land ownership analysis displayed that the distribution of the functions, and the private, semi-public, and public ownership of the lands are the factors that influenced the presence or absence of green spaces in Nicosia. Therefore, In the selected neighbourhoods, functional green spaces were identified. The functional green spaces are mostly located in the Çağlayan neighbourhood, such as Çağlayan park, sports clubs, and fields. However, in the Köşklüçiftlik neighbourhood, the only public functional green space is Kumal Park, built along the row of pine trees planted in the British period along the track of a former railway. Yenişehir neighbourhood is the biggest neighbourhood among all; however, almost no public functional green spaces developed in the area due to the existence of various public and institutional buildings. Apart from the density of the green spaces, the types of the plant's species and consequently the green spaces form altered due to the fashionable and possible plantation pattern in formal and informal functions.

Consequently, the designed framework integrated the morphological and typological methods to examine the green spaces' structure and pattern. The overall findings indicated that the designed framework is applicable on macro and micro-level in different cases. The findings of the selected cases proved the applicability of the framework on different scales, from plot to city scale, although their morphological

character would be different from one another, it presents an opportunity to discuss the morphological characteristic of green spaces in different contexts.

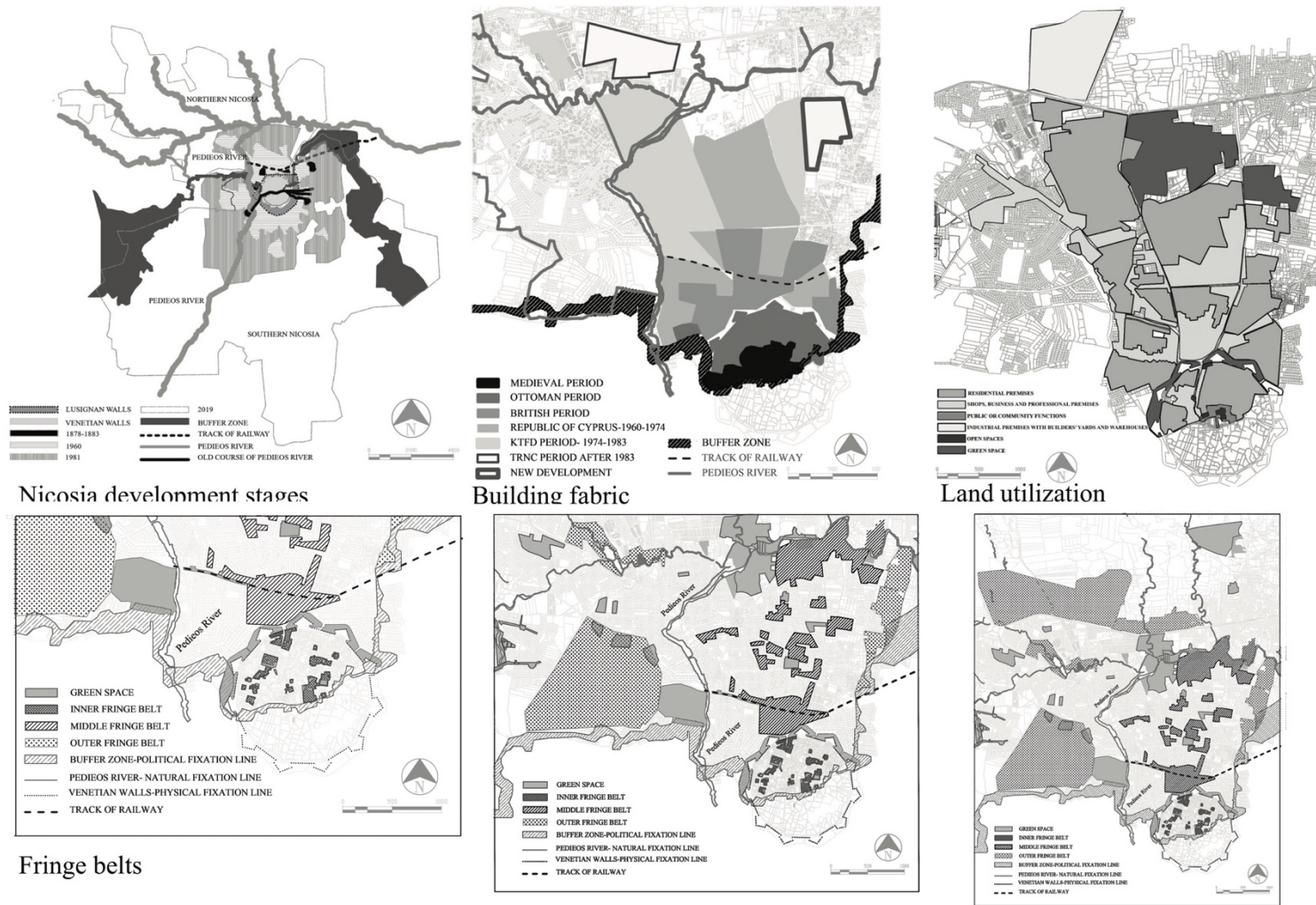


Figure 107: Overall macro-level analysis



Figure 108: Overall micro-level analysis

Chapter 6

CONCLUSION AND DISCUSSIONS

The study of urban morphology has been extended and developed in various disciplines; however, this thesis focused on geographical and architectural approaches. Conzen and Caniggia developed their concepts in different directions and applied their methods in various studies. Apart from Conzen and Caniggia, the current study considered the morphological approaches of other morphologists, such as Karl Kropf and Poul Osmond, to discuss gaps related to the consideration of green space in urban morphological analysis. The reflections of various approaches provide a strong background for the current research to prove the necessity of considering green spaces as an element of urban form in morphological analysis.

5.7 Discussion

This study has indicated the capability of thinking about green spaces as an individual component of urban structure. Even though the present research concentrated on specific parts of the small city, the analysis specified that, similar to tracking the development of plots or streets in historical analysis, the pattern of formation and transformation of green space can also be read.

More generally, the study provided opportunities to understand the green space of the northern part of Nicosia and the structure of green space that is shaped by various physical, natural, and political structures. However, understanding the whole arrangement of green spaces at the city scale, with all the multiple layers of the method,

helped examine the roles of large-scale areas of green space, perhaps associated with fringe belts. Small-scale regions, related to residential plots, in the overall pattern of green space, and the extent to which processes affecting built forms are the same or different to those involving green spaces.

