

## **Exploring the Evolution and Structure of the Urban Fabric. Paris, Vienna, Athens.**

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### EXTENDED ABSTRACT

The specific subject of my doctoral dissertation, titled "Exploring the Evolution and Structure of the Urban Fabric: Paris, Vienna, Athens" is the exploration of and morphological approach to the physical development of the urban fabric, primarily focusing on the examples of these three major cities (in decreasing order of size, Paris, Athens, Vienna).

From the 1980s to the 2020s, my research has focused on the development of the anthropogenic environment in relation to the planet's natural environment. My interest has been centred on the continuous, uncontrolled expansion of the built environment and the corresponding urban sprawl within the geographical space. At first I wondered how this expansion had occurred, while at the same time all the ideas I came into contact with as a student of architecture and urban and regional planning and design had to do with this particular subject. I was taught and I studied these ideas as central tenets, advocated with insight by many active researchers and thinkers, from the 19th century to the late 20th century, and continuing into the early 21st century and underlined the issue of defining the boundaries of human activity in its various dimensions. These were accompanied by a continuous and extensive engagement, expressed through architectural designs, urban planning projects, and artistic interventions, as well as through written and oral discourse, that is to say literary, historical, political, social, economic, ecological, and more broadly, scientific and technological analyses within the framework of collective organizations or individually, worldwide.

My own work developed within the analytical framework of various academic and research organizations in several countries. I primarily engaged in research and focused on related topics, using various analytical methods and developing different analytical approaches. These research efforts followed two main lines of theoretical and empirical investigation: one, on the social perspective at the level of urban planning and design and the other concerning the physical morphology of urban fabric development.

This doctoral dissertation is situated within the second approach, that is, within a framework of understanding and seeking solutions for controlling the enlargement of artificial space. The artificialization of geographical space is definitely linked to complex and multifaceted phenomena that touch upon all dimensions of human society and interact with both the abiotic as well as the living environment of the planet. The necessity for specialized scientific fields as well as a broader interdisciplinary approach to this artificialization, arises within these dimensions and opens up horizons for the analytical investigations of its various manifestations. The intent of the work is for the theoretical and empirical processes presented herein to integrate into this broader, open field, with a particular focus on a specific proposal of morphological approach to the physical

development of urban space and the establishment of a method for describing and analysing its changes. In this study, changes in urban space are comprehended as the totality of local transformations and enlargements of the built fabric of an urban area that occur during its development over time.

The term *urban fabric* as employed in this work implies the composition, from the total structured spaces of the city that possess stereometric properties (distinguishing them from bioclimatic, for example, where the field and methods of analysis are different) and are artificial objects - architectural elements, as they are designed before their implementation. It is nevertheless important to note that these architectural elements, spatially, result from multiple social, economic, cultural, political, and technological processes.

An understanding of whether the urban fabric, which is the focus of this research, evolves or develops, was undertaken. This effort led to the following position: "Evolution" refers to a sequence of changes that highlights a phenomenon along with the various adaptation processes it brings about. On the other hand, the term "development" generally refers to the issue of identifying and representing natural and complex phenomena related to the form of objects. Although evolution and development are interrelated phenomena, the theoretical perspective and specific content of morphology was showcased, along with the concept of development of the complex physical object of *urban fabric*. I approached this development morphologically by identifying its specific structure through the method that was developed.

I developed a method of morphological approach that establishes biunivocal correspondences between the primary, secondary, and tertiary elements of the urban fabric, as they were named within the framework of the work. The boundaries and divisions that arise from the real, designed, and implemented urban space are considered primary elements, including streets, buildings, city blocks, land parcels, and the topographical lines of the geomorphological elements that constitute the physical substrate of the urban fabric. Secondary and tertiary elements are geometrically characterized objects that are determined, within the framework of the method by a series of actions related to the accumulations and co-ordinations that occur over a period of time during the expansion of an urban area, with the local transformations and local enlargements of the urban fabric. The thesis argues that the sets of these primary, secondary, and tertiary elements, their relationships, and the actions that represent the relationships constitute a structure. This structure, both geometrically and analytically, links accumulations and syntaxes and reveals the morphogenesis during the physical development of the fabric. Within the findings of the analysis, specifically of the form revealed by the structure based on the correspondences between the elements, I consider the interpretation and acceptance of modifications in the framework of spatial planning, on a macroscopic scale, to be possible.

