‘PARAMETRIC LANDSCAPE URBANISM’:
A MODEL PROPOSAL FOR OPERATIONAL FRAMEWORK

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ABSTRACT

`PARAMETRIC LANDSCAPE URBANISM`:
A MODEL PROPOSAL FOR OPERATIONAL FRAMEWORK

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Most of the contemporary cities today tend to integrate landscape into their infrastructure of water harvesting, land reclamation, and transportation by reclaiming them as the new system of public space. In this context, landscape urbanism suggests new methodologies to design and organize that comprehensive and complex integration process. The question of organizing that integration has already become a a prominent question both in practice and research. With the new interpretation of the landscape concept, landscape urbanism can be a new sustainable approach to urban design field in a wider framework of infrastructure and territory. From this standpoint, this thesis discusses the emerging approaches in landscape urbanism from a methodological perspective. While landscape architecture is used to be understood with a simplistic reduction of ‘design with nature,' modern city planning has already proved its limited disciplinary capability to manage the complexity of urban formation under the dynamic influence of a suite of urban realms and ecological factors. Giving the fact that landscape architecture needs to be provided with more strategic perspectives on urban form and city planning that require more robust tools and techniques to deal with the cities by controlling the territorial flows and networks, a possible coalition of the two disciplines (i.e. landscape architecture and urban planning) can emerge as a new field. Landscape urbanism, in this context, requires a search for new methodologies providing an alternative outlook on both representation and design. In this framework, this research mainly discusses the emerging techniques applied in the recent design and research projects in landscape urbanism. The study mainly focuses on the issue of design tools and techniques applied in the field. Not only the existing design methods but also a possible alternative will be eventually argued in the proposed study.

In this context, the London Olympic Park is selected as a case and the proposed model is tested via the design algorithm applied on a real basis. Rather than focusing on the end-product, the study of design modelling rather aims to open up a discussion on the process itself by applying the method of parametric modelling in urban context. The research finally concludes the overall discussion with the alternative design patterns for the selected case study area.

Keywords: Parametric Design, Landscape Design, Urban Design, Landscape Urbanism

ÖZ

\`PARAMETRİK PEYZAJ ŞEHİRCİLİĞİ\`: OPERASYONEL BİR ÇERÇEVE İÇİN MODEL ÖNERİSİ

Akman, Sadık Deniz

Yüksek Lisans,Kentsel Tasarım, Şehir ve Bölge Planlama Bölümü
Tez Yöneticisi: Yrd. Doç. Dr. Olgu Çalışkan

Ağustos 2017, 125 Sayfa

Günümüzde peyzaj kavramını, kentsel form ve programları ile bütünleşebilen şehirler; yağmur suyu yönetimi, atıl durumdaki altyapının yeniden kentsel mekan olarak kazandırılması gibi bir çok açıdan yüksek başarımlar göstermektedirler. Bu bağlamda, peyzaj şehirciliği, tasarıma sunduğu yeni yöntemler ve kent-peyzaj bütünleşmesini organize etmesiyle, uygulama ve araştırmaya önemli girdiler sunmaktadır. Peyzaj kavramının bu bağlamda yeniden yorumlanmasıyla, altyapı ve arazi çerçevesinde, peyzaj şehirciligi kentsel tasarım alanında yenilikçi ve sürdürülebilir bir yaklaşım olarak karşımıza çıkmaktadır. Bu açıdan tez, tasarım ve planlama alanındaki yeni modelleri, yöntemsel açıdan tartışmaya açmaktadır. Peyzaj mimarlığı geleneksel olarak, basitleştirilmiş biçimde 'doğa ile tasarım' olarak anlaşılmış olsada, modern şehircilikte kentsel süreçlerin karışık yapısının peyzajın dinamik yapısıyla yönetebileceğini kanıtlamıştır. Peyzaj şehirciligi bu bağlamda kendisini kentsel form üretimi üzerinden stratejik perspektifle ortaya koymalı, şehir planlama ve peyzaj mimarlığı arasındaki olası bir arayüzü sağlamak amacıyla, arazi akışı ve kentsel ağ gibi kontrol mekanizmalarını kurarken daha güçlü araçlara ve yöntemlere gerek duymaktadır bu durum ancak peyzaj şehirciliğinin alternatif tasarım araçlarına ve yöntemlerine araştırmasıyla olasıdır.

Bu çerçevede, tez, peyzaj tasarımı ve planlaması alanında ortaya konmuş projeler üzerinden peyzaj şehirciliğindeki yenilikçi tasarım tekniklerini tartışmaktadır. Bu anlamda, araştırma ağırlıklı olarak pratikte uygulanan tasarım yöntemleri ve araçları üzerine odaklanmaktadır. Örnek çalışmada ise var olan tasarım yöntemlerine yönelik tartışma üzerinden yeni bir alternatif model önerisi gelistirilmektedir.

Bu bağlamda, Londra Olimpiyat Parkı örnek alan olarak seçilmiştir. Önerilen parametrik model, belirlenen parametreler doğrultusunda tasarım algoritması ile test edilmiştir. Çalışma, seçili alanın özgün mekansal sorunlarına yanıt vermekten cok modelin hedeflemiş olduğu parametrik operasyonlara ve üretken algoritmik tasarım modeline altlık sunmaktadır. Model önerisi olarak geliştirilen araştırma, çalışma alanı üzerinden alternatif örüntüleri ortaya koymakta ve model önerisinin genel kurgusunu belirleyip test etmektedir.

Anahtar Kelimeler: Parametrik Tasarım, Peyzaj Tasarımı, Kentsel Tasarım, Peyzaj Şehirciliği

To My Family…

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Sadık Deniz Akman

August, 2017

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CHAPTER 1

INTRODUCTION

With the emerging field of landscape urbanism discourse, some cities have emphasized landscape more into their accounts. The incorporation of landscape into cities has been demonstrated in various performative aspects such as brown field reclamation, green infrastructure, water purification and flood management. Landscape urbanism affects architecture and design fields by suggesting new strategies and concepts to integrate city and nature as one entity thoroughly and looking for a stronger basis in research and practice.

When the new term ‘landscape urbanism’ was created in the late 1990s out of the landscape architecture profession, its discourse brought a huge change and was discussed in both academia and practice (Waldheim, 2006). James Corner and Charles Waldheim are the leading professionals on the topic ‘landscape urbanism’.

Through the promises of landscape urbanism, ideas can be utilized as a new concept in the field of urban design when explored from a wider perspective. Thus, this thesis aims to discuss the emerging design methodologies in landscape urbanism.

Although the field of landscape architecture was defined as a naïve and misconducted reduction of `nature with design`(McHarg, 1969), it recently gained an important role in the field of urban design. Modern urban design field started to look at innovative ways to cope with the complexity of urban tissues under the constant threats of human activities. In modern urbanism, studies need to urgently find new methodologies and models, which provide an alternative approach on both interpretation and framework creating a possibility for a new organization of multidisciplinary area.

1.1 Problem Statement

In the age of information, the global society is involved in electronics, computer programs and machinery like never before. Innovative technologies that have been created make lives easier and more efficient which have also influenced creative minds. As an emerging field, computer science has been extremely prevalent in the discourse of architecture and design fields. With new technological improvements computer science allows us to understand the process of thinking and complexity of nature more easily and efficiently.

By the groundbreaking processes of design, the field of architecture started searching for new systems and multidisciplinary tools to explore its limits, in landscape architecture and urban planning. Such a systematic search for a possible integration between landscape architecture and urban planning in the context of space creation in the urban design field stands out as the biggest problem in this research.

While `parametric urbanism` and `parametricism` guide the thematical framework of this research, possible collaboration between landscape urbanism and parametric design is investigated. Using parametric principles, both their structure and the relationship between research fields ensure a definition of landscape elements and interaction between those elements with the main aim of the `parametric` definitions and their potentialities to create emergent, generative and innovative spaces (Figure 1).

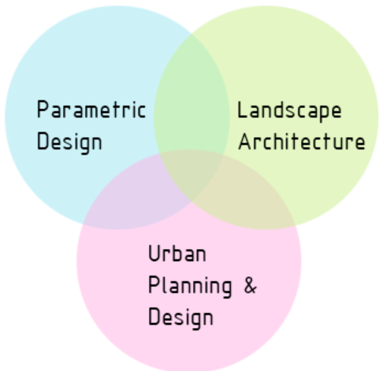


Figure 1: The main disciplinary domains that the research tends to relate

Despite that generative urbanism utilizing parametric design tools and techniques is an approach that has been widely accepted in contemporary urban design, it has limited use in the practice of landscape architecture and landscape urbanism. By considering the theoretical background of landscape urbanism and parametric urbanism, this research explores the possibility of creating a coalition between these two different approaches to provide a framework for a generative model. In attempt of improving the understanding of space formation and experimenting with their morphological elements, geometries, and their relationships, certain parametric methods need to be developed. Examining and applying generative modeling to urban design typology may theoretically improve further outcomes by iterating various forms of variables and have a great potential to break off traditional codes and standards to create an influential pathway for designers and researchers.

The concepts of landscape urbanism and landscape have already been methodologically researched regarding the possibility of integrating landscape architecture and urban planning. In Table 1, the investigated research questions are listed. To answer the research questions, existing emergent methods and tools of generative design are looked into.

Table 1: Research Questions

Can landscape urbanism provide an efficient and useful design approach to urban design?
Can landscape urbanism be incorporated with urban space making processes?
Can the emerging generative design method `parametric design` be utilized as an operational tool in landscape urbanism?

1.2 Aims of the Research

The key objective of this study is to propose a model consisting of landscape elements that can deal with the issue of space creation in the urban design field. The research study seeks to find alternative strategies by looking at different approaches. Moreover, it focuses on `landscape urbanism` and its theoretical background to define a research area and look for possibilities of `landscape` concept to be used as a new morphological element in urban design space making process.

In search of new methodologies, the emerging techniques called `parametric design` applied within the new design and research projects in urban design practice are discussed in this research. Also, a comparison between new emerging techniques and traditional architecture and landscape architecture practices is carried out. In addition to looking at existing and emerging methods, this thesis investigates new possibilities to be suggested.

There has not been sufficient studies on exploring the full potential of introducing new digital design tools to find ways to include landscape elements in generative and relational design tools that can be utilized as an interface between landscape architecture and urban design. Thus, this thesis aims to investigate the possibilities of utilizing parametric design tools in urban space design in the special context of landscape urbanism (Figure 2).

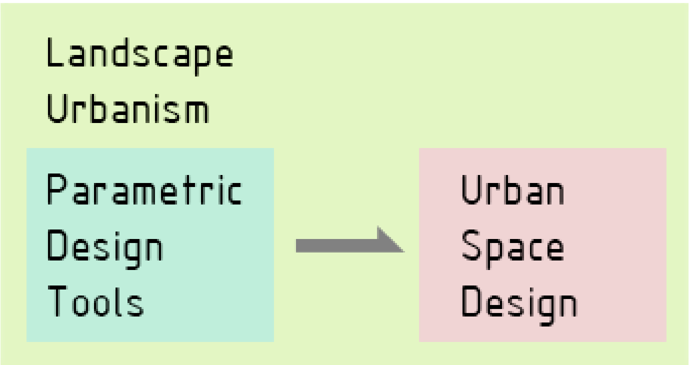


Figure 2: Scope of the research

The model approach developed for the parametric design of landscape elements is created by using the parametric definition of the morphological elements of landscape urbanism. It is mainly argued that the final result could come up with a series of systematically generated typologies.

1.3 Method of the Research

The main parts of this research constitutes of seven stages, as can be seen in Figure 3.

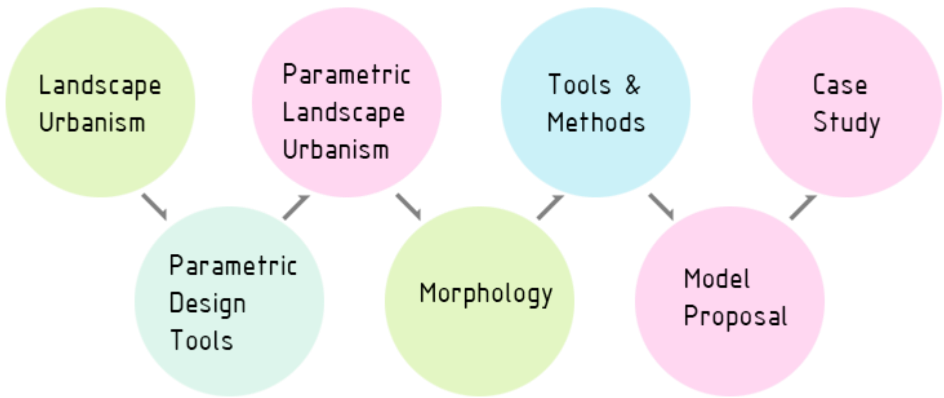


Figure 3: The main parts of the Research

A wide-range of literature on parametric design and landscape urbanism is reviewed in this research. Although those two areas are relatively liberated topics, they are very similar regarding the methods used to solve some complex urban design problems. The theoretical and generative model are the outcomes of this design thesis.

The proposed model aims to achieve a better understanding of how landscape elements come together with parameters and how they interact with each other in a generative manner. Landscape elements are not only created by two-dimensional sections but also by three-dimensional elements to fully understand how landscape can also be integrated into the creation process of landscape-urban morphology.

This thesis focuses on the analysis of details, the outcomes of the end product and the generative design model. Incorporating new approaches and design tools in landscape urbanism and re-combining design methods and strategies to include the concept of landscape in the urban design field are argued in this research.

1.4 Scope of the Research

This research is composed of three main chapters apart from the introduction and conclusion parts. It begins with a theoretical framework, then examines the landscape urbanism project cases, and concludes with a model proposal along with a general evaluation.

This thesis starts with an introductory chapter on the main hypothesis of the issue of space formation in urban design, in which parametric models would provide a generative tool including landscape elements in the design process. Afterward, an overview that covers the scale of the design model proposal and questions to draw the framework of the research area is given.

In the Second chapter, the concept of landscape urbanism is discussed in detail concerning the basic categories and the main approaches revealed in given examples and projects. In a critical review of the major readings of landscape urbanism, a conceptual framework for the thesis provides a re-reading of `landscape urbanism` in a critical and practical perspective. Through the multiple dimensions of landscape, urbanism has been highly discussed in recent years in theoretical content; the thesis tends to understand the possibilities of landscape urbanism from a methodological perspective to achieve models and practice outcomes of the design field.

In the following chapter, the current state of the art on parametric urbanism is critically discussed with its presented methods and project examples. The framework of `parametric urbanism` discourse is further explored to its morphological and perceptual income by examining its outputs to parametric design thinking. Tools and methods in an actual urban context is applied by the practitioner and parametric design projects case examples are examined for further collaboration between parametric urbanism and landscape urbanism tool and methods in the final hypothetical model.

The proposal for the operating environment will generate a new terminology in the landscape field to be used as a morphological indicator and create new elements and operations to the emerging field. While bringing parametric design and the developing technique of computational design into the landscape urbanism domain, the idea of \`parametric urbanism\` is reviewed to make a clear evaluation of parametric design methods.

Finally, in the concluding chapter, the reader is provided with a series of critical statements on the major findings of the research. This part provides the results of the design model proposal through a comparison between the algorithmically generated urban form variations. A discussion on the interrelation between parametric design and landscape urbanism is eventually made to test the relevance of landscape elements in urban space design to create distinctive morphologies at the level of urban scale.

CHAPTER 2

LANDSCAPE URBANISM

This chapter focuses on the significance of landscape urbanism. Landscape urbanism projects and fundamental aspects emerging from them, has been searching for possible integration approaches between landscape architecture and urban design. To create a robust methodology and framework for a parametric model, this chapter will investigate contemporary and previous projects of landscape urbanism. Theoretical discussions on landscape urbanism, its history, emergence and practice, provides a critical discussion though field and project examples and gives hints for creating a morphological aspect of landscape urbanism by defining missing elements and relational operations. The main aim of this chapter is to develop an operational framework focusing on morphological aspect of landscape urbanism field.

Landscape urbanism intertwines city, environment and ecology in an organic manner and has been in the urban design agenda since the early 1990s. The main focus of this chapter is to understand what landscape urbanism generically and key aspects regarding urban design and urban morphology. This thesis claims that all urbanism discourses are significant and they could interplay with each other to find a different mixture of theories. Urbanism discourses also have important contributions in urban morphology to create new urban typologies and performative spaces. Therefore, this chapter focuses on the establishment of an operational framework to define new urban design elements that can form the basis for parametrical operations and explain why landscape urbanism is important and how it is distinctive from other urbanism concepts such as new urbanism.

Most of the pre-industrialized cities were small and the surrounding landscapes were always very close to them. In modern times, urban areas cover broad spaces and consequently understading the relationship between natural and urban environment has became more important. The changing relationship between urban and natural environment has also influenced architecture and related professions. With the growing importance of city and landscape relationship, the popularity of landscape urbanism has also expanded. Through the changing relationship between nature and city, a differentiation in professional disciplines such as landscape architecture was created which gained popularity during modern urbanization.

In the discourse of urbanism, many ideas and themes were generated through history, and some of them still exist. However, over time, the necessity for these ideas and themes decreased and even forgotten. To illustrate, Garden City Idea from Ebenezer Howard (Howard & Osborn, 1965) is currently in contemporary urbanism discourse and has highly substantial effects on urban projects over the world. The idea of Landscape urbanism evolved from recent ideas such as Garden City Idea and the main ideas were taken from Ian McHarg's book `Design with Nature' (McHarg, 1969) which discusses the relationship between city and landscape, in other words human versus nature.

In the last decade, landscape urbanism has been a debated topic among practitioners and academicians who are involved in forming the contemporary urban area. Landscape urbanism offers a new understanding of the concept of landscape and empowers its meaning in relation to urban realms. With landscape, urbanism discourses present new urban morphologies that look for new approaches and models when designing the city to overcome conventional urban design methods.

Climate change is a factor that is taken into consideration when designing cities and landscape urbanism plays a vital role in this process. New ways and strategies must be found for cities to adapt with climate change. Since there are many cities growing around seaports, adaptation to rising sea levels will become a major consideration in time. Adaptation is one of the concepts introduced in landscape urbanism discourse; it means learning new ways to organize the natural environment. To organize urban environment, constant change and adaptation are critical to overcome occurring temporary incidents in cities. Today cities are facing many environmental and economic problems. Thus, the concept of the landscape can suggest adaptive elements to create strategies for adaptive cities.

New conditions that will evolve into natural systems over time should be created and built. Adaptation comes from evolution. The creation of new solutions for new circumstances is encoded in human DNA. To be able to survive, the human race has continuously adapted itself to changing circumstances and environments. By making an analogy, cities have also evolved and adapted to new conditions. Considering landscape as an evolving entity rather than a stable one can be a great tool to manage cities that are in an evolution process.

The main aim of this chapter is to define the concept of landscape urbanism and create a framework for parametrical operations. Since cities today are facing many global issues, landscape urbanism has to ground itself with adaptable tools. Tools and methods are needed to define design operations that can control the evolutionary process of urbanization and create adaptive city scenarios that are coherent with landscape and nature. Experimenting with those operations will provide the field of urban design with a model of research by design that would define how landscape urbanism practice works and how it can be characterized.

2.1 LANDSCAPE URBANISM AS A NEW FIELD OF RESEARCH AND PRACTICE

2.1.1 Definition of Landscape Urbanism

As one of urban planning theories, landscape urbanism which is a theory that supports the idea of urbanism according to landscape dynamics (i.e. it is constraints and potentials) instead of building structure only. Although the term of 'landscape urbanism' has been used in many different forms since it was first found in the middle of the 1990s, it is commonly referred to as postmodernist or post-postmodernist. This citation is seen as a response to the shortcomings of new urbanism.

As a new challenge to new urbanism, landscape urbanism was defined by Brown, Dixon, & Gillham (2009) as "A mode of thinking about the design and functioning of cities that uses landscape as lens by which cities are both understood and shaped."(p. 262). Landscape urbanism briefly uses landscape as a medium for designing cities and a model for contemporary city (Waldheim, 2016). Although landscape has been used as a medium for design in many contemporary project concepts, there is a potential for creating a new approach to the process of contemporary urbanization.

According to Heins (2015), the relationship between the competing urban design movements new urbanism and landscape urbanism has been antagonistic and this antagonistic discussions have a more negative effect compared to the creation of new opportunities for emerging urbanization problems.

From the very definition of landscape urbanism discussion, both landscape urbanism and new urbanism are concerned with suburban sprawl and developing solutions for complex urbanization processes. Although the two fields seem contradictory, they both aim to find a general framework for development and construction. In that regard, this thesis focuses on finding methods and tools rather than carrying out a field discussion of both urbanism concepts (Ellis, 2015). Landscape urbanism has been already influencing the field of urban design by expanding the understanding of public green space beyond streets. However, the development of unique tools and methods are still needed to have a ground breaking approach towards urbanism (Kullmann, 2015).

By the late 1990s, post-industrial cities in the United States, such as Detroit, were declining and the term ‘landscape urbanism’ was used by landscape architects to refer to such cities. On the other hand, by the early 2000s, the European architects used the same term to refer to flexible approaches that to create a fusion between large-scale infrastructure, residence, and open space.

2.1.1.1 History of Landscape Urbanism

In this chapter, a new look will be taken into the history and emergence of landscape urbanism and a timeline displaying important milestones is created (Figure 4).

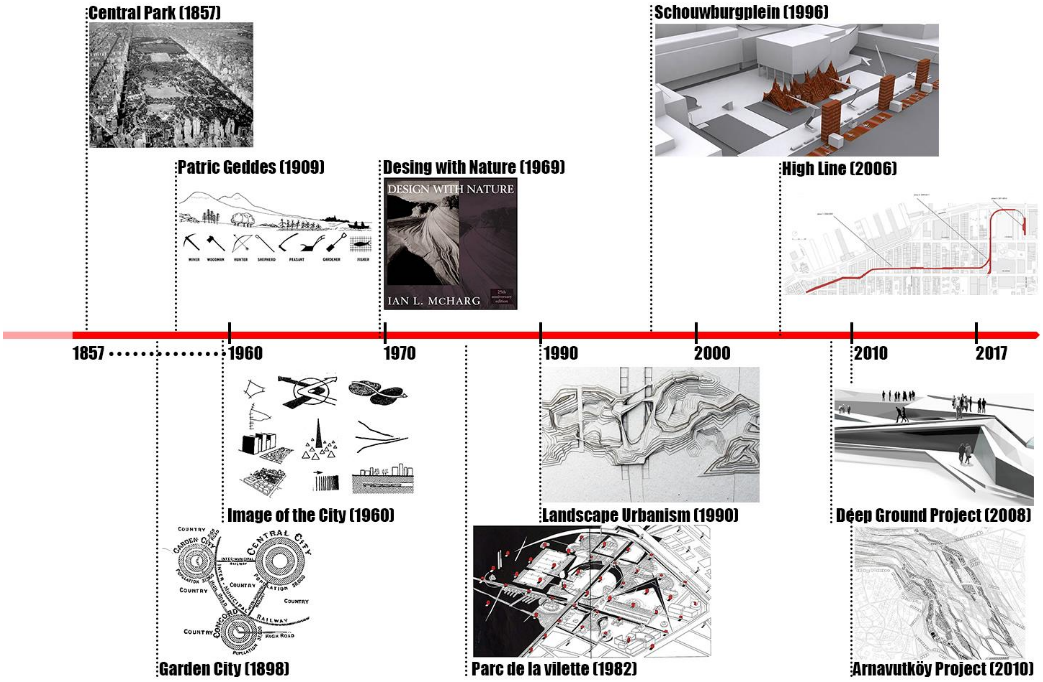


Figure 4: Brief history of Landscape Urbanism

In the book *The Landscape of Man* by Jellicoe & Jellicoe (1964), it is clearly explained that history of landscape and understanding of landscape has been changed as follows:

> *"The popular conception of landscape design has been that it is an art confined to private gardens and park. This is understandable, because it is only in the present century that the collective landscape has emerged as a social necessity. If the universal demand for landscape is therefore so different from the past, what do we gain from a study of history? (p. 7)"*

As urban areas expanded, they grew around existing country areas as well. Some of them were preserved as parks such as Bryant Park and Central Park. The reservation of Central Park in New York City was a major step in bringing what appears to be a natural landscape into a close relationship with the surrounding city streets. While cities are growing in a fast pace, the formation of a relationship between landscape and cities became more important and complicated. Frederick Law Olmsted was the first American Landscape Architect and the designer of Central Park. Despite that Central Park is a completely artificially designed park, it has evolved to become a functioning landscape in the growing metropolitan city of New (Figure 5). To this day, Central Park is a significant park and public space in New York (Figure 6).

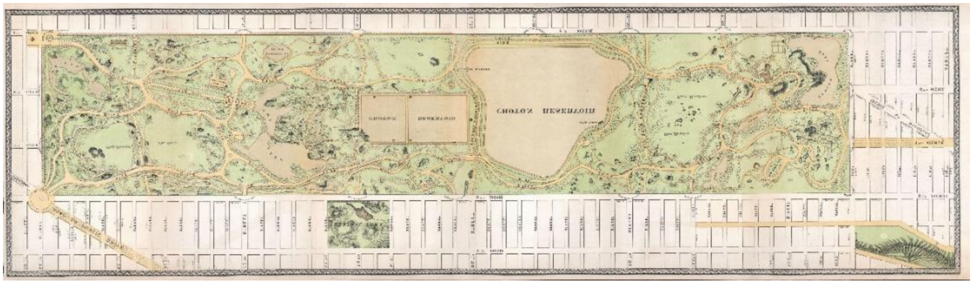


Figure 5: Central Park old map (Source: Rogers E., 2017)

Figure 6: Central Park Satellite view (Source: Chardon H., 2017)

While cities are becoming industrialized and moving further away from the countryside, the designated green spaces and landscape areas were not sufficient to meet the needs of inhabitants. The demand for being able to get in touch with nature without the need to move to the countryside was arisen. One of the most influential and talented people to think about these issues was Ebenezer Howard who published his book *Tomorrow, A Peaceful Path to Real Reform* in 1898 which was later retitled *Garden Cities of Tomorrow* (Howard & Osborn, 1965). In the book, the social city diagram demonstrates (Figure 7) the distinguish between town and country, and country and town mixture that could deliver the city living along with the green spaces, animal ecology, plants and air corridor. One of his ideas included building green belts which preserve and sustain wild life around cities and distribute new communities into satellite towns is still a functioning idea in contemporary urbanism. Howard’s ideas were can be considered as the starting point for the utilization of landscape urbanism in city development. His approach succeeded in organizing and designing the development of two prototype garden suburbs and even today green belt and satellite town ideas are globally constructed.

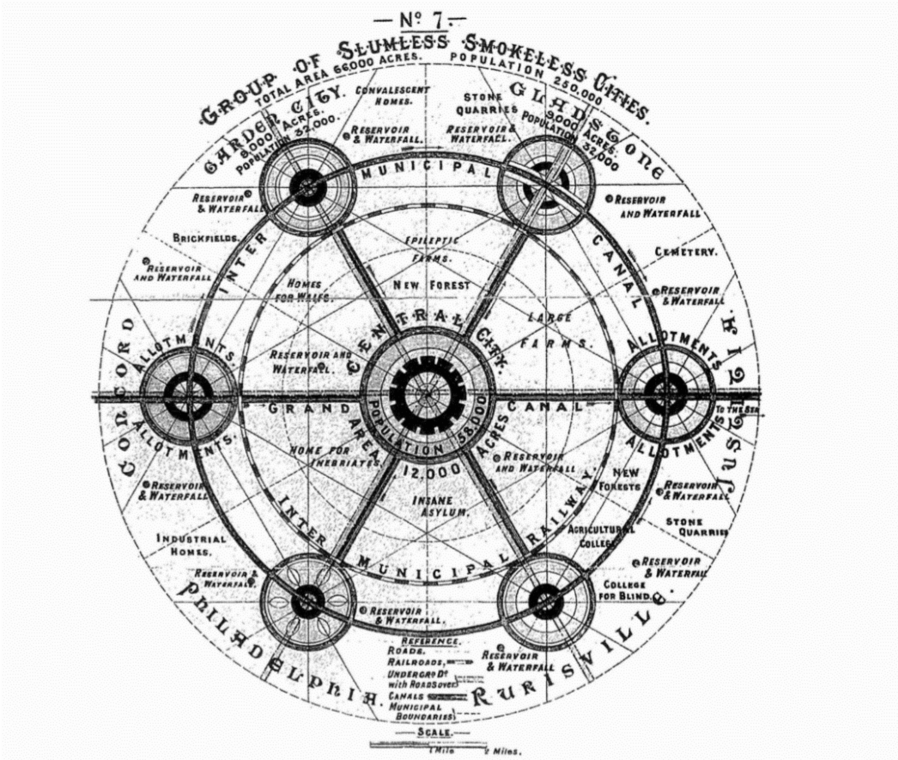


Figure 7: `The Social City` by Ebenezer Howard, 1898. Original diagram
(Source: Fisherman, 1982)

Another aspect of landscape urbanism background started with the construction of great works through environmental design which became possible after catastrophic effects of the industrial revolution and industry developments. Environmental design and engineering provided the ability overcome some challenges introduced in urban areas by industrialization. During that time, the concept of landscape urbanism emerged and played an essential role in forming today's understand of urbanism. Today, the concept of landscape urbanism allows changing and designing the surrounding nature to adopt changes in cities.

Another example demonstrating the positive impact of urbanism and environmental design on cities is having the possibility grappling with current problems originate from conventional infrastructural layout and industrial fields. The misguided use of elevated highways, railways and brownfields are environmentally damaging to regional and urban context and it is engagement with the urban core. An elevated line in Manhattan that had outlived its usefulness has been turned into an elevated park and thus introduced an innovative and adaptive model in the development of strategy. The predominance of cities by elevated railways and highways can be retrofitted, and brownfields can be converted into sustainable green areas involving many activities in it.

Highline Park will be discussed in detail to give an example of landscape urbanism project. This park successfully made use of old elevated railway infrastructure to achieve the world-renowned urban project (Figure 8).

