PATTERN FORMATION in URBANISM
A critical reflection on URBAN MORPHOLOGY PLANNING & DESIGN
PATTERN FORMATION in URBANISM
A Critical Reflection on Urban Morphology, Planning and Design

Proefschrift

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pattern, n. and adj.

I. An example or model to be imitated; an example of particular excellence; a person who or thing which is worthy of copying; an exemplar; an archetype. A thing is to be made; a design, an outline; an original.

II. a. A regular or decorative arrangement, often repeated, esp. on a manufactured article such as a carpet, fabric, etc.; a style, type, or class of decoration, composition, or elaboration of form.

b. A regular and intelligible form or sequence discernible in certain actions or situations.

(Oxford English Dictionary, 2012)
In this research, the basic factors, the underlying concepts and the main ideas on/of urban pattern formation are discussed. The attempt to reveal such a far-reaching phenomena does necessarily cover the three relevant aspects; conception, creation and control of collective urban form. This basically makes the research argue a conceptual framework comprising the three sub-domains of urbanism as a field of research and practice: morphology, design and planning. The cross relations between these domains are to be constructed from an updated critical perspective. That means, the research does not only tend to depict the intrinsic relations within the ‘trinity’ of urbanism, but also to reflect on the fields with regards to their current potentials and limitations in the way of achieving ‘good’ urban patterns.

During the six-year period of the research, the most frequent question-like remark that the author has received was as follow: “I see what you do. You are doing like what Christopher Alexander did in the 1970s”. If not making annoyed, that recurring question actually let him recognise the lack of a precise comprehension of the idea of ‘pattern’ in urbanism [as well as the undeniable influence of C. Alexander in urban design thinking].

The negative reaction to the remarks was not actually resulted from a latent reservations about the ‘Alexandrian theory’, which is not the case at all, but mainly due to the widespread incomplete comprehension about the term mainly influenced by Alexander’s original interpretation within ‘A Pattern Language’ (1977).

With ‘A Pattern Language’, Alexander and his colleagues (1977) argued ‘patterns’ as the basic elements of the spatial ‘language’, which is supposed to be common for everybody in the production of living environments (pp. x). The critical point is that a pattern, in this context, is not essentially regarded as something physical as mostly [and wrongly] conceived, but an actual one, in the meaning of being related to the acts, actions or practices. In ‘The Timeless Way of Building’, Alexander (1979) clarifies this point as follows:

“… What then is the fundamental ‘structure’ of a building or a town? It is made up of certain concrete elements... And each of these elements has a specific pattern of events associated with it. Families living in the houses, cars and buses driving in the streets, … people walking through the doors…” (pp. 82-83).

Even seen in this short quotation, what meant by ‘pattern’ in Alexander’s pattern theory is principally a kind of activity pattern rather than a physical one. Moreover, it is not predominantly regarded as a physical entity (or arrangement) perceived through its internal regularities, but as an abstract ‘instruction’ to ‘solve the [design] problems’ [1] (Alexander et al., 1979: x-xvii). In this sense, what implied with ‘pattern’ basically corresponds to the first definition of the concept given in the opening passage above. In this view, the ‘pattern’ is suggested as a model (or archetype) to be applied in different ways, rather than the regular and intelligible form-compositions [not necessarily the products of an archetype].

We can argue that it is fairly possible to develop different views on the issue of urban patterns. One of them, in this sense, might assign a central position to the physical being of the spatial regularities while avoiding any normative and essentialist perspective. That indeed represents the starting point of my research. By putting ‘physical pattern’ of the built environment, which comprise the group of buildings, the network of streets and the layout of plots, into the focus of interest [instead of ‘activity pattern’], the author essentially aims to reveal

---

[1] With reference to the patterns given in the book, Alexander (1979) makes the following statement: “Each solution is stated in such a way that it gives the essential field of relationships needed to solve the problem… It constraints only those essentials which cannot be avoided if you really want to solve the problem.” (pp. xiii-xiv)
1. INTRODUCTION

The basic mechanisms, tools and the conceptions of understanding, planning and designing the urban patterns.

The broad perspective dealing with the issue in a large context is basically inspired by another classic work on the same subject, ‘The City Shaped: Urban Patterns and Meanings Through History’ authored by Spiro Kostof (1991). In the introduction of his seminal book, Kostof (1991) states that understanding urban from (and its history) involves various aspects such as “ownership of urban land, … the power of government to take over private property for public use, the institution of legally binding master plan, … building codes and other regulatory measures, instruments of funding urban change” and so on (p. 11). As seen here, most of the aspects cited by him mainly address planning and design as the purposeful acts of making the cities (Kostof, 1991: 53). That perspective to understand urban patterns with regards to spatial planning and design has also adopted by the author of the current work long ago. This alternative view basically characterised the initial problem statements and the questions put forward at a very early period of the research.

In the beginning of the study, the author proposed the aim of the research as the provision of a conceptual tool to develop a design-based planning approach especially for the countries in which the planned morphological qualities are rather disputable as in the case of Turkey (Çalıskan, 2007). In the course of time, such a naïve objective of solving a deep-rooted systemic problem with academic research has evolved into something else. Through researching, the author recognised that the practical aim of a system definition for spatial planning to produce ‘good city form’ (Lynch, 1981), in general, requires a wide-ranging knowledge that would involve both design and morphology. Thereby, the main objective of the research, in time, has turned into the provision of a unified body of knowledge on urban morphology, planning and design in the specific context of ‘urban pattern formation’.

That underlying objective basically characterised by the theoretical assumption relating design and morphology within one conceptual framework (Marshall and Çalıskan, 2011). In this framework, morphology and design belongs to the same cognitive

Figure 1.1. Huit etats de ‘Taureau’ (The eight states of Taurus) by Pablo Picasso (1946): In the search for abstraction in painting. (Source: Musée Picasso, Paris, 2005 -the postcard-)
domain, called abstraction.

As a mental performance to perceive and represent the real world, abstraction is mostly associated with art. Unlike the common perception, not until the emergence of abstract art in the 20th century, did the systemic abstraction as the transformation of the perceived reality take a role in the visual arts (Moszynska, 1990: 7). (see Figure 1.1) Yet in the case of design, abstraction has always been an explicit condition of design thinking, with its own codes and coding systems since its foundation as a discipline (Schumacher, 2011: 239). Going back to the highlighted definition of Moszynska (1990) above, we would say that while ‘transformation’ implies the metal construction of a desired spatial state by design, the act of perceiving (and conceiving) the physical ‘reality’ entails morphology. Acting in the same domain (of abstraction) with design, morphology essentially provides design with the fundamental knowledge for its creative operation. (see Figure 1.2)

Figure 1.2. The ‘joint framework’ of morphology (recognition), planning (control) and design. (Adapted from: Marshall and Çalıskan, 2011: 415)

Thinking in this way, morphology can be assumed as the foundation of design, the interface between the ‘real world’ (the existing built environment) and the design image. (Marshall and Çalıskan, 2011: 415). By the same token, the spatial design remains as a transitional phase to be converted into the actual urban fabric via construction (Ibid). Within this framework, the role of planning is to control the design activity mainly by means of guidance.
and review processes.

Within this context, the research deliberately excludes the issues of ‘making’, the direct production of the built fabric without any systemic analysis. Though the generative quality of informal urbanism is mentioned, the ‘making’ process involved in the non-planned space production is not explicitly discussed in the research. Likewise, the realisation of the design scheme on the real ground (construction) has remained out of the concern as well.

Designing at the national level: ‘Point City’, the project for ‘redesigning Holland’ by OMA (1993) (Koolhaas et al., 1995: 892)

Designing the region: Rule based-development scenarios for Randstad, the Netherlands. (Source: Sijmonds et al., 2003)

Designing the metropolitan area: Concept model linking Almere to Amsterdam by Atelier Ijmeer, 2004 (Source: Dijk, 2008)

**Figure 1.3.** Designing large-scale form and structures: They are big, but still design.
Broadly speaking, what we mean by morphology is the study of the abstract inter-relations between the components of any form creating a composite whole or the Gestalt[2] (Zwicky, 1969: 34 cited in Ritchey, 2002: 3). Therefore the term can easily differentiate itself from the two other concepts in our framework. Nevertheless, one can easily ask how the author distinguishes design from planning, of which the conceptual demarcation is quite imprecise in the current literature. In this context, the author tends to clarify the distinction between the two fields with regard to their intrinsic relations with form and morphology. From this perspective, we would argue that what distinguishes design from planning is not the levels of scale. To be called as ‘design’, it is fairly possible to construct conscious morphological relations on the large scales as well. (see Figure 1.3)

That means within its abstract domain, it is theoretically possible to apply design thinking for all the scale-levels. On the contrary to the conventional perception (Banham, 1976: 130; Lang, 1985; Erickson et al. 2001: 5), urban design is not categorically limited to a certain scale-frame. In other words, ‘big design’ does not necessarily mean planning, as ‘small design’ is not always subject to architecture.

Then what essentially differentiates design from planning is its direct relation with morphology as depicted in the conceptual scheme above. (see Figure 1.2) Design basically translates the knowledge of the existing forms and patterns into the mental construction of future form-compositions. Nonetheless, planning interacts with morphology indirectly through design. As an act of procedural organisation to achieve a pre-defined goal, planning is the making of an orderly sequence of actions that will lead to the achievement of a stated goal or goals (Hall, 1975:3). Within that context, the research designates control and guidance as the prominent tasks of planning in relation to morphology and design. Therefore, coordinating the discrete design acts by the plans, and conditioning their internal (morphological) quality via the codes and regulations (Ben-Joseph, 2005; Lehnerer, 2009; Marshall (ed.), 2011; Talen, 2012) are specifically regarded as the central issues to be discussed on the issue of planning.

In this framework, the author of the research specifies urban fabric as the common ground of urban morphology, planning and design. As both the subject of urban morphology, and the object of physical planning and design, urban fabric broadly refers to the physical expression of the control and regulation patterns in urban space. Interchangeably used with the terms of ‘tissue’ and ‘texture’ in the literature (Caniggia and Maffei: 1979, Kropf, 1996), urban fabric basically implies the collective body of the generic urban components (i.e. streets, buildings and plots) composed within a rule-based framework. (see Chapter 2)

Owing to the non-arbitrary perceived regularities, I tend to conceptualize urban fabric with the notion of pattern. However, observed through all scales of the artificial and organic life, ‘pattern’ is a scale-free phenomenon like design (Ball, 2009: 1-30). For instance, in urban context, one can easily speak of the pattern of a metropolitan region or that of an sub-continental agglomeration. That’s why; in order to make the analyses of urban patterns morphologically relevant, the actual patterns examined in the research have been delineated at the intermediate scale-levels in which the basic components of urban fabric are all meaningful and observable. For that purpose, the major scale levels included in the research covers a certain range from urban ensemble (block-groups) to district. By involving the scale

---

[2] From this perspective, the notion of morphology applies not only for the built environment, but also in other fields like geology, botany and biology and astronomy (Zwicky, 1969: 34 cited in Ritchey, 2002: 3)
of neighbourhood in the range, the scale-interval of the research accordingly varies between the nominal values between 100 m to 1 km in radius.\[^3\]

Finally, the underlying reason behind the use of the term, ‘formation’ given in the main title should be noted as well. With the term, the two corresponding meanings are implied together: the thing formed, or the process of forming, a putting or coming into form (OED, 2012). By this way, both the idea of process and that of product would be discussed parallelly. In the urban context, the process-oriented connotation of the concept basically indicates the four types of spatial (re)establishments, preserving, reinforcing, repairing, and creating urban fabric \[^4\] (Attoe and Logan, 1989: 106). (see Figure 1.4)

![Figure 1.4. The basic types of spatial (re)establishment (After: Attoe and Logan, 1989: 106)](image)

In this framework, the research mainly focuses on creation instead of transformation or preservation of the urban fabric. This is due to the fact that the research basically aims to reveal how the different morphological components are put together (design) and regulated in a control framework (planning). This requires a specific attention to the emergence of the idea of a form, its generation as pattern and eventuating as fabric.

1. **Scope of the research**

As addressed by Anderson (1972), there are basically the two types of scientific researches, the ‘intensive’ ones going for the fundamental laws, and the ‘extensive’ ones going for the explanation of the phenomena in terms of known fundamental theories (Anderson, 1972: 363). The current research represents the later one with its inclusive framework given in Figure 1.2. However, it should be noted that such an account is not a point that has been pre-determined in the beginning of the research. Instead, it has been brought about through the inquiry process itself.

Having started with the examination of the planned urban tissues in different contexts, the author felt the necessity to delve into the core questions of urban morphology (i.e. abstraction, classification and typology in addition to the different approaches and the modes of representation). Likewise, gaining more insight about the production of the built environment in terms of design control and planning, he realised the significance of design thinking in the morphological quality of the planned urban fabrics. However, involving design analysis in the framework did not cease the research-wise questioning at all. Examining the design theory in depth, he saw that the emerging trends in urban design suggested a remarkable potential to improve the settled conventions on the practice of morphological planning.

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\[^3\] The nominal radii of each corresponding scale-levels in the research are determined with reference to the ranges defined by Jong (2005: 37)

\[^4\] In this context, preservation would imply zero-formation with the lack of new morphological components added.
and design. Consequently, in the fourth year of the research, the author decided to involve the issue of new design methods (the so-called parametricism) in the main framework of the research. Therefore, the topic eventually included as the last chapter should not be regarded as the ultimate fulfilment of the research, but as the final section that completes the overall picture to be ultimately presented.

It is also worth to mention that during the parallel researches on those related sections, the new research questions have been generated and added into the existing framework. In this respect, the organisation of the research within this period has been realised differently than what the common methodologies offer, starting with a specific (problem-oriented) research question, and end up with a singular overarching result. Instead, the overall body of the research has emerged out of a series of successive questions formulated in due course. Therefore, instead of pursuing the whole process with reference to a problem statement defined at the outset, the emerging research questions let the relevant problem statements to be formulated, consecutively.

In this manner, the overall research process practiced basically represents a kind of bottom-up approach through the emerging research questions within a flexible framework.

2. The basic research questions and the problem statements

After setting the overall scope of the research, we can elaborate the content by go through the basic research questions and the problem statements. (see Table 1.1)

Table 1.1. The research questions and the problem statements within each section of the research

<table>
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<th>The parts of the research</th>
<th>The initial research questions</th>
<th>The problem statements accordingly formulated</th>
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<tr>
<td>Conceptualisations on Collective Urban Form and Formation</td>
<td>What are the main categories and typologies characterising the theories of form and formation in urbanism?</td>
<td>The lack of a consistent and unified terminology comprising the notions of form, structure and pattern.</td>
</tr>
<tr>
<td></td>
<td>Is it possible to categorise the historical epochs and the main-stream paradigms of urbanism from a morphological perspective?</td>
<td>The need for an updated typology of collective urban form in the light of the emerging conceptions of urban morphology.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The need for positioning the emerging approaches of planning and design into the broad (historical) framework of urbanism.</td>
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## Understanding the Urban Morphology

What are the main modes of inquiry to conceive urban forms and patterns?

Do the levels of abstraction and the modes of representation essentially shape our cognition in morphology?

Is it possible to suggest a unifying framework of the morphological indicators in urbanism?

The conventional classifications about the field of urban morphology are insufficient due to the fact that they disregard some fundamental suppositions on form in general.

There exists a fragmented terminology of morphological indicators within the field.

## Planning the Urban Morphology

What is the operational relationship between planning and (designed) urban morphology?

What are the main planning tools to control the formation of urban patterns?

What would be the main differences between the different planning systems in terms of controlling the design(s)?

What is the key quality indicator to assess the performance of a design control system from a morphological point of view?

Not only the types of the instruments, but also the different ways of their synchronised use require more discussion with regards to the issue of design control in planning.

The classical contradiction between top-down and bottom-up fashions of design and planning would not be truly relevant in practice with regards to the possibility of 'controlled flexibility' via the plan and the code.

There is a need for a firm definition of urban coherence as one of the most generic term used for the production of 'good urban form'.
### Designing the Urban Morphology

<table>
<thead>
<tr>
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<th>Answer</th>
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<tbody>
<tr>
<td>How do designers think morphologically in design?</td>
<td>Urban design thinking has not been considered as a special research topic in the research field of design methodology, so far.</td>
</tr>
<tr>
<td>What is the current state of art in the conception of design thinking?</td>
<td>The contemporary perspectives on design thinking could not find their reflection in the literature of urban planning and design.</td>
</tr>
<tr>
<td>What are the changing perspectives in design methodology?</td>
<td>There is an apparent inconsistency in theory and practice with regards to the conventional prescription of design thinking in urbanism.</td>
</tr>
<tr>
<td>What are their equivalences in urbanism?</td>
<td>In order to update the conventional models, a new comprehension of design thinking is needed for urbanism in the light of a renewed set of conceptions to be provided.</td>
</tr>
<tr>
<td>Do the actual designers perform in accordance with our settled conceptual models, which are still widely influential in the education of urban planning and design?</td>
<td>‘Parametric design’ as a developing method has a serious potential to challenge the orthodox approaches to urban planning design. Nevertheless, its theoretical background is currently deprived of an genuine understanding of the contemporary paradigms in urbanism (i.e. complexity, emergence).</td>
</tr>
</tbody>
</table>

### Emerging Trends and Tendencies in Urban Design

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the emerging paradigms in urbanism, which would influence the new design methodologies?</td>
<td>‘Parametric design’ as a developing method has a serious potential to challenge the orthodox approaches to urban planning design. Nevertheless, its theoretical background is currently deprived of an genuine understanding of the contemporary paradigms in urbanism (i.e. complexity, emergence).</td>
</tr>
<tr>
<td>What are the new design methods, which would potentially challenge the existing approaches in urban planning and design?</td>
<td>The application of a new technique with an old conception on urban pattern formation ends up with a series of problems in actual context.</td>
</tr>
<tr>
<td>What are the positive and negative aspects within the current application of the new design methods in urbanism? –specifically in relation to the actual planning frameworks-</td>
<td></td>
</tr>
</tbody>
</table>
As seen in the table above, the research consists of a series of distinct but interdependent sections. Instead of having a single research question, each section consists of its own set of questions. This basically makes the chapters be organised under a particular theme, which is theoretically elaborated via a separate literature review.

With the themes discussed, the author aims to provide a unified body of knowledge and a holistic critical perspective for a potential integration of the fields of urban morphology, planning and design. This point has been argued by Marshall and Çalıskan (ed., 2011) before. With the current research, the author tends to extend the scope of the ‘joint framework’ suggested with S. Marshall (on urban morphology and design\(^5\)) by taking ‘planning’ into consideration as well. Via problematizing the design control from a morphological perspective, the issue of planning is aimed to be related with the other two fields. However, such a comprehensive view is not finalised with a so-called applied model that would claim to integrate all the three fields in a single framework. This would be certainly over ambitious for one research. Instead, the essential basis of an integrative knowledge is suggested for the future works that would potentially cooperate the specific aspects of the sub-themes (i.e. indicators of urban form, design coding and parametric design) investigated within this study.

Looking at the problem statements closer, one could easily see that they mostly emphasise the lack of consistency and relevance between theory and practice.

- Insufficiency of the conceptual contradiction between top-down and bottom-up to characterise the planning systems in the context of design control;
- the established misconception of design thinking in urbanism;
- the lack of a well-founded theoretical insight of urban complexity and emergence within parametric urban design as the prevailing paradigm and a new design method for the generation of complex fabrics

...can be regarded as the prominent problematic issues to be exemplified in this genre.

Moreover, for the readers having a political perspective on urbanism, the viewpoint of the author pursued in the research would be seem too much ‘physicalist’ in a sense that it focuses on formation from a morphological point of view [rather than space production in the view of spatial political economics]. With regards to the suggested scope that apparently centralise the physical aspects of urbanism, such a perception would be seen reasonable. However, this does not mean that the author categorically rejects the political discourse on planning and design within the framework of the research. While acknowledging the relevance of political theory in understanding the structural dimensions of city development and design (see Chapter 1, ‘the basic conceptions in urbanism’), the research posits itself in the ‘new physicalist’ school of urbanism\(^6\) without necessarily opposing with the basic premises of spatial political economics in general.

At this point, it should be also noted that the critical reflection in the research is not aimed for suggesting a full-fledged normative perspective on design and planning, ul-

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\(^6\) ‘New physicalist’ approach is founded on the basic assumption that physical planning and design has an operational and problem-solving capacity to manage growth and change by small-scale (physical) interventions. The contemporary standpoint of the school is basically developed on the theories of complexity and evolution. For a concise discussion on ‘physicalism’ in urbanism, see: Batty, M., and Marshall, S. (2009) ‘The Evolution of Cities: Geddes, Abercrombie, and the New Physicalism’, Town Planning Review 80(6), pp. 551 - 574
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The research, in this sense, does not tend to come up with a definition of ‘good urban form’ or ‘good urban design’. The critical knowledge of the fields elaborated in the limits of the research is believed to provide an operational basis for the future studies in this (normative) genre.

Though the research questions are related to each other on the basis of the main topic, ‘pattern formation in urbanism’, they are distinct enough not to be represented within one theoretical model. In this context, the frequently encountered question of ‘what the research specifically problematizes’ cannot be answered with a single statement in the context of our research. The set of problem statements given in Table 1.1 essentially address an overarching theme rather than a single problem to be explored. In this sense, the basic motivation of the research is not to solve a problem, but to reveal the problems specified by the multiple research questions.