I developed the method according to a hypothetico-deductive syllogism and analysis based on the introductory observations and initial proposals of Chapter 1. My subject was the 're-conceptions and analytical approaches of urban space' and the results from the specific theoretical and empirical investigations of Chapters 2, 3, 4, and 5. The individual research subjects of these chapters were:

- Chapter 2, 'theoretical and methodological issues of reading urban space,'
- Chapter 3, 'redefining the specific field of work regarding physical morphology,'
- Chapter 4, 'developing the method of morphological approach to the physical development and enlargement of the urban fabric,' and
- Chapter 5, 'investigating the prerequisites for the application of the method to the entire urban area of a city.'

Specific findings and conclusions were gradually synthesized to support the thesis with regard to the necessity of further research for the control of the enlargement of artificial space with theoretically and empirically specialized data and analyses. Thus, I argue that the specific field of analytical specialization in the physical morphology of the urban fabric supported here is situated within a broader framework of investigating artificial space through poly-, inter-, and trans-disciplinary research. The contribution of this specific research field is the crucial issue brought into discussion, in the conclusion of the work, within the scope and in light of further extensive application of the method, through independent interdisciplinary team research and the implementation of quantitative analysis aimed at further processing and standardization, as well as the digitalization of data and analytical processes of the method.

The thesis comprises two parts in six chapters:

- The first part, is more general and aims to present the introductory observations, the initial proposals, and the theoretical and methodological issues through a review of reconceptions and analytical approaches, as well as the specific description of urban space and its enlargement.
- The second part progressively explores the positions of the thesis, redefines the specific field concerning morphology and the urban fabric, ultimately leading to the proposal of a morphological approach to the physical development of the urban fabric.

The initial interrogation is presented in subsection 1.1, titled 'The subject, sources, and elements of the work'. A series of observations, questions, themes, and concepts form the core of the approach proposed later in the thesis, focusing on the structured fabric of the urban environment. The concepts of *fabric*, *sequence*, *physical constitution*, *space-logic*, and '*morpho-logic*' are introduced. Questions are raised regarding the ongoing expansion in the geographic relief of the urban and artificial environment in general, with references to specific examples, such as the enlargement of suburban zones and the phenomenon of *ruralopolis*.

The central hypothesis formulated in the work is that through the prism of "morpho-logic"- - complementarily to analogous or different approaches-- descriptive and analytical elements of the transformations of the city space can be showcased. Even though these transformations are determined by social and economic conditions, cultural origins, and local histories, etc., specialised analyses can determine their physical constitution.

The field research is presented in the broader sense of the term 'field,' referring to the area of data collection. This includes the mapping and analysis of morphogenetic phenomena in the development of urban fabric, considering examples from three major cities, Paris, Athens, and Vienna, as well as a number of other historical and contemporary examples of cities or urban segments. Extensive use of urban maps at different scales from various time periods is made. Original graphical and cartographic representations were also generated and used as research data. The literature and previous personal research served as sources for many elements of this study. A systematic review of historical and recent research on morphology is also presented, along with the supplementary creation of a working glossary ('lexicon of urban fabric morphology'), which includes references collected within the scope of this study and aims to analyse definitions and scientific positions for 205 concepts. The totality of these concepts and selected references constitutes the interdisciplinary substrate of this work.