The micro-level analysis in the selected neighbourhoods revealed that the initial planning considered the open space in the plot scale. The advanced rules and regulations in Nicosia's master plan for developing detached houses with setbacks from the street edges provided enough open spaces in the plot scale. The defined plot coverage of up to 60% in the master plan (see section 5.5.2) provides open space on the plot; however, it was not specified the type of surfaces (soft or hard) and vegetation coverage percentage. The Analyses showed that in many plots, green spaces were organized around the buildings in various types and forms on plots head, plots tail or both. Most green spaces appeared on corner plots due to the plot's size, shape, and privacy issues. In plot scale, the green spaces' size depended on the buildings' proximity to the street's edges; however, in the selected neighbourhoods, the green spaces on the plot tail were bigger due to certain setbacks.

Urbanization and housing demands lead to the appearance of multi-story buildings and continuous expansion of urban built-up areas in Nicosia. Consequently, by increasing the building density, green space density decreased, and the erosion of green space in plot scale happened. The analysis presented how the recent developments, the amalgamation of plots, and the creation of taller buildings ignored the significance of green spaces in order to provide parking spaces for fulfilling the regulation requirements. On the other hand, the green space advantage and recommended standards have been discussed in different parts of the world to decline the

urbanization impact on the quality of human life and stated that any urban resident should have access to green space. The green space standard published by the United Nations is 30 m² per capita, the European Union standard is 26 m² per capita, the USA (determined by the Public Health Bureau and the Department of Housing) is 18 m² per capita, the World Health Organization standard is 9 m² per capita. (Khalil, 2014) Therefore, it is unavoidable to reconsider the plot size, ratio and plot coverage for developing multi-story buildings in rules and regulations, consequently adapting and reflecting the amount of green space per capita based on human needs.

The plant typology on plots indicated that citrus, fig, olive, cacti, tall shrubs, and hedges are the most common types of plants that have been planted in selected neighbourhoods; however, the pine and cypress trees spatially planted in Köşklüçiftlik during the British period. Therefore, the designed framework assisted in assessing the green spaces typologies and morphologies in these selected neighbourhoods.

On the other hand, the street analysis emphasized the requirement of consideration of green space in street space in the selected neighbourhoods. While the results of the recent studies on the advantages of green spaces in urban spaces showed that the green spaces' existences in the urban environment provide various social, cultural, environmental, and economic values. The streets in Nicosia's usually remain without trees and green spaces. Nevertheless, the significance of trees on sidewalks is fundamental for such a hot climate to provide a comfort zone for pedestrians, encourage the residents to walk, and decrease the usage of cars. For instance, strategically placed trees and shade structures allow citizens to spend time in open space. Specific plants, colours, and flowers in urban spaces can elevate the human mood during their commute or on a walk and livens the environment.

