

SCALE IN URBAN DESIGN: THE NOTION OF SCALE IN SPATIAL DESIGN
THINKING

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ABSTRACT

SCALE IN URBAN DESIGN: THE NOTION OF SCALE IN SPATIAL DESIGN THINKING

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Scale is used to be one of the fundamental aspects in design, as well as in science and politics. Since the cognition of design is operated on different frame and grain of the given physical entities, different levels of scale selected in design process is utilized as a tool to manage the different levels of complexity involved in design processes. From another perspective, scale and scalar definition of any imagination and intervention in spatial design does also imply certain approaches to urbanism. That means it is possible to define different schools and approaches in architectural and urban design based on their consciously determined level of scale in operation.

In the context of urban design, which covers a wide spectrum of scale in practice (from the level of building complex to urban fabric), the concept of scale unavoidably gets a critical position to characterize the idiosyncratic nature of design thinking in urbanism. Especially considering the fact that spatial design is a complex act of human mind requiring a certain level of abstraction for the sake of efficiency, scale can be taken as kind of cognitive tool for an effective operation of designer in action. Regarding the wide scale scope of urbanism, we can consider designing in urban

context a kind of multi-scale operation of creative human mind. Despite the common consensus on that point, the question of how designers think through different levels of scale synchronically and relationally is yet to be explained by further studies in design thinking

Keywords: Design Thinking, Urban Design, Scale, Scalar Operations, Design Process

ÖZ

KENTSEL TASARIMDA ÖLÇEK: ÖLÇEK KAVRAMININ MEKANSAL TASARIM DÜŞÜNCESİNDEKİ YERİ

Koçer, Çağrı
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Ölçek, tasarımın yanı sıra bilim ve politikadaki temel unsurlardan biri olarak kullanılır. Tasarımın bilişi, verilen fiziksel varlıkların farklı karelerinde ve tanelerinde işlendiğinden, tasarım sürecinde seçilen farklı seviyelerde ölçekler, tasarım süreçlerinde yer alan farklı karmaşıklık seviyelerini yönetmede bir araç olarak kullanılır. Bir başka açıdan bakıldığında, mekansal tasarıma herhangi bir hayal gücü ve müdahalenin ölçeği ve skaler olarak tanımlanması aynı zamanda şehirciliğe yönelik bazı yaklaşımları da ifade eder. Bu, mimari ve kentsel tasarımdaki farklı okulları ve yaklaşımları, bilinçli bir şekilde belirlenmiş çalışma seviyelerine göre tanımlamanın mümkün olduğu anlamına gelir.

Uygulamada geniş bir ölçek yelpazesini kapsayan kentsel tasarım bağlamında (bina kompleksi seviyesinden kentsel yapıya), ölçek kavramı kaçınılmaz olarak şehircilikte tasarım düşüncesinin kendine özgü doğasını karakterize etmek için kritik bir konuma sahiptir. Özellikle mekansal tasarımın verimlilik uğruna belirli bir soyutlama gerektiren insan aklının karmaşık bir eylemi olduğu düşünüldüğünde, ölçek tasarımcının etkin bir şekilde çalışması için bilişsel bir araç olarak algılanabilir. Geniş

ölçekli şehirciliğin kapsamı ile ilgili olarak, kentsel bağlamda yaratıcı insan aklının bir çeşit çok ölçekli çalışmasını tasarlamayı düşünebiliriz. Bu noktada ortak fikir birliğine rağmen, tasarımcıların farklı ölçek seviyelerinde nasıl senkronize ve ilişkisel olarak düşündükleri sorusu henüz tasarım düşüncesindeki daha ileri çalışmalar ile açıklanmamıştır.

Anahtar Kelimeler: Tasarım Düşüncesi, Kentsel Tasarım, Ölçek, Ölçeksel İşlemler, Tasarım Süreci

To My Family

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CHAPTER 1

INTRODUCTION

1.1. Context and Problem Definition

Since design practice has become a profession in the 16th Century, the scale has been used as a term and notion to convey data and ideas among actors involved at different levels of abstraction. Although the actors involved in design practice are aware of this ability of the scale, the potential of it in spatial design thinking has not been studied comprehensively. In addition to this task that the notion carries on, understanding the scale and its effect on the design process and the spatial perception of the designer will clarify the contribution of the notion of scale in spatial design thinking.

The emergence of the notion and its active involvement in design practice encompasses a wide historical range. In this comprehensive range, the change in the scale first showed itself etymologically. Parallel to this etymological change, the notion presented itself both conceptually and terminologically in different fields like music, cinema and natural sciences after 16th century. The etymological change and the implementation of scale in different fields, blended with the political, social and technological changes throughout history evolved it into the notion valid in design practice today.

The fact that the notion of scale has been actively used in different fields for five hundred years has greatly changed the position of the notion in any production process. Especially in spatial thinking, from the beginning to the end of the design activity, every step of the process began to take place at the level of abstraction that the scale brought with it. The different levels of abstraction brought by the scale began to create a new terminology within the discourse related to spatial design thinking. The two most important terms used in the scope of this research are discussed by

Taeke M. de Jong (2012). According to Jong, any object of design has an upper limit(frame). This upper limit is determined by the radius of the largest circle or globe circumscribing the object. (Jong, 2012, p.27). In addition, there is also a lower limit (grain) related to the level of abstraction defined by the upper limit. For example, while an urban design task within a 300m radius frame considers buildings as grains, an architectural design with a 10 m radius considers bricks as grain. Scale determines the frame in which the designer is responsible and decides on the relations of the grains within.

In that sense, the task of determining the frame and grains that the designer is responsible for has created the basis of professional designation of the fields of spatial design with the political and sociological changes. The scale created this distinction both with the level of abstraction it brought and with the frames of different sizes it determined. Different level of abstraction and frames allows different actors of spatial design to control the abstract knowledge required to constitute a new profession. (Abbott, 1988)

The task of the notion of scale determining the boundaries in which the designer is responsible has also influenced the growing discourse of spatial design thinking. The scale was already used as a notion for design from the moment it began to take part in design practice. In addition, the notion has become a cognitive tool for designers with the rigid frame it brings. Repeated activities such as ‘scaling up’ and ‘scaling down’ became their cognitive implications to legitimize the resulting design work. (Yaneva, 2005). Technological developments have made these scalar actions much easier and faster for the designer. The fact that the notion of scale becomes a cognitive tool constitutes the first step of the argument that this notion can be used consciously to produce design.

The change in the task imposed on the notion of scale changed the relationship between architecture and urban design. Especially in terms of defining the frame and the relationships and sizes of the grains contained inside from the beginning of the

20th century. Different figures that came to the forefront in the field of architecture tried to understand the relationship between architecture and urban design by pushing the limits of the scale. These projects, where the limits of the scale are enforced, manifested themselves in various scales (neighborhood, urban, city...). Different frame and grain relationships from various scales have produced multiple discourses in order to explore the ideas that this notion can bring in for spatial design thinking. The projects that produce discourse on the frame and relations defined by the scale increased with the avant-garde groups that emerged in the field of design especially due to the political and sociological events developed in the world after 1945. As a result of this increase, projects that questioned the connection between architecture and urban design, both spatially and politically, at different scale have been produced.

This change of the notion, whether consciously or unconsciously, has changed the designers view of the relationship between architecture and urban design. The focus of the projects that tried to understand the different frame and grain configurations has changed in each project, specific to its natural, political and sociological context. However, the effect of the notion of scale on spatial design thinking has not been studied by focusing on the different frame and grain relations. Therefore, this research tries to understand the place of the notion of scale in spatial design thinking in the relationship between urban design and architecture.

1.2 Aim of the Study and Research Questions

The aim of this research is to understand the change in the notion of scale and its effect on spatial design thinking especially in the relationship between architecture and urban design. While trying to understand that, projects that tried to reveal this relationship from different scalar frames will be taken as the basis of this research. In addition to the spatial characteristics of these projects, the decisions of the actors involved in the design process will also be subject of this research. Reason is, producing discourse on design process and production through the notion of scale is another aim, so it is necessary to approach the notion and its relationship with design from different

perspectives. In order to understand these aims, this research will focus on the following question;

‘Is it possible to generate a series of strategic and tactical scalar operations for spatial design thinking in urbanism?’

The word scale undergoes a semantic process before it takes place in design practice as a notion. In the first part of this research, it will be useful to see the etymologic origins of the notion and how it acquired the meaning used today. The first research question towards understanding this is;

‘What are the origins of the notion of scale?’

The answer to this question will establish the basic infrastructure for the scale and will allow subsequent research questions to emerge.

The first research question reveals that the scale finds itself a place as a term in different fields other than design practice. Therefore, the following question which will be asked to better understand the notion and its role in different practices is;

‘What other fields of study and production use the notion of scale’

This question aims to understand the similarities and differences between the use and methods of the scale in different fields and to reveal the possibilities of the notion’s potential. At the same time, the first discourses on a scale-oriented production will begin with this question.

The infrastructure established with the first two questions will lead to the third question which is closer to the main research question. This question is;

‘How is the notion of scale positioned in spatial design thinking?’

This question is intended to better understand the main objective of the research compared to previous questions. Therefore, the answer to this question should be much more comprehensive. In that sense, the place of the scale as a basic notion in design, its importance related to professional designation of the fields in spatial design

thinking, its relationship with the designer as a cognitive tool are going to be revealed by the answer of this question.

Before answering the main research question of this research, it is necessary to ask two more questions in order to understand the role of the notion in design thinking. These questions are;

‘Why were the limits of scale enforced? What are the desired results?’

The answers to these questions will be given by examining the projects and researches that tried to understand the relationship between architecture and urban design. All these projects are the ones that pushed the limits of the frame and grain relationships that scale brought. The analysis of these studies will serve to reveal that the scale is not only a tool or a term in design practice but a notion that can produce solutions to different design problems. These research questions will constitute the base necessary to answer the main research question.

1.3 Methodology of the Research

This analytical research is conducted by the literature review of spatial design thinking studies and the design methods in architecture and urban design to form a general understanding related to the notion of scale. The comprehensive literature review contains etymological, technical, spatial definitions of the notion related to design thinking in architecture and urban design. To create a general correlation between different fields, and to generate a discourse, various production methods and examples from different fields are investigated.

The framework created by the comprehensive literature review and samples, which define the scale as a design method rather than a tool, provided a theoretical background for understanding the role of scale in various fields. To achieve this, certain projects were analyzed to form a comprehensive and consistent case study group. The projects were examined to identify the actions, factors, solutions within their political, sociological and environmental contexts to understand the role of the

scale. It is aimed to reveal design strategies and tactics related to notion of scale in urbanism and spatial design thinking through in-depth analysis/examination of the selected projects.

To justify the consistency of the operations of scalar design thinking during this analysis phase, projects were selected from different contexts. While selecting different contexts, political and sociological differences are also examined apart from the geographical locations. Another factor is variety of the designers. In the selected projects, an attempt was made to include as many different designers and design groups as possible. More than one project of some design groups were included but it was intended not to include more than one project of a single designer.

The aim of this research is to understand the position of scale in spatial design thinking in urban design. Therefore, it is necessary to know the scale range of urban design practice accepted within the spatial design. So, the selected projects have also taken into account the established scale assumptions of architecture, urban design and planning. The accepted scale range of urban design currently overlaps with architecture and planning at different scales. These conflicts provide richness in selected projects and are useful for generating arguments about the notion. When determining the accepted scale of architecture, urban design and planning, the table produced by Roberts and Green (2001,p.5) is taken as reference.

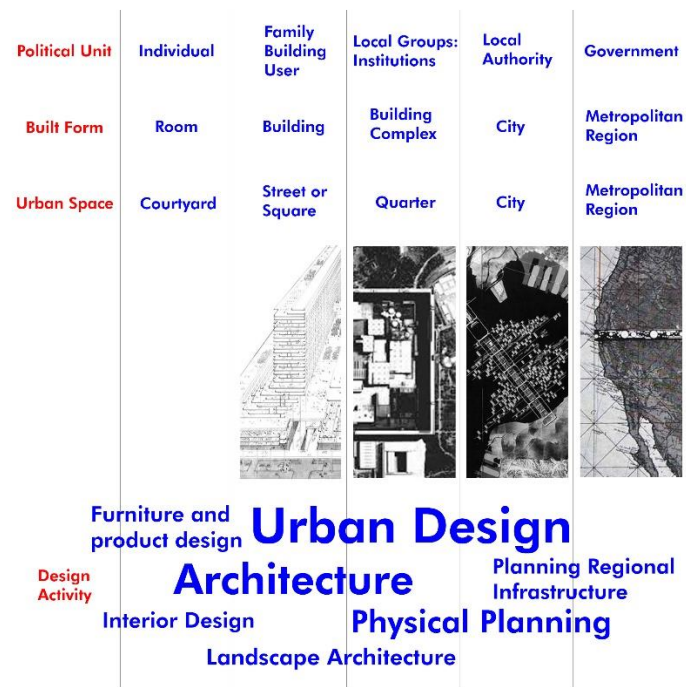


Figure 1.1. Scalar assumptions in fields of spatial design thinking (Source: Roberts and Green, 2001)

The projects examined were mainly selected from different scales where urban design intersected with architecture and planning. The projects have been selected from a wide range from street scale to metropolitan region. In addition to the distinction made by Roberts and Green (2001), the projects examined by this research are classified according to the area they cover. This classification is block, ensemble, neighborhood, district, city, city region.

The time interval of the projects used in the analysis has been concentrated in a certain period depending on the design environment and the developments in the construction field. 1960s was an important period with the radical groups who influenced the design world and enhanced the understanding of the scale in the design thinking. The selected projects are designed between 1930-2012.

As a result, projects are selected to form a suitable case study group to find the elements in which strategy and tactics are applied in urban design thinking focusing on the notion of scale. These case studies will set out the connections and relations

necessary to uncover the operations based on the strategies and tactics and this research will discuss that.

1.4 Structure of the Study

This thesis is constructed in five chapters. The opening chapter, **Chapter 1** provides a general understanding about the research along with the basic definitions of the context, problem definition, aim of the study, research questions, the methodology and the structure.

Chapter 2 introduces the etymology of scale in a broad manner, as it defines the basic framework of the study. The semantic development of the word scale in different language families directly affects the tool feature of the notion of scale in the field of design. Furthermore, the first inferences regarding its role in the design process emerge from the etymological journey of the word. After that, meanings and functions of the notion of scale in other fields like mathematics, natural sciences, music, cinema and politics are examined. Mathematics, natural sciences, music and cinema as production-based fields are examined in terms of revealing both similarities and differences to the design process. Although the notion of scale is based on the same etymologic origins in each of these fields, the way they use and perceive the notion as a term differs according to the production dynamics and to the resulting products of these areas. Different than these fields, politics does not directly use the term scale as a part of political terminology. However, as the basis of the political discourse created by the notion of scale and this relation is also included in this part of the research.

Chapter 3 is a comprehensive and detailed study of the relationship between the notion of scale and spatial design thinking. This chapter consists of four sub-chapters. In these sub-chapters the technical use and importance of the notion of scale in design is discussed first to form a basis for the following discussion. Secondly, professionalization in the design world and its relationship with the notion of scale is explained. The third sub-chapter explores how the notion of scale manifests itself as a cognitive tool in the design process and sets out the first discourses for the fourth sub-

chapter and the fourth chapter. In the last sub-chapter, some of the fundamental projects (that forms the basis of urban design theories of modern era) in the course of history that used the notion of scale as a theme directly or indirectly are gathered. Those projects are crucial as they pushed the limit of the notion of scale and they cover an important layer of information for this study. This sub-chapter emphasizes the importance of the notion of scale in the discourses developed on the relationship between architecture and city. At the same time, it reveals similarities, progresses and interactions between these projects that use scale as a design theme.

Chapter 4 analyses the scalar thinking in urban design projects in connection with the third chapter. While the previous chapter provides an understanding of how scale can be used as a design theme, this chapter seeks to interpret an analytical thinking of scalar thinking in urban design. Following this process, this chapter also includes the introduction of the elements and operations necessary to produce urban design projects through the notion of scale. Fifty-six projects are examined for this part of the research, and the scalar elements used to implement the notion of scale are revealed. The aims and methods of these scalar elements are explained and detailed one by one. This chapter also tries to understand the strategic and tactical operations used in the design process in order to understand how these scalar elements serve to control the notion of scale. As a result of this chapter, the analytical outcome of the fifty-six projects in which scalar elements emerge is examined through different scalar operations related to design processes.

Finally, **Chapter 5** hosts an overall discussion of this conducted research. This chapter highlights some aspects that can be referred to as concluding remarks. Firstly, a general understanding of the notion of scale reveals that this notion and term is more than a simple tool. Scale has different impacts on spatial thinking, and this directly affects the design process. Secondly, the place of the notion of scale in contemporary design world and its impact on developments in this field is more than expected. Thirdly, the implications of scalar elements and scalar operations are derived from the selected projects on design production and current academic discussion of the notion

of scale. As a result, this chapter discusses the impact and use of emerging scalar elements and operations on spatial design thinking and concludes some further research questions remarked.

CHAPTER 2

THE NOTION OF SCALE

Design is not the only area where the notion of scale is used or discussed. There are different fields that use this notion, it filters the information at different levels and increases the power of the designer/producer/researchers on the process and context. Realizing that the notion of scale provides similar advantages and control in different areas will increase the effect of the notion. It will be useful to understand the etymologic process of the term and to see its influence in other fields in order to strengthen the discourse that this thesis wants to put forward.

2.1. Etymology of the Term

Designers are using various design tools to understand and express ideas. The tool to be discussed within the context of the current research is ‘scale and scalar operations. This implies that this thesis tends to reveal how scale operates as one of the fundamental tools of design. Best way to understand and evaluate a concept, or an idea, is to examine its roots and sources. Presumably, this leads to a comprehensive examination of its etymology and its transforming meaning from past to present.

Etymology implies the long journey of the concept from different geographies to different cultures. Different point of views from different geographies and cultures provide an understanding of the thinking process of human mind in a more comprehensive way. As a matter of fact, it can be used to link different designers in different fields, as well.

Every word evolves in time and gets more and different meanings. This evolution process defines what we have understood from that specific word so far. Looking at different language families and recognizing different evolutions would strengthen the

basic knowledge and understanding of the word and its meaning. So, what is the meaning of scale?

In the field of etymology, all languages belong to a language family. There are thirty-six language families in five main headings.¹ For this etymological research there are two language families to be followed for the word, “scale” in English and “ölçek” in Turkish: **Indian-European** language family and **Ural-Altay** language family.

The roots of the word “scale” are from **Indian-European** language family branch, and this language family gives information about the European point of view.

Scale is a term that is used by designers in different fields and in various media, for a long interval of time. The term ‘scale’ has a long history and trackable evolution. It is rooted in the early Renaissance in the 16th Century when the term ‘architecture’ and ‘construction’ were separated from each other. However, ‘scale’ wasn’t first used in 16th Century Renaissance. The early traces of the term go back to the years of 1250-1300 (Dictionary, 2018). Those traces are linked as in the graphic below;

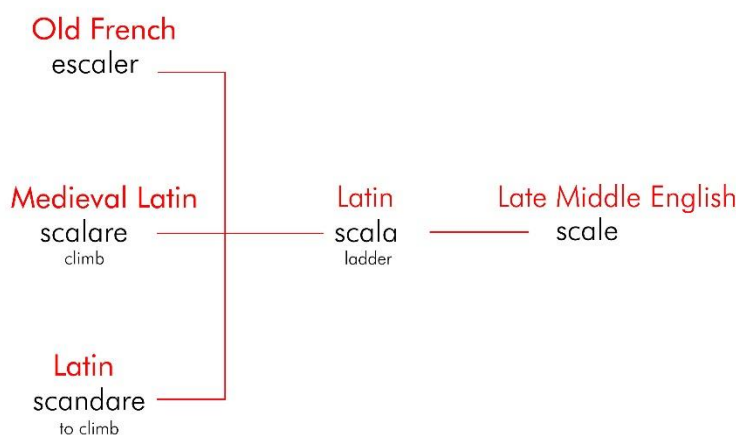


Figure 2.1. Etymologic branching of the word

¹ These are “Hami-Sami language family”, “Buyeo language family”, “Ural-Altay language family”, “Indian-European language family” and “Chinese-Tibetan language family”.

Scale can be used as a verb or as a noun. While verbal version of the term expresses the action, state or a relation between two things (Dictionary, 2018). Noun version implies the elements of subject for verbs (Dictionary, 2018). Even trying to understand the meaning and the nature of the word with the most basic elements like noun and verb shows its relations with design and production in a meaningful way. The way in which the terms used in the sentence can produce discourse about its use in the design process. The verb star describes the relationship between design elements, while the noun describes its relationship to design actions. ‘Action’, ‘state’, ‘relation’, ‘element’ these are the terms which are significantly used in design theory.

The word scale has more than 100 different meanings (Merriam-Webster Dictionary, 2018), in different fields like cartography, engineering, music, zoology, planning, design etc. both as a verb and a noun. Originally, all these definitions are linked to same meaning of the term. From these various options, two basic definitions of the term are important in this context. These definitions are;

Scale (v.)

*"to climb by or as by a ladder," late 14c., from scale (n.) "a ladder," from Latin scala "ladder, flight of stairs," from *scansla, from stem of scandere "to climb"(Etymonline, 2018)*

Scale(n.)

"series of registering marks to measure by; marks laid down to determine distance along a line," late 14c., from Latin scala "ladder, staircase" (see scale (v.1)). Meaning "succession or series of steps" is from c. 1600; that of "standard for estimation" (large scale, small scale, etc.) is from 1620s. Musical sense (1590s), and the meaning "proportion of a representation to the actual object" (1660s) are via Italian scala, from Latin scala. (Etymonline, 2018)

Of course, because of the nature of the language noun and verb definitions are also linked to each other. The root of the word is same in both verb and noun version. The word scale is related with the **action of ascend-descend gradually**. This can be sensed in the locative meaning, which refers to “staircase” and “*series of registering marks to measure*”. The verb definition (14c.) “*to climb by or as by a ladder*” also strongly implies the early traces of this action. Having a gradual change in an action implies control, precision and different levels of information. This is directly linked with the design action.

According to the Wyld, an eighteenth-century surveyor,

“Scale is a stair providing means for ascending and descending between the great and the small or in music between the high and the low” (Emmons,2005)

This quotation indicates that the meaning of the word scale in the 14th century keeps its traces in 18th century and evolves into a meaning of **stairs**. Even in today, relation between the word scale and action of ascend-descend is still valid. German architect and conservator Friedrich Mielke produced a comprehensive research about stairs, in the book series of “Elements of Architecture” (2013) by Rem Koolhaas. “Stairs” is a part of a comprehensive book collection of 15. Mielke’s research about stairs includes numerous photographs, measurements, sketches, tables etc. He has a collection of 20 volume book series called “Scalalogia”. These volumes contain everything about stairs. Mielkes’ element “stairs” directly relates with the word scale and action of ascend-descend gradually. His own term “Scalalogy” is also unique and powerful in the meaning (Lenz, 2018).

“... I made a difference between Stair Research and Scalalogy. Scalalogy is, so to speak..the opera(singing), since it raises things to a higher level.”
(translated from German, Mielke’s interview with Stephan Trueby, 2013)

Mielke didn’t name its study “Stair Research” but “Scalalogy” because he was aware of the potential and meaning of the word scale and how it acts as a tool for designers. In each design process, ideas and decisions gradually pile up to become product. The

entire CAD modelling and graphic design programs that we are used today, are utilizing layers and levelling actions to support design. This correlation is strong with the definition of the word in modern design processes and interfaces.

Back to the noun meaning of ‘scale’ in 1600s, the word implies *"standard for estimation"*. This implies a meaning of scale as **a standard to read or understand what is represented on paper or medium**. This was due to Renaissance: paper became easily accessible and the architects were separated from the construction sites. Architects like Serlio and Palladio started using papers to give information about the site with units of measurements. All architects have different ways to give scalar information in a different way. After its original use in Italy, giving scalar information in design began to spread through Europe. In 1560s, English cartographers started to show scale in their maps. In the final quarter of the 16th century, “scale” takes its place in the medium of representation (Emmons, 2005).