3. **Method(s) of the research**

The methods utilised in the research stem from the basic research objectives, which include:

- organising the vast body of the field knowledge [of urban morphology, planning and design] through cross references,
- reflecting on the existing knowledge from a critical perspective,
- exploring the new conceptions to consolidate the basis of the disciplinary knowledge.

In this framework, the research provides an extensive review on the specialised literature of the three fields. Since each chapter comprises the relatively independent themes, the chapters introduce their own corresponding literature. By this means, all the critical aspects of the main theme (urban pattern formation) are aimed to be covered. Though this might be considered as a factor of fragmentation, it would be also taken as an opportunity provided for the reader to exclusively focus on a certain part with a substantial body of the background information and case studies.

By the same token, the case studies in the research are not organised in a unified framework to achieve a single all-embracing research conclusion, either. Each case study is conducted with an independent research question and with different set of database. In this context, there are two types of case studies involved: **plan analysis** and **design analysis**.

The plan analyses, on the one hand, are conducted to understand the design control mechanisms utilised in the three countries, the UK, the Netherlands and Turkey. For that purpose, the same type of –housing- development plans are illustrated historically (according to the ten-year periods) for each context. The analyses have been made with a series of archival research done in the planning departments in Essex, the UK, Almere, the Netherlands and Ankara, Turkey. In each city, the author interviewed with the local planners to gain more insight about the plans and the design control processes realised. All the planned development sites (the neighbourhoods) selected for the plan analysis have been visited and visually documented.

The design analysis, on the other hand, comprises a focused analysis investigating the details of the design process exemplified by the designers. The analysis was made by a close examination of the intermediate design drawings provided by the two designers of the
two different urban design projects. Accompanied by the self-reflective interviews, the analysis basically tends to reveal the cognitive structure of design thinking especially with regards to the relation between analysis (morphology) and design.

4. Outline of the thesis

As I depicted in Table 1.1, the thesis is organised in five thematic sections. In the light of the main research questions cited above, the content of the chapters can be briefly introduced as follows.

The thesis is opened up with an introductory chapter on the conceptualisations on collective urban form and formation. Revisiting the basic categories of morphology, ‘form-composition’, ‘structure’ and ‘pattern/fabric’, the first chapter aims to clarify the original implications of the terms used both in design and morphology. By this means, the different approaches urbanism and the schools of (urban) morphology are aimed to be discussed more precisely. Then, the chapter continues with the conceptualisation of ‘collective urban form’, which is one of the primary concepts throughout the research. Following an updated typification of collective urban form, the introductory chapter is finalised with two typologies on urbanism. While the first typology is about the historical transformation of urban form-control mainly with regards to the actors, instruments and the socio-political motives; the second one is about the mainstream paradigms differing based on their underlying assumptions on urban formation.

In the third chapter, the field of urban morphology is discussed in detail with reference to the basic categories and the main approaches classified according to the different interpretations of those categories (i.e. typology and abstraction). Following the critical review of the major analytical methods of urban morphology, a conceptual framework is suggested for urban morphological analyses. This conceptual framework comprises about forty indicators of urban form organised through a comprehensive literature review and the original definitions of the new indicators.

In the following chapter, the second field of the research, planning is involved in the frame of discussion. After the initial definitions of the main instruments of design control, the planning regimes are discussed in the context of the three countries through the actual plan typologies they have. The intrinsic relations between plans and codes in terms of control and guidance are specified with a series of plan analyses made for the nine districts developed within the three decades in those countries. Ultimately, the question of the performance of a design control system is explored with the morphological analysis of urban coherence applied for the case study areas. The method of morphological analysis is originally introduced for that research.

Afterwards, the fifth chapter considers the issue of designing urban form with a specific emphasis on design cognition. Questioning the nature of design thinking in urbanism, the chapter primarily provides the reader with the fundamentals of design. Following the discussion on the basic (mental) mechanisms to deal with the complexity within a design process, the idea of design methodology is revisited with an overview of the design studies. Consequently, the theoretical review is completed through examining the procedural models of design thinking in the literature of urbanism. With reference to the contemporary

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7 The district level implies the area of urban land with a nominal radius of 1 km.
conception of design, the conventional approach to design process in urbanism is criticised. On this critical basis, a new conceptual framework is argued for urban design process with a loose analogy of evolution and emergence. In order to test the argumentations and to provide a concrete (empirical) ground on the issue, an in-depth design analyses is presented. In the light of the findings of the analysis, an alternative (conceptual) model of urban design process is suggested at the end of the chapter.

In the last chapter, the research is finalised with a critical overview of the emerging trends and tendencies in urbanism with regards to the contemporary understanding of spatial planning and design. From this viewpoint, the research brings parametric design, the developing technique of computational design, into question. While doing that, the idea of ‘generative urbanism’ is revisited to make a clear evaluation of the parametric design methods, which are claimed to perform as the generative systems in urban design. So in the first part of the discussion, the design method of parametric (computational) design is described with a cross reference to the conventional (analogue) design techniques examined in the previous chapter on design thinking. Then in the second part of the review, the relevance of the so-called ‘parametric urbanism’ is investigated in relation to the actual design control mechanisms given in the early chapter on planning. For that purpose, the last case study is introduced in order to understand the real potentials and limitations within the application of a parametric design method in an actual urban context. The Kartal-Pendik masterplan project in Istanbul, Turkey is critically reviewed as the case-study.

Finally, in the conclusion chapter, the reader is provided with a series of all-embracing (evaluative) statements on the major findings of the research. Considering the extent of the study, this is considered as the critical part of the dissertation to figure out the various foregoing discussions within a relational manner. In the conclusion, the specific components of the possible future studies will be addressed in relation to the current one, as well.
2 CONCEPTUALISATIONS ON COLLECTIVE URBAN FORM & FORMATION
1. The Basic Categories of the Morphology

Mostly referred interchangeably in common use, form, structure and pattern are the main categories of morphology. Since they comprise different sets of aspects, their use in analysis or design potentially involves discrete assumptions, which need to be clarified. In this regard, in order to prevent any conceptual ambiguity within the research, each category is delineated with reference to their intrinsic properties, quality indicators, the required performances, generation tools and actions. (see Table 2.1)

Table 2.1. The main aspects of form, order and pattern.

<table>
<thead>
<tr>
<th>Form-Composition</th>
<th>Structure</th>
<th>Pattern &amp; Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>object(s)</td>
<td>Lines, planes and volumes</td>
<td>Framework or network</td>
</tr>
<tr>
<td>basic properties</td>
<td>Shape, Size, Colour and texture, Position and orientation, Proportion, Coverage (density), Contrast (figure vs. ground, solid vs. void), Enclosure, Porosity, Depth (visual)</td>
<td>Typology, Hierarchy, Datum, Depth (topological), Symmetry (topological), Distributedness, Connection</td>
</tr>
</tbody>
</table>
Due to the fundamental differences in connotations, each category basically entails
the different modes of thinking when dealing with a given spatial phenomena. This is actu-
ally the point that will illuminate the following analyses in the research. As seen in Table 2.1,
the concepts of form and pattern are respectively presented with those of composition and
fabric. Such a supplementary fine-tuning derives from the underlying intention to specify
the terms in the context of built environment, which involve both the conscious design acts
and the emergent dynamics through different levels of operations.

### 1.1 Form-composition

Every artefact acquires a form. The principal property of form is the characteristic
shape that the object has (Ball, 2009: 19). As argued by Arnheim (1974) form is ‘the vis-
ible shape of content’ (p. 96). That relates the form with a particular function or behaviour
and a certain configuration of the form-elements affording certain operations. As a visual
property, shape is the result of the specific configuration of surfaces and edges of the form

<table>
<thead>
<tr>
<th>basic qualities</th>
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</thead>
<tbody>
<tr>
<td>Harmony</td>
</tr>
<tr>
<td>Balance/statis</td>
</tr>
<tr>
<td>Unity</td>
</tr>
<tr>
<td>Variety</td>
</tr>
<tr>
<td>Permeability</td>
</tr>
<tr>
<td>Contiguity</td>
</tr>
<tr>
<td>Porosity</td>
</tr>
<tr>
<td>Continuation (good-contour)</td>
</tr>
</tbody>
</table>

| De)centrality |
| Continuity |
| Integrity |
| Intelligibility |
| Segregation |
| Diffusion |

| Proximity |
| Legibility |
| Consistency |
| Coherence |
| Self-similarity |
| Diversity |

<table>
<thead>
<tr>
<th>generative operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articulation</td>
</tr>
<tr>
<td>(massing and layout)</td>
</tr>
</tbody>
</table>

| Organisation (ordering and structuring) |

| Propagation |

<table>
<thead>
<tr>
<th>acts for creation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combination</td>
</tr>
<tr>
<td>Subdivision</td>
</tr>
<tr>
<td>Assemblage</td>
</tr>
<tr>
<td>Coupling</td>
</tr>
<tr>
<td>Mounting</td>
</tr>
<tr>
<td>Alliance</td>
</tr>
<tr>
<td>Overlapping</td>
</tr>
<tr>
<td>Subtraction</td>
</tr>
<tr>
<td>Subtraction</td>
</tr>
<tr>
<td>Amalgamation</td>
</tr>
</tbody>
</table>

| Connection |
| Separation |
| Distantiation |
| Linkage |

| Tessellation |
| Iteration |
| Translation |
| Reflection |
| Interweaving |
| Multiplication |
| Knitting |
| Superimposition |
| Gradation |

<table>
<thead>
<tr>
<th>tools of generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial lines</td>
</tr>
<tr>
<td>Generic grid</td>
</tr>
<tr>
<td>Zones</td>
</tr>
<tr>
<td>Systems of proportioning</td>
</tr>
</tbody>
</table>

| Unitary types and rules of assemblage |

| Code and algorithm |
In this sense, depending on position and distancing of the observer, what we perceive as ‘form’ is the overall coherent image of the outline and the external surfaces of a material object or a composite figure. Such a sensory perception involves both mass and space, and therefore rejects the contradictory categorisation of form and space (as called counter-form) (Ching, 1979; Hillier, 2005). In urban context, despite fundamentally relying on the state of relatedness (rather than enclosure), the organisation of urban space still depends on the exposition of physical elements (masses and planes) defining the void. That’s the reason why, space is not argued as a distinct category in the conceptual framework of morphology suggested here.

Figure 2.1. Form-composition of a neighbourhood in Medina, Tunis: depending on the view-angle of the observer, the tactile quality of the setting is mainly perceived through the mass-space relationship in the third dimension and the materialisation of the surface.

Ching (1979) specifies shape, size, colour, texture, position, orientation and visual inertia (stability of form) as the seven basic properties of form (pp. 34-35). By excluding the last property of inertia, which is essentially the property of object-form rather than the collective-form, we can update the list for urban composition with the additional properties of coverage (density), enclosure, contrast (figure-ground), porosity and depth. (see Table 2.1) While the first two properties mainly cover the two-dimensional qualities, the others connote the three-dimensional characteristics of urban form.

The urban form illustrated in Figure 2.1 covers all the sensuously perceived tactile qualities of mass (i.e. surface counters and pores and volumes). Nevertheless, this is not the only way to represent a form-composition. What is given in our example can be called ‘fili-gree form’ with all tailored details and treatments.

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1 This argument is parallel to the definition of urban and architectural form by Norberg-Schulz. In this definition, Norberg-Schulz involves the elements of space cells, mass forms, boundary surfaces, and their relations with each other. See: Norberg-Schulz, C. (1965) Intentions in Architecture, Cambridge, Massachusetts: MIT Press, pp. 97 cited in Rowe, P. G. (1987) Design Thinking, Cambridge, Massachusetts: The MIT Press, pp. 120)
According to Manty (1985), there would be two other types of form representation, which are the ‘basic form’ representing the main lines of massing and layout, and the ‘adapted form’ that is acquired by fitting the basic form into a given context. Along with the ‘filigree form’, either of these two types can be involved in the representation of urban form. (p. 34). (see Figure 2.2) The difference in the level of abstraction of form is practically relevant in terms of the issue of control in the production of built fabric. The question of who defines what in which degree of detail basically depends on the interpretation of form through different levels of abstraction.

As argued by Bill (1958), form is the sum of all the functional elements of which the external characteristics are expressed in a perceived unity (pp. 109-111). That implies the basic principle of gestalt; *the whole is greater than the sum of the parts* (Arnhem, 1974: 78). The basic assumption here is that the form of an artefact is a relational entity. From this perspective, in his ‘Notes on the Synthesis of Form’ Alexander (1964) reflects on the definition of form with reference to both shape as the fundamental property of form and its organisation as follows: “The crucial quality of shape, no matter of what kind, lies in its organization, and when we think of it this way we call it form” (p. 134). The key concepts, relation, organisation and unity, which are apparently intrinsic in the definition of form, in this sense, lead us to the idea ‘composition’: ‘the product of a designer’s strategically compiled and arranged spatial elements’ (Exner et al., 2009: 54).

Before discussing the concept of composition, it would be useful to revisit Bill’s (1958) point about unity originally made about the product-form, within our context of urban form. Due to the various typical components involved in the production of built environment, urban form is morphologically (re)combinatorial (Lozano, 1991: 241-42). Within the limitations of structural systems (both on the scale of building and settlement), the same typological elements are combined in different compositions, which in turn let the larger spatial patterns emerge. In his sense, the perceived unity remains relevant within a limited spatial context that is under the direct control of the designer (or ‘maker’). Varying from block to ensemble, this is what perceived as a gestaltic unity to be considered under the category of *form-composition*. In this framework, form-composition turns out to be a combinatory entity, which is visually perceived as a physical unity mostly as the product of an intentional and a controlled building act.

Adapted from the Renaissance painting, the term of composition was introduced as a design notion into architecture in the mid-19\textsuperscript{th} century (Steenbergen et al., 2002: 14). Its current definition, “an artistic combination of elements into a conceivable whole” (Ibid) still
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echoes its historical origin. When first utilised, the term represented a new way of thinking in design as opposed to the settled ideas of distribution and disposition. While those two terms entail the act of subdivision of an entire volume or an area (in accordance with the laws of symmetry), composition implies combining the components to make a complex whole (Leupen et al., 1997: 47). In urban context, these two operations (subdivision and combination) both involve in the production of form-composition. Operating with lines, planes and/or volumes, the basic products of composition in urbanism are layout (of streets or buildings) and massing, which both represent the perceived quality of a built environment[^2].

By means of a series of cognitive operations to construct the relations between the primitive form components (see Chapter 5), one creates a form-composition by articulating the explicit properties of the elements (i.e. volume, and surface). If the articulation process is done within a representational domain (i.e. drawing or modelling) through a kind of reflective thinking, this is what we call ‘design’. If the form is constructed directly on the site by experimenting the material and establishing the relations between the components without any a-priori mental model, then this is what we call ‘making’. Depending on the property relations and the spatial control system, the unique combination of the (professional) act of design and making (by the non-professionals) basically illustrate the socio-spatial characteristics of the built environment in a specific context.

1.2 Structure

Structure, in general, can be defined as the logical organisation of the constituent elements linked according to certain ordering rules, which regulate the network of spatial connections and separations in a system. In mathematics, structure is a formal system of the relations of certain logical types (Whyte, 1965: 21). From the linguistic point of view, it is taken as an abstract system in which the elements are mutually organised (Gauthier, 2005: 92). Sociologically, it refers to the networks of relations (i.e. class, power, kinship or age structure) constraining the human agency (Giddens, 1984: 207-08). In design, it is the intangible concept of order (Steenbergen et al., 2002: 18). With the concept of ‘structural skeleton’, it is meant by the configuration of the visual forces that hold the elements of a graphic composition together (Arnheim, 1974: 93). In urbanism, unlike the architectural understanding of the term as the concrete skeleton (support system) of a building (Leupen, et al., 1997: 102), structure is the abstract system of spatial organisation holding the morphological elements together in a given context.

In all views, what mainly matters for structure, in general, is the internal consistency of the whole. Therefore rather than the individual quality of the elements, the relationship between the units is the primary aspect in the definition of structure (Sturrock, 1986: 6).

Like a literary composition based on a certain vocabulary and syntax of the language, urban from-compositions are not arbitrary entities, but the product of an underlying order-

[^2]: In this respect, form-composition is not necessarily a three-dimensional phenomenon. With all the internal geometric relations involved, layout is the two-dimensional version of form-composition. As seen in the terms used in urban design literature (i.e. housing layout, street layout), layout represents a kind of geometric order controlled by design.
The system is mainly constructed on the aspects of the axial (or segmental) configuration of the streets, the adjacency relations between the buildings, and their entrances in relation to the street. In this framework, reducing a form-composition into nodes and links is the essential mental operation for the representation of urban structure. (see Figure 2.3)

As seen in the structural diagram above, each building within the frame of the street segments is represented with a node independently of its size and shape. The idea behind this is seeing the composed buildings as discrete units connected to each other [and to the street] in particular ways. Likewise, depending on the purpose of analysis, the internal spaces of the buildings could be represented by single nodes as well.

Although what usually implied by ‘urban structure’ is the street network of a settlement, we could say that despite its structural role in a spatial organisation, a street network is not ‘the structure’ in its own right. With land subdivision, street network is one of the elements of urban structure on which the individual building forms are composed.

This point is basically parallel to the statement made by R. Buckminster Fuller, an American systems theorist and the designer of the structural systems. As clearly argued by Fuller (1965), ‘structure is not a ‘thing’, it is not ‘solid’ (p. 68). It is the abstraction of a tactile (spatial or graphical) organisation. As a mental construct, it is open to be interpreted by different form-compositions.
With regards to abstraction, it is possible to classify structure into two: **syntactic (configurational) structure and logical (constitutional) structure.** On the one hand, the syntactic structures are the spatial configuration of a set of interconnected elements (i.e. street segments, buildings). Since it reduces streets into the lines or the elementary units into the points, the syntactic structure is a kind of dimensionless representation of form and space. Therefore, one cannot make metric measurement on it. The logical structures, on the other hand, are the graph of the constitutional units in a composition. Each unit is represented in a relational set independently of their size and shape. Vertices (nodes) and edges (links) are the basic elements of any logical structure. (see Figure 2.4)

**Figure 2.4.** The two types of the spatial structure of a hypothetical street layout: The syntactic (configurational) structure represented as axial map —middle— and the topological structure as a connectivity graph. Note that each single axis is converted into a node within the topological map in which the geometric metric properties of the network lose its validity.

*Symmetry, distributedness and depth* are the main properties of the syntactic (configurational) structures (Hillier et al., 1984: 94-97; Marshall, 2005: 165-169). In order to reveal these properties in terms of the qualities of *centrality (integration), betweenness (choice), connectivity and continuity* (Hillier, 2005; 2012; Marshall, 2005: 120-23), it is necessary to represent spatial configurations as constitutional (topological) structures.

**Figure 2.5.** The basic types of logical (mathematical) structures, which are also applied in spatial morphology and design (Source: Kotnik, 2011: 327)
Despite being the most common type in configurational morphology, topological structure is not the only one in the class of logical structures. Kotnik (2011) basically describes the three types of logical structures:

- **Organisational structures** which gives the quantitative characteristics of any (social or spatial) form in terms of sets, subdivisions and hierarchies,
- **Algebraic (combinatoric) structures** informing us of the (re)combinability of the elements within a set,
- **Topological structures** concern the connectedness and the proximity relations of the elements within a spatial composition (pp. 328-29). (see Figure 2.5)

The difference in the types of structure is not only relevant for analysing urban form, but also for design. As discussed by Kotnik (2011), the selection of the types of structure in design essentially characterises the basic design approach (p. 333). (See: Chapter 6)

In compositional design, spatial frameworks are the structures holding the whole setting together (Kasprisin, 2011: 68). Different spatial patterns categorised in terms of their internal order (i.e. tributary, grid), the route network or the cellular pattern of the property layout (the plots) of the cities can be considered as the syntactic structure on which the building units are connected and separated with/from each other through the links and/or edges. Performing as a framework, the street network and the plot layout might both connect and contain the compositional elements depending on our perception. In both cases, structure holds the intrinsic, mathematical and quantifiable properties of the spatial entity unlike form, which is associated with the extrinsic qualities like shape and surface (Nes, 2002: 12-13). In this respect, structure is conceived only by abstraction to reveal the intrinsic features of a spatial order.  (see Figure 2.6)

![Figure 2.6](image.png)
enough to obtain the complete constitutional information in the case of an urban composition. What depicted with syntactic structure, in Simon’s (1969) term, is a ‘state description’, which is not enough to reveal any complex system. As White (1965) discusses, though the term structure implies a state of equilibrium and stability, the static perception is not always relevant for the complex structures in physics. In this regard, he suggests understanding those structures by their few collective parameters (pp. 25-26). In the context of urban form as a complex system (see: the further discussion below), the collective parameters imply the ordering rules\(^4\) that characterise the generation of urban form.

To clarify the point, we can have a look at the sampling case given in Figure 2.1 and 2.3 above. The rich compositional variety observed in the collective fabric is not actually the consequence of the syntactic structure (i.e. the links of streets or the cells of plots), but the few building codes (ordering rules) used in that Tunisian community:

- maximisation of the area devoted to the house in the plot,
- courtyard within each unit,
- the dead-end streets each serving around six houses in the middle,
- indirect relation between the front doors and the courtyards,
- indirect co-positioning of the front doors along the alleys (Davis, 1999: 2002).

The analogy of chess, at that point, would be useful to uncover the relation between rule and the (urban) structure. As the chessboard defines the frame of the moves based on the rules of the game, the structure of the city frames the design operations based on the building rules. The street networks and the ownership patterns (plot layout) of the cities can be regarded within this structural analogy. Accordingly, urban structure is an abstract frame by which the agents’ building operations are conditioned.