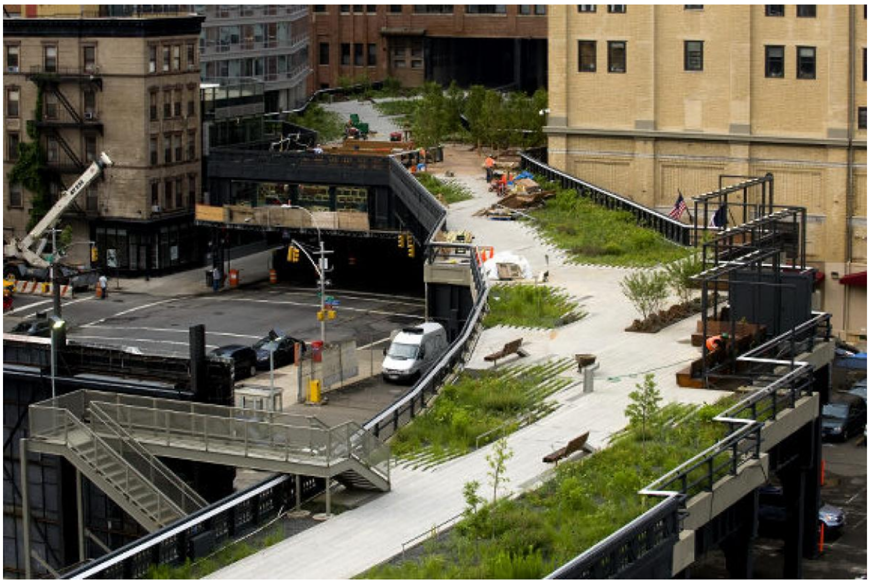


Figure 8: High Line Park (Source: NY Daily News, n.d.)

Climate change has led urban designers to find new approaches for adaptation which in turn drew attention to taking natural forces into consideration. Many countries invest in projects to find the methods needed for the protectection of their environment from natural disasters. For example, due to the vulnerability of Venice to sea-level rise, an agenda was set to build gates that would protect the bay. There are many examples of cities that have been developing solutions against natural disasters. Landscape urbanism includes the aspect of finding adaptive solutions to future disasters and hazards.

Designing with nature is a fundamental aspect of urban design, however, over the years, the incorporation of this aspect into design has been slowly diminishing. Consequently, issues related to designing cities that should be adapted to natural phenomena have emerged. Moreover, neglecting the aspect of designing with nature in cities has partially exacerbated other environmental problems such as global warming. As claimed since its emergence as a special field of urbanism, landscape urbanism can overcome the emerging complications by applying more sustainable approaches when re-designing cities.

In his book *Design with Nature* (McHarg, 1969), Ian Marg stresses on the importance of taking into account the forces of nature when designing cities rather than using only engineering approaches. The author described nature as a set of static conditions since the evolution of cities was a slow paced process at that time. Nevertheless, the evolution of cities and nature more dynamic which requires more adaptive, perspectives especially across coastal areas. In other words, nature should be seen as a moving target and the dynamic forces of nature should be understood. One could even argue that in today’s world the aim is to design nature itself rather than designing with nature by creating ecologies that are sustainable and can overcome shocks. Hence, new strategies and tools should be utilized to be able to design nature.

During the past half-century, there has been an increase in the use of the cultural and disciplinary role of landscape in conceptualizing and implementing urban design strategies. To understand this trajectory, it is important to trace the emergence of landscape urbanism by following the work of McHarg.

2.1.1.2 Emergence of Landscape Urbanism

In the mid-1990s, the concept of landscape urbanism was defined by Charles Waldheim, who was a former student of McHarg and had built this concept on the work of James Corner. The development of the concept landscape urbanism started in America in 1996 when Waldheim described the practices that intersected urban design with landscape architecture (Waldheim, 2016).

The dispersed horizontal nature of North American urban form has enforced the concept of landscape urbanism, especially in the post-industrial states. The concept has attempted to fill the gap between two disciplinary areas. In the late 20th century there has been an increase in cultural awareness regarding environmental issues, especially to anthropogenic climate change. This awareness was mainly obtained from the regional planning thinkers of the century such as Lewis Mumford and Patrick Geddes.

Through landscape urbanism, the relationship between city and nature was not portrayed in a conflicted manner, but rather in an integrated approach in which the systemic and physical interfaces were incorporated into buildings, infrastructures, cultures and natural ecologies. This method initially aimed to renovate and strengthen post-industrial areas and shrink cities such as Cleveland, Leipzig, and Manchester. It also aimed to remediate desolated and polluted landscapes.

Spirn (1985) discussed that a city`s natural processes and human forms work together in a manner to explain the relationship between city and nature as entities that worked together rather than being in a conflicted relationship.

The strict techniques of centralized planning were modified through alternative strategies developed by landscape urbanism. These alternative strategies are more flexible and loose. As stated by Stan Allen, landscape urbanism design strategies are utilized to eliminate the cumbersome structure of traditional space making approaches (Allen, 1999).

In the mid-1990s, landscape urbanism was also shaped as an intellectual and a disciplinary domain. It was based on previous projects such as Central Park in New York and Emerald Necklace in Boston, which were both created by Frederick Law Olmstead. These projects were not only designed for visual attractiveness, but also for creating a metropolitan sanitation areas and they incorporated feats of civil and hydrologic engineering (Hung, Aquino & Waldheim, 2012).

The morphology of contemporary cities has been modified through years. Cedric Price's diagram of `*the City as an Egg*` is a descriptive illustration of this case (Figure 9). The structure of cities has changed from having prominent city walls to a softer structure that is incorporated into the city center. To understand the complexity of cities, new techniques and approaches should be utilized. Today, production and recreation are the two most important elements of a city.

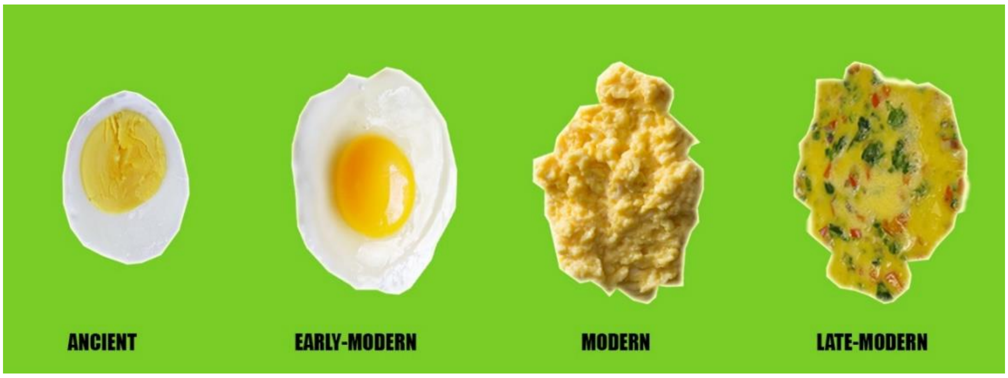


Figure 9: `City as an Egg` by Cedric Prince, ca. 2001
(courtesy Cedric Prince Fonds, Canadian Centre for Architecture, Montreal)

Landscape urbanism as an emerging field criticizes generic models of modernization and urbanization. It represents a model of a coalition between landscape, city, and heterogeneous urbanism rather than homogenizing the effects of the late capitalism.

In that regard, providing coalition between architecture and landscape and claiming the importance of new concepts and multi-disciplinary works of landscape urbanism Hall (2007) mentions the following:

> *"Today's context of speed, international interconnection, and hyper control of development requires rapid and flexible design strategies. Too often an architect is expected to present a concept for a very large project with just a few weeks to prepare and must conceptually coalesce landscape and architecture to give direction to public space. Fusing landscape and public space in large commercial urban developments requires quick interdisciplinary conceptual. (p. 37)"*

In the book of *Urban Design Green Dimensions* by Moughtin and Shirley (2005), the role of landscape in the formation of city as a medium to structuring element was discussed as, "Landscape is a dominant structuring element. The role of landscape as the unifying element in the sitting of building groups has been discussed elsewhere." (p. 152). This notion can be developed further so that landscape is elevated to the position of the predominant factor in the generation of urban form (Moughtin & Shirley, 2005).

In the book The *Architecture of Towns and Cities* by Spreiregen (1965), it was argued that the form of landscape is one of the most crucial determinants of a city`s form. Furthermore, it is mentioned that urban designers first consider and observe terrain in other words topography of landscape in relation to architecture and city to create a design relationship. Therefore, the argument of using landscape as a medium for urbanization processes is a solid discussion.

It is vital to define a relationship between landscape and city, rather than viewing it as a static image. According to Eisner, Gallion & Eisner, the relationship between landscape and city structures has changed through urbanization and post-industrial ages (Eisner, Gallion, & Eisner, 1993). In ancient times, cities were surrounded by walls for the purpose of protection from natural disasters. The relationship between landscape and city has changed over time and these two concepts (city and landscape) started to emerged (Eisner et al., 1993)(Figure 10).

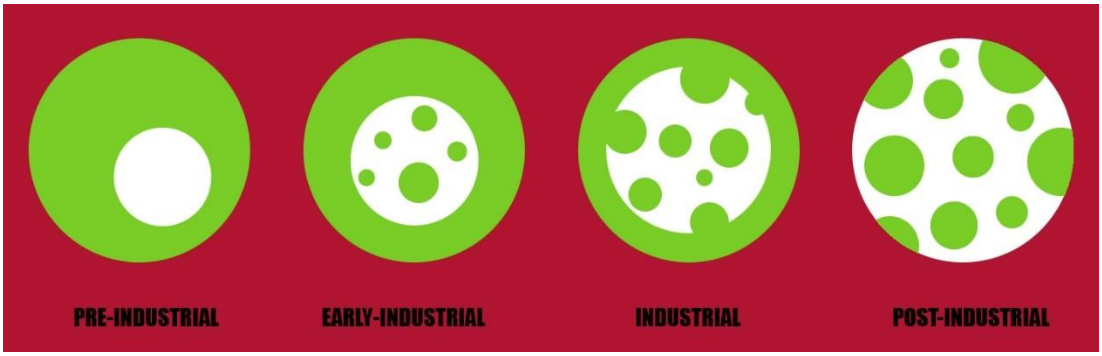


Figure 10: Cultural-Natural Landscape diagram

Landscape urbanism focuses on infrastructure and considers landscape as a complex element of the city to rehabilitate urban sites in dense built environments. Brownfields and huge vacant post-industrial sites are other fields of landscape urbanism to be operated.

The consideration of a city as a tree has certain limitations. Cities are not trees (Alexander, 1965) because they do not grow, reproduce and heal themselves; the agent for their change is man. Describing a city in terms of its heart, lungs and arteries does not help in analyzing the problems of a city (Moughtin & Shirley, 2005). The formation of a city is an act carried out by human beings. Landscape is one of the most fruitful metaphors because it includes ecosystem, flora and fauna as comprehensive concepts.

When landscape urbanism field emerged in the 1990s, James Corner coined the term and stated that `landscape` is a concept that has metaphorical associations, especially for many contemporary architects and urbanists (Corner, 2006). He argued that while centralized planning followed a linear process, landscape urbanism, on the other hand, offered a nonlinear process. The question whether landscape urbanism can be considered as an emergent field that can provide an answer to a contemporary city's `new design model`, still remains blurry.

Since landscape and urbanism create dialectical synthesis, it is important to mention some of the advantages that implicitly emerge in landscape urbanism (Waldheim, 2006).

- The Conflation
- Integration
- Fluid Exchange Between Natural and Engineered Infrastructural Systems

It is important to state that strategies and concepts of landscape urbanism has had various influences on the urbanism discourse. One of the main approaches considered in landscape urbanism is the structure of the multidisciplinary field, which allows different professions to work together on the same platform, create new ideas and develop new concepts. Unlike gray urbanism which implies real estate development to accumulate capital by urban land, landscape urbanism focuses on ecological tactics and infrastructural strategies which have not been included in the main discussions of urbanism discourse. Thinking about the way infrastructure can change and lead urban morphologies may result in innovative design ideas and new interventions. Responsiveness to nature and dynamic coalitions are other important aspects of landscape urbanism.

In contemporary urbanism discourse, there is more emphasis on bottom-up approaches that try to reveal the complexity of cities. Landscape urbanism offers preliminary small-scale operations within the body of its dynamic and organic structure. Rather than huge structures, the solutions provided by landscape urbanism in the sense of materials and scale, especially soft-landscaping installations, which require few resources and cost effective methods, provide a step-by-step implementation.

The use of landscape as an infrastructure in cities is also a highly discussed topic in landscape urbanism. Since current infrastructure systems are so static and costly, landscape infrastructure provides ecological, sustainable and dynamic infrastructural ideas for contemporary cities such as:

- Walks and roads
- Vegetation
- Drainage swales
- Land forms
- Water harvesting lines

The new elements of urban morphologies provide an opportunity to create social, sustainable, adaptable and performative places.

It is no coincidence that landscape urbanism has emerged as the most robust and fully formed critique for urban design since most of population lives and work in urban areas, with the introduction of those new elements stated, it is very important to have a working model for renewal of urban design .

2.1.1.3 The Practice of Landscape Urbanism and Its Critiques

Landscape urbanism was addressed to have four basic characteristics by James Corner in 2006 publication *Terra Fluxus* (Corner, 2006). Field ecology was used to obtain these basic features to describe the constant interrelation between environmental and engineering systems. The different layers of cities and infrastructures can be viewed as an interconnected ecosystem that is analogous to looking at a forest. The four fundamental characteristics described by Corner are the continuous process of urbanization, staging of surfaces, operational method and influence of landscape design on surroundings (Corner, 2006).

In the first feature, urbanization is described as a continuous process rather than a group of physical structures. In other words, the systemic manifestation in space and time of capital flows, regulatory policy, and other influences are all considered when describing urbanization. Thus, urbanization is seen as a cumulative and continuous process by landscape urbanism rather than a clear and fixed outcome.

Staging of surfaces is defined as the second characteristic. Here, the influence of horizontal structures on the process of urbanization is described. The formation of singular design solutions is not the main focus in this characteristic, but rather the choreography of a network of elements that result in a succession of interaction and processes is of concern.

The third characteristic is operational method. This features views the development of strategies as a reaction to the demands and changes that the urban conditions undergo through the years. While the instantaneousness of a master plan is refused in this characteristic, developing an operating system that can handle the flow and movement of urbanization process is recommended. Hence, shifts in scale across time and space are worked on directly.

The fourth characteristic can be looked at as an argument that asserts the influence of material practice of planning and design on all the elements that surrounds it. Corner argues that the most important factor in a culture of a city is public areas and spaces where memories and passions lie (Corner, 2006).

In the last 20 years, landscape urbanism has been a powerful source of creativity and innovation in planning and designing cities. The five most common critiques are promoting of sprawl, focusing on process rather than product, over-sizing public realm, exploiting environmental issues and excessively depending on large urban parks (Duany & Talen, 2013).

Landscape urbanism promotes spreading or sprawling of the urban form, rather than forming concentrated urban centers. The interest towards organization strategies that are non-hierarchical has empowered landscape urbanism to manage density demands of emerging cities. Another aspect landscape urbanism is criticized on is valuing process and indefiniteness over defined and structured architectural forms. The third critique is over-scaling public areas that cause the urbanistic utility of street and buildings to be gradually destroyed. The final and most common aspect that landscape-driven urbanization is criticized for being overly dependent on unachievable large parks which are utilized as the main tools in design operation. Hence, one can argue that landscape urbanism is a represented form of landscape architecture.

Despite the criticism, a variety of ideological movements were created based on landscape urbanism. One of the first emerging lines of thought was called landscape infrastructure. This movement mainly focused on the possibility of forming regional scales' and ecologically driven networks' performative nature. Many scholars, such as Alan Berger and Pierre Belanger, supported the conceptualization of urban infrastructural system in a soft, multifunctional and flexible way which was not visualized from an engineering perspective but rather from the perspectives that require longer transformation periods and are adaptable to change (Mostafavi & Doherty, 2010). The system's decentralized and diffused nature makes it an approach that is flexible and highly adaptable to stress. Hence, landscape infrastructure as an approach that modifies and improves our current understanding of urban form conceptualization and can re-determine the way we will conceptualize design and plan for future urbanization while focusing on the correlation between economy and ecology (Mostafavi & Doherty, 2010).

Landscape urbanism can be seen as a practice that surpasses previous traditional disciplinary approaches by its creative nature. This method requires knowledge and expertise in different fields such as ecology, engineering, social policy and the political process. Moreover, it is used in significant and scaled contemporary urbanization projects. Consequently, urbanistic projects concentrate on process and elements or urbanization rather than mainly form and space. In this discussion, the potential of considering landscape as an instrument of urbanization confirms the fact that landscape cannot be limited to trees and topography. When mentioning landscape considerations in a city, one must take into account the continuous evolvement of the ecosystem over time which cannot be controlled solely by physical design (Mostafavi & Doherty, 2010).

2.1.2 Contemporary Practice of Landscape Urbanism

> *"It is in the context of urban design`s unrealized promise that landscape urbanism has emerged in the past decade. Landscape urbanism has come to stand for an alternative within the broad base of urban design historically defined (Hung, Aquino & Waldheim, 2012, p. 10)."*

Whether or not landscape urbanism generates the urban form in contemporary urban morphology is not a solid question anymore, it is clear that as an emerging field of landscape urbanism, especially in the USA, it has been already in practice as an operational method. Rather than concentrating on the ideological stand of landscape urbanism, this thesis aims to focus on how to extract operational model and method tools from existing contemporary practice of landscape urbanism. In this chapter, the thesis will focus on how landscape urbanism operates on contemporary applications and practices to de-code landscape urbanism operations and methods. We could call it `reverse engineering` of landscape urbanism from practice to theory.

The field is not only landscape architecture applied to the urban form. It is the idea of landscape forces as extra parameters rather than conventional architectural rules which generation urban form. Contemporary understanding of landscape has been shifted from a passive and static image to a current and operational landscape. There is a paradigm shift of idea of a landscape about how it functions and how it operates over time to fulfill contemporary practical needs of changing dynamics of complex urban forms.

2.1.2.1 Practical Domains of Landscape Urbanism

Landscape urbanism adds performance to the common lands which have been vacant and had no previous potential. According to Shane (Shane, 2006), the concept offers potentialities to the urban brown fields in the form of:

- Aesthetic
- Ecology
- Agricultural Values

Contemporary understanding of landscape includes many aspects such as:

- Economical
- Social
- Cultural
- Morphological
- Political
- Ecological

Which concept of landscape has multilayered that explains current conditions of complex urban setting? Shane (2006) explains that:

> *"Landscape urbanists want to continue the search for a new basis of a performative urbanism that emerges from the bottom up, geared to the*

> *technological and ecological realities of the post-industrial world… Implies an opportunity open urban design out beyond the current rigid and polarized situation to the world where the past building systems and landscape can be included as systems within urban design (p. 65).”*

To represent landscape urbanism as a potential field for the creation of new methodologies in contemporary urban design practice, Waldheim (2006) stated the following:

> *“The practices of many designers for who landscape had replaced architectural form as the primary medium of city making. This understanding of decentralized post-industrial urban form highlighted the leftover void spaces of the city as potential Commons (p. 57-58).”*

In the concept of landscape, the multi layered characteristic of landscape has a complex ecology with rich potentials to practice landscape urbanism. According to Julia Czerniak (2006), innovative urban landscapes have the following features: time over spaces, performance over appearance and effect over meaning.

That means urban landscapes have the potential to transform the understanding of the concept of landscape in which the concept of landscape urbanism can perform. The operation of contemporary landscape urbanism performances can be seen in both specific areas and also specific areas which are hard to operate places are such as,

- Mundane parking facilities
- Difficult spaces under elevated roads
- Complex transit interchanges
- Landscape generated by water processes

2.1.2.2 Use of Landscape Urbanism Concepts

After the post-industrialization era, digital technologies have been used as main motives to simulate, shape and analyze the complex regional landscape processes that affect the local scale. Thus, there has been a vast increase in the use of visual techniques and new digital tools to reveal larger context and hidden systems of landscape and city. In a larger scale, landscape urbanism with its dynamic hidden landscape forces can be utilized in the field of urban design. Richard Weller (2006) described these forces as an influential design generator provided by landscape urbanism:

- Complexity
- Diversity
- Instability
- Indeterminacy

To mention some of those performances on a larger scale to understand better how landscape urbanism concept related to urban design field and what performativity outputs it represents in landscape urbanism discourse.

Diversity is one the main domains of landscape ecology performances. Ecology and diversity of nature are some of the best essential design concepts in urban design. In the field of urban design, designers have always been appreciating diverse urban places; this is what makes a city more livable and more attractive a an urban health life. To break the monotonous urban life, design should be inspired by nature and diversity of ecology to create public realms that can include every type of people.

Another aspect is flux of landscape terrain. The use of outputs of landscape shapes is already a major force in the design field; however, in today’s world the understanding of landscape forces are more dynamic. Landscape is also considered to be changed by the force in the field of urban design. After the occurrence of huge disasters and misunderstandings, considerations of urban planning, every domain of city design groups started to consider landscape as a dynamic force which is in constant flux that shapes the environment, to adapt to those changes regarding urban fabric and landscape relationships.

Globalization is a major topic in urban design. Money flows around the world and competing cities are trying to become the most attractive city for the investors to be able to make investments in infrastructure, real estates, and commercial fields. In that sense, adaptation to the instability of economics in global scale cities is prepared instability of money flows and design can be a useful tool to cope with worldwide attraction. There is a lot to learn from landscape structure because it offers unstable conditions that can easily adapt to constant changing of global forces. Recently, there has been an increase in discussions on mechanisms and methods that are self-organized in the area of urban design. Since top-down master planning approaches are not able to rule cities, bottom-up techniques and tools started to gain more importance in the process of city organization. Understanding these concepts became more crucial. Therefore, the new methodologies provided by self-organizing systems have the ability to cope with city problems. Cities evolve through time and adapt to changes according to their self-organizing structures. Landscape urbanism can find answers to the search of the interface between architecture and landscape (Figure 11).

Figure 11: Landscape as interface (Source: Plasma Studio, 2011)

Aesthetics are crucial features to be considered in city design. Since inhabitants spend most of their lives in cities, it is expected to create aesthetically satisfying urban landscapes. Design is a great tool that can be used to enhance the beauty of nature. Since scenic landscape are appreciated as art pieces, landscape has a huge influence on the process of city design. Therefore, landscape urbanism offers a natural looking urban landscape that is attractive for urban life. It also created an ambition to live in beautiful green areas rather than dirty looking industrial cities (Figure 12).

Figure 12: Designed aesthetics of urban landscape (Source: Rogers D., 2016)

According to Tatom (2006), the benefits of landscape urbanism include:

- New road morphologies
- Programmatic richness
- Metropolitan ambition
- Morphological continuity
- Design of public realm

Thus, Tatom (2006) views landscape urbanism as a field that offers new road morphologies that can solve issues related with industrial cities such as solving the dependence on cars and lack of pedestrian life in city streets during the industrialization era of USA (Figure 13).

Figure 13: Sprawl in American cities
(Source: Shaw M., 2017, Courtesy Chris Waits / Flickr, n.d.)

Jacobs argued that urban sprawl resulted in the creation of cities that lacked street life and enjoyable urban places which were the consequence of massive horizontal urban morphologies (1961). Landscape urbanism with it benefits offers a broad range of concepts that can be used as influential solutions for post-industrial cities suffering from urban sprawl.

Finally, Duany & Talen explain landscape approach as a generative design tool in the urban design field as follows:

> *"A landscape approach to the design of the city means that urban design is searching for emergent form rather than preconceived final form. What is designed and ordered is not so much the form as the process and the process of change. Such dynamic and adaptive design addresses not just growth and development but also shrinking, not just development but recycling and restructuring (p. 250)."*

2.2 LEADING DESIGN APPLICATIONS IN LANDSCAPE URBANISM

2.2.1 Parc De La Villette, Paris – Bernard Tschumi (1982)

Another example is the culmination of an international project competition for Parc de la Villette in Paris (1982). This research will focus on Bernard Tschumi winning submission. The proposal was less oriented towards a singular formal resolution and more towards a strategy process related to changing programs and uses contained within the park over time. The park works as a platform for social and cultural interaction (Figure 14).

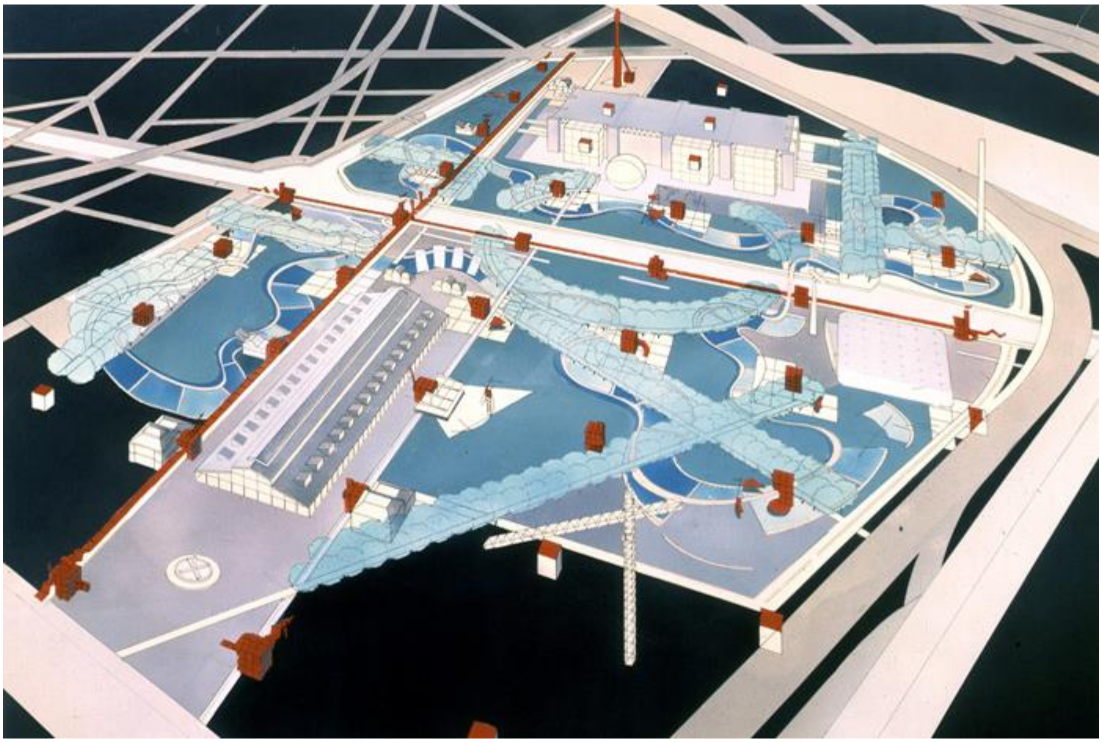


Figure 14: Overview of Parc de la Villette (Source: Bernard Tschumi Architects, 1982)

In the Parc de la Villette, Tschumi proposed an architecture of incoherence that its primary purpose was to upset the architectural assumptions regarding existing architecture discourse. In other words, the main idea was to show that complex program and design concepts can be organized without any reference to the traditional rules of composition or other general gestalt rules. The park was designed in a series of three specific layers which are *lines, points and surfaces* (Figure 15). These layers work as a deconstructive architectural program for non-programed use concept in landscape urbanism.

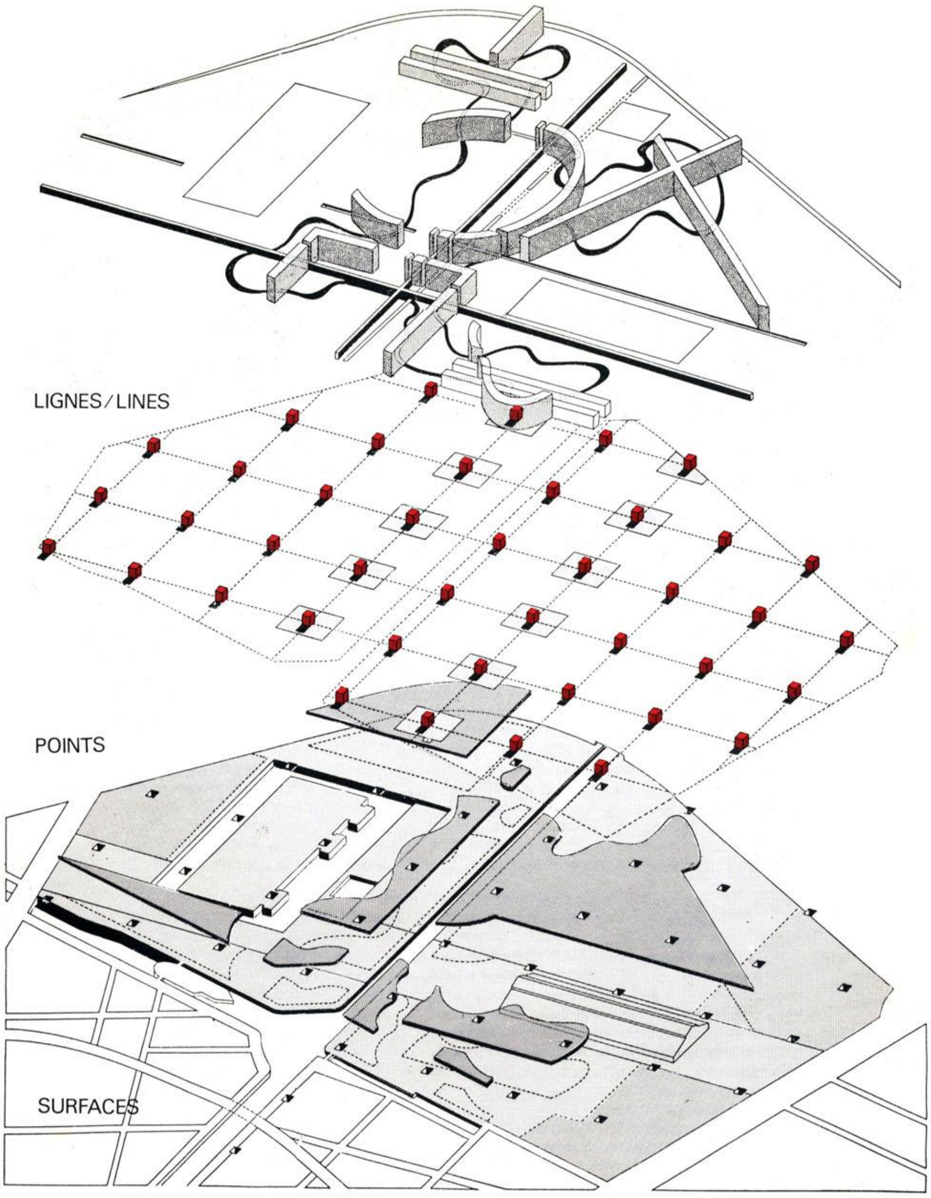


Figure 15: Geometrical layers of the Parc de la Villette
(Source: Bernard Tschumi Architects, 1982)

The design for the Parc de la Villette was selected from over 470 international competing designs. The main bjectives of the competition was to mark the vision of an era and to act upon the future economic and cultural development of a key area in

Paris. As described in the competition, La Villette was not intended to represent a simple landscape replica. This “urban park for the 21st century” was developed as a complex program for cultural and entertainment facilities (Bernard Tschumi Architects, 1982).