As discussed in chapter five, mainly the high social class residents started to build large houses outside of the historical walls in a bigger plot with new housing typology. Although the size of the plots increased and the typology of the buildings has been changed to achieve a better living environment, green space as a feature of urban development has been generally neglected both by planning legislation and by the reality of development from the beginning. The plot pattern of the new development and new building typologies have restricted the proportion and density of greenery and gardens in most of the neighbourhoods. Ioannou (2016) argued that Nicosia's early suburbs provided small public green spaces, however at the beginning of their development, they were covered by full of Mediterranean orchards and flowers, and gardens surrounded the freestanding housing units. Land utilization analysis determined that the public open spaces, mainly public green spaces, are limited in Northern Nicosia, specifically in the scale of the neighbourhoods. Although there are few communal spaces in each neighbourhood, the amount and size of those amenities are not enough to serve the demands of growing populations. The selected area of Northern Nicosia has now become a central business area. By increasing the commercial, offices and business functions in this part of the city, the demand for developing stylish and aesthetically pleasing spaces as public open spaces with appropriate design and facilities is evitable. These types of spaces enhance the daily life of city dwellers. Nicosia's land-use planning system needs to consider the development of more public functional green space in scale of a neighbourhood, district, and city.

5.8 Evaluation of the Proposed Framework

Poul Osmand's methodology was the starting point for considering green space as an element of urban form; however, his approach is more ecological than architectural. The proposed framework in this thesis looks to the green space as a vital component of urban form. It is designed on two different levels; it is more unrestricted to examine both on a macro or micro level. One of the proposed framework's strengths is that it is scale-independent and applicable from the city level to the plot level. Therefore, it provided a guideline for considering green space in any case study. Presentation of the proposed framework exposes that, although the approach wanted to be practical, there would be specific difficulties in dealing with the cities that are not planned or developed with a particular configuration and are more heterogeneous.

The framework applied in the middle fringe belt of northern Nicosia indicates that this method can be used at both the macro and micro levels. Although it was applied to both macro and micro levels in Northern Nicosia, the methodology has specific difficulties, such as limited access to the data from southern Nicosia to analyse the whole city at the macro level.

The limitations of the investigation are acknowledged, and this thesis intended to identify which factors and variables were relevant in a morphological study of Nicosia's green spaces. The analysis highlighted the city's elements and physical changes through time. The present study collected data during the autumn and spring when, in this climate, vegetation appears after the seasonal rains.

The research demonstrated that the framework's application met the most crucial aim – filling the gap in morphological studies by considering green and open spaces and

discussing them by their elements and components. However, as the framework was applied to only a single city and limited to the middle fringe belt, further research and comparative studies are needed to properly assess the opportunities and limitations of the method in different circumstances.

5.9 Further Study

For further discussion, the green space can be analyzed on the city's scale, and the green space network can be linked to understanding the development pattern of green space for future growth. The designed framework assessed the structure of the green spaces at the urban level, which can contribute to planning further development of green spaces and help to understand the opportunities, possibilities, and limitations of future outcomes.

Urban studies show that various social, cultural, and economic factors have changed the urban form and development; therefore, these factors might also influence urban green space formation. Apart from environmental factors, climate and seasonal changes, the current study mainly focused on physical, natural, and political issues by evaluating the urban green space formation on the macro scale. However, the social, cultural, individual willingness, and lifestyle also might influence the appearance of specific typology while considering the micro-level. Consequently, the future concentrations can be the social and cultural factors in urban green space formation and considering social approaches of morphological studies to develop the current designed framework.

As mentioned, green spaces are more than an effort to beautify city streets; they are essential to a city's function. Urban green spaces, in addition to creating the natural

ecosystem, microclimates, affecting the quality of air, decreasing soil erosion and pollution; provides visual appeal and a sense of community, impacting the mental, well-being, and everyday lives of those who live and work in the city. Every single square meter of urban green space has an ecological performance on the network of green space; therefore, it affects the structure of the green spaces as well. Consequently, any changes in ecology may also change the city's morphology. Thus, ecological studies need to be part of further research in order to discuss the holistic image to plan and manage urban green spaces for the benefit of urban dwellers and biodiversity.

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