Implying the syntactic framework of the cities, Herztberger (1991) argues that structure stands for the collective, general and more objective. It is subject to the public control for the common interest. Allowing various interpretations on itself, structure is usually more resilient than form (p. 94). As originally discussed by him, the medieval plazas converted from the Roman amphitheatres remaining in the same structural framework can be taken as a kind of typological example on that (Ibid, pp. 102-103). In larger context, this point reminds us the network structure of cities persisting despite the various operations made within the built fabric. The recognition of this morphological fact potentially provides an outlook for the definition of responsive design strategies congruent with the structural characteristics of urban form.

1.3 Pattern and fabric

‘Pattern’ is the repetitive configuration of the physical entities in space or that of the events in time (Christen, 2009: 72). The recognised repetitions and internal regularity based on a structural framework or rule-set is the fundamental condition of a pattern. Though not being identical, the repeating elements of a pattern are usually same in type and similar in form. Moreover, their configuration may not be mathematically perfect via the complete symmetry. Certainly, the repetitive organisation should be recognisable to call any intricate

As argued by Spreiregen (1965), urban pattern is the geometry, regular or irregular, formed by routes, spaces and buildings (p. 55). Seen in this definition, pattern as a physical entity involves all the compositional elements in its repetitive structure. The rule-based implication of the local design moves give rise to the global configuration of spaces (public, private or semi-public/private) and buildings. The aggregation of mass and space as the interacted elements of any form-composition generates urban patterns. In this context, the successive assimilation of the typical building units into a larger and ever-growing whole make the form being perceived as a generic fabric. Once the immediate spatial order of buildings (and streets) aggregates in time, a certain thematic (typical) continuity arises (Habraken, 1996: 8). The order at the constitutional level—being made up of similar parts in similar relations (Hillier, 1996: 187)—lets urban patterns recognisable as the distinct surfaces through the overall city fabric.\(^5\) (see Figure 2.7)

The interacting layers of the circulation network, open-space systems, building settings and their subdivision, and plot layout altogether compose urban pattern. The interactions between the layers are indirectly ensured by the building rules (i.e. on street width, plot depth, building height), which are all interrelated with another within a state of concurrence (Talen, 2012: 72). The type and density of correspondences between the constitutional layers basically determines the level of coherence of an urban pattern. (see Chapter 4) Within this

\(^5\) Grasping the unity between the distant objects, which are similar in size, shape and colour (material) is a fundamental operation of human perception (Arnheim, 1974: 79-80). This cognitive ability also enables us to recognise the spatial patterns as discrete morphological entities.
relational framework, the patterned application of spatial enclosure and hierarchy within the built fabric generates the characteristic urban fabrics under the influence of local building and design codes.

Referred interchangeably with ‘tissue’ and ‘texture’ (Kropf, 1996; Osmond, 2009), urban fabric broadly refers to the physical expression of the complex appropriation, control and regulation patterns of the societies on urban space.\(^6\) Despite being the most basic unit of analysis in urban morphology, urban fabric (or ‘tissue’) has various definitions in the literature:

- ‘building fabric’: “the actual three-dimensional mark of physical structures on the land ownership parcel” (Kostof, 1991: 26).
- ‘tessutto urbano’: “the conceptual project corresponding the aggregative system of several building types within a homogenous historical domain” (Caniggia and Maffei: 1979:247).
- ‘urban tissue’: “the superimposition of several structures acting at different scales, but which appears as a system with linkages in each part of the city” (Panerai et al., 2004: 158).

The hierarchal synthesis of all components which create an organic whole having distinct levels of resolutions (Kropf: 1996: 252).

“arrangement of lots, blocks and streets, or the demarcation of the owned space of the city” (Scheer, 2010: 47-48).

The diversity within the definitions also reflects the difficulty to identify the urban fabrics in terms of their basic properties (i.e. frequency, rhythm, closeness), which are hardly recognizable via mere visual observation as in the case of form-composition. With reference to the original meaning of fabric, ‘any body formed by the conjunction of dissimilar parts’ (OED, 2012), we can consider urban fabric as the collective body of the elementary forms and spaces (i.e. buildings and streets) composed within a patterned relationship. In this context, an urban fabric is the tactile and volumetric manifestation of urban pattern, as a texture of the typical compound units (grain).\(^7\) From this perspective, one could suggest that although singular form-compositions as the product of a conscious individual design have definite a form and shape, we cannot describe urban fabric with an explicit formal language. As plainly expressed by Habraken (2000), “urban fabric is mainly a structure of interrelations and continuities. The house may project a distinct exterior shape, but urban fabric is all internal experience” (p. 287).

Unlike form-composition, which is a deliberate product of individual design or making, fabric is an emergent artefact. Its embodiment takes a long period of time through the piecemeal aggregations and transformations involving many particular form-compositions (Alexander, 1979: 493-510). In this respect, with reference to Moholy-Nagy’s (1968) quotation given in the beginning of the chapter, we would argue that man’s unfulfilled vision of order produced form, but only men’s unpredictable, multiple interactions produced fabric.

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\(^6\) The term, urban fabric has not a wide area of usage in urban literature. While it is shortly defined as “the physical, built form of an urban place” in the Dictionary of Urbanism (Cowan, 2005); in the Glossary on urban morphology (Larkham et al., 1990) the ‘built fabric’ connotes “the building material and architectural style in which a structure or group of structures is constructed” instead of as a term form collective urban form. See: http://www.urbanform.org/glossary.html, accessed in December 2011.

\(^7\) Speiregen (1965) suggests an alternative definition of ‘grain’ as the degree of fineness or coarseness, rather than as the element of urban fabric.
The point is that despite the crucial distinction between design and emergence, the ornaments as the most archaic form of pattern formation and urban fabric have the same generative structure in essence. Though a stonemason carving an intricate relief or a Turkish carpet weaver aims to achieve a ‘meaningful’ overall geometry at the end (unlike the case in urban formation), they do not operate on a pre-conceived blueprint, but on a simple algorithmic rule-set which generates the harmonious whole, at the end. (see Figure 2.8) In this regards, pattern formation in all scale-levels is an emergent phenomenon.

In that framework, urban fabric requires a different way of thinking than the object-form, which can be apprehended as totality with its definite boundary (Lozano, 1991: 38). Rather than a clear outline, the ordered relationships between the urban elements, the colonnade, the square, street and the building units (i.e. entrances, bay windows) let urban patterns be perceived as an intelligibly intricate whole. The continuous stimuli with the changing fragments that we receive from inside ultimately provide us a holistic urban image on the districts of the city (Steenbergen et al., 2002: 15).

The elements generating the pattern are not identical but exhibit certain typological similarities. Like in all living systems, although the constitutional units are same in their fundamental features (i.e. internal arrangement), they slightly differ each other in terms of size, shape and appearance. (Rowland, 1964: 52). That basic quality called ‘self-similarity’ is also the condition for urban patterns in which no singular design application can be fully the same in form as the earlier. The natural tendency to divergence due to the intrinsic disability of human mind to reproduce the same type of artefacts perfectly (Ibid, p. 56; Steadman, 1979: 71-98) can be regarded as the evolutionary basis of the pleasant variation within the emergent urban fabrics.

1.4 A relational framework

To clarify the implicit relationships between the major morphological concepts discussed, reflecting on them within one conceptual framework would be useful. After such a long conceptual introduction given above, the reader can still have a vague idea about what is essentially concerned within each category; form, structure and pattern. For this reason, the literary expressions of the concepts through verbal representation would help us to elucidate the specific content of each category. Reading Italo Calvino’s (1972) celebrated novel, Invisible Cities, from that perspective, one can easily trace the specific uses of the categories in the representation of space. (see Table 2.2)
Table 2.2. The literary expressions of form, structure and pattern: some fragments from Italo Calvino’s novel, *Invisible Cities* (1972)

| form | “… shall I attempt to describe Zaira, city of high bastions. I could tell you how many steps make up the streets rising like stairways, and the degree of the arcades’ curves, and what kind of zinc scales cover the roofs” (Calvino, 1972: 9) |
| structure | “… There are two ways of describing the city of Dorothea: you can say that four aluminium towers rise from its walls flanking seven gates with spring operated drawbridges that span the moat whose water feeds four green canals which cross the city, dividing it into nine quarters..” (Ibid: 8) |
| pattern | “… he is walking along the streets and he remembers the order by which the copper clock follows the barber’s striped awning, then the fountain with the nine jets, …, the Turkish bath, the cafe at the corner, the alley that leads to the harbor. This city which cannot be expunged from the mind is like an armature, a honeycomb in whose cells each of us can place the things he wants to remember.” (Ibid: 13) |

As seen in Calvino’s (1972) narratives, form is highly associated with the physical elements and their compositions, which are subject to the limits of human perception. It is expressible by signs and symbols through analogies and metaphors. Structure, on the other hand is all about the order conceived, a particular state of regulation, arrangement and disposition of the elements within a composition. Its literary expressions mainly concern access and separation in space. Finally, thinking about pattern is to discern the intrinsic spatial repetitions and relations governing the moves and interactions in space. The successive recognition of the recurring form-components and the spatial repetitions ends up with a recognisable image of the whole fabric.

We can narrate form, structure and pattern with the linguistic domains of syntax, semantics and pragmatics respectively. From this perspective, if ‘form’ is the semantic expression of an artefact (Bill, 1957: 103) through the encoded signs and symbols of a (visual or verbal) language, ‘structure’ belongs to the domain of syntax dealing with the connected
order or system of things, constitution of a body (OED, 2012). Accordingly, form can be taken as the meaningful expression of a syntactic order. Nevertheless, while an object-form (i.e. building) can be characterised with a singular meaning (i.e. sanctity, homeness), the construction of the meaning of urban form is more an indirect, open and collective process. It requires certain congruence to be constructed between form and activity in the longue durée within a wider spatial context (Steinitz, 1968). That calls for the notion of ‘pattern’ within the field of pragmatics concerned with the human action and use. Therefore, not the form and structure, but essentially the internal pattern of a settlement does condition, if not determines, the shared meaning of urban space. In this sense, urban pattern does contribute to the collective construction of meaning, as an object of pragmatics. Then, social meaning is not something consciously imposed on space, but basically emerges out of the relationships in the physical configuration [urban pattern][8] (Hiller et al., 1984: 16).

In the light of the brief discussion cited above, we could construct a general/relational framework on the formation of urban patterns. (see Figure 2.9)

![Conceptual framework of urban formation based on the relationships between the fundamental categories of the (urban) morphology](image)

Figure 2.9. Conceptual framework of urban formation based on the relationships between the fundamental categories of the (urban) morphology

As Habraken (1985) argues, (spatial) form is an object that invites performance and behaviour of people (p. 92). This is very basis of any human artefact motivated by the satisfaction of certain needs and aspirations (Banz, 1970: 89). Being oriented by a desired behaviour (i.e. function or activity), designing a spatial form is a purposeful act. Yet, there is no direct relation between the intended spatial performance and the actual urban form. Form, as an instance, is articulated in a configurative framework (structure) or realized in accordance with a certain set of rules. Both rule and structure aims for ensuring the desired (future) performance in use.[9] Rule and structure operate in the domain of order, the logic of construction (Ball, 2009: 21). In this context, form can be considered as the spatial embodiment of an ordering system depending on the abstract rules (Hillier and Hanson, 1984: 34) within a syntactic structure. In other words, form is the material expression of the rule and structure in a specific context. Therefore, the term, ‘order’ does not necessarily imply the geometric organisation of space merely for the sake of symmetry, balance or visual harmony [as argued

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8 Such a framework essentially contradicts with the idea of meaning as the underlying story of structure and (urban) design as crafting of meaning into form (Kasprisin, 2011: 8-9), and to the simplistic definition of urban form as a product of ‘urban meaning’ and functions (Castells, 1983: 24). Instead, such a view delimits the notion of singular meaning into the form of the individual design practice (i.e. architectural design) and addresses the construction of social meaning throughout the collective and evolutionary production of urban form.

9 In the context of urban design, the intended user performance within the spatial form is expressed in explicit measures and instructions called ‘programme’.
by Hanson (1989) in opposition to ‘structure’]. Instead, order broadly connotes the state of regulation by morphological rules and structures, which can involve in the emergence of complex spatial patterns rather than a static disposition.\[10\]

While the transition from order to form would be called design, the move from form-composition to pattern can be called generation. At this point, Ball’s (2009) emphasis on the distinction between form and pattern is important. Accordingly, while pattern is a multiple phenomenon typically extended in space, form is more an individual affair, bounded and finite. (p. 19). In this regard, as opposed to the instantaneous character of composition (in design), the temporal character of the pattern is one of the major distinction points between form and pattern. While a form-composition can be designed in accordance with a geometric order in a certain time-period, the spatial pattern is generated over the long run via the codes, the shared explicit rules of building. The generative codes\[11\] are utilised to reproduce the singular form-compositions within the repetitive and intelligible system of a pattern. What we call ‘urban fabric’, in this context, is no more than the emerging physical expression of a spatial pattern.

With an analogy to linguistics, the relation between structure and form is similar to that between langue (language) and parole (speech) discussed by F. Saussure, a Swiss linguist. For him, while langue is the whole linguistic system of a language with a full vocabulary, parole is the actual individual expression of the language in speech or writing (Palmer, 1997: 22). Likewise, form is a parole-like instantiation of a generic order via a structure and rule-system. Then again, form can be analysed in terms of structure and rule. In this view, while the form as instance is individual (like speech), the spatial structure and rule is essentially generic and generative like language.

With reference to the subtle distinction between perception and cognition,\[12\] we would state that an urban fabric, as a complex artefact, is either perceived as form or conceived as structure and rule-set due to the different morpho-logical levels it exposes as given in the conceptual framework. (see Figure 2.9) As also discussed by Lefebvre (1974), form is subject to the direct spatial experience and sensation, whereas structure is conceivable only through (mental) representation (p. 369). Representation here implies the act of abstraction in order to clarify the syntactic relations within the fabric.

Our conceptual framework on pattern formation suggests some complementary issues on design and morphology for further reflections. The each morphological category discussed basically corresponds to a certain type of creative actions. Spatial organization, at the first level, entails ordering, logical and comprehensible definition of the structure (configuration) or procedure (rules) (Marshall, 2009: 28-30). The basic act of form-composition, at the second level, is articulation, creation of mass and space by giving the (ordered) spatial units the right dimension and correct measure of closeness accommodating the intended

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10 The choice between rule and structure, the two ordering tools also represents the different design approaches. While generating form via the configurative rules suggests a rule-based design approach, designing the structure to facilitate the successive formation on it refers to the structuralist design methods. Designing the form without involving into ordering with rules or structures implies compositional design, which entails formalism in general.

11 In Hillier and Hanson’s (1984) definition, code is an underlying system of rules by which spatio-temporal events are to be correlated and interpreted (pp. 203). In this definition, the ‘spatio-temporal events’ correspond to the individual acts of design and building as ‘instances’.

12 As clearly defined by Lozano (1991) in spatial context, perception is an act of apprehending by mind and senses, of observing, whereas cognition is the act consciously gaining information [mainly via abstraction] (pp. 260).
relations (Hertzberger, 1991: 193). By the same token, the corresponding actions for pattern formation are *generation* and *emergence* at the ultimate level. Unless it is not totally set by an authority in a short time span, the formation of urban pattern is not subject to a total control by form-articulation, but to the stochastic application of the building codes through collective generation. In this framework, (trans)formation of the collective urban form essentially comprises the parallel states, *behavior*, *order*, *instance* and *concurrency* in an open-system.

What we call ‘design’ basically involves both of those two operations, the spatial organization (ordering) and the articulation of form-composition in a specific level of scale (Schumacher, 2011: 164). While composition comprises the deliberate disposition of a small number of building elements within a relational contiguity (Ibid, p.175), organization (ordering) implicates framing the spatial composition by delineating the types of the units to be involved and their allowable relations to be built up. The term framing here connotes a very basic operation of spatial design, which includes the definition of boundaries, the ordered relationships between inside and outside, and the access conditions. The different set of frames altogether constitutes the framework in which the further design moves are operated[13] (Unwin, 1997: 104).

2. Nature of Urban Form and Formation

In the second part of the chapter, the essential properties of urban form and formation is aimed to be revealed. For this purpose, the collective complex, evolutionary, typological, ruled-based, law-governed and control-driven nature of the phenomenon is delineated as the major components of the discussion.

2.1 Collective:

Unless a corporate body develops the complete settlement via an imposed network structure or the mass-produced building units, urban fabrics are essentially a kind of collective product. They emerge as the recursive application of the singular design instances on individual parcels based on the common building codes, within a common space-structure (i.e. the open space network). Diverse individual acts of design and building are involved in the long-term production and transformation of urban form within a shared process (Davis, 1999: 5). Although many designers and planners tend to consider it a kind of ‘fragmentation’ with a negative connotation, the intrinsic multiplicity in the responsibility of design and building at different levels is a very nature of urban formation (Habraken, 1985: 102-103), which would be utilised as a conscious strategy for designing morphological diversity.

As the one who originally conceptualised ‘collective form’, F. Maki argues that urban form cannot be subject to the single design operation within a closed architectural field, but the interplay of forms in an open framework (Maki, 1964; D’Hooghe, 2010: 44-47). Even the most ambitious plans mastering the urban form under the provision of central authority mostly face many morphological deviations from the ideal scheme incrementally due to the further interventions by many agencies over time. In this sense, collectivity in form

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13 By reminding ‘framian’, the etymological root of the word ‘frame’, Unwin (1997) argues the provision of support as the essential aim of ‘framing’ in design (pp, 104)
production\textsuperscript{[14]} does not imply a group-action in a certain time-period, but basically a long-term and distributed process, which cannot be centrally operated in the long run.

Since urban pattern is formed upon the structure owned and utilised as a common entity, its formation is subject to the collective interest. Therefore, any single design action in the fabric is always monitored with regards to its future impact on its immediate or larger collective context.

As also pointed out above, urban form is recombinant in morphological sense (Shane, 2005). Yet combination is not the key feature in urban typo-morphology, but the collectiveness. The different forms of the collective form production basically characterise the type of an urban fabric.

The feature of collectivity is another factor that makes urban form contrary to the notion of ‘unit/object form’, which is designed, built or utilised by a single agency. As also originally argued by Marshall (2009), as opposed to the corporate object, in which the sub-units support the central function and purpose of the whole, a collective entity is composed by the units which are the products of distributed or shared intelligence (p. 135). Within the same view, Banz (1970) defines ‘collective form’ in a scalar framework. As each scale-level connotes the different production factors, it addresses community as the agent of collective spatial production. (see Table 2.3)

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|}
\hline
\textbf{Limiting dimension (nominal radius)} & \textbf{Intimate scale} & \textbf{Personal scale} & \textbf{Public scale} & \textbf{Macro scale} \\
\hline
& 10 m & 30 m & 100 m-1 km & Unlimited \\
\hline
\textbf{Form category} & Unit form & Unit form & Collective form & Urban image \\
\hline
\textbf{Main form determinant} & Individual needs & Group needs & Collective needs & Human needs \\
\hline
\end{tabular}
\caption{Unit from, collective form and macro-from (Adapted from: Banz, 1970: 104)}
\end{table}

\textsuperscript{14} The term, ‘collective’ here does not have a connotation of ‘communality’ in terms of shared (common) ownership, but essentially to the state of acting or behaving simultaneously, if not identically.
The morphological distinction between *figure* (as individual form) and *fabric* (as collective form) also signifies a socio-political antinomy in urbanism. In the history, many absolute (or even democratic) authorities have tended to initiate and impose planning and design programmes leaving some figure-like permanent marks on city fabrics (i.e. monumental buildings, building complexes or ceremonial axes).\(^{15}\) Nonetheless, the product of these interventions could not dominate the complete form of the cities through the ever growing and (internally) transforming body of urban fabric at all. All the aerial images of the cities basically display the supremacy of collective urban fabric over small portion of singular form-compositions [i.e. ensembles, parks and squares] as particular design product. (see Figure 2.10) We can claim that such a point basically reveals the innate capacity of man in space production within the collective body of the built form.\(^{16}\)

Finally, it should be noted that collectivity of pattern formation does not mean a kind of guaranteed harmony in societal level. Given the condition of conflicting interests between the groups and individuals, collective urban form is always subject to a constant game of conflict resolved by design and politics either in formal (planning) or informal (negotiation) processes.

### 2.2 Complex:

If it does not denote the fully controlled group act towards a particular end, collectivity implies the collection of individual actions preforming within a certain rule-system, which is basically the condition of human environment. This point unavoidably brings us to the idea of complexity as a state of uncertainty within collective action.

In its generic use, the term complexity is taken as a normative concept by being confused with the notions of diversity and variation in urban design.\(^{17}\) However, complexity does not principally refer to the physical nature of form as a state, but to the formation of an adaptive system as a process (Simon, 1969: 210). That means, when we claim complexity of urban form, we basically mean the complexity of its formation rather than its complicated spatial configuration.\(^{18}\)

From this perspective, urban patterns can be considered as the complex systems. Originally arguing the city in terms of the idea of ‘organised complexity’, Jacobs (1961) presents the multiplicity of choice experienced with the emergent diversity of the urban elements (i.e. street, block and building) as the source of urban complexity. In this sense, she suggested us

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15 This is basically still the case in contemporary capitalist democracy in which large scale operations are executed within urban fabric in the form of so-called ‘big architecture.