The red structures can present an area for expressing new activities over time. The non-programme related use of the buildings can be interpreted as an evolving system for public space (Figure 16). Instead of placing it out of the city and its natural atmosphere, the park is kept within the city to carry its notion by providing a space to carry out social and cultural activities such as workshops, gyms, playgrounds, exhibitions, concerts, science centers, games and open public theaters (Bernard Tschumi Architects, 1982).

Figure 16: View from point elements in Parc de la Villette
(Source: Bernard Tschumi Architects, 1982)

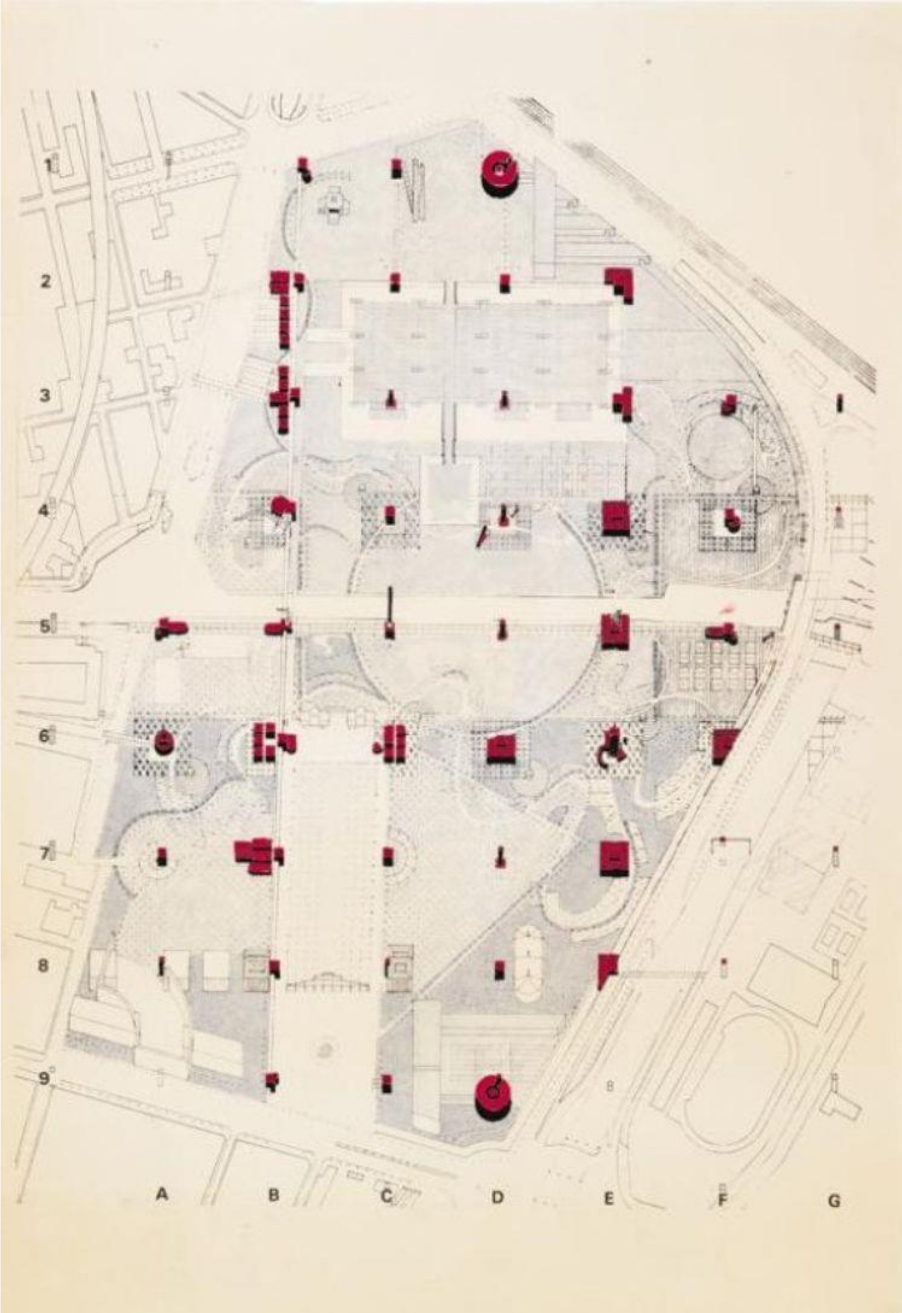


Figure 17: Superimposed elements in Parc de la Villette
(Source: Bernard Tschumi Architects, 1982)

The success of the park comes from the attempt to integrate these three systems (points, lines and surfaces) as a coherent and defined architecture. The park design superimposed each one the systems which distort and clash with one another to create a multi purpose and multi-use open field system (Figure 17).

2.2.2 Schouwburgplein, Rotterdam - West 8 (1996)

Despite its prime location, the Theatre Square was formerly a dead urban space. Since West 8 designed an elevated square area, the location became one the most visited urban public squares in Rotterdam. The square expected to use at different times of the day and a relationship with users and surrounding environment. The material of the ground surface works as performativity surface according to changing conditions of sunlight and climate to maximize sun light. Schouwburgplein project is an excellent example for different material use in landscape urbanism (Figure 18).

Figure 18: Schouwburgplein Square in Rotterdam (Source: West 8, 1996)

There are fifteen-meters high ventilation towers that start from the underground parking which are displayed as strong vertical elements on the square (Lange, 2016). Each of these lightweight steel structures is activated with LED displays. Together the three towers form a digital clock. At night, the towers are lit from the inside spreading a soft filtered light (Lange, 2016). The center of the square is finished with a deck of perforated metal panels and a wooden play area. The perforated metal panels are lit from below with white, green and black fluorescent tubes. Connections for electricity and water, as well as facilities to build tents and fencing for temporary events, are built onto the floor (Lange, 2016).

Fluorescent lights form a radiant Milky Way at night. The whole square seems to be floating because of the linear lights that are mounted under the edge of the raised deck. The last major features of the square are the four hydraulic lighting elements. Their configuration can be interactively altered by the inhabitants of the city (Lange, 2016).

The square is very relevant to its context, the red structure symbolizes the Rotterdam Port which provides an integration point between the public square and people (Figure 19). Also, it is near the urban center where the city theater, music hall and biggest movie theater in Rotterdam are.

Figure 19: Schouwburgplein Square at night (Source: Source: West 8, 1996)

This contemporary urban square design, with custom furniture, iconic crane-like lights that park users can operate, and a trademarked hardscape pattern, is a reflection of the Port of Rotterdam. Capped by a light-deck square that replaced an outdated and leaking parking roof structure, the design includes a light structure using durable materials that have remarkably withstood the test of time and heavy usage (West 8, 1996).

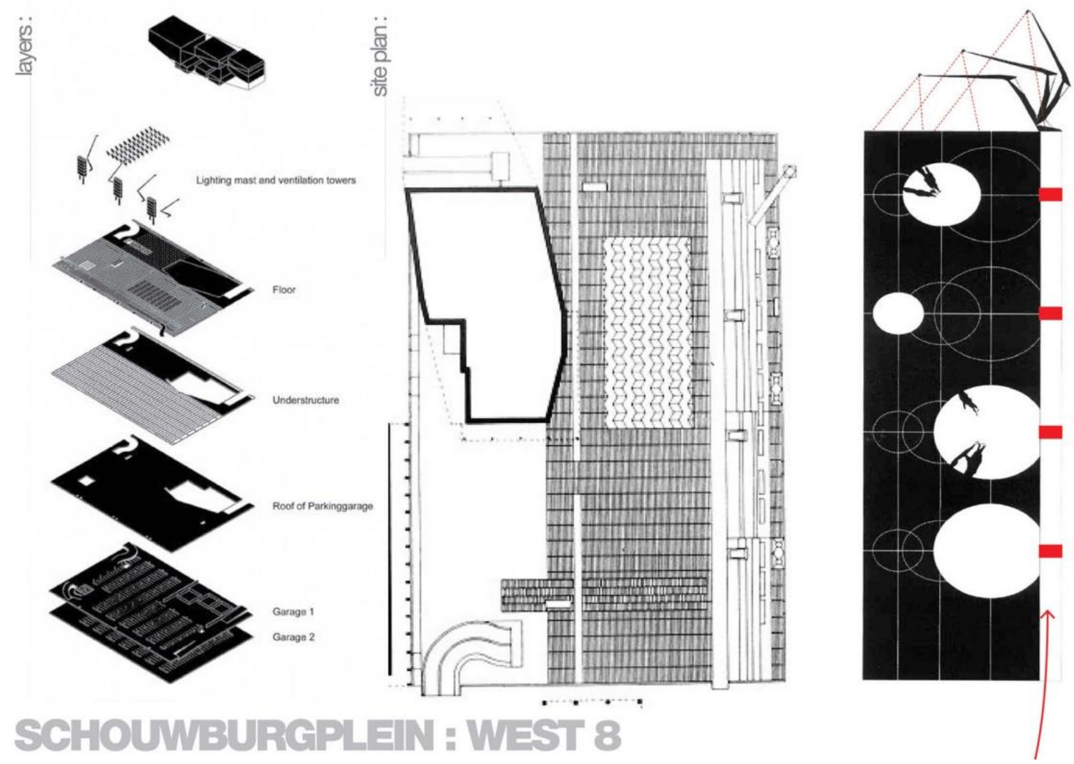


Figure 20: Multi layers of design concept (Source: Source: West 8, 1996)

By raising the surface of the square above the surrounding area, the “city stage” was created for festivals and installations, framed by the city skyline and its “audience” of inhabitants. This interactive public space, flexible in use, changes throughout the day and from season to another (West 8, 1996) (Figure 20).

2.2.3 High Line Project, New York – Field Operations (2006)

The High Line (also known as the High Line Park) is a 1.45-mile-long (2.33 km) linear park in New York City that was built in Manhattan on an elevated section of a disused New York Central Railroad spur called the West Side Line (Letsch, 2014). Field operations with the lead of James Corner led the design and construction of this reclaimed as a recreational and urban public open space in the very core of Manhattan city. Since 2009, the High Line project has become an influential project for all design disciplines and demonstrated the vitality of the concept of innovative design in defining an urban life neighborhoods. As a leading project, Highline also exhibited how innovative projects can be great investments for cities that are looking for inspiration to become global cities.

The design idea of Highline is characterized by its linear movement that create alternative vistas and different urban experiences for the surrounding neighborhoods and people. The usage of soft and hard landscaping, urban theaters, urban vistas, lightning and vegetation concepts are some of the experiences in the design of area (Figure 21).

Figure 21: High Line Park from top (Source: Field Operations, 2006)

The High Line Park has gained a huge success in creating new public spaces in the city of New York and building a participated public relationship. After the completion of the project, the neighborhood and people around the park were also attached to the park, supported its maintenance and continued the collaboration with the government and private interest to keep the project safe and sustained (Letsch, 2014).

The success of the project can also be attributed to the design and implementation. Preservation strategies and innovative concepts come together for the adaptive reuse of an existing structure which is also an important concept in landscape urbanism. While developing structures on an existing train line, High Line Park considered recreational public promenade as iconic views and vistas for urban experiences (Figure 22). Although existing stages were built step-by-step and the development of the park occurred in a relatively long period of time, having a successful and cooperative design team was crucial in keeping the coherence along the whole line. The last section of the park was built upon the identity and character of existing sections, new innovative ways were created to respond the radically different context of the development (Letsch, 2014).

Figure 22: A vista point in High Line Park (Source: Field Operations, 2006)

The High Line Park is a place that is used to host temporary events, street performances, small installations and gatherings. It functions as a green infrastructure for the city as well as a cultural location for the people living around. Moreover, with its multifunctional program it has become tourist attraction point.

2.3 MORPHOLOGY OF LANDSCAPE URBANISM

Landscape and infrastructure have become two elements in urban design that allow design disciplines to gain operative force in the process of territorial transformation (Nijhuis, Jauslin, & van der Hoeven, 2016). In the context of landscape urbanism morphology, this thesis aims to develop re-defining concepts for landscape and infrastructure as morphological and geometrical form of elements that can deal with complex urban landscape issues.

2.3.1 Morphological Elements of Landscape Urbanism

With new elements provided by landscape urbanism, urban morphology can create more adaptable places in cities. Using elements such as vegetation, ground, pavements, drainage swales, and land forms, in which landscape can be utilized as surfaces, is a useful tool for creating new form of concepts that are adaptable to architecture and the environment.

Between the academic years 2014-2015, Middle East Technical University's Urban Design Studio worked on urban morphology and re-defined urban design elements through an urban coding project that focused on design codes and generation processes. The main research questions investigated the way codes can perform in space and the relationship between design and code (Figure 23).

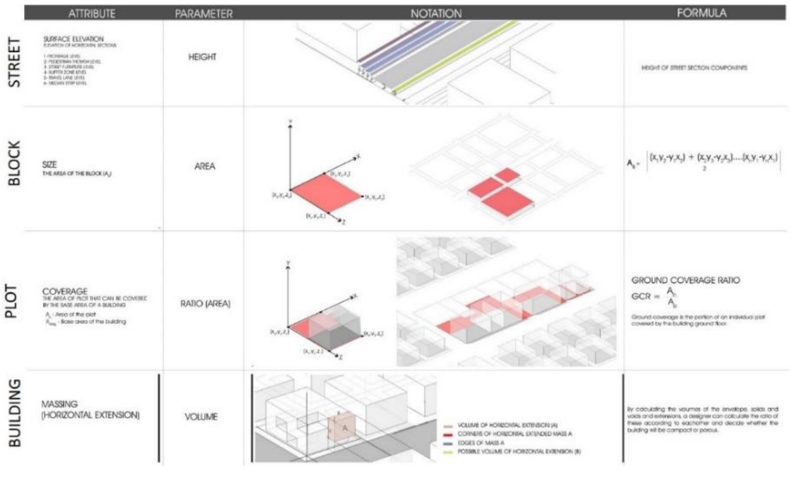


Figure 23: Definitions of main urban morphological elements
(Source: METU Master of Urban Design Studio, 2014)

Finding a relationship between elements of urban design to fully understand the field of design research is necessary to be able to use the elements and generate the design process. As defined by the studio, the main morphological elements are street, plot, building, and blocks. Hence, the questions asked are what the new elements of landscape urbanism are and what their parameters are regarding urban morphology.

While basic urban design elements have been defined, the precise definition of the morphological element set for landscape urbanism was needed to create an operational framework. The definition of the new elements of landscape urbanism required research on existing elements and experimental high level of abstraction to build conceptual framework fully.

In this research, the author first prepared some metaphorical experiments (Figure 24) on landscape urbanism elements. After experiments, there were general expressions regarding urban morphology and urban form generation (Figure 25).

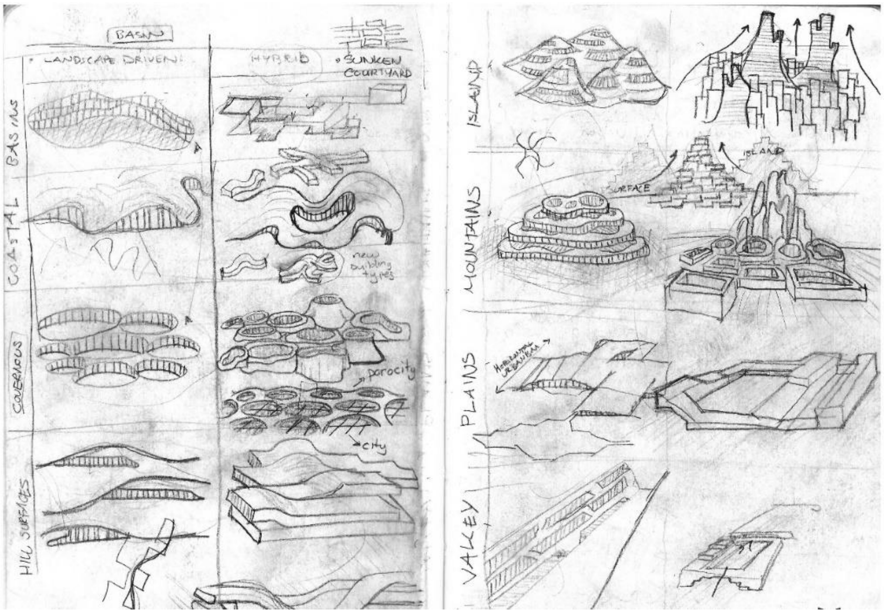


Figure 24: Preliminary sketches of defining the elements of landscape urbanism

Using existing topographical shapes and landforms are not enough to shape the city form, and it does not present sufficient parameters to create a generative design tool.

While the landscape offers a variety of influences and exciting concepts for designers, the limited topography and metaphorical approaches in landscape urbanism makes it difficult to utilize all potentials to form generation methods (Figure 26).

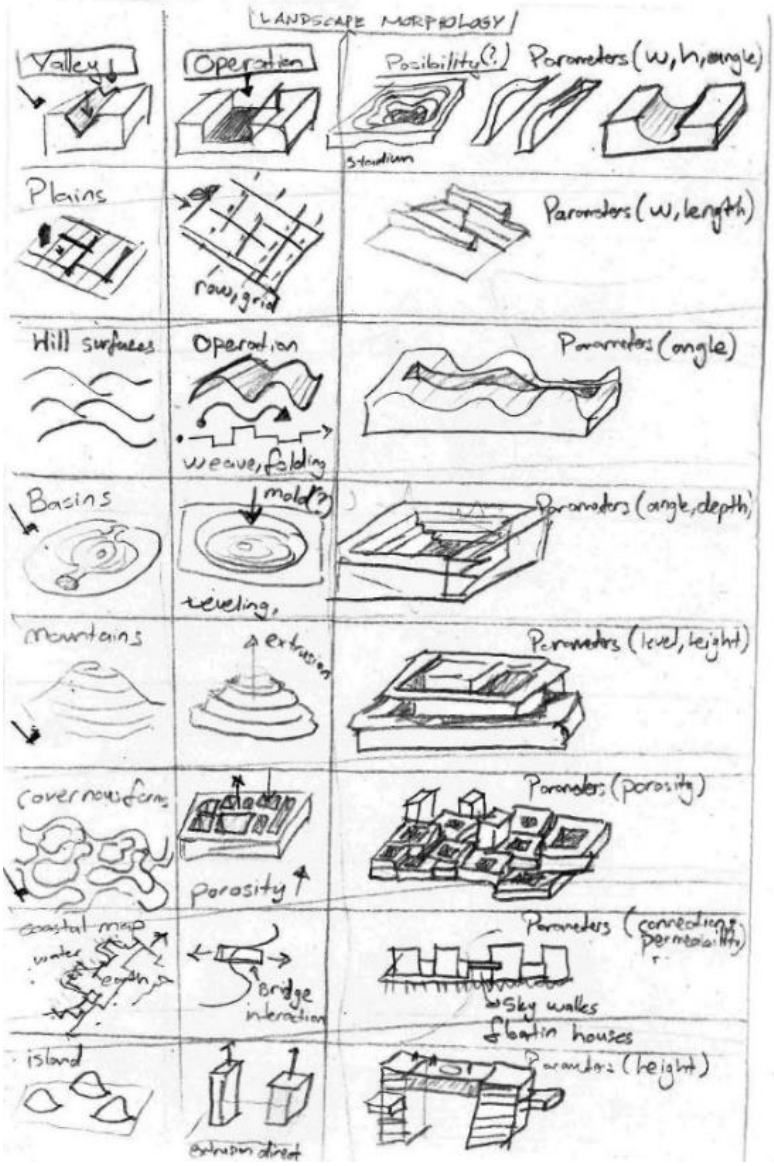


Figure 25: Landscape morphology experiments

In landscape urbanism projects, elements such as a water system, infrastructure and landform are crucial for defining the city. They should also be considered as main components besides street, building, plot, and block.

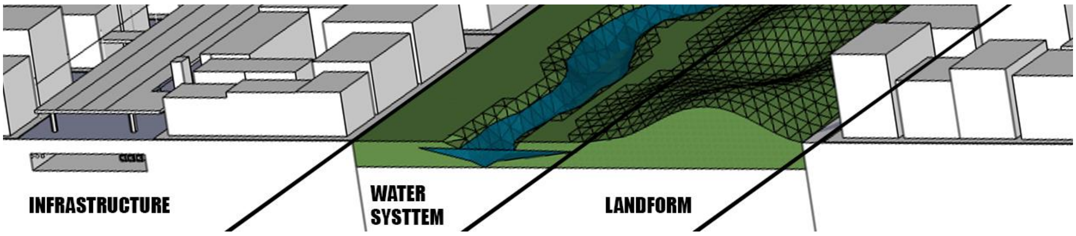


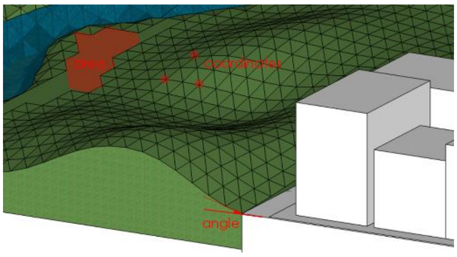
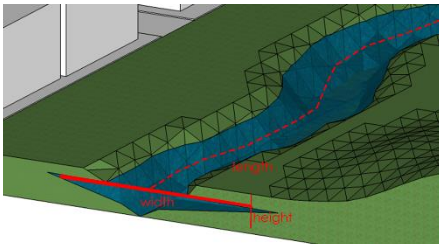
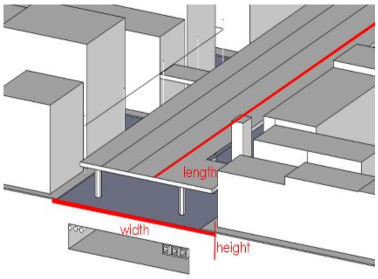
Figure 26: Typological elements of landscape urbanism

In addition to buildings and streets which can be considered as urban morphological elements, water system, infrastructure and landform represent another level of the network in almost every western city (Figure 27).

Figure 27: Main urban elements in some German cities

By looking at leading projects, the author aims to explore where urban morphological elements are mostly used in landscape urbanism projects. In that regard, the main morphological elements of landscape urbanism are specified as follow: water system, infrastructure, and landform (Table 2).

Table 2: Typological Elements of Landscape Urbanism

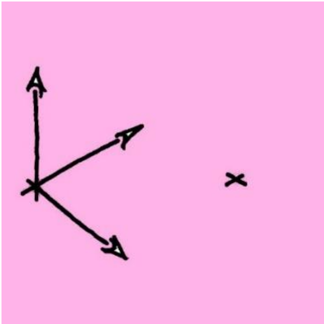
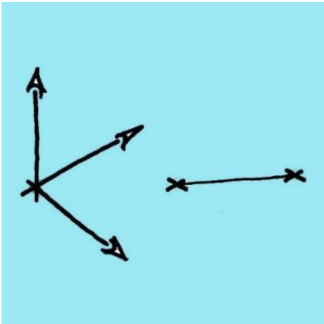
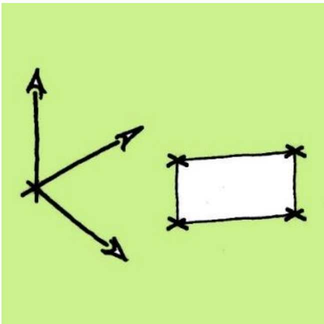
Elements	Attributes	Notation	Parameters
Landform • Hills • Plains • Hard & Soft surfaces	Elevation Surface Degree Size Surface		Area Coordinates Angle
Water System • River • Streams • Ponds Bays	Coverage Depth		Width Height Length
Infrastructure • Transport • Sewers • Electricity	Coverage Depth		Width Height Length

However, those elements are not enough to provide an explanation for every context because they are derived from western cities and similar conditions may not be present in other cities around the world. The typological elements are context based and are not flexible to achieve adaptable design operations regarding geometrical definitions.

The full set of operational elements can be defined via abstracting landscape elements as such: (Table 3)

- Landmarks, Follies as *Point*
- River, Infrastructure, transportation, canals are as *Line*
- Hard and soft ground as *Surface*

Table 3: Morphological Elements of Landscape Urbanism

Elements	Attributes	Notation	Parameters
Points • Landmarks • Follies	Amount Location		Distance Coordinates
Lines • River • Infrastructure • Transportation • Canals	Size Coverage Depth		Width Altitude Angle
Surfaces • Hard Surfaces • Soft Surfaces	Size Coverage Depth		Area Level Thickness

The new elements of landscape urbanism include points, lines, and surfaces to create a new and generative framework. All the elements should be included in the operational model.

Rather than the design elements involved in conventional landscape architecture, the definition of a geometrical and flexible set of components can be achieved. Landscape urbanism has been criticized for using traditional methods and tools of landscape architecture through old elements and approaches. With the new geometrical definition of the morphological elements, landscape urbanism can provide a different design control mechanism.

2.3.2 Defining the Basic Operations

Defining operations for morphological elements of landscape urbanism are;

- Definition and explanation of operation
- Notation

2.3.2.1 Point Operation

Points as a landscape urbanism element are the core element by which every other element can be defined. They are location based solid elements such as landmarks, follies, meeting hubs. Points provide connection, integration, attraction to be associated with other elements and surroundings.

Alignment: It is one of the most known designs concepts that is utilized to line up elements. The logic behind this operation is to organize elements along their base points to achieve a ground of organized and controlled repetitions on land (Figure 28). Composition and an increasing sense of unity can be utilized by alignment operation for point elements.

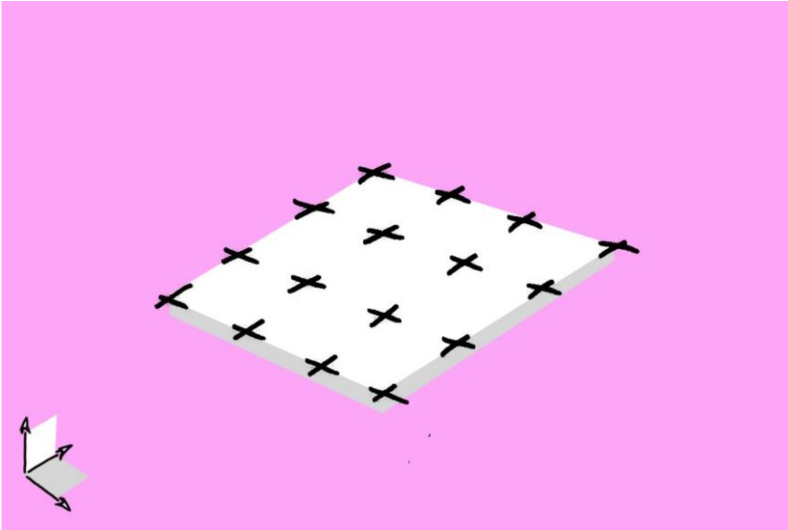


Figure 28: Alignment operation for landscape urbanism

2.3.2.2 Line Operation

A line is defined as a vectorized axis, running through the landscape with supplement parameters such as width and height. Water canals, transportation channels and street promenades can be considered as a line that functions as a connector.

Pinching: It is an operation for lines to measure the distance between canal networks and create new lines in a network with pinching points that modify overlapping lines in desired points. Pinching points work as connection hubs for new attraction points (Figure 29). Pulling lines in a network creates overlapped attraction points that work as the generators of hub points. The logic of this operation is to create new urban hubs by joint lines.

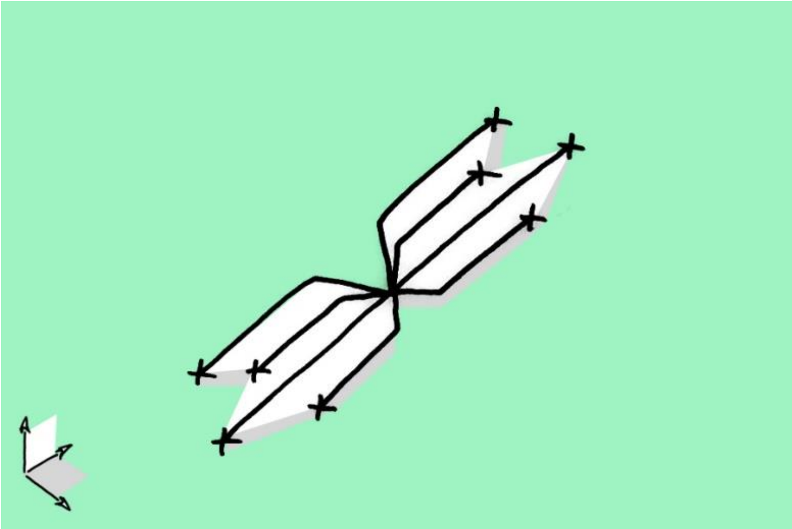


Figure 29: Representation of pinching operation

Distortion: As an act of `*spreading*' the operation, lines are distorted by using point elements. Distorting lines with a point is used to curve or change the angle of straight lines, which can create new paths for vector channels in the network (Figure 30). The logic behind this operation is to spread points and distort lines through the formation of a distance between points and lines. Distortion operation can create new directions and bind them together in a certain radius.

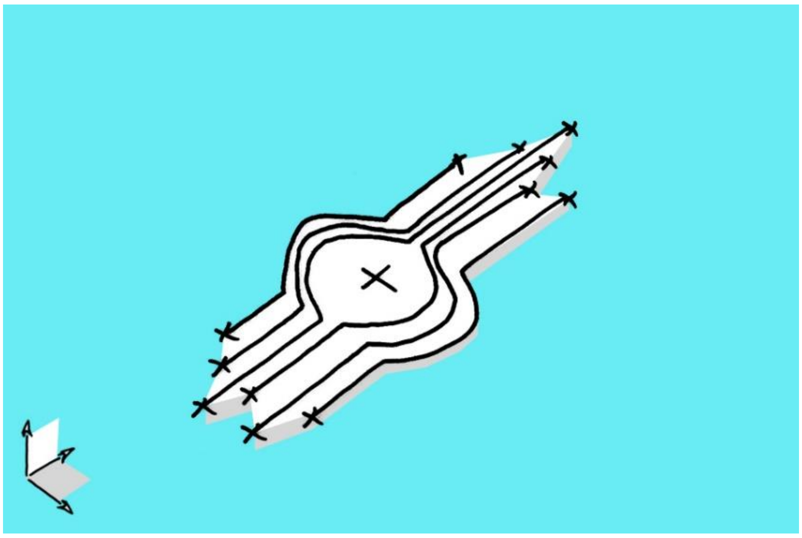


Figure 30: Distorted lines with using point element

2.3.2.3 Surface Operation

Surfaces are geomorphic entities such as plains, valleys, hills, plateaus and mountains. While a landform, in general, constitutes of complex geographical shapes and features, in urban design it works as an operative model. Morphological elements, geometrical definitions and landform processes are necessary inputs for the generation of urban design space. Surface in landscape urbanism includes no buildings; however, it has the potential for the recreation and vegetation of activities and social spaces.