This definition also gives ideas about how a designer used scale in that era and it implies a very specific function. Architect or designer used “scale” to give information about how constructor should navigate while estimating sizes of spaces and elements of construction. In short, “scale” is used in construction process, as a tool to understand the design. This function also creates communication between the architect/designer and the constructor.

With all this accumulation in the 1600s the definition of “scale”, became clearer and the word “estimation” was erased from the dictionary meaning. Scale clearly became *"proportion of a representation to the actual object"*.

From then on, the definition of the scale became more interdisciplinary with the advancement of telescope and microscope in the 17th and the 18th century. It started to take place in the literature like “Gulliver’s Travels” by Jonathan Swift (1726) and ‘Micromegas’ by Voltaire (1752). These products of literature used scale as a tool to produce a story, which show the correlation and relation between different sizes both in artistic and philosophical way. A more popular and contemporary example is Italo

Calvino's 'Invisible Cities' (1972), where he describes different cities in the book, and his imaginary city of Olinda is depicted through different levels of scale (Hedges, 2010). A more recent and more philosophical example can be Jorge Luis Borges' 'Full-size map' (1946) where he discusses the meaninglessness of a full-size map. This is exact reflection of the action that designers do with CAD Programs in today's world (Emmons, 2005).

From the mid-13th century on, the definition of the word scale has evolved and took its rich form, that the current research tries to reveal today. It did never lose any of its meanings and purposes; as a matter of fact, it got more different connotation through each domain. The ever-expanding use of the notion of scale shows how it conveys a lot of information and ideas, including those in design.

After the word 'scale' more information related to the notion of scale is derived from the word's Turkish origins. There is more than one definition for the term "scale" in Turkish. Some of them are straightforward definitions and they are directly explanations on geographical or agricultural sense. One definition is the main one as it covers the all:

Ölçek (n.)

Birim olarak kabul edilen herhangi bir şeyin alabildiği kadar ölçü (TDK, 2019)

(The measurement which can be taken by anything considered as a unit.)²

Root of the word "ölçek" is ölç-. The root ölç- is derived from the verb "ölçmek" in the Middle Turkish. Root ölç- comes from the word "ülüg" from the old Turkish period which means scale (measuring instrument) or share out. Word "ölçmek" is derived from both middle and old Turkish period to modern Turkish.

² Translated by Olgu Çalışkan

The word “ölçek” is derived with +(g)Ak affix in Turkish (Nisanyan, 2019). This affix turns transitive verbs to nouns. Transitive verbs are the verbs which can contains the role of objects in their own meaning or can have objects in sentence. Link between the root ölç- and the word ölçek is important so, analyzing them simultaneously will beneficial.

Middle Turkish is the development period of Turkish language, after old Turkish period, in the 11-15th Century. Best-known example of West Middle Turkish is Codex Cumanicus. First traces of the word “ölçek” and root ölç- are seen in 1303 in Codex Cumanicus (Nisanyan, 2019). Codex Cumanicus is a dictionary that was compiled in the 14th century. It is the first Turkish source, which is written with the Latin alphabet. It is written by Franciscan monks who showed missionary activities in the downstream basin of the Volga River to understand the local community and that’s why it is written in colloquial language. Codex consists of two parts: one is written by Italians and one is written by Germans. There are visible differences between these two parts, in terms of spelling. The Italian section consists of two separate dictionaries. One of these dictionaries is in alphabetical order and the other one is sorted by subject. The words in the Italian section are in the form of three columns, Latin, Persian and Kipchak. On the other hand, the German section, German - Kipchak and Latin - Kipchak words are arranged in an irregular manner. The importance of German section is that it includes a compilation of Kipchak folk literature and oral literature. There are many riddles, lullabies, proverbs and religious texts (Bahadırođlu, 2016).

In Codex cumanicus;

Kipchak: [Codex Cumanicus, 1303] (Nisanyan, 2019)

mensuro - Tr: olğarmen [ölčermen] (Ölç-)

mensura - Tr: olza [ölče] (Ölç-)

mensura - Tr: olğa [olca] (Ölçek)

As mentioned, Codex Cumanicus is a dictionary, this quality of the book allow comparison to derive information. Root, word and corresponding meanings are identifiable. Words “mensuro” and “mensura” can be easily link with the word “measure” in English, and the root ölç- is identifiable in the Kipchak words. So, first traces of the word simply used in the meaning of measure. In the Kipchak Turkish the root ölç- have its original meaning as a verb but examples show that there is no differentiation between the root ölç- and the word ölçek. Word mensura is used for both. Original meaning of the root ölç- stayed the same from the 1303 till today.

After Codex Cumanicus traces of the word ölçek reveals itself in the dictionary of İbni Mühenna. İbni Mühenna is a linguist who lived in Bağdat and Merage in the late 13th century or early 14th century. Dictionary was written in the Arabic language this choice is valid in accordance with the terms of era. Dictionary is divided into three parts. The first part of the book is Persian, the second part is Turkish, the third part is Mongolian (Gül, Ağca, 2014, pp.21-22).

İbni Mühenna, Lugat, before 1310 (Nisanyan, 2019)

Ölçek: *al-ḳadr wa'l-handāza [miktar and endaze]*

Miktar (*n.*) (TDK, 2019)

Bir şeyin ölçülebilen, sayılabilen veya azalıp çoğalabilen durumu, nicelik.

(Measure, quantifiable or fluctuant status, quantity.)

Endaze (*n.*) (TDK, 2019)

65 santimetrelik uzunluk ölçüsü

(Length measurement of 65 cm.)

In dictionary of İbni Mühenna, “ölçek” corresponds to miktar (quantity) and endaze(ell) in modern Turkish. These lexical meanings show how the definition of the word develops. Today, “ölçek” corresponds to status of quantifiable and quantity. Different than measure having a quantifiable status gives a word power to explain the

states of increase and decrease. This semantic change leads to the “notion of scale” of today.

In the same century with İbni Mühenna, the word “ölçek” can be traced in a different dictionary. In 1312, scholar Ebu Hayyan writes Kitabu'l İdrak which is a Kipchak grammar and dictionary. Purpose of the book is to teach Turkish to Arabs. Grammar part of the book contains phono-morphology of the Kipchak grammar and dictionary part contains nearly 3500 words. In the dictionary part definition of the scale is found as;

Kipchak: [Ebu Hayyan, Kitabu'l-İdrak, 1312] (Nisanyan, 2019)

ölçi: al-ḳiyās

Kıyas (n.) (arabic, ḳiyās)

Karşılaştırma, oranlama, mukayese. (TDK, 2019)

(Comparison, proportioning, analogy.)

In addition to İbni Mühenna’s dictionary meaning of scale, Ebu Hayyan’s dictionary definition proposed new terms as **comparison and proportioning**. By this way, the notion of scale has gained the status of being a reference. The root ölç- is visible and identifiable in Ebu Hayyan’s dictionary as ölçi. It also has similar notation with the modern Turkish word “ölçü”, which means “measurement”.

Starting from the Old Turkish Period and three references from the Turkish, which are “Codex Cummanicus”, “İbni Mühenna’s Dictionary” and “Ebu Hayyan’s Kitabu'l İdrak”, word and the root completed its progress in reference to old Turkish, Kipchak Turkish and Arabic languages. After this linguistic transformation, the word scale gained a rich implication.

2.2. Basic Definitions of Scale

Etymologically, the notion of scale has proved that it contains much more than its narrow meaning. For this reason, in many different scientific fields, the word has been able to position itself without losing its main connotation. In order to achieve a better understanding and to interpret actual effect of the notion in design, it would be useful to examine its power in other fields, as well there are different fields which are using scale in multiple ways. While some scientific fields use the word in a framework closer to its original meaning, some have made it possible to find a place in their context. For this reason, when choosing the areas where the word is used, we will examine the fields which use the term within a framework close to its original meaning and those that interpret it in their own context. Their potential use in design and conformity to creativity in design will be taken into consideration, as well there are five sub-titles under basic definitions of the scale. Each reflects the effect of the word from a different angle.

2.2.1. Mathematics & Natural Sciences

Natural sciences are fundamental in the history of science. It can be traced back to the ancient Greece to our time with lots of scientists like Galileo, Descartes, Newton. The fundamental branches of science considered as a natural science are;

- Astronomy
- Biology
- Chemistry
- Materials science
- Earth Sciences (i.e. geology, geography, geophysics)
- Physics

From those fields there are some branches, which are highly related to the notion of scale. Physics, biology and earth sciences are the ones that have strong impact on the notion itself.

To understand the role of scale in those fields, natural sciences by themselves are not enough; there should be another field of study, to elaborate the discussion. Mathematics as an abstract and theoretical science is the one to undertake this role. The reason is any natural sciences cannot be discussed apart from mathematics, especially from the area of physics. The later topics that will be discussed under this chapter will be all connected to mathematics, as well.

Scale as a basic term of mathematics is the ratio of the size of a given object on a representational medium (i.e. drawing, model) to its actual size (Dictionary, 2019). In fact, this definition is the basic term that is used for drawings and models in design to give a reference to the original product/output. It works as a tool to question, understand and legitimize sizes, ratios and spaces. The term and its definition were questioned many times in the history of science.

Galileo Galilei (1564-1642) who is considered as a father of the modern science (West, 2017, p.55) was the figure who originally asked deliberate questions about the issue of scale. It is no surprising that Galileo was the person who gets his reputation by evolving telescope into its perfect form, to understand the notion of scale in cosmological and context. His works on the notion of scale will create the backbone for this part of the research and create the perfect correlation within the framework of mathematics and natural sciences. Galileo's argument on the notion of scale can be narrated in a way to create relation between different scientific fields starting with mathematics specifically on geometry, then to physics as structure, after that biology related to the structure of biological creatures.

In the last book of Galileo "Two New Sciences", he represents his ideas about scaling laws in the form of a conversation between three philosophers Salviati, Sagredo and Simplicio in the Venetian Arsenal³. First important aspect he mentioned in his book

³ The Shipyard of Republic of Venice at that time.

was “Square-Cube law”. In ‘Two New Sciences’ one of the philosopher characters Salviati explains to another character Simplicio;

Now you must know, Simplicio, that it is not possible to diminish the surface of a solid body in the same ratio as the weight, and at the same time maintain similarity of figure. For since it is clear that in the case of a diminishing solid the weight grows less in proportion to the volume, and since the volume always diminishes more rapidly than the surface, when the same shape is maintained, the weight must therefore diminish more rapidly than the surface. But geometry teaches us that, in the case of similar solids, the ratio of two volumes is greater than the ratio of their surfaces... (Galilei, 1914)

What he tries to explain mathematically, if the length of an edge of a cube increases by one unit, the base area increases by factor of two therefore its volume increases by factor of three. Of course, Galileo wasn't the first person who mentioned this mathematical fact. The important aspect he contributed was relating this geometrical information to the physics. His main point was about strength of the pillar and beams. Their strength is not related to their length but with their cross-sectional areas, a pillar with a certain size can support four times than a pillar with a half size of cross section (West, 2017, p.61). Then, it is an important detail that book takes place in the Venetian Arsenal, where big ships are built which are just a scaled-up version of a boat. This logarithmic change and its relationship with the notion of scale has a strong effect in scientific terms.

This relation of the proportional growth and contraction of objects with logarithmic changes formed a base on the concepts of size and measurement in scientific fields. Richter scale is one of the measurement systems which effectively uses this relation. Richter scale grows in orders of magnitude in other words the powers of ten and it makes us compare the bigness of the quakes. This vast logarithmic change makes it easier to grasp the interval between each quake. The importance here is not the Richter scale but effect of powers of ten and then gap it jumps. Impressive effect of powers

of ten shown in the famous video of Charles and Ray Eames “Powers of Ten” and how zoom in and zoom out effects our world to understand the relative scale of Universe according to an order of magnitude. This video also gives hints and references to the relation between scale in math and geography (Eames and Eames, 1977).



Figure 2.2. A scene from the movie 'Powers of Ten the Relative Size of Things in Universe' (Source: Eames and Eames, 1977)

In the following conversation between Salviati and Simplicio, Salviati explains why it is meaningless to increase the size of a structure in a vast manner because at some point it will started to collapse under its own weight. Then creates the relation with the biology why there can't be enormous animals or trees. The reason is explained in mathematical way the strength of a pillar corresponds to a bone and it is not related with its length but its cross section. Scaling a bone in proportion will result in collapse.

...the impossibility of building ships, palaces, or temples of enormous size in such a way that their oars, yards, beams, iron-bolts, and, in short, all their other parts will hold together; nor can nature produce trees of extraordinary size because the branches would break down under their own weight; ...Whereas, if the size of a body be diminished, the strength of that body is not

diminished in the same proportion; indeed the smaller the body the greater its relative strength...(Galilei, 1914)

This text also reveals the concept of “relative strength”. For example, an ant can carry much heavier objects than its own weight, but a human can only carry approximately as much as he/she weights. The size of an object and the lack of proportionality of the strength and durability provide the information that, a scale change effects each factor of design differently.

Starting from the discussion of Galileo, scale and its relationship with the science influenced the other fields. Related to our context, geography is one of them. In modern world every map has a scale, as in basic mathematical terms. The scale in maps gives a reference point to understand the sizes of the countries and the continents. All maps are abstract versions of the form of the lands. Scale is the tool which allows to measure distances and dimensions of geographical with almost zero error.

This issue was taken into consideration by Benoit Mandelbrot (1924-2010), who was a French-American mathematician, in his paper published in Science magazine in 1967 “How Long Is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension” (West, 2017, p. 172). He was the one who brings the term fractal in measuring geographical curves, in reference to Fry Richardson’s (1960) paper, “Statics of Deadly Quarrels”:

Lewis Fry Richardson was trying to understand the concept of war in mathematical terms and he resulted of finding out lengths of cost-lines and borders have inconsistencies in every other source. Those inconsistencies were not just small numbers but hundreds of kilometers. He found out these changes were occurring because most of the borders and coastlines are not straight. According to zoom in level of the geometrical curves, lengths of the borders and the coastlines are changing. In his book “Scale”, West (2017) explains this “coastline paradox” which is going to be named “Richardson effect”, in a perfect analogy,

Suppose you want to make a rough estimate of the length of your living room. This can be straightforwardly accomplished by laying down a meter stick end to end (in a straight line) and counting how many times it fits in between the walls. You discover that it takes just over 6 times and so conclude that the room is roughly 6 meters long. Sometime later you find that you need a more accurate estimate and so use the finer-grained resolution of a 10-centimeter ruler to make the estimate. Carefully placing it end to end you find that it takes just under 63 times to fit it across the room, leading to a more accurate approximation for its length of 63×10 centimeters, which is 630 centimeters, or 6.3 meters. Obviously you can repeat this process over and over again with finer and finer resolutions depending on how accurately you want to know the answer. If you were to measure the room to an accuracy of millimeters, you might find that its length is 6.289 meters (West, 2017, p. 167).

After Richardson's findings (1960), Mandelbrot worked the issue to carry forward this study. Mandelbrot's (1967) paper named "How Long Is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension" finds out that, geographical curves are infinite or undefinable when zoomed in, but they are "self-similar". Every scaled map is a "*reduced scaled image of the whole*" (Mandelbrot, 1967, p.156). Importance of Mandelbrot's paper is, it verifies that it is pointless to have a map without any scale because you won't grasp the information of resolution. Even you know the unit of the distance, you need to know the resolution to understand its accuracy.

Scale from its basic meaning reaches a detailed and comprehensive meaning with mathematics and natural sciences. From Galileo to Mandelbrot natural sciences are using the term scale to understand and legitimize nature and living creatures with consistent logarithmic jumps between frames of different sizes. In the act of design scale as a notion helps designers to understand the context with these different frames, they are working and legitimize the design idea. The notion of scale in science provides strong and significant references to scale in design.

2.2.2. Music

Music is one of the most important fundamental fields in human society. Another important aspect for our context is that music is more rational and systematic art than other types of art. This quality of the music makes this subject valuable for this research. “Scale” as a concept holds a very important position in music, this discourse depends on relation between mathematics and music.

While trying to understand the role of “scale” in music, starting with correlation between music and mathematics will be beneficial. So, what makes music related to mathematics? Most basic unit-based terminology of the music is ‘frequency’, which makes it so related with mathematics.

“Frequency: Frequency refers to the number of compression–rarefaction cycles that occur per unit of time, usually one second.” (Benward and Saker, 2015, p.15)

According to Benward & Saker (2015), music is not just a frequency and sound determines itself in four main aspects. These four aspects are listed as; *pitch, intensity, duration and timbre*. All these four terminologies are vital for music, but main focus of this study will be on pitch and duration as they are more related to the context. So, what makes pitch related to the context?

“Pitch: Pitch is the highness or lowness of a sound. The greater the number of sound waves produced per second of an elastic body, the higher the sound we hear; the fewer sound waves per second, the lower the sound.” (Benward and Saker, 2015, p.15)

Pitch is the definition helps to classify sounds. Pitch is one of the essential aspects of sound, but it isn’t completely an objective physical property. Certain frequency of a pitch can be measured, but identification of a sound as high or low, is a subjective assessment. This kind of immeasurable aspect of sound is called psychoacoustic.

Psychoacoustics is the study of sound perception (Dictionary, 2019). This quality of the pitch creates a need for other definition to classify and communicate over sounds. So, how to classify a sound as high or low? What is the reference and what is the measurement? Scale as a design and natural science terminology step in. “Scale” gives references and control points to sound, by collecting pitches.

“Scale(music): Collection of pitches in ascending and descending order.”

(Benward and Saker, 2015, p.27)

As mentioned before, pitch is highly related with the frequency and there are some exact frequencies for certain pitches, which are called tones. Basically, an octave is the distance between one certain pitch and its double frequency. Both of those pitches are classified as the same tone. Scale in music helps to divide this octave space into a certain number of steps. There are various scales in music but generally most of the scale spans take reference from a single octave. Scale step is the distance between two successive tones in a scale and generally one scale step is considered as a tone. In a musical scale those steps do not have to be equal, so there can be infinite number of tones in between. That’s why there are numerous scales in music and scales are categorized according to their scale steps. Most common scale categories are diatonic, chromatic, major and minor. (Benward and Saker, 2015)

To understand this concept better, most common scale will help to visualize the relation between octave, pitch, scale step: C Major (Do Major) as used in western music. C Major Scale is;

C-D-E-F-G-A-B-C

Do-Re-Mi-Fa-Sol-La-Si-Do

This scale is learned by every student in elementary school. It is easy to apply and understand and now it will be used to analyze what was mentioned above. There are two C (Do) tones in the scale. Second one has the double frequency from the first one and in between them there are 6 tones, which makes an octave. After this, octave it

repeats itself. The distance between C (Do) and D (Re) is called a scale step. There is a rule to identify a scale as the major scale. There has to be an exact pattern for a major scale, and this pattern is

Tone-Tone-Semi Tone-Tone-Tone-Tone-Semi Tone-Tone

In simple terms, from C (Do) to D (Re) there is a whole tone as a distance. From D (Re) to E (Mi) there is a half-tone distance. Both of those gaps called a scale step, but their interval is different. Different than major scale in chromatic scale, each step is a semi-tone, and it is another common scale in western music.

The term “scale” in music used as a tool to understand relation between elements. In musical sense, these elements are pitches. To understand one sound and to use it in correlation with another, you need different scale categories. In most of the cases, one or two scale sets are used in a musical piece. It makes musicians job easier and creates a control over sounds more systematically. In this context, the notion of scale reveals itself as a tool for understanding specific frames and musical intervals. The notion controls the infinity created by the fact that each pitch can produce infinite number of tones like natural numbers in mathematics. This quality of the ‘scale’ in music shows correlation with the ‘scale’ in design.

2.2.3. Cinematography

Cinema as an art and a production method is relatively a new one compared to other means of art like painting or music. It is considered as the continuation of photography. It is hard to consider a starting point for cinema, but in most cases, it is taken as the invention of Cinematograph⁴ by Lumiere brothers in 1895. There is an earlier trial of Edison, which is named Kinetograph⁵, however it was not as successful as Lumiere brothers’ device. The invention date of Cinematograph indicates how

⁴ Machine invented by Lumiere Brothers

⁵ Machine invented by Edison

young this cinematography medium is. However, it is highly related with the modern world.

So, how does the production of cinema take place in this research? Understanding the definition of cinematography is important in that sense;

Cinematography (n.)

the art or technique of motion-picture photography. (Dictionary, 2019)

The word “motion” is the key point of this definition. “Motion” refers to “time” and “time” refers to “scale”. Gilles Deleuze (2007) defines cinema as “blocks of movement / duration” (Deleuze and Lapoujade, 2007, pp.312-324). This definition brings the word “duration”. The dictionary meaning of “duration” is “the length of time something continues or exists” (Dictionary, 2019). In other words, in cinema as a medium, time is the length and time becomes a definable and a divisible unit. Algebraically, there is infinite number between two defined numbers. You can divide one second as much as you want. It is very similar with the music when there is infinite number of notes between two defined frequencies.

With this power of duration in cinematography, a new type of space-time relation can be created. Shifting and playing with the time is possible because of this infinite situation can be generated in between each block of time. Concept of time moves forward in real life but in the creative process of cinema you can play with it and present the story in an artificial time than real- time (Mascelli, 1998, p.68). This takes us back to the Deleuze’s (2007) quote, “*Cinema tells story with blocks of movement/ duration*”. The quality of a creative process defines according to how these blocks are played. Most famous directors like Kurosawa, Kubrick, Tarkovsky are all masters of playing these blocks of durations. Nolan brothers as today’s one of the most popular directors always uses the layer of time concept as a tool to create movies and TV shows.

The notion of “scale” in cinema can be perceived in two ways; one can be related with the issue of continuity and manipulation of blocks of duration and the other one is the perception of size in cinema. Even they seem like two different issues, they intersect with each other in the cinema medium. To control the continuity, cinema directors are using a concept called “Shooting Plan”. As Mascelli (1998) said, “Every motion picture should be based on a shooting plan.” (Mascelli, 1998, p.67). Shooting plan shows how a movie is going to be produced in real time and in real life. This is the part where director decides what he/she wants to show and how he/she is going to play with those blocks of movement/duration. In this part, the reference is the frame in which director is going to use these blocks. Every frame is a “zoom in” or a “zoom out” action in unit of time. As in the definition of scale, there is a length defined by the time and the frames are zoomed in or zoomed out in this length of time.

Different than playing with the blocks, the other issue is about perception of size in cinema. Every movie has its own time and space. This information is coming from Mascelli (1998) and Deleuze (2007). In each space and time, perception of size is an issue. This issue of size is not only about the size of an object but also it is the size of an action. As human beings we perceive a size according to a reference (Mascelli, 1998). Movies are the places where this illusion of scale created on purpose. There are multiple ways to do that with the technical methods of the creating a movie. Those are related to the notion of scale are; shot compositions, *forced perspective*, *miniatures*, *movement and relativity*. (Zamanian, 2016)

Shot compositions are related with the frame. There are multiple shot compositions according to what you want to show as an object or action. There is a term called ‘shooting scale’ in the subcategory of static shot types (UT Dallas, 2019). Those are;

1. Big close-up shot (BCU)
2. Close-up shot (CU)
3. Medium shot (MS)
4. Medium wide shot (MLS)

5. Wide shot (full shot, FS)
6. Extreme wide shot (long shot, LS)

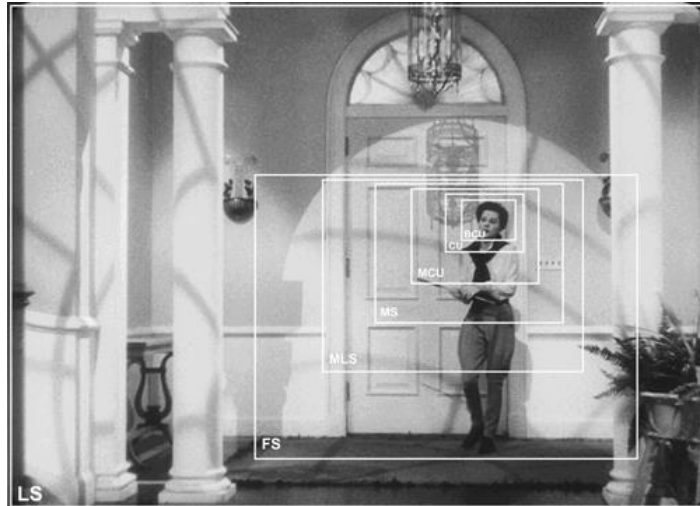


Figure 2.3. Relationship between frame of camera and the shots

One of the most famous examples for using the shot composition to create illusion of scale is the opening scene of the first “Star Wars” movie where audience sees a massive size of the spaceship named “Star Destroyer” (Starwars.com, 2016). Because of the selection of the shot type audiences perception of scale is played by the director even the spaceship is a miniature model.



