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Research Article

Between Parametricism and Pragmatism Concept Design Problematics in Zaha Hadid Architects' Digital Projects

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Abstract

This study provides a comprehensive analysis of the challenges in Zaha Hadid Architects' parametrical projects, focusing on recent digital technologies in the realms of "Architecture" and "Urban planning." Recently, Zaha Hadid Architects "urban-scale" project has awarded the title of "Parametric-urbanism" introduced a new urban design term to the world. This research delves into the design and implementation issues encountered in the Istanbul Kartal-Pendik Master Plan, parametric design which planned non-realistic, and fluiding plots and parcels not dependent on the city maps. 20th century early urban planning doctrines of C. Sitte and some French urbanists known as pragmatists, and realistic. The study expected to contribute design discourse with new approach parametric projects via French pragmatists problem solving methods. A comparative method is used to analyze the late 20th century parametric theories, and urbanism ideologies of 20th century; CIAM, Le Corbusier and French urbanists' "realistic" and "problem-solving" methods. Zaha Hadid Architects' "urban-scale" projects created via abstractions of parametric repetitive forms considered problematic. Some inconsistencies are observed in design and implementation process secondary parametric urban elements; road, axis, plot, parcel, block design and dimensions. Also, the urban scale parametric projects can be problematic in complicated, old, historical cities like Rome, Paris, Istanbul.

Keywords

Architecture, Parametricism, Pragmatism, Urban Design Theories, ZHA Architects

1. Introduction

This study presents a research involved the main problematic of design and implementation of parametricism with particular focus on "urban-scale" projects by Zaha Hadid Architects' in the context of the 20th-Century urban planning theories. Istanbul Kartal-Pendik District Master Plan creating a parametric skyline designed paradoxically for historical Istanbul Asian Side silhouette. With the innovative approaches in architecture and urban planning and the development of digital design parametricism it has evolved as a highly demanded design concept. While digital design represents a pioneering new style, it also creates certain challenges that may manifest as systematic design problems in the future. Nevertheless, these issues are being addressed by a worldwide network of designers who are working competitively to refine and improve parametric design techniques. Thus, this study aims to contribute to the subject and propose new approach via French pragmatists' method to reveal the existent problematic on the background of "urban-scale" parametric projects. Although, parametricism considered as an innovative method has gained significant devotion in re-

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cent research, there has also been a resurgence of interest in old urbanism ideologies and some design methods from past have also made a comeback. Therefore, this research aimed to contribute to the subject in the context of past urban planning discourse. The research methodology involves examining urban planning theories and doctrines, analyzing both Zaha Hadid's parametricsm, and other pragmatist French urbanists "realistic", "problem-solving" method, and CIAM's *The Congrès Internationaux d'Architecture Moderne*, (The International Congresses of Modern Architecture) technique also sorted by parametric designer as "modernist-urbanist". The parametric urban design and planning considered as a latest design approach the parametric architectural design method that developed after the 1990s. Zaha Hadid Architects are known for her remarkable avant-garde architectural design style primarily in parametrical architecture and urban planning in the late 20th century. Although their works are concentrated on free from topography with non-90-degree fluiding forms forced the limits of parametric urbanism. (Figures 1-2)

Since the in their earlier competition projects like The Peak in Singapore designed on a dark space form lacked and ignored the topography. The main problematic observed in their urban-scale projects, even in the earliest examples, is the planning projects without considering city maps and urban topography. While many studies have been conducted on various research subjects related to Zaha Hadid's projects, few have focused on the problematic aspects of their urban-scale projects. Thus, this study aims to address this research gap by focusing on their urban-scale projects and contributing to the literature on this subject.

Today, the concept of parametric design is widely used in "architecture" and "urban-design" projects, and it is becoming increasingly significant. However, the problems and challenges of its derivative, "parametric urbanism," have not been well revealed, particularly in city-scale projects.

Istanbul, Kartal-Pendik District Master Plan is aiming the addressing urbanization challenges in Istanbul by developing a subcenter on Istanbul's Asian side. The project involves recovering land that was previously occupied by industrial estates, and designing a new urban center that will help to relieve pressure on the historic core of the city [23]. One of the key challenges of the project integrating the new subcenter with the surrounding suburban towns, which are characterized by irregular, small scale parcels. This require careful planning and design to ensure that the new development is sensitive to the local context and complements the existing urban fabric.

While the Zaha Hadid Architects, planned many projects worldwide, only a few for historical cities, such as the MAXXI, National Museum of Contemporary Art and Architecture in Rome (Figures 1-2) or the Kartal-Pendik Master plan in Istanbul (Figures 3-4), and they reflect these common features. Although parametric design has been used in architecture for many years, the application in "urban-scale" projects only recently gained attention. The Istanbul Kartal-Pendik District Master Plan drew worldwide interest and was found to be a worthy as a research subject by academics in the multidisciplinary areas of architectural design, urban planning, and morphology.

The main problematic regarding the execution of prominent parametric projects by Zaha Hadid Architects' have not been thoroughly examined in urban-scale. The issues background of implementing such projects are still not well understood. In a recent article by P. Schumacher, titled "*Parametricsm A New Global Design For Architecture and Urban Design*" there is detailed and explanatory information about the design process phases for the Istanbul Kartal-Pendik project, which is an example of a parametric urbanism and city-scale projects.

In his recent article P. Schumacher analysis, the Istanbul, Kartal-Pendik District Masterplan parametricism and was among the notable work labeled as "parametric-urbanism" as a new term which is first mentioned. According to P. Schumacher: the competition winner and awarded the title by the AADRL *Architectural Association Design Research Laboratory*, as "Parametric Urbanism" (considering it is not a well-known title previously) the Master plans of ZHA, Zaha Hadid Architects were found to be quite remarkable [23]. In this article it is mentioned that the parametric design process focuses mainly on the creation technique of urban forms in the preliminary phase, inspired by the abstraction of Frei Otto, and then transferred them to urban topography to represent road networks. This approach may have been far from addressing the realistic urban fabric values and problems. These studies that focused on parametric urban planning may not have specifically addressed the realities of urban problems encountered in the cities. When examining the research tools used in the study of city-scale projects based on parametricism, it could be useful to approach the "problems" of "parametric-urbanism" planning and applications with different method, particularly with pragmatic methods based on real urban topography. Thus, various other research tools may be use examine the problems of "parametric urbanism"' planning and practices. Therefore, an original research method is proposed that focuses on revealing real problems of urban topography and city arranged as secondary elements: city axis, avenues, roads, parcels, plots, and blocks, etc. A method is used obtain urban-parametric projects and urban forms through abstractions, and inferences of real topographic data, (without considering a realistic method like French planners'). However, in this research the French urbanists "realistic" method and research tool were specified and used to discover problems topographic forms and examine the secondary city elements (roads, axis, plots, etc.) to search for the design and planning problematics of "urban-scale" parametrical projects.