Surfaces or planes, in geometrical terms, are infinite definitions of landscape grounds. The concept of surface in landscape represents a dynamic component having a thickness rather than a two-dimensional flat surface. The soft (vegetation) ground and the hard (paved) surface are two different surface types. The shape of the surfaces can be determined either by curves or straight lines. Different shapes of surfaces can be utilized as sports fields, entertainment spaces, open spaces or public spaces.

Pixelation: Pixelation displays a section of a surface which could either be square-shaped or any other shape as a piece of the surface. The same operation is performed on all surfaces. Using a base shape as the main domain, size and height parameters can be changed to the desired scenario (Figure 31).

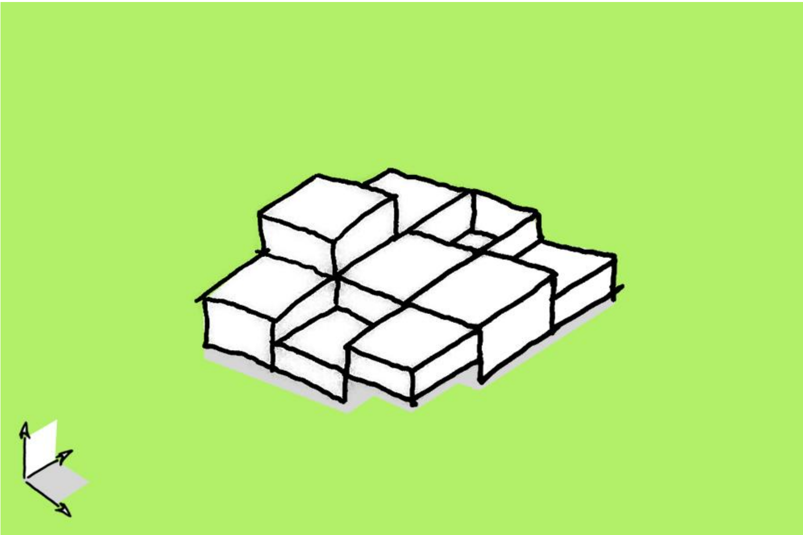


Figure 31: Pixelation operation for displaying a section of the surface

The concept describes the spatial operation for the figure-ground relationship, attempting to understand and re-arrange the landscape as a surface that can be pixelated into smaller pieces and shapes. This concept can create a new open-closed space relationship by combining surface-line-point elements to allow open ended spatial variations.

2.3.3 Operational Framework

Design operations in landscape urbanism are claimed to be used in the generation of morphological urban form. Despite the presence of new tools and techniques, there has been a lack of experimentation with the tools to be able to justify their use. To adapt those instruments and technologies, there should be a framework which could be operated as experimental models to show what operations can be achieved by using those tools and how it can be adapted into the contemporary urbanism discourse. By doing that, landscape urbanism can be more clarified to justify itself regarding urban morphology.

> *In conclusion, there is a lack of morphological research in the field of landscape urbanism. By looking at theoretical discussions, it is evident that there are strong interactions and connections between city and landscape; however, there is a lack of methods and approaches to integrate new elements of Urban Landscape and to combine the fragmented pattern of urbanization process. An operational framework defining morphological elements and basic relational operations between those elements have been defined in this chapter. In that sense, a detailed study on parametric modeling and new emergent tools and methods will be introduced in the next chapter to create a proposal model.*

CHAPTER 3

‘PARAMETRIC URBANISM’

This chapter investigates the potential of newly emerging design methods and tools by looking at the so called `parametric urbanism` discourse. A discussion on `parametricism` and current state of the art of parametric urbanism will be carried out. Parametric urbanism will be critically discussed through recent project examples. The tools and methods utilized in projects will be given as an example for parametric models that provide a framework for operational models.

In today’s world, digitalization has become an essential tool in architecture and design fields. Computers have become tools for devising the design process itself. After the emergence of parametric design, which is a field that allows architects to create variations and carry out experiments, many design forms were created within a given set of parameters. Recently, these tools took part in the emergence of the theory `parametricism` as a new design discourse style that was championed by Patrick Schumacher, a theorist, and practitioner of parametric design (Schumacher, 2009).

Despite the widespread use of parametric design software and tools among architects and planning professionals, the method has not been utilized widely in the profession of landscape architecture. Although the abilities and performances achieved through the use of these tools were demonstrated by some projects, there is still a need to do more research and experiment in the field of landscape architecture.

3.1 PARAMETRIC URBANISM: CURRENT STATE OF ART

In the present, the process of designing can become time consuming when traditional design methods are utilized. Since technology is developing and the understanding of design process is changing, designing does not have to be bound to conventional design methods and tools. Design is not a one directional process and it is becoming a highly complex issue with new parameters introduced into processes of form finding. The human mind has a certain capacity to use new tools and technology to help in understanding and achieving accomplishments and solving problems regarding design goals. Contemporary urbanism, in this context, is experiencing a dramatic change in design methodologies as well.

By using new techniques and technologies in the design process, such as coding, digital fabrication and parametric modeling, professionals and designers are now able to efficiently design more variations through a less time-consuming processes. Digital tools, software (e.g. Rhino and Grasshopper) and technologies are advancing at an unprecedented rate with more people involved to develop open sources for the communities to improve. From this point of view, an emerging design trend is experienced by many academician `parametric design` or `algorithmic design` in the way to generate new forms and patterns.

Parametric design tools could now make daily operations and task which architects and designers performed manually in a higher performance and minimal time. Although standard digital tools such as CAD and image editing are utilized still in routine design processes, digital design tools have a revolutionary impact on form-finding through complex geometries.

3.1.1 Definition of ‘Parametric Urbanism’

When Patrik Schumacher coined the term `parametricism` to represent new design and theories from the new methods and tools, parametricism was not utilized yet to solve modern city problems; today parametricism is more than available to prove itself to be used as an operational instrument for all scales of urban design applications (Schumacher, 2009). Whether parametricism is a new style of architecture or not is a still relevant question.

Parametricism aims to cope with all contextual design factors as a model, including quantitative and qualitative data, to achieve a broad range of design variations. Those variations need guiding principles and a certain set of codes to be represented as a practical tool for designers to justify this bold proclaim.

Overall the very premise of so-called parametricism is that all urban elements and components must be parametrically defined and related explicitly in an algorithmic framework. Instead of configuring solid geometries, parametric design tools brings flexibility and form optimization through generating variations with responsive and adaptive models (Figure 32).

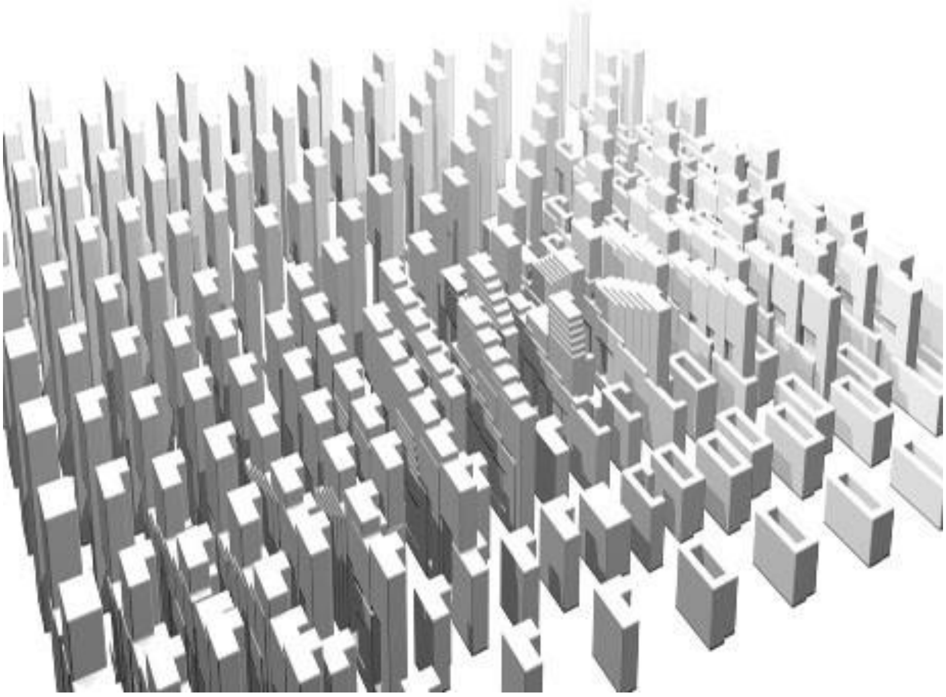


Figure 32: Form variations of hypothetical typologies via parametric modeling (Source: Verebes T., 2013)

Whether we take parametricism as a style or not, it is important to recognize parametric tools and their potentiality in design. Since parametricism as a style is highly disputable and criticized discourse, in theory, this very new area is open to exploration and utilization through new design experiments. To be able to develop new methodologies via the issue of parametrical tools, the parametric design must be free of the discussion of parametricism as a style.

In this regard, parametric tools should be utilized by designers to solve complex urban problems. Reverse engineering of highly complex natural systems and design operations can be used by parametric tools that could lead to generative design applications. Parametric tools have the ability to visualize design process and 3D model at the same time and gives the capacity to control design process while making it more explicit for all.

3.1.2 Contemporary Practice of 'Parametric Urbanism'

Concepts of parametric modeling have reached the urban scale and the practice of city design. Even though parametric urbanism is a new area, there are operational models for more exploration and experiments for urban design. Generative algorithms and parametric modeling have been studied to understand the urban form and systems in the urban design field for complex environments.

It is important to have set up framework and structure for evaluating parameters in form-finding studies, the thesis emphasizes landscape urbanism project cases to find out parameters and operations for parametric model in landscape urbanism. By this way, ideas and methodologies used in the model can be applied to any context related to landscape urbanism projects.

The proposed model suggests that landscape urbanism parameters can be defined to integrate landscape morphological elements; to design an efficient pathway to create new generative proposals about urban fabric. For this purpose, some contemporary design applications are to be examined in the search for possible integrations of landscape urbanism elements into the production of urban spatial structure.

3.2 LEADING RESEARCH AND PROJECTS OF 'PARAMETRIC URBANISM'

The following case studies look at how designers and planners are recently utilizing parametric design tools. In practice, via application and experiments, parametric modeling justifies how the emerging methods achieve higher performances in design. Accordingly, design related professions such as landscape architects, planners, and urban designers can envision and integrate their design ideas to their research and projects as well.

3.2.1 Kartal Masterplan, Istanbul, Turkey – Zaha Hadid Architects (2006)

Zaha Hadid Architects is a design office that has been utilizing parametric design tools for the last fifteen years. In 2006, Kartal-Pendik International Masterplan Project Competition was commissioned by the Metropolitan Istanbul Municipality, Zaha Hadid Architects project proposal was awarded at the first price, and it has become one of the important parametric urban design projects in the literature. The project area is in the shoreline fabric holding its post-industrial character. The main intention of the new development was to reduce the pressure of growing city core by redeveloping the large piece of derelict urban land of the city (Figure 33).

Figure 33: Master Plan proposal for Kartal, Istanbul with the parametric modeling technique (Source: Zaha Hadid Architects, 2006)

The project area considered as blank space allows designers to utilize parametric tools to initiate a kind of flexible grid layout without taking any ownership rights into account in the design process.

The design layout, in this context, offers an original street network with the fundamental design parameters. Existing points of circulation considered as the primary factor to create new road layout. This approach creates new street network typologies, and it is responsive according to structures and public spaces (Figure 34).

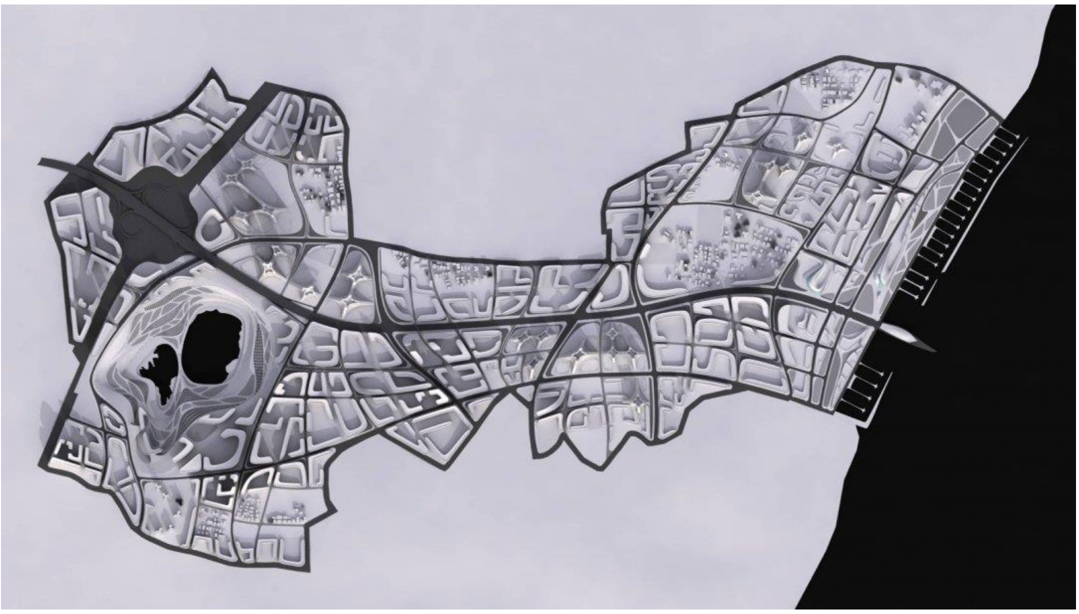


Figure 34: The new street network and building typologies created by the parametric modeling (Source: Zaha Hadid Architects, 2006)

Despite the fact that the design proposal spanned three years of research, it is still at the conceptual level, not applicable to the area. The main reason why the model has not been integrated into the practice is that model approach did not consider the existing design codes and coding aspects of the Turkish planning system. This required substantially some revisions and calibrations, which, in turn, caused a very inefficient planning process in real (Çalışkan, 2013). This signifies the necessity to involve the settled planning procedures in the algorithmic definition of the parametric models (Figure 35).

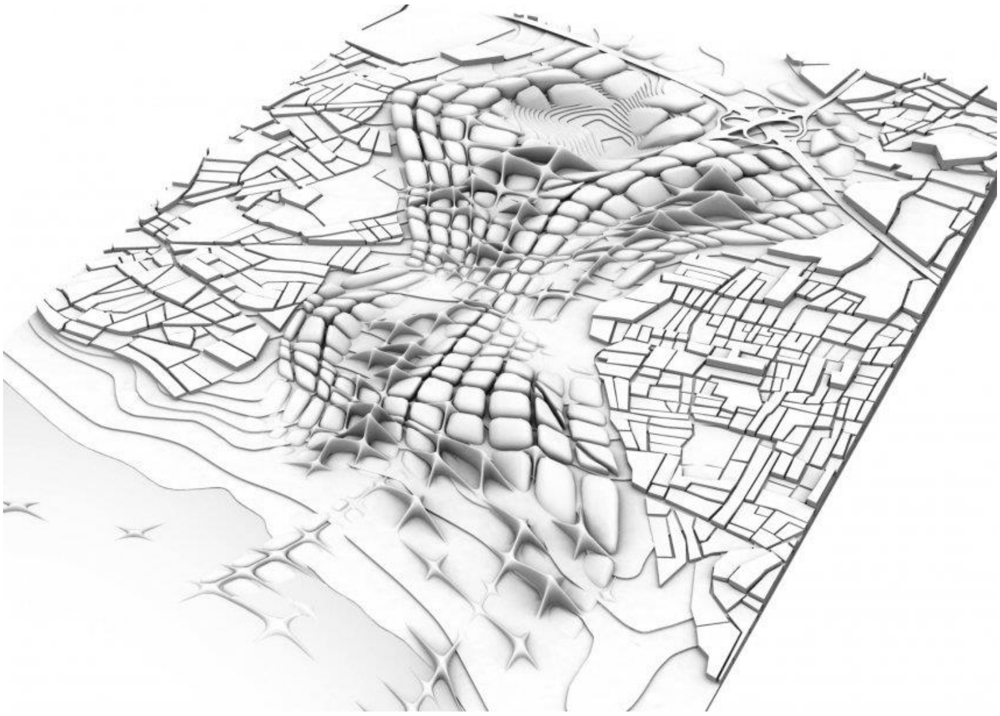


Figure 35: Overall parametric design model (Source: Zaha Hadid Architects, 2006)

A lot more research and experiments still need to be considered when it comes to the construction phase of the project. So, the parametric design being a new model practice is still limited, and needs more exploration and development to be fully operational and applicable in urban design scale.

3.2.2 `Deep Ground Project`: Thickened Ground Concept, Shenzhen – Groundlab (2008)

Thickened ground concept developed by Groundlab was used for the application of the landscape and urban fabric integration process in 2008. The surface of the terrain was used, as a design component in this project, to shape public space and (underground) infrastructure. Concept mainly focuses on the surface having certain thickness and segments to control for the creation of spatial complexity while allowing different programs to utilize as a space generator (Figure 36).

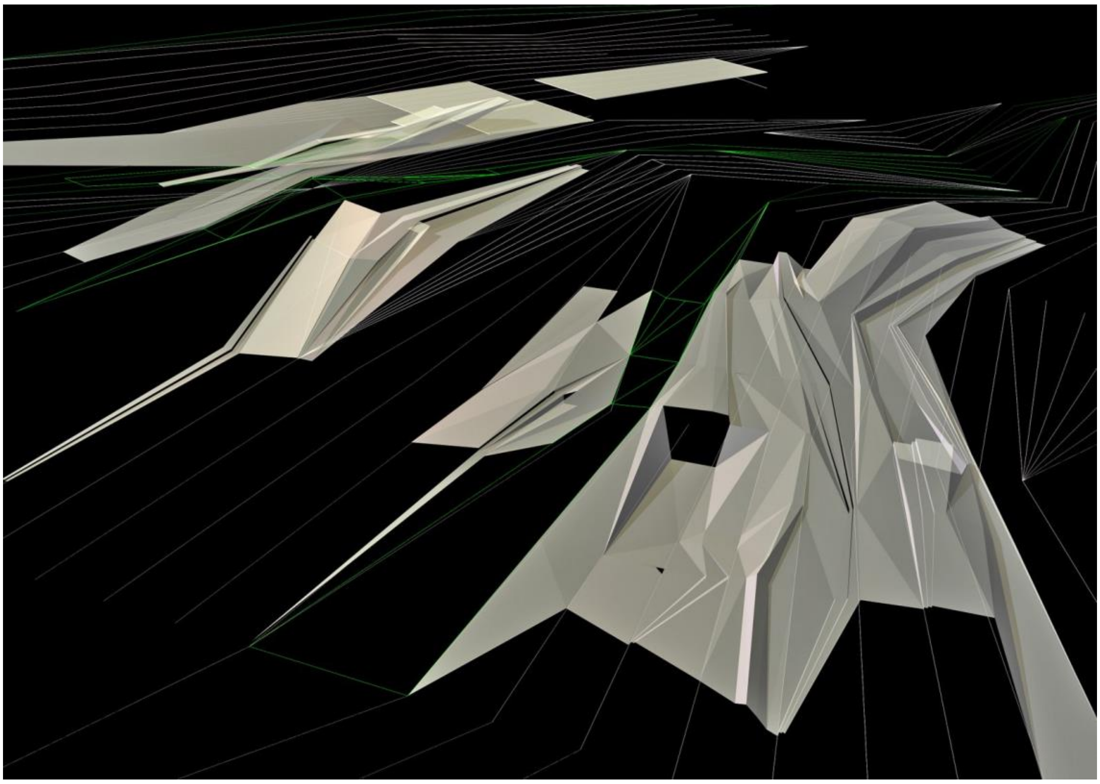


Figure 36: Deep Ground project space-ground relationship (Source: Groundlab, 2008)

In that regard, `the thickened ground` concept works like a mixture of spatial elements and programs providing new functions, new typologies into urban open space. Combining infrastructure and urban surface as a macro-scale space creation is an alternative approach to the conventional understanding of building vs. nature discourse. Using river bend as a surface and creating open spaces, infrastructure, and multi-functional uses, the concept is challenging settled conception of landscape architecture in urban context as well (Figure 37).

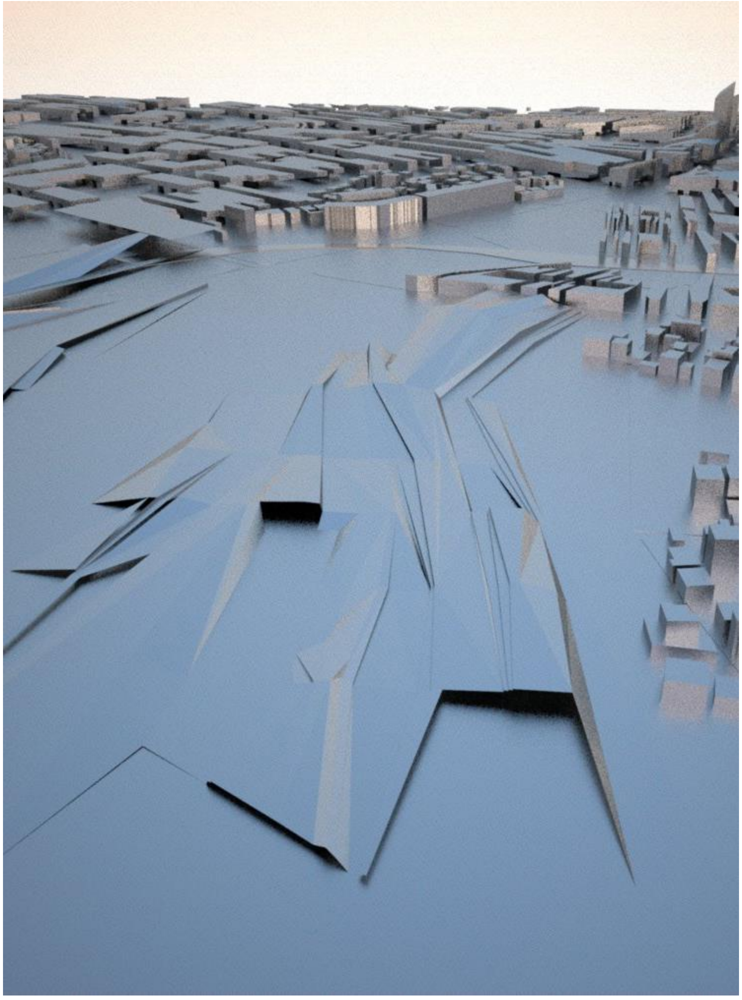


Figure 37: Concept of thickened ground applied to an urban context
(Source: Groundlab, 2008)

The river bend as the natural formation leads to mapping the environment of the city and the core ordering logic of the major layout in its ecology. Surface operations in the design projects are applied to the area such as folding and leveling to create different levels and increasing intensity and size, gaining overall value to the landform.

After developing the concept of *'thickened ground'* the design project continues with Deep Ground competition using the same concept as the main design idea. `Thickening` as a landscape urbanism strategy to create multiple uses of figure-ground relationship is proved to be highly performative operation in design.

Since landscape urbanism mainly focuses on surface operations in the articulation of the landform, thickened ground has been a highly performative achievement in the broad urban context through the generation of micro spatial structures. (Figure 38)

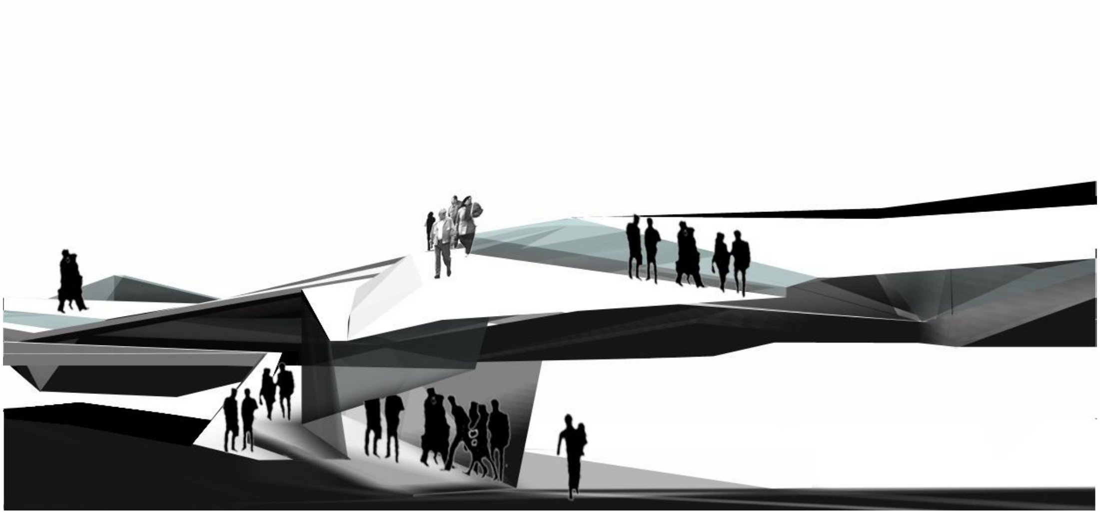


Figure 38: The multilayered urban landscape parametrically modeled within the `Deep Ground` Project (Source: Groundlab, 2008)

Finally, the project has shown that strategy and concepts of landscape urbanism have the certain potentiality for the integration of landform and urban fabric, which are not necessarily as opposing formation, but the relational ones. By the project, one could claim that we can create programmatic differentiation with the help of parametric modeling tools and techniques.

3.2.3 Arnavutkoy Project- 'Relational Urbanism`Studio - Berlage Institute (2010)

`The Relational Urbanism` based in Berlage Institute, Rotterdam, The Netherlands. Studio conducted a design research studio in 2010. The site was in the Arnavutköy, western side of Istanbul. A studio course focused on the major problems of the fast growth rate. The area is highly populated and exposed to rapid immigration from other parts of Turkey (Llabres and Rico, 2012).

Figure 39: Generation of site grid (Source: Llabres and Rico, 2012)

The aim of the model is the production of a mixed use urban fabric that could host various economic activities (Llabres & Rico, 2012). While providing different patterns of urban fabric to create complex urban structure, project manages to keep existing patterns and understanding of resources such as water discharges, land use and topography in the design process (Llabres & Rico, 2012) (Figure 39).

The site grid responding to the existing topography is defining plot sizes. The site mesh was generated by using existing contour lines as main guiding geometry. Different sizes of plot tested according to their sizes, either too narrow (20 m) or too large (200 m) for the formation of plot layout (Llabres & Rico, 2012). After defining the location of urban plots according to water structure, those plots created the final layout of the site grid for the model (Figure 40).

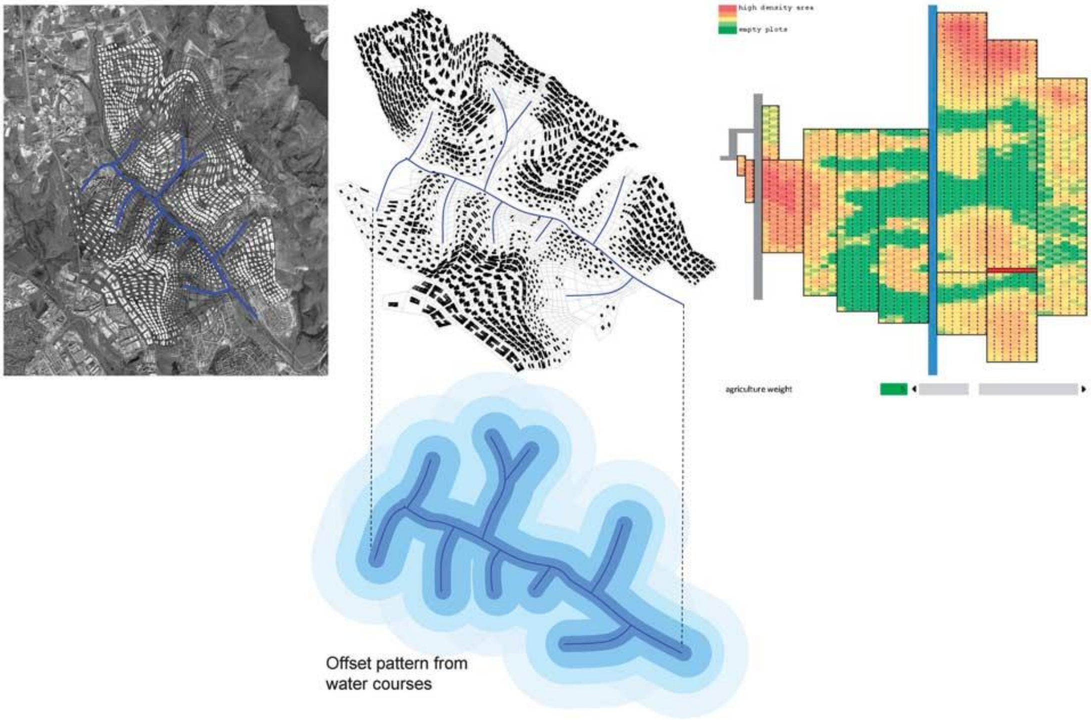


Figure 40: Land use and density maps generated by existing water regime
(Source: Llabres & Rico, 2012)

The distribution and control patterns generated the urban fabric through water bodies and existing topography. Building typology is not generated accordingly in the meantime, but rather its catalog was involved in the testing model. The massing of building blocks arranged according to water bodies and different building forms applied according to that parameters (Llabres & Rico, 2012).

The river conditions land uses such as urban agriculture, residential and light industrial areas, and defines sizes and massing according to the density of water regime. In all stages of design process, urban farming, the residential and industrial zones are property located so that density and possible integration between production and living can be matched (Figure 41).