Figure 2.4. Star Destroyer Scene

Forced perspective is another way to create a size illusion in consideration of scale. It is a way to create false reference to audience to perceive things in different sizes. You can see the examples of this in the famous movie series “Lord of The Rings”. The size of the hobbit character is smaller than an average human. They are creating this illusion without using any computer-generated image (Zamanian, 2016).



Figure 2.5. Hobbits in the Lord of the Rings, even there isn't a huge height difference between actors with the forced perspective audience perception of scale is changed to there is a difference in size between the characters.

In cinema, two other methods use perception of scale: ‘miniatures’ and ‘movement’. In most of the movies, directors prefer to use miniatures rather than computer generated images. The reason is that the physical effects applied on the miniatures create more convincing images with its relative world having its own space-time. Blocks of duration are again important for this part. A miniature is not a real size object and it cannot act in the same time sequence with a real size object. For example, think of a scenario where an explosion happens. There is a difference between detonating a miniature and detonating an actual size object because of the speed of explosion. In an explosion where a miniature is used, everything will spread much faster than an explosion where an actual object is used. For this reason, to create the illusion of scale, director slows the time of the shot; in other words, he/she plays with the blocks of duration and uses a miniature to create the illusion for a new

relativity. Stanley Kubrick’s classic “2001: A Space Odyssey” was shot in 1968 when the technology was not that developed as today and the first three ‘Star Wars’ movies are the finest examples for using miniatures in cinema.

Similarly, the issue of movement is used in cinema in order to manipulate different scales. When size of an object gets bigger, the number of air molecules it is going to collide will increase; this is the very brief explanation of why a bigger object moves slower than a smaller object. In a movie, a big object can be computer-generated, or it can be miniature acting in slower movements to create a different sense of scale. In the movie named “Pacific Rim” by Guillermo Del Toro, to make the fighting robots look enormously huge, Del Toro played with the duration of the fighting scenes (Zamanian, 2016).

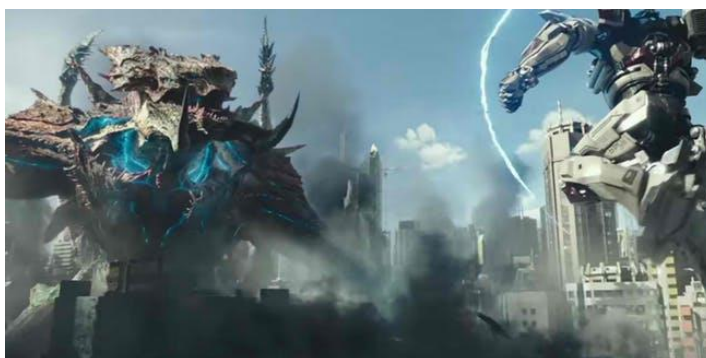


Figure 2.6. Robots of Pasific Rim

Notion of scale is related with the cinematography not just in the terminological way but also as a concept to create consistent space and time. The nucleus of cinematography is space and time and the scale are the method to create them. In the creative process of cinema, the creator (generally it is the director for this field) has to use the method of scale in various ways for the correlation and the consistency.

2.3. Politics

Politics as a social interplay does actually operate on the very notion of scale. Strong relationship between scale and politics comes from the inseparable relation between city, politics, and economy.

Politics as a word comes from the same Greek word 'Politics'. It was also the title of the Aristotle's book, 'Politics' written in 350 (B.C.). The word's root comes from the ancient Greek word "polis" which means "affairs of the cities" (Merriam-Webster, 2019). In contemporary meaning it is considered as the science of government (Merriam-Webster, 2019). This shows the core relationship between city and politics.

To clarify this relation, it will be beneficial to understand the term urban which is created by the emergence of the city. The reason is that urbanization and city are related with each other according to the notion of scale and this relation establishes the connection between politics and scale. When trying to understand the concept of urbanism, there are three important terms: these are Polis, Civitas and Urbs (Aureli, 2011, p.2). These terms will create the base for understanding the historical progress of the bond between urbanism, politics and scale.

To establish the relation between politics and scale first it is necessary to understand the parts which create the city. So, to understand these parts Aristotle's definition for politics is a valid starting point. According to Aristotle, politics is the space of decision making for the sake of the public interest (Aureli, 2011, p.2). Because of the etymological relation between the word 'polis' and 'politics' the space Aristotle defines in his definition of politics is polis which is the city in the Ancient Greek. However, aspects which create a city aren't just politics, the second term which bonds politics and the city is economy. That's why Aristotle in his discussion of politics also makes a definition of economy. He defines economy as a private space which is the house (Aureli, 2011, p.3). Both politics and economy are defined with their spatial quality within the discourse of Aristotle. Economy is the private space as it is the smallest component of the city, and politics is the public space where society

makes decisions. This relation between economy and politics is a scalar relation according to Aristotle's discourse. These definitions also showed themselves as concrete spaces at that time. House as a small-scale space which is the heart of economy with a limited interaction. On the contrary Agora as a big-scale space as a confrontation area which creates is a suitable environment for politics. Together they create the 'polis' which is the city.

After the Greek polis, in historical process trying to understand relations between city, politics and economy in the Roman Empire will be useful to include the notion of urbanization in the discussion. Reason is the term 'Urbs' is first used in the Roman Empire. Urbs defines an urban or rural area (Dictionary, 2019) in its meaning in contemporary. The Roman Empire used the term 'Urbs' to define their territories similar to the definition of 'polis' in Ancient Greek. Main difference is Greek polis is framed by a walled perimeter, urbs in contrast were not fortified. Urbs is politically becoming a term used to impose the idea that the Roman Empire can grow to an unlimited extent. Related to the notion of scale Greek polis defines a concrete frame with its perimeter wall but urbs is concept without any frame it is scaleless. This is all about the imperialistic vision of the Roman Empire.

In the ancient Greek, politics and economy establishes the city as unit and frame, Roman Empire with its imperialistic approach break the frame and use this scaleless situation as politics then what is the economic unit? For the Roman Empire this unit is 'civitas'. As its dictionary meaning civitas is a body of people constituting a politically organized community. (Merriam-Webster, 2019). The economic power of the Roman Empire comes from the organized community as civitas is the term which collects people and creates the unit within the unlimited frame of the Empire. Different people form the different identity can consider themselves Roman with term civitas coming from the Roman law. Aureli (2011) describes this condition as follows;

“The Roman Empire, by contrast, can be described as an insatiable network in which the empire's diversity became an all-inclusive totality. This totality was the settlement process that originated in the logic of the urbs. The urbs, in contrast to the insular logic of the Greek polis, represents the expansionist and inclusive logic of the Roman territories.” (Aureli, 2011, p.8)

To use the term Empire after the name of a state like the Roman Empire, it must have gathered various nations from different ethnicity under its rule. However, it is hard to control a society which is formed by people from different ethnicity. In the Roman Empire civitas, as it builds a politically organized community, allowed people from various nations live under the rule of Roman Law. This new economic unit change the frame of the economy in time with the demographic expansion, agricultural improvements and artisanal industry. These aspects created some communities to gain more economic power and created bourgeoisie. This economic unit created the rural and feudal order within the unlimited plane of the urbs (Aureli, 2011, p.8). These orders and communities defined zoom-in frames. From now on this identity remained as the economic identity of the city with the 19th Century.

In the 19th Century the urbs defined in the Roman Empire absorb the civitas with the power it gained from Industrial Revolution and capitalism. Aureli (2011) explains this absorption as follows;

...over the last three centuries we have witnessed the triumph of a new form of human association based entirely on the mastery of the urbs. Enter urbanization (Aureli, 2011, p.8).

The word urbanization which contains qualities of both urbs and civitas was introduced by Spanish engineer and planner Ildefons Cerda. He explained and legitimized the concept of urbanization in his book ‘The General Theory of Urbanization’. While he is legitimizing the concept, he claimed that the concept of city which defines a finite frame cannot contain the aspects of the city; politics and economy. According to him space contains politics and economy, should allow a

limitless space for enhanced movement and communication by capitalism. Urbanization allows for scaleless expansion of units that creates the political space. To control this scaleless the design paradigm Cerda used, generates a homogeneous and controllable formation at the new scale of urban design. This homogenous situation also balances the economy by distributing economic communities and balancing class differences.

After Cerda's urbanization and industrial revolution cities started to grow with the effect of capitalism. Even though Cerda wanted to 'ruralize the city and urbanize the countryside'(Cerda, 1967, p.87) economic power was seized by some specific communities with the establishment of factories. This effected migration from village to city ratios. Cities became more urbanized rather than becoming rural, economic and social capital started to gather in the cities and political power of the city grow stronger. As the larger cities created more social capital with the industrial revolution, unit which generates the economy became more compact. Factories and production spaces became the unit for economy.

This economic change with the 19th century and capitalism created the modern city society living today. Scale of economic unit started to vary. The urban scale Cerda presented, created a frame to control different of economic units in various scales and the collage of these frames formed the cities which is the space of politics.

CHAPTER 3

SCALE IN SPATIAL DESIGN AND PLANNING

After understanding the notion in a general sense, it is necessary to understand the impact of scale on design particularly to produce discourse on spatial thinking in the context of relation between architecture and urban design. The effect of the notion has influenced the design field of various perspectives since it is already a powerful tool of design practice. In addition to its impact as a basic tool, its role in the design process as a cognitive aspect, its effect on the professional designation of the fields in spatial design and its use as a theme in different design projects will be examined.

3.1. Scale as a Notion in Design

The notion of scale finds an important place to itself in a world which is constantly producing. In each field, scale takes a critical role within its scope of meaning without losing reference to its etymologic origin. This evolution of the word implied and revealed important aspects of the notion's role in discovery and production. This feature of scale also expresses itself in design practice.

From a basic perspective, design is an activity conducted all humanity. In their daily lives, people constantly engage in design action. It is sometimes a cake baked, or a new color they chooses for a bedroom wall. These daily activities occur in every corner of the world. Also, it is possible to derive/deduct from the historical artefacts discovered that, design activity persisted throughout the history of humanity. If there is an object which is not produced or shaped by nature itself, it is designed by a human. Today this action is conducted by some people in particular who are professionals referred to as designers, but it was not always like that. In the past, the act of design was a collective or a shared ability for survival. Also, in history, there was not any prior activity such as drawing or sketching before designing. Instead it was a craft-

based activity. In our modern world this action detached from its sub-activities and design became by itself. In most of the design tasks the process of making starts after the design activity finishes (Cross, 2013, pp.3-4).

To create a correlation between design and the process of making, the designer needs to produce materials to guide the actors who conduct the making process. This correlation creates a need for a means of communication between making process and design act. From the 16th century when the design practice actually starts to become a profession, the first method to provide this communication presents itself as drawing. The basic task of scale in design practice starts at this point.

Design as a term holds 10 different meanings in the dictionary.⁶ Each of them contains words like sketch, plan, drawing, outline and organization. All these terms imply that there is a need for a guide to apply design. This quality of design evolved over time. Similar drawings produced today were first used in early Renaissance. The reason why this happened in that time is, it became easy to acquire paper and the architects started to isolate themselves from construction. In those times, to guide the constructors to build the form, designers gave the sense of scale using measures related to the human body and its variations. Today it is possible to trace those units in the western world⁷. Famous Renaissance architects like Serlio and Palladio used various units and scales to guide the construction. They were using different measurement systems for different contexts, and they only included graphic scale, which is a primitive example of a scale bar on the primary vertical centerline of a plan. In some cases Serlio did not provide a notion to indicate scale. The reason is that, the plan was proportioned within itself, for a certain measurement to be understood, it could be calculated from the whole (Emmons, 2005, pp.227-228).

The graphic scale as a primitive way of using scale in design became the standard representation tool in the end of the sixteenth century. At that time, there were a lot of

⁶ Design. (n.d.). Retrieved June 25, 2019, from <https://www.dictionary.com/browse/design?s=t>

⁷ For example, there is a measurement unit which is called foot (foot=30.48cm).

units of measurement and a universal consent was not present. That is why, initiating a graphic scale was important. After the graphic scale became a common element of the design process in the seventeenth- and eighteenth-centuries, the notion started to gain more importance not just in design but also in fields like cartography and astrology (Emmons, 2005, p.229).

Technological development of the telescope and the microscope in the seventeenth century affected the world significantly. These two inventions have broken all basic judgments about the concepts of size and dimension acknowledged by artists, designers and scientists around the world. The transition from the graphic scale to the architectural scale took place in a world where all these developments occurred. However, the acceptance of this architectural scale as the norm occurred in the twentieth century.

In the twenty-first century, drawing and making a model of the form is a codified indexical representation of the existing or proposed real-world objects (Austin & Perin, 2016, p.14). The representation of a form evolved and manifests itself in a much more abstract way than before. Like in seventeenth-century, technological developments affected this evolution significantly. Notion of scale reacted to this change and gained more importance in design than before. Scale transformed from being a reference to show certain dimensional relationship to a notion that directs the design process. It takes up the role of determining the scope and power of design and controlling frame and grain relations.

3.2. Scale as the Basis of Professional Designation of the Fields in Spatial Design

In the twenty-first century, the act of design is a common profession. As mentioned before, design became a profession from a collective or a shared act of survival. The need for tools and shelter makes the design act a goal-oriented activity (Çalışkan, 2012, pp.272-296). Design as a profession is divided into multiple branches. Related to notion of scale these branches can be listed as architecture, city planning, urban design, interior design, and industrial design. It would not be wrong to say that all

those professions are derived from architecture with the division of labor. To call a certain field of work a profession, it requires to contain a cumulative knowledge in an independent system.⁸ Professions are the organized individuals who are experts on a specific field with profound education. After the separation, each of those professions need to claim a legitimization. As a matter of fact, this issue is not only related with the capital, but it is also related with social and cultural acceptance. Conflict between authorities and public, which are the sources of legitimization, creates the division of professions (Abbott, 1988, p.59).

To gain the legitimization and become a profession there should be a group who controls and claims the knowledge and the skills necessary. Division of labor is an outcome of interrelation within the major professions. According to Abbott (1988), there are two ways to control the knowledge and the skill of a certain field. The first one is to dominate the technique itself, especially in craft-based professions and the other is controlling abstract knowledge. Controlling abstract knowledge is the root of the division of labor in design. The reason for why these practical skills are required to execute a work, emerged from abstract knowledge. New abstraction of generating knowledge creates new skills and creates new professions. Abbott (1988) also claims that, *“Only a knowledge system governed by abstractions can redefine its problems and tasks, defend them from interlopers, and seize new problems.”* (Abbott, 1988, pp.8-9)

In the early stages most of the design act, as a profession, was related with the arts and crafts. Architect as a title, not as a profession, can be traced back to the third millennium BC (Kostof,1977).The residential cluster painting on the wall at Çatalhöyük in Anatolia can be considered as a primitive example of graphic communication from even earlier, as it is dated seventh millennium B.C..The term ‘architect’ also covered the professions like urban designer or city planner to a certain extent. Related to its scale and complexity there is always an actor who conducts and

⁸ Profession. (n.d.). Retrieved July 10, 2019, from <https://www.dictionary.com/browse/profession>

organizes the building action. Kostof (1977) claims that for all historical context “*The architect's role is that of mediator between the client or patron, that is, the person who decides to build, and the work force with its overseers, which we might collectively refer to as the builder.*” (Kostof & Cuff, 1977, p.6). Before the separation of spatial design works, the title ‘architect’ was also a sub-title to bear. In Egypt, the famous Imhotep who can be considered as an architect, has titles as a scribe, astronomer, magician and healer besides architect. One of the first descriptions related with urban planning appears on the Epic of Gilgamesh (one of the oldest epics of human history) shows that architect as a figure not only deals with building, but with all spatial design activity related to human life. Also, the patterns in the remains of ancient cities shows that there was a concern about the spatial organization of the cities.

The first appearance of architecture as a profession in the field of design is during the Italian Renaissance (Larson, 2018, p.3). This appearance is related with the issue of legitimization. City-state system of the Italian Renaissance created a new patronage system. In addition, the growth of the merchant class created a new social and cultural context for spatial design. In the late 14th century these authorities tried to create a new façade for the city and looked for individuals who could manage this task. Most of those individuals who undertook this task were craftsmen like stonecutters, goldsmiths, cabinetmakers and painters. Later in the 15th century the title architect started to separate itself from the acts of craft. Architects started to take part in civil engineering projects, mostly hydraulic works but also, they took part in developing fortification (Larson, 2018, p.3). In the Renaissance era, there was a notion of the ideal city which was also argued and discussed by architects and understandably, painters.



Figure 3.1. The Ideal City by Fra Carnevale (1480-1484) (Source: Wikipedia, 2019)

The first architects gained acceptance related to their civic duty from the society in Renaissance. This acceptance and the patronage of the capital created the suitable environment for the legitimization for architecture to become profession. They created the abstract representation of buildings and creating such a mediator medium was highly related with their craftsmen background. Actors like Alberti and Antonio Filarete created the theoretical foundation. This foundation did not involve architecture, but also created the foundation for city planning and urban design. All these aspects are matching with the Abbott's (1988) requirements for defining a profession. In this context with controlled abstract knowledge and technique, architecture became a profession which contains all spatial design tasks, in the age of Renaissance. Other design tasks were still handled by the craftsmen. Yet the separation on producing some specific objects began to emerge in this era.

Until the 19th century, the profession of architecture also took over the spatial duties which are arguably the fields of city planning and urban design. The main reason was at that time, there was no patronage for different scalar works like urban design or industrial design. Most of those needs were filled by craftsmen and architects who had specialized in different scales. In the 17th and 18th century, the first traces of division of labor in design started to surface. In the 18th century, monarchical rulers attempted to change and redesign their cities. In some cases, major disasters lead to major urban changes. In some cities most of these tasks were held by architects. At the same time, the first trials of group work on same design tasks in small scale, mass manufacturing of tapestries, furniture, metalwork, and porcelain are seen in this century. Those

attempts are not enough to create division of labor in design related to Abbot's (1988) discourse. To create legitimization there was need for a big socio-cultural impact which would happen in the 19th century.

Developments, social and cultural effects of the industrial revolution in the 19th century have greatly affected the division of labor in the fields of design and production. Rise of the industry created a new patronage system and society. It transformed the urbanization, consumption habits of the society and the speed of production. In social terms, the reason why people started to immigrate to cities was the work opportunities in factories. All of those are promoted by the private business companies. Related to that, a wider middle class emerged. Population of the cities started to increase rapidly, and this created the need for healthier living spaces for people. This new middle-class society demanded designed products which are fashionable. These developments created the background for the legitimization for those fields, but to become a separated profession there is a need for controlling the abstract knowledge and technique. In the field of city planning and urban design, this abstract knowledge and theoretical background would be formed by Baron Georges-Eugene Haussmann with his new model of Paris in 1852, civil engineer Ildefons Cerda with his plan of Barcelona in 1854 (Aureli, 2011, p.9) and Ebenezer Howard who is known as the first urban planning theorist with his book entitled "Garden Cities of Tomorrow" (1898). The important point is, these three figures are not architects who work on spatial tasks in different scales but people who did not have any design background. They were not just interested in spatial aspects, but they also consider the city and society together in reference to sociology and economy. In the field of industrial design, C. Dresser who is considered the first industrial designer and theorist with wide range of design knowledge has to be mentioned. Dresser was not a craftsman, but he was educated in the field of design in the Government School of Design in London (Oshinsky, 2006). The change in the society and in economy with the new patrons of industrial revolution created the necessary foundation for separation of city planning and industrial design. Foundation of Royal Institute of

British Architects separated the profession of architecture from city planning and industrial design in 1834 (Kostof, 1977, p.192).

Abbott's discourse (1988, p.59) came forward with the industrial revolution. After the 19th century city planners and industrial designers dominated the abstract knowledge and the change in the technical requirements separated those fields from craftsmen and architects and they became different professions. All historical background of professions related to design is based on changes in the notion of scale. Scale in its nature, is a tool to control the abstract level of information, and it defines the frame for the designer. This aspect of the scale fits perfectly as it defines the limits of different design professions. The scale of a project defines whether it is a duty for an architect or a city planner. In some cases, there is need for professions that design and bring solutions at different scales. In the modern times, this separation between professions gained momentum. The debate about their acceptance as a profession is still valid today. Abbott's (1988) discourse related to abstract knowledge which creates the theoretical background surfaced in the historical context in the act of design and separated the design acts related to their scales.

After all those divisions in professions which relate themselves in design separated the act of design and the process of making. This aspect is valid in all fields, and in most cases, designers are not working on the actual object or site but on intervening media they created in the Renaissance era. Different than artists and craftsmen of today who usually work on the final product; architects, planners and industrial designers put most of their efforts to the representation act like drawing and modeling (Evans, 1997, pp.211-212). Since they are the ones dominating the abstract knowledge, they are also the ones who are affecting and ruling the techniques of the process of making. This separation from the process make design-based professions segregated within themselves. This issue causes design to gain its autonomy and isolate itself from other factors. The notion of scale fulfills the most basic task. It enables the communication between the intellectual process and the product. Whilst it severed and isolated itself, the limits of design started to become blurred, and the

notion of scale has helped the designer to create its frame of reference with the consistent new perception and reality it provides. This creates the duality of separating and giving autonomy to each profession in design and allows them to communicate with each other.

3.3. Scale as a Cognitive Tool in Design

The final product of a design process does not shaped by a linear process. While creating a solution to a design problem, actors in the design practice constantly seek solutions from various angles. These different angles are mainly provided by means of media in which design is represented, especially for architecture and urban design related to the sizes they are dealing with. Since the 16th century media used in design practice have been physical models and two-dimensional drawings, sketches. Even though these media have been replaced by digital platforms due to technological advances, their functions have basically not changed. The primary notion that provides the relationship between the media used by the actors involved in the design practice and the design problem is the scale.

Due to the fact that design activity is not a linear process, every actor involved in design activity is constantly looking for interfaces that will internalize them to the design and make it easier the understand the problems it brings. These interfaces are basically abstract reflections of what is real. Each media that turns into an interface, defines itself with a different abstraction in the context of its scale. These media, defined by the scale, provide different information each time according to the frame and grains they represent. Different scales used in the design process provide space for the actors to produce different solutions to the design problem at hand.

When architectural and urban design problems are tried to be analyzed in their real scale, problems of magnitude arise which cannot be perceived. Transitions between the frame and grain information that come with different scales help the designer to make connections between these scalar differences which organize spatial definitions. For this reason, designers use the notion of scale in a controlled way to uncover and

solve the design problems arisen and cannot be perceived at the same time. This process in which different scales are used increases the designer's knowledge in a controlled manner. Scalar operations in two-dimensional or three-dimensional media are used as a discovery tool.

Conscious scale changes made in the design process create connections for the same design problem cognitively. According to Yaneva (2005), these actions performed on scale take place in varying rhythms. Sometimes these scalar changes are sequentially '*scale up*' or '*scale down*', while in some cases '*scale jumps*' can occur. The scalar jumps defined by Yaneva also indicate that the design process is not linear. Design, which presents itself with a number of problems completely unknown in the beginning, provide the designer a trial and error learning method with sudden scale jumps. The changing contrast and rhythm of these scale jumps for each project leads to a unique solution for a specific design problem.

Architecture and urban design ultimately produce results for human scale. However, in order to obtain the result that is meaningful to us, the designer has to master the information put forward at different scales. Spatial data of different scales can only be examined through media. The frame and grain relations brought by the scale are cognitively placed in the designer's head. This information, which is located at a different scale, is essential to create the necessary accumulation for the absolute product. Each drawing, sketch or model with different scales will provide different experiences for the designer and allow them to produce ideas for real experience. The notion also makes it easier for the designer to share experiences related to space and the intellectual process produced with other actors. Constantly switching between different scales will ultimately ensure that the result is appropriate to human scale.