In the following subsections, the following were discussed:

The method of re-cognition, considered here as the logical connection of the initial propositions and denoting the final result, in a well-ordered system for the analysis of this space. The initial propositions act as pseudo-definitions at the level of investigation with the initial hypothesis. Although the role of the initial propositions is fundamentally rhetorical, in a hypothetical deductive system of assumptions, of demonstrative actions and their logical connections with the desired outcome, at the same time it is shown to be suitable for the introduction of the following processes. It was ascertained that researchers and scholars have been found consistently to agree on the unquestionable necessity of a theoretical, scientific foundation in the analysis of the complex space that is the anthropogenic structured environment. Through this perspective, the specializations that arise from various approaches can operate cumulatively or even synergistically--not necessarily antagonistically--either as individual theories or even as schools of thought.

It was also noted that earlier definitions related to the anthropogenic environment generally remained open, deferring refinements and clarifications for a later time. Indeed, analyses of the decades that followed these initial definitions are in line with them, but they become specialized through the use of advanced technological, mainly digital, capabilities, aimed at knowing every human activity at any given moment and at any geographical point. With these capabilities, as ambiguity can be reduced and the specialization of the analysis of urban phenomena in general intensified, certain theoretical issues can also be revisited to some extent.

An issue that has emerged as a perennial focus both for analytical and research-oriented paths is that of *de-composition* and *re-composition* of spatial objects. I believe that the de-composition and re-composition, involving the description, analysis, and/or design of spatial objects, brings to the forefront the question of stable theoretical reference points for scientific and technical specialization regarding the city, urban space, and urban development<sup>1</sup>. From the

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<sup>1</sup> In this work, the term 'physical development' is used, the concept of which differs from the concept of 'urban development' and refers to the specific instance of urban development and the activities of urban society, which is the enlargement of the built environment. It is this particular aspect that the morphological approach focuses on, with the aim of expanding spatial planning on a macroscopic scale.

perspective of contemporary perceptions, I think that the need for specialized description becomes more evident. Description, however, is interconnected with both analysis and the design of urban space as a theoretical process of de-composition and re-composition within the framework of each specific spatial intervention.

Furthermore, it was observed that analysis in the preliminary phase of the design of urban intervention typically functions as a validation of the intervention and primarily aims at the technical documentation of the spatial intervention. However, the preliminary phase refers to an approach of reading the urban space that tends to become autonomous and detached from the very spatial intervention it seeks to document, as the data are drawn from a multidisciplinary field. With this autonomy, the levels of description, analysis, and design become distinct from each other. Consequently, a scientific, technical, and methodological challenge arises for articulating these levels with each other as well as with reality, according to the theoretical or empirical hypothetico-deductive scientific methods.

From the observations of the introductory chapter, questions arose regarding the way one perceives urban space and its deconstruction-reconstruction:

- The first question pertains to defining the boundaries of specialized analysis and research, depending on the viewing scale of the reality of the built environment, given that the various scales differentiate the object examined. As an example, at micro-scales (such as the materials used, their chemical and physical properties, or their functional aspects and forms), the objects of analysis are related to architecture. On the other hand, at macro-scales, objects like extensive residential areas are subject to urban and city planning; larger geographic regions are examined mainly as spatial structures of economic-social-political organization.
- The second question relates to how the reality of the structured human-made environment correlates with endogenous micro-phenomena, their analytical elements, and the structures that simultaneously connect them across all scales.

In accordance with the above, the goal of the investigations in the subsequent chapters was twofold: first, there was a description of urban development in its spatial manifestations in a way which relates form to the actual physical space of the city and articulates the formation of the urban fabric and its changes over time. Secondly, clarification was provided, through hypothetico-deductive and empirical reasoning, along with a specific method proposal for finding, representing, and analysing the morphogenesis at the macro-scale of the urban space, as previously mentioned.

The main bibliographic references in Chapter 1 pertain to Lefebvre, Alexander, Habraken, Inam, Carmona, Dovey, Pafka, Marshal, Castex, Panerai, Tafuri, Massey, Castells, Pinol, Preteceille, Kropf, Rossi, Mumford, Lakatos, Canguilhem, Foucault, Blanché, Heisenberg, Monod, and others.