Providing a more comprehensive review of the specified research; problematics on Zaha Hadid Architects' "urban-scale" projects are also examined in the context of 20th -century theories and "problem-solving" methods of French

urbanists. In 20th-century, projects designed by architects and planners in that era not considered existing old, city maps and topography so, French urbanists developed a distinctive and "problem-solving" method. Hence, these methods of the French "pragmatists" can be traced back to the principles of the great Austrian urban planning theorist C. Sitte's book *Der Städtebau*, (The Construction of City). Thus, the continuation of this school of 20th-century urbanists such as Henri Prost, (as architect-urbanist he prepared first Masterplans of the Istanbul city in the early 20th century) and his colleagues' "realistic" and "problem-solving" methods, known as founders of the Urbanism discipline in the early 20th century is examined. The French urbanists' methods could be used to reveal and solve the real problematic in Zaha Hadid Architects' projects [7]. In the context, CIAM is included to explain other urban planning disciplines of that era. CIAM and its prominent representative Le Corbusier did not consider the old urban fabric city of Paris when designing an urban-scale project like *Plan Voisin*. This emphasized the difference between the pragmatists' ideology and that of Le Corbusier.

2. The Research Methodology

This research aims to reveal the main problematics in the design and implementation of parametric urban planning via comparative analysis of parameticism and other urban planning techniques like CIAM, and French urbanists; Henri Prost and his colleagues "problem-solving" methods, based on two French urban planning theorists; F. Choay (in the book *l'Urbanisme Utopies et Réalités*) and P. Merlin. The study also focuse on examination projects such as the Istanbul, Kartal-Pendik Master Plan (Figure 9) to reveal problematic issues related to parametrical applications in the old, existing urban fabric, and city network in Istanbul, Kartal-Pendik district. The analysis is established on two main research paradigms:

1) The first research paradigm aims to explain Zaha Hadid Architects' parametric project design and implementation problematic by comparing them with the other urbanists "problem-solving" or pragmatist planning tools and methods of the lesser-known "realistic" approach in which French urbanists examined the problems in cities through detailed research on city maps at the beginning of the 20th century.
2) The second research paradigm is focus on the examining the urban planning methods used by Zaha Hadid Architects' projects as explained in P. Schumacher's latest article. Specifically, the problems examine stemmed from the design abstraction of parametrical fluidal forms, plot, block, design and production and road and axis planning. The problems of integration of these parametric; repetitive urban forms and roads and axis into the existing old urban fabric and network, as well as the implementation problems that arose from the application of parametric projects are also examined.

As an urban planning tool parametricism is first introduced as "Parametric-Urbanism" and is demonstrated through a series of competition-winning projects in urban theory. These projects are designed using computational design methodologies and multidisciplinary techniques, ranging from "building-scale" to "city-scale," and are examined through the urban planning theories. Zaha Hadid Architects' Kartal-Pendik District Master Plan is an example of an urban-scale project designed using parametric paradigms; "The concept of relationality extends its involvement from urbanism to architecture, and only then can the desired accentuating correlations be intensified by involving the systematic modulation of tectonic features [23]." While parametrically arranged "urban-scale" projects present new, innovative, more developed, and sophisticated suggestions for urban design, the implementation process led to some complex problems. These problems mostly stem from the old, historical urban fabric, which can create difficulties in practice. Even though newly designed landforms and parcels indicate the use of sophisticated design techniques, the implementation process of parametrically repetitive and subsequent parcels led to problems.

3. The Late 20th Century, a New Parametric Design Tool: Problems Large-Scale Projects in Urban Context

Toward the end of the 20th century, computer technologies and computational design became new design tools and determinants that significantly impacted the world of architecture. Digital technologies led to revolutionary developments with new design parameters, such as parametricism. Planning digital-based designs, specifically in large-scale projects, is considered a new application. Zaha Hadid's challenging ideas, which she pursued since her university years, beyond traditional architectural design methods, were realized through advanced modern computers turning them into new tools. Recently computer technologies have been adopted as the primary tool in architectural design, allowing for precise and boundary-pushing designs. Due to their projects, the developing computational design world has gained a new term in its terminology: "Parametric-urbanism," which highlights the urbanist potential of parametric design. This new design term is demonstrated by a series of competition-winning master plans [23]. Parametric design is considered a well-prepared and elaborated design approach that has been applied to many projects by their design group and has also been introduced as large-scale urbanism [24], They confront specific difficulties when solving urban problems and implementing projects. Even though explain that they considered the topography expressing via geometrical forms [25] (Figure 9), some problems emerge when planning urban-scale projects such as; land, plot, block design, and planning derived from analyzing the existing urban fabric and urban network according to the

overall designing techniques' general character of the multi-disciplinary technological and dialectical form ascendancy (bottom-up approach)."

Especially planning old, historical cities and their urban fabric often creates specific problems, in urban-scale projects. The old urban fabric, which consists of spontaneously developed irregular smaller and older parcels and a complex road network, leads to problems such as planning new roads, plots, parcels, and blocks that are not compatible with the city's real maps. The newly designed urban parts aim to ensure urban continuity within the city network, but parametrically designed plots, parcels, and blocks may indicate incompatibility between the existing urban fabric and parametric forms.

Although planning with digitalized parametric forms is considered a well-resolved approach, it can lead to some problems that do not coincide with the reality of cities. Thus, they may create multiple problematics in the cities, such as the continuity of the axis, incompatible parcel, and block dimensions, and differential and alienation to the existing urban fabric and network. While digital design is indispensable today and has become part of the technological transformations that have swept through all aspects of civilization, impacting, and changing our lives through the digitalization of all products, services, and professional disciplines [24] it may not be efficient to solve the city's urban-based problems that depend solely on parametric forms. (Figures 1 and 2)

3.1. The Urban Planning Theories Mid 1950's, CIAM, Modernism - The Praise of the Geometry

1) Two Direction of French Urban Theories; CIAM, Le Corbusier, and other Group of Urban planners

Architectural design techniques have evolved into different design paths with the emergence of parametricism, and rapidly developed parametric design has declared its sovereignty in the architectural design world since the 1990s. However, some theories from the past continue to develop in the design background. Although, parametric design has recently become fascinating as a new design tool in the design discourse that developed after the 1990s, when the back to the history of the design world, two approach became prominent in the middle of the 20th century. The first was the pioneered by Le Corbusier, and CIAM, [15] and the others are the French architect-urbanist groups that identified themselves by approaching the cities with a distinctive and problem-solving method [7]. Especially since the beginning of the 20th century, new, modern, and pragmatic ideologies have dominated the world of architecture and urban planning. In the mid-20th century, some architectural design and urban planning ideas came to the forefront in France. However, modern planners of the 20th century did not adequately consider topography and geography in their projects for city planning [16]. In the early 20th century, French urban planners realized that the projects designed by planners or architects were not compatible with existing topography and city maps [17]. Thus, they developed new "pragmatic" and "problem-solving" methods depend on realistic city maps.