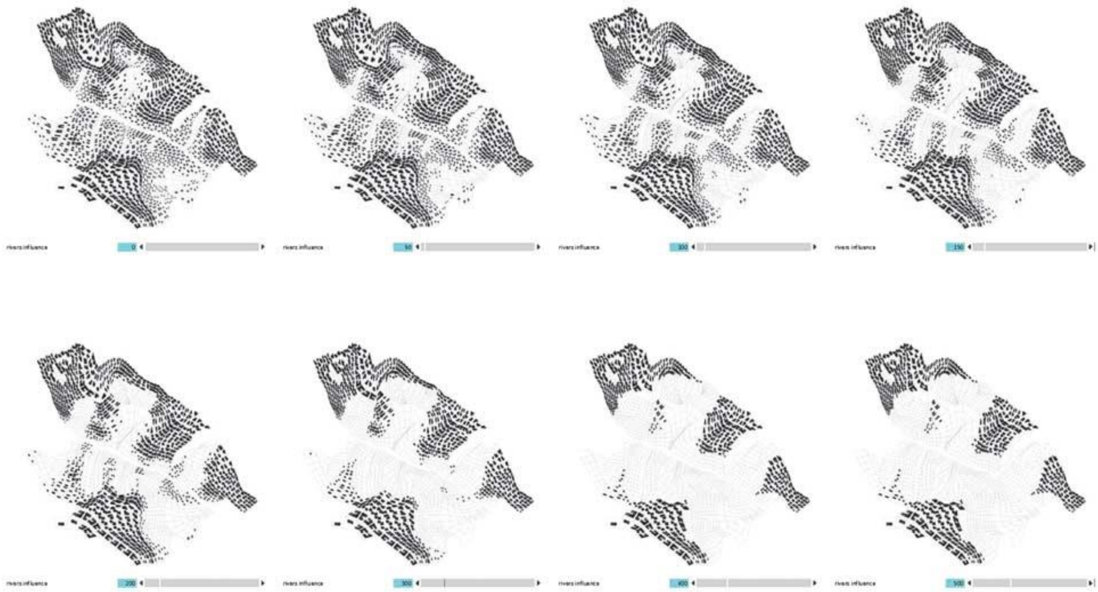


Figure 41: Different variations of density level (Source: Llabres & Rico, 2012)

Even though project approach is very challenging regarding the use of generative design, the model shows that parametric codes for landscape forces are more than capable of providing performative inputs for the design process. By the creation of multi-layered urban spaces, relational urbanism model indicates that overlapping relationships between the social, economic and morphological aspects can be defined in the large-scale distributions of the built fabric by parametrical design tools (Figure 42).

Relational Urbanism model offers the exploration of the potentials of large-scale and multi-layered urban development and design through using dynamic design parameters. Simultaneously growing spatial design proposals can create new variations of design solutions while new parameters can be added into the design process.

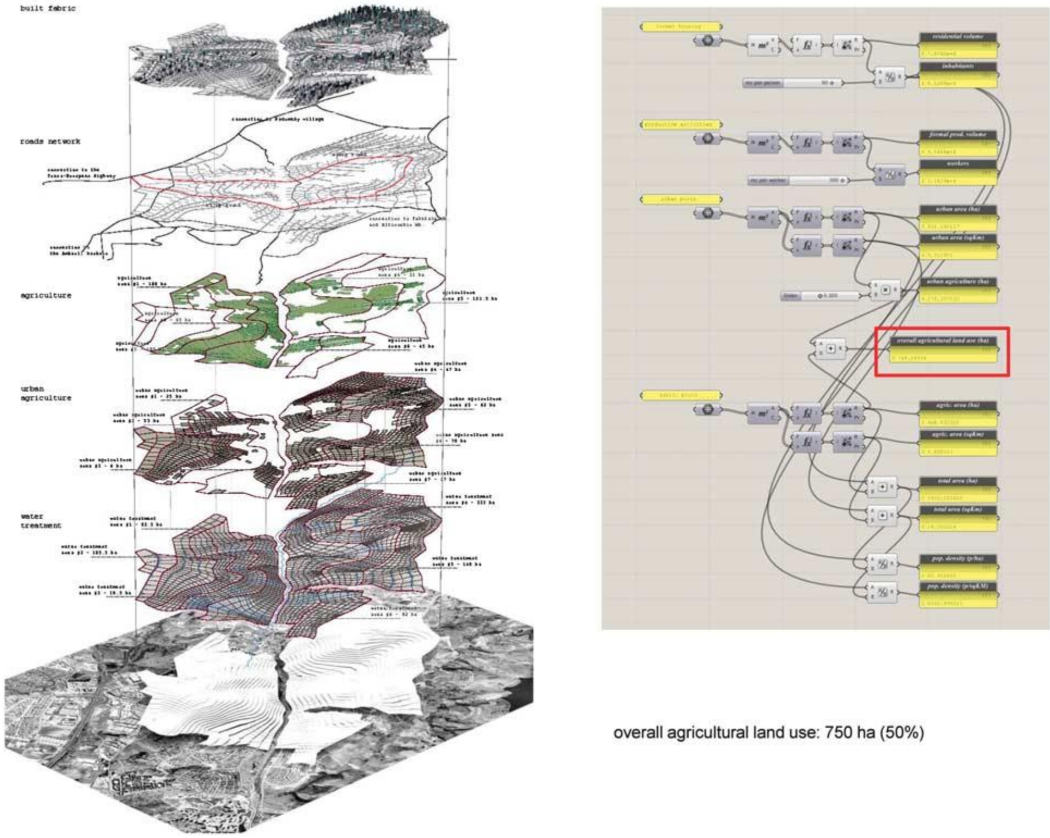


Figure 42: Multilayered urban landscape controlled and generated by the parametric model (Source: Llabres & Rico, 2012)

3.2.4 'Ruling the City': Parametric Urban Design Coding – METU Master of Urban Design Studio (2014-15)

Design codes as a tool to define the urban design processes through morphological elements of urban form come to the fore as a control mechanism within a context in which the core units of the urban form and the coherence between them are defined. Two years ago, within the design research studio of METU Urban Design Program, the design codes were considered as a part of a new approach towards urban morphology in the search for defining morphological relationships of urban form parametrically.

The aim of the design research project was to display the parametric process of urban design. The research defined its approach as *parametric morphology*.

Parametric morphology approach is used in the purport of re-defining the components of urban form through compositional or structural relations. Thus the design research leading to parametric definitions of the morphological elements of urban forms and the performative definitions of urban design codes are presented. Based on a matrix called 'code matrix' generative urban codes have been produced within a predefined framework design and principles. To observe whether the generative codes serve to reach different end-products (design variations), they have been tested in experimental cases.

In 2014-2015 academic year, METU Master of Urban Design Program, urban coding, and design codes have been considered as control tools for the design process within a context in which the core elements of the urban form and the coherence between them are defined. From this point of view, a code index and code matrix were structured to provide the layout for the formation of the parametric language of urban form come up with a series of explicit design. In this framework, the basic elements of urban form have been specified as follows:

Street as a public thoroughfare in a built environment
Block as the smallest unit of collective urban form that gives access to plots by streets
Plot as a piece of land that represents the smallest expression of ownership
Building as any relatively permanent enclosed structure on a plot

However, the basic definitions of these morphological elements are incapable of establishing an explicit relationship between them. Therefore, the elements of the urban form have been re-defined parametrically by splitting them into smaller components. Accordingly;

A ***Street*** is a composite element defined by *sidewalk, lane, street median, and frontage zone, through pedestrian zone, street furniture zone, buffer zone, travel lane and median strip* (Figure 43).

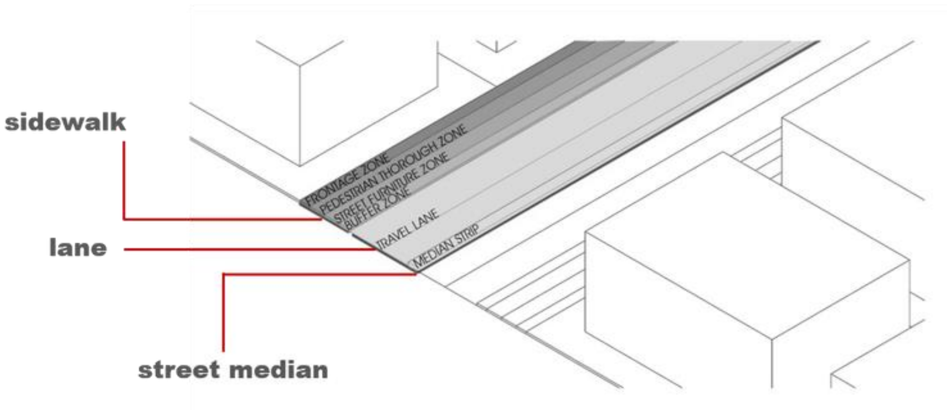


Figure 43: The spatial components of street

An ***urban block*** is defined by *edges and corners* (Figure 44).

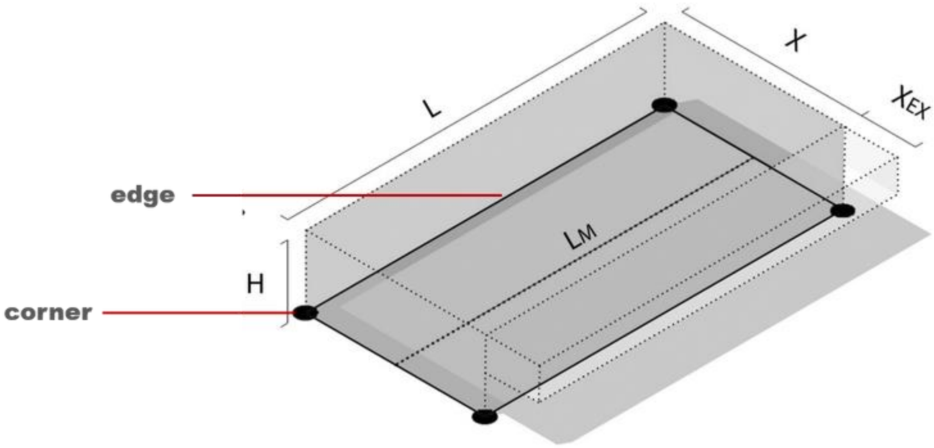


Figure 44: The constructive elements of urban block

A ***plot*** is defined by *edges and corners* (Figure 45).

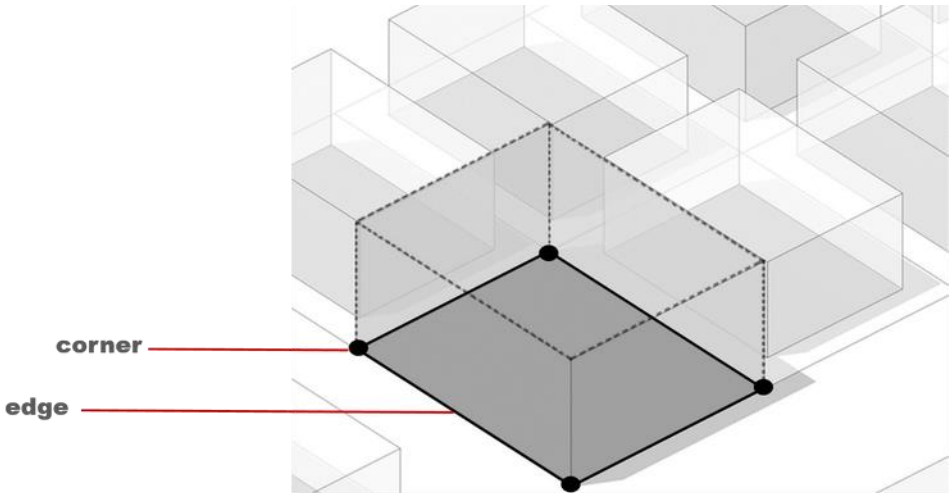


Figure 45: The constructive elements of the plot

Finally, the ***building*** is defined by *edges*, *corners*, *surfaces*, *and openings*, *as an abstract geometry* (Figure 46).

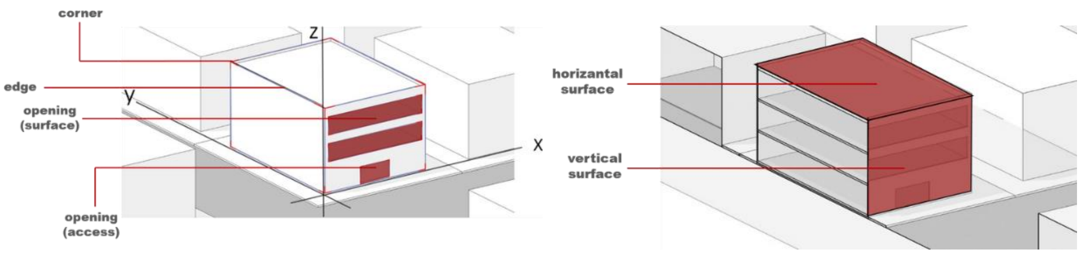


Figure 46: The components of building

The code index is not limited to the definitions of these elements. In the following steps of the code index formation, the definitions through components aim to describe the existing typologies of urban elements. Therefore, a column is added to the index, which categorizes the urban elements on their attributes. Each attribute in the index is measured in a certain parameter. Figure 47 shows the parameters of each morphological element.

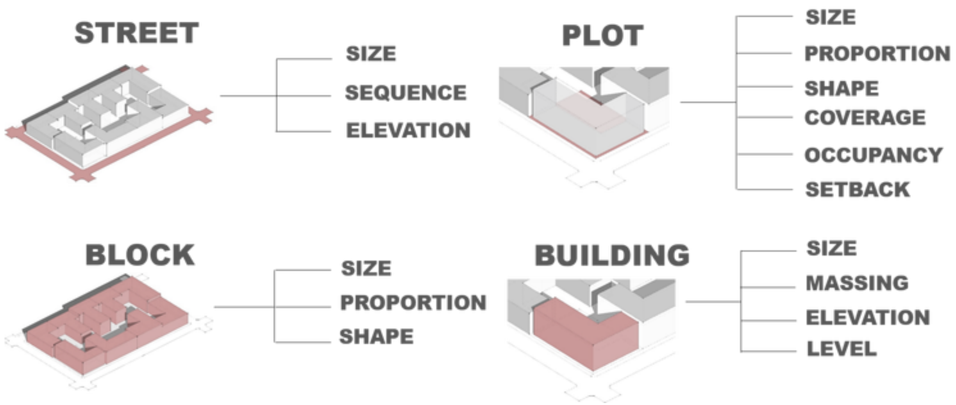


Figure 47: Parameters of the elements of urban form

For instance, in the case of a plot, *proportion* attribute is measured by frontal edge/lateral edge ratio whose parameter is the *length.* Proportion attribute characterizes the plot as deep/shallow or narrow/wide, which, in turn, conditions the different morphologies with other elements of urban form. Figure 48 illustrates the proportion attribute.

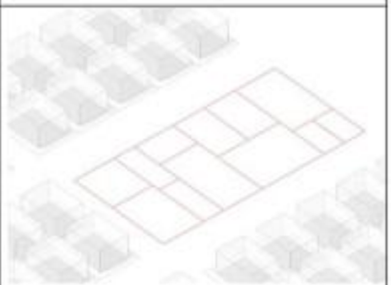
ATTRIBUTE	PARAMETER	NOTATION
Proportion *(Proportioning the edges of plot)*	Ratio *(Length)*	

Figure 48: `Proportion` as one of the attributes of plot

Code index is the table that enables to construct the language of the urban morphology. It is not sufficient to illustrate the relations of urban components with one another. To that end, a code matrix was set to represent the compositional relations between urban elements in a systematic manner.

Code matrix is a rectangular array of structure in rows and columns. Each relation between the urban elements may correspond to a building code, which is parametrically established. That means each parametric definition can perform as a generative urban code in practice.

As an example, *variety in depth* code is the relation between the lateral edge of the plot and lateral surface of the building, which is defined with `*length*` parameter. Any changes in the length of the lateral side of the plot alter the extension potentiality of the building. As a result, one of the expected performances of variety in depth code is to increase the diversity in the configuration inside the urban block. In other words, it provides an opportunity to form various courtyards within the block. Figure 49 shows the notation of variety in depth code in code matrix.

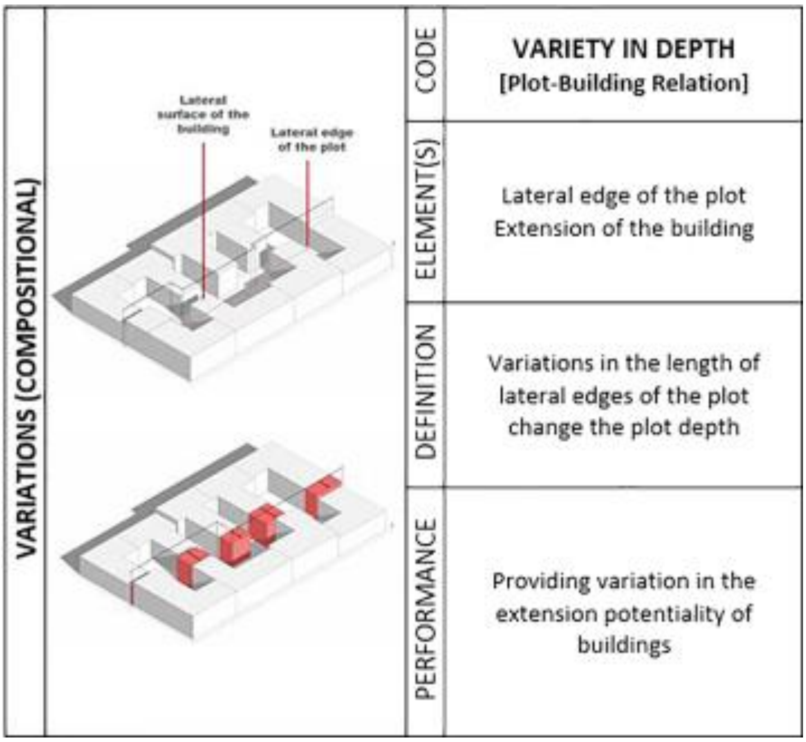


Figure 49: Fragment from the `code matrix`: the code called `variety in depth'

Based on the parameters, the morphological codes aim to afford some level of flexibility in spatial performance. In other words, there is no fixed kind and level of functional performance that code may provide. If the parameter changes, the spatial performances of the form is conditioned accordingly (Figure 50).

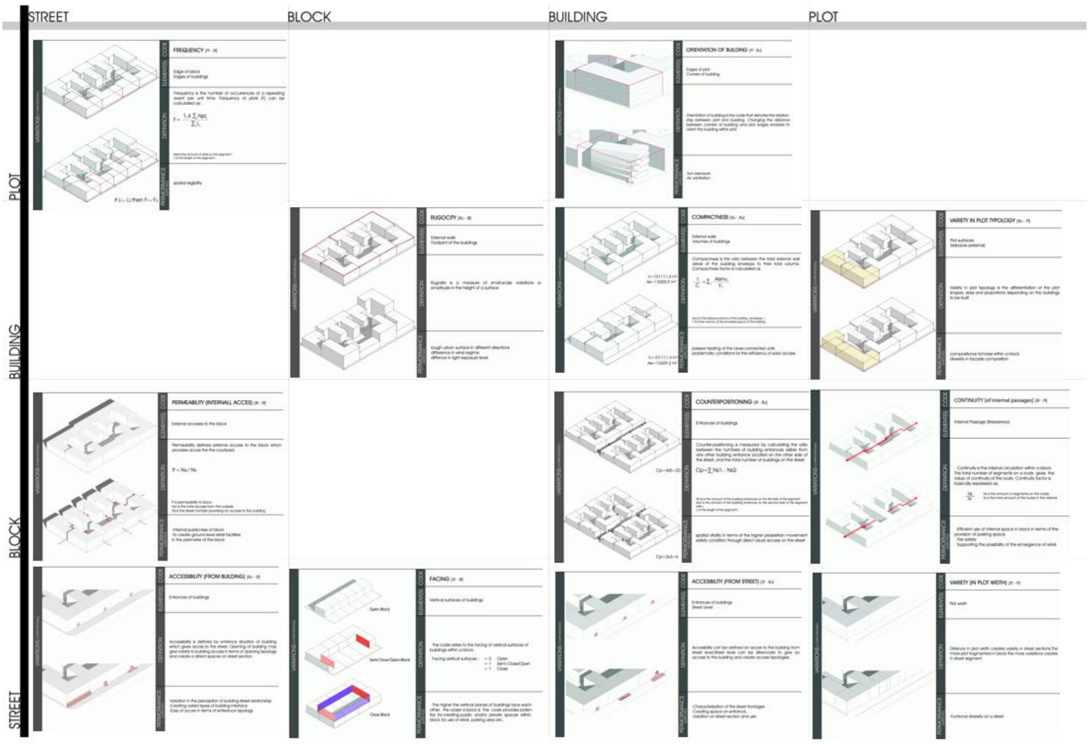


Figure 50: Code Matrix

Thus, the *expected performances* were also given in the matrix. Furthermore, it is important to indicate how to read code matrix. It is noticed that the code produced by the relation of the plot with the building is dissimilar with the one generated by the relation of building with the plot. Code matrix and the correlation between urban elements are structured as seen in Figure 51.

By the formation of generative urban codes through such code matrix, it is assumed that design can ensure the urban areas with the desired performances. In the following part, the operational use of parametric morphological codes will be illustrated with the example projects made in METU MUD Studio and the course of `Parametric Urban Design` in 2014-2015 academic year.

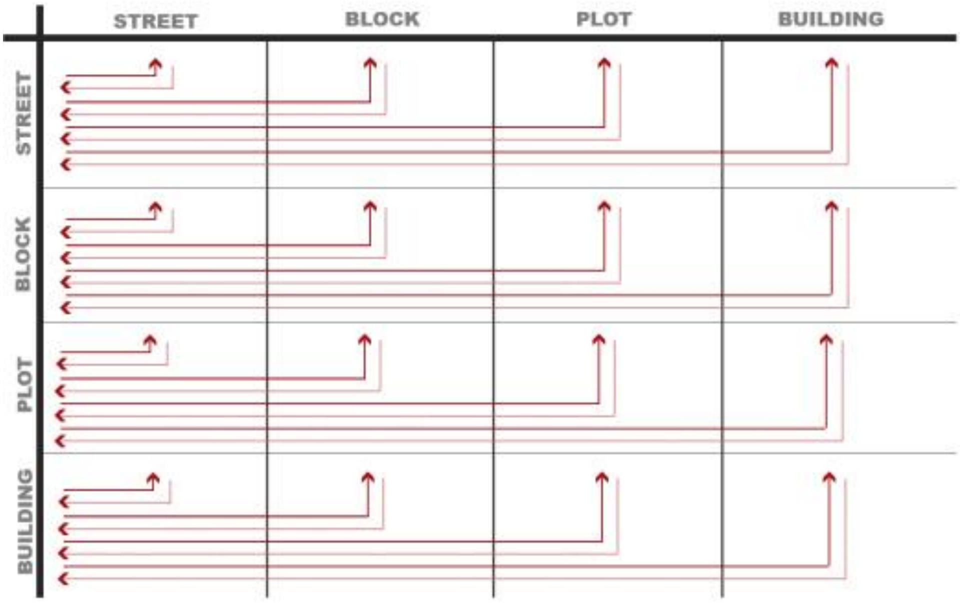


Figure 51: Structure of code matrix

3.2.4.1 Project Case

The design research conducted in the 2014-2015 academic year of METU Urban Design Master Program reconsiders the intrinsic relationship between code and design, and operates a code based design to generate and control the complex urban forms.

Bostancı neighborhood in Kadıköy district of Istanbul was selected as a hypothetical study area for the design research conducted in the 2014-2015 academic year of METU Urban Design Master Program. Through the test process, a programming language, called Grasshopper 3D was used to create design algorithms and to visualize the variations produced.

The project of design research aims to define basic elements of urban formation and relationship between those basic elements creating an operational framework for models. That relationship can be parametrically measurable and creates new form compositions via the creative and parametrical framework. The use of codes was tested in a real context in Istanbul, Turkey by selecting regular urban blocks which are subject to be transformed into a multiple-property ownership pattern (Figure 52).

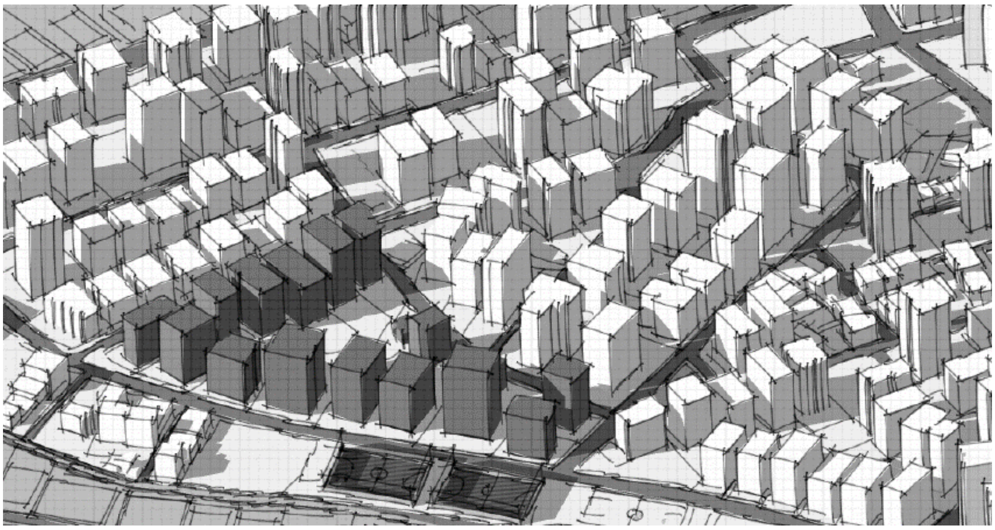


Figure 52: Bostancı neighborhood in Kadıköy, district of Istanbul

Case study adopts a street based urban design approach as opposed to a block-based planning. It focuses on the characteristics of the "*street*" The approach of this study is to create open spaces in a hierarchical order consisting of public, semi-public and private spaces on different levels of buildings. Rather than designing solids, voids are articulated within the urban block as design tools to explore the block based design variations (Figure 53).

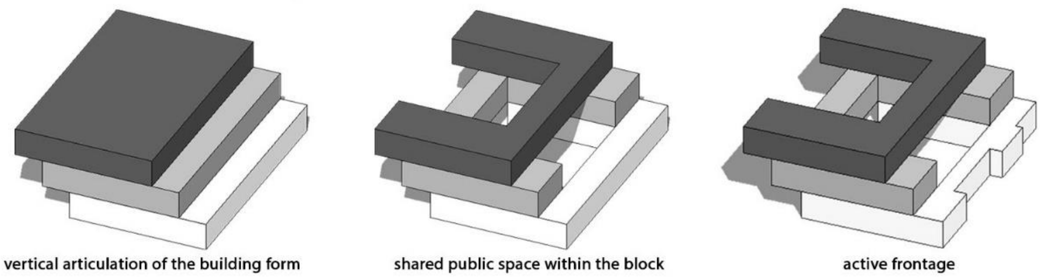


Figure 53: Design concept based on horizontal and vertical volume articulations

3.2.4.2 Algorithm

In parallel with the aim of fostering public life above street level, the frontal facades of the buildings in each level are recessed and extended from the street median to form volumetric transitionary spaces at each street level. The main relationship that is established among the elements of the urban form in this design algorithm is between the street and building. The parameter in which the street-building relationship is established varies with each code constituting the design algorithm.

Facade Articulation Code: To increase horizontal interactions between the street levels, connections are formed where the distance between opposite vertical surfaces are the closest. Similarly, the vertical interactions are provided by vertical space volumes connecting the different street levels (Figure 54).

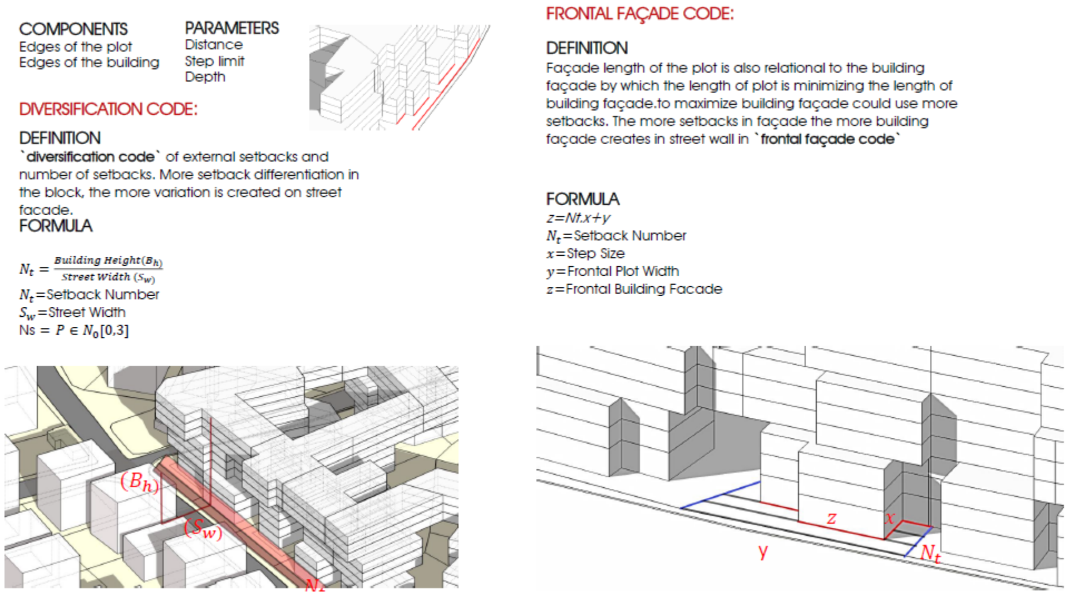


Figure 54: Facade articulation codes via setback system applied on every level of building formation

Expected performances include compositional richness in block typology, maximization of coverage area of frontal street facades and variation of street facade by maximizing the frontal diversity of street wall.

Attachment Code: To maximize surface continuation of horizontal interaction between the plots, connections are formed where the distance between buildings segments are maximized according to setbacks. Similarly, the vertical interactions are provided by vertical space volumes connecting different setbacks in each segment of the building that creates voids and open volumes for each segment (Figure 55).

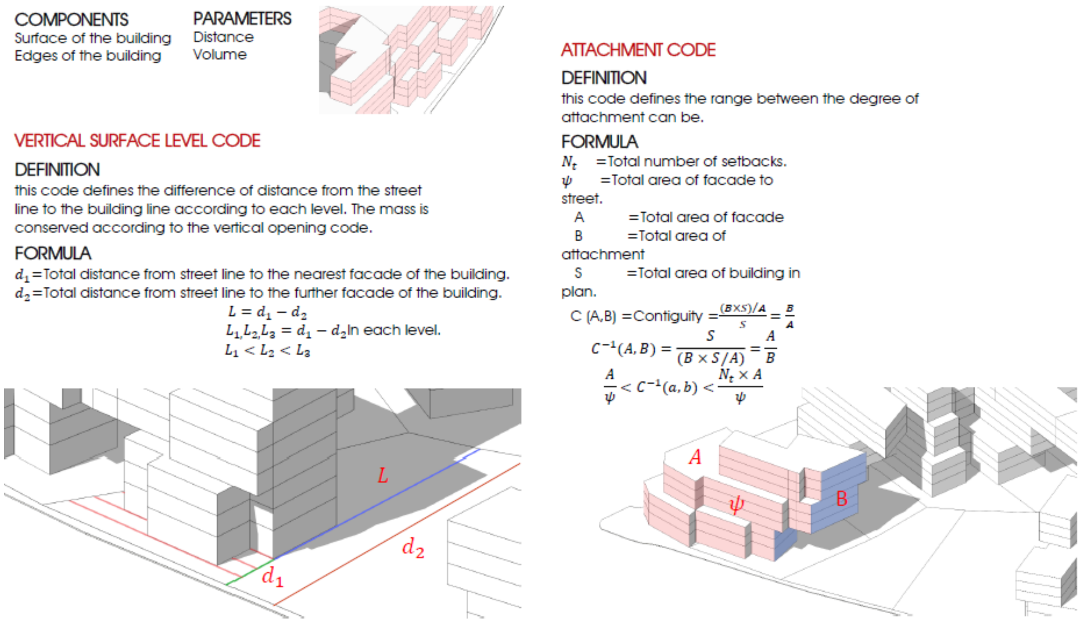


Figure 55: Plot by plot attachments of every segment of the building levels

Compositional increased porosity in block typology, creation of a variety of different open spaces on upper segments of building block, continuity of facade, and variation on street facade by surface area connections are expected performances.