16 For a counter argument, see: Rossi, A. (1982) *The Architecture of the City*, Cambridge, Massachusetts: The MIT Press. In his seminal book, Rossi (1982) conceptualises urban form with the distinction between *dwellings* and *the primary elements*. For him, while primary elements as the monuments ensure the spatial permanence, dwellings are relatively more fragile and temporary though they always cover the main portion of the total surface area.


18 The point is that a simply conceived urban pattern may theoretically be the product of the complex urban processes.
to introduce a kind of inductive reasoning about the city form by considering the bottom-up interactions rather than the statistically reducible states (pp. 428-48).

In the light of the theoretical influence of J. Jacobs, many authors have elaborated the complex nature of urban form in different aspects. From them, Batty (2007) argues complexity in terms of the large number of variables and local interactions involved and the unpredictable global (morphological) behaviours emerged. According to him, order and structure is no more than the global entity emerging from the bottom-up spontaneous actions of the system components. Compositional variations, novelty and surprise are all the product of unpredictable interactions between the individuals acting on his/her own parcel in instant relation to the neighbouring one.\[19\]

In a parallel view, Marshall (2009) emphasises the organic kind of complexity of urban form, which differentiate itself from the machines in which the ‘complicated’ setting and its ultimate performance is pre-conceived. Unlikely, urban complexity entails human agency, which cannot conceive and control the overall relations between the ‘building-blocks’ (components) despite putting conscious actions on the local scale \[20\] (pp. 130-32). The recognition of the complex nature of physical form of the cities, in this sense, is critical to specify the relevant scale of (design) operations in spatial planning.

The complex relations between form-components is conceptualised by Salingaros (2000) with the notion of ‘coupling’. In terms of the interaction between the different elements (i.e. pavements, walls, building units), the strong connections at the lower scales form the module-like units (i.e. streets and blocks) which in turn couple with the same kind of modules creating a coherent whole on the larger scale. Such a morphological process is usually observed in traditional urbanism in which coupling is active even at the level of single plot on which the individual reproduces its own territory in relation to the neighbouring unit s (Hakim, 2008).

The complex nature of urban form requires a multi-layered way of morpho-logics. Since the complex systems end up with the (dynamic) wholes, which expose a different character from the sum of the parts, the emergent urban fabrics cannot be characterised by reducing them into its smaller portions.\[21\] This is the point which should be considered specifically by (urban) morphological analysts. 

2.3 Evolutionary:

There is no possibility for the generation of new species independent from the existing tree of life in evolution. Each species descends from some previous life forms through countless transitional variations. This is very nature of the gradual and continuous process of evolution (Mayr, 2002: 94). The continuity between predecessors and descendants through variation is principally valid for the world of artificial as well (Marshall, 2009: 173). Even the

20 While emphasising the organic nature of urban complexity, Marshall (2009) concludes with the idea of ‘city as an organism’. Due to the competitive components within urban form(ation) [unlike the organisms in which all the ‘organs’ serve for the interest of the whole body], he rejects this settled analogy.
21 For instance, the input on block formation does not adequately inform us about the pattern of the neighbourhood.
most groundbreaking inventions are the descendants of the early forms of artifacts, on which
the purposeful or unintentional variations applied (Steadman, 1979). Such a necessary con-
tinuity in artificial evolution can be directly related to the nature of design thinking, which
unavoidably relies on the precedents, the existing building elements and the past solutions
as the necessary (informational) input for the new designs proposals (Colquhoun, 1969). As
a product of various individual design acts, urban form does not suggest an exemption from
this fact. Resting upon the existing body of knowledge about building, the individuals or the
corporate agents mostly tend to reinterpret the precedents within the existing built environ-
ment performing like a gene pool for the new recombinations and mutations in design. Due
to the inherited tendency to deviate the ideal model through instancing (intentionally or by
unavoidable mistakes), the individual interpretations are not perfectly alike. In this context,
a ‘natural’ tendency to typological variation within a morphological unity is observed, un-
less a kind of radical intervention is applied into the given context. (see Figure 2.11)

Figure 2.11. Development and transformation of central Glasgow: The growth of city fabric reveals
not only the structural continuity but also the ruptures (‘mutations’) in building typology (Source:
Evans, 1999: 346)

Explicitly arguing on the same case of Glasgow given above, Marshall (2009) claims
that what makes such a formation evolutionary is essentially the open-ended character of
the development of which course could not be predicted at the outset as in the case of an
organism ultimatly achiving a model-form. In this view, the apperent changes in the body of
urban fabric [the phenotype (O.C.)] is the result of the changes in code(s), units and scale of

This point brings us to the conceptual distinction made by Hillier and Leaman (1974).
In terms of morphology and design, the authors argues a distinction between ‘local time’
and ‘evolutionary time’ (p. 8). While the local time refers to the immediate act of design (and use), the evolutionary time applies for the long-term spatial being of the built environment. As seen in Figure 2.11, while cities grow in evolutionary time, they also expose as series of internal transformation as the aggregation of individual (re)developments in local time. In the long-run process, it is possible to observe the different levels of resistance of the urban form-components to change. While the streets and open-space structure persist more, the inhabitants continuously alter the built fabric (Scheer, 2001: 28-37). With reference to the actual tendency to variation mentioned above, the built fabric always incline to the evolutionary transformations through the gradual change in elementary typologies.

Nevertheless, we should note that when we talk about the evolution of form, we do not mean the so-called evolution of any specific built-form (as an instance), but the embedded types (of the various building elements) within the form itself. Like the fact that the individuals do not evolve, but their genotypes, the form of cities do not evolve, but they truly grow and transform through the evolved building typologies.

In this sense, unlike the individual organisms, cities live their evolution within their own developmental process. Then, it would not be wrong to claim that developmental (ontogenetic) and evolutionary (phylogenetic) processes run parallel in urban formation. Both mutation and inheritance take place in the form of innovation and tradition through the long life cycles of human settlements (Marshall, 2009: 245-47). At that point, the critical question would be about the exact definition of evolutionary change through urban formation. Principally, we can consider the fundamental transformations in the genotypic characteristics of urban elements as the moment of variation in evolutionary terms. This happens either by the accumulation of small changes in time or the radical ruptures by innovation. This point unavoidably leads us to the idea of type and typology.

2.4 Typological:

Morphological elements of urban form and their organisations show certain characteristics of family resemblance. In accordance with the generic and flexible nature of ‘type’ (Habraken, 1988b), the typical components of urban form are reproduced by the diverse individual interpretations, (re)combinations and variations over the long time periods. (see Figure 2.12) Urban patterns are actually the end-result of the continuous combinatorial processes of various typologies following certain morphological (aggregation) rules (Jea-Hoon, 1994: 89). In this context, the recognition of a certain type does not occur at the level of urban form, but at the level of building units of which its accumulative effect lets urban fabric come into the view in a certain image.

23 For further discussion on the subtle distinction between developmental and evolutionary conceptions in urban morphology, planning an design, see: Kropf (2001) and Marshall (2009)
2. CONCEPTUALISATIONS ON COLLECTIVE URBAN FORM & FORMATION

Figure 2.12. Variations within the single theme and typology, the Tunisian 'courtyard-house': The recurrent use of certain building typology ends up with a characteristic urban typo-morphology (illustrated in Figure 2.1). Note the uniformity around the same organisational principle allowing many compositional alternations. (Davis, 1999: 138).

Then what is the source of urban typologies? Typicality of urban form does not derive from the search for an ideal image of society and space (with a naïve understanding of the notion), but it is basically due to the shared knowledge of building as a generative factor informing the singular designs with the codes of spatial organisation (Habraken, 1985: 24-27). For Caniggia et al. (1979), type is a kind of undesigned concept, the synthesis of building culture in a place and era oriented, in the mind of each individual builder. (p. 75). As the shared generative knowledge, type basically represents a kind of social contract, a widely accepted routine for the collective operation of building in urban context. The social construction of a type through the successive generations in the form of ‘collective codification’ (Gauthier, 2005) basically stands for the collective and evolutionary nature of urban form as the other complementary features mentioned above.

‘Type’ in urbanism is essentially an evolutionary concept, for being emergent rather than being instantaneously invented (Scheer, 2010: 6). This is because of the intrinsic nature of design thinking which to a large extent relies on the existing catalogue of spatial types and typologies trough their already proven performances[24] (Colquhoun, 1969; Jones, 2001). The recognised link between type and (artificial) evolution would also explain the relevance of type in built environment in terms of the temporal reliance on particular systems (i.e. construction and design) and their adaptive transformations with the technological advancements in time. Urban typologies endure as far as they respond to the immediate conditions in which they are reproduced. The changes in the external conditions (i.e. economy, technology or culture) trigger a series of transformation, which are usually in the form of gradual

adaptations (Ibid, pp. 27-46).

Performing like a genetic code, type conveys the generic knowledge about the elements and their relations. In this regard, type does not only ensure the consistence in space but also the permanence in time through the slow changes and adaptations (Davis, 1999: 149-154). Therefore it is possible to consider type as an evolutionary component of urban form since the urban typological processes comprise the fundamental mechanisms like descent, variation and selection (Kropf, 2001: 37).

For Mitchell (1990), the complex constructions of various kinds of human artefacts (including cities -O.C.-) are the assemblages of the instances interpreted from a specified set of types (p. 86). It means that the perceived form of built environment in a specific context is constituted by the different expressions of the same genes through typological variations. While the essential properties of the different instances are the same, their accidental properties may vary within the same typology.

As the principle of form, type offers a combination of various systems that entail the spatial, physical (material) and/or stylistic properties. With such an embedded (tacit) knowledge, type enables us to communicate around the common themes in building. (Habraken, 1987a; 1988b). Since it simplifies the various thematic (conventional) rules in a single, abstract and comprehensible image, type indeed acts as a conveyor of the shared knowledge to the generations. This can be regarded as the basic cognitive factor, which makes city building a collective phenomenon.

Nonetheless, typicality of urban form cannot be fully described by the notion of type as a code of collective knowledge. Though such a formulation is relevant to the traditional societies based on the craftsmen’s imitations of the shared models (Lozano, 1990: 14), it falls insufficient (and even romantic) for the modern societies acting upon a fragmented pattern of values and mental images. Instead, the typicality of urban form in the modern metropolis is ensured by a series of standard norms and regulations on various systems such as construction, transport or land-ownership that altogether derive a certain collective typology in urban context.

2.5 Rule-based:

In design of artefacts, the mind develops and obeys its own rules. This is very basis of design thinking while managing the inherent problem of complexity (Habraken, 1985: 78). In urban context, the relevance of the point derives from the spatial forms that are comprised by the systems (i.e. circulation, subdivision) defined by the explicit rule sets (Ibid, pp. 39-40). The basic need for rule in designing the different systems of urban form within a standardised framework is met by codes (Ben-Joseph, 2005). Transmitting the controller’s message for the desired performance of spatial compositions, codes are the explicit representation of building rules. Since they are executed by the following generations [with occasional reforms], codes of the cities ensure a certain urban typology in its applied context. (see Figure 2.13)
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Figure 2.13. The 'typical' fabric of the modern Turkish cities, Istanbul –left-, Ankara –middle- and Mersin –right-. Note the apparent typo-morphological similarity between the different cities developed through the same (national) regulative system. (Source: The author’s personal archive, 2001-)

The rules on various functional systems altogether generating the specific form-typologies are the basic input for urban pattern formation. The collective character of urban form entailing the involvement of the various actors during the production process requires a common basis of coordination. In order to maintain the integrity of discrete actions, the shared knowledge of building culture is formalised as a rule system. Urban rules can be either in the form of implicit (social) conducts, customs and rituals or the explicit codes of formal regulation (Davis, 1999: 15; 202).

The use of rules in pattern formation is mainly for resolving the conflicting interests, which occasionally arise in the production of collective urban form and guaranteeing both the individual (design) freedom and the common interest through the development of urban property (Lehnerer, 2009: 64-65). In this context, rules basically control what to get built, where and in which form and/or processes. Without any pre-conception of what the overall (collective) form looks like, urban rules condition the emerging image of the cities (Talen, 2012: 5). Therefore, their restricted (local) operations have a cumulative effect on city form. The successive application of a simple rule at the lower scale-level (i.e. distancing to control building heights) in turn defines the overall character of urban form (Ibid, p. 6). Carmona et al. (2006) argues this point in terms of the distinction between the scale of intervention and the scale of intention of an urban rule in the context of design codes (p. 240).

Centralisation of social norms on building is realised when the shared conducts and principles are codified as standards. Then the rules are utilised to coordinate the land development and to regulate the production of the built fabric through various design applications. Though it had derived from various motivations such as the symbolism of religion and power (Ben-Joseph, 2005: 6-24), the modern urban rules have essentially operated within in the domain of (instrumental) rationality in terms of the functional aspects of form (i.e. public health and safety).

Traditional (informal) building rules, on the other hand, are not the product of a conscious standardisation of formal/functional imperatives. Within a local area of application (i.e. building, street frontage), they have been used for maximising the utility of land and equity in space or ensure the realisation of cultural norms (i.e. privacy) (Davis, 1999: 202-204). Instead of prescribing the ultimate form, traditional codes generally put prescriptive and performative rules, which provide a real possibility for various compositional interpreta-
tions (Hakim, 2008).

We can classify urban rules in general into two: the procedural rules controlling the building and construction process, and the formal rules defining the desired form as an end product of design. The procedural rules involve the rules which influence the form(ation) indirectly (i.e. financing rules and design review). As the most common formal urban rules, the standards, guidelines and the design codes give direct reference to the physical design form. Cited respectively from generic to the specific context of planning and design, the kinds of urban rules and their relative dominance in design-control differentiate through the planning regimes in which the rules operate. (see Chapter 4)

2.6 Law-governed:

To Hillier (1985), the regularities in spatial form does not only result from the rules involved, but also from their cooperation with the structural laws delimiting the morphological possibilities in design. The point made about the law-like regularities of urban form (as an artificial system) actually ensures the scientific relevance of morphology, the spatial logic of form. The morphological necessities limited by the ‘configurational possibilities’ within urban form are shared by different spatial cultures (Hillier and Hanson, 1983). This enables us to derive certain laws underlying urban morphology. Nonetheless, the morphological laws of urban formation are not like the ones in natural science that are expressible with mathematical precision on which the whole scientific circle ultimately agrees. Though being tested by the explicit models, the rule-like generalisations about the city form remain mostly as generic principles and yet to be gained a common consent in order to be called ‘law’ scientifically. In this context, without discussing their relevance it is possible to cite some ‘morphological laws’, which have achieved more or less a wide acceptance in the literature. As you see below, some statements, which are argued as the lawful morphological features do occasionally contradict with another.

- Comprising the same structural characteristic of complex systems, urban form has a hierarchal organisation (Habraken, 1987a: 11). Spatial patterns contain an embedded control hierarchy involving five level of physical (sub)systems, city structure, district, building, floor plan and interior arrangement. Each level basically constitutes a functional sub-whole constituted by the lower levels, while serving and holding the one below (Habraken, 1985: 110; 2000: 65). The relation between the levels is asymmetrical. For instance, the configuration of buildings does not make a street, but it is mainly conditioned by the street layout within a dependency relationship (Habraken, 1987b: 10). Therefore, the higher levels have the necessary priority and dominance over the lower ones in design and formation. What unpredictably emergences in urban formation could only be the lower-level relationships within the given (high-level) framework (Ibid, p. 19).

- Naturally grown cities have the intrinsic structure of semi-lattice rather than a tree. A living urban fabric is organised as a complex system made by the sets of elements interacting each other through the inner binding forces. Each subset overlaps with another and form a coherent whole instead of comprising a simple tree-like hierarchy (Alexander, 1966).

- Coherent urban structures are made of the components on the small scale and obey

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25 Hillier (1989) classifies urban morphological laws as follow: 1. laws for generation of urban form (laws of the object itself), 2. laws of how society uses the laws of the object to give spatial form to the social relations (the laws from society to urban form), and 3. laws of how urban form affects the society (laws from urban to society).
the rule of the organisational hierarchies in complex systems. Accordingly, a higher scale requires small scales to be formed. That means higher levels in the spatial patterns depend on the lower ones. The assemblage of urban fabric therefore proceeds from small to large, not the other way around (Salingaros, 2000).

- Most of the spaces in cities are linear and compose the overall system of spatial continuity in the form of intersecting rings called ‘beady ring’ on which there are always alternative routes between the different nodes of the overall structure (Hillier et al, 1984, Hillier, 1985: 165).

- Due to the limited configurational possibilities within urban form in terms of the fundamental paradox between compactness and linearity, emergent process of spatial structure tends to optimise the conflicting relation between integration and visibility. Optimisation of these two factors ends up with an overall shape of cities (deformed wheel) which is ‘nearly invariant’ for many towns in spite of topographic differences (Hiller, 1996: 264-68; Hillier, 2012: 134-36). Accordingly, each city has an ‘integration core’ which is connected to the edge via quasi-radial long lines (spokes) in several directions (Hillier, 1989; 2002).

- The aspatial structure of cities is made up of the foreground of few long lines and the background of the large number of small lines. While the foreground network maximises the global integration and movement, the background network restrict the global accesses, and constitutes the locally integrated tissues supporting residential culture. The conceived configurational duality within a whole spatial structure makes the settlements intelligible for human cognition (Hillier, 2002; 2005).

- As argued by D’arcy Thompson’s (1917) in the context of natural forms, ‘growth creates, but form limits growth’ does also apply to the spatial form (Lozano, 1999: 99). As growth dictates change in form within a certain structural threshold, settlements also have to engage the typo-morphological change through getting larger in size. The emerging programmes imposed by the increase in population, which cannot be responded by the existing fabric mainly trigger that transformation. This can be regarded as structural adaptation of urban form beyond certain limits (Ibid, pp. 114-117).

- Production of urban form follows three basic ‘laws of urban topology’: (1.) Contiguity of urban space: all public space connected is connected to a single contiguous system, (2.) Adjacency of private space: every private plot connects to the public space, (3.) ‘Gravity: contiguity of building with the ground plan: all urban floor space ultimately connects to a single plane (Steadman and Marshall, 2005: 7-8).

2.7 Control-driven:

It would not be wrong to associate form and formation with the inherent motivation of men to control the natural and human environment. By defining control with reference to (trans)formation of space (i.e. introducing physical elements into space, their displacement and removal), Habraken (2000) argues the levels of physical systems as the territorial control domains of the society (pp. 8-11). In each level, design professionals and users claim certain responsibilities of control. The different form-typologies, in this sense, can also be characterised in terms of the different types and grain of control patterns.

Territoriality in terms of the antagonistic relation between the public domain and the private space is a fundamental aspect of control in the formation of urban fabrics. The
configuration and the materialisation of the built environment, which define the hierarchy of demarcation, personalisation and control within urban space can be regarded as the territorial rules in design control (Lang, 1987: 156). In this sense, the responsiveness of urban design to the territorial relations mainly depends on the consideration about the control patterns in urban form.

For Günay (1997), the material foundation of control in urbanism is the property relations on urban land. The scale and magnitude of control over urban space is mainly conditioned by the type of ownership in terms of being public, private or communal; small or large; and being individual or shared (p. 6). This view basically considers physical planning and design as the ‘re-arrangement of property rights’ in form and space (Ibid, pp. 27). Regarding the rights and responsibilities in use, Habraken (2000) tends to disconnect the direct relation between control and ownership (p. 37). Günay (1997) at that point makes a clear distinction between ‘ownership’ as having right to complete control over the object and ‘possession’ as the factual control including occupancy (p. 35). That is indeed the major determining factor on the scale and magnitude of the interventions in planning and designs through development and transformation of urban land.

The morphological nature of the built environment is basically the function of the degree and characteristics of public control over private property. For instance, the more fragmented and patchworked character of the British urban landscape, in comparison to its continental counterparts, can be explained by the fragmented pattern of private land ownership and the little public interest to impose a strict regulation on land throughout the history (Booth, 1996: 8).

The necessary relation between (individual) design and (public) control is conceptualised by Hall (1996) with the notion of ‘design control’. Emphasizing the incremental nature of development and transformation in which many agencies take place through piecemeal interventions in uneven rates, Hall (1996) argues design control essential. The essentiality of control is not due to the existence of an authority that knows the ‘good’ and tell what to do, but because of the material needs to ensure ‘internal stability’ (p. 3). From this perspective, controlling urban design is pluralistic act with incremental change in/of the built environment by harmonising the conflicting interests.

The authority to control building processes in terms of the actors involved, the operational scale, type and hierarchy in general brings the issue of urban design into a political context. Beyond the debates on styles and symbolism, the notion of control suggests a relevant basis for the politics of (urban) form. The critical point is that control and form(ation) are not in a one-way relationship. As individual design characterise morphology in the long term, the emergent structural characteristics of urban form (i.e. visibility, topological depth) determine the patterns of social control in terms of co-presence (integration) and exclusion (segregation) (Hillier, 2005). This, in turn, conditions the type and locations of the further design interventions within urban body.