French urban design theorist Françoise Choay emphasized the main problematic with Le Corbusier's projects stated that: "The weakness of the connection between urbanism and architecture in his works does not consider the historical urban fabric in his urbanism practices. This was the main problematic in Le Corbusier's design [5]." Le Corbusier's architectural approach relied on arranging forms using 90-degree angles strict geometrical forms, which are not compatible with the complex patterns and topography of existing urban fabric. He preferred the planning of modern urban plans and does not see value the picturesque irregularity of the old, medieval city [14]. Therefore, Le Corbusier's urban planning formulas defined as rational urbanism led to problems in cities and suburbs according to human requirements [18].

Le Corbusier's method is classified as Modernist-urbanist also criticized by a P. Schumacher against the curves as the popular architectural forms that applied by parametricism: "Le Corbusier admired the city order of the old Romans and rejected sentimental modern-day attachment to the picturesque irregularity of the medieval city: The curve is ruinous, difficult and dangerous, it is indeed a paralyzing thing [23]."

Although parametricism claims have developed completely different path from Le Corbusier's modernism ideology, still completely undeniable that it represents a leading planning method of the past, and on the contrary, it may even argue that parametricism has been used as a tool to justify the benefits of the architecture [23]. Le Corbusier's architectural limitation is not his insistence upon order but rather his limited conception of order in terms of classical geometry which since taught us to recognize, measure and simulate the complex patterns that was emerged from processes of self-organization, also, his urban patterns are identified as resulted from unplanned settlements which processes might now be analyze and it is appreciate their underlying logic and rationality, that was, their hidden regularity and associated power [23].

2) CIAM, and Other Group of French Urban Planners, Problem Solvers; Pragmatism &Realism

In the mid of the 20th- century, in addition to CIAM, another group of architects known as French architect-urbanists, including Henri Prost and his colleagues, who were the first-generation urbanist (educated in Architectural School not Urbanism or City Planning) and founders of the *l'urbanisme*; later developed new, realistic, pragmatic, and problem-solving planning methods [9]. These new methods were inspired by the ideas of culturalists or historicists such as C. Sitte from the 19th century [16]. Françoise Choay also contributed to the development of new theories of urbanism in her book -*l'Urbanisme Utopies Et Réalités* (Urbanism, Utopia and Realism) [3]. The urban planning discourse of the French architects-urbanists explained with the two types of models specified by a matrix: The first model is that of the Progressists and the second is of the Culturalists (also known as the

Historians' model), [5]. (Table 1) The culturalist model is re-evaluated, re-inspired, and re-organized in terms of plannings and drawings [16]. As the city planning emerged in the first half of the 20th- century, this model is defined as a "realistic" urbanism and is among the new theories [9]. The urbanists' "realistic" approach and "problem-solving" pragmatic methods are influenced by the protective approach of C. Citte, and J. Ruskin, as well as some innovative modern methods of the 20th- century planners such as: Cerda and Le Corbusier [16]. (Table 1). At the beginning of the 20th- century, new urbanism theories are applied by some French urbanists to produce new solutions to the existing urban problems in a pragmatical context [6].

Therefore, some French urbanists adopt a problem-solving approach to urban design. Although it is not possible to define a specific "style" of urbanism, this model of urbanism is considered an accomplish and applicable method for resolving urban problems. However, Zaha Hadid Architects' design discourse may not be entirely separate from the leading planning theories of the 20th century. (Table 1) Given that Hadid's education based on 20th-century theories, it is possible to identify the influence of this school of thought in her designs.

Table 1. *Comparisons Of the Observed Urban Planning Theories and the Parametricism, Table, Autor.*

URBAN THEORIES	FORMS-BLOCKS	INTEGRATION TO THE CITY	INTEGRATION TO THE TOPOGRAPHY	INTEGRATION TO URBAN NETWORK	GREEN-AREAS
CIAM	Rigit Block Forms & Modulation	Integration Problems	Integration Problems	Integration Problems	Green Theme
PRAGMATIC Problem Solving	Compatible Forms &	Problem solving-Integrated	Problem Solving-Integrated	Problem Solving-Integrated	Realistic-Nature
PARAMET RICISM	Fluidal Block Forms, Expression of Digital Techno., Fabric Modulations	Integration Problems Expression of Digitalized Technologies	Integration Problems, Expression of Digitalized Technologies	Integration Problems, Expression of Digitalized Technologies	Un-realistic Nature

3.2. Zaha Hadid Architects' New Synergy Between Computing and Design Thinking

The architectural design approach of Zaha Hadid Architects explained as relying on a synergy between the designer's genius and modern computer technology. Her unique architectural style has given rise to new terms such as deconstructivism, abstractionism, and parametricism. Despite not having built a major building yet, she is already considered a major figure in architectural deconstructivism by the Metropolitan Museum of Art [18]. Her works considered as examples of the newly defining architectural design method parametricism [26] (Figures 1 and 2) (Table 2) An article profiling in the *New Yorker* magazine titled her "the abstractionist" [22]. Later, she is awarded the *Pritzker Prize* in 2004, and the one of the jury chairman Lord Rothschild commented that "At the same time as her theoretical and academic work as a practitioner architect unsewered in commitment to modernism. Always inventive, she would move away from existing typology from high-tech and has shifted the geometry of buildings [21]."