Solid-Void Code: In spatial distribution of the voids above ground level, the voids above the field level, named as carved spaces, are randomly distributed in each plot. If the carved spaces intersect with the vertical surface of the building, they are characterized as private spaces. On the other hand, if carved spaces do not intersect with the building's vertical surface, carved spaces are characterized as common spaces.

To create interspaces above the street level, the target points designated on the street level are moved to upper levels. Every plot creates openings on the facade to allow street continuity on the block and have permeable street layout opening for the public to inside the block (Figure 56).

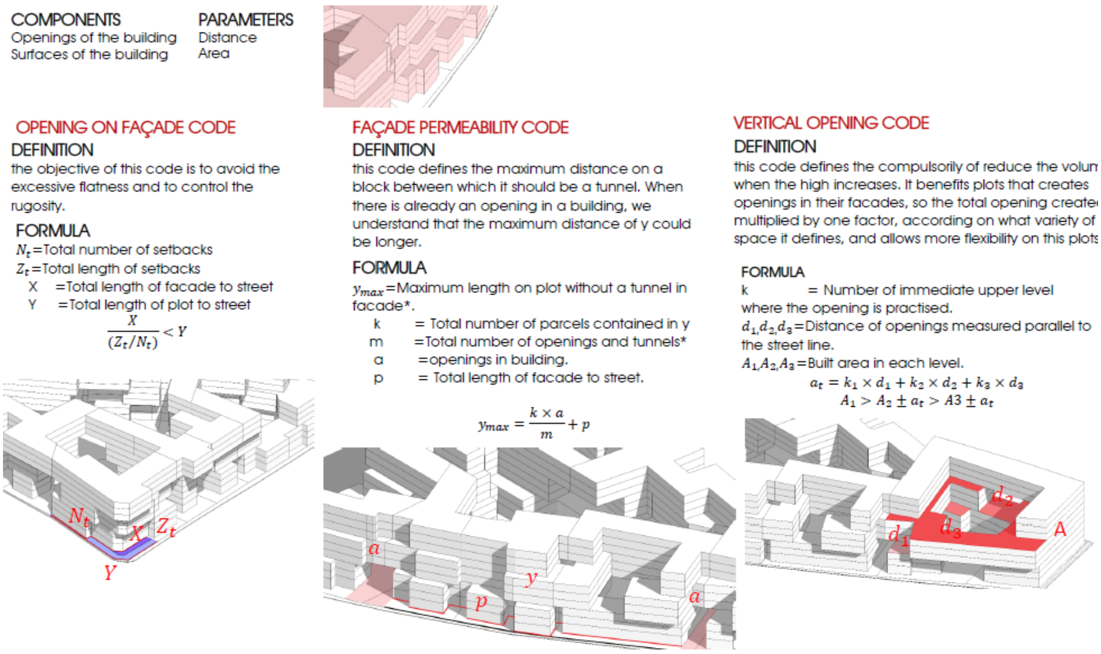


Figure 56: Expansion factor above the street level

Since the form and distribution of undulation varies at each level, variations in volumetric horizontal and vertical spaces are created using recessions and extensions. Expected performances include passive heating on building block, variation of open-close volumes and increase in block permeability.

3.2.4.3 Variations

The variation test aims to address the separation of public and private domains from each other by defining setbacks and facade relationship. To verify the capacity of generative urban codes to create alternative design solutions for desired performances, a variation matrix is prepared based on setbacks, vertical articulations, and openings. Figure 57 shows the transformation of the study area by the design codes and framework modeled by parametric design tools.

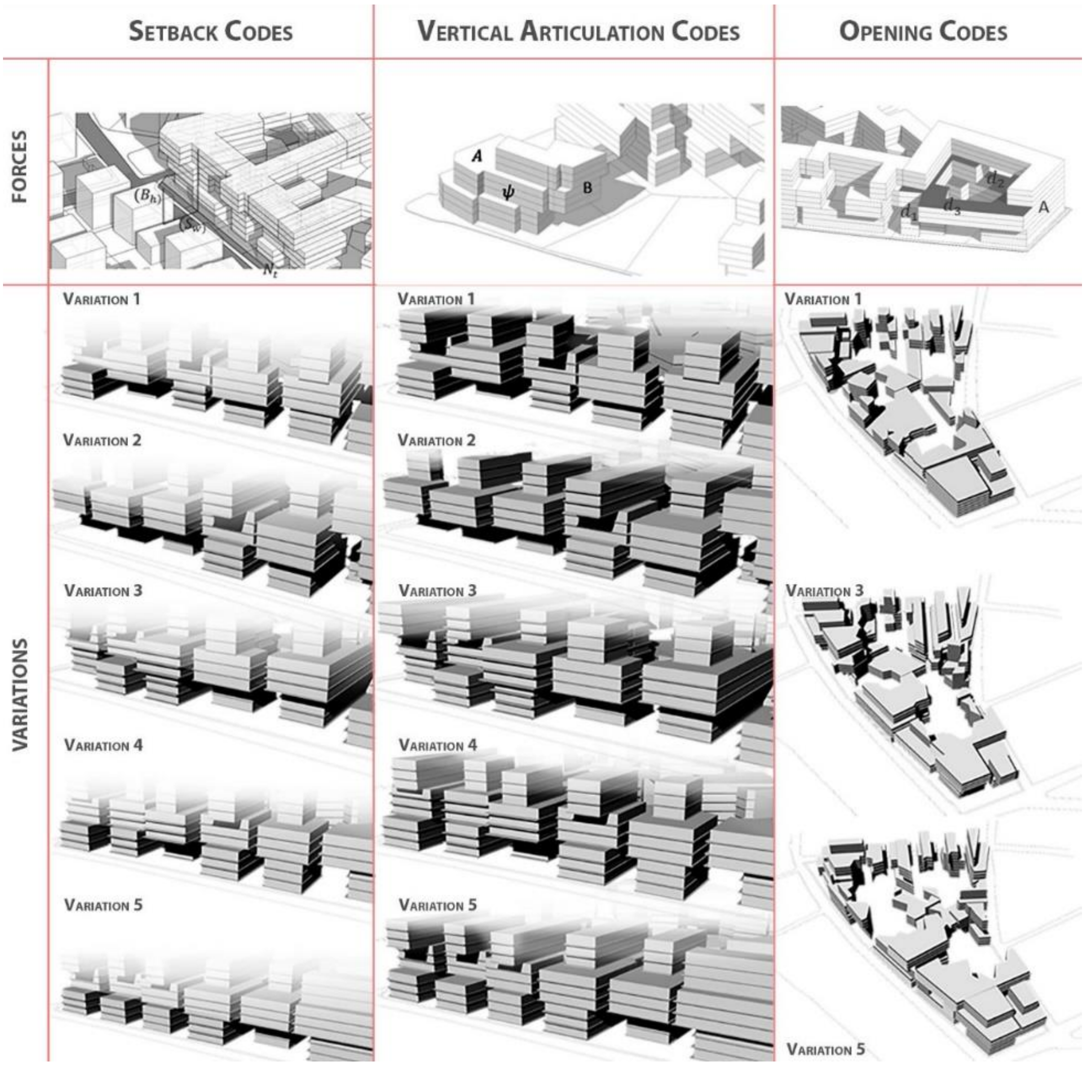


Figure 57: Transformation of study area above the ground level

The design variations are produced by generative urban codes. The determination of the height of the voids by the ratio given above, provides effective lighting for private and common spaces. Transformation was generated by a plot (Figure 58).

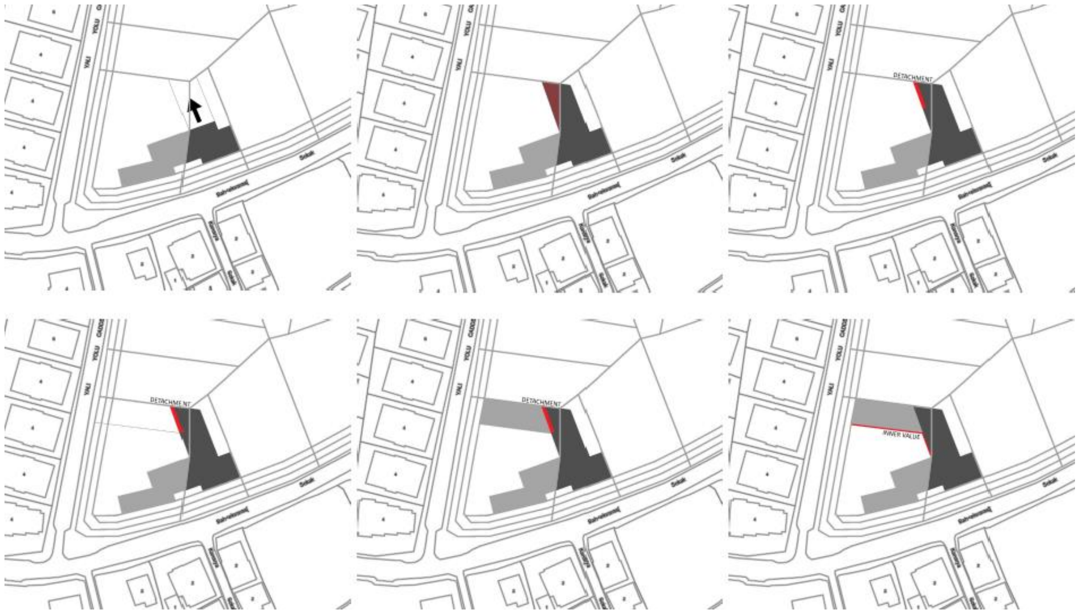


Figure 58: Transformation of study area on the ground level

In Figure 59, void percentage in the total envelope of the block is kept constant, while the number of void volumes differentiates. In Figure 60, the number of surface connections is kept constant, while the void percentage in the total envelope of the block varies.

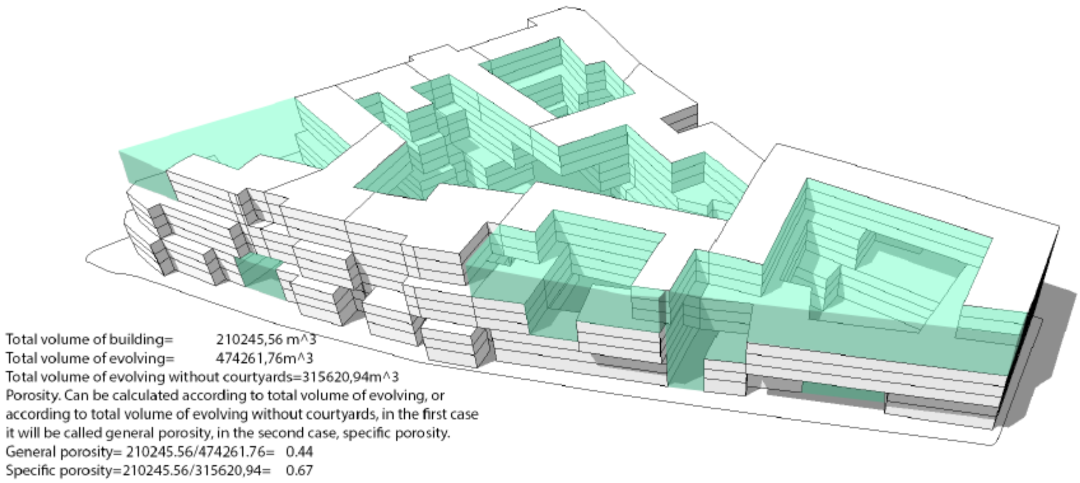


Figure 59: The distribution of total void percentage with an increasing proportion rate

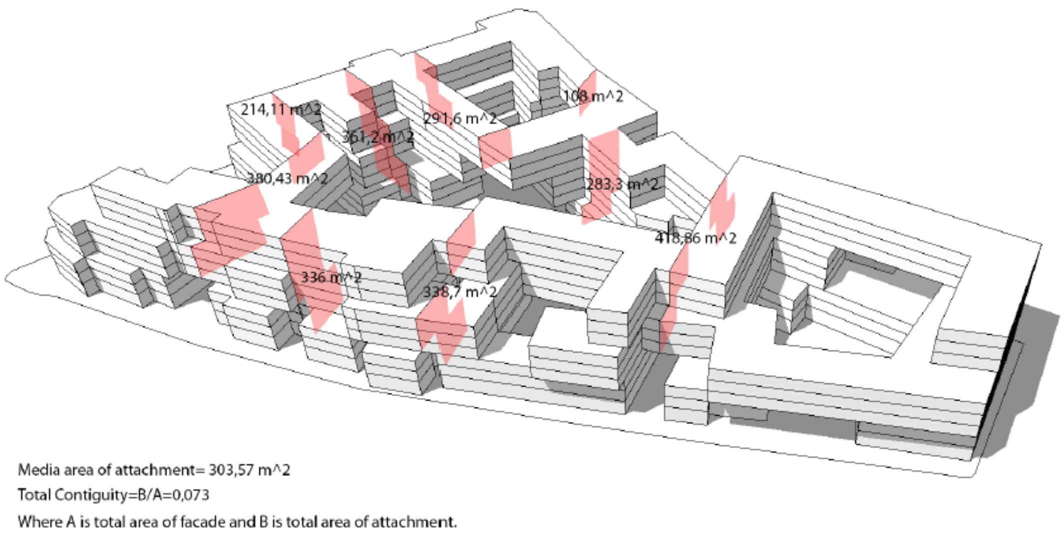


Figure 60: The continuity of attachment surfaces provided by attachment code

The percentage rate of voids is increased to create more common and private spaces at the upper levels of the buildings (Figure 61).

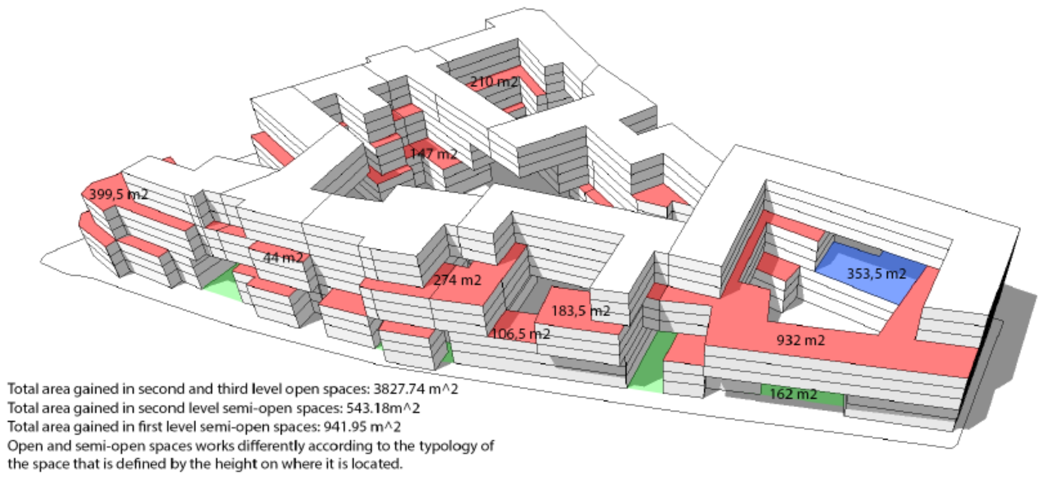


Figure 61: Spatial distribution of open spaces according to every segment of buildings

As a follow-up phase of the design research, the generative urban codes were tested on a hypothetical context in Kadıköy district of Istanbul, Turkey. The tests were aimed to result in more than one unique end product. In line with the digital form generation techniques (Grasshopper 3D), variations in the formation of the block were produced within the context of algorithmic thinking.

The same codes are tested on using parametric modeling tools to create more form variations on urban design course; parametric coding is set up to achieve similar performances such as active frontage, public open space, changes in courtyards, maximization of frontal commercial facades and maximization of sun exposure and wind circulation (Figure 62).

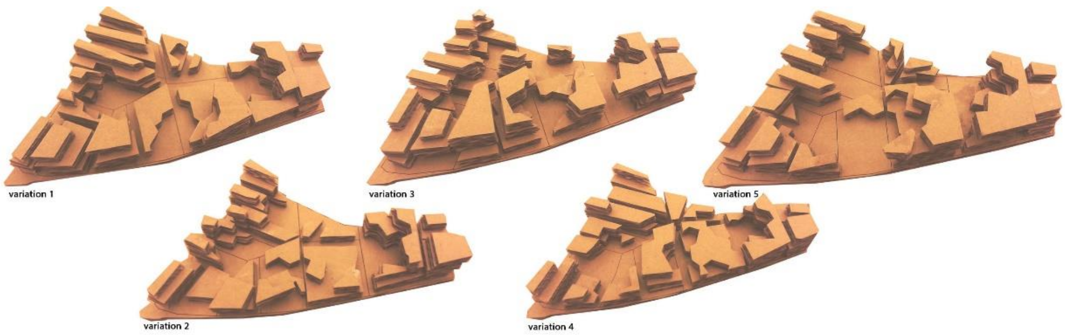


Figure 62: Three-dimensional views of the form variations generated by parametric modeling made for UD755 Parametric Urban Design course Spring 2015 term.

3.2.4.4 Performances of the Project Case

By adopting the approah of parametric morphology, this urban design research concentrates on generating complex urban fabrics through design codes. To systematically define generative urban codes with the aspects of urban morphology, a code index constituting of the language of complex urban forms and a code matrix correlating the different elements of urban form on a performative basis were produced.

The use of parametrical models provides a working methodology where urban formation is evaluated remotely via the help of parametric design tools and techniques. Due to the dynamic and flexible character of the parametrical design modeling interface, the researchers and designers can develop new relationships between the spatial distribution of urban form and performative outcomes of space formation. The design process becomes a dynamic interaction between urban design elements such as urban block, plot, street and buildings by creating manipulative variable and form variations.

It is the collaborative and multi-disciplinary process of urban design coding. Moreover, each group had different ideas and discussions during the design process. It means many different perspectives, skills, and ways of thinking about urbanism are brought to operational studio works.

> *In this chapter, parametric urbanism was discussed and tools and methods were used in an actual urban context. Parametric design project case examples were examined to create a further collaboration between parametric urbanism and landscape urbanism tools and methods in the final hypothetical model. In the next chapter, more details on the proposed parametric model is given. The model framework and the relationship between elements and their operations will be discussed in the fourth chapter through a case study area (The London Olympic Park).*

CHAPTER 4

PARAMETRIC APPROACH TO LANDSCAPE URBANISM: MODELLING THE LANDSCAPE STRUCTURE IN URBAN CONTEXT

In the previous chapters, landscape urbanism and parametric urbanism have been discussed in the dimension of morphology to create an operational model for a possible integration between fragmented urban landscape elements. In this chapter, a proposed model will be tested through a case study area to have emergent forms and possible performances. In that regard, this chapter contributes to the parametric approach by modelling the landscape structure in an urban context and providing detailed analyses of the case study as well as a discussion of performative potentials of the model.

Since parametric modeling tools have recently gained wider application in the field of master planning and changed the way design processes are, experimenting these tools and utilizing them as an integral part of the design process has become an important research topic in the area of design. This chapter discusses how these tools can be orchestrated in urbanism by controlling urban spaces, and the landscape elements.

The chapter also discusses the possibility to suggest a robust method for 'parametric landscape urbanism' for a better integration between landscape morphology and city structure. The model is supposed to have a key position between landscape urbanism and parametric design which would eventually provide generative design interface.

The parametric design interface may be called 'the model of parametric landscape urbanism' following a methodology that integrates landscape topography and surface operations as the design inputs on the project site (London Olympic Park). It is already exposed to more inputs from architectural design.

The model starts with the generation of the site grid that uses land surfaces and river patterns from existing site components to create a so-called 3D mesh as the basis for landscape structure. The model defines and operates a new network which provides necessary connections between existing urban structures such as topography, road network and existing buildings utilizing 'wool thread model[1]' The model definition, in this context, continues with establishing a relationship between the surface structure of the site and the proposed network by defining parametric rules controlling angles, distance, and height of the built structures.

The final step is the generation of new surface relationships and articulation of those surfaces using slope analysis. The parametric interface allows the model to feedback newly created surfaces as new inputs for the generation of urban network laid on the ground.

The model allows the overall control of the complex urban landscape morphology with the representation of a predefined landscape indicators regarding river, infrastructure, and the terrain. A model presents a circular feedback mechanism for the concurrent operations within the design process.

4.1 PARAMETRIC (RE)DEFINITION OF LANDSCAPE URBANISM: A MODEL PROPOSAL

The parametric design suggests an operational toolset for designers to involve different factors of the environment, such as topography, the wind, and water, which are major inputs in landscape design and planning. Re-involvement of those factors on a parametric basis can provide new opportunities to strengthen and enrich the planned landscape operations in urban context.

4.1.1 Necessity of Parametric Modelling in Landscape Urbanism

In the contemporary world, public design discourses focus on the landscape-city

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[1] Depending on the adjustable parameter of the thread's sur-length, the apparatus –

through the fusion of threads – computes a solution that significantly reduces the

overall length of the path system while maintaining a low average detour factor (Schumacher, 2009).

relationship, thus created a number of exemplary projects. Even though there are numerous successful projects built since the emerging interest, there is still a lack of theoretical background and operational framework. Searching of landform for urban design projects generating new landforms, it is still needed to define landscape topography and their intrinsic landscape parameters.

In urban design practices and theory, there is a lack of landscape parameters regarding landscape urbanism. Landscape urbanism has a lot to offer about the theory of landscape-city relationship, but it primarily needs to be grounded into practice and urban design codes.

This chapter will focus on tools and techniques and thus a possible model for ‘parametric landscape urbanism' the thesis creates a framework that explains how these tools and techniques can be used as an operational model.

4.1.2 Opportunities and Constraints of Parametric Model for Landscape Urbanism

The model combines the main site inputs within landscape analysis and design, which might be claimed to provide more possibilities for the generative design process in landscape urbanism. Nevertheless, it should be noted that landscape parameters are limited to data set in the thesis. Regarding topography, the study area does not provide a broad range of slopes and topographical and territorial variations and diversity about landscape morphology. Thus the model creates its own hypothetic 3D mesh surface to articulate and study landscape forms.

Since the model aims to generate new urban structures in large open fields within dense urban fabrics, the parametric model is tested in the context of London Olympic Park. The necessary connections between the two sites of the study area are a major problem as well as the prominent opportunity for the generation of new landscape forms in the area. The model, in this regard, is expected to improve the performance of (natural) ground and (urban) structure relationships for possible spatial programs.

4.2 MODEL DEFINITION: PROPOSAL FOR AN OPERATIONAL FRAMEWORK

The objective of the parametric modeling is to control the parametric design operations and additional morphological analyses in urban areas, as an alternative to so-called blueprint master plans. The model experiments for a morphological design process applied in landscape urbanism while responding to the emerging complexity of the network structures and surface conditions in urban contexts.

4.2.1 Aim of the Model

The thesis explores the generation of landform as a field of urban design practice. It positions itself within contemporary landscape urbanism practices, in close connection with urban design. The connection is provided by the field of urban morphology in possible relations with the social and cultural aspects. In that respect, it is separated from the mainstream approaches to ecological and sustainable design and planning[2].

The model uses landscape as a driving force in which the urban morphology performs as the generator, and claims to be a tool for a generative design process for developing the field of landscape urbanism. Since the area of landscape urbanism has been critical about regionalist positions, conservation and ecology, the thesis will be a generative tool for active urban form using emerging tools and operations of parametric design. Within this context, while landscape urbanism discourse provides the theoretical background, the thesis is guided by a practical knowledge of landscape architecture and urban design fields.

The thesis develops a model proposal for an abstract understanding of complex landscape formations on a parametric basis. The morphological operations involved are to generate a variety of restructuring urban fields integrating different portions of the overall urban fabric. It can also provide alternative design thinking process and

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[2] For the major examples to that approach, see: green urbanism, sustainable urbanism, ecological urbanism, clean urbanism, agricultural urbanism.

aims to prove how urban morphology can be designed and reconsidered.

4.2.2 Elementary Parametric Operations of Landscape Urbanism

To create a generative framework for landscape urbanism, the operational model ought to include a series of simple parametric operations controlling the associative relationships of those elements. The definition of regular and flexible operations of landscape urbanism is crucial for an effective monitoring process of generative design modeling.

4.2.2.1 Alignment

Alignment is a parametric operation to arrange the components of landscape structure on the ground. Elements are organized along their base-points to consequently achieve the three-dimensional ground structure in diversity while controlling each point to compose hypothetical land-form relationship (Figure 63).

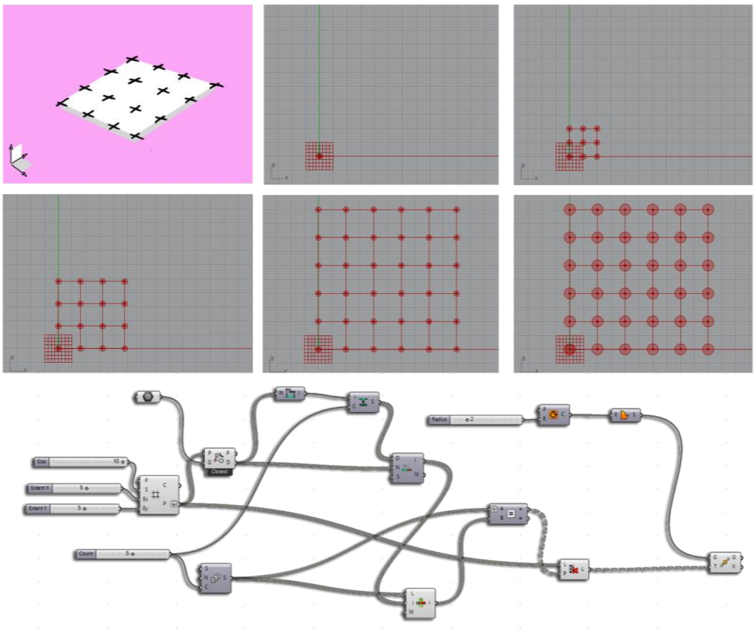

Figure 63: Algorithmic definition of the operation, `Alignment'

4.2.2.2 Distortion and Pinching

Distortion is an operation which controls curves of network system by adjusting their intersection points to modify them with attraction points. Those control points can be arranged according to the desired increase or decrease in average the distances between the point and curve system.

The operation of (linear) distortion with points can result in the creation of new curves changing the angles of curves (Figure 64).

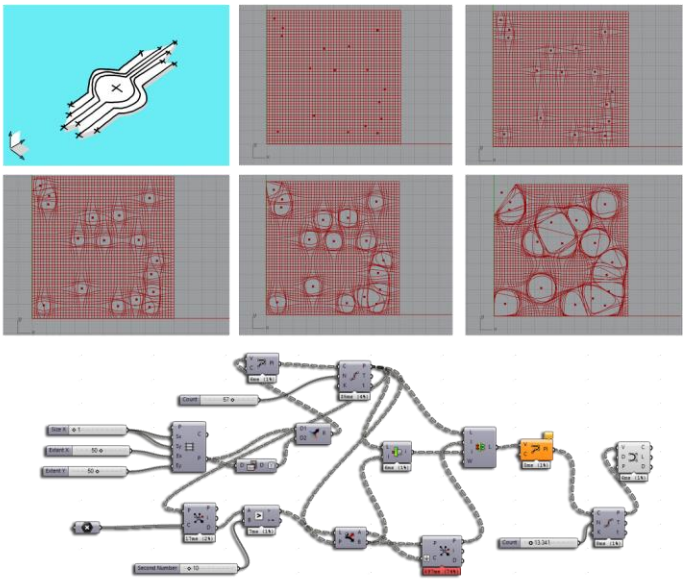

Figure 64: Algorithmic definition of the operation, `Distortion'

Pinching is a similar elemental operation of distortion, which uses the control point(s) to pull the curves subject to the parametric control processes (Figure 65).

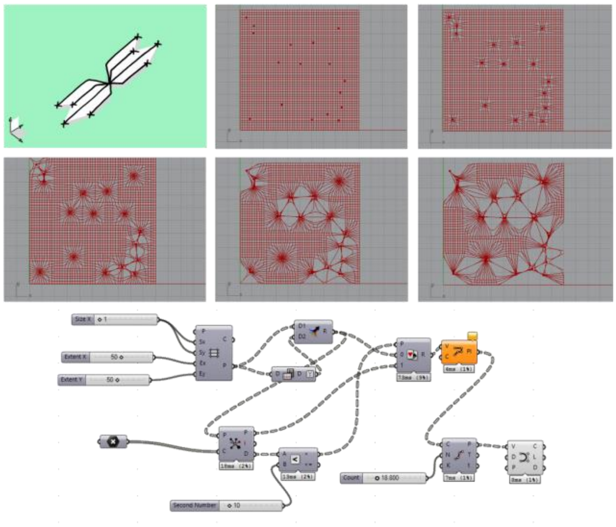

Figure 65: Algorithmic definition of the operation, `Pinching'

Spaces or network hubs can be created with this operation. Generating new joint points creating connection hubs and attraction points.

4.2.2.3 Pixelation

After defining surfaces, pixelation operation is used to articulate surface-mesh as guiding points to operate new surfaces in design. Those surfaces could either be square or other irregular shapes. Pixelation operation can control cell size, height, and width (Figure 66).