The results of these scalar actions are not predictable even if all of them are conscious. Therefore, the designer makes use of the information collected after scaling actions cognitively. Since this body of cognitive knowledge is constantly found in different scales and media, simultaneous studies of different scale in the design process gain

importance. As well as in the different areas mentioned at the second chapter of this research, scale inevitably brings a frame along with the design process. This frame limits and translates unlimited amount of information meaningful to the designer. Since the designer will not be able to understand and grasp all of this information at the same time, usage of continuous scalar changes in a nonlinear way makes the scale a cognitive tool.

3.4. Scale as a Design Theme

In the act of design, legitimization of a product/project is valuable and necessary for the designer to control the process and ensure the communication with the client or patron. Each design act influenced by various conditions and decisions within an unlimited choice. To limit and create a consistency in a product/project, gathering the design process under a certain design theme is useful for the process and the outcome.

Basically, theme means (Dictionary, 2019)

“-a subject of discourse, discussion, meditation, or composition

-a unifying or dominant idea”

A design theme can be created in reference to many different topics. It can be based on social sciences, economy, technology, cultural influences, historical background, art and more and the notion of scale can be one of them. Scale is a self-contained term that is already involved in all design process. There are multiple actors in the history of design, used the notion of scale as a theme and pushed the limits of the term. It can be traced back to the myth of Tower of Babel. In the myth, scale as a theme used to create a new idealistic, impractical and utopian approach. First actors who actually use the scale a theme is the producers of the visionary architecture of the Renaissance. After that, in the modernism era Corbusier used the theme scale to create new urbanistic argument. By this way, the real users of the notion of scale in an urbanistic approach will arise thirty years later in the 1960s in the light of CIAM and to create a concrete idea, they will use the theme scale to idealize the abstract. The 20th and 21st

century actors who use the scale as a theme will generate a new discourse with the help of this notion.

In the time of Renaissance, advance progress in the representation of buildings with the introduction of perspective and development of tools to create visuals, build the fundamental environment for creating imaginary architectural scenes (Burden, 2000). This enables artists/designers of Renaissance to push the boundaries of architecture. The reconciliation of the structure from the real world made it easier for them to examine and challenge the notion of scale. Etienne-Louise Boulle, Claude Nicolas Ledoux and Jean-Jacques Lequeu are the architects who produced extravagant example of the visionary architecture. All of them pushed the limits of the notion of scale but Boulle's designs were more than this. Most of his works, related with the visionary architecture, are combination of simplicity and monumentality (Kaufmann, 1968, p460). His works like 'Palais d'Assemblee NAtionale', 'Pyramidal and Conical Cenotaph', 'Spiral Tower', 'Deuxieme projet pour la Bibliothèqure' and famous 'Newton Memorial' are produced with elements like continuous stretch walls and halls, massive resized geometrical shapes and a great number of repetitive structural elements . In his drawings he commonly used tree and human silhouettes to emphasize the sense of scale and scale-less. These visionary architecture trials are crucial examples of the scale as a theme in the 18th Century.

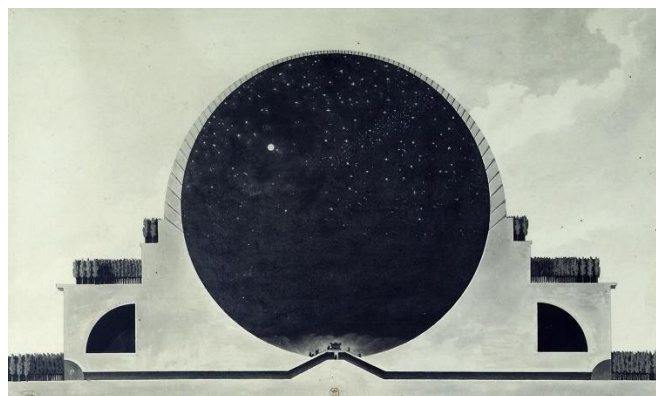


Figure 3.2. Newton Memorial (Source: Archfaily, 2019)

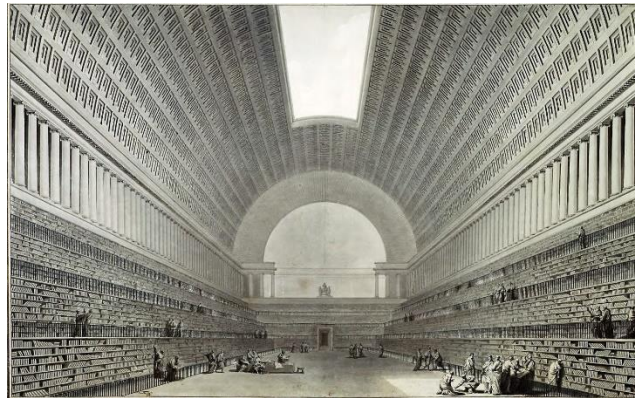


Figure 3.3. Deuxieme projet pour la Bibliothèque (Source: Archdaily, 2019)

In 20th century, the discussion on the notion of scale as a theme will be solidified. In Banham's book "Megastructure: Urban Futures of the Recent Past" he explains how notion of scale creates the link between urban design and architecture. Of course, the visionary architects of the Renaissance were not trying to relate their works with urban context, as their main concern was creating monumentality within the unlimited scale of the paper. In the context of Banham, the project that can be accepted as a precedent that is related to the notion of scale is Le Corbusier's 'Fort L'Empereur in Algiers' dated 1930 (Banham, 1976, p.8). This project was designed as an extension to the city Algiers and was totally changing the idea of colonial port city (Maruhn, 2008, pp.44-48). Banham describes the idea of the project as a large-scale grid, *"like a giant bookcase of reinforced concrete on the shelves of which the inhabitants have built two-story houses to suit their own taste, not necessarily in le style Corbu"* (Banham, 1976, p.8) Banham's definition of a giant bookcase is implying information that the notion of scale not just a cognitive tool but the project is designed to push limits of the scale. Another point is, Corbusier takes its scalar references from the nature itself; the length of the building coming from the natural curve of the shore, highway rifts the middle of the housing units. Containing a highway is crucial in the project because the road as a mean of transport gives this vast structure of an urban quality. The project also idealizes the importance of mobilization. The highway that was proposed was

long and wide. This spatial quality of a highway shows its effect in scalar terms as a long-stretched structure. This project is an endless linear high-rise structure which creates repudiation of hierarchy within shape of the city (Maruhn, 2008, pp.44-48).

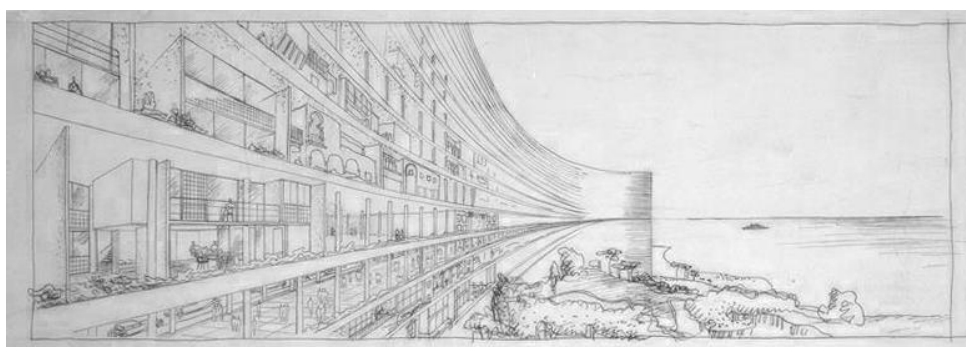


Figure 3.4. *Corbusier's Fort L'Empereur* (Source: *Foundation Le Corbusier, 2019*)

In the year of 1928, just two years before Corbusier proposed his Fort L'Empereur project, International Congresses of Modern Architecture (CIAM) was founded by Le Corbusier, Helen de Mandrot and Sigfried Giedion. Main purpose of these congress called CIAM was widening the principles of Modern Movement in different fields of design like architecture, urbanism, industrial design and many others. CIAM has multiple meetings till its disintegration in 1959. In the fourth meeting of CIAM in Athens in 1933 the members of the congress argued about the ideal city as titled 'The Functional City'. At this point on, CIAM's main aim was not architecture but urban design. They claimed that social problems of the city can be solved by distribution of the population into high-rise apartments. In this sense they also claimed that the notion of scale is not just tool for representation but a term to guide the design. In Athens Charter in 1933, they list the four functions of the city as dwelling, recreation, work, transportation (Corbusier, 1973). Both housing and transportation functions they list are two fundamental design elements of Corbusier's 'Fort L'Empereur' project. After the Athens Charter, next CIAM called CIAM IX congress was held in Aix-en-Provence, France, 1953. The title of the congress was 'Conflicts on habitat' and the notion 'habitat' didn't just refer to dwelling but implied a total of all living spaces.

The congress shaped a more in-dept discussion related to dwelling and unit. Studies of Bidonville Mahieddine Reconstruction (Algiers), by CIAM-Alger and Carrieres Centrale Casablanca by GAMMA (Team of Georges Candilis), were trying to understand the pattern formation and structure of dwellings in shanty-zones of city. The other two studies that attracted the attentions in the congress were 'Urban Re-Identification' in reference to their 'Golden Lane Housing Competition' project by Alison and Peter Smithson and 'Zone Project' by Pat Crooke, Andrew Derbyshire and John Voelcker (which is their graduation project in AA School of Architecture) (Heuvel, Risselada, 2005, pp.20-34). Both projects aimed to create a discussion on multiplication of a unit to create superstructure as a new urban pattern. GAMMA interprets a housing block as a basic element while Crooke, Derbyshire and Voelcker are uses average family of five as a basic unit. Idea of a unit and its multiplication to create a urban design project, created the base for scale to become a design theme. With this congress implied with these harsh discussions started in between new generation of CIAM and the old. This event will lead to CIAM X and CIAM'59.

CIAM X took place in Dubrovnik in 1956 an its proposed title was 'Scales of Association'. This title itself shows that the notion of scale not just a tool but an approach to their general idea about urban design. They claimed that relation between size of the population and the design forms are in reference to scale of association. This idea mostly supported by Alison and Peter Smithson in the housing projects they presented. (Pedret, 2005)

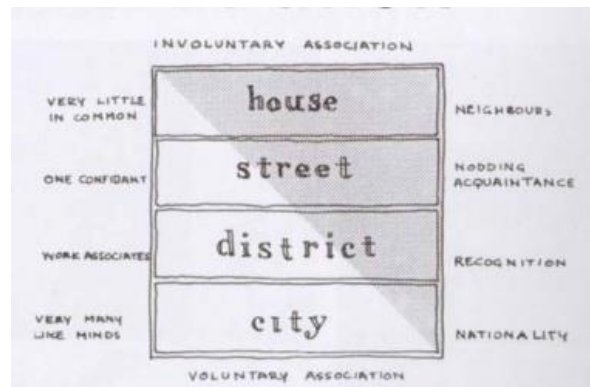


Figure 3.5. A. & P. Smithson, Scales of Association Diagram (Source: Pedret,2005)

The idea of unit related to dwelling and repetition was used in many projects presented in the CIAM X, but (other than the Smithsons' 'Scales of Association' projects) it was developed just a bit from the previous congress related to the notion of scale.

Three years later in 1959 last CIAM Congress was held in Otterlo, Netherlands. The importance of this conference was not only the projects presented but also the participants. There were 43 participants from 20 countries, including names like Louis Kahn with 'Richards Medical Research Building' project and Kenzo Tange with 'Tokyo City Hall' project. The presence of Tange in the congress was important. His presence in the conference shows that he is sharing the same concerns and idea of the congress. In the congress he shared and support some ideas with the Peter Smithson. One year after the congress he presented his project known as 'A plan for Tokyo' aka 'Tokyo Bay Project' in the World Design Conference,(Urban, 2008, pp.94-96) which was one of the first project that truly pushed the limits of the notion of scale. (Pedret, 2005)

'A Plan for Tokyo' is a project that spans the bay of Tokyo with huge steel beams, carrying big platforms with high-rises and freeways which 200,000 cars per hour can use. It is a big project solves the problems in all levels of 'Scale of Association'. The project shows strong correlation with the Corbusier's Fort L'Empereur and ideas of CIAM with its vast size and formal relations like house stacks back to back over a

transportation axis. It is visible that Tange and his design team⁹ uses the notion of scale as a theme to create a high-tech Mega-Tokyo (Urban, 2008, pp.94-96) and create a strong A-Frame section using it repeatedly to control whole design.

Kisho Kurokawa is another important name at that time who was in the Tange's design team and used the notion of scale in his project 'Agricultural Clusters' in 1960. The term 'cluster' used in the name of the project was a reference to CIAM's clustered dwelling unit. Kurokawa's project was composed of layers that contain an agricultural land in between. He refers the project as a city not a building. Kurokawa also participated Team 10 meeting in 1962, this shows that he was aware of the west and Team 10 is aware of Kurokawa. Needless to say, Kurokawa's effect is going to be visible in Team 10 projects. (Kasahara, Matsushita, Mizutani, 2018)

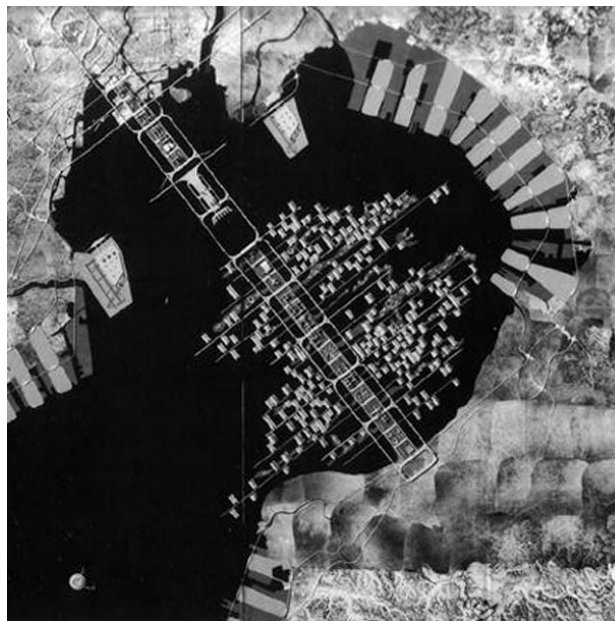


Figure 3.6. Kenzo Tange and Team, A Plan for Tokyo,1960 (Source: Archeyes, 2019)

⁹ Tange's design the plan with Arata Isozaki, Koji Kamiya, Heiki Koh, Kisho Kurokawa and Satao Watanabe.

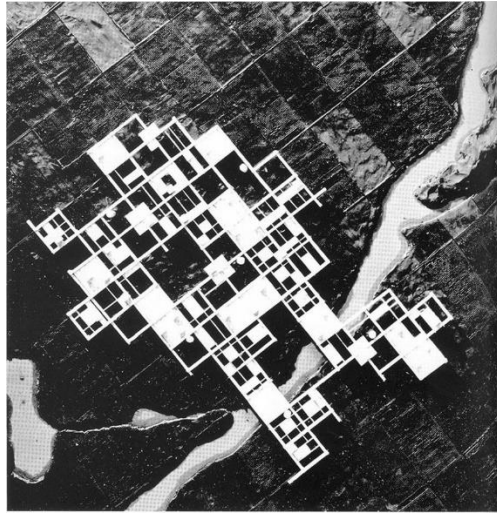


Figure 3.7. Kisho Kurokawa, Agricultural Cluster, 1960, (Source: Kasahara, Matsushita, Mizutani, 2018)

In the following years of 1960's the notion of scale is tested and implied by many designer and groups in a more avant-garde and critical way. Cedric Prices project 'Fun Palace' can be considered as an initiator. Cedric Price brought another point of view to the sight about the notion of scale with his famous project 'Fun Palace' in 1962. This project proposed a constant change inside a certain frame basically. What is more important is that, it defined a relation which can be called the *time-scale*.(Banham, 1976, p.88) In the blueprints of the project, the distances are written in unit of time in reference to the average walking speed of a human. Price also estimated a life span for the project which is ten years. Even the Prices work is more architectural than urban it influenced the Archigram and their projects like 'Plug-In City' and 'Walking City' in 1964.

'Plug-In City' project contains a diagonal frame where there are mobile office towers on a superhighway and capsule housing units that are plugged into the structure. There are units which can be plugged into a frame and mobilization is highly indicated. The design actions aspired in 'Plug-in City' show resemblance with the previous examples. In the main image of the project 'Walking City', multiple walking cities in front of the

Long Island NY are seen. This project creates a city which is mobile all the time and in fact it is a criticize to New York and its constant mobility. These unrealistic cities can travel anywhere while connected to each other with long stretched tubes. Archigram was acting like the visionary architects in the Renaissance and they were using utopian urban scenarios to criticize and understand the concrete real. What they used to create these imaginary powerful scenarios was simple: it was the notion of scale.

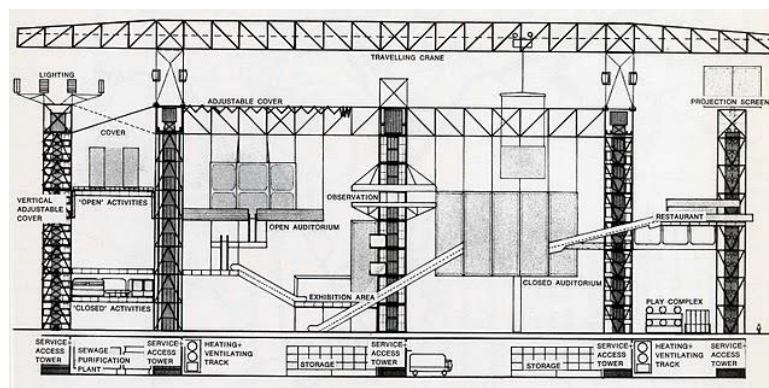


Figure 3.8. Cedric Price, Fun Palace, 1962 (Source: Wikipedia, 2019)

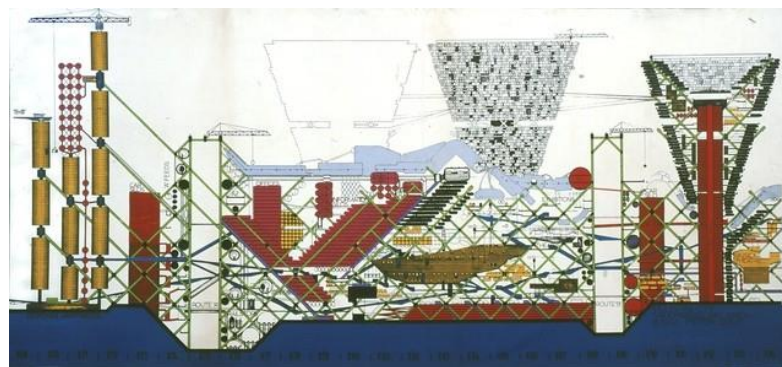


Figure 3.9. Archigram, Plug-in City, 1964 (Source: Archdaily, 2019)

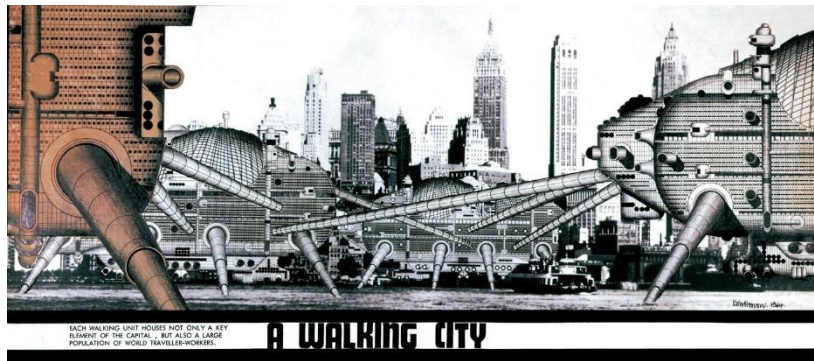


Figure 3.10. Archigram, Walking City, 1964 (Source: Archdaily, 2019)

In the same year Fumihiko Maki, one of the Japanese ‘Metabolists’, named these structures the others designed by various architects and designers from different countries as ‘Mega-Structure’ in reference to Kenzo Tange. He defined the term in his book ‘Investigations in Collective Forms’ as follows,

The Megastructure is a large frame in which all the functions of a city or part of a city are housed... In a sense it is a man-made feature of the landscape... a mass-human scale form which includes a Mega-form, and discrete, rapidly changing functional units which fit within the larger framework. (Maki, 1964, p.8)

He claims that the task of a megastructure is to propose an ‘urban structure for the future’. In the definition of megastructure, he uses all the design elements and actions they all starting from Corbusier to Archigram: Unit, frame, stem, block and rapid change, in reference to emphasize the mobilization, and create the fundamentals of a megastructure while pushing the limits of scale.

Parallel to all this after the declaration of CIAM, Team 10 organized several meetings in 1960-61-62 and 65. The meetings in 1962 and 1965 are important related to notion of scale. Projects presented by Candilis-Josic-Woods, who were also active figures of the Team 10 at that time, designed highly influential and strong examples related to issue of scale. The projects they represented in 1962 meeting were called ‘University of Bochum Competition’ and ‘Vallee de Belleville Winter Resort’. Both of the

projects were similar to each other and their main design ideas and decisions were highly related to methods of a huge scale project. In both projects the main structural element was a large stem for human mobilization and accommodation units that were attached to this stem to create a correlation between artificial and natural landscape. Form of the projects allow infinite situation that designers can make it bigger and bigger endlessly. (Heuvel, Risselada, 2005, pp.110-112) There is a significant resemblance between Kenzo Tange's 'A Project for Tokyo' are visible especially with the 'University of Bochum Competition'.



Figure 3.11. Candilis-Josic-Woods, University of Bochum Competition, 1962 (Source: Avermaete, 2005)

In Team 10 meeting dated in 1965, again Candilis-Josic-Woods presented two projects which created a strong impact on scale issue. Projects were named as 'Frankfurt Römerberg' and 'Berlin Free University'. The main idea of these projects was to create a whole which contains a synthetic order of the all functions. In Frankfurt they wanted to design a new urban district in an area destroyed completely in the World War II which was bounded by a river. The projects were the combination of three elements. First one is that, they integrated several big platforms on top of each other.

Second element was a series of columns with a 9 m interval to create a 36x36 m grid. Then they superimpose these two elements to create a structure to allow buildings to plug-in. Thirdly, they created openings in the platforms to allow buildings to get higher and creates relation between platforms. They first implied these actions in the Frankfurt exemplar and then they use the same set of rules to design 'Berlin Free University' project. What is different from the others were that Candilis-Josic-Woods were using the notion of scale in a more horizontal way. Woods mentions these buildings as 'groundscapers' and claims that this organization creates more possibilities for communication and exchange. (Heuvel, Risselada, 2005, pp.132-134) It is visible that Candilis-Josic-Woods was highly influenced by the Japanese 'Metabolists'. Formal quality and the design methods of the both Frankfurt and Berlin projects shows strong resemblance with the Kurokawa's 'Agricultural Clusters'. In fact, it is known that these Japanese architects were contributed to CIAM and Team 10 meetings so, they were aware of each other

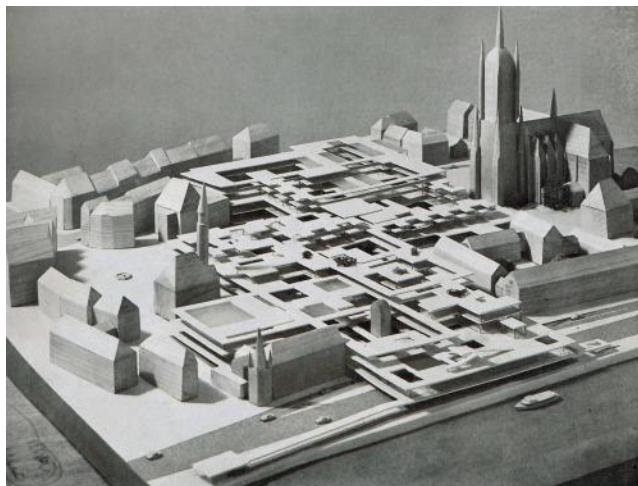


Figure 3.12. Candilis-Josic-Woods, Frankfurt Römerberg, 1963 (Source: Avermaete, 2005)



Figure 3.13. Candilis-Josic-Woods, Berlin Free University, 1963 (Source: Avermaete, 2005)

Similar to Archigram a new avant-garde group who used the notion of scale to create visionary urbanistic scenarios to react and criticize the modernist perspective emerged in 1966: Archizoom members of the team was Andrea Branzi as the founder, Gilberto Corretti, Paolo Deganello and Massima Morozzi. Their project No-Stop City claimed that with the technological developments there is no need for a centralized modern city. Their project takes its reference from the concept of Supermarket as it is a homogenous space of capitalist city. Elements of the project were residential units and free- form organic shapes juxtaposed with a grid structure (Branzi, 1969). This repetitive nature of the project allows city to extend infinitely. Main approach and design elements are similar with the ‘Frankfurt Römerberg’ and ‘Berlin Free University Projects’ of Candilis-Josic-Woods related to notion of scale.