Figure 1. *MAXXI Museum's axis considered to historical Rome city urban topography and buildings. The city Axis schema shown on the new Museum (red) and existing, old city axis (yellow) by Autor. MAXXI Museum, Rome, Italy. Image originally, Casabella, No. 786, p.675-678.*

Figure 2. *MAXXI Museum, Rome, Italy. Photo, Casabella, No. 786, p.675-678.*

3.3. Zaha Hadid Architects' Design Method, and Approach: The Rome Project MAXXI

1) Zaha Hadid's Projects and Design Approach in Her Early Career Years

Until the end of the 20th century, Zaha Hadid's architectural design dialect that is known for its innovative use of computational design and technology, which represented a new spirit of architecture. Hadid introduced a new architectural design tool that went far beyond human abilities through sophisticated computational design and fabrication. R. Koolhaas would state that "Her broad vision was consisted of worlds of angles she already focused on during her university years [13]." One of her earlier projects is the Design Museum, described in 2016 as having highly expressive, sweeping, variable, fluid forms with multiple perspective points and fragmented geometry that evoke the chaos of modern life [26]. Some of her project is focused on urban topography and landscape as an integrated part of existing city maps, considered as significant design factor. However, Edwin Heathcote express opposing opinions on her interventions in the topography rather than integrating it into the projects. In his article in the *Financial Times*, Heathcote noted that Hadid transformed the existing urban landscape with the Guangzhou Opera House, as the building rose in the center of the new business area [12]. (Table 2). According to Heathcote in 2011; "Z. Hadid produced a building that considered to integrate the surrounding landscape into a vortex of movement and a swirling space observed as both an alien object in a landscape of incomprehensible vastness (and often overwhelming banality), and as an extrusion of the peculiar nature of this landscape [26]".

2) MAXXI Project, Rome and Zaha Hadid Studio Courses in Yale University

Another significant project of Zaha Hadid's is the MAXXI National Museum of Contemporary art And Architecture in Rome project, specifically design in an ancient city of Rome, Italy. In contrast to their previous projects that reflect deconstructivism and exclude the earth and topography, the MAXXI project is planned in harmony with the topography and integrated into the old city layers [7]. During architectural studio lessons at Yale University, she explains that 'The MAXXI Project is designed as part of the existing diagonal city map system in the old, historical city of Rome's topography [1]. (Figures 1 and 2). Z. Hadid also mentions in Yale School that some historical elements in the city may be installed into modern destinations, adding that; "We could take that some further by installing historic elements into modern destinations [10]." Indeed, this idea included some references to the historicist C. Sitte and French problem-solving methods. Also describes that: "The Architect applied to computer technology and used serpentine like forms to match the natural folds of the old city's topography in her MAXXI Project in Rome [10]." (Figures 1 and 2) This approach is also declared by Schumacher: "The most important conceptual-formal-spatial innovations of folding in architecture are the concept of field conditions, continuous differentiation, iteration versus repetition, the slogans from part to particle and from typology to topology, and more concretely the concept of a single surface project [24]."

Table 2. *General Classification About Zaha Hadid's Projects. Table, Autor.*

ZAHA HADID PROJECTS	EARLY PROJECTS (BEFORE PARAMETRİCİSM)	ARCHITECTURAL PARAMETRICISM	URBAN PARAMETRICISM (Also Examined In This Study)
	1) The Peak, Hong Kong. 2) Cardiff Opera House. 3) Vitra Fire Station, Germany. 4) Copenhagen Museum Extension, Denmark.	1) Guangzhou Opera House, China. 2) Morpheous Hotel, Macau. 3) Dream Hotel, China. 4) Bejing Airport, China. 5) H. Aliyev, Cultural 6) Center, Azerbaijan.	1) MAXXI, Museum, Rome, Italy. 2) Istanbul, Kartal, Pendik Masterplan, Turkey.

3.4. Istanbul, Kartal-Pendik Master Plan: Multi-Disciplinary Parametricism, Architecture and the Urban Design

At the end of the 20th century, parametric design and computer thinking declared its hegemony in the architectural design world develop after the first avant-garde movement and later modernism. Parametricism as a digital design tool used by Zaha Hadid Architects, to identify and develop their architectural projects and applications. Although parametricism is initially developed as a design concept primarily used for architectural projects, later progressed, and evolved a multi-disciplinary technique. Their parametric urban-scale planning and multi-disciplinary techniques, from the "building-scale" to the "urban-scale" are considered a pervasive application that can be seen at all scales, from architecture to interior design, as well as large urban design [23].

The overall design technique is evidenced by the general character of the multi-disciplinary technological and dialectical form of ascendancy approach. The use of parametricism in "urban-scale" projects requires more complicated and sophisticated design and planning techniques than in "architectural-scale" projects, which can lead to complex problems, especially if the city plans are not well analyzed and examined. Therefore, they explain their city-scale plan and application methods while also emphasizing the adaptability problems that arise with the use of parametricism in urban-scale projects.

The integration of the evolving built environment, from urban distribution to architectural morphology needs to detail tectonic articulation and the systematic modulation, so it produces facilitations and the areal orientation, so the parametric urbanism may apply using the tools the parametric accentuation, parametric figuration –of fluidal and variable urban forms, plots, and blocks – [23]. However, the parametricism the main paradigms of this planning tool observe in their projects identified with flowing, folding, enveloped urban forms, solid plots and blocks or voids. The parametrical urban plannings is contains unusual design paradigms, and implementation problems technically which is also being more sophisticated than common architectural practices. Although the application of new and dissimilar parametrical forms on a unemployed city plot does not create significant problems, it may be led some adaptation and integration problems in the old, existing urban fabric network developed spontaneously over the years. This lack of harmony between newly produced parametric forms and existing forms can be make planning more problematic, especially when dealing with secondary urban elements such as; Axes, roads, streets, plots, and parcel arrangements. The integration of abstract forms into the existing urban fabric, as considered in the Istanbul, Kartal Master Plan, lead to the adaptation of unrealistic parametric forms to the existing urban network, be challenging. Therefore, Zaha Hadid's urban-scale projects, such as the Rome MAXXI Museum and the Istanbul Kartal-Pendik Master Plan, require constant consideration and analysis to ensure that they are compatible with the existing urban fabric and can be implemented successfully. (Figures 1, 2, 9)

Zaha Hadid's parametric design approach aims to create a sense of continuity and fluidity between the different scales of the urban context, from the plot design to the block design and beyond. However, this approach this sometimes may lead to problems of integration and compatibility with the existing urban fabric, particularly when the parametric forms are disconnected from the surrounding context. In the case of Istanbul's Kartal-Pendik Master Plan, (Figure 9) for example, some critics are argued that the parametric design elements are not well integrated with the existing street network, and topography, which creates a sense of disorientation and disconnection for the users of the space. (Figure 9)