Chapter 2 focuses on "theoretical and methodological issues in describing urban space and its enlargement." It explores the unclear boundary between the definition of "city" and the specific description of particular cities, as well as the quantity of information related to the

measurement, visualization, and description of urban space. Problems in describing the enlargement of the city through theoretical analysis are identified, and a literature review is conducted regarding the spatial evaluation of the "position of the urban agent" and its mechanical perspective. The paradoxical functional relationship "activity-space" is also considered. Conceptualizations of "substance" and "change" in human space, artificial order, and natural deconstruction, culminating in an experimental exploration of representativeness outside of time and focusing on the irregular arrangement of the lattice and the form of the city, are analysed.

The theoretical analyses in Chapter 2, along with further consideration and experimentation, strengthen the theoretical position of the work regarding the research process of developing a method for reading the urban fabric. The chapter examines interpretations of the city and supports the acceptance of the coexistence of multiple ways of viewing and expressing knowledge:

- by analogy
- by demonstrability
- by experimental trials and their verifications
- by the acceptance of thematic dispersion

These different approaches to understanding and expressing knowledge are explored and embraced within the research process.

Finally, this chapter includes an extensive empirical analysis of urban morphology. It examines relationships between buildings, land parcels, city blocks, and streets with cartographic and illustrative analyses for characteristic cases of urban divisions during different historical phases of development, from pre-urban, rural settlements to early urban and previous urban phases in the current urban state.

The illustrative analyses:

- Demonstrate the persistence of the primary urban element, which is the city block.
- Investigate various cases of urban fabric in both pre-urban and urban forms, focusing on the divisions within city blocks to land parcels.
- Depict small clusters of city blocks in central or suburban areas of the selected major cities (Paris, Athens, Vienna) during different phases of their historical development, from a pre-urban, and rural state, even a primitive-urban state to their actual urban state.
- Analyse the relationships of geometric regulation inside an individual city block arousing between land parcel boundaries and city block boundaries. In particular, examples of city blocks that belong to central and suburban areas of the three selected cities presenting continuous or open system of building construction are analysed. These blocks vary in size and in their partitions and their contours are of different geometrical forms.
- Finally, analyse, the relationships of geometrical organization of buildings by land parcel/land lot inside the above city blocks.

This chapter establishes the need for both the geo-historical reading of the urban space and the morphological approach to the built environment.

The main references in this regard include Rossi, Blanché, George, Greimas, the French Sémiotique group, Massey, Jess, Vidler, Habraken, Lefebvre, Foucault, Mumford, Jarroson, Ellul, Sennett, Patch, Chalfen, Avdelidi, Monod, Benevolo, Bökemann, Canguilhem, Christaller, Zeitoun, Stevens, Thom, Kempf, Boudon, Mandelbrot, Salingaros, D'Arcy Thompson, Coarelli, Braudel, Basham, Finke, et al., Castex, Depaule, Panerai, Costa, among many other bibliographical, archival, cartographic, or photographic sources. This chapter includes extensive visual and processed material from my own personal collection.

Chapter 3 focuses on the specific field and the terms used to approach the physical morphology of the urban fabric as follows:

- By emphasizing the critical analysis of the field closest to the theme of this work, which is called "urban morphology," examining its sources and the scientific field that supports it, with an emphasis on its geographical and historical perspective.
- By resetting the boundaries of the field of the "physical morphology of the urban fabric." This field aims to read the "real" object of physical development. The chapter addresses more specific theoretical issues related to the interdisciplinary dimension of the architectural-urban perspective on the terms "morphogenesis," "form," and "structure."
- By reviewing and discussing the "scale," which is considered a central issue in reading the urban fabric, physical transformation, and its morphological approach. The criteria chosen for reading physical objects do not have the same significance depending on the scale of the identification of their structural characteristics. Moreover, the type of approach as well as the objects under examination are scale dependent and vary accordingly.
- Finally, by examining the duality of "content-form" and the issue of the inherent properties of the architecture, the artificial constructed object that constitutes the urban fabric (such as buildings, streets, etc.). The reading of reality is made a function of scale, in the light of the physical and geometric perspective, where simultaneous reading with a physical perspective refers to the real object and one with a geometric perspective refers to the form, on different scales between them.