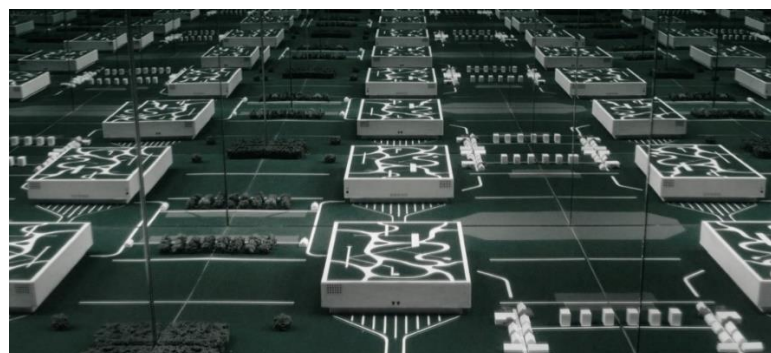


Figure 3.14. Archizoom, No-Stop City, 1966 (Source: UTS interior spatial design,2019)

In the end of the 60's utopian urban ideas became more homogenous and the idea of a unit started to be dominant. Groups like Archigram, Archizoom and Team X discussed and criticized urban theories of eighteenth and nineteenth century, evolution of the modern city, functionalism and rationalism from the Marxist perspective (Stauffer, 2008, pp.211-215). Last project of the 60's that, considered all these aspects was Superstudio's 'Il Monumento Continuo'. Project was designed for the Biennale Trigon in Graz in 1969. It was composed of an oversized, abstract, infinite, linear structure the images of the work show only this linear endless surface and there is no plan, elevation or section of this project. As in the No-Stop City it has a homogenous shape which connects everything. Everything is attached to each other in a grid formation. Like the visionary architects in Renaissance. They were trying to create a monument which encircle the whole world and control it. They take their references from the monuments which they call as continuous monuments like Great Wall of China, aqueducts, superhighways, dams, large scale technical structures. It is vivid that the notion of scale was used as theme as they are used design actions like stretch and resize to achieve a model of total urbanization (Stauffer, 2008, pp.211-215).

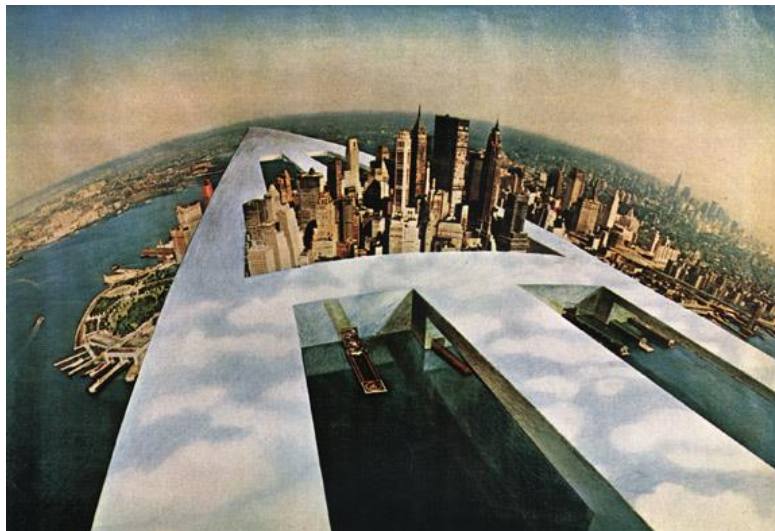


Figure 3.15. Superstudio, Continuous Monument,1969 (Source: Archdaily, 2019)

In 1970s, West Berlin was struggling with an urban crisis as a result of the Second World War and this caused partition of the Berlin into two cities. In 1971, Rem Koolhaas who was studying at AA School of architecture, visited the Berlin Wall and studied it to generate a design idea from it, for his third-year project (Koolhaas, 1995, pp.570-578). He identified the wall as not just a linear structure that cuts the city into two but also the wall that offers a linear possibilities for a different architectural events. As Koolhaas (1995) mentions, all those events occurred with the political will created in between the defined spatial condition of the Berlin Wall. This political will is not coming from the actual political situation of Germany but comes from how it defines a linearity and closure. The Berlin Wall was acting just like another architectural element of division, and its discourse comes from its linearity and size.

After his Berlin visit Koolhaas presented his third-year project and called it 'Exodus: The Voluntary Prisoners of Architecture' in 1972. The Project was about testing the potential of the Berlin wall in London. Project was basically a city sized prison which was encircled by two vast walls and in between these walls there were several architectural events are presented in a linear fashion referring to the nature of the wall. The spaces which holds these architectural events were dividing London into eight enclosed parts: Reception Area, Central Area, Ceremonial Square, The Park of the Four Elements, Square of Arts, Baths, Park of Aggression and The Allotments. Users were the voluntary prisoners of this enclosure which is creating a political will. Projects uses the negative acts of a wall such as division, isolation, inequality, aggression, destruction and convert them to create architectural event spaces where people voluntarily take part (Koolhaas, 1995, pp.8-9). As a discourse there are some similarities between Superstudio's 'Continuous Monument' and Koolhaas 'Exodus'. 'Exodus' is not a series of identical modules like 'Continuous Monument' but both projects claims that there is a need for a monument to control and restrain the society. Koolhaas says that psychological and symbolic effect of the wall is much more powerful in reference to its physical aspects. This means that scalar exaggeration of the wall becomes the substantial element of the design.

Berlin Wall not the only used reference in Koolhaas 'Exodus' project. First traces of the idea started to emerge when Koolhaas met Oswald Mathias Ungers and see his project named 'Grünzug Süd' which designed in the late 1960s and he represented this project in the 1966 Team 10 meeting. The definition and the function of the wall in Koolhaas 'Exodus' as it creates a closure and allows a linear possibility to architectural events is similar to Ungers's design logic in 'Grünzug Süd'. Ungers' definition of wall transforms into different spaces in a discontinuous linear organization and each change happens radically. Housing complex of Grünzug Süd cuts through the city and creates different conditions for the city in an instant.

Koolhaas used these ideas which he gained from The Berlin Wall and the Grünzug Süd. Exodus just like Ungers' project holds a linear composition which has eight different enclosed spaces happening in an instant, one after another. The urban discourse of the 'Exodus' project stems from the fact that it is an urban analogy. Each of these separate parts represent the elements of the city (the suburb, the hospital, the museum, the park) (Aureli, 2011, p.197) and claims that separation, aggression and contradiction are the default action/act of the city, and the voluntary prisoners are the people who accepted this quality of the city. 'Exodus' project plays with the simple architectural element wall in a scalar manner to create a frame which city occurs inside. For the next step, this frame he defined was divided into sub-frames to control and design the urban context this creates a finite condition in an infinite condition. This idea was taking reference from the historical examples that pushed the limits of the notion of scale. In the previous examples like 'Continuous Monument' or 'No-Stop City' modules or grids were used to legitimize the design ideas behind. With it was claimed that each module, unit or separation gains its own autonomy, creates space for new possibilities with the new defined frame.

Oswald Mathias Ungers
Köln-Zollstock Grünzug Süd
 Planung 1962-04

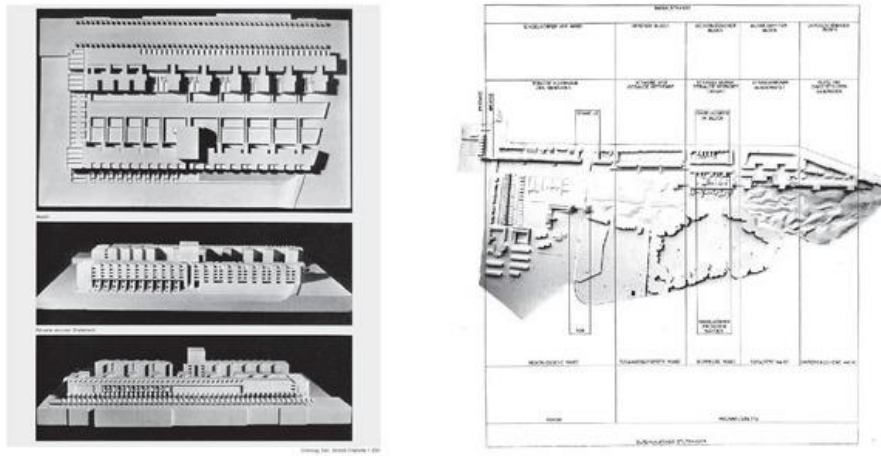


Figure 3.16. Oswald M. Ungers, Grünzug Süd, 1964 (Source: Archplus, 2019)

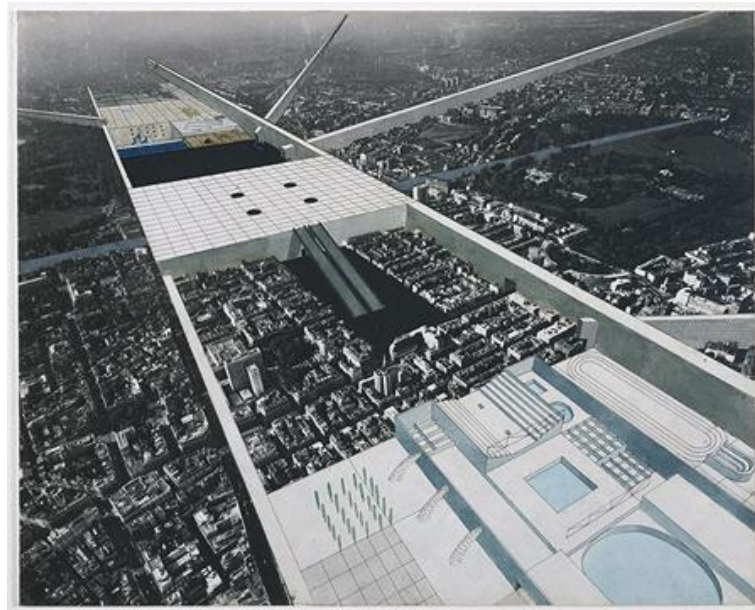


Figure 3.17. Rem Koolhaas, Exodus, 1972 (Koolhaas, 1994)

This cumulative idea generated by Koolhaas and Ungers was further developed in 1977. In those years population of West Berlin started to decrease vastly. An architect group under the leadership of Ungers started a project called 'Berlin as a Green Archipelago' to solve problems of the West Berlin. Rem Koolhaas was also part of this group as he created strong relations with Ungers himself and his works. The infrastructure of the 'Berlin as a Green Archipelago' project had already begun to be shaped by Ungers with his previous works like, 'Cologne Neue Stadt', 'Berlin Markisches Viertel', 'Enschede dormitory', historical examples of communal life in America and most importantly his research on the Superblock in Vienna. On top of those examples Exodus became the link in between to create the base of this project. Qualities of the 'Superblock' in Vienna was the reference for both Ungers and Koolhaas. These 'Superblocks' have a simple monumental architectural form which can be identified easily and then create a political will just like the walls of Exodus. Each Superblock contains different architectural spaces such as clinic, library, laundry, gym, restaurant, kinder garden. Separation of these spaces are defined sharply and distributed related to form of the Superblock. As these qualities each Superblock is self-sufficient, it leads to the autonomy of the Superblock. That's why Ungers defines each of them as 'Archipelagos' meaning individual island connected with the city as an infrastructure. 'Berlin as Green Archipelago' tries to define the city with architectural forms. This definition divides the city and derives frame and limits of the architectural space. The frames and limits create separate architectural entities which gained their own autonomies. As a result, Berlin aimed to become 'cities within the city' (Aureli, 2011, p.178). In the whole design idea, role of notion of scale is crucial. Ungers and Koolhaas exaggerate the formal qualities of the architectural forms and give them their own autonomy in a certain sub-frame. In other words, they form wider perspective to create correlation between them. In each sub-frame a separate module occurs and gains its own autonomy within its limits.

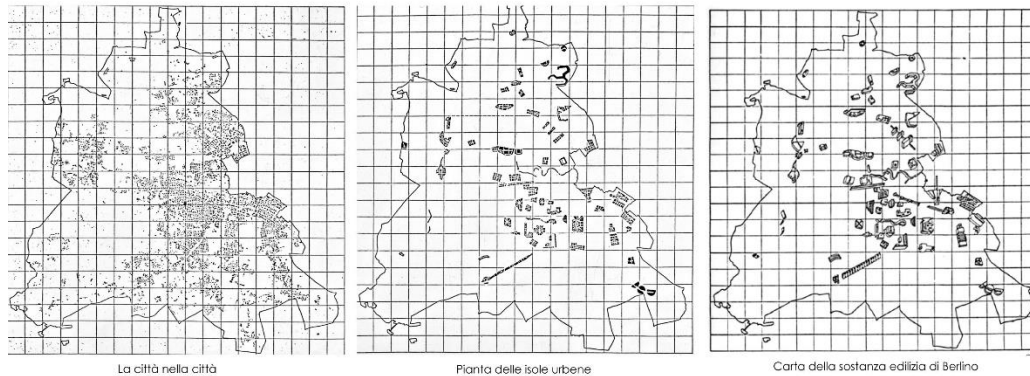


Figure 3.18. Oswald Mathias Ungers, Rem Koolhaas, Hans Kallhoff, Arthur Ovaska, and Peter Riemann, *The City within the City-Berlin as a Green Archipelago*, 1977. The city as a "project of crisis," shrinking the city to its significant and irreducible parts. (Source: Ungers, 1978)

The idea behind all these projects Koolhaas and Ungers take part, is a reference from previous the projects which pushed the limits the notion of scale. Koolhaas and Ungers interpret and legitimize the ideas of the precedents, indeed. The design paradigms they created, combines abstract and concrete together, becomes a critique of the modernist praxis of urban design. In parallel to ‘Berlin as Green Archipelago’ project Rem Koolhaas will publish ‘*Delirious New York: A Retroactive Manifesto for Manhattan*’ which is a manifesto on urbanism of 20th Century taking Manhattan as a case study. The conceptual and ideologic base for this work is built with the ideas Koolhaas generated from Ungers’s works and his ‘Exodus’ project. Similar to ‘Berlin as Green Archipelago’ project, ‘*Delirious New York*’ analyzes New York through individuality of exemplary buildings such as; Rockefeller Center, the RCA Building, the Downtown Athletic Club and the Waldorf-Astoria Hotel. Koolhaas defines these buildings as ‘cities within cities.’ (Aureli, 2011, pp. 212-213). Apart from its social and ideological context one example Koolhaas uses as a case is highly related with the scale issue. ‘The Downtown Athletic Club’ is an important example of how autonomous stack of platforms creates an infinite possibility for a structure. This buildings relation with the scale is stated by Koolhaas, as he defines the ‘Downtown Athletic Club’ as “a locker room the size of a Skyscraper” (Koolhaas, 1994, p.157) The structure is formed in a series of 38 superimposed platforms, and the area of each similar platform connected

with 13 elevators. This basic definition of the building is sufficient to see some of the qualities which is discussed earlier by designers. Superimposed platforms on a structural system was used in the late Team 10 projects and elevators are the representation of the idea of mobilization. The infinite quality of these layers is reference to module or unit idea coming from the late 60's but in the 'Downtown Athletic Club' each of them has autonomous identity. Koolhaas explains how each platform offers a different program: Each platform is an abstract composition of activities that can be generated indefinitely within a defined finite platform in the linear organization of the monumentality of the skyscraper. References of such analysis of the structure is easily traceable from the historical progress of the creating big structures and trying the limits of the notion of scale. Important aspect of these research conducted by Koolhaas is that he turns this analysis and understanding in to design strategy.

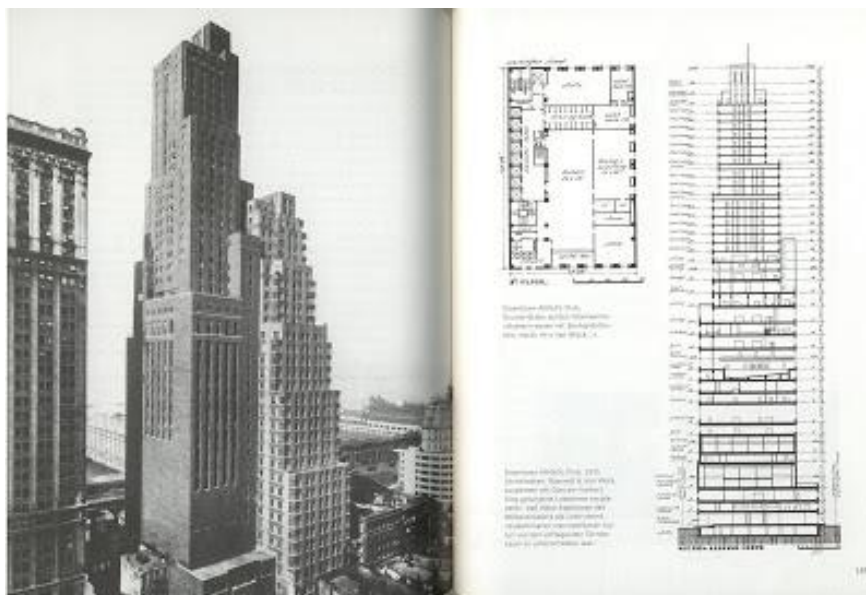


Figure 3.19 The Downtown Athletic Club, photograph, plan and section From *Delirious New York* (Source: Koolhaas, 1978)

In 1982 a competition was held for Parc de la Villette, in Paris. Rem Koolhaas entered the competition with a project which is a full representation of his argument in

Delirious New York, especially the idea of The Downtown Athletic Club. Koolhaas and his design team OMA define the project they proposed for Parc de la Villette as not a definitive park, but a method that will generate a park (OMA, 2019). The project's design method composed of five steps. First, they distribute the major programmatic needs in horizontal bands all along the site. These bands have two references: one is from the project 'Exodus' as the bands are the spaces divided in between the walls and the other one is the 'Downtown Athletic Club' as they are like separate platforms of a skyscraper. This individuality allows each program to gain its own autonomy. Then they distributed the facilities like kiosks, playgrounds, barbecue spots according to point grid which they called confetti. This point grid creates relation and communication in between each band like an infrastructure. A 'round forest' as the architectural element which is the only stable decision in the whole process was added. OMA defines this is the architectural element of the project. For the next step, they created the axis for the mobilization within the park as a last layer. Superimposition of all these layers creates the method which will generate the park. All of these steps for the method comes from the early works and references of Rem Koolhaas. His learnings from Ungers, Delirious New York, OMA projects (like Parc de la Villette) would lead him to the idea of 'Bigness', his most important manifesto on scale and size.

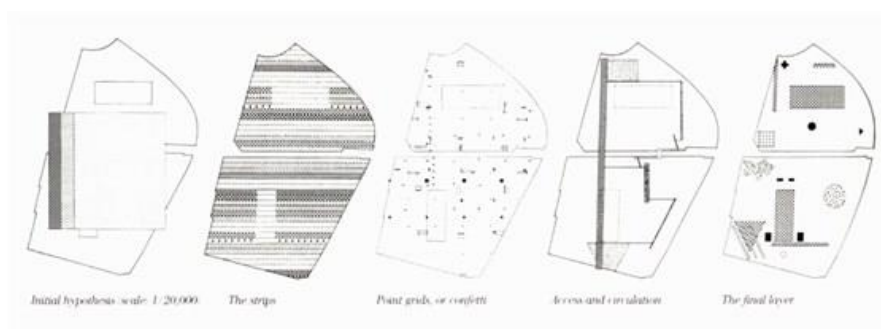


Figure 3.20. Layers of the Parc de la Villette Competition Project by OMA, 1982 (Source: OMA, 2019)

In the late 1960's Ralph Wilcoxon who is a planning librarian at the College of Environmental Design at Berkeley, proposed a definition for the word 'megastructure' which is a popular term related to scale discussion. In his '*Megastructure Bibliography*' he gives the definition in four-parts; a megastructure should be constructed of modular units, capable of great or even 'unlimited' extension, a structural framework into which smaller structural units(for example, rooms, houses or small buildings of other sorts) can be built-or even 'plugged-in' or 'clipped-on' after having been prefabricated elsewhere, and a structural framework expected to have a useful life much longer than that of the smaller units which might support (Banham, 1976, p.8) This definitions actually cover the most of the projects discussed till the end of 1960's, and after that Ungers and Koolhaas brought all these discussions to a more comprehensive and deeper framework with their projects and discussions.

'Bigness' as a manifesto tries to define architecture beyond a certain scale. Koolhaas published his manifesto in his famous book 'S, M, L, XL' in 1994. The manifesto has been told under 6 parts and in each part Koolhaas explains how idea of 'Bigness' effects and changes the paradigms of design. He names the parts to explain his manifesto as; Theorems, Modernization, Maximum, Beginning, Team and Bastion. He explains the 'Theorems' of 'Bigness' under five other subtitles. In this part the infrastructure of the manifesto was created and, he gives clues and general ideas of Bigness. Koolhaas' 'Bigness' has potential to reconstruct the whole, resurrect the real, reinvent the collective, reclaim maximum possibility with the autonomy it creates and allows (Koolhaas, 1995, pp.8-9). 'Bigness' separates itself from any ideology related to politics or architecture, it does not follow any movements or requires a new economy. 'Bigness' offers a new beginning, relationships, identities and it creates new events. It promotes and demands interaction between its new elements, but it keeps them separate. An individual cannot rule 'Bigness', it requires a collectivity and a team of forces. It is the savior of architecture; 'Bigness' does not need city, it is urbanism vs. architecture (Koolhaas, 1995, pp.8-9). Koolhaas' use of urbanism vs. architecture when describing 'Bigness' shows that his definition stems from a concern

related to scale. Architecture and urbanism, which are constantly overlapping in scale, form the basis of the spatial design practice and the boundaries defined by the scale in both fields are beginning to lose their prominence in each other. This demonstrates the pointlessness of the designer staying within the readily agreed scalar definitions. It is a basic demonstration that act of design should be the result of conflict information from different scales. Koolhaas' discussion about the problem of large becomes a general theme, a metaphor which can generate a design just like the 'Parc de la Villete' project. It gives reference to Banham and its works on Megastructures offers a guide to create Bigness and what it will constitute. 'Bigness' enhances the capability and power of the notion of scale.

Rem Koolhaas' 'Bigness' strongly influenced the design scene in the scope of architecture and urban design. After Koolhaas' definition of 'bigness', it has been repeatedly questioned and discussed in the academic community. In the current scene of the design society, Pier Vittorio Aureli is the figure that discusses urban design and architectural form related to the notion of scale in his research and design office DOGMA with Martino Tattara. They are building their discussion from the problems of urban design and the problem of large (Aureli, 2015). From the projects of DOGMA, there are two projects which are related to the notion of scale. These projects are Stop-City (2007), A Simple Heart (2011).