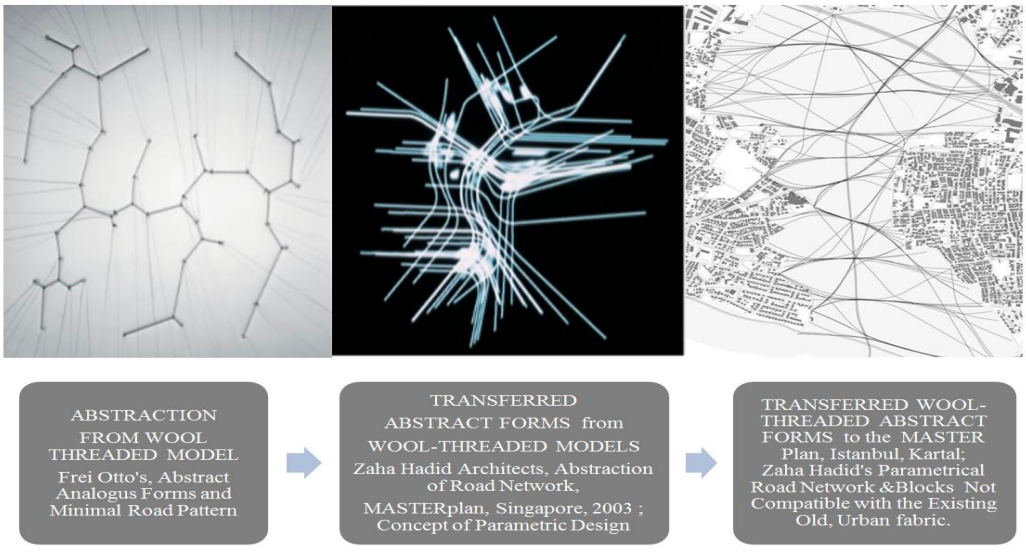

Figure 3. *PHASES of Parametrical Urban-Planning: via Transformation Frei Otto's Analogous Abstract Forms, to the Urban Forms Table, by Autor. İmages, A New Global Design, pp. 19-17-20.*

1) Parametric Urban Forms Obtained Through the Experimental Abstraction

The Istanbul Kartal-Pendik project by Zaha Hadid Architects preliminary concept generated respecting the parametricist paradigms on unmediated connections, the adjacent context, incoming lines of circulation, deemed an input for the urban geometry [23]. The project site is being reclaimed in industrial estates and surrounded by the small-grain fabric of suburban towns [23]. The parametrical design concept is aims to obtain the according to Frei Otto's experimental analysis [20]. In this experiment magnets and floating polystyrene chips are used cluster around the floating magnetic needles that maintain distance themselves obtained resembles the settlement patterns like in real urban landscapes [23, 20]. Based to this experiment, Frei Otto distinguish urban network through three fundamental types of configurations: direct path networks, minimal path networks and minimizing detour networks. The wool-threaded models over the theoretical direct, the characteristic patterns are surfaced in different regions of the parametric space [23]. (Figure 3, left, mid). The result of this experiment is explained that closely resembles the typical settlement patterns found in our real urban landscapes [23]. These forms which created inspired from Frei Otto's abstractions (octagonal forms) are transferred to the urban design project. However, abstracted parcels in project does not equivalent the old road system in the existing industrial fabric. (Figure 3, mid-right) These complex configurations in which multiple readings are latent constructed as a parametric model with extremely figuration, thus parametric variations triggered "gestalt-catastrophes "the quantitative modification of these parameters' qualitative shifts [23]. According to gestalt principles the topographic relation between "buildings" and "topography" not a significant matter. As a result, this Master plan proposal exhibits an alienated appearance and lacks integration with the existing urban fabric and network, it is far from solving real urban problems.

Figure 4. *PHASES of Parametrical Urban-Planning, via Transformation Frei Otto's Abstract Forms to the Urban Forms Table, Autor. İmages, A New Global Design, pp. 20-21, ZHA, website. Analysis (red) by Autor.*

2) Designing Parametric Systematic-Modulation and Urban Forms; Roads, Streets, Plots, and Blocks, etc.

The preliminary design method is used in the Istanbul, Pendik-Kartal Masterplan by transferring the abstract parametric forms obtained from the of Frei Otto's abstract forms. (Figures 3-4) Although the city axis, streets and roads are analysis in the project based on the existing city maps, incompatible urban forms are also obtained through abstractions. (Figure 4, mid, right). Especially, the extended plots the roads axis are assumed to be arranged appropriately in the project,

depend on real dimension of plots (originating from the existing forms of city-marked on red). (Figure 4, mid, right) In the final phase of the project, in 3D last image, the parcel forms are altered to parametrical systematic-modulation with repetitive square shape forms with void or inner courtyard (also referred to Cerda's blocks in Barcelona city) [4]. (Figures 6 to 8 right). These predetermined repetitive forms are explained in the project as the desired accentuating correlations intensified by involving "systematic modulation" of tectonic features, specified of the 'calligraphy blocks [23]. Assumed that planned to replace the vast monotony of older planned developments and the disorienting visual chaos that marks virtually all unregulated contemporary city expansions. urban maps, [23]. The definite dimensions of the city maps are arranged obtained through the abstracted "parametric" and "repetitive" forms (Figures 6 to 8 right). Although in project it is explained that they considered the topography and tried to express it through geometrical forms [25], it observed that the resulting forms do not adequately reflect this idea (Figure 4-left, mid, right) Indeed, these "systematic modulation" does not suitable with spontaneously formed old, existing, urban fabric in years. However, the newly generated repetitive and parametrical urban forms exhibit a distinct and incompatible character compared to the old, existing urban fabric (Figure 4) (Figures 6 to 8 right).