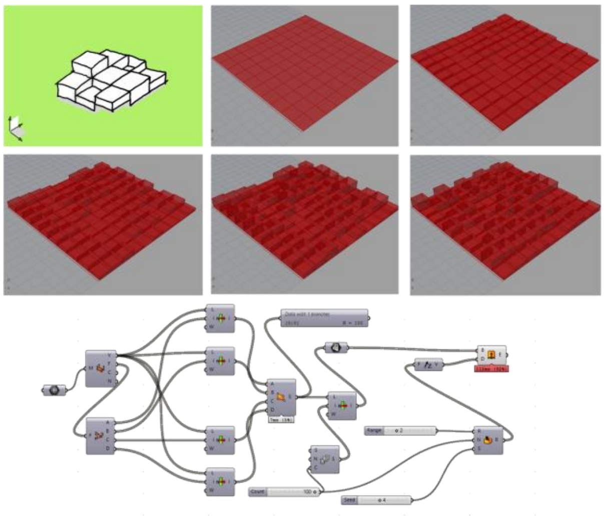

Figure 66: Algorithmic definition of the operation, `Pixelation'

4.2.3 Operational Framework of the Model: *The Workflow*

Having defined the basic operations of the parametric model, the system of the model which associates the basic elements through a series of operations can be constructed. The suggested interface, in this sense, links the 3D representation of the site with parametric design operations with all the indicators in the generative design processes (Figure 67). The design control interface operates within a parametric framework called '*workflow*'.

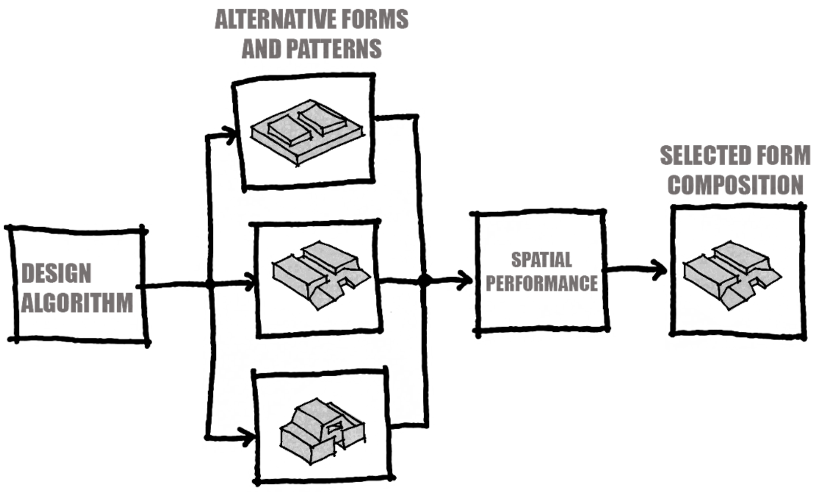

Figure 67: Workflow of the proposed parametric model

The designer, who uses the model, has to select the relevant indicators according to the study area and coordinate them to link all the patterns in the background while incorporating them into the interface. All the defined parameters in the model can be changed according to the design program, which is flexible in use. However, the algorithmic structure of the relations between operations is fixed. These relations are used to create relational and generative scripted design modeling. Thus, visualization can vary substantially according to parameters and existing context input. Points, lines, and surfaces are the main elements for creating complex relationships and operations for the parametric model (Figure 68)

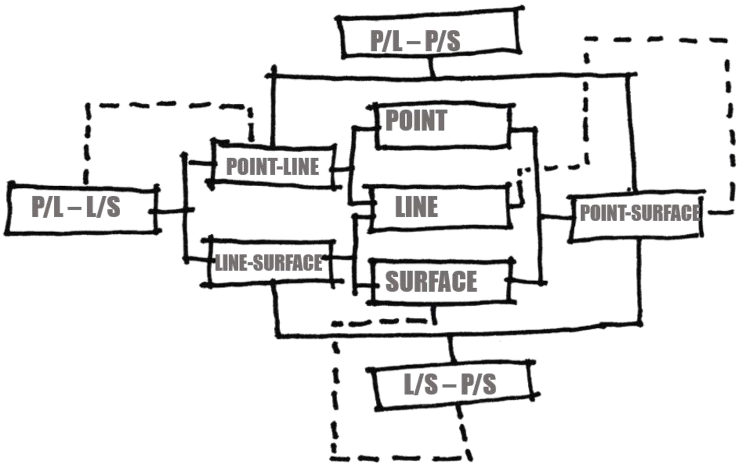

Figure 68: Controlled relationship of the basic parametric components within the model

Rhino is the software utilized for modeling in 3D-modelling. Grasshopper, in this context, is the plug-in used within Rhino as a parametric scripting and modeling tool. The model of these instruments is utilized to control landscape morphology and create an accessible user-interface. Grasshopper provides users to put all the written design algorithms and operations into a visual canvas. The values represented in the software as \`components\` are connected to each other with wires in canvas, and all transactions create controlled relationships (Figure 69).

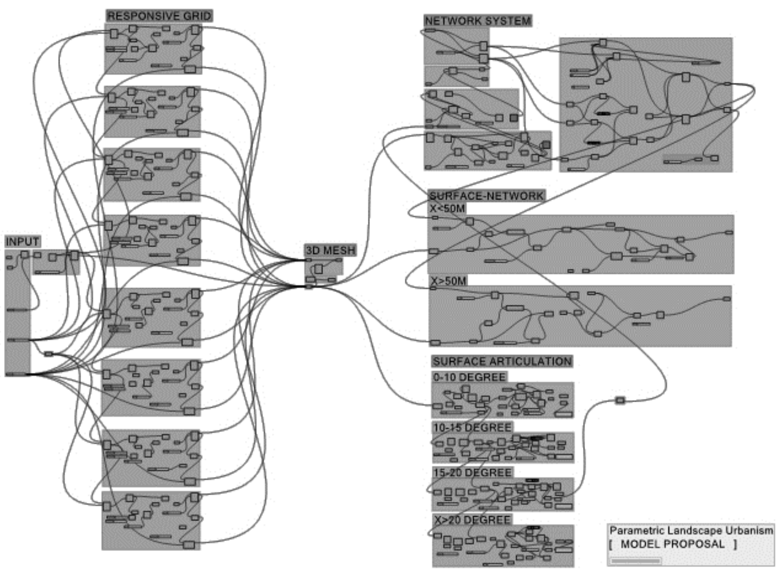

Figure 69: Algorithmic definition of the proposed parametric model

The algorithmic definition of the model comprises the four steps (Figure 70):

- Generation of the Site Grid (3D Mesh),
- Generation of the Network,
- Articulation of Surfaces,
- Articulation of the Surface-Network Relationship

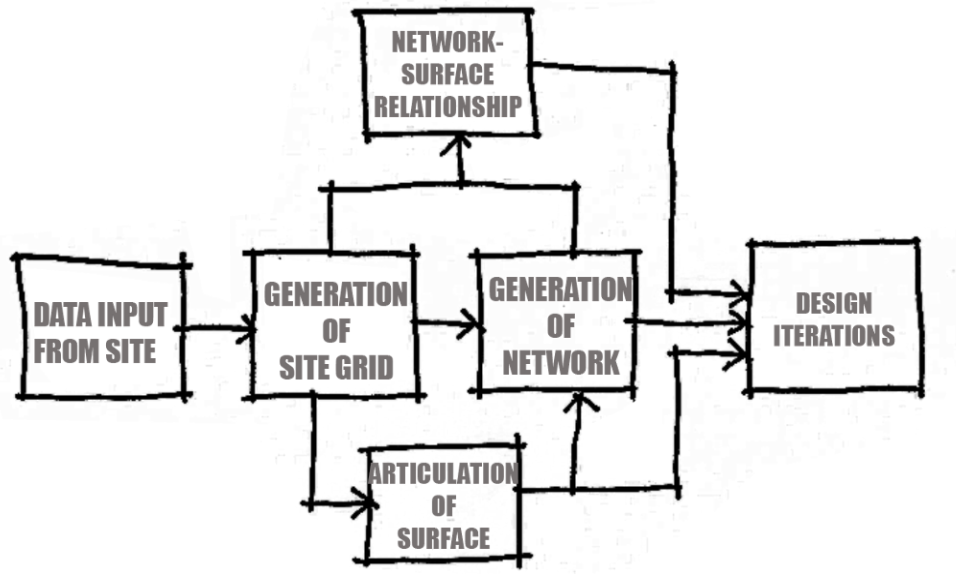

Figure 70: Algorithmic definition of the proposed parametric model

4.2.3.1 Generation of Site-Grid: *3D-meshing*

The 3D-mesh has been created from existing river structure; it is hypothetically topography model for this design research. The parametric model works on a 3D-mesh that is generated as a relational basis on which all the parametric operations of landscape and urban morphology occur.

Creation of 3D-mesh as a geometrical construction is linked to parameters of the existing site such as a river, topography, and infrastructure. The flexible mesh structure represents the shape and size of the location according to the given parameter and provides dynamism in surface operations.

The layout of the cells in a dynamic mesh changes according to site variables and gives a frame for further operations for landscape formation. It creates digitalized topography to shape and manipulate the landform.

Points and line in 3D-mesh provide a dynamic topographical model for flexible control in design. A dynamic model of mesh can be separately controlled with every face, and it can react to inputs just by basic operations such as `pushing and pulling` or `alignment.' Even though dynamic grid model is changing in every test process, this flexibility gives room for the generation of a wide variety of forms (Figure 71). This dynamic grid, in other words, can generate and modify different surface scenarios in the urban design process.

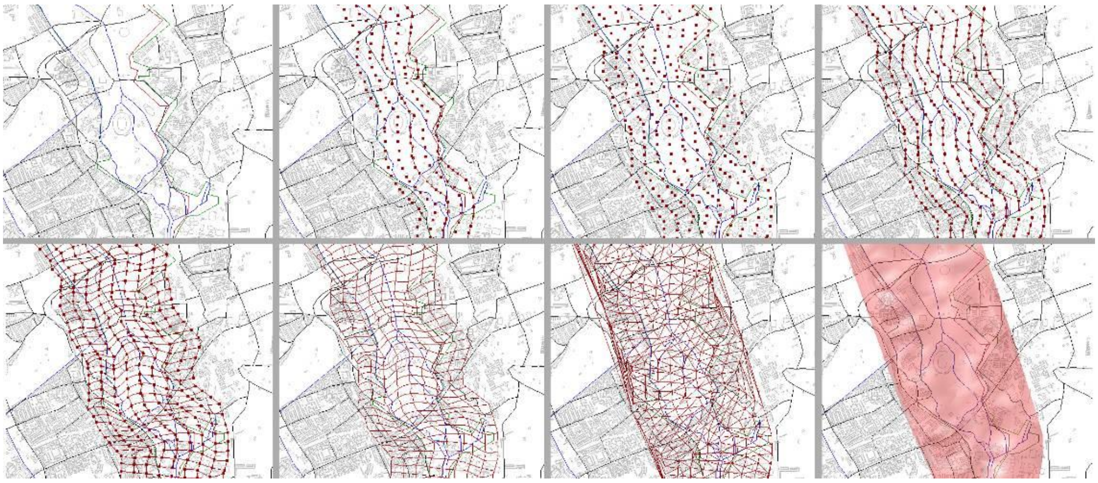

Figure 71: Stepwise generation of the 3D-mesh, the `Site Grid'

4.2.3.2 Generation of the Network: *'Wool Thread Model'*

The next operation is the parametric definition of the network structure, which will connect the external network of the study area. To that aim, an already existing technique called '*wool thread model'* is used. These networks, by this supplementary model, is generated algorithmically according to the three parameters, a distance of existing building points, coordination of start points of existing network system and coordination and number of generated surfaces. Those parameters create a link between existing urban fabrics such as existing street network, existing building and newly generated volumes from the 3D-mesh.

There are too many ways to create urban networks depending on the context and generation of structure. Wool thread model fits the study area as an experimental model since it is the most efficient way to detouring factor within the network while minimizing a number of paths required in the generation of the structure. Wool-thread model is utilized for this purpose. This computational tool reduces the overall length of the path system while maintaining a low average detour factor (Schumacher, 2009) (Figure 72).

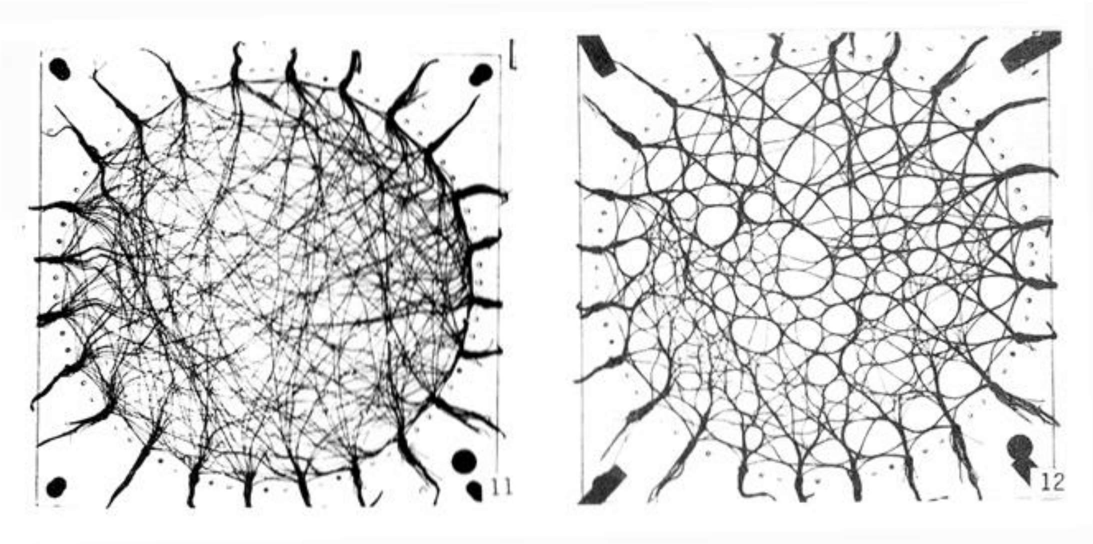

Figure 72: Wool-thread model to compute and generate the optimized network structure regarding the detour factor (Source: Schumacher, 2009)

The parametrically generated model network uses the geometry of the 3D-mesh to construct the geometry of the parallel stripes which works in a parallel direction with existing networks. Starting points of the network are defined by existing street systems and existing buildings which are used as binding factors for re-directing paths by pushing out the network path into another direction (Figure 73).

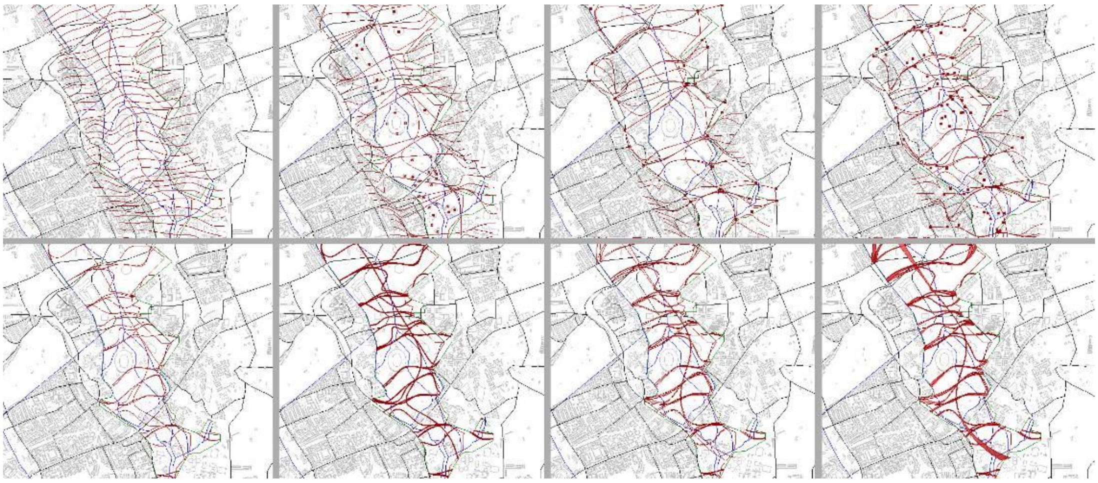

Figure 73: Step by step, generation of the 'Network System'

The relational network system reacts to the existing topography and existing buildings to shape its characteristic path system. While 3D-mesh is changing and adding new volumes, network reacts to the street pattern simultaneously by changing the angle of existing street network curve.

4.2.3.3 Articulation of the Surfaces

The slope angle of every surface face defines the operation of the surfaces. According to angle parameters, surfaces create either terracing by decreasing their angles to allow buildable and habitable space or filling areas to design new spaces for the outcome. This part of operations also enables the generation of volume and masses within the 3D-mesh surfaces.

The layout of the mesh surface was defined as the generation of site-grid operation. Every cell in a dynamic grid changed according to site conditions and emerged out of the landscape topography model. Those interactions have parameters of the step size of every cell which geometrically defines `slope` of cells according to slope analyses face reacting to it. Processes such as `terracing` and `cut and fill` are utilized to control landscape morphology in urban micro-scape fabrication, which can be articulated as new territorial land-forms and urban programs (Figure 74).

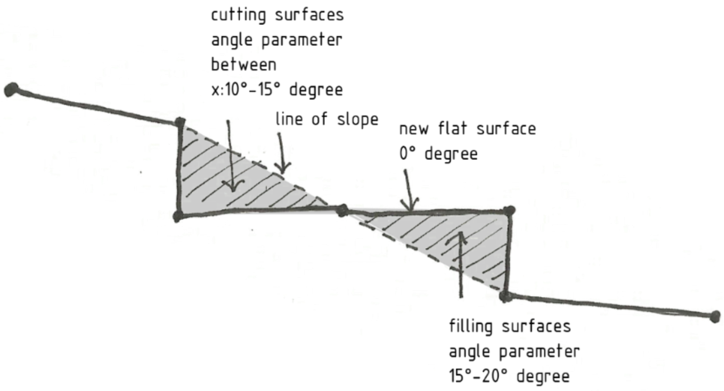

Figure 74: Cut and Fill operation in the articulation of the surface

While defining the slope surfaces, the designer has to decide on how to control the intrinsic parameters generating the overall 3D-mesh surfaces. Basic diagrams demonstrate how control patterns generate distribution surface operations according to the slope of the face as in Figure 75. Depending on the slope, distribution of *`solid`* and *`void`* has been controlled to generate habitable surfaces and to optimize volumes and areas.

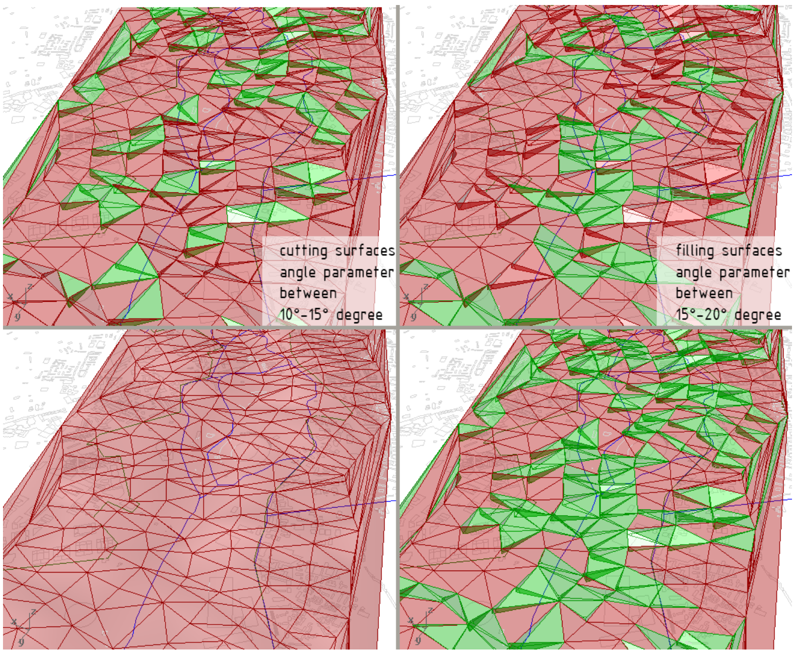

Figure 75: Surfaces generated according to angle parameter

All the volumetric variations are not randomized but parametrically controlled with slopes. This operation tries to communicate with the surface to use the existing methodology of ground operations, which is derived from landscape urbanism theory, and it can be customized to achieve different performances.

4.2.3.4 Articulation of the Surface-Network Relationship

Height control of network creates a link between surface and network according to the distance between them. If the distance between network systems and surfaces are below 50m, it creates extending surface to carry network systems, and if it is higher than 50m, then it creates bridges to hold network systems on the top of topography.

This network structure to be generated by the existing urban fabrics is incorporated with the 3D-mesh surfaces that has the role of making the overall outcome as the new landform.

The parameter of distance between network systems and surfaces are defined by the designer to whether surface face extends to network or creates bridges to carry new infrastructures. By this means, the model shows that infrastructure of the network system can be considered applicable regarding the construction phase. However, more importantly, the surface is reacting to a network system with pre-defined distance relationship and operates accordingly by creating a characteristic network system. In the example shown in Figure 76, the overall layout of the network is parametrically associated with the land surface. In the given example, the bridge is generated if the vertical distance between the network structure and the ground is higher than 50m. On the other hand, the surface extends to the network to create an elevated if the distance is less than 50m (Figure 77).

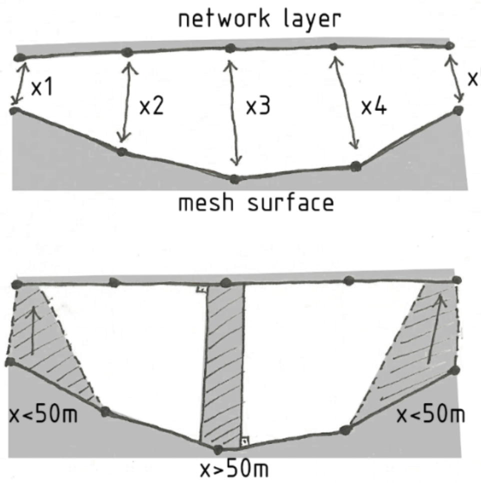

Figure 76: Parametric behavior of the ground within the model by the surface-network operation

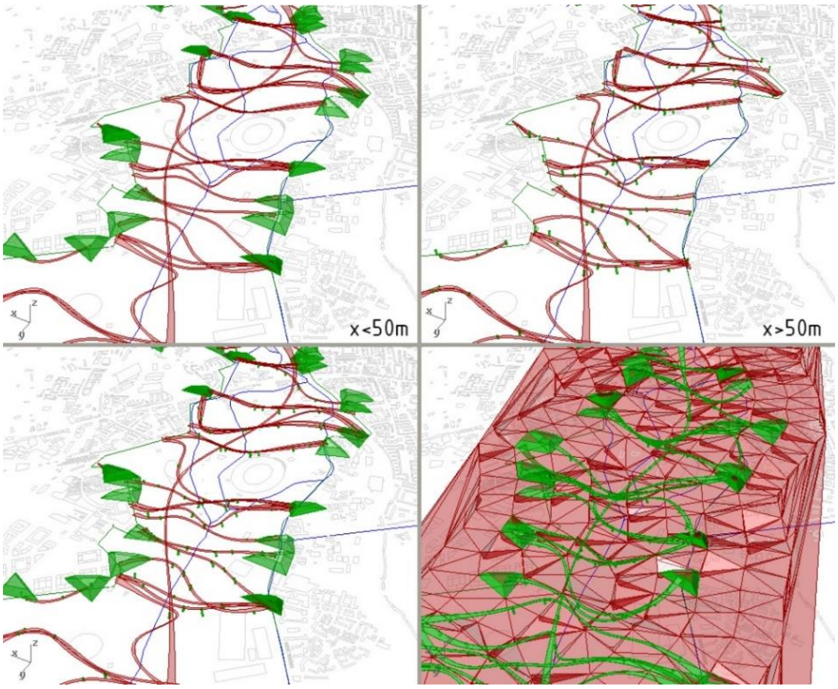

Figure 77: Generation of the new surfaces within the 3D-mesh and the network structure

The first mode of control does not only tend to provide a connection between ground and network system, but also generates new surfaces between network and ground. This method allows the generation of new volumes to be put into the next design step and considers where bridges and extensions created.

Volumes are created in mesh surfaces, generated spaces go into network systems as a new input giving feedback to all algorithm. Hence, the last output of the network also includes generated volumes and voids in the design process.

The operations of the model are communicated through both 3D-mesh surfaces and network model. Using existing data and new inputs from generated operations, the model produces the overall massing and volumes for each generated mesh surface. By this way, the designer can study the diverse impacts of the design operations, and their possible results through the design process.

Surface articulation and network system operations add an extra layer of control pattern into the design algorithm with putting new surface coordination as a parameter into algorithm and changing existing network path. This parallel operation of a feedback system should match an overall equation in the network generation. Even though the final output is a linear one, this circular system puts more generated data into design algorithm.

Such a feedback system is significant in creating an emergent and generative model. The relational model is creating two sided feedback system also generates non-linear design process.

Within this operation, the algorithm allocates the cells and their positions depending on the cell formation. It transforms the network structure according to new volumes of the surface morphology (Figure 78).

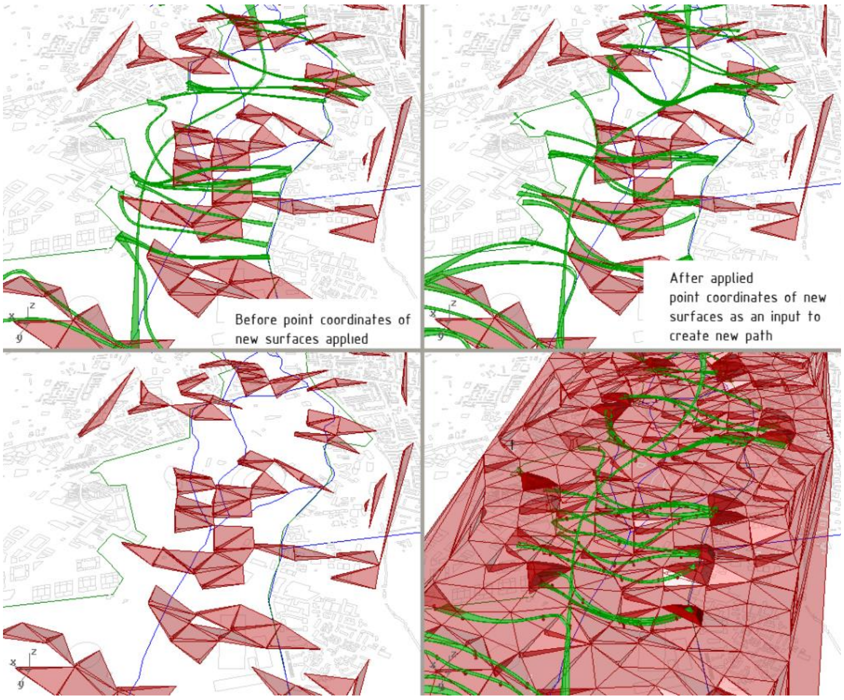

Figure 78: Network path is transformed after the generative surfaces applied as a new parametric input

So far, the described method and the embedded operations are defined on an algorithmic basis. In the following section, the model is applied in a real urban context.

4.2.4 Project Case: London Olympic Park

The project site is London Olympic Park as the post-industrialized area. After the industrial revolution, the park acquired a natural characteristic along with the agricultural regions in highly populated London city. The area had to cope with the continuously increasing population of London while maintaining an overall landscape characteristic (Hopkins & Neal, 2012).

The main aim of the proposal is the generation of urban landscape forms to experiment with parametric landscape urbanism operations. By applying the proposed parametric model to the site within the existing urban fabric, a link between both sides of the valley is to be created while providing new spatial formation and programmatic opportunities that the area may afford in the future.

The proposal model explores different patterns of the spatial structure while the designer maintains existing landscape and urban information as the main inputs. By this way, an alternative approach to the London Olympic Park 2030 Master Plan could be suggested in order to achieve a generic model for landscape urbanism.

4.2.4.1 Site Selection

The Olympic Legacy Master Plan is an essential and comprehensive project that the city of London has been planning since the Olympic Games 2012. The city worked with a group of communities, stakeholders, and professionals. With the conclusion of the 2012 Olympic Games, the transformation of the Olympic Park has begun, a new metropolitan district in the east of London (Figure 79). The Olympic Legacy Master plan covers all perspectives of urban design and development. It also takes into consideration landscape as well as infrastructure through its old industrial and landscape character legacy (Figure 80).

Figure 79: Transformation of the London Olympic Park, from 2007 to 2030 (Hopkins & Neal, 2012)

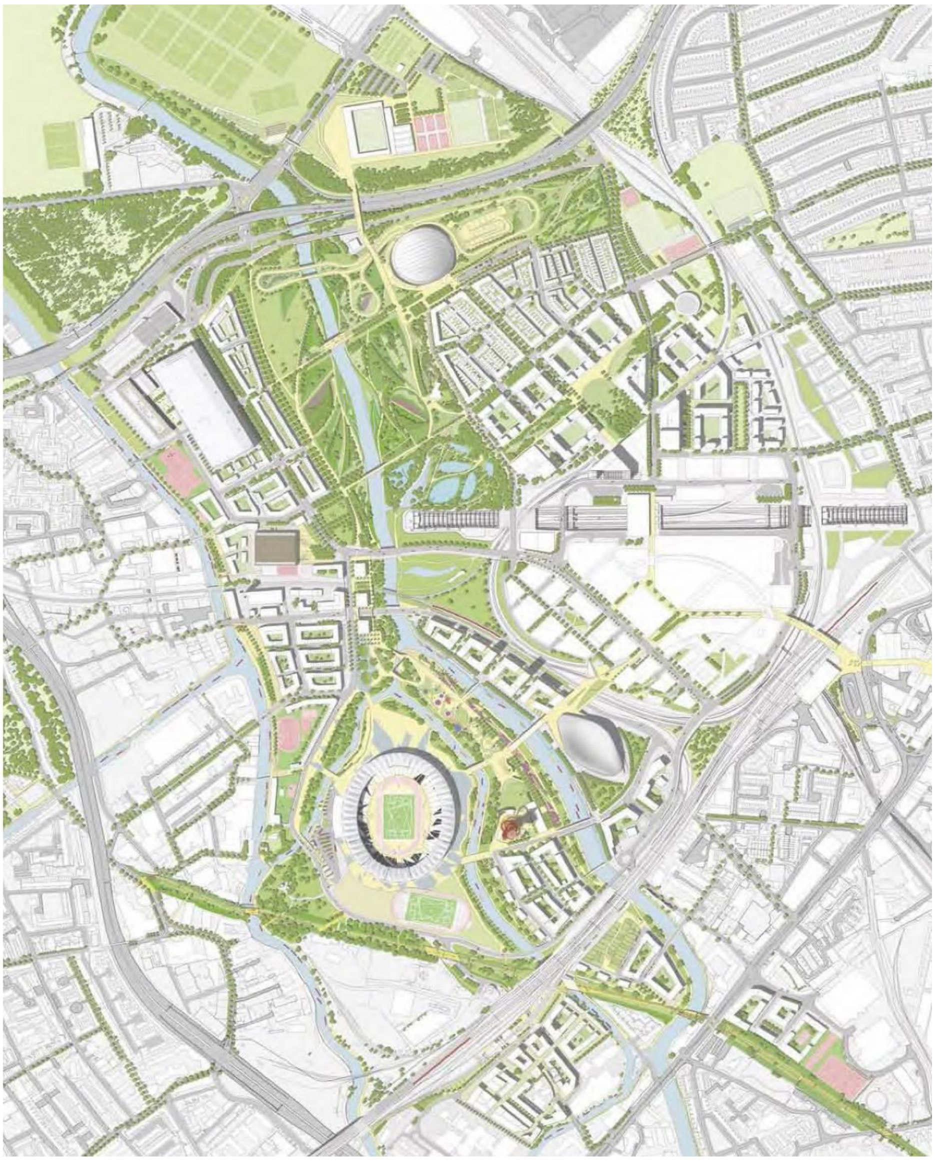

Figure 80: Olympic Legacy Master plan, 2030 (Hopkins & Neal, 2012)

The main reason why London Olympic park is selected to test the proposed model is that along with its unique urban landscape characteristic, the site suggests a very relevant basis for the application. Regarding urban morphology, the site provides a broad range of network patterns, infrastructure, and urban landscape forms to be rearticulated by the model.