As the name suggests, Stop-City project is a contemporary critique of Archizoom's Non-Stop City. Contrary to Non-Stop City, Stop-City seeks to define both formal and political boundaries. It has a simple architectural form that develops vertically to create a powerful and monumental image of the absolute limit. This massive verticality formed through repetition of a basic unit to create a platform and those platforms creates a massive block. Block is a city with 500.000 inhabitants and each slab is a "city within a city". (Aureli, Tattara, 2007, p.3) Each block is a self-contained city, independent from program or activity, an experiment that uses architectural form to determine a frame for the city. Using a unit in a repetitive way to create a massive block indicates that DOGMA use familiar actions that push the limits of the notion of

scale. They are using infinite number of repetitive actions to create a controllable design with limits, which is the discourse used and putted forward by Ungers and Koolhaas.

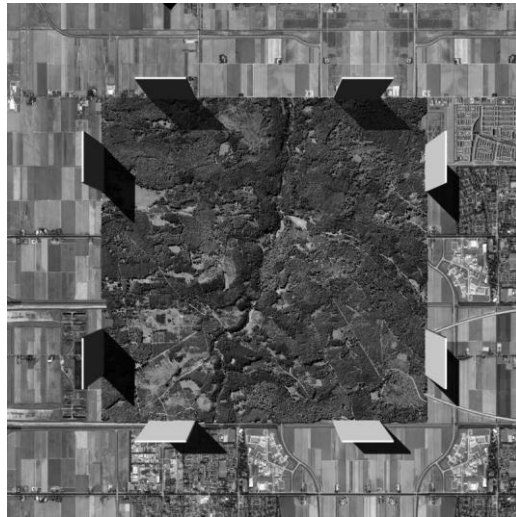


Figure 3.21. DOGMA, Stop City, 2007 (Source: Socks Studio, 2019)

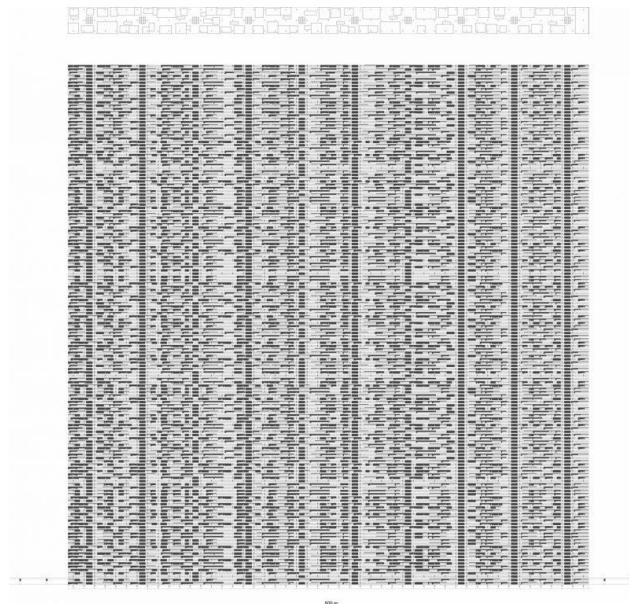


Figure 3.22. . DOGMA, Stop City elevation, 2007 (Source: Socks Studio, 2019)

The last project to be examined in this chapter of the thesis is DOGMA's 'A Simple Heart' (2009) project. Among the projects examined, it is the most contemporary one and has a strong discourse on the notion of scale. The influence of the works of Koolhaas and Ungers are clearly traced in the project. The main objective of the project is to introduce an idea of the city based on architecture. They want to criticize that the modern city is merely the relationship between architectural and urban forms of different scales. In doing so, they emphasize the singular and finite space defined by the architectural form in the city. Indicating importance of the repetition of the architectural form to create the city but underlining that these repetitions do not have to be identical. So, a generative principle can define an environment of possible forms (Aureli, Tattara, 2011).

Based on all these discourses, DOGMA's project proposes twenty-two units in eleven different locations. These locations are Amsterdam, The Hague, Delft, Rotterdam, Antwerp, Brussels, Liege, Cologne, Dusseldorf, Aachen and Utrecht. However, the units are not located in the city center but in the proximity of these cities near the railway network. In this project, the definition of a unit is used as the basic unit of a whole like previous examined projects but in a different scale. This is due to the main purpose of the project. In previous projects, the unit definition was used for singular and finite architectural forms which controls the notion of scale. This time the unit also defines a singular and finite form but this time it is a single unit in city scale. The unit is a wall defining a closed area of 800m x 800m. This wall is twenty-five meters thick and twenty floors high. It accommodates eight hundred and sixty rooms and each room allow one or two people to stay. The area defined by the unit is covered with a transparent roof and this roof is carried by a 10m x 10m grid structural system. The whole system is called 'Edufactory' and it is a university campus enlarged to the scale of an urban region. In the selected locations for the project the knowledge and social exchange is explicit. Using the notion of scale, this design stands against the fragmentation created by the contemporary urbanization with the framing and defining power of form (Aureli, Tattara, 2011). As it can be understood from the definition

and design of the project, 'A Simple Heart' project, based on the information it received from its precedents, examines the relations between architecture and urban design after that forms a contemporary discourse on the notion of scale. In addition, it clearly demonstrates the common elements, design strategies and tactics used in projects that handle the notion of scale.



Figure 3.23. DOGMA, A Simple Heart I, 2011 (Source: Aureli and Tattara, 2011)

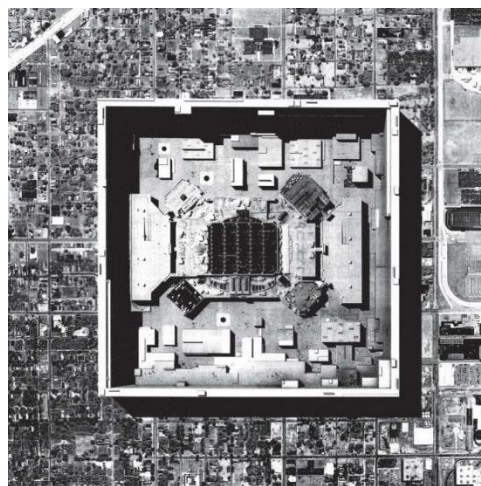


Figure 3.24. DOGMA, A Simple Heart II, 2011 (Source: Aureli and Tattara, 2011)



Figure 3.25. DOGMA, A Simple Heart III, 2011 (Source: Aureli and Tattara, 2011)

As it can be understood from the projects examined in this chapter, urban design projects where the limits of the notion of scale are enforced have been continuously influenced by each other as design methods and academic discourses in the historical process. This situation has caused similarities and repetitions about using the notion of scale in design process. These similarities and repetitions sometimes show themselves as elements used in design and sometimes in strategic and tactical decisions in design. In order to understand the place of the notion of scale in spatial design thinking, it will be beneficial to reveal these similarities and repetitions. In the following chapter, the similarities and repetitions in this historical context will be revealed by examining more projects designed in different contexts by different designers on the notion of scale.

CHAPTER 4

SCALAR THINKING IN URBAN DESIGN: A *COMPARATIVE DESIGN ANALYSIS*

Design is a process of making strategic and tactical decisions. To understand the importance of scalar thinking in urban design is related to these strategic and tactical decisions, there is a need to analyze several projects and identify the **elements** designers use to conduct a form related to scalar thinking. After revealing the elements suitable for scalar thinking which emerged in the historical process of urban design, actions should be classified to conduct a comparative design analysis. Determining relevant **operations** introduced in projects will enable this classification. Operations are specified by analyzing the projects by applying a classification on the strategic and tactical actions involved. These operations revealed will present themselves as the outcomes of the comparative design analysis related to scalar thinking.

There are many projects that examined or were concerned about the notion of scale other than this thesis analyses. However, the projects selected within the scope of this comparative design analysis include projects which are produced by well-known designers who were sensitive to the developing design trends and their effects at that time.

4.1. Grains in Frames

All of the projects that the notion of scale is used in have been directly or indirectly influenced by each other, starting from the 20th Century. From the conscious to unconscious communication between these projects, similarities and common properties arose. Since design is a process of making strategic and tactical decisions, these similarities and common properties are largely reflected in the actions of design. The strategies and tactics are focused around some certain elements and operations. These elements and operations make these strategies and tactics syntactically clearer

and more analytical. The notion of scale, in the design process, creates certain complexity. Each project used at least one of these elements and operations in correlation with each other to control and maintain this complexity. Delineating the titles as elements and operations for the analytical process can be seen as a preliminary step to understand the notion of scale in spatial design thinking. In addition to that, making this distinction allows the terms to be used as tools to analyze how different combination of elements and operations were used in projects.

The discussion on the notion of scale is generally based on the control of the design process and complexity within a given frame. All the projects discussed related to scale have used some similar basic elements to achieve this control. Particularly in urban design, the frame laid down by the scale cannot be solved only within the frame of the same scale. Recently, Campbell's (2018) discourse related to the importance of '*making massive small changes*' in urban design shows that grains within the frame are important components of solution for a design problem. All the projects discussed related to this notion have used some similar basic grains as elements to achieve this control. Each of the elements mentioned in this section are identified by the definitions of the designers on their projects or by analyzes carried out by the researchers. The analysis of these images, drawings, models and diagrams have been made considering the comments and critics of the designers or architectural theorists of these projects. Especially the projects and academic studies of Reyner Banham, Alena Yaneva, Rem Koolhaas, Pier Vittorio Aureli and Jon Lang, as the conference papers and books from different authors examining the notion of scale played an important role in determining these elements.

4.1.1. Unit

Unit is the most basic element of the discussion related to the notion of scale. Since the notion of scale basically consists of understanding a number of magnitudes and representing them in an abstract, meaningful and informative way, the unit can be considered as the basis of this discussion. Unit is an important element to maintain

and control the level of complexity in the projects where the notion of scale is probed, by its strong relationship with the notion¹⁰. Unit as a spatial term represents itself as the smallest aspect of the design. Because of its quality it does not make sense to use this element singular, like a single brick. Therefore, it can be used effectively with other design elements such as grid, block and stem and it forms the cluster. Therefore, it is very suitable for many projects and it is more widely used than other design elements.

Unit was used as the smallest control mechanism of the whole. The projects that include unit are distributed to all time intervals examined. It is not found by some designer or a design group, and it is not used in a specific period. It is possible to see this unit whenever the notion of scale issue is involved in the design world.

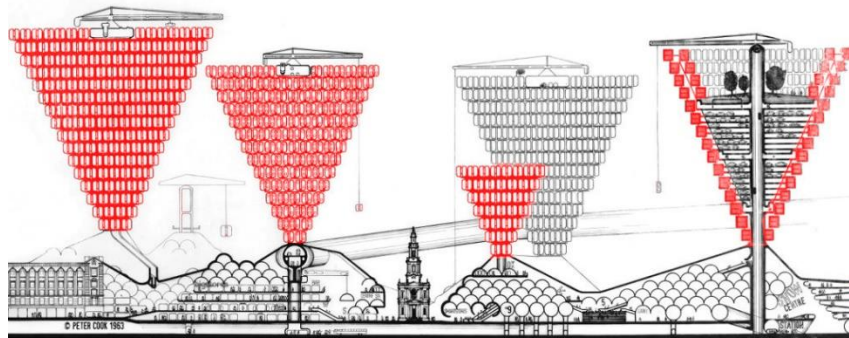


Figure 4.1. Peter Cook, Plug-in City, 1964 (Source: Archdaily, 2019)

4.1.2. Cluster

Cluster is the set of units. Cluster in its dictionary definition is “a number of things of same kind, growing or held together, a bunch of something”(Dictionary, 2019). Although the cluster is formed by units, it is important to differentiate them as two

¹⁰ Developments of the today's technological world also increased its importance; the whole digital production process has become dependent on the concept of the unit since the digital media works with it. Naturally, the intensive use of digital media in the field of design, the concept of unit has become a major part of the design process apart from its previous usage.

specific aspects. What cluster refers to in design proposals can be different from unit. What is more, in some cases cluster acts like a unit and design actions are applied according to that.

The number of selected projects that specifically use the cluster rather than other elements is fewer. However, in some projects using cluster, instead of unit, as an element becomes important for operational analysis of the projects. Therefore, although it is used as an element in a small number of projects, it is important for understanding the scalar operations emerged in the case studies.

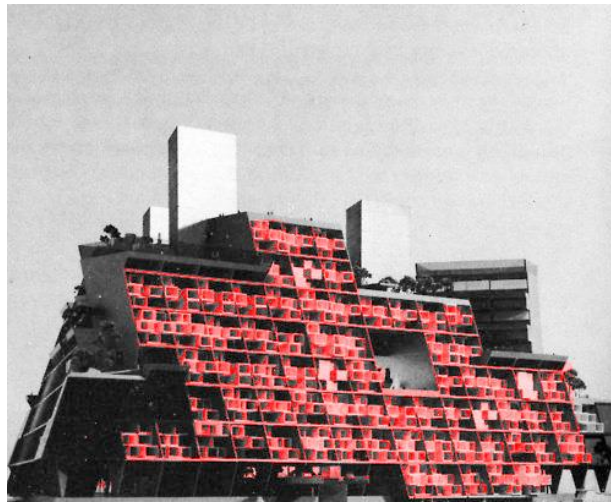


Figure 4.2. Buckminster Fuller, Triton City Project, 1968

4.1.3. Grid

Grid is another commonly used element in design related to the notion of scale. Basically, it is the network of uniformly spaced, horizontal and perpendicular lines (Dictionary, 2019). Grid is generally used as the base frame that creates the spatial references, as in the selected projects. Generally, in the urban projects, grid proposes an ideal infrastructure or a structure with economic and repetitive spaces. This is due to the capacity of the element to define an infinite space that can be generated

endlessly. It is the element that provides the control of the relationship between frame and the other elements in the design. It usually works together with other elements because the base it provides an efficient environment for the implementation of other design elements, most commonly unit element. The reason for that grid defines uniformed spaces that can be filled with units.

This collaboration between grid and unit effected the number of the grid in the case studies. It is not an element that emerged or became popular in a certain time period. However, there are popular projects where the grid is used, such as Suprestudio's 'Continous Monument', Archizoom's 'No-Stop City' or as a more recent example DOGMA's 'Fields of Wall'.

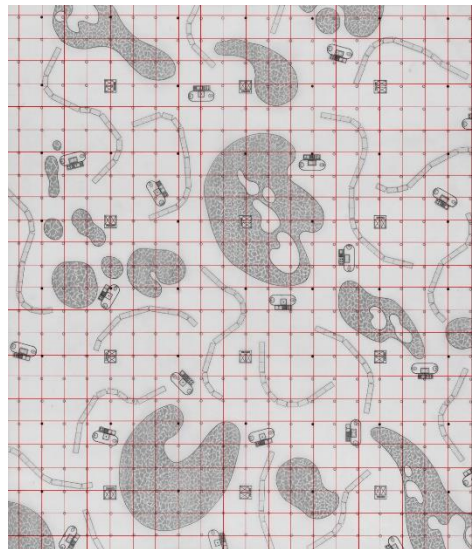


Figure 4.3. Archizoom, No-stop City, 1970 (Source: MOMA, 2019)

4.1.4. Block

Block is a commonly used term in architecture and urban design. Block is generally used for defining mass housing units. Actually, the spatial terminology of block is not

far from this meaning. The dictionary defines block as ‘a solid mass’¹¹ this aspect of the term implies its strong spatial quality. So, block as a spatial term is defined as a strong and definite limit. What is more, it offers possibility of an autonomous space within the solid frame it defines. The relation of block with the discussion related to the autonomous space gained importance with the work and discourses of Ungers and Koolhaas in the 1970s. Within this scope, the notion of block represents a basic shape with a definitive outer frame that offers different spatial possibilities within.

The term block was used as a control tool of scale. The block was mostly used in the urban projects of Team 10 members and in the contemporary projects of Rem Koolhaas and DOGMA for the autonomous space quality it offers within its frame.

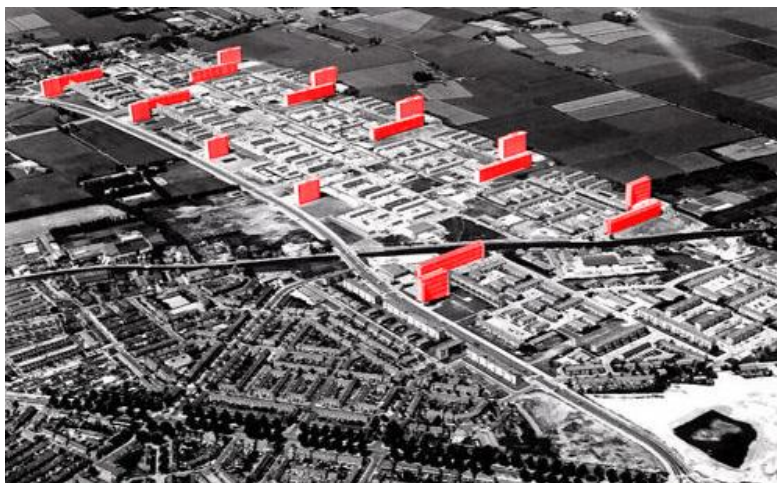


Figure 4.4. Van den Broek and Bakema, Leeuwarden Noord, 1959 (Source: Risselada, 2005)

4.1.5. Platform

Platform as an element, find its place in scalar thinking similar to the block. As block implies a limited frame, platform also defines a limited frame, but on a horizontal plane. In the selected projects, platform can define itself as a horizontal surface or

¹¹ (n.d.). Block. Retrieved from <https://www.dictionary.com/browse/block?s=t>

structure, and in some cases, it can be both. Unlike grid, platform does not have to have uniformly spaced intervals, gaps or lines. Platform offers an autonomous space within the frame it defines. Platform is suitable for working with other design elements and as it is particularly working in the horizontal plane, it is frequently used with the stem element.

Although it was also used in the projects before the 1960's, the first projects that implied a spatial definition were Team 10's 'Berlin Free University' (1963) and 'Frankfurt Römerberg Competition' (1963) projects. After Team 10, with the work and discourses of Ungers and Koolhaas in the 1970s, platform became an important part of the autonomous space discussion together with the block. Its scale wise definition has come to the fore later than other elements. Therefore, it is used only in 16 projects that are examined.



Figure 4.5. Kisho Kurokawa, Agricultural City, 1961 (Source: Kasahara, Matsushita, Mizutani, 2018)

4.1.6. Stem

Stem is a term that mentioned with Team 10, especially with the projects of Candilis-Josic-Woods. Although the term was also visible in other projects before Team 10, the trials of the spatial quality of the term came to the fore during 1930s with the works of Le Corbusier. Originally stem is ‘the ascending axis of the plants’ generally used to define branches of a plant¹². It forms the infrastructure that provides the distribution of the basic needs of the plant. This biological function of the stem represents itself as an analogy in the projects related to the notion of scale. In architectural and urban design projects, it serves as a space for mobility and service infrastructure. It is the spatial equivalent of the solid relationship between scale and mobility.

Stem was used as a communication element that deals with the notion of scale. As mentioned, it was mostly seen in the Team 10 projects and in other projects such as Unger’s “Grünzug Süd Competition” project that was designed in 1960s. The enthusiasm of the design community towards mobilization in 1960s was the reason why this notion was used extensively in that period.

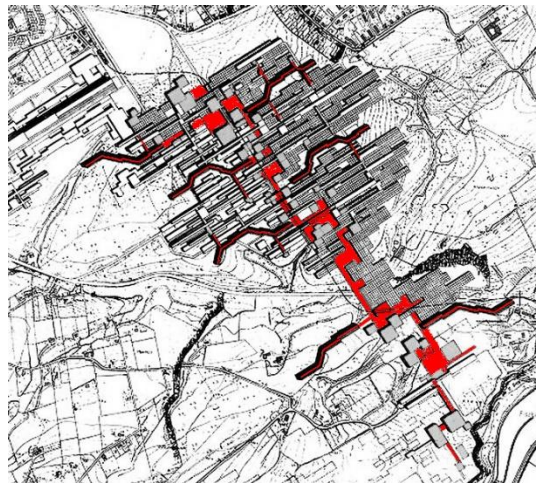


Figure 4.6. Candilis-Josic-Woods, University of Bochum Competition, 1962 (Source: Avermaete, 2005)

¹² (n.d.). Stem. Retrieved from <https://www.dictionary.com/browse/stem?s=t>

4.2. Scalar Elements

Urban design problems can manifest themselves at various scales. In order to understand the relationship between the notion and spatial thinking, different scales have been observed in the projects examined. However, the elements used in the projects are similar. This similarity provides a common ground and insight about how designers solve different frame and grain relationships with the help of the same elements. Of course, many elements have been used in the projects examined, but the selected elements are the ones that establish the relationship between scale and spatial thinking. In addition, these elements show different grain properties. This quality of the elements are important for this research so this was also a reason for their selection. The elements emerge from the discussed projects which meet all the criteria are; block, stem, unit, grid, platform and cluster.

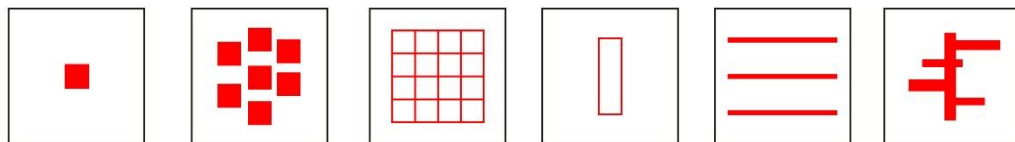


Figure 4.7. Element icons, Unit, Cluster, Grid, Block, Platform, Stem

4.3. Act of Scale

Emphasizing the relevance of the design process with strategy and tactics is crucial for this study. This emphasis is the necessary infrastructure for the implementation of the scalar operations which emerge through the strategical and tactical decisions. As far as it goes, all design and production processes involve several strategic and tactical decisions and a design process centering upon the notion of scale is no different from the general understanding of the design process.

Michel de Certeau's 1980 dated article called 'The Practice of Everyday Life' defines "strategy" and "tactic" as a spatial terminology. This study will be based De Certeau's way of defining and differentiating these two terms. De Certeau (1980) defines strategy as *'the calculation or manipulation of power relationships which that becomes possible as soon as a subject with will and power can be isolated.'* (De Certeau, 1980, p.36) He argues that the term strategy constitutes a certain spatial limitation or a frame and it forms the basis of the relations with external factors within these limits. So, each strategic decision is an action of distinguishing the power of a space within a frame. The strategic decisions provide an environment for frames of different sizes that may be needed over time for different tactical decisions. This situation gives each frame its own independence. A space with limits, provides observed and measured control over design with the antecedent knowledge it creates (De Certeau, 1980, p.36).

Based on De Certeau's (1980) discourse related to strategy, the notion of scale brings a problem of bigness along when it is involved in a design process. The strategy becomes defining the frame or limit that should be controlled independently. Bigness becomes the 'power' in De Certeau's(1980) definition of strategy. The effort to control this power becomes the task of the notion of scale. For this reason, other strategic decisions cannot come to the forefront when identifying scalar operations.

Tactical decisions take a critical position in design related to the notion of scale, as the strategy has a strong and supreme impact. De Certeau (1980) defines tactic as *'a calculated action determined by the absence of a proper locus'* (De Certeau, 1980, p.36). In contrast to strategy, tactics do not have limits since they are complementary decisions. This limitless situation provides control of the design since tactical decisions are the sub-sets of strategic decisions. Tactics are isolated, precise and detailed actions within the frame defined by the strategy.

De Certeau's strategy and tactic definitions are mainly based on Carl von Clausewitz who was a Prussian general and military theorist. The book 'On War' (1832), Clausewitz (1832) calls tactics as the "art of the weak ". This definition is important

for design related to the notion of scale. In fact, the person who conducts the design action falls into a weak position under the power of the notion of scale and the problem of bigness it brings. The designer needs tactics to control the notion of scale and conduct the design. In other words, it should turn the strategic decisions brought by the notion of scale into tactics. Therefore, scalar operations are a kind of tactics to legitimize and control the strategic decisions brought by the notion of scale or by other thematic considerations involved.

As a result of the relationship between design thinking and the notion of scale within the idea of the strategy and tactics, definition of the scalar operations is necessary. The infrastructure required to extract the scalar operations was formed by the scalar elements listed as unit, cluster, grid, block, platform and stem. The analysis of how these scalar elements were used to control strategic frames identified in the selected projects will reveal the scalar operations that were sought.