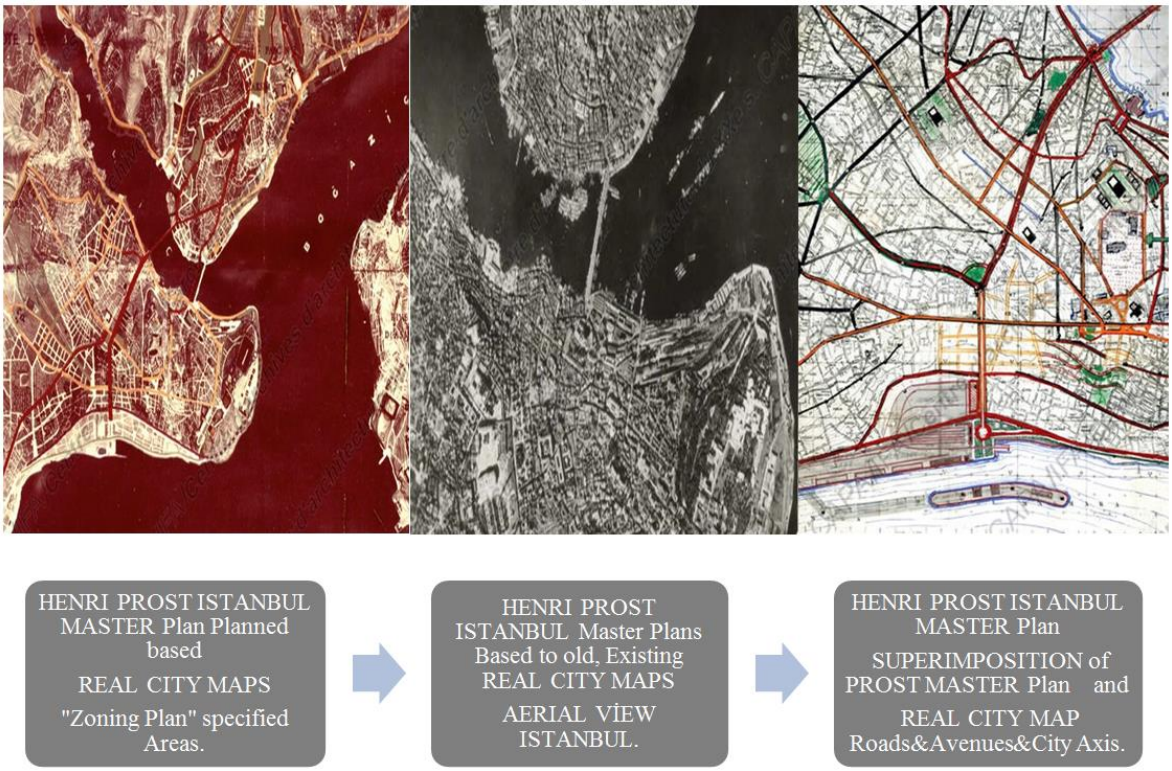

Figure 5. *PHASES of Problem Solving Urban-Planning via City Maps. IFA, Archives, Paris Parametricism and Comparing the French Urbanists' Pragmatist Methods.*

According to analysis, that is realized by the examining on Kartal-Pendik-Master plan it is observed that Zaha Hadid Architects' design approach, which relies on parametric design principles obtained through abstraction, may not be compatible with existing urban fabric and forms. (Figures 3, 4) (Figure 6, right) In this context, by considering solving the real problems in cities, urban planners are developed solutions more compatible through examining the existing urban fabric. For example, in the early 20th century French architect-urbanists, progressed some "realistic" and "pragmatic" methods focuses on "problem-solving" and inferring realistic solutions from existing city maps, provided valuable insights. Their problem-solving approaches in urban design, which involves analyzing existing city maps and addressing real-world urban issues through practical and realistic solutions. This method is consisting of more realistic approach the parametric design used by Zaha Hadid Architects project, focused primarily on generating abstract forms through parametric design principles then transmit and integrate them into the existing urban fabric. (Figure 4 left, mid, and right) French architect-urbanists applied historic data and city maps to their planning and design projects, inspiration from the traditional *l'embellissement, l'arrangement,* or "regulatory, beautifying, realistic" method of old French urban design school. The method developed by French architect-urbanist H. Prost, known as "modernization," project, is also applied in

Istanbul's development plans. He adopted a method and even drawn Istanbul Master plans directly on an Istanbul city's Touristic Map (Figure 5-right) emphasis on organizing roads, axes, squares, blocks, and other urban elements based on the real problems of the city and proposing practical solutions. In other words, the urban forms proposed by the French architect-urbanists are grounded in the reality of the city and aimed to solve existent urban problems. (Figure 5 left, mid, right) (Figures 6 to 8 Left).

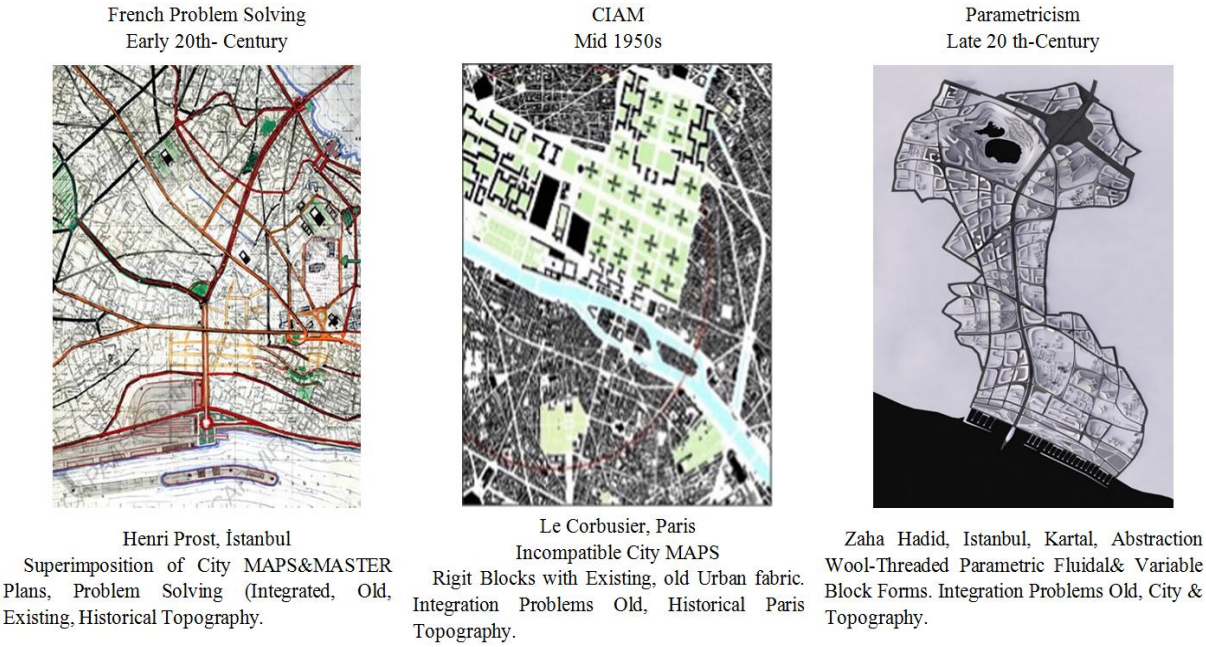

Figure 6. *COMPARISONS DESIGN OUTPUTS: Morphological Analysis Urban-Forms Parametrical/Others. Table, Autor. Images, (Left) IFA Archives, Paris, (Mid) Foundation Le Corbusier. (Right) ZHA, website.*