In this chapter, the main references include Lefebvre, Racine Wald-Topalov, D'Arcy Thompson, Goethe, Sorre, Durkheim, Halbwachs, International Seminar of Urban Form, Whitehand, Conzen, Leighly, Xenakis, Muratori, Emmerich, Rossi, Trappa, Petruccioli, Krier, Panerai, Vidler, Hillier, Monod, Thom, Secchi, Habraken, Aymonino, Boudon, Le Corbusier, Klein, and many others.

Chapter 4 encompasses the method that was developed as applied to selected regions. It constitutes an empirical research process, involving the interpretation of a series of diagrams and the analysis of urban examples. The research primarily focuses on identifying secondary elements related to the macroscopic, geometric standardization of the analysis. The relationships

and properties of these secondary elements are explored, as they reflect the relationships and properties of the primary elements of the urban fabric, as well as reflecting the accumulations and syntaxes during the processes of urban settlement, densification, and expansion. This research is conducted within the context of topographical correlations, with geometric regulations and divisions within the relationships of "streets-city blocks-parcels of urban land-buildings" identified in section 2.3.2.

New hypotheses are investigated in the actual spaces of selected regions and the real-world data are taken into account as two-dimensional topographical entities. Geometric elements are determined and graphically represented on the topographic data of cartographic representation. Two different states of the same urban area are compared, with a time gap of several decades between them. This comparison allows for the description of scaled relationships and interdependencies of urban fabric elements during development. As background, use is made of historical and contemporary general-use maps of the same medium geographical scale provided by the official geographic organization for each urban area.

The proposed morphological approach to capture and analyse the transformations of the urban fabric of a selected urban area includes the following steps:

- The analysis begins by interpreting the interrelationships of the primary urban elements, such as urban boundaries, spatial divisions into building blocks, land parcels, building structures, accumulations, and syntaxes. These interpretations lead to the identification of "secondary" elements, such as axes and division boundaries, which encompass and represent the primary elements for macroscopic geometric processing.
- The secondary elements are subjected to categorization and grouping operations. Through these operations, the secondary elements acquire properties related to the gradual accumulations and syntaxes of the primary elements of the urban fabric.
- The successive characterization of secondary elements leads to an ordered set, which, along with the entire set of operations, constitutes a structure. This structure arises from the manner in which the urban fabric develops and is related to the expansion and transformations of a specific urban area over a certain period.
- An important result of this process is the identification of "tertiary" elements, shaped by oriented curves that divide the study area into two topological regions. The sets of these oriented curves form a pattern (form). This pattern describes the sequence of accumulations and syntaxes of the primary elements of the urban fabric in accordance with the real development (expansion and transformation) of the urban fabric over time.

The significance of such a form lies in the description of the sequence of accumulations and syntaxes of primary elements in accordance with the real development process (growth and transformation) of the urban fabric over time. Moreover, this real development process establishes

a one-to-one correspondence between the secondary and tertiary elements subject to geometric processing and the primary elements subject to urban and spatial planning and design. Thus, any change in the primary elements leads to a change in the properties of the secondary and tertiary elements and vice versa. With the structure attributed to the properties of the secondary elements, it becomes possible to distinguish the relationships between them in a geometric space that, beyond the metric properties of the primary elements of the urban fabric, correlates with the morphogenetic process at the level of accumulations and syntaxes, the shape of which is determined by the tertiary elements. This finding is a valuable outcome of the project and could serve as a tool and object of study for large-scale spatial planning and design if further work is done, possibly involving mathematical and computational analysis and modelling.