4.3.1. Multiplication

Multiplication is an action based on “making many” or “increasing the quantity”¹³. The basic scalar element “unit” is commonly and effectively used with multiplication. Therefore, with this scalar operation, it is easy to control the frame determined by the notion of scale. Unit can be designed in smaller frames and it makes multiplication an effective application to solve the problem of bigness. Through this relationship, multiplication is used in every project where unit is used.

Multiplication can be traced in different scales according to the function of the projects. In some cases, it can be seen as a repetition of a structural element, such as ‘Festival Plaza’ (1970) project of Kenzo Tange or in some cases it can be seen as the placement of a defined block element one after another, like the multiplication of the residential blocks in Reginald Malcolmson’s ‘Metro Linear City’ (1957) project.

¹³ (n.d.). Multiplication. Retrieved from <https://www.dictionary.com/browse/multiplication?s=t>

Although this operation can be seen in many projects with different functions it is mostly derived from the residential projects. Each of the houses can be accepted as a unit in the design process and multiplication on different axes within the specified frame will create the control over the notion of scale. After the Second World War, a housing crisis emerged especially in Europe. During those years, in many of the projects that were designed to overcome this problem, the power of multiplication was used. The most well-known example of that is Le Corbusier's 'Unité d'Habitation' structure in Marseille, dated 1952. This project uses the easy relationship between unit and multiplication to create a form which can accommodate a huge number of people.

Multiplication manifested in many projects in different historical contexts. 'Unité d'Habitation' was not the first project of Le Corbusier where he tested the relationship of the unit and multiplication operation. With his previous project called "Fort L'empereur" (1931) he tried to create and control the same bigness. This project is also considered as the precedent of the projects dealing with the notion of scale. Multiplication is the most commonly used scalar operation in the analyzed projects.

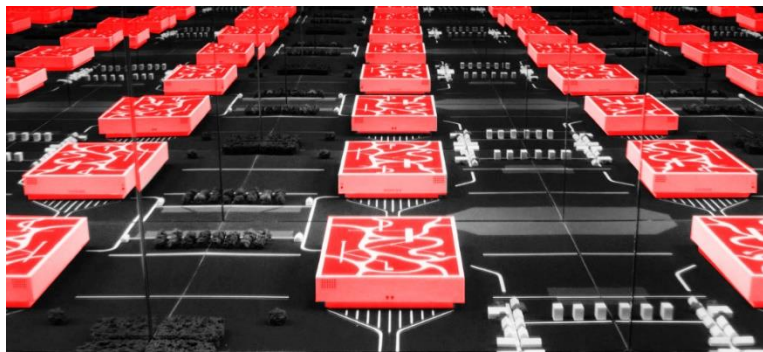


Figure 4.8. Archizoom, No-Stop City, 1966 (Source: UTS interior spatial design,2019)

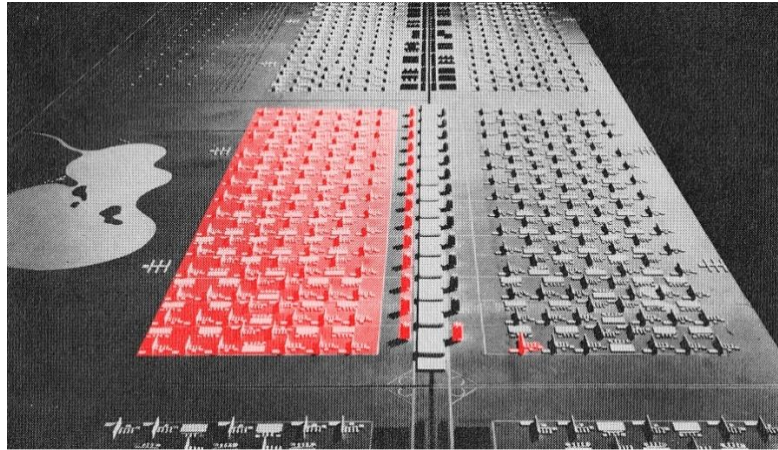


Figure 4.9. Reginald Malcolmson, Metro Linear City, 1957

4.3.2. Stretching

Stretching can basically be perceived as the extension of an object on a single axis. The ability to extend an object on a single axis up to a certain limit or without any limit reveals itself as a valuable operation in the discussion of the notion of scale. This operation has emerged to provide the mobilization within the frame brought by the notion of scale and to establish the relations between the unit, block and cluster.

Stretching can be examined since the projects of visionary architects of Renaissance, for example Boulees's 'Palais d'Assemblée Nationale', the most effective and consistent projects related with this scalar operation are, urban design projects designed by Team X members in 1960s. When Team 10 introduced the stem element, their main purpose was to control circulation and mobilization throughout the design effectively. In order to provide that they extended the spaces on an axis; in other words, they used Stretching as a scalar operation. The projects that best illustrate the use of this operation are Candilis-Josic-Woods' proposal for "Bochum University Competition" (1962) and Van den Broek and Bakeman's proposal for the same "Bochum University Competition" (1962), and Candilis-Josic-Woods's 'Vallee de Belleville Winter Resort' (1962) project. In these three projects, the stem element was Stretched on the axis as required to connect the spaces.

In some other cases, Stretching was used with grid, like in ‘Grünzug Süd Competition’ proposal of Ungers’ in 1965. These types of examples are less in number than the examples that use Stretching together with stem element. Nevertheless, there are some conceptual projects, which pushed the limits of this scalar operation, and a very important example is Alan Boutwell and Mike Michell’s ‘Comprehensive City’ (1969) project. The project is mainly a Stretched structure which contains a city from the east to the west of the continent of North America. This shows how Stretching can be an operational counterpart of the emphasis on mobilization in projects centering the notion of scale.

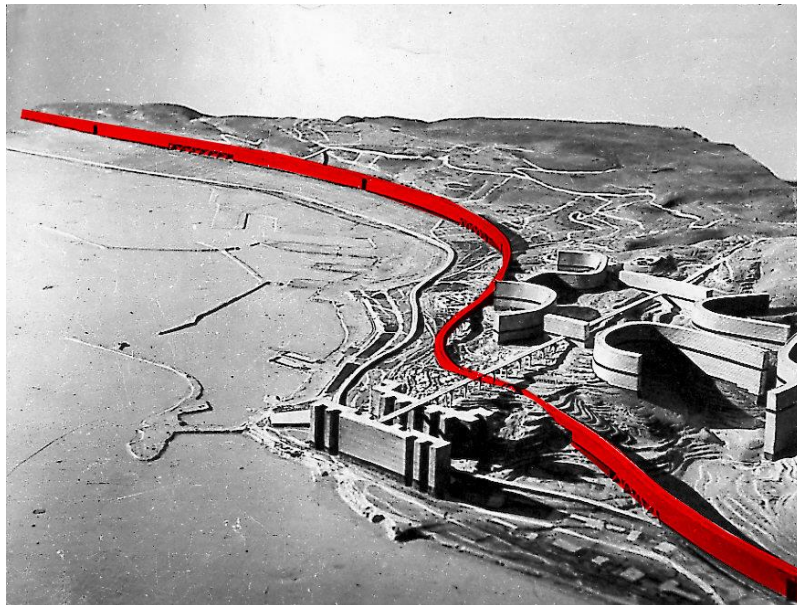


Figure 4.10. Corbusier's Fort L'Empereur (Source: Foundation Le Corbusier, 2019)

4.3.3. Re-size

Re-size is an operation basically about changing all dimensions of an object, surface or space at the same ratio. It can be considered as a basic operation, just like multiplication, in projects where the notion of scale stands out. The reason is, the

visionary architects of the Renaissance, which are regarded as the precedents of this concept, used this operation strongly to emphasize the effect of monumentality.

Re-size operation is visible in 18 of the selected projects, generally in utopian or dystopic projects that express an idea in a monumental way. Etienne-Louis Boullée's 'Newton Memorial' (1784) is a good example of this operation and it also includes monumentality. The out-of-human-scale space created by Boullée by re-sizing a sphere highlights the monumental and impressive effect aimed for the tomb of Newton, and this can be traced especially in Boullée's section drawing.

Most of the re-size operation related projects are paper architecture, but there is a crucial example in which this operation is applied and constructed: 'Continuous Monument' (1969) by Super Studio. The project can be abstracted as a multiplication of a grid structure by re-size. The project is so big that it can cover an entire city. Another reason for using re-size operation in this project is the discourse it produces thanks to its extreme dimensions.

In contemporary design world, re-size operation forms the basis of the use of scale notion. In a design process, looking at a design idea in different scales is the application of resize operation to a specific frame. Although it is such a basic operation, enlarging an entire space at the same ratio makes the control of the design difficult in urban scale and it creates compeller structural problems. For this reason, this operation has not been used as often as other operations such as multiplication or Stretching

As a result, re-size is one of the first operations that come to mind related to the notion of scale. Although it is not constantly used in projects, it is an operation that has emerged as a reference action to understand the relationship between frame and scalar elements.



Figure 4.11. Superstudio, Continuous Monument, 1969 (Source: Archdaily, 2019)

4.3.4. Superimposition

Superimposition is less used as a tactical action than other operations. However, this is not because the impact of this operation on the projects is low or ineffective. On the contrary, this is due to the fact that the operation comes with big and compelling tactical decisions for the frame of the design. Superimposition, as the definition, is used in the production area, refers to print or place a form over another so that both can act or be seen at once.

Similar to the Stretching, superimposition also came to the forefront with Team 10 projects, especially with Candilis-Josic-Woods 'Frankfurt Römerberg' (1963) and 'Berlin Free University' (1963) projects. These two projects are successive projects with similar design strategies and tactics. It should be also mentioned that, these projects are inspired from Kisho Kurokawa's 'Agricultural City' (1960) project, which was the first project that this operation came to the fore. Superimposition operation emerged in these projects with the use of grid and platform elements. At the same time, the presence of these elements is the reason for this operation to bring compelling and big tactical actions. Kurokawa's project, which can be considered as a scale-based trial, is designed as a master plan. The project consists of a large platform

and a structural system that is constructed over the agricultural land, using a 100-meter to 100-meter grid. Kurokawa designs the project by superimposing the earth surface, the circulation provided by the platform and the structural system.

Kurokawa's project would be the reference of the so-called "mat-building" projects, which were later to be built by Team X members. Candilis-Josic-Woods' project 'Berlin Free University', designed by using superimposition operation and is also one of the mat-buildings. Similar to 'Agricultural City' project, 'Berlin Free University' is also designed by superimpositioned platforms with different functions. When four different grid-based platforms including the structural system, open-close space organization, circulation and mass elements containing the functions are superimpositioned, the final form of the structure is created. Superimposition operation is used to control the design frame of 'Berlin Free University'.

Superimposition operation is often used with Division and resize operations due to the problem of bigness it brings. In the projects mentioned, Division operation is actively used to control different spatial frames during the design process. Superimposition is a very useful operation for absorbing the strategic decisions brought by the notion of scale and turning them into the tactical operation. The reason for that is, the autonomous spaces created by other operations that are examined to control the notion of scale, can relate to each other through superimposition.



Figure 4.12. Superimposed Platforms of the Berlin Free University, Candilis-Josic-Woods, 1963

4.3.5. Division

Division is relatively a more contemporary one among the other operations that were mentioned. The reason is the fact that projects like ‘Berlin as Green Archipelago’, ‘Exodus’, ‘A Simple Heart’ which put forward the discussion of the boundary

condition of spaces and the state of autonomy created by this limitation, are relatively more up to date.

The fact that the operation has been used more in current projects does not mean that this operation was not valid in the historical process of scale based urban projects. Division basically refers to the act of separating or splitting a whole. Therefore, Division solves the problem of bigness by dividing the frame that was brought by the notion of scale into more controlled sub-frames. This enables Division to manifest itself in various projects from different periods.

Although it is used less than other operations, the academic and intellectual discussion that Division brings, produces more discourse related to the notion of scale. There are few selected projects which used this operation, but there are more of them that contributed to the theory of architecture and urban design. Oswald Mathias Ungers, Rem Koolhaas and Pier Vittorio Aureli, who are the designers of the mentioned projects, used Division in their design and produced academic works related to these designs. Koolhaas' 'Delirious New York' (1978) and Aureli's 'The Possibility of an Absolute Architecture' (2011) are strong examples for understanding the academic discourse that this operation produced. Of course, the discussions mentioned in these academic works are not developed only through this operation, but the effect of Koolhaas' argument on the spatial divisive feature of the Berlin wall in his "Exodus" (1972) project cannot be underestimated. In short, Division directly provides the control over the frame in projects related to the notion of scale.



Figure 4.13. Rem Koolhaas, Exodus, 1972 (Source: Koolhaas, 1994)

4.3.6. Plug-in and Clip

Plug-in and clip-on can be examined as the tactical relationship operated in the same genre, syntactically. The other spatial operations examined are revealed by the analysis of the applied design tactics with the use of spatial elements, from the selected projects. Plug-in and clip-on operations also reveal themselves as design tactics, but different than the other operations, they also emerge from the third definition of megastructure in Ralph Wilcoxon's 'Megastructure Bibliography' (1968): *'a structural framework into which smaller structural units can be built-or even 'plugged-in' or 'clipped-on' after having been prefabricated elsewhere'*. For this reason, they are widely used in projects designed based on the notion of scale.

Although these two operations are very similar to each other, there are differences that affect the design process related to the action they direct. The plug-in indicates more of an insertion action while the clip-on indicates more of an attaching action.

Insertion and attaching actions as their definition suggests, usually emerged with unit and multiplication operation in the projects. For this reason, they were generally used in housing projects and in 1960s utopian projects that pushed the limits of the notion of scale. As its name clearly suggests, the most famous project that revealed these operations is the 'Plug-in City' by Peter Cook from Archigram. This project suggests

an imaginary city with modular residential units which are plugged-in to a mega machine containing an infrastructure. The project creates a base for the evolving megastructure that blends residences, transportation and all other services with units which can constantly change. It offers a collective and alternative urban scenario with operations plug-in and clip-on and also contributes to the relation between the notion of scale and mobilization (Merin, 2013)

Although there were many projects in which these operations were used before, this avant-garde project by Peter Cook greatly affected the use of these two operations in many realized projects, not only with the tactical operations they offer but also with the advantage they create during the construction process. For example, Georg Heinirch's 'Autobahnüberbauung Schlangenhader' (1971) project in Berlin represents the ideology of the 'Plug-in City' with the mobilization element it contains and the connection of many houses to a linear infrastructure.

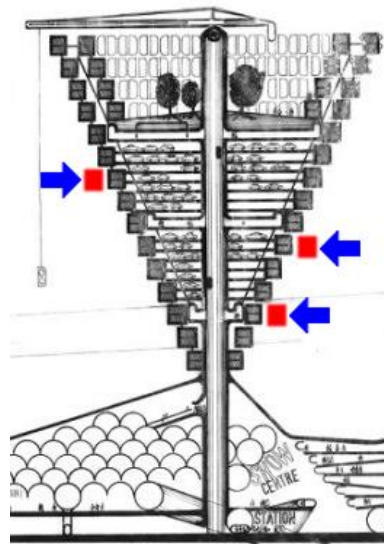


Figure 4.14. Peter Cook, Plug-in City, 1964 (Source: Archdaily, 2019)

4.4. Concluding Remarks

Designers are using multiple frames brought by different scales and try to find answers to design problems by establishing relationship between them. Different frames provide information about the same context at different levels of abstraction. These levels of abstraction change the grain relations of each scale. As the elements used in different frame and grain relations are similar, the strategic decision coming from the scale selection shows operational similarity while transforming to tactics. The projects examined revealed this similarity between the mentioned operations. These operations are multiplication, stretch, re-size, superimposition, divide, plug-in and clip-on.

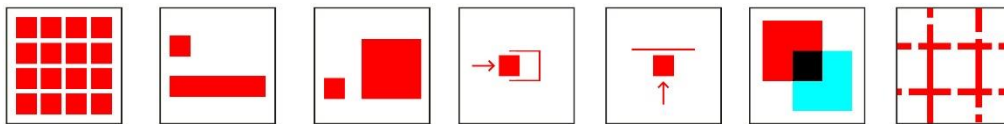


Figure 4.15. Operation icons, Multiplication, Stretching, Re-size, Plug-in, Clip-on, Superimposition, Division

These operations have been used mainly to understand frame and grain relationships of all levels of abstraction and to produce design. They have been useful for understanding the relationship between architecture and urban design, and for producing discourses related to design. They are used in all projects examined in the context of this research and each operation strongly contributed to the formal and spatial quality of projects. Their role in understanding the scalar problems allowed designers to divide major design problems into tactical decisions.

The introduction of the scalar elements and operations constitutes a suitable base for the studies to be conducted on scale. In particular, to compare the formal and spatial characteristics between projects that already have their own discourse. Different combinations of these elements and operations will provide different scalar experiences. Spatial and formal characteristics of these experiences can be compared

with the projects that may be the precedents of these experiences and they can be pushed to produce new discourses.

These elements and operations are notions that will help to understand and learn. For designers who need work in a different context and scale than they are accustomed to, these notions become robust testing tools to understand the fundamental scaling problems. Taking these elements and operations as a basis will facilitate communication between designers working at different scales. For new design students who are not familiar with the notion of scale, these concepts will be helpful for them understand how to behave at different levels of abstract information.

As a result, the elements and operations developed to understand the strong relationship of scale with design contribute to spatial design thinking in urban design. They can be used to understand and create different spatial and formal experiences. In addition to the scalar elements and operations in the projects examined, different sets of projects may introduce new elements and operations that can be added to them. In fact, it is not possible to discuss the whole discussion related to the notion of scale solely on the mentioned elements and operations. The projects examined include projects aimed at understanding the relationship between architecture and urban design in a certain period and within the limits of a certain scale. Therefore, it is necessary to look at the elements and operations in this context.

CHAPTER 5

CONCLUSION

The main purpose of this research is to understand the notion of scale and its relationship with spatial design thinking. This issue was examined from different perspectives of various production methods and design practice. These investigations revealed that scale had a major impact in the design environment and it is getting stronger. Specifically, in urban design, scale has often been used not only as a tool for space production, but also to introduce ideas and create a discourse related to the context of design practice. This quality of scale allowed the notion to take a strong stand in spatial design thinking. As a result, this study was attempting to concretize this connection between scale and spatial design thinking.

The development in technology, the change in production methods and the innovation in design media have accelerated the process of designing and consequently changed the meaning and use of the notion. In the earlier days, this relation of design and context was limited because the information flow between them was slow and difficult, so the notion of scale was only used for establishing basic communication between design and the actual act of production. Now, since various technological developments occurred, acts of “zoom-in” and “zoom-out” allow an easy information flow between design and context in a controversial way. This greatly increased the role of scale in design activity. The scalar limits that the designer used to understand the relationship between context and design have disappeared.

Contemporary design methods emphasized the use of scale in spatial design thinking, especially in urban design. The notion has become hugely effective and powerful with many experimental and radical trials in the urban context with different groups of designers. This research is specifically focused in and after modernism era, where the limits of scale had been consciously pushed. All these projects and the changing

methods of production showed that the notion had an influence and impact on design, production and spatial thinking.

As a term, scale shows itself not only in design practice but in many different fields in different contexts. Therefore, in order to understand the impact of the notion in spatial design thinking, looking at its different meanings and different effects in various fields has created a more solid basis for the research. The reason is, scale provides a continuous connection in etymological context, different production areas and design practice. Scale is essentially a tool for abstraction of complexly collected groups of information. Therefore, it manifests itself in different areas. Although these information groups differ in every field, the basic function of the notion has not changed.

The first output of this study is the etymological research of scale. The reason for this is all basic information about the notion comes mainly from its etymological development. In order to achieve this, the research on the development and meaning of scale has been put forward from two different language families. As a result, the first step of the relationship between different production areas and design practice on scale was formed.

Scale has various meanings and different identities, which can be interpreted as a notion, a term or a theme, from various fields. Many of these fields are intertwined with production and its process, and they have their own definition for scale. The first field in this context is natural sciences. The reason for this is the basic scientific relationship the notion establishes with mathematics and natural sciences. In addition, natural sciences constantly try to understand the complex information around us. Particularly in geography, physics and biology, scale contributes significantly as a notion. Approaching these areas from the context of scale allows designers to have initial ideas about the possibilities that the notion contains. In music, it is the scale that divides the pitches of notes at regular intervals, which creates an environment to control a complex group of sound and allows the musician to create the musical pieces.

Scale in music, similar to its spatial definition, allows the composer to determine his/her own context and draw boundaries in an infinite situation. The notion acts similarly but creates a different production environment in cinema. In cinema, the basic element of the production is the frames of scenes. Each frame in cinema is designed one by one, so each can be used to create a different perception by the director. In contrast to other fields, scale is a tool to produce this complex group of information which is the movie.

Although the discussion on scale and politics is different from other fields, it is one of the major contributors to this thesis in terms of its connection to spatial design thinking and changing perception from production to urbanization. In this part, the discussion is produced based on the important figures and discourses related to urbanization from ancient Greece to the present day. The concept of city is dealt with in an abstract way through the frame it defines and the grains in it. On this, the relationship between the frame and grain relations that have changed in the present day is examined with the notion of scale. Scale and politics provide a reference for understanding the projects and their relationship with the city which are examined in the following chapters. Also, the first discourses on the frame and grain relations that will serve to concretize the connection between scale and spatial design thinking emerges in this chapter.

It is important to understand and examine all these meanings and interpretations of scale in various fields, as it is not specific only to design process. Researching such a wide concept like this only in a design-oriented way would be overlooking the potential it contains. Therefore, the first part of the study examines the different meanings and uses of notion through some fields associated with process and production.

After understanding the basic knowledge related to scale from different perspectives, the effects of scale in design practice was examined in the next chapter. In addition to the fact that the scale scale being basically a tool for communication in design practice, its role in the professionalization in the fields of spatial design, its cognitive impact on

the designer in the design process and finally the urban projects that consider or use scale as a theme were mentioned.

Historically, in parallel with its etymological progress, scale has changed continuously in the practice of design. This change began with the notion being a means of communication between the designer and production. This role of scale formed the basis of the notion's importance in design practice. This foundation created the abstract knowledge that enabled professionalization. Together with architecture, different occupational groups involved in spatial design have started to professionalize with abstract knowledge, which are mainly separated related to the scalar differences. Of course, the abstract knowledge that led to this distinction was shared among all these fields of spatial design. This sharing and technological development enabled each designer to be aware of the information revealed through different scales. This enabled the designer to quickly acquire information of different scales at the same time. A designer working on a design problem started to control the problem based on different levels of abstraction. This feature of scale increased the cognitive knowledge gained by the designer. The group of cognitive knowledge gained by the designer has led to the emergence of the design by relating both context of the design and abstract knowledge from different scales.

Along with modernism, the world underwent radical changes in the ideas of spatial design thinking. Different design groups and conferences started to produce influential discourses related to space. Starting from the 1930's, the relationship between architecture and urban design was frequently discussed in CIAM conferences. The notion of scale has found a strong place in this discussion since it was one of the notions which connected them. Especially after CIAM, radical design groups such as Japanese Metabolists, TEAM 10, Archigram, Archizoom, and Super Studio have frequently used the power and impact of scale in their projects. The projects they put forward produced spatial discourses related to their natural, sociological and political context. Usage of the radical scalar decisions made by them produced discourses on the relationship between space and form. Along with the political developments in the

70s, the relationship between architecture and urban design started to be considered in a more political perspective after the 60s' radical groups, especially with the works of Ungers and Koolhaas. The notion also played an important role in the transmission of the idea presented by the design in these projects. When this discussion became more contemporary, the debate on scale was still political due to the effects of 70's. However, this discussion is not only about bigness, as the radical design groups' of the 60's was, but rather on small changes and compression quality of the space. Changes in the small frame of the scale and its impact on the bigger frame of urban design were discussed.

Understanding the place of the notion of scale in different production areas and design practice bring out the necessary knowledge to reveal the relationship between scale and spatial design thinking, which is the main objective of this research. Although these chapters constitute a basis for the research, it is not enough to concretize spatial design thinking through scale. So, in addition to that a case study group was formed from the projects that examined the interaction between architecture and urban design through radical scalar decisions. These projects were chosen from different designers in different contexts. All that was necessary to produce a series of scalar operations.