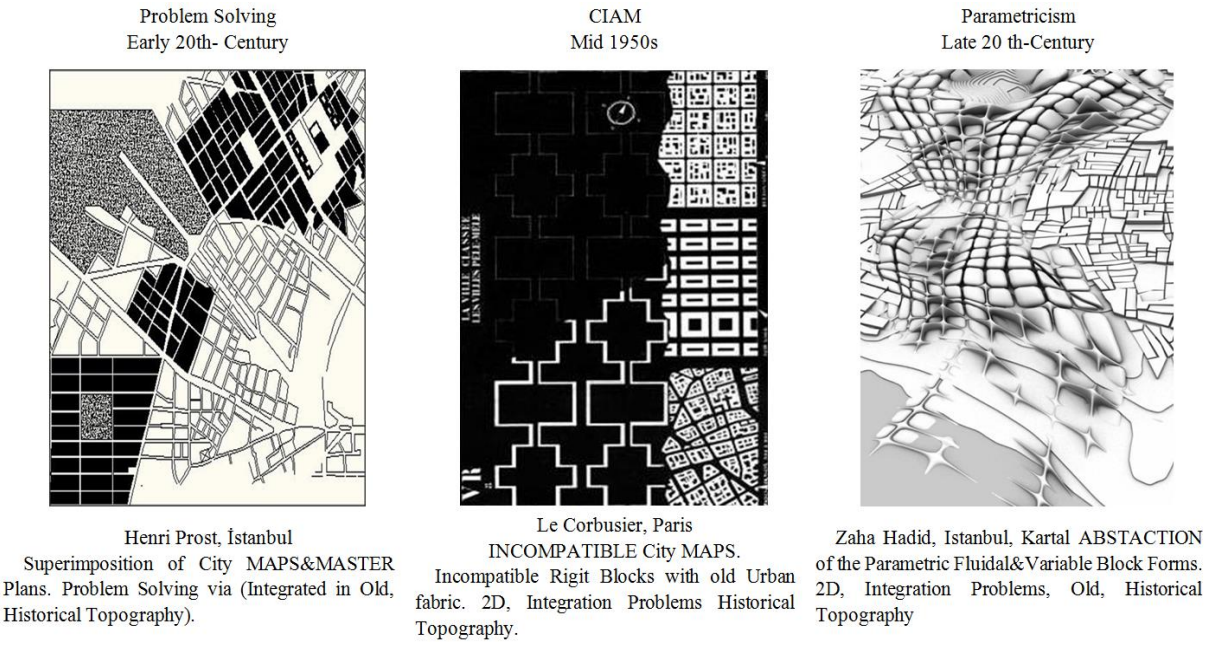

Figure 7. *COMPARISON DESIGN OUTPUTS: Morphological Analysis, Block-Forms Parametrical /Others. Table, (Left), by Autor orig. IFA Archives, Paris. (Mid) Foundation Le Corbusier, (Right) ZHA, website.*

Zaha Hadid Architects disregard the topographical facts which are also not included angles in its originally arranged for environment [8]. (Table 3, Figures 3-4) However, the main problem is the residential parcels did not comply with

such a complicated parametric design concept and created problems for Government side and landowners (Figures 6-7-8 right) (Figure 9). Although, this projects properly solve in terms of design problems, however it might not contain realistic urban solutions in practice especially created problems between Municipality and landowners. These issues ultimately stalled the implementation of project by the Regional Municipality as well as the project's inconsistency with the urban fact to inextricable difficulties –especially, some bureaucratic problems depend on land ownership and fragmented property ownership after the series of debates between the Government [2] It may explain that the Kartal Master plan could not be implemented due to project problems.

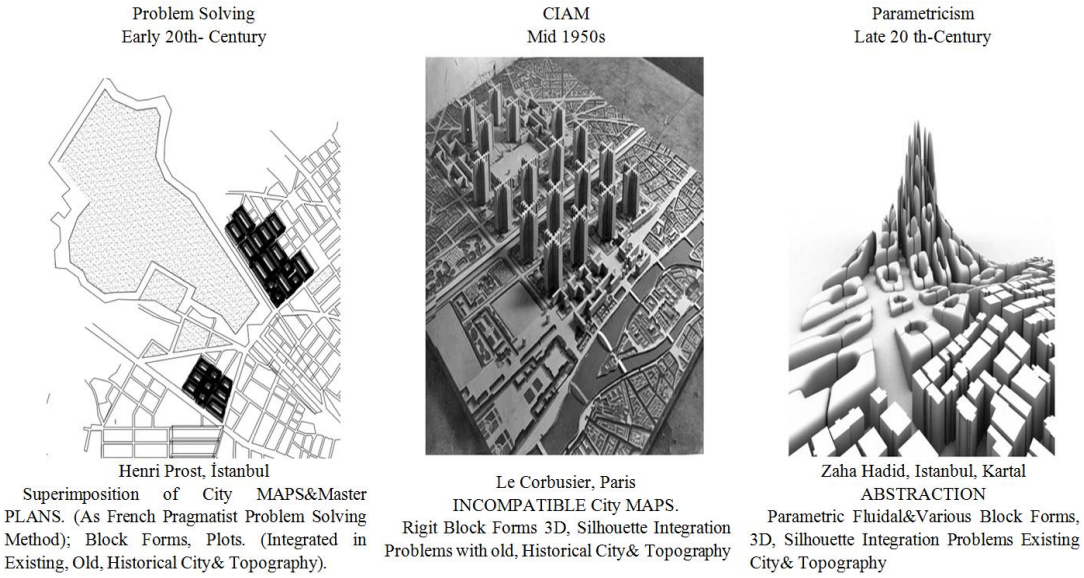

Figure 8. *COMPARISON DESIGN OUTPUTS: Morphological Analysis, Parametrical/CIAM/Others, Block-Forms (3Dimensions). Table, Autor. Images, (Left), Autor orig. IFA Archives, Paris, (Mid) Foundation Le Corbusier. (Right) ZHA. Website.*

Table 3. *The Main Problematics Examined ZHA, Zaha Hadid's Istanbul, Kartal Masterplan.*

The Main Problematics Examined ZHA, Zaha Hadid Kartal Masterplan Gentrification Projects in Kartal Region, Istanbul;
The main theme dependent on defining plots and blocks by parametric architecture.
The expression of topography and blocks according to the digitalized drawing technologies
Poor land and its surroundings to establish synergetic relationships.
The application of parametric design that does not match with existing urban fabric.
Un-realistic project approaches of the project and its elements.
Inextricable difficulties of implementation- legal (including competing stakeholders and fragmented property ownership-.