3. **Typology of Collective Urban Form**

Typification of the collective form according to the basic morphological properties may provide us a better understanding of the actual urban textures. Fumihiko Maki, a Japanese architect, suggested the first concise classification of collective form within his short
script published in 1964. Accordingly, Maki (1964) argued *compositional form*, *magaform* and *group-form* as the basic types with reference to the intrinsic relationships between the elements forming the fabric. In this framework, ‘compositional form’ represents a geometric and static statement of a single design scheme, whereas ‘megastructure’ is a concentration of different functional units along with a single large-scale frame. Finally, the ‘group form’ is the fabric evolves from a system of generative elements (pp. 6-23). (see Figure 2.14)

**Figure 2.14.** The typology of collective form suggested by F. Maki: *compositional form* –left-, *magaform* –middle- and *group-form* –right- (Source: Maki, 1964: 6)

Though it has not been accepted as a common reference in urban morphology, Maki’s (1964) framework on form typology still provides a very relevant basis for urban typomorphology. Nevertheless, we should note that his definition of ‘collective form’ as ‘the segments of the total form of the city’ (Maki et al., 1965: 116) is not truly consistent with his original way of thinking in the definition form-typologies, which was based on the nature of formation rather than the form itself.

**Figure 2.15.** The typology of collective form revisited: *composite form*, *aggregate form*, *megaform* and *collage *

In this respect, the alternative urban form typology is suggested by revisiting the original classification by Maki (1964) with reference to the notion of collectivity implying the condition of social/collective interest in both production and use. Accordingly, *composite form*, *aggregate form*, *megaform* and *collage* are re-defined as the new collective form-typologies. (see Figure 2.15)

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26 In this context, the term ‘compositional’ is replaced with the term, *composite*, since it responds to the main idea more properly. Moreover, the ‘group-form’ is re-named as *aggregate form* due to the weakness of the term, ‘group’, to give the essence of the formation discussed. Finally, *campus-form* and *collage* are added into the new typological framework.
3.1 Composite form:

Composite form is a type of urban fabric that is organised by the preconceived geometric relations between the elements. It is usually the spatial expression of an abstract diagram. Therefore, composite forms can easily be abstracted as parti, the simple scheme of the underlying idea of spatial composition. In composite form, the two-dimensional graphic organisation of figure and ground characterises the total layout.

The relations between the elements are not overt with the physical linkages, but usually implied by the geometry, the reciprocal (graphical) tension between the elements (Trancik, 1986: 107). Each individual building is complete in itself and positioned in relation to the others within the whole setting (Maki et al., 1965: 118). For this reason, the composition is static by its morphological nature in which as if one further addition or subtraction would disturb the total balance created. The central and/or local symmetries imposed via a simple geometric order result in a kind of spatial equilibrium, which gives the built-fabric a complete graphical effect mostly intentionally.

In composite forms, the geometric order rules the overall spatial system. As in many case, the orthographic unity of composite form is recognisable when looked from above. (see Figure 2.16. ‘Composition with Grey, Red, Yellow and Blue’ by P. Mondrian (1920): The harmonious colour surfaces are geometrically ordered in a formal composition.

Figure 2.16. ‘Composition with Grey, Red, Yellow and Blue’ by P. Mondrian (1920): The harmonious colour surfaces are geometrically ordered in a formal composition.

Figure 2.17. A neighbourhood in Amsterdam, the Netherlands: Buildings and open-spaces are organised with a characteristic graphic language, a controlled geometric variation and unity. (Source: Amsterdam Municipality, 2008)
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Nonetheless, as in many cases, the graphical clarity in two dimensions does not always guarantee the intelligibility of the spatial structure when one moves within the pattern (Hillier et al., 1983: 50). This is mostly due to the over repetitions of the standardised units in the planned composition. (see Figure 2.17)

Even though the end product may be a pluralistic one in form, the composite fabrics are usually subject to the individual articulation of a designer. Full orchestration of the form-components is the basic design motivation of the form-typology. Rooted in the very early conscious organisation of the civic spaces in the antiquity (Morris, 1979: 1-36), composite form is one of the most basic types in urbanism, which is still applied for the control of a considerable portion of urban developments today.

Composite forms correspond to what Scheer (2001) calls static tissues in which the plot layout and street pattern are designed together and surveyed at the same time in order to develop the land in a short time period (p. 34). Since they are designed as the ultimate state, the composite forms do not usually offer a flexible setting to be transformed by further subdivisions and hybrid additions.

3.2 Aggregate form:

Figure 2.18. A fragment from ‘Wheat Field With Crows’ by Van Gogh (1890): The various short brush strokes of paint are beautifully aggregated into the one scene.

In place of Maki’s (1964) class of ‘group form’, the author suggests the term ‘aggregate’, which is supposed to reflect the basic characteristics of the form-type originally discussed. Also coined by Caniggia et al. (1979), the term, aggregate means the fabric which is structured in time with a series of building converging progressively (p. 118). Then, aggregate form is the type of spatial form, which is generated by numerous buildings interactively grouped along an armature without any preconceived image of the whole. The individual elements within the tissue are built in accordance with the generative rules rather than a given (configurational) structure. Therefore, an aggregate form is emergent by its nature, and cannot be reduced into a simplified diagram of spatial organisation (parti). With the current understanding of emergence, the individual building acts are not in a conscious effort to create a total image at the end of the collective form-making processes - as opposed to what Maki (1964) claims-. The macro-pattern is essentially beyond the anticipation and control of the individuals (Marshall, 2009: 159). The personal ignorance to the ultimate macro-pattern to emerge does essentially differ an aggregate form composition from an impressionist painting, which are both based on various small ‘strokes’. (see Figure 2.18 and 2.19)
Figure 2.19. An informal (squatter) development in Ankara, Turkey: The aggregation of many individual buildings creates an irregular order on the larger context of the so-called 'organic' urban tissue. (Adapted from: Ankara Municipality, 2000)

Rather than performing upon a given spatial structure, the high-level order of the aggregate forms emerges out of the individual interactions taken place in accordance with the certain ordering rules. The reciprocal relations between the individual buildings added into the system are ensured by a continuous feedback and negotiation. Therefore in terms of the group cognition, aggregate fabric represents the highest level of collectivity in pattern formation in comparison to the other urban form-types. The intricate structure of an aggregate form is not because of vagueness in property relations, but due to the intensive collocation of the individual units connected to the common property (open-space network) without any high-level order imposed. This actually implies the basis of aggregative processes argued by Hillier, (1985). Accordingly, each new unit aggregated into the system has to have direct access to the open space structure (p. 165). This ensures the permeability of aggregate fabrics.

Depending on the individual accumulations, aggregate forms grow slowly. This reinforces the shared collective structure unfolded in time. This point is emphasised by Alexander (2002) as the essential condition for organic unity and wholeness. To him, the growth pattern relying on the existing structure and creating sub-centres is also observed in the morphogenesis of all the living systems (pp. 52-84). This development pattern is what Alexander (2002) calls 'structure-preserving transformation'.

Aggregate form is observed in the settlements where the primary property relations are based on possession rather than ownership like in the medieval cities in history or the informal urban areas today (Günay, 1999: 115). Due to the limited control capacity in possession, each individual occupier creates a close relationship with the previously possessed neighbouring plot. Therefore, the lack of an overarching geometry governing the structure is the evidence of the adaptive character of aggregate forms. Nonetheless, the ‘informal’ patterns generated by aggregation are no less ordered than composite forms within planned developments. The emergent order in informal settings doesn’t have a simple geometric regularity as composite forms, which usually affords unintelligible spatial structures through arbitrary (internal) variation (Hillier et al., 1983: 50).

One of the prominent features of the aggregate form is that the building units are typi-
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cal, if not modular. [27] Displaying a certain family resemblance morphologically, the typical units share the same ordering rules to compose a coherent collective tissue. Finally, unlike a composite form, which is preconceived on an Euclidean surface, aggregate forms are geomorphic in essence. They usually tend to conform to the contours of the natural terrain on which the development takes place.

3.3 Megaform:

We can define megaform as a kind of collective form organised on a single structure that performs either as a frame or spine for the whole system. The organising tool of a megaform is not a geometric (abstract) structure (i.e. force-lines or generic grids as in the case of composite form), but a physical one enabling the circulation within the unified spatial setting. The important point here is that to call megaform a kind of collective form, the physical unification within a single mass is not the necessary condition. The basic condition of the typology is its form-process as in the case of the other types. What makes a megaform a unique type is the design and control process of the main structure (or frame) that is centrally operated. The reason why we still count megaform in the main category of collective form is that its reproduction through the individual units connected to the central structure and its operation (i.e. management and maintenance) run by the collective agency. From this view, an Italian hill town, as Maki (1964) exemplified, or a prehistoric settlement (i.e. Çatalhöyük, Turkey), which are all monolithic within their global form can not be considered as megaform, but as an aggregate form emerged through the close-compaction of individual dwellings.

In this framework, we can classify megaform into two, in terms of their major morphological qualities as follow.

3.3.1 Megastructure:

Megastructure is a large frame in which a number of urban functions are integrated (Maki, 1964: 8). Organised on a hierarchic linear (construction) framework, they comprise various functional units, which are usually defined as modules. Due to its size of coverage and programme. a megastructure is perceived as a consciously designed urban landscape. (see Figure 2.21)

27 ‘Modular’ in terms of being designed for a construction or fabrication.
The underlying idea of megastructure is that the unpredictable change is not a desirable factor. Therefore a static frame ideally performs as an instrument for functional unity, visual consistency and the state of equilibrium (Maki, 1964: 11). The emerging techniques in large-scale climatic control are also seen as the supplementary factor of the habitation within the megastructures (Ibid).

Though it gained popularity with the growing interest in planning and architectural circles in the 1960s, the type of megastructure is actually an old idea in urban history with a few examples such as Porto Vecchio, the housing complex as a multilevel bridge structure in Florence or the old London Bridge accommodating multi-storey buildings running almost its entire length (Ibid, pp. 14-15).

In his seminal work on megastructures, Banham (1976) emphasizes the four fundamental futures of the form-typology as follow: (1.) constructed of modular units, (2.) capable of great extension, (3.) constituted by a structural framework into which smaller units can be built or ‘plugged-in’, (4.) having a structural framework that is expected to have a longer life-span than that of the smaller units (p. 8).

Taking it as a central design idea, we can see an implicit analogy of city structure (with streets, passages and squares) as the skeleton of urban form holding all the other components together. As seen in Benham’s (1976) description above, the basic design assumption behind the idea of megastructure is that the overall form-composition could be flexible in response to the changing needs and demands (via transforming or replacing the functional units) while the main structure remains intact (Maki et al., 1965: 118). Therefore, a megastructure is assumed to be open-ended and interconnected (Trancik, 1986: 107). As a designed form-typology, megastructure represents a conscious aspiration of combining centrality in control with spontaneity in formation. Claiming the (mega)structural framework as the foundation of urban fabric to be articulated by the individual infills represents a strong view about the idea supporting this type in urban design (Habraken, 1972; Hertzberger, 1991: 108-110). In this view, the large-scale support structures are supposed to house various individual ‘do-it-yourself’-like insertions creating a structurally controlled collective entity. That interpretation of megastructure principally contradicts with the common understanding.
of megastructure as a large, interconnected building dominated by the architectural thinking about cities (Barnett, 1986: 157).

Mainly because of the need for a permanent central initiative for construction and management, and the large capital investments required, the megastructure could not become a common form typology in urbanism.

### 3.3.2 Campus-form:

Originally having introduced the concept, Scheer (2001) defines ‘campus tissues’ as the access controlled planned urban areas owned by a single agency, having an internal (private) circulation system that connects the buildings belonging to the same functional programme (p. 34). Few entrances into the system basically provide a certain level of segregation of a campus-form from its surrounding, which is desired for the efficiency of the internal utilisation of the area. (see Figure 2.22)

![Figure 2.22. The campus-form of La Défense, Paris: Located in an orbital motorway system with a central spine, the collective form is organised in an open, but a spatially controlled system. Note that the buildings and clusters do not necessarily correspond to each other, but they are strictly part of the same network structure.](image)

Universities, airports, industrial parks, corporate campuses and government centres represent the most typical examples to campus-form (Ibid). Because of the ownership status based on a single agency, there is no plot layout in the campus-forms. Therefore the transformations in the building composition within campus tissues do not require any subdivision on land. Therefore only the location of new buildings and their compositional relations with existing ones are subject to consideration in case of any physical transformation within a campus-form. Nevertheless, the typology does not usually offer a positive condition for the further (re)developments on existing tissue. If it cannot be improved, to a certain extent, the capacity of the existing circulation system causes certain limitations for the fabric to be developed on the same infrastructure.
3.4 Collage:

As the final category of collective urban form typology, ‘collage’ comprises a series of self-contained building-complexes that exhibits weak compositional relationships with its surrounding space and the immediate neighbouring buildings. From an anthropological perspective, the generation of the collage form can be associated with the method of bricolage, derived from the French term, *bricoler*, which describes making things with various materials that are available at hand at the very moment of creation (Gosling et al., 1984: 139). During the 20th century, various avant-garde painters adopted the method into the visual arts to make spontaneous compositions, which did not obey the conventional organisation rules (Hanlon, 2009: 214). What we see in those images is that the parts are not subsumed into the whole image while keeping their individual identity intact. The compositional unity for all is mainly provided by the regular grouping of the irregular figures (Ibid, p. 25). (see Figure 2.23) Nevertheless, in the context of urban collage, the unity is not obtained by regularity in setting, but the evenness in compositional variation of the units and the typological similarities between the units. (see Figure 2.24)

Figure 2.23. A fragment from a suprematist painting by Kazimir Malevich (1915): The discrete elements are apparently incorporated in a weak or no compositional relationship.

Figure 2.24. The historic centre of the city of Khiva, Uzbekistan: A number of madrasas, the mosques complex, the bazaar and the residential buildings compose a collage-like urban fabric. Note the lack of both the geometric and structural coordination between the buildings and clusters. (Source: Herdeg, 1990: 65)
Though it comprises a similar generative process with that of aggregate form [through piecemeal accretion of individual buildings], collage form basically lacks a consistent ordering rule applied to the whole system. While growing, it does not tend to preserve the existing (syntactic) structure either. Spaces in a collage form are nonfigural and their relationships with masses are unpredictable and ambivalent in terms of orientation, coverage and depth. That is the reason why; a collage form does not offer an intelligible spatial structure within its global pattern.

The collage type is historically rooted in the pre-Hellenistic period of the Greece and the ancient Rome in which the civic centre was composed by artful building complexes having weak relationships to other buildings and to the public space.\(^{[28]}\) (Moholy-Nagy, 1968: 127-28). As finely examined by Bacon (1967), the central fabric of the classical Rome was formed by the gradual accumulation of the individual buildings held together only by the pressure of the ever-growing surrounding city fabric rather than a unifying geometric order (p. 86).

Despite having a negative connotation within the modernist design discourse [due to the lack of organisational principles], the idea of collage as an urban form-typology was appreciated by the critical (neo-rationalist) urban design theory that was prominently argued by Rowe and Koetter (1975). For them, with its internal diversity and the morphological variation, collage represents the condition of political plurality in space as a libertarian value in urbanism. We should note that in the contemporary applications of the type in urban design practice, it is hard to follow such an ideological motivation.\(^{[29]}\) Furthermore, they essentially contradict with the basic feature of collage urban form not designed instantly, but emerging historically.

\(^{28}\) The engraving of *Campus Martius*, Rome drawn by Giovanni Battista Piranesi (1757–61) can be taken as an iconographic work informing on urban collage. See: [http://www.quondam.com/27/2743a.htm](http://www.quondam.com/27/2743a.htm), accessed in October 2012

\(^{29}\) For an iconic example, see: the competition entry by MVRDV (2008) for Tirana, Albania, [http://www.mvrdv.nl/#/projects/381tiranalakesidemasterplan](http://www.mvrdv.nl/#/projects/381tiranalakesidemasterplan), accessed in March 2011
As discussed by Kostof (1991) in a historical framework, cities are in constant transition and random interaction between the predetermined (planned) and the spontaneous tissues which apparently create a kind of coexistence and somehow dichotomy between the different type of spatial patterns (pp. 46-51). The city fabrics, in general, do not tend to rely on the same typology of urban form. Due to being built over a long period of (evolutionary) time, they combine different tissues within the same spatial context. Apparently, the different fabrics produced by the codes of their time-periods may be fused through the smooth morphological transitions creating a new urban coherence on the larger scale. By this means, the processes are possibly ended up with the emergence of new hybrid form-typologies. (see Figure 2.25) This point basically reveals the adaptive nature of collective urban form.

4. **Typology of urbanism: a historical framework**

In the rest of the discussion, we tend to suggest two types of the ‘typology of urbanism’: historical and ideological. In the current section, the first typology is based on the historical variation in controlling urban form. The main aspects characterising the typology, in this context, are as follows:

1. The changing relationships between the structure and form (regarding the distinction between frame and infill),
2. The changing instruments and social motivations behind the control of distinct form typologies.

As Marshall (2011) argues, two key instruments are made use of in the construction of order in urban form: plan and code[^30] (p. 1). When we look at urban history from a designerly perspective, it is possible to see the periodic transformations of the relation between plans and codes through changing modes of land production, the actors of production and control, and the socio-political conjuncture in which the actors perform. From this perspective, the author tends to categorize urbanism within six periods: classical, traditional, neoclassical, early-modern, modern and post-modern urbanism. In addition to those, the contemporary trend is categorised under the title of hypermodernity that will be thoroughly discussed in the final chapter. (see Chapter 6) In the current part, without intending to give details on morphology of the cities in each period, Specification of the intrinsic features of morphological control from a historical perspective is conjuncture primarily aimed.

4.1 **Classical urbanism:**

With the term, classical we basically refer to the Greek and Roman period in the history of Western civilisation. Though having had differences in political organisation within their lifetimes, these two cultures were basically developed through the same mode of production based on slavery and free citizenship determining the eligibility for land-ownership. Like their early counterparts in Egypt, Mesopotamia and Indus Valley, the Greeks and Romans were characterised by the culture of ‘town making’ thanks to their colonialist political structure (Burke, 1971; Morris, 1979). In both cases, unlike the emergence of their early cities growing through the accumulation of unplanned residential areas around the

[^30]: For a specific and thorough discussion on the role of code in the production of physical environment, see Ben-Joseph (2005)
generative elements of civic spaces, the cities that were developed by rational order mainly typify the basic features of the classical urbanism.

Rationality of the grid was deriving from devising the street layout in accordance with the climatic condition of the site instead of simply considering a collective control by symbolic geometry. As seen in the writings of Vitruvius (1998), the Romans devise the orthogonal layout in consideration of the the wind-paths in the building site while ensuring the desired breezes to get into the fabric.

In accordance with the nature of colonisation, the settlements were subject to the total control with a rigid framework in which the civic spaces and the generic built-fabric were to be located. Utilised to organise the complete layout of the city, grid was the most fundamental element of space organisation in the Greek colonial towns all over the Mediterranean basin\(^{[31]}\) (Carter, 1983: 21). The complex built fabric constituted by individual houses and civic buildings were accompanied by the diagrammatic simplicity of the high-level order in the Greek and Roman towns. The central control of urban form was limited to the city structure. The urban grid as the flexible matrix of development was allowing many possible internal subdivisions as response to the changing needs and economies (Stoppani, 2011: 261). The built fabric, in this context, was spontaneously generated with the aggregation of the single houses based on a certain collective typology, which is subtly varied in internal layout and size. The same average amount of subdivision within the urban blocks was the main factor keeping the variation within a certain level of typological uniformity (Carter, 1983: 23). (see Figure 2.26, left)

![Figure 2.26](image_url)

**Figure 2.26.** The layout of the block formation (as strips) in Olynthus, an antique Greek city –left, and the plan of Timgad, a Roman settlement –right-. Note the typological variation in building setting contrasted with the simple geometric order imposed by the gridiron system. (Adapted from: Carter, 1983: 25; Morris, 1979: 55)

\(^{31}\) Though it was a widely used in Egypt and Assyria (Moholy-Nagy, 1968: 173, Kostof, 1991: 103-104) as a form-control tool long before the Greeks, gridiron is usually associated with the Greek urbanism.
In control terms, Roman urbanism has many motives inherited from its Greek antecedent. The carefully engineered civic layout was the main ordering devise in the Roman cities. As observed in the Greek towns, the coexistence of the low-level (structural) order ensured by an orthogonal layout and fine-grain block infills [made by individuals] was the prime feature of Roman urban formation. Yet unlike their Greek precursors, the Romans introduced hierarchy into the city structure that created a centralised street configuration accompanied by the architectural codes for civic spaces -i.e. colonnaded footways, principle junctions- (Burke, 1971: 31-33). Furthermore, unlike the ancient Greeks, the limits of the city structure were determined at the very origin of the Roman cities (Rykwert, 1976: 85). Yet, the way to approach form-control featuring the classical urbanism essentially remained the same. To our current knowledge, the Roman style of form-control was based on the abstract cadastral plans, which were not drawn on actual cartographic data. Nevertheless, we do not exactly know the actual role of plan in determination of the town structure. In one view, only after the subdivision of land, the plan called *forma* was drawn as a cadastral map (Stoppani, 2011: 260). In another view, the land was divided once the cadastral plan had been drawn based on a coordinate system (Ben-Joseph. 2005: 26). Yet, in both cases, as in the case of Greek urbanism (Morris, 1979: 35), structuring urban form was not based on the academic (formal) planning and design rules. This applies even for the grid structure, which varied in different applications on ground. With reference to few principle codes (i.e. on the borders, the gates locations and the principle routes, *cardo* and *decumanus*), towns were founded mainly on the field by land surveying with the aid of an apparatus called *groma* in a ritualistic manner (Rykwert, 1976: 41-71). The plan (produced before or after a land survey) was only devised for the delineation of the external border and the orthogonal subdivision of land without specifying the internal fabric. (Stoppani, 2011: 260). Simple building regulations (i.e. building heights, street encroachment) were applied for the individual constructions within the collective built fabric (Eisner et al., 1993: 112, Moholy-Nagy, 1968: 24). In these respects, the classical urbanism can be characterised as a subtle combination of total city structure based on few ordering principles, and the collectively composed built fabric by few (individual) building rules. This basically resulted in immense compositional variations around a certain (structural) typology within the ancient settlements.