The frame and grain relationship, which was put forward in the previous chapters, is at the center of the discussion on scale. Particularly for understanding the impact of scale of form as a concrete result of spatial thinking. It is understood from the previous part of the research that one of the main tasks of the notion in a design problem is to determine the frame that the designer work in and tries to understand. Each changing scale helps the designer produce forms by putting a different frame and different level of abstraction. Of course, for these frames to be useful, the grain relations within these frames should also be understood. Scalar operations emerge in understanding and producing these grain relations.

The projects discussed within the scope of this research were designs in various scales. Scale differences between the projects produce different levels of abstract information

through their analysis. However, the grains used in these abstract levels were similar. Because of this similarity these grains were classified and presented as scalar elements.

The result of this study is presented as the scalar operations applied to the scalar elements. Scalar operations provide control over the frame set out by the scale itself. Like in scalar elements, scalar operations also showed similarities in different projects in different scales. The introduction of operations makes the relationship between spatial design thinking and the notion of scale more perceptible. Of course, these emerging operations are not necessarily the ones that should be used in a design centering the notion of scale. When examining these operations and elements, the case study group should be considered. After all, these are the scalar elements and operations of this project set. Still, it will be beneficial for the resulting product of a design act to examine the precedent projects in which these operations occurred and were used.

Scalar elements and operations are not limited to those produced in this research. Expansion of the projects examined may add new elements and operations. This condition will create different frame and grain relations and new discourses related to the notion. Another point is that, these operations and elements are useful in design production. They can be used to produce solutions to design problems. For this purpose, variations can be obtained by using different combinations of elements and operations related to the frame and grain relationship that comes with the scale of design. The activity of using scale as a cognitive tool will become faster and more productive.

The notion of scale has gained great importance with the changing design practice. It is not just a mathematical concept that provides communication and gives information about the design in certain proportions. In addition, scale is a notion that is actively involved in the design activity today. Therefore, this issue is open to further studies in many respects. As a continuation of this research, it is possible to design projects over

different frame and grain relationships with scalar elements and operations. Producing such a design product will reveal the results of this research more clearly and legitimize the outputs. Also, obtaining the opinions of different designers working in different scales related to the scalar operations and being involved in a design process in the context of this research will also justify the outputs.

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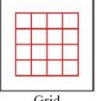
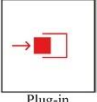


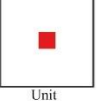
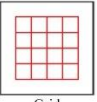

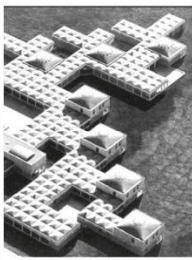
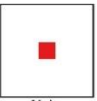
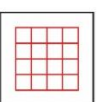

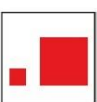

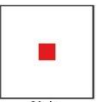


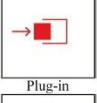
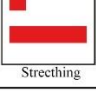
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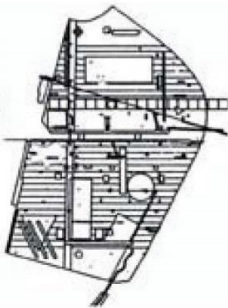


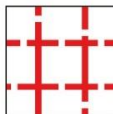



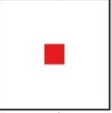
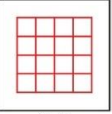
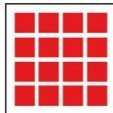
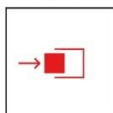
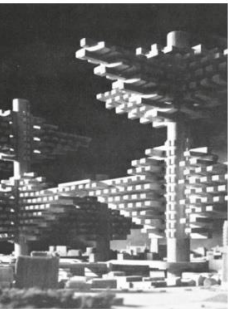
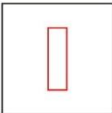


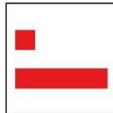
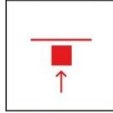
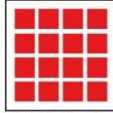
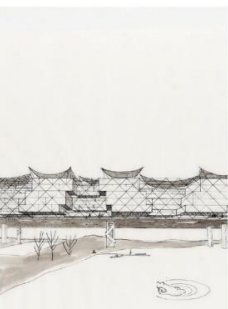

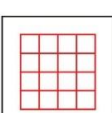
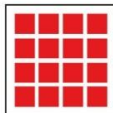
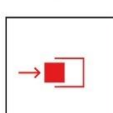
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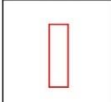
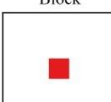
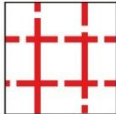

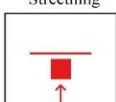


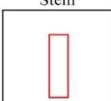
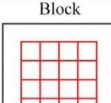


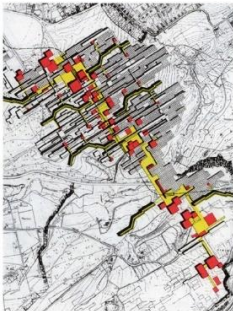

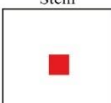
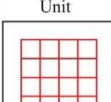

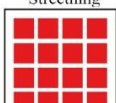
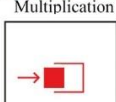


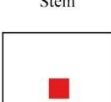

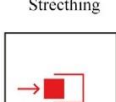
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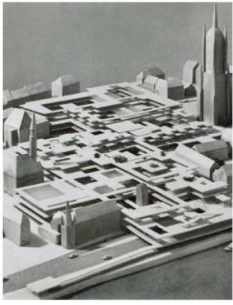


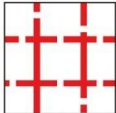



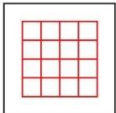
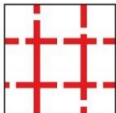


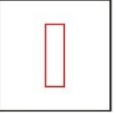
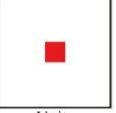
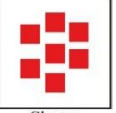


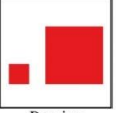
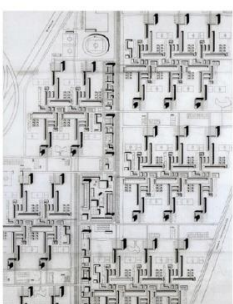
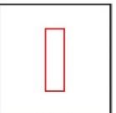
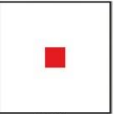

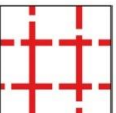

APPENDICES

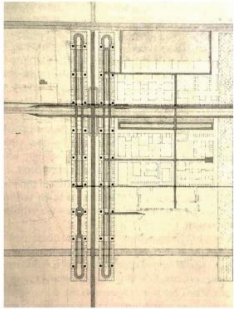
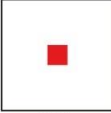
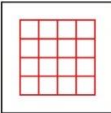

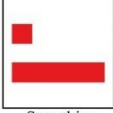
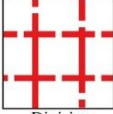


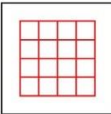

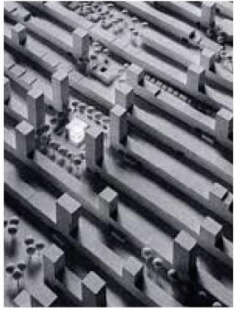
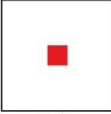
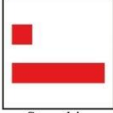

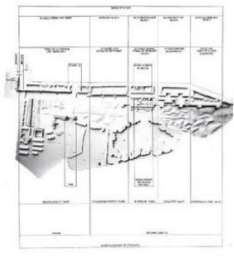

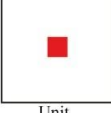
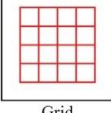
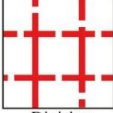

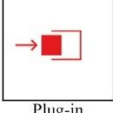
A. Inventory of Scholar Operations and Elements in Spatial Design

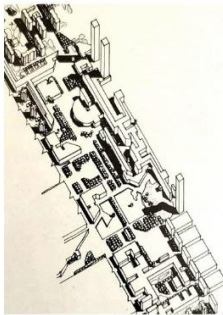
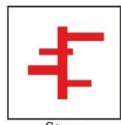
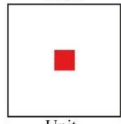
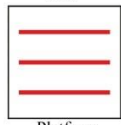
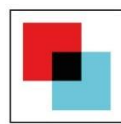
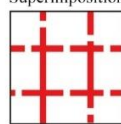
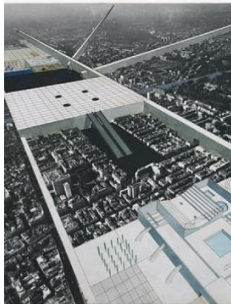
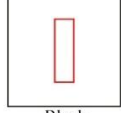
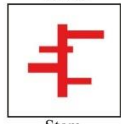
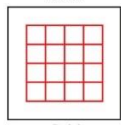
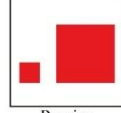
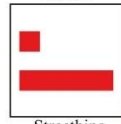
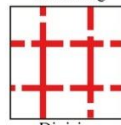

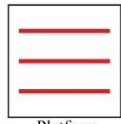
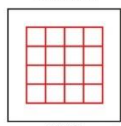
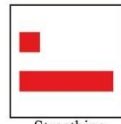
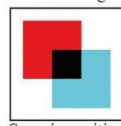
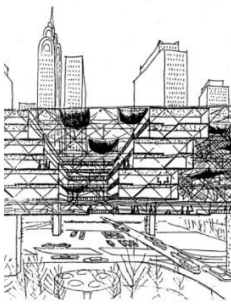
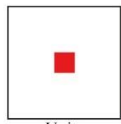
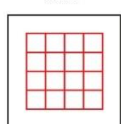

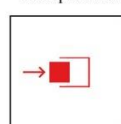
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 Kasbah Houses	1969	Piet Blom	 Unit  Grid	 Multiplication
 Amsterdam Orhanage	1960	Aldo van Eyck	 Unit  Grid	 Multiplication  Re-size
 Habitat Montreal	1967	Safdie, David, Barnott	 Unit  Cluster	 Multiplication  Plug-in  Strething



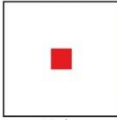




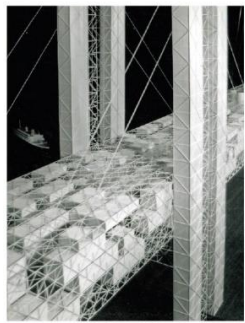
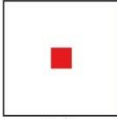
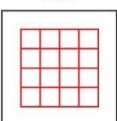

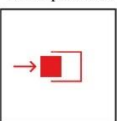
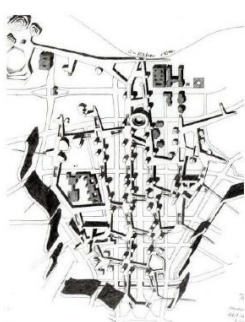




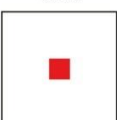

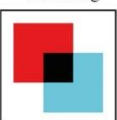
Project	Year	Author	Elements	Operation
 <p>Parc de La Villette</p>	1982	Rem Koolhaas / OMA	 <p>Platform</p>  <p>Stem</p>	 <p>Division</p>  <p>Superimposition</p>
 <p>Autobahnüberbauung Schlangenbader</p>	1971	Georg Heinirch	 <p>Stem</p>  <p>Unit</p>  <p>Grid</p>	 <p>Multiplication</p>  <p>Plug-in</p>
 <p>Clusters in the Air</p>	1963	Irata Isozaki	 <p>Block</p>  <p>Unit</p>  <p>Cluster</p>	 <p>Stretching</p>  <p>Clip-on</p>  <p>Multiplication</p>
 <p>African Proposal</p>	1959	Yona Friedman	 <p>Unit</p>  <p>Grid</p>	 <p>Multiplication</p>  <p>Plug-in</p>

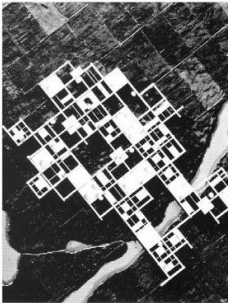

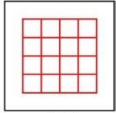
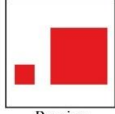
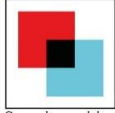
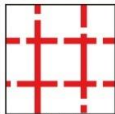
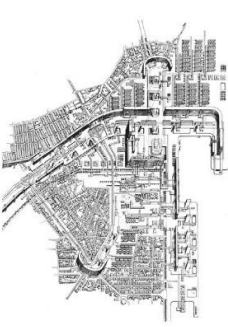

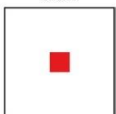

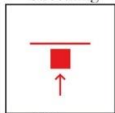
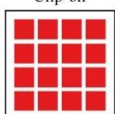


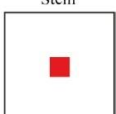

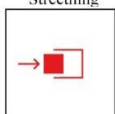

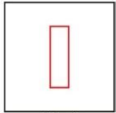
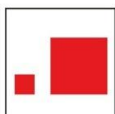
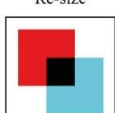
Project	Year	Author	Elements	Operation
 <p>Buikslotermeer Urban Study</p>	1962	Van den Broek and Bakema	 <p>Stem</p>  <p>Block</p>  <p>Unit</p>	 <p>Division</p>  <p>Stretching</p>  <p>Clip-on</p>
 <p>Bochum University Competition</p>	1962	Van den Broek and Bakema	 <p>Stem</p>  <p>Block</p>  <p>Grid</p>	 <p>Stretching</p>  <p>Clip-on</p>
 <p>Bochum University Competition</p>	1962	Candilis-Josic-Woods	 <p>Stem</p>  <p>Unit</p>  <p>Grid</p>	 <p>Stretching</p>  <p>Multiplication</p>  <p>Plug-in</p>
 <p>Vallee de Belleville Winter Resort</p>	1962	Candilis-Josic-Woods	 <p>Stem</p>  <p>Unit</p>	 <p>Stretching</p>  <p>Plug-in</p>

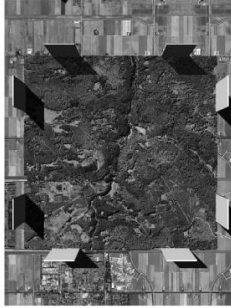
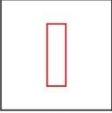




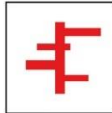
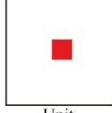


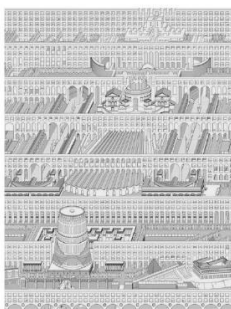
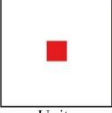
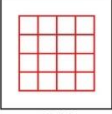
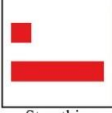
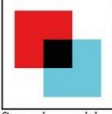
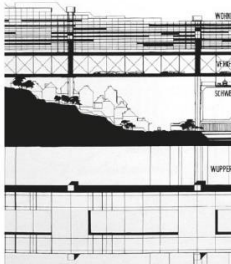

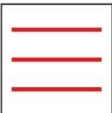

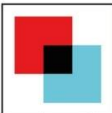
Project	Year	Author	Elements	Operation
 <p>Frankfurt Römerberg Competition</p>	1963	Candilis-Josic-Woods	 <p>Platform</p>  <p>Grid</p>	 <p>Division</p>  <p>Superimposition</p>
 <p>Berlin Free University</p>	1963	Candilis-Josic-Woods	 <p>Platform</p>  <p>Grid</p>	 <p>Division</p>  <p>Superimposition</p>
 <p>Leeuwarden Noord Extension</p>	1959	Van den Broek and Bakema	 <p>Block</p>  <p>Unit</p>  <p>Cluster</p>	 <p>Division</p>  <p>Multiplication</p>  <p>Re-size</p>
 <p>Kennemerland Regional Plan</p>	1957	Van den Broek and Bakema	 <p>Block</p>  <p>Unit</p>  <p>Cluster</p>	 <p>Division</p>  <p>Multiplication</p>

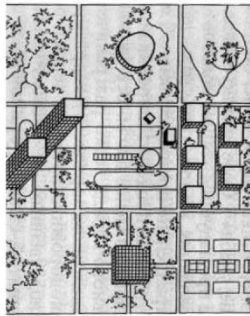
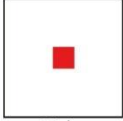
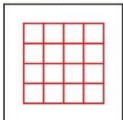
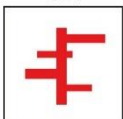
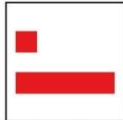
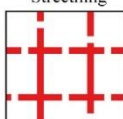


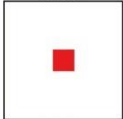
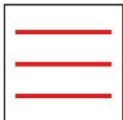
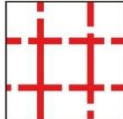
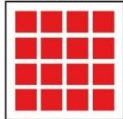



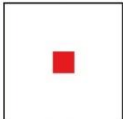
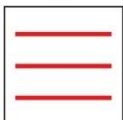
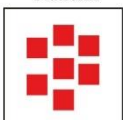

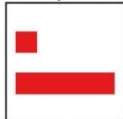
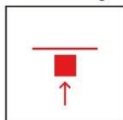
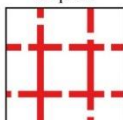
Project	Year	Author	Elements	Operation
 <p>University of Florence Extensions Project</p>	1972	Vittorio Gregotti and Team	 <p>Unit</p>  <p>Grid</p>	 <p>Multiplication</p>  <p>Stretching</p>  <p>Division</p>
 <p>Township in Gujarat</p>	1964	Doshi and Kohn	 <p>Cluster</p>  <p>Grid</p>	 <p>Multiplication</p>
 <p>Ruhwald Competition</p>	1965	Wewerka	 <p>Unit</p>	 <p>Stretching</p>  <p>Multiplication</p>
 <p>Grünzug Süd Competition</p>	1962	Oswald Mathias Ungers	 <p>Stem</p>  <p>Unit</p>  <p>Grid</p>	 <p>Division</p>  <p>Stretching</p>  <p>Plug-in</p>

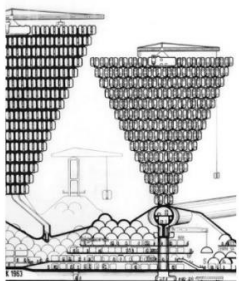
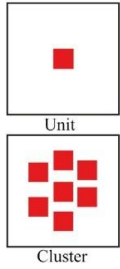
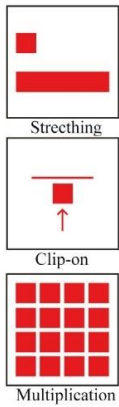

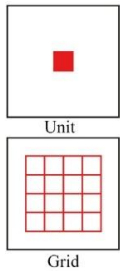
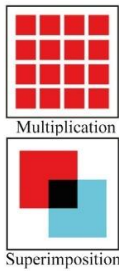
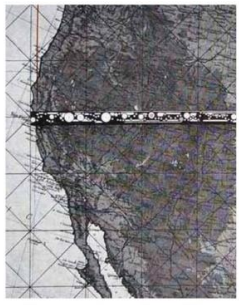
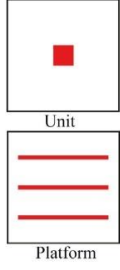
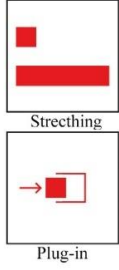

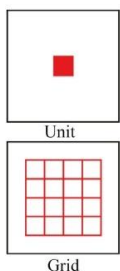
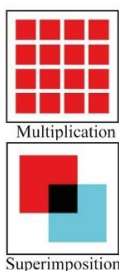
Project	Year	Author	Elements	Operation
 <p>The New City</p>	1967	Cornell UD	 Stem  Unit  Platform	 Superimposition  Division
 <p>Exodus</p>	1972	Rem Koolhaas	 Block  Stem  Grid	 Re-size  Stretching  Division
 <p>Fitzrovia Traffic Re-organization Proposal</p>	1962	Haxworth, Woodward, Richardson	 Platform  Grid	 Stretching  Superimposition
 <p>Urbanisme Spatiale</p>	1962	Yona Friedman	 Unit  Grid	 Multiplication  Plug-in

Project	Year	Author	Elements	Operation
 <p>Lower Manhattan Express Way</p>	1970	Paul Rudolph	 <p>Stem</p>  <p>Unit</p>  <p>Platform</p>	 <p>Multiplication</p>  <p>Stretching</p>  <p>Clip-on</p>
 <p>Bridge City</p>	2011	Yona Friedman	 <p>Unit</p>  <p>Grid</p>	 <p>Multiplication</p>  <p>Plug-in</p>
 <p>Berlin Hauptstadt Competition</p>	1957	Alison and Peter Smithson	 <p>Platform</p>	 <p>Superimposition</p>
 <p>Toulouse-Le-Mirail Urban Extension</p>	1961	Candilis-Josic-Woods	 <p>Stem</p>  <p>Unit</p>	 <p>Stretching</p>  <p>Superimposition</p>

Project	Year	Author	Elements	Operation
 <p>Agricultural City Project</p>	1961	Kisho Kurokawa	 <p>Platform</p>  <p>Grid</p>	 <p>Re-size</p>  <p>Superimposition</p>  <p>Division</p>
 <p>Tel Aviv City Centre</p>	1962	Van den Broek and Bakema	 <p>Stem</p>  <p>Unit</p>	 <p>Streething</p>  <p>Clip-on</p>  <p>Multiplication</p>
 <p>Fort L'Empereur</p>	1931	Le Corbusier	 <p>Stem</p>  <p>Unit</p>	 <p>Streething</p>  <p>Plug-in</p>
 <p>A Simple Heart</p>	2011	DOGMA	 <p>Block</p>	 <p>Re-size</p>  <p>Superimposition</p>

Project	Year	Author	Elements	Operation
 <p>Stop City</p>	2007	DOGMA	 <p>Block</p>  <p>Unit</p>	 <p>Re-size</p>  <p>Multiplication</p>
 <p>Caen Herouville</p>	1961	Candilis-Josic-Woods	 <p>Stem</p>  <p>Unit</p>  <p>Cluster</p>	 <p>Multiplication</p>
 <p>Fields Of Walls</p>	2012	DOGMA	 <p>Unit</p>  <p>Grid</p>	 <p>Stretching</p>  <p>Superimposition</p>
 <p>Bridge City above the Wupper</p>	1969	Alan Boutwell	 <p>Stem</p>  <p>Platform</p>	 <p>Stretching</p>  <p>Superimposition</p>

Project	Year	Author	Elements	Operation
 <p>Plan For Magnitogorsk</p>	1930	OSA and Ivan Leonidov	 <p>Unit</p>  <p>Grid</p>  <p>Stem</p>	 <p>Strecthing</p>  <p>Division</p>
 <p>Metro-Linear City Project</p>	1957	Reginald Malcolmson	 <p>Stem</p>  <p>Unit</p>  <p>Platform</p>	 <p>Division</p>  <p>Multiplication</p>  <p>Strecthing</p>
 <p>Tokyo Bay Project</p>	1960	Kenzo Tange	 <p>Stem</p>  <p>Unit</p>  <p>Platform</p>  <p>Cluster</p>	 <p>Multiplication</p>  <p>Strecthing</p>  <p>Clip-on</p>  <p>Division</p>

Project	Year	Author	Elements	Operation
 <p>Plug-in City</p>	1964	Archigram-Peter Cook	 <p>Unit Cluster</p>	 <p>Stretching Clip-on Multiplication</p>
 <p>Continuous Monument</p>	1969	Superstudio	 <p>Unit Grid</p>	 <p>Multiplication Superimposition</p>
 <p>Comprehensive City Project</p>	1969	Alan Boutwell and Mike Mitchell	 <p>Unit Platform</p>	 <p>Stretching Plug-in</p>
 <p>No-Stop City</p>	1970	Archizoom	 <p>Unit Grid</p>	 <p>Multiplication Superimposition</p>