The search, discovery, and representation of the elements, structure, and form mentioned earlier are based on cartographic, geometric, and detailed descriptive statistics and graphical analyses. The spatial analysis units include 1) the totality of the urban area of specific cities: Paris, Vienna, and Athens; 2) subsets or sections of the aforementioned cities. Specifically, I selected the La-Boucle-de-la-Seine (Paris) and Hietzing (Vienna) areas for applying the method, based on the criteria presented in section 4.1.2. In the case of La-Boucle-de-la-Seine, the elaboration includes explanations and detailed analyses of the processes, while in the case of Hietzing, only the processes for verifying the method are included.

Chapter 5 encompasses the final research processes of the thesis and examines both general and specific prerequisites for the application of the morphological approach method in the case of large cities urban areas.

The reference examples for this investigation are the urban areas of the major cities Paris, Vienna, and Athens. These cities were selected because, although they differ from one another, they each have a long history, and their urban areas are characterized by the coexistence of a wide range of different forms of built environment. Theoretically, this choice both specializes and limits the scope of the research to a common geo-historical context, namely, the European one. Nevertheless, the inclusion of studies of cities in different geo-historical areas and continents, although a necessary research endeavour, extends far beyond the scope of the present dissertation and requires the establishment of foundational research based, as previously mentioned, on the technical specifications of further mathematical elaboration, standardization and digitization of the method.

For an extensive and precise application of the method in the case of a large urban area, it would be indispensable to carry out an independent interdisciplinary research project and conduct quantitative research aimed at further mathematical processing and standardization, as well as digitization of both the data and the analytical procedures of the developed method. The prospect of such a project, beyond the scope of the present dissertation, would represent the natural continuation of the research processes described here.

Therefore, in this dissertation, more emphasis was placed on completing the research processes in a hypothetico-deductive and systematic way to support the proposal and explain the method. This method was originally developed by focusing, on the one hand, on the theoretical and empirical research of the interpretations of discrete spatial phenomena, with particular

attention to the enlargement of anthropogenic space as well as the field of physical morphology. On the other hand, it focuses on their synthesis and processing as a method of morphological approach to local transformations and enlargement of the built environment, as well as on the study of the prerequisites for their application.

In this chapter, the conditions for the implementation of the proposed method were examined, along with the manifestations, possibilities, and problems that arise in the case of large urban areas. The aim of both the pilot phase of research, which I consider to have conducted in this work, and the desired broader and quantitative research, is the creation of a corpus of empirical data capable of detailed comparison of the morphological findings with geo-historical and non-spatial data. The goal is to obtain findings from the case study of an entire urban area that can be compared with findings from another city or different types of cities, with the aim of enriching the body of quantitative and qualitative data for further elaboration of the method.

It is expected that the potential of morphological control over the enlargement and planning and design of urban development will be confirmed to identify the possibilities of controlling its fluid physical development through form and the morphogenetic process of development.

References are made to Mavridou, Lakatos, Kuhn, Costa, Benevolo, Foucault, Chadych et al, Couperie, Czeike, Schmidt, Mastrapas, Prevelakis, Travlos, Choay, Charre, Grimal, Pirenne, Moser, Vitruvius, Lavedan, Martin, Biris, Sivignon et al., Hassinger, Abdelidis, etc. Additionally, data sources include Eurostat, Elstat, Statistik Austria, INSEE, IAURIF, (Hellenic) Army Geographical Service, (Hellenic) National Social Research Center, Organisation of Planning and Environmental Protection of Athens, Bibliothèque Nationale, IGN, Magistrat der Stadt Wien, and more.

The final Chapter 6 includes general conclusions with specific subsections on "Object and Findings," "On Terminology," "Evolution, Development, Morphogenesis," and "On Methodology" of the work.