The Olympic master plan is part of a big development project that is still in progress. Thus, the area provides an open discussion regarding urban design quality. Moreover, different variations and scenarios are worth exploring since the project is still in progress. The proposed model, in this context, basically demonstrates alternatives for the master plan of London Olympic area with the elementary and relational (parametric) operations defined.

Despite the fact that the study case area has been a disputable issue economically, socially and politically in urbanism, the thesis proposal demonstrates possible experiments on landscape urbanism focusing on the urban morphological dimension and possible spatial performances of the transformation.

In the model application, the river bend locating in the middle of the area is regarded as the backbone of the new public open space surrounded by urban developments. One key task of the model is the creation of new landscape morphologies and spaces accordingly. Another key task is combining two sides of the valley with a new network system, which is also a model that focuses on the waterfronts.

Reason for the selection of London Olympic Park site was that the riverfront and surrounding landscape characteristic which is disconnected from rest of the surrounding urban fabric. The given condition does create another problematic issue to be dealt by design. The model, in this regard, aims for a smooth transition between landscape and the urban fabric. This rich context provides interesting qualities for the generative modeling tool and possibilities for the application of generative design process.

Another crucial aspect of site selection criteria was the slope and topography of the area, which provides a broad range of different slopes and rich terrain characteristics. The area has high points, vistas, and edges to be re-articulated by the parametric model.

4.2.4.2 Model Application

The first set of operations in the application of the model has to do with the existing site information, and modeling of 3D grid-mesh provides a morphological basis to create a new landscape terrain in the site.

The second operation applies a network system, providing infrastructure and transport hubs to bridge between the two sides of London Olympic Park area. The operation aims to create relationship on both sides of land, and increases the capability of transportation.

Finally, a set of related scenarios around operations and elements are demonstrated in the third part of the model application. The model tends to open up new discussions on the possibilities for forming a potential link between the development of the area and alternative scenarios, which can be developed in the future.

4.2.4.3 Algorithm

Despite the presence of various parametric design tools and software, Grasshopper is one the most popular and most chosen generative modeling software available for designers, academicians and practitioners. In this thesis proposal model, Rhino and the plug-in Grasshopper were selected as modeling tools for the application process on the London Olympic Park study case.

The interface provides a broad range of operations, geometries, and mathematical functions to manipulate geometries and generate forms.

This organization of interface provides the designer with the organization of parametric operations and design process for generating certain geometries and patterns. While new patterns are created in the generative process of design algorithm, feedback system creates new layers of details in the application process, which, in turn, is resulted in various spatial scenarios for the study site.

4.2.4.4 Generation of the Site Structure

The project is located in the area where River Lea meets River Thames. Both sides of the rivers are surrounded by urban fabric and industrial zones. Rather than utilizing fixed grid which is a general technique in conventional design methods, a model work was created on a flexible 3D-mesh as a basis of a landscape structure (Figure 81).

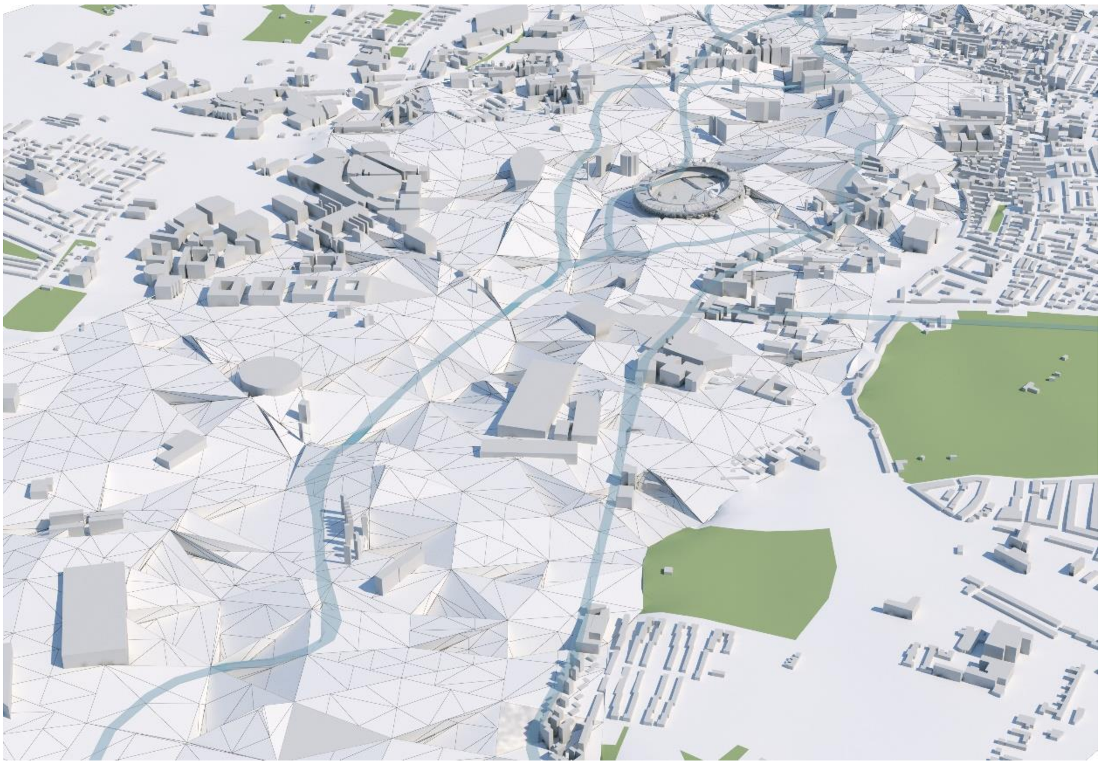

Figure 81: Surfaces generated by the site grid algorithm

Generation of site structure starts with the definition of lines from river movement pattern as a base of shape and responds to existing topography characteristics and convenient plot sizes. The site makes use of the contour lines as main guiding geometry to generate a mesh while using elevated curves to create 3D-mesh surfaces.

Subdivision of cells creates separate surfaces where plots are more or less close to each other. Subdivision of the mesh from top view to see how the mesh is related to river movement. After testing some cell sizes, the model keeps mesh cell-size between 20m and 200m which are considered as the optimum range for the spatial layout of the site. Considering the valley topography, cell-surfaces are changed according to terrain to be able to have some different variety of slopes.

The development of the generative algorithm for the site begins with taking the access points from the field and the river. Since the access points are connected to the existing network system and building pattern, next step becomes the manipulation of those points to create new network structures.

4.2.4.5 Generation of Networks System

As the second stage of design, a network system is generated to merge the two sides of the river and to combine existing network system to serve for the area (Figure 82).

Figure 82: The figure-ground map showing solid-void relationships within the proposed parametric model

Figure 83: One of the alternative scenario generated by the proposed parametric landscape model for London Park Area

First main input is existing network system, which are connection points for the area (Figure 83). This existing connection mainly stops at the edge of the project area and provides a poor connection regarding network continuity. The second input is existing buildings inside the area, which is mainly old industrial heritage or stadium and facilities, which have been built during London Olympic Games (2012). The last input is newly created surface relationship, as the designed topography creates new spaces, network system uses those spaces as inputs to the algorithm as a feedback system (Figure 84).

Figure 84: The new circulation network and the landform proposed by the generative parametric model

The next part of the generation process of the network system is adding the attraction points to control the generated network concerning the existing network, existing buildings, and newly generated surface. These points are defined in a 3D coordination system in the algorithm as parametric inputs (Figure 85).

Figure 85: Overall view of the proposal generated by the parametric model

After the access points and attractor points are identified in the algorithm, the new network system generated with wool-thread network system as explained above to create new roads, urban linkages, passages, and skywalks.

4.2.4.6 Articulation of Surfaces-Network Relationships

The application of the model on the site proceeds with three types of surface and network relationships.

1- Surface > Network Relationship

2- Surface – Surface Relationship

3- Network > Surface Relationship

In this case, three different separate algorithms are connected to each other in a relational way to establish a controlled communication between the surface and network system.

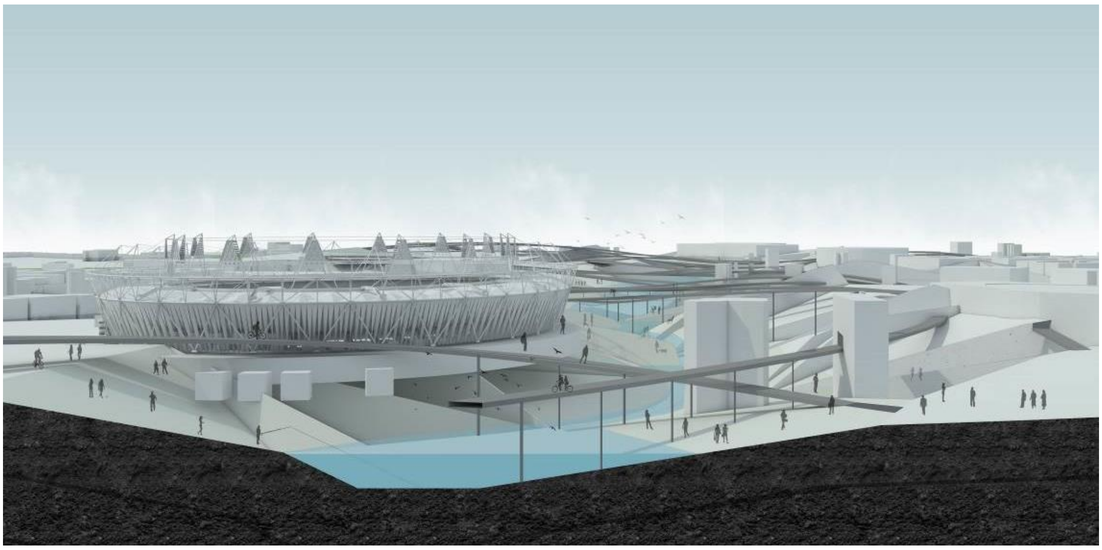

Figure 86: A possible section from study case area with the new network connections between two sides of Lea Valley

Surface - Network Relationship:

The first set of relationships is constructed between the mesh-surface and the network system following their inner formation. The distance between network system and surface creates a new layer of relationship, which connects network system to the corresponding surfaces to create a physical connection. Thus, the algorithm works for the distribution of volumes. Accordingly, if surface-network distance is over 50m, the bridges create skywalks and urban linkages floating over urban surfaces. If surface-network distance is below 50m, urban passages and extensions of surfaces into network system is generated (Figure 86).

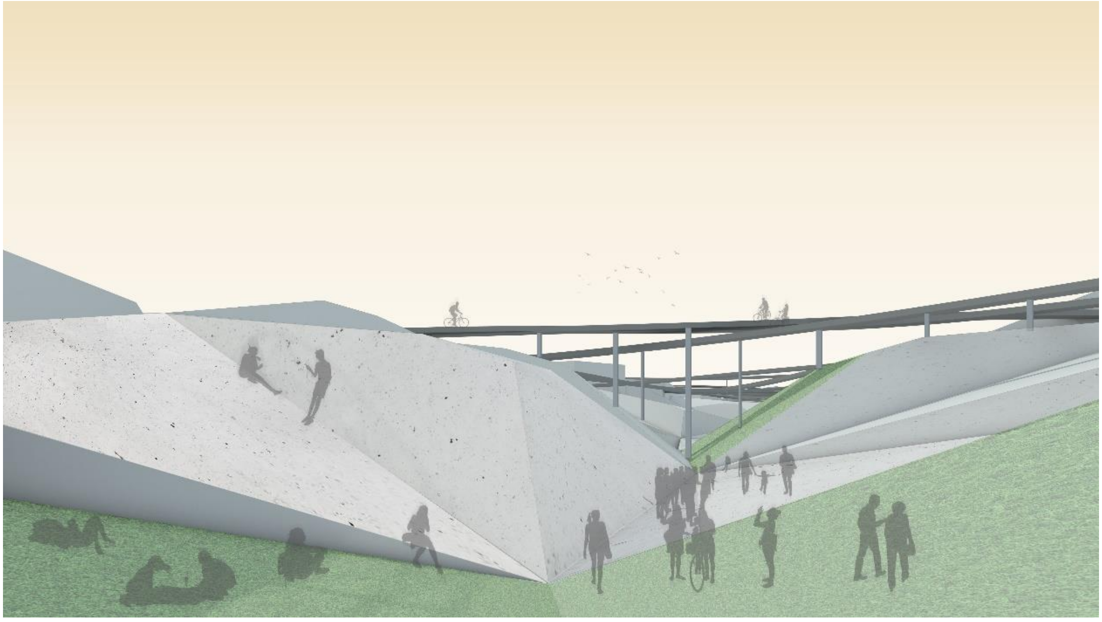

Figure 87: Perspective view showing the multilayered landscape structure through diverse activity patterns

The distribution of the surfaces extending to the network structure was generated according to the two main principles: distance between surface center points and a point on network system defines the urban operation of extension of surfaces. The overall site grid would be linked to the network system. In this first relationship, elevated surfaces created for generation of possible activity places (Figure 87).

Surface – Surface Relationship

The second relation is surface articulation in which massing and creation of voids were generated. After the pattern of the surface were analyzed according to their slope properties, four different categories defined (0°-10°, 10°-15°, 15°-20°, 20°-30°) to select surface articulation operations. Different slope angles result in different surface operations. While some angles create terraces and flat surfaces by articulating massing, some angles create urban theaters and vista points (Figure 88).

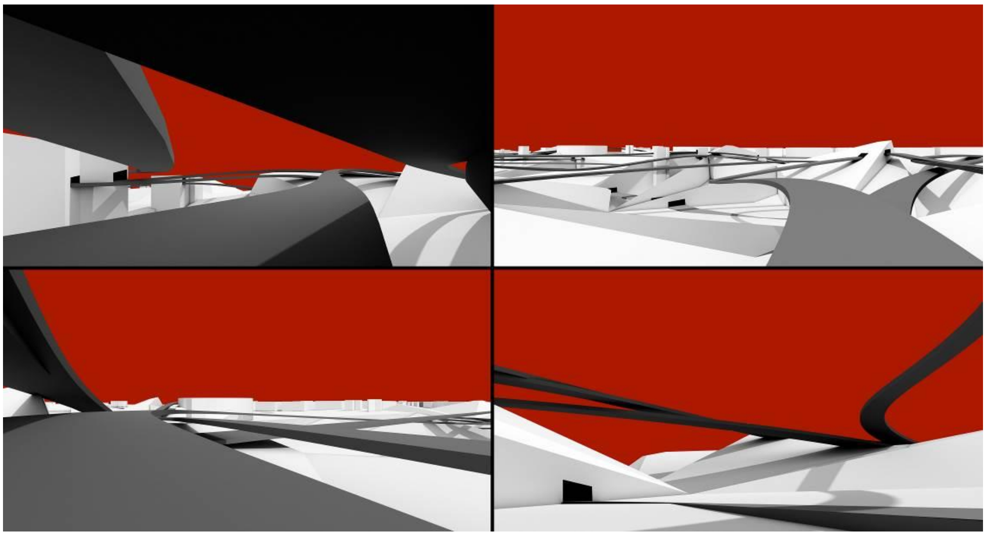

Figure 88: Series of images showing the possible articulations of the landform

Network > Surface Relationship

After the articulation of surfaces are finished, and a new spatial structure is generated, those patterns, which are new surfaces plugged into the distribution of networks system. Coordinates of surfaces as a parameter changing existing network path and obtaining relational algorithm of surface-network layout. This last relationship between surface-network systems corresponds to overall relational characteristics of the design process and generates new paths and directions to the network system (Figure 89).

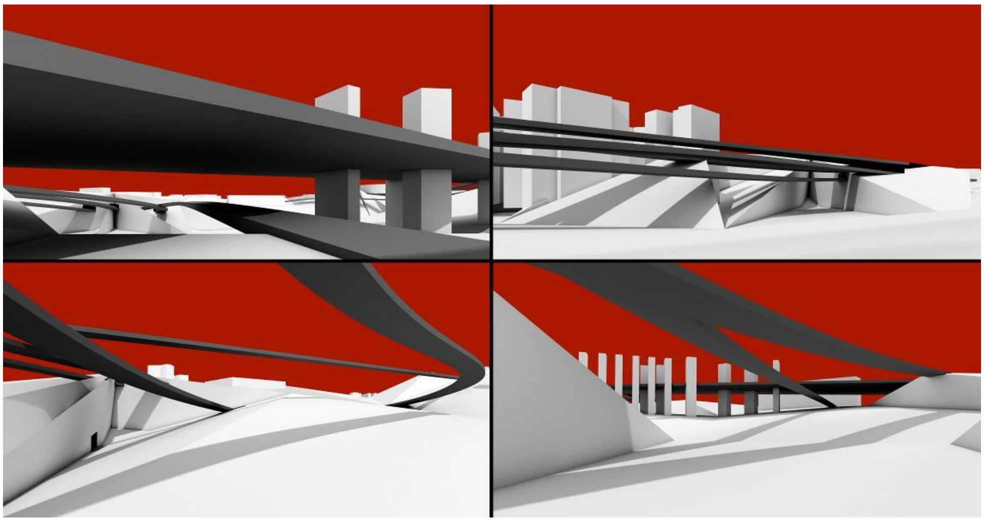

Figure 89: Articulation of landscape surfaces and network system generating new roads, pedestrian links, passages, and skywalks

All these surface and network operations generate extra layers of relationships while maintaining the existing landscape characters as the basis. The dynamic movement of the landscape structure is reproduced by surface operations with the overlapping territorial systems within the model. The multi-layered outcome of the finalized model, in this context, is presented with a series of visual renders within the post-production process.

4.2.5 Performative Potential of the Model

As depicted with the model renders in Figure 88 and 89, the spaces generated by the model potentially afford diverse urban and recreational programs. For instance, urban theaters are formed by landscape surface operations, which could host either commercial or public activity in London Olympic Park. The possible green areas in the valley can be either for urban agriculture or public events. These open-endless spaces allow users to enjoy flexible public places to be engaged in multiple activities.

Terracing of slope and forming landscape would provide the fabric with various occasional activities in the area. Multi-functional space can offer a broad range of use, from commercial spaces and small scale ateliers and shops to local food production.

The amount of details and outcome of different typologies are fundamental design research decision for the performative success of the parametric model. Even though the output of the model is the end-result of an experimental form-finding process, variations of landscape morphology about their spatial performance were expected during the research (Figure 90).

The ambition of the model proposal, in this regard, is to move from the core definitions of landscape urbanism operations, and to come up with new form-finding methods in urban landscape concept. This spatial implication provides a broad range of opportunities for almost similar context regarding landscape performances and dynamic outcome of the overall design quality as well.

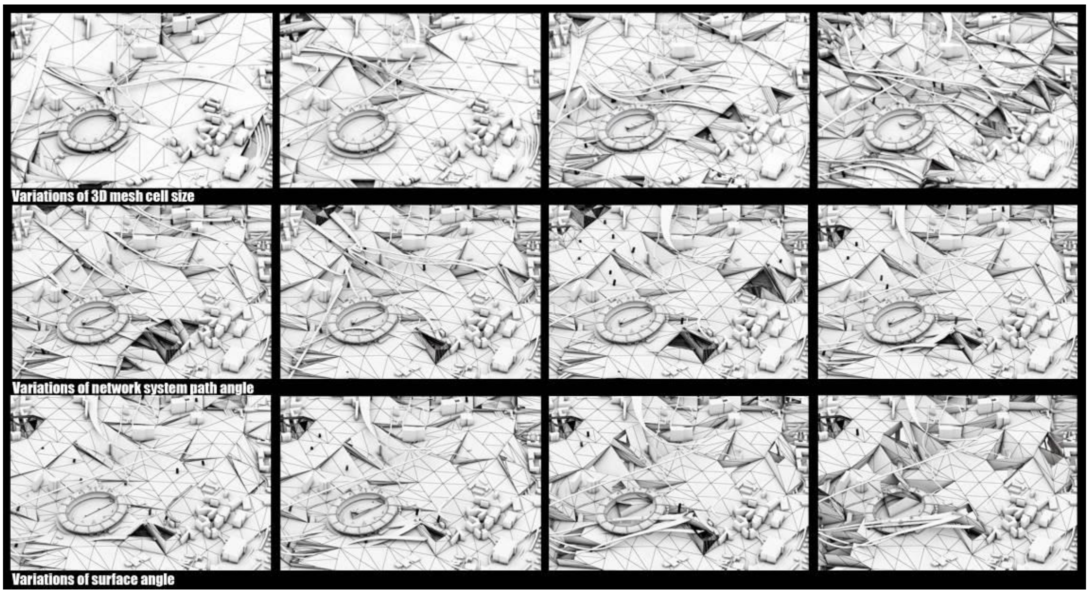

Figure 90: The Design variations produced by the generative algorithm

In the final chapter of this thesis, the design variations produced by the generative algorithm and model have been tested on a real urban landscape context. Design research has been carried out to test the proposed model and see the capabilities and potentials of parametric tools in landscape urbanism. This research has contributed to the parametric approach of morphology in landscape urbanism by providing a methodology that utilizes new tools and methods in urban design. The proposed model has provided a contribution to the field of landscape urbanism because of the current lack of methods in landscape urbanism and architecture fields to make use of recent parametric modelling tools. In this chapter, the framework of the model and methodology of landscape urbanism has been discussed in detail. The analyses and discussions made through the case study has provided a robust discussion of parametric modeling. Rather than carrying out a research that seeks finding a form, this research has focused on a model that has control mechanisms for urban form and provides a landscape system framework.

CHAPTER 5

CONCLUSION

The following concluding points in this chapter focuses on understanding the use of parametric tools in landscape architecture and urban design. In this chapter, a possible methodology for landscape urbanism will be discussed through a model proposal. Most importantly, the model on `parametric landscape urbanism` will be applied in the context of urban landscape through an experimental methodology in contribution to the school of landscape urbanism.

5.1 TOWARDS A METHOD OF 'PARAMETRIC LANDSCAPE URBANISM'

Today, landscape urbanism is in search for new methodologies in design. One could argue that it still needs a robust methodological framework to justify itself in the domain of planning and design. Contemporary experiments and applications of landscape urbanism, in this regard, focus on parametric and algorithmic models in design. In this context, flexibility, fluidly, computation, and performance are highly effective elements in emerging discourses of both contemporary parametric design and landscape urbanism.

5.1.1 Need for a Methodological Approach for Landscape Urbanism

In the current context of landscape urbanism in search for new supporting methods in design, the research proposed a model that suggests a generative modelling tool tending to incorporate the deep-seated aspects of landscape urbanism field with the methodic components of parametric modelling.

Based on the parametric modeling tool and process applied and used in this research, there are a number of advantages and disadvantages that must be identified and evaluated.

Firstly, the application of this method supports the design process by enabling variations in form through multiple generation and evaluation iterations of the emergent forms and patterns in design process. In addition, the parametric model provides designers with a clear understanding of how the elements of the design morphology are connected and manipulated to make up a larger system that helped in the conceptualization of urban landscape morphology in place.

The application of generative modeling in the context of landscape urbanism can respond to the four initial research questions, as follows:

- What can generative modeling offer to the theory and practice of urban design?

In the light of the proposed model, the generative design methods have a potential significant impact on the changing role of designers in landscape architecture and urban design. While design processes are becoming more computational, solutions offered by digital tools can be applied on design problems to create variations and quick solutions. Since landscape urbanism rejects landscape as a static image and advocates operational landscape in both theory and practice, generative modeling offers emergent performances in finding design process.

- What are the peculiarities of the design experience in the application of parametric design in landscape urbanism?

In the proposed framework, generative modelling can be applied on surface operations to deal with complex landscape forms. Landscape surfaces with parameters such as angle, area, and height can be considered in shaping urban forms. Those parametrical landscape urbanism operations can be used during the utilization of design process and form finding experiments.

- What kind of spatial performances can be ensured with the application of the model in landscape design and planning?

The proposed model demonstrated that the expected performance of relational framework is a very critical factor for the performance of design proposal. Once the model is investigated, its spatial performance is revealed in a number of ways. As it was shown in a series of images and 3D models, and representations, emergent forms of the model reflect performances such as diverse activities, landscape-urban surfaces integration, and existing surfaces potential functionalities. In landscape urbanism, the real challenge is not exploring forms rather providing a control mechanism for complex landscape shapes. Experience from the application of parametric design in landscape urbanism revealed the capacity of controlling landscape form in a relational (algorithmic) framework which can be used as a guideline.

5.1.2 The Main Limitations of the Model

While proposing the use of the model in landscape urbanism, for the sake of its future development, the limitations of the suggested method should be stated as well.

Parametric tools basically need various design experiments to truly aid landscape architecture and urban design in the provision of new form typologies for landscape urbanism. Many aspects of landscape design such as zoning, slope analyses, grading, water harvesting, land (surface) reclamation, and infrastructure as public space already have a large set of data that can be quantified and interpreted by parametric modeling. In the current level of the research, the model is not associated with any quantitative database, but performs on a computational spatial framework. In this regard, more research is needed to quantify ecological, economic, social and cultural aspects of design to involve in spatial modelling. The larger set of information, in this sense, is believed to enrich the possibilities of formal variations in design.

The most negative fact about the parametric design process is that the initial set up of the algorithmic framework is a time-consuming process, depending on the complexity of the system subject to be modelled in design. Though there is a wide range of platforms to improve the skill of algorithmic thinking, altering the already settled way of thinking in analog design still remains a challenging issue in parametric design. In addition, a key part of the evaluative process is that in parametric modeling, only one specific variable could be manipulated at a certain moment during the design process. Although manipulating one variable can change multiple parts of the design, only one variable can be evaluated and understood in the iterative process. Since the manipulation of one component results in a complete definition of the complex form-structure, generation of design form takes a long time to render a real time model.

In the research, the parametric model for landscape urbanism focused on landscape as a driver of urbanism rather than solely that of landscape design, which means landscape formations and morphology have been integrated for designing the model for urban research. It provides a new way of thinking for urban design based on landscape approach for the generation of urban form. Nevertheless, in the current context of the research, ecological and economical aspects of design are excluded. With the generation of emergent spatial compositions and patterns, the model basically enables us to derive some conclusions on the possible performative aspects of the space in actual use and experiment. Landscape formations and morphology are serving as integrative factors creating coherent surfaces on the fragmented tissues of the city, which would be able to generate new modes of socio-cultural experience as well.

5.1.3 Potentials of Parametric Modelling for Landscape Urbanism

Parametric modeling offers an experimental ground to develop high variation of design operations within landscape urbanism domain. The diverse implications of the model on site still need to be investigated with an emphasis on morphological operations and components. This way, the applicable interface of parametric design modeling will allow users to create fast-paced design iterations while providing a user-friendly and transparent design process.

To fully utilize the parametric modeling tools, parametric thinking and software skills must be involved in the education of spatial planing and design. If the use of parametric modelling gets wider application in design, it potentially opens up new interpretations of spatial formation in urbanism. As the thought process and tools are learned more during design education, the ability to use parametric tools will become more common. Very few urban design projects and research are currently exploring the possibilities of parametric design, leading to this process can be regarded as a challenging agenda for the different schools of design and planning.

Parametric modeling, in this sense, affords to explore novel forms and patterns while discovering new spatial possibilities that would respond to the given constraints defined within the plan frameworks. Additionally, since the algorithms are created in as a generic model which would be contextualized with the special sets of local codes, the paremetric models can be applied in different urban contexts.

The most promising benefit of parametric tools is the ability to combine different fields of professions such as architecture, city planning, and landscape architecture within the relational (algorithmic) parametric urban design field. By being able to merge these areas, new forms and ideas can be generated that may not have been thought of or considered before. As a matter of fact, there are a series of elements of landscape design morphology that are yet to be explored by parametric tools and techniques. In this context, landscape surface operations, landscape infrastructure, territory, waterscapes, and urban ground performance can be considered and incorporated within the model.

5.1.4 Future Implications of the Model

Future research in the field of generative modeling has rich possibilities. Currently, the realm of parametric design techniques is being improved with so many new applications. Therefore exploration of new methodologies in parametric design is an open-ended process.

As already reviewed in the research, using generative models to explore and experiment novel procedures in urban context is gaining popularity in both research and practice. The so-called `parametric landscape urbanism` offers future studies to come up with unprecedented applications of landscape architecture and urban design on larger contexts of urban realms.

The proposed model tends to provide a concrete basis to discuss the possibility of landscape urbanism and parametric modelling in the context of urbanism. Since the dynamic nature of computational design makes designers be informed about the constant development in design technology, the designers in the field of urbanism have to continuously research the emerging tools and techniques in parametric modelling and experimenting with them while revisiting the settled theories on the formation and transformation of the cities.

The current research in computational design tends to extend the scalar boundaries of spatial design from that of building to the urban territory. This way, disciplinary integration is becoming more crucial than before. Further investigations on spatial form finding processes in urbanism require more relationships between the different disciplines such as computer engineering, environmental engineering, and UX (User Experience) design and more cooperation between both the techniques and tools in multi-disciplinary settings.

> *The advanced capacity of computational techniques have provided designers with new comprehensions and operational skills to be utilized in design. Urban design has been one of the domains which would be exposed to such a transformative influence of the new design technologies. This current research on 'parametric landscape urbanism' can be incorporated into this condition as well. By means of parametric modelling techniques, one could argue that the creative capacity of designers to cope with more complex design problems in urbanism calls for further research on spatial design methodologies.*

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