4.2 Traditional urbanism:

By the term ‘traditional’, here, we basically imply its antinomy with ‘the modern’, the holistic/rational thinking with an underlying will to control human and natural environment. In this context, traditional urbanism denotes a certain mode of space and form production based on the social conducts which were not explicitly codified with a systemic mind-set.

Traditional urbanism historically corresponds to the medieval period following the enduring tradition of the Roman order. After the collapse of the empire in AD 476, the cities in a vast area of Europe, North Africa and Asia Minor were (re)produced with the generative mechanisms of traditional urbanism. The term ‘generative’ is consciously used here because the notion of planned urban settlements (with a structural order) would not be

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32 As stated by Moholy-Nagy (1968), city building based on few rules is a typical feature of colonial urbanism, which should perform efficiently in different territories. (pp. 182).
valid anymore for about one thousand years in the Western [and Mediterranean] urbanism. Instead, under the privileges given by the feudal lords to inhabitants to possess the individual piece of land, burgesses of each settlement were the actual agents generating the urban form incrementally (Eisner et al., 1993: 75). The building process was based on individual creativity and craftsmanship performing under the supervision of the client in accordance with few informal building rules (Davis, 1999: 49).

Acting in an open-system without any central control, medieval cities have been the first real model of ‘ordered complexity’ in urban context. The lack of any central control on the physical environment was a result of the property relations within the feudal system; which was based on the dominance of individual possession (Günay, 1999: 117-118).

Bastides, the new settlements founded at once, can be considered as ‘planned’ communities with a preconceived urban structure, their streets were also laid out by the local codes responding to the requirements of everyday life [i.e. the street widths according to the vehicle carriage] (Carter, 1983: 44). Likely, due to the prevailing security concerns of the era, limiting the extension of settlements via the fortification walls was one of the prominent control aspects in medieval urbanism like those in the Greek and Roman periods (Burke, 1971: 55).

Figure 2.27. A section from the traditional urban fabric of Brussels –adapted from Braun and Hogenberg’s (1572) Civitates Orbis Terrarum. (Source: Historic City Maps, 2012)

Despite a number of planned new towns during the during the 13th and 14th centuries in Europe, adaptive growth patterns predominantly characterised traditional urbanism. The proscriptive codes regulating the possible conflicts between the neighbouring house owners performed as a generative rule system producing an enormous variation in form-compositions (Hakim, 2008). The very collective character of traditional urban form was mainly due to the social organisation of burgesses as communes collectively dealing with the lord or king (Morris, 1979: 69). Then the lack of a central authority in the control of formation and formal planning invalidated the idea of hierarchy in city structure (Spreiregen, 1965: 11). (see Figure 2.27) The visual richness of the townscape and the diversity within irregular geometry were actually generated on the basis of such a characteristic form-control. While each single building was built in relation to the adjacent one within neighbouring plot, overall fabric was used to emerge through the piecemeal adaptations in a successive manner. Such
a bottom-up process can be taken as the reason why traditional fabrics still sustain through the changing needs of contemporary societies.

Although traditional urbanism is based on bottom-up codes and local conducts of building, one can not argue that it was lacking some considerations on the emerging large-scale structure. As observed in various medieval town plans, the simple organising principles such as the linearity of main streets leading to the gates, the central location of the market place in the intersection of the main thoroughfares, the rules entailing the houses to cover the entire street frontage on plot (Morris, 1979: 78, 96) were the common structural codes of the traditional city.

4.3 Neoclassical urbanism:

Geometry has appeared,
Land surveying encompassed everything.
Nothing on earth lies beyond measurement. (Berman, 1982: 177)

The anonymous poem written for the celebration of St. Petersburg, the new city founded with the order of Peter the Great in the zenith of the Baroque period (the 17th and the 18th century A.D.) truly represents the radical break from the conduct of the traditional urbanism based on individual agglomerations without any ‘rational’ control. This new era in the Western urbanism is actually rooted in Renaissance taken place about two centuries before St. Petersburg.

With the Renaissance under the renowned intellectual interest into the antiquity, the idea of the constitution of order in space based on the ideal principles was flourished in urbanism. The period between the 15th and the late 18th century epitomised a new approach in the control of urban form and space. The rise of mercantilist nation-states went along with an emergent idea of constructing an absolute control over space through the ordered and rationalised public ownership [as opposed to the fragmentary possession within medieval period] (Günay, 1999: 119). In this context, calling the period neoclassical with reference to the revival of the classical antiquity, we would argue a clear historical (dis)continuity in spatial design. Conceiving the town plan as a single work of art by total geometric control, neoclassical urbanism basically remodelled the Roman approach to city building (Abercrombie, 1914: 197). The intensive inclination to the classical antiquity and the translations of Greek and Roman treatises during the Renaissance provided the ideal basis of neoclassical urban architecture. Behind the stylistic expression of the form-geometry of the plans in that period, the underlying influence of Vitruvius, a Roman engineer-architect who systematized the Roman building tradition in his ‘ten books on architecture’ could be claimed (Bacon, 1967: 217)

While Renaissance urbanism responded to the increasing pressure of urban population to the old fabric of the cities with the redefinition of urban space and ideal cities, the Baroque period introduced a kind of an open spatial system unifying the city and landscape towards urban periphery. Both of those sub-periods in neoclassical urbanism were limited to urban extensions or redevelopment of the old districts in addition to the few new city foundations (Morris, 1979: 123-25). Restructuring urban fabric under the control of central
2. CONCEPTUALISATIONS ON COLLECTIVE URBAN FORM & FORMATION

Autocratic power resulted in a new holistic understanding of urban form-control. Despite producing open forms, the control system was quite a close and central one in the Baroque period as opposed to its medieval counterpart. Unlike the adaptive nature of form-control within the traditional urbanism, the neoclassical period was relying on the geometric plans setting out the uniform patterns and monumental forms (Carter, 1983: 115; Eisner et al., 1993: 84-85). The tendency to the holistic control of space and form can be regarded as the dawn of the modernist perception in urbanism. There is no doubt that behind the architectural order projected into the city as the ‘grand manner’, there was a political agenda of the absolute sovereign of autocracy enhancing the social order in space (Kostof, 1991: 215-16). The advanced surveying methods and tools introduced from the 16th century should also be considered as the material basis of the preconceived neoclassical order in urban space. (Ibid, p. 132).

With neoclassical urbanism, for the first time in urban history, the plasticity of building setting was considered as the main aspect in the composition of public spaces. The perfect symmetry within building complexes placed in public spaces as a figure in the Renaissance period was replaced by the integration of the complex into the well proportioned enclosed public space within the Baroque period (Schumacher, 2012: 631). The invention of perspective as a tool of spatial representation was the practical basis of the new tendency for such an unified urban composition. The building setting was conceived as the system of a pictorial alignment of facades and building elevations to be coordinated with linear perspective (Lefebvre, 1974: 273)

Within this context, codification of the design knowledge and the emergence of architecture as a formal discipline in Renaissance (Schumacher, 2011: 81-87) was another critical factor for the operation of neoclassical urbanism.

Figure 2.28. The definitive plan of Edinburgh, Scotland’s New Town as extension of the city (1768). The plan comprises all the major elements of the classical urbanism: the primary axis, the gridiron and the enclosed space. Note that the overall building composition is determined only as a footprint within a fixed grid layout. (Adapted from: Wikipedia, 2012)

Unlike traditional urbanism in which making was the dominant act of space and form production, specification of the collective form by designer with his own tools and formal language characterised the new perception of city as a product of single design act.
On the other hand, the idea of total production of urban form in neoclassical period was limited with the actual capacity of housing markets to produce a unified urban fabric on large scale. Therefore the design schemes were mostly based on the determination of urban layout as a single network structure and the footprint of buildings rather than the articulation of their 3D-compositions in detail. In the case of the developments which were not executed by state, compositional unity within the building setting was usually enforced by the extra regulations. The design guidelines on building frontage supplementing the ground plans [as in the case of Edinburgh’s New Town and Haussmanian Paris (Talen, 2012: 140)] or erecting the continuous facades along the street and letting the rest of the plot [behind the facade] be built by individual owners (Kostof, 1991: 260) were the common tools of ensuring compositional standardisation and uniformity.

In addition to the (enclosed) space and the network (gridiron), the axial line (the primary street) turned to be the major element of regulating urban form since the Renaissance. In addition to its symbolic use, the emergent role of the straight line (the axis) in design process was also an inevitable response to the emerging condition of non-pedestrian traffic following throughways (Burke, 1971: 69).

The regulative basis of the form-control in neoclassical period of urbanism was not the systemic rules of building, but the ideal principles of design (i.e. proportions for symmetry and unity) to create aesthetic uniformity in urban space (Morris, 1979: 125-28). Regarding the search for an artistic representation of urban form as a coherent architectural entity, we can claim that the neoclassical urbanism represents the historical root of the enduring compositional approach in modern urban design.

### 4.4 Early-modern urbanism:

The period in which the transition from mercantilism to industrialisation occurred in parallel to a rapid phase of urbanisation resulted in a specific set of tools and techniques in the control of urban form. Considering the basic characteristics of the new technical approaches in general, we can define the period as the ‘early-modern’ urbanism, which would eventually lead to the modernist era.

The socio-political transformation of the monarchies into the nation-states during the 19th century unavoidably resulted in a critical shift in the type of the actors and the basic motivations in Western urbanism. The emergence of the real estate sector and speculative developments (in the hands of suppliers and contractors), and the municipal regulations on building (Davis, 1999: 54-66) indicated the dawn of the early-modern period in urbanism. The symbolism of central power and the perceived political prestige in space was mostly

33 Despite having emerged as a separate profession, design was still a close-linked and parallel act with building in the Renaissance (Davis, 1999: 54). The complete liberation from each other would be realised within modernity.

34 The idea, which is still valid for in different forms, is historically rooted in the treatises of Leon Battista Alberti, the leading figure in the theory of architecture in Renaissance. For him, the city is made out of buildings in the same way in which the building is made out of rooms: “… if a city, according to the opinion of Philosophers, be no more than a great House, and, on the other hand, a house be a little city; why may it not be said, that the members of that house are so many little houses; such as the court-yard, the Hall, the Parlour, the Portico, and the like?”. With this regard, equating the house with the city, Alberti basically claims the same logic applied in the formation of both building and city as an individual design product. see: Alberti, L. B. (1415 [1955]) Ten Books on Architecture, (ed.) J. Rykwert, London: Alec Tiranti, pp. 13
replaced by the pragmatic stimuli of land colonisation in the ‘New World’ and the aim to control emerging industrial urbanism in the mainland continent. The increasing domination of private property of the flourishing middle class from the late 18th century characterised the early period of modernity (Günay, 1999: 124). The pragmatist tendency to meet the emerging actual needs of the era (i.e. the rapid production of urban land) would end up with the functionalist conviction of the modern urbanism in the following period. In this context, the emerging bourgeoisie (i.e. land speculators, individual builders and associations) replaced the early profile of the developers in classical urbanism [the nobles and clergy].

Within this framework, the early urbanisation of the North American cities displays the typical characteristics of the early-modern urbanism. As seen in the foundation and development of the colonial towns in America and in the transformation of the old city fabrics in Europe between the 17th and 19th century, western urbanism introduced a rational conception of urban code to be widely used in the control of urban form. In American context, the Laws of the Indies represents the first systematic codification of town planning practice (Reps, 1965: 28). Adopted by the Spanish Empire in 1573 for the colonial settlements found in America, the law introduced a series of building codes. The codes involved the regulations needed for the establishment of a new settlement. The principles for site selection, the size, location, shape and the alignment of the main plaza, the street dimensions and layout, and land subdivision were the codes, which are still utilised to control the contemporary developments (Lejeune, 2011). At first glance, it seems that the codes imposed a strict control on urban form in a modernistic manner. Nonetheless, the flexibility of the instructions resulted in a profound variation between the towns built according to the same law (Ibid, p. 73). The Land Ordinance enacted in 1785 provided another kind of central regulatory framework for the development of the modern metropolis in the States. Introducing the subdivision rules with a significant similarity to the Roman surveying systems, the ordinance basically set the rules for the grid-iron system based on a scalar division of the grid-cells without specifying the building condition inside (Talen, 2012: 41). Both of the regulations represented the basic characteristics of early modern urbanism in which the local authorities were used to control large-scale developments structurally by a plan while regulating the individually developed built-fabric via few building rules. Unlike its neoclassical counterparts, the American grid was not derived from the idea of total control of form and space as a political symbol, but from more pragmatic concerns such as fast and easy land-surveying, and transferring ownership during the phase of rapid colonisation (Kostof, 1991: 100).

The plans [as structural framework] allocating open spaces were laid out by public body or the land developer. While the planned street layouts were set by the local authority, the citizens were expected to build their own houses on their plots according to the generic building codes (Moule et al., 1994: xxi). Then a kind of incremental growth were being preceded within a given structure (the grid) in accordance with the flexible public control (see Figure 2.29). Reps’ (1965) depiction of a typical town development process in the States in the late-1600s finely illustrates the centrally controlled and the individually produced components of urban form: “… the basic plan had been prepared, lots surveyed and conveyed their owners, a whole portion of the town added, and the first buildings erected.” (p. 161). In this context, a ruling movement system was accompanied by the multiplicity of architectural applications within the individual plots. Without crediting to the neoclassical tradition, in which
the grid was set for composing the enclosed (urban) space. American urbanism employed the gridiron system rather in a neutral manner without objectifying the space. Circulation and land subdivision were the main functional concerns of the early-modern grid formation (Gandelsonas, 1999: 22).

Figure 2.29. Urban formations within the grid network set out in San Francisco in 1852 -right-, and a section from Eixample, Barcelona, the district still being developed based on the Barcelona Plan by Cerdà (1859) –left-. Note that the both maps illustrate the various individual applications within the blocks of single plan structure. (Adapted from: Martin et al., 2009: 102; Carter, 1983: 56)

While the development of modern metropolis was in progress with the commanding role of surveyors in the New World, civil engineers mainly leaded the same process during the early-modern period of the 19th century in Europe. This was basically due to the developing transportation techniques acting as a new urban form generator of the era. As in the case of American urbanism, Spain was taken a foremost role in shaping the modern understanding of city building in Europe. In addition to Arturo Soria y Mata (1844-1920) in Madrid, Ildefons Cerdà provided a new conception of physical planning with his extension plan of Barcelona (1859). His iconic plan scheme afforded a unique systemic combination of urban structuring and formation. The planned layout of the extensive gridiron offered a very robust structure, which was built over 150 years with gradual extensions and infills (Busquets et al., 2009: 50-51). The long-lasting formation of the built-fabric within the grid-cells (blocks), on the other hand, was controlled by the bylaws[35] (Corominas et al., 2009). Few parameters on plot occupation, height and alignment of the buildings flourished an immersive typological diversity within morphological unity (Peremiquel et al., 2009). Such a system of collective city development based on many individual buildings in accordance with a single (structure) plan and few design rules essentially characterised the common morphology of early-modern urbanism.

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35 Not the original plan, which proposed a certain building layout in the urban blocks, but the execution of the plan with a different block-fabric typology than that of the original plan (Hertzberger, 1991: 122) has actually resulted in the characteristic approach that we call early-modern, today.
4.5 Modern urbanism

Modern urbanism can be identified with the specialization in the production of the built environment. The early central role of the surveyor and investor in determining the layout of cities as in the early-modern urbanism was to cease from the turn of the 20th century. This transformation accompanied with the dawn of planning as a modern profession as response to the inherent problems of the modern industrial city from the late-19th century (Hall, 1975: 11-25). The new condition of modernity inevitably addressed a radical change in the methods and the tools of controlling urban form.

As the complexity of city building and transformation increased, the disassociation of the engineers structuring the large-scale systems, and the developers (or the state officials) building the land parcels occurred in parallel with the emergence of the planners as an autonomous (public) agent. Though this transformation did not invalidate the tradition of ‘master designer’ at once, due to the lasting reliance on the ‘architect-planners’, the act of designing urban form gradually turned into a kind of professional performance under the control of public regulations. Thus as much as the master plan defining all the aspect of urban form, the standardized building codes became the other prominent tool of form-control within the domain planning (Ben-Joseph, 2005: 40-45). Such an indirect control realized via zoning ordinances and bylaws signified an historical shift in the motivation of urban design as well. From the early-20th century on, designing urban form in the context of complexity was to be controlled by a series of systematically rationalized technical norms and standards rather than the normative and stylistic design conceptions of the ruling elite.

Figure 2.30. Master plan for Antwerp designed by Le Corbusier (1933): A complete district area is controlled by the total road layout and the building setting composed in the third dimension (Adapted from: Corbusier, 1964: 271)

The institutionalisation of modern urban planning went parallel to the political authorisation of (state and corporate) power on land production and the provision of socio-spatial control (Lefebvre, 1974: 312-51). Under the overarching notion of ‘public interest’, that point characterised the act of designing urban form as well. Unlike the early-modern period, the radical modernity in urbanism has been enhanced with the idea of total control.
of urban form.\footnote{36} This involved both design of urban massing (built fabric) and the structure (network system) within one plan-scheme.\footnote{37} The fundamental belief in ‘the plan’ reached its heydays within modernism. For Le Corbusier (1932), \textit{the plan must rule} and city planning as a \textit{three-dimensional science} should control the form in all details on an extensive scale as much as possible (pp. 8, 185, 199). In this regard, most of the development plans before and after the world-wars were not limiting themselves with the subdivision of land. They were mostly complemented with the architectural articulation of the building types and compositions either in detail or as the geometrically abstract figures (Barnett, 1986: 137-156). (see Figure 2.30)

The emergence of central regulations on modern urban fabric ended up with a remarkable change of plan techniques as well. The enduring motivation to control urban form as a whole was practiced within the discrepancy between the long-lasting tradition of master plan(ing) and comprehensive land-use planning. While the former tended to control the physical character of the city directly, the later was utilised to define urban form via the functional zones and the associated building codes and standards (Talen, 2002: 301). In this sense, the controlled urban form which were composed of different building typologies [defined in accordance with their functions] became the common model of modern urbanism. The compositional segmentation that was legible in the early iconic examples of modernist urban design schemes (Frampton, 1980: 180) would become a generic morphology thanks to the zoning regulations governing the formation of modern cities. Then the rationalist conception of controlling urban form that was rooted in the Classical Antiquity, would ultimately reach its zenith of functionalism with modern urbanism. Having failed to adapt itself to the changing social dynamics of modern society (Transick, 1990), functionalist stance of modernity, in turn, would be systematically criticised by the neo-rationalists school in urbanism.\footnote{38}

In the same respect, modernity represents a new age of urbanism in which the control of urban form breaks its connection with spatial symbolism through decorative disposition of buildings via symmetry and proportion in space. This would imply the rationalisation of urban form with the functional considerations of land use planning. In addition to the ideological conjuncture of the time, the enlarging scale of (re)production modern metropolis can be regarded as the material basis of such a principal shift in design thinking. Behind both the uniform image and the total control of urban form, there were prevailing mass-production techniques of the modern construction industry based on a vast standardisation of the building elements. Formal standardisation based on the functional programmes revealed itself with the stark repetition of the building units composing the estates, which were spatially segregated according to their functional and social programme (Schumacher, 2012: 635-38).

\footnote{36} The rhetoric cited from ‘The Radiant City’, one of the most influential texts of the modernist urbanism reveals the point as follows: argues the ideal scale of plan control as follows: “Let us make our plans, plans on a scale with twentieth century events, plans equally as big as Satan’s. Plans to trample Satan back into the dust! Big! Big!” (Le Corbusier, 1933: 185).

\footnote{37} The first example to the holistic design approach in modernist urbanism is the first garden city movement coordinated by R. Unwin and B. Pakker with their detailed physical plans in the early 1900s. see: Unwin, R. (1909 [1971]) \textit{Town Planning in Practice: An Introduction to the Art of Designing Cities and Suburbs}, New York, B. Blom

Modern urban movement was mainly driven by the state interventions with the massive production of social housing on the large stock of public land in cooperation with the private sector (Günay, 1999: 152). On this political basis, the planned formation took place on the large sections of undivided land parcels through the development of new towns and city extensions or the redevelopment of old central districts, during the last century.

Cutting the close-relation between the building, block and the street, modernist urbanism substantially differs from the previous models as well. Unlike the early-modern common model, in which the network-cell (urban block) was used to serve for the containment of the built-fabric, the modernist invention of ‘super-block’ [as an over-sized version of the conventional urban block] considerably liberated the built-up fabric from the grid. The prevailing practical factor behind this transformation was the changing mode of mobility in the modern city. With the turn of the century, the increasing levels of speed in vehicular traffic made the traditional street fall from grace and made motorways the prominent element of city building (Çalışkan, 2011). From this period on, the considerations on the controlled relationships between building, street and block have been weakened in the design of urban form.

4.6 Postmodern urbanism

The term ‘postmodern’ generally implies the end of industrial capitalism, which dominated the last century till the late-1980s. Characterised by the ‘flexible accumulation’ of capital within the post-fordist production mode and the fragmentation of the political power through economic decentralisation (Harvey, 1989), the period brought about a new conception of urban form. With the retreat of public agency from the productive sectors in national economies (i.e. housing), the scale and the programme of the land development have significantly changed in many cities under the pressure of deregulation and privatisation (Loukaitou-Sideris et al., 1998). The emerging socio-political context has challenged the conventional design and planning paradigms, as well (Ellin, 1996: 9-103; Schumacher, 2011: 73-74).