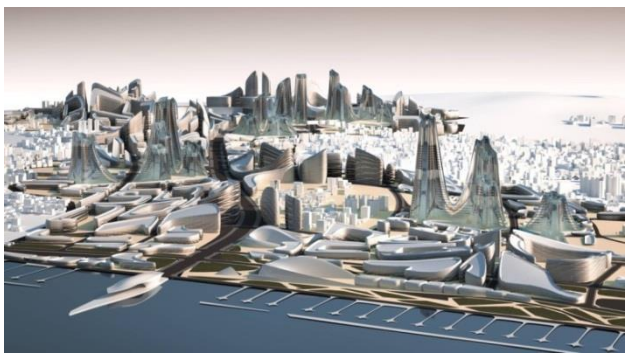

Figure 9. *Istanbul, Kartal Master Plan, Istanbul, Turkey. Photo, ZHA, Zaha Hadid Architects website.*

4. Discussions

Parametric design went beyond that is foreseen through the end of the 20th century they have a significant impact on the world of architecture and urban planning since the post-1990s period. Digital design has allowed architects and designers to create complex, regenerative concept design that are previously even impossible to conceive of. Parametric design will likely continue to play a crucial role in shaping the future of architecture and urban planning, as it offers a powerful tool for generating diverse and adaptable solutions.

Although parametricism has become a significant design method in recent years, some past urban planning ideologies and design methods have also made a comeback. Therefore, the scope of the research is expanded, and research depend on a comparative method is used. Hence, the urban planning methods of Zaha Hadid and other pragmatist French urbanists, such as "realistic" and "problem-solving" approaches, as well as the techniques of CIAM, are examined in this study.

Due to research had a limited scope, Zaha Hadid's earlier period projects considered to a lesser extent than her more recent works. Thus, Istanbul, Kartal-Pendik Master plan is the primary focus of the research as a case study as well as the an urban-scale project. The research aimed to analyze and compare the Architect's design approach with earlier urbanism doctrines and ideologies, with a particular emphasis on Istanbul, Kartal-Pendik Master plan. Although it is not possible to find a place many of her projects in the research, only the data inferred from this project contribute to a conclusion.

Also, at the beginning the research is achieved an assumption that problems arise they does not adopt urban design ideas and city maps in “urban-scale” projects. However, during to Zaha Hadid’s studio lessons in Yale University, particularly in design process in Rome, MAXXI projects witnessed some explanations of the projects that they highly considered the historical past and layers of the ancient Rome city. Although they focus on a different method within the scope of parametricism in the Kartal-Pendik Master plan, achieved the fact that also considers old, historical cities, urban layers, and urban maps like Rome city. In this project, they indicate a different approach followed design theories close to the French pragmatists’ ideologies and methods considering the city maps and topography especially in old, historic city in Rome.

Furthermore, the main problematic specified in the project that is observed that the Kartal-Pendik Master project does not comply with real city maps and has problems due to the existing, old irregular Master plans and topography developed spontaneously in the years, it is considered to a successful project in terms of design. It is also unfortunate for the skyline of city of Istanbul that this great project of ZHA. Zaha Hadid Architects was not implemented.

5. Conclusion

In this study the design paradigms of parametric design searched via comparative research method also the other urban planning theories; CIAM and some French urbanists’ pragmatist "problem-solving" method is examined. The Istanbul Kartal plan proposal and the parametricism, which is used as a planning tool and the reasons of the problems of this project were examined. (Figures 3 to 5), (Figures 6 to 8).

The Istanbul, Kartal-Pendik Master plan is a well-planned project designed by Zaha Hadid Architects adopt a parametric design tool as regenerative digital design. Although digital design offers many conveniences to produce specific design techniques in the design world in the 20th century, it is observed that some difficulties confronted in especially after the preliminary design phase; In the “architectural-scale” and implementation. While the parametric design may have solved design problems, it may not have provided realistic urban solutions in practice. This highlights the need for designers and architects to consider not only the aesthetic and conceptual aspects of their projects but also their practical implementation in real-world urban maps and environments.

According to result of the comparative analysis realized on the project.

1) The main problematic observed in the process of the transformation and replacement of abstracted forms to the urban maps.
2) The problems are observed in the parametric design especially in the design phase and transition from “city-scale” to “architectural-scale” and transmitting the abstract forms to the repetitive parametric systems which is not compatible with each other on the real city and maps.
3) The most problematic phase that observed in the research also reveals the problems of incompatibility of parametric plots and parcels with existing parcels, is in the “architectural-scale” project design phase and implementation phase.

Also, it is observed that in the implementation phase, parametric forms indicates that adaptation problems to the existing city forms and maps, as irrelevant and not compatible the existing city topography arranged by parametric principles. Design problems mostly arise in the implementation of "urban-scale" projects in the old and historical urban fabric. Furthermore secondary elements like; the city axis, street axis, as well as the shape and dimension of; plot, parcel, block, and building-blocks do not compatible to the existing urban fabric. The French architect-urbanists’ method may be proposed to solve the problems stemmed from parametricsm. French urbanists’ method known as “problem-solving” and they analyzed the cities through the real city maps, real data and outputs. French architect-urbanist Henri Prost applied this method and designed the city plans of Istanbul directly on the

city maps, the axes of the city, its roads, and the blocks and buildings that border those roads.

According to the determined result of the analysis, the designs produced by French urbanists through the approaching the projects with problem solving method compatible with the current city maps, forms and these are planned accordance to the city network, avenues, streets, plots, and parcels.

On conclusion, also, for parametric "urban-scale" projects, an intermediate method may be developed by being inspired by the method of the French urbanists;

1) In "urban-scale" phase; city axes, roads and blocks may be developed or abstracted through the real city maps.
2) However, in "architecture-scale", in block and building design, besides city-maps also various abstraction methods may be used.
3) In other words; In the "urban-scale", in accordance with the urban reality the main connections and features of the super-forms at the urban-scale like; City axes, streets, axes, plots, and parcels, etc. may be determined on real maps. However, at the "architectural-scale", it would be better to determine parametric sub-forms through parametric abstraction, independent of city maps like; building-blocks and buildings etc.

On this research also some solutions proposed to the problematic that parametric designers confronted on their "urban-scale" project; Based to "realistic" and "pragmatic" ideologies the French urbanists' "urban-design" ideas applied in the "urban-scale" projects. French urbanists' pragmatic method may be used in the "urban-scale" project phase for preparing city plans, and that parametric systems could be utilized through an abstraction originating from real city maps instead of some forms not related to city elements.

Data Availability Statement

Kindly confirm that the DATA shared my manuscript is ethically correct and available to share. Furthermore, as an Autor I am Hülya Coskun as an "only Author" also "Corresponding Autor" is only person has responsibility on this manuscript.

Abbreviations

AADRL: Architectural Association Design Research Laboratory.

CIAM: The Congrès Internationaux d'Architecture Moderne (The International Congress of Modern Architecture).

MAXXI: National Museum of Contemporary art and Architecture in Rome

ZHA: Zaha Hadid Architects

Conflicts of Interest

The author declared that no conflicts of interest.

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