In this context, the so-called postmodern urbanism basically altered the modernist notion of comprehensive/master planning by replacing it with project-based development strategies of the free-market economy. Accordingly, large-scale developments taking place on the publicly owned urban land in accordance with the centrally produced end-state plans were transformed into the incremental realisation of land developments and the thematic interventions in the form of local strategic projects (Burgess et al., 2009). Such a shift from total-control of city to piecemeal production of urban form signifies a renewed interest on the morphological relations between the elements of the intermediate-scale of urban form (Çalışkan and Marshall, 2011). Nevertheless, the master plan approach was not completely altered within the postmodern urbanism in terms of the design control approaches suggested. Planning the cities physically in a holistic fashion has been actually re-presented as the rhetoric of ‘architecture of community’ (Katz, 1994; Kier, 2009) in the postmodern period of urbanism. The emerging design discourse essentially connotes the objective of regenerating communities, which were declined with the former modernist urban programmes. Such an agenda has proceeded in parallel to the development of a new profession called ‘urban design’. With a conventional denotation of an architect who designs a fragment of a city with
or without the buildings’ (Ellin, 1996: 88), ‘urban designers’ have been expected to combine the physical design thinking with the tools of planning. Such new understanding in the profession eventually resulted in an alternative approach to control urban form in the so-called postmodern period. Then in the light of the prevalent postmodern reaction against the formal purity, anonymity and standardization of modernity (Loukaitou-Sideris et al., 1998), the total formalism entailed by the modernist master-planning approach would be expected to be replaced with a more flexible model. However, when we look at the contemporary practice in urban design, it is quite hard to observe a radical break from the convention of master planning. Unlike a possible shift from the ‘domination over space’ -by designing- to ‘the regulation of space’ -by ordering- (Günay, 1999: 182; Marshall, 2009: 28-30), the so-called postmodern urban design schemes are mostly limited to the formal diversity within a large fabric articulated by a single master plan scheme.\[39\]

Though there have been plenty of different critiques emerged against the modernist urbanism from the last quarter of the 20th century, none of them have truly suggested a thorough and identifiable alternative to it, but New Urbanism. Despite being originated and developed within the American context, due to its internationalized theory and practice since the publication of the Charter of New Urbanism (CNU) in 2000, New Urbanist movement can be characterized as the dominant genre of urbanism within the international post-modern context (Marshall, 2003).

New Urbanism basically seeks to re-formulate the relationship between building, block and street which was ignored within the modernist convention in the last century. In this sense, the movement represents an integrative and holistic fashion in form-control. Nevertheless, this comprehensive total control attitude has been realised within a slightly different way than its modernist counterpart. With a renewed agenda of re-establishing the deteriorated affiliation between town and country (which was the main theme of the early Anglo-Saxon tradition of modern planning), the new urbanists introduced a new method, called the transect, which is claimed to enable planners to conceive the extended area of human settlements through the sections of spatial transition from urban core to the rural

periphery (Talen, 2002). The new method is not supposed to be analytical, but a prescriptive one with the supplementary design rules called, *Smart Code*. Organised according to the sections of ‘the transect’, the new urbanist design codes are aimed to develop characteristic urban patterns for each (transect) zone by means of the formal variables about building density, typology and configuration. By this mean, a continuous variation in morphology is claimed at neighbourhood level up to the scale of local region (Duany, 2002; CATS, 2009).

While reacting against the ‘creatively destructive’ attitude of modernity, the postmodern urbanism has exposed quite a conservative approach to urban formation. The design codes principally defined for the state of permanency (Moule et al., 1994: xxii). They do not tend to challenge the conventional form and building typologies with new design transformations, but provide an already established typological catalogue allowing variation within one theme. This mainly drives from a strong belief in tradition within postmodernism. The theme of permanence in New Urbanism also shows itself with the lack of control tools to deal with morphological change in a dynamic fashion. Moreover, rejecting the idea of city as an unrestrained entity, and defining it with the well-contained neighbourhoods and districts (Hebbert, 2003: 195), the New Urbanist projects have failed to offer a genuine alternative for a generative approach to urbanism, which is principally based on the model of open-system emergence (Mehaffy et al., 2010).

New Urbanist design codes are mostly the form-based codes involving various architectural aspects (i.e. building type, form and massing, façade composition, plot size and dimensions, and landscaping) to create characteristic urban districts (Walters, 2007: 90-91; Parolek et al., 2008). Methodologically, the postmodern ‘new’ urbanism typifies a unique approach to form-control through an unprecedented balance between a fixed master plan and the incremental design code(s). The specified codes are usually supplemented to a plan scheme. The urban layouts designated by the plan predetermine the route structure, subdivisions and the exact setting of the main civic buildings. In most plans, the search for the neoclassical ‘grand manner’ via the formal diagram-like urban layouts is evident. (see Figure 2.31) While the blueprint designates the street layout and the plot subdivision, the building composition is essentially controlled by the design codes delineating the coverage and the rough massing (envelope) of the buildings. The variation within the same building typology is ensured by the varied size of plot subdivision (as ‘initial lotting’) within the block layout (Moule et al., 1994). Therefore the codes of neo-traditional (postmodern) urbanism are not generative in essence as in the case of traditional (medieval) urbanism, but a prescriptive one describing how the form of an urban element should look like. The individual designs are expected *not to compromise the town’s underlying structure* already established by the master plan (Katz, 1994: 17). With an implicit assumption on the success of traditional forms (i.e. semi-closed places, traditional building typologies) the postmodern urban codes are not derived from the actual limitations of the production modes and the techniques as before, but from the idealised formal principles. These ultimately signify that urbanism in that phase is yet to be ‘new’ enough to practice the emerging idea of *planning without plan* in a truly flexible manner by relying on the performative codes like those in traditional urbanism.

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40 Originally initiated as a commercial product being marketed by Duany Plater-Zyberk & Co. in 2003, the Smart Code has been a publicly accessible open source since 2004. For more information: http://www.smart-codecentral.org/, accessed in May 2011
4.7 **Hypermodern urbanism**

Mostly used interchangeably with ‘late-modernity’[^1], the notion of ‘hypermodern’ implies the subsequent period of so-called postmodernity throughout the emerging an/or intensified dynamics of speed, mobility and relativity (Armitage, 1999). The material basis behind such a new perception is still post-fordism, the dominant mode of production evolved from the late-1970s. As a flexible production mode, postfordism is characterised by the decentralised production factors participating into the process from different locations and fields of specialisation. The information processing, coordinated by various centres basically operates on links over the production networks (Virno, 2001). Before reflecting on the mode in consideration to space production, it would be useful to delineate the major paradigmatic shifts from postmodernism to hypermodernity.

As discussed by Cuthbert (2007) the socio-political programme of postmodernism is associated with the notions of indeterminacy, deconstruction and deregulation, which evidently suggest a counter-condition to the so-called modernist ideas of regulation, control and order (pp. 217). The former postmodern tendency towards deregulation affected the role of spatial planning and design as well (Loukaitou-Sideris et al., 1988). However, under the current stream of the opinions about the need for the state regulation and control (especially after the political and financial crises arisen within the last decade), the role of planning and design seems to be different for the forthcoming period. Such a speculative remark to be made on urban design would go hand in hand with the renewed understanding of rule and order in the contemporary theory of social complexity. As opposed to the anti-rationalist programme of post-modernist philosophy, the contemporary understanding of societal organisation acknowledges the generative role of agency in the context of (ordered) complexity (Byrne, 1998: 42-46). This view finds its philosophical roots in the theory of ‘spontaneous order’ (the order that emerges from the multiple actions obeying the same rules of conduct), which was originally argued by Friedrich Hayek (1973). In the light of this general perspective, we may expect a new approach to design and development control in planning. Such an approach would rely on the rule-based models ensuring the individual freedom and diversity within a flexible ordering system.

It is possible to assert that all the socioeconomic crises in history ended up with a shift in the mode of space production. In that sense, postmodern ideology has arisen after the global economic crises of the late-1970s and suggested its own socio-political agenda including spatial planning and design. In reaction to the alienated social environment within the simply ordered, standardised and monotonous planned urban fabrics, the postmodernist laissez-faire has claimed for a vivid variation and characteristic contradiction within the built-environment. However, the actual process has ended up with a kind of spatial ‘complexity without order’ (Schumacher, 2012: 680) mainly revealed by disorientation, fragmentation and incoherence in actual context (Loukaitou-Sideris et al., 1998).

Then in another context of global crises that we have been experiencing since the first decade of the century, we would expect another shift in the production of urban form

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[^1]: For a clear definition of ‘late-modernity’ as the renewed continuity of modernity (unlike the notion of post-modernity as the counter-condition of post-modernity), see: Giddens, A. (1990) _The Consequences of Modernity_, Cambridge: Polity Press
and space. Considering the (re)emerging tendencies for public regulation and control,[42] it would not be that much speculative to assert a new phase of urbanisation based on the idea of ‘organised complexity’ (Jacobs, 1961) by means of controlling the complex urban processes via rule-based performative and flexible regulations. In this regard, any new approach putting an alterative way to establish urban coherence and integration via generative rules and regulations would be the model to characterise the 21st century urbanism.

Given these conditions above, no unique design and planning approach seems to claim to be the new operational model for the production and control of urban form. The emerging idea of ‘parametricism’, in this sense, offers a serious exception. As opposed to the term’s common connotation as ‘form-language’ Schumacher (2008) claims parametricism as an emerging ‘style’ in the meaning of a methodology (process) and technique in spatial design. Operating on the algorithmic definitions of the associative geometries, parametric design models have been widely used as generative systems within computational design for the last decade. Due to its capacity to involve a large number of inputs processed and associated with each other via few simple rules to create highly varied sophisticated physical patterns, parametric design has already claimed its position in urban design practice as an alternative to modernist and postmodernist urbanism. (Schumacher, 2012: 676-700).

Through many from-generation and editing operations (i.e. cloning, randomizing, scaling), parametric systems have enabled designers to create an enormous number of unpredictable complex geometries, which was not possible by analogue design. By this way, the flexibility of real-time form variation is ensured within an explicit and accessible (algorithmic) model unlike the closed-system of conventional design procedures.

Considering the currency of post-fordism leaning on the information processing technologies within decentralised production systems, it is possible to argue the relevance of the use of algorithmic design models with multi-agent production processes of the contemporary built environment. With its high capacity to control the numerous inputs and components via an explicit algorithm, parametric design models currently represent a strong candidate to perform as the enduring applied method of hypermodern urbanism. However, this potential highly depends on the urban programme of parametricism to clearly specify the novel relation between the urban elements, which are to be structured (framed) and generated (emerged) in the context of complexity.

In this framework, the role of spatial designers and planners might also be expected to transform. If the predominant role of the plan and plan code(s) are to be replaced with the design rules (the generative codes) and the algorithms applied within a parametric (design control) framework, the urban designers would be expected to be the ones who specify the performative rules of urban morphology (if not the scripters writing design algorithms). Obviously, such a practical transformation requires a conceptual shift from articulation to ordering and/or from formal composition to form-generation (or form-finding) in urban design. The last but not the least, any future candidate model of the so-called hypermodern urbanism needs to respond to all the actual factors of space production (i.e. the prevailing types of agents, the scales of production, cultural motivations and intentions), as it has always been the case for the previous models in urban planning and design history. (see: Table 2.4)

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[42] For a recent discussion on the renewed role of public control and regulation over the market system, see: The Economist, *The Rise of State Capitalism: The Emerging World’s New Model*, special issue, 21st January 2012
Table 2.4. Periodization of the history of form control in urbanism.

<table>
<thead>
<tr>
<th>Class</th>
<th>Classical Urbanism</th>
<th>Traditional Urbanism</th>
<th>Neo-Classical Urbanism</th>
<th>Early-Modern Urbanism</th>
<th>Modern Urbanism</th>
<th>Postmodern Urbanism</th>
<th>Hypermodern Urbanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited Private Ownership</td>
<td>State and citizens</td>
<td>Individual and local community</td>
<td>The nobles, the clergy and the large landowners</td>
<td>Property developers, building societies and individuals</td>
<td>State, housing associations and individuals</td>
<td>Private developers</td>
<td>Private developers, individuals or communities</td>
</tr>
<tr>
<td>Controller</td>
<td>Surveyor</td>
<td>The master builder(s) craftsmen</td>
<td>Military engineer architect</td>
<td>Surveyor, civil engineer</td>
<td>Architect, city planner</td>
<td>Architect, urban designer and planners</td>
<td>Urban designer and programmer</td>
</tr>
<tr>
<td>Scale(s) of creative intention</td>
<td>City</td>
<td>Building cluster or street</td>
<td>Large segments of the city or total</td>
<td>City</td>
<td>City and region</td>
<td>Neighbourhood or town</td>
<td>Neighbourhood and city parts</td>
</tr>
<tr>
<td>Scale(s) of production</td>
<td>Plot</td>
<td>Individual building plot</td>
<td>City parts and extensions</td>
<td>Plot and block</td>
<td>Neighbourhood (settlement), district and city</td>
<td>Block, neighbourhood and town</td>
<td>Plot, block, street and ensemble</td>
</tr>
<tr>
<td>Constitution of design</td>
<td>Flexible ordering rules</td>
<td>Local building codes</td>
<td>Ideal ordering principles</td>
<td>Subdivision plan and building code</td>
<td>Master plan and design norms/</td>
<td>Plan, the codes and guidelines</td>
<td>Design rules and algorithm</td>
</tr>
<tr>
<td>Control instrument</td>
<td>Cadastral plan and ‘groma’</td>
<td>Marking ruler and plummet</td>
<td>T-t-square and compass (perspective and plan drawing)</td>
<td>Framework plan, design instructions, chord and ruler</td>
<td>Blueprint and/or zoning ordinance</td>
<td>Pattern book and guideline</td>
<td>Parametric model</td>
</tr>
<tr>
<td>Prevailing mode of production</td>
<td>Antique mode of production</td>
<td>Feudalist or Asiatic mode of production</td>
<td>Mercantilism</td>
<td>Mercantilism, early capitalism</td>
<td>Fordist industrial capitalism/socialism</td>
<td>Advanced (post-fordist) corporate or state capitalism</td>
<td>Post-fordism</td>
</tr>
<tr>
<td>Type of land ownership</td>
<td>Limited private ownership</td>
<td>Individual possession</td>
<td>Private or absolute (state) ownership</td>
<td>Private or corporate ownership</td>
<td>Private, corporate or state ownership</td>
<td>Private ad corporate ownership</td>
<td>Private, corporate and/or collective</td>
</tr>
<tr>
<td>Socio-political / cultural motivation</td>
<td>Rational order and ritualistic myths</td>
<td>Domestic needs and safety</td>
<td>Symbolism of the power, prestige and aesthetic unity</td>
<td>Colonisation of land, physical and political order</td>
<td>Standardized uniformity, hygiene and speed</td>
<td>Sense of place and vernacular</td>
<td>Diversity within unity, ordered complexity, flexibility</td>
</tr>
</tbody>
</table>

*Note: The table is a simplified representation of the complexities involved in urban form control, highlighting key differences across various periods.*
5. Typology of urbanism: the basic conceptions and the mainstream paradigms

In addition to the historical framework given above, another typification on urbanism would be argued with regards to the conceptions of urban pattern formation. A general understanding of the production of built environment, whether it is a product of the conscious human action (of design and planning) or that of all-embracing social (i.e. political, cultural and economic) system, basically determines the ideological distinctions between the major paradigms of urbanism. As a matter of fact, such a question is not special to urbanism, but a very longstanding one in sociology. The dualism between action (of human agent) and structure has always been a prominent line of distinction between the schools of sociology (Giddens, 1984: 116-18; King, 2009). The priority given to the human will or to the structural mechanisms of the social systems in the account of reality corresponds to the discrepancy between sociological individualism versus structuralism (Mayhew, 1980). Individualism, on the one hand, stands for voluntarism embracing free will. It basically suggests that man is capable of controlling his action with consciously planned actions in the light of subjectively defined values and rational choice (Mayhew, 1981). This assumes the pro-active and productive power of the individuals. In this sense, the approach would be also called as interventionism. Obviously, the issue of built environment and its production do not offer an exemption from this framework. Structuralism, on the other hand, primarily takes the mechanisms and the impersonal constraints of the social systems into consideration and portrays them as the primary forces over the individual or corporate actions (Sturrock, 1986: 19). It is apparently possible to consider design and planning in the latter category. From that perspective, it is also possible to read urban theory based on this meta-theoretical distinction. In our framework, I suggest to classify the mainstream approaches into the two antithetical conceptions: urban form as a constructed phenomenon versus urban form as a structured phenomenon. (see Figure 2.32)

Figure 2.32. The conceptions of urban form according to the perceived and the asserted role of spatial design and planning.
5.1 Urban form as a constructed phenomenon

In the first set of paradigms, we will see the dominance of the ‘interventionist’ understanding in which the relation between the subject and object (built environment in our case) is considered intentional. In that view, the individuals have an innate capacity to organise their environment through their conscious memory and synthesis of past, present and future (Sturrock, 1986: 49-50). Therefore, the constructive role of planning and design is categorically acknowledged.

This approach is, in general, recognised through its conviction of free will that has a superior position in social phenomena. A firm reliance on the creative power of human imagination leads to the idea of individual being that occupies a primary position over the social processes and structure. The history of man-made environment, in this view, is conceived as the history of design imagination (Moholy-Nagy, 1968: 18). It is basically human purpose and wilfulness that act as the deriving force making the cities (Kostof, 1991: 53). By the same token, design and planning is regarded as the conscious acts of the actor instead of the conditioned routine of the actee (Spriet 1989) (one acted upon). Although it may not explicitly put in that way, it is possible to follow the interventionist lines of thought about the phenomenon urban formation in the first class of urban paradigms. Accordingly, urban form is argued as a kind of epiphenomenon constructed by the whim of design ideas and actions in relation to the broader socio-economic context. Then again, urban history is viewed as the history of design ideologies motivated by the norms, desires and values. This is based on the supposition that ‘men make history’ rather than the idea of ‘history over men’.

5.1.1 Compositional urbanism:

His systemic search for a designed picturesque in urban fabric makes Camillo Sitte, the Austrian architect and planner the leading figure of the physicalist approach in modern urban planning. As seen in the title of his seminal work City Planning According to the Artistic Principles, Sitte (1889) pursues an individual mastermind acting upon the universal principles of city design. His endeavour to combine the intrinsic (morphological) quality of the traditional public spaces with the modern systems (in the name of ‘urban arrangement’) would result in the emergence of a compositional approach in urban design.

Upon the same view commenced by Sitte (1889) [in terms of the honoured position given to the design act in the production of urban space], Edmund Bacon, an American architect and planner suggested perhaps the most influential theoretical treatise of the compositional approach in modern urban design.

For further discussion, see: Mayhew, 1980: 361

As an iconic example to the designerly reading of the history of urban form, ‘The City Shaped’ represents a subtle approach to the idea of city as a constructed phenomenon. In the introduction, Spiro Kostof (1991) argues his point as follows: “Cities, even those attributed to spontaneous processes inherent to a region, are never entirely procedural events: at some level, city making always entails an act of will on the part of a leader or collectivity.” (pp. 33)
urbanism. In his seminal book, ‘Design of Cities’, Bacon (1967) starts his comprehensive overview of urban design with the chapter titled ‘The City as an Act of Will’ (p. 13). As seen in the title, the definition of city reflects the underlying assumption on its production process. From a clear voluntarist perspective, Bacon (1967) claims that future is what we make it (Ibid). That means the skilful deployment of architectural energy has a real potential to articulate the whole fabric of the city (Ibid, p. 18). This implies another assumption that the city can be totally designed as an extension of architectural experience. The assumption represents the governing motivation of the compositional urban design to achieve a continuous and harmonious city form like a complete architectural masterpiece.\(^{45}\)

In this regard, the ‘master plan’ represents both the means and the desired end. As a tool to discipline the future form setting, master plan has a privileged role in the compositional urbanism. For Leon Krier, the leading architect urbanist, the master plan regulates all the aspects of urban form including the ground plan, the skyline and the architecture. Since it is necessary to maintain the harmony of the whole, the plan should be conceived as the construction of a city what the constitution is to the life of a nation. (Krier, 2009: 119). In this sense, all the individual aspects of architecture (i.e. building types, volume and setbacks) are expected to conform with the preset outlines of the master plan.

According to the compositional conception, urban space and form is architectonically defined by putting the long-term social phenomenon into a subsidiary position. The compositional approach in urbanism is historically originated from the Beaux-Arts school which was first introduced the notion of ‘composition’ into design thinking in the 19\(^\text{th}\) century. In this view, just like the buildings composed by the structural elements, cities were to be composed by the buildings within the same compositional logic (Engel, 2002: 85). Standing on the formalist ideas of ordering spatial systems with the timeless design principles (i.e. symmetry, proportional harmony) and ideal typologies, the school persuaded its influence on urban scale (with axial and hierarchical organisations, static spaces and monumentality) and created an original interpretation of urbanism as large-scale architecture (Lozano, 1991: 23; Attoe et al., 1989: 16). With a new interpretation, the neo-rationalist urbanists in the contemporary design theory and practice have taken over this compositional fashion. For them, the city is composed of various urban patterns characterised by the designed tensions between solids and voids (Rowe et al., 1978). Even though the functional programme changes in time, what endure are the form typologies expressing the collective memory (Rossi, 1982).

Unlike the other urban design paradigms to be cited below, the theory of compositional approach in urbanism is established through the practice. Modern urban architecture qualified with the visionary projects of ‘city design’ in the early 20\(^\text{th}\) century represents the inspirational basis of the compositional urbanism\(^{46}\). The shared feature of those projects is that they are mentioned with the ‘author’ of the plan. That indicates the mastership-oriented nature of the view relying on the individual creativity. It would not be wrong to claim that

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\(^{45}\) The architectural perspective on (compositional) urbanism can be seen in Louis Khan’s view on urban planning: “The plan of a city is like the plan of a house [and] Architecture is also the street” see: Kahn, L. I. (1953) ‘Toward a plan for midtown Philadelphia’, Perspecta, 2, pp. 11, cited in Arkaraprasertkul, 2012: 183

\(^{46}\) R. Unwin and B. Parker’s plans for Letchworth Garden City and Hamstead Garden Suburb (1902,1906), H. Berglage’s Plan of Amsterdam South (1902), D. Burnham and E. H. Bennett’s Plan of Chicago (1909) can be considered as the early examples of the iconic city design projects.
such a strong tradition in urbanism was inherited from the cult of individual master designer enduring in architecture, which had an immense influence on urban design theory and practice.

Nevertheless, despite relying on the model of the skilled designer, modern compositional urbanism does not tend to replicate the Renaissance ideal of the designer having a single artistic authority in spatial composition. Bacon (1967) substantially updated this approach by arguing ‘three-dimensional planning’ as a creative interplay between ‘idea’ and ‘action’. The cyclic feedback process between the stakeholders was suggested to be driven by a leading design idea that organises the different design actions within a structured coherent whole (pp. 254-62). In this context, the ‘total organism’ of the city structure is supposed to be developed part by part over time (Ibid, p. 301). In this view, the individual designer still occupies a central position to influence if not to dictate the decisions of the actors involved.\[47\]

A conservative political positioning is implicitly embedded in compositional urbanism. A strong belief in the absolute consensus between the central political power and community as opposed to the political diversity and contradiction within the cosmopolitan urban societies is quite evident in the rhetoric of the school.[48] One can see this viewpoint relevant when considering the relative position of designers towards the ruling political authority since the foundation of architecture as a profession with the Renaissance.

\[5.1.2\] Regulative urbanism:

Regulative approach to urban form basically entails the idea of planning as the process of controlling and directing the discrete actions for a foreseen future. This view comprises the recognition of the long-term transformations and the broad environmental context. Such a perspective represents an idiosyncratic interpretation of evolution in which the purposeful act of man co-exists with the independent forces of ecology.

Rooted in the idea of modern town planning, originally introduced by Patrick Geddes (1915), the settled perception of spatial planners has been based on an understanding of the city as an ‘evolved organism’ which is not purely a ‘designed’ artefact, but a product of the controllable environmental factors (Marshall et al., 2009). Unlike the mechanistic approaches to city (like that of compositional one) conceiving city as a devised artefact, the modern founders of spatial planning recognized the ‘organic’ qualities of cities based on the idea of growth. Yet for them, the so-called organic growth of the cities was not a phenomenon that we had to go along with its negative externalities, but a controllable one through acquiring the optimal urban form (Batty et al., 2009). That interpretation has indeed suggested an active role for planning. What expected from a plan was basically to harmonize the discrete forces of (social and physical) environment in order to achieve the ideal future form of the (urban) organism. This point brings us to the notion of ‘control’, which is the key concept of planning. As one of the most used terms by planners (maybe with ‘process’ and

47 Involving different architects into the realisation of his master plans, Rob Krier another leading figure in compositional urbanism, illustrates the similar compromising interpretation today. See: Krier, R. (2006) Town Spaces: Contemporary Interpretations in Traditional Urbanism, Basel: Birkhäuser
48 While Edmund Bacon praises the ‘impressive civic achievement’ of Sixtus V to recreate Rome; Le Corbusier (1933) dedicates his magnum opus on urbanism to ‘authority’ with capital letters. Finally, Leon Krier expresses his gratitude to Prince of Wales for his ‘undaunted courage’ put forth the foundation of Pounbury new town (Le Corbusier, 1933; Bacon 1967 131; Krier, 2009: vi)
2. CONCEPTUALISATIONS ON COLLECTIVE URBAN FORM & FORMATION

The ‘control’ of built environment connotes regulating urban formation by the plans and/or codes in consideration of external (social, economic and environmental) forces. In this regard, by providing an indirect role to ‘the planner’ as a creative agent, the so-called regulative approach essentially differs from the compositional one which reserves the central position of the designer in the production of built environment.

It would not be incorrect to claim that the regulative approach in urbanism was developed by a theoretical disengagement from the tradition of compositional urbanism while exposing certain continuities in practice (i.e. the first planners originally being architect). Patrick Abercrombie, a protagonist of modern town planning and a follower of P. Geddes, put forward the first theoretical reaction to the ‘architectural conception of city building’. In his article dated in 1914, with a direct reference to the Renaissance period, he argued his point as follows: “The architect can no longer afford to be aesthetically pure in Town Planning. Not only is life in cities infinitely more complex than it was before, but it is generally agreed that the old simple and direct ways of doing things are now no longer possible.” (Abercrombie, 1914: 195). This line of thought essentially signifies the emergence of the regulative approach to urbanism by planning, which would liberate urban design from the compositional concerns of urban architecture. Despite having some weaknesses on a proper comprehension of design thinking (Çalışkan, 2012), regulative urbanism has represented a remarkable paradigmatic shift from design to control in the name of planning.

With his seminal book, ‘Urban Design as Public Policy’, Jonathan Barnett originally argued for a regulative approach to urbanism in 1974. Considering the long-standing formalist tendencies in urban architecture and the dominance of the non-physicalist systems approach in planning, such an interpretation of design and planning was indeed representing an original viewpoint in that period of time. As seen in the title, Barnett (1974) suggested an alternative view on design, which is policy oriented rather than the form. Though he did not presented an ambition to create an alternative theory, Barnett (1974) basically reflected on the contemporary American practice and re-conceptualised the urban design process. Accordingly, he argued for the guidance of the design decisions by the generic rules rather than directly designing the form itself. This alternative interpretation would be elaborated later on with the name of ‘design control’ in planning. This view basically recognises the actual production process of modern city fabric into which various actors involve and therefore necessitate a kind of coordination in action based on the design morphology (Hall, 1996). The regulative approach developed under the title of design control has made serious progress with the application of design guidelines and codes, which do not necessarily depict the design forms, but outline them via the generic parameters and principles (Walters, 2007).

The need for an inclusive coordination is basically originated from the strong belief in
spatial order and harmony in larger context.\textsuperscript{49} Therefore, although its main interest is about regulating the generic form (unlike ‘designing’ as in compositional urbanism), it is possible to classify regulative urbanism within the interventionist branch of the philosophical framework. (see Figure 2.32) This view is essentially supported by the intrinsic normative way of thinking in planning. It is possible to observe the value-laden position of regulative urbanism with the apparent conviction on the enduring idea of ‘good city form’ in the literature (Talen and Ellis, 2002).

5.1.3 Generative urbanism:

Although it covers a relatively limited area of influence within the contemporary planning and design practice, generative approach has a significant position in urban design theory. Rejecting the idea of ‘designing the city’ via holistic form-compositions, generative urbanism stands for the bottom-up formation of urban fabric the for the sake of the desired ‘organics unity’ and ‘wholeness’ observed in the traditional cities. By the same token, generative urbanism emphasise the form processes rather than the universal qualities and the principles of the form-composition. Therefore, not the form itself, but the way to produce (collective) form is argued as the genuine source of the timeless quality of human environment. Nevertheless, despite being initiated as a kind of procedural theory to discuss the design method itself, generative urbanism has developed a kind of substantial theory of design with an increasing emphasis on the ontology of form and formation.

The core philosophical and methodological background of the generative approach can be followed in the thirty five-year oeuvre of Christopher Alexander. Rejecting his former rationalist perspective on design process, C. Alexander and his friends published ‘A Pattern Language’ in 1977 and tended to articulate the relational elements of the built environment embedded on different scale levels. The originality of the book drives from the inductive way of reasoning on urban form. Rather than a descriptive method to be followed or a normative definition of the good urban form, Alexander et al. (1977) provided a common language of design which was supposed to be a generative instrument subject to the various individual interpretations. Once establishing the language, C. Alexander and his colleagues have developed some model approaches for a generative urban design process. Within the following studies, Alexander tried to reveal how the gradually emerging ‘organic order’ would be achieved by piecemeal growth as a conscious design strategy. In ‘The Oregon Experiment’, Alexander et al. (1975) argued the idea as follows: “By piecemeal growth, we mean growth that goes forward in small steps, where each project spreads out and adapts itself to the twists and turns of function and site”. (p. 67). This implementation did actually lay the foundation of a new urbanist theory in the search for ‘designed spontaneity’ and coherent wholeness. In ‘A New Theory of Urban Design’, Alexander et al. (1987) have claimed that

\textsuperscript{49} Taking randomness as an inferior quality of formation, regulative approach apparently is in an obvious search for the large-scale order (even on the metropolitan scale) with a specific set of building codes (Talen, 2012: 72-74; Scheer, 2010: 66). This is principally oriented by an implicit belief in order to ensure efficiency in space.
the new practice of planning and design should be based on the individual projects rather than the master plans centrally imposed. As demonstrated within a small-step participatory design process, the coherent whole would be generated only by the incremental design rules that are mainly on space, layout, construction and (morphological) centres\[50\] (p. 30).

Only two years after the publication of ‘A New Theory’, W. Attoe and D. Logan (1989) published *American Urban Architecture*. With the original conceptualisation suggested, this book essentially represents more than a review of the design practice. With the concept of ‘urban catalyst’, they truly elaborated the emerging generative design approach. Rejecting the idea of single grand visions for the cities, Attoe and Logan (1989) argued certain design strategies organising the catalytic reaction of modest and incremental interventions based on a sequence of limited and achievable visions. Being in the form of urban elements such as an arcade, a building or a building complex, an urban catalyst was supposed to trigger some positive externalities for the transformation of its surrounding, in a less predictable way than a laboratory chemistry (pp. 46-47). Sharing the same underlying idea of ‘wholeness’ with Alexander et al. (1987), Attoe and Logan (1989) imagined the city as a series of (generated) wholes (coherent ensembles) that ultimately interact with each other.

Generative theory is highly inspired by the informal ordering systems of traditional urban settlements. As a clear example, Hakim (2007) discusses the use of generative systems in urbanism. Rather than the blueprints stating the end-result, generative design systems guides the development, transformation or preservation of the built fabric via a few simple rules and design codes defining what to do as the small-step procedures of building (Hakim, 2007). While suggesting the prescriptive rules providing a room for various interpretations, Hakim (2007) also argues for a kind of ‘temporal priority’ to be introduced into design control. Accordingly, rather than applying the same rules to each person isolated, the rules are applied in accordance with the previous application taken place in the neighbouring parcel (p. 96). This is assumed to enhance the morphological coherence of the collective fabric.

In the contemporary circle of urban design, M. W. Mehaffy, the champion of the generative theories of C. Alexander, has provided a global view to the generative methods in urban design. In his overview, Mehaffy (2008) stresses the conflicting views on the idea of ‘code’ for generative urbanism.\[51\] Accordingly, we see that the subtle relation between form and performance in the context of design coding is yet to be defined for a successful application of generative urbanism in practice.

The underlying idea within the generative school of design is that the production of spatial form cannot be limited to the professional act of design. It should be mainly considered in the context of ‘making’ as the product of non-specialised body of knowledge on building. This view clearly rejects the idea of the single-designer, institutional or corporate plan schemes in urbanism.

\[50\] The idea of emergent whole in spatial structure claimed by Alexander et al. (1987) rejects the ‘blindness to large structure’ which results in incoherent, scattered and fragmented fabrics (pp. 50). This point essentially contradicts with the contemporary understanding of emergence which is based on the individual agency both thinking and acting locally within a factual ignorance about the global order (Johnson, 2001: 73-100; Marshall, 2009: 149-161).

\[51\] In his paper, Mehaffy (2008) does not use the term ‘generative urbanism’, but prefers to refer ‘new urbanism’.

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5.2 Urban form as a structured phenomenon

Structuralist approach in urbanism finds its roots in the structuralist school of sociology. Accordingly, the individual is not the unit of analysis, but the network of relations in the social masses. Not the individual action (i.e. design), but the ordering social system is prominently taken into account in structuralism (Mayhew, 1980: 338, 345). It is claimed that social and spatial being of the individual is either determined or influenced by the mechanisms of overall societal structure. In its most reductionist version, Marxist structural view basically suggests that all the cultural and political phenomena are the subject of the fundamental dynamics of the production modes and the historico-economic bases (Hall, 1998: 26). On that basis, urban form is seen as one of the elements of social superstructure.

The structuralist thinking by definition is holistic rather an atomistic one (Sturrock, 1986: 21). This view results in a modest conception or a conscious ignorance of the notion of design as an act of individual or corporate agent. The act of design is considered only within the inclusive social context, in this view. Since the social production (i.e. cities) is assumed to be largely independent of individual control and conscious action (Mayhew, 1980: 345), the design notion is not highly credited in the structuralist urban literature, in comparison to planning.

In the context of urbanism, the author suggests the two approaches within the structuralist worldview. Considering ‘aggregation’ and ‘emergence’, the chief categories of the social processes argued in the structuralist literature (Ibid, p. 339), we can classify the structuralist urbanism into two branches: the accumulative and the emergent approach. Respectively, while the former considers the aggregate properties of society (i.e. capital accumulation and class structure), the later underlines the emerging network relations between the agents to understand the phenomenon of urban formation.

5.2.1 Accumulative urbanism:

The first school within the ‘accumulative’ approach is the school of urban ecology claiming a functionalist view on urbanization. As the prominent one, the Chicago School interpreted the city as a dynamic system evolving with the changing patterns of functional specialisation and the division of labour. The deliberate use of the concept of ‘structure’ rather than ‘form’ basically signifies their structuralist mind-set about the city, which is based on an implicit relegation of (urban) form to the socio-spatial processes. Modelling the industrial city with the abstract zoning and sectoring schemes, the school offered not a political, but a functionalist understanding of urban form through the conflicting and cooperative relations between the social classes and production factors –i.e. manufacturing or business zones- of the city (Hall, 1998: 8-11). The key mechanisms of human ecology (i.e. concentration, (de)centralisation, invasion and succession) are taken as the main factors shaping the city structure.

As a critique of the quantitative geography school, the Neo-Marxist scholars have searched for an alternative interpretation of urban formation by introducing the concept of the reproduction of social space from the late 1970s. Within his influential book, Castells (1977) suggested a theoretical bridge between social and spatial structures in terms of economy, politics and ideology. In the debate on the ‘theory of space’, Castells (1977) clearly
argues his structuralist positioning as follows: “Urban space is structured, that is to say, it is not organised randomly, and social processes at work in it express the determinisms of each type and each period of social organisation” (p. 115). In the search for the ‘structural laws of the spatial forms’, he rejects the metaphysical freedom of man: “… space and cities are not the products of will and interest of dominant classes, genders and apparatuses, but, the result of a process in which they are resisted by dominant classes, genders and subjects.” (Castells, 1983: 62). In this view, Castells discusses the specific states of the (socio-political) structure that gives form to space. Then he concludes that urban form is the accumulated and socially combined historical product to be understood only in the light of conflicting social relations (Castells: 1977: 219).

Such a materialist, but an extremely abstract notion of space (and its production) finds its historico-conceptual framework within David Harvey’s critical reflection on the issue of capitalist urbanization. With regards to the processes of capital accumulation, Harvey (1981) basically argues that the capital, in the Marxist sense, needs to restructure its form of accumulation to ensure the surplus value constantly created. In this context, once the system goes in crises with the decreasing rates of surplus value, the production of housing and infrastructure is intensified and taken over by the capital (and the state) for the sake of reproduction of labour force. By this means, the production of the built environment is initiated as a response to the crises of over-accumulation within the capitalist system. This phase eventually implies (re)production of the physical city.

Those conceptualisations are philosophically preceded by the historico-materialist interpretation of urbanism, which was thoroughly presented within Henri Lefebvre’s seminal book, ‘The Production of Space’. In Lefebvre’s (1974) framework, the concept of form falls into the overarching notion of space, which is essentially not a thing, but rather a set of relations between things -objects and products- (p. 83). He postulates that in relation to the property relations, the forces of production (i.e. technology, capital and knowledge) impose a form on earth or land (Ibid, p. 85). In this context, the domination of space (by capital) is realised by the conscious spatial representation of planning. Acting as a technocratic instrument, planning is basically informed by knowledge and ideology to intervene and transform the spatial textures [urban patterns] (pp. 39-42).

Following that abstract conception, Cuthbert (2005, 2006) tended to concretise the perspective of spatial political economy with a direct reference to urban design. For him, as human consciousness results from the dominant mode of production, with a historico-materialist interpretation, urban design (the conscious spatial control of human being) should be viewed as the outcome of the enduring social production of space with reference to its material and symbolic dimensions (Cuthbert, 2005: 53). In this view, design in urban context is essentially an act of the symbolic configuration of spatial elements that essentially represents the ruling forces of the economic and ideological superstructures (Cuthbert, 2006). Within his severe critique against the contemporary urban design theory, Cuthbert (2006) accuses the disciplinary circle of being disconnected from socio-structural aspects. Consequently, he comes up with the four critical propositions on the actual function of the contemporary
urban design:

1. Consolidating the capitalist mode of production by assisting land (re)development, and resolving the conflicts in it,
2. Reinforcing the state policies through managing the bureaucratic procedures with plans, codes and policies,
3. Organising the urban infrastructure to facilitate the circulation of man and commodity for the sake of system efficiency,
4. Supporting the symbolic representation of the capital via the codification of the image of urban space and form (Ibid, pp. 76-77).

In the first branch of structuralist approaches cited here, the issue of urban formation is regarded as an inevitable consequence of the accumulation of the economic (functional) or sociopolitical forces. In this respect, the urban form is considered as an artefact, which is not directly produced, by the acts of design and planning, but as a social phenomenon controlled by the socioeconomic forces (i.e. the means of production) accumulated and conflicting in the course of time. From this perspective, by merging the categories of ‘formal’ and ‘political’ in a historical framework, Aureli (2011) has recently argued the city as a political confrontation (pp. xi). The analogy of city as an archipelago where parts are juxtaposed through the relentless antagonistic (political) encounters (Ibid) basically represents underlying assumption of the overall school of accumulative urbanism.

4.2.1 Emergent urbanism:

As we shall discuss ‘the new trends and tendencies in urban design’ within the final chapter in detail, the idea of complexity is both to be the enduring paradigm for the contemporary urbanism and the key theoretical assumption of the so-called emergent urbanism. In the context of planning and design, complexity implies the impossibility of a top-down regulator of the system performing externally (Batty, 2007). Therefore, it requires designers to act locally within the emergent processes as an alternative strategy to steer the system from bottom up as opposed to the ‘regulative approach’ acting above and beyond the local context.

Such a perspective has originally adapted into the field of urban planning and design by an American journalist. With reference to the early idea of ‘organised complexity’, Jane Jacobs (1961) argued the city to be diverse and heterogeneous as a complex system which could not be structured in a top-down manner, but to be generated via small number of local variables. “The science of city planning [regulative urbanism] and the art of city design [compositional urbanism], in real life for real cities, must become the science and art of catalysing and nourishing close-grained working relationships” (Jacobs, 1961: 14). As seen in the quotation, Jacobs (1961) does not argue a categorical rejection of the idea of planning and design per se. Instead, she reacts to their conventional interpretations, and therefore addresses a new way of design thinking. In her approach, organising cities with a direct reference to the small-
scale urban elements (i.e. plot and street), the already existing socio-spatial dynamics would be given a prior consideration in the generation and evolution of urban fabric.

In this regard, emergent urbanism represents a welcoming approach both to the idea of (social and functional) structure and design. By emphasising the interplay between structure and agency it suggests a mild structuralist perspective acknowledging the role of conscious decision-making (on the local-scale) in the formation of spatial structure. This point can be clearly recognised in the works of Juval Portugali, who argues the idea of emergence with reference to the concept of self-organisation. Porugali (2011) defines cities as open and adaptive systems of which the global structure emerges through the nonlinear process of bottom-up interactions. The emergent novel (spatial) structures, in turn, make the individuals act upon the ‘order parameters’ of the structure itself. That means while structure is (self-) organised by various local interactions, it also steers the future actions via the emerging (structural) properties (‘control parameters’). Such a system condition far from equilibrium is basically the driving force of pattern formation (pp. 54-71). In this framework, Alfasi and Portugali (2007) suggest a model of the ‘self-planned city’ to be organised with the performance rules for the individual/local design actions rather than the long-term visions, predictions and master plans. These rules are supposed to act as the urban codes ensuring the qualitative relations between the elements of the built environment.

Combining the configurational approach to urban morphology with his original conception of the social production of space, Bill Hillier clarifies the structuralist basis of emergent urbanism. He argues that the physical and spatial structure of the cities emerge out of numerous (anonymous) constructive human actions, while the individual actions at the micro-scale, in turn, are affected by the emergent macro-spatial structure (Hillier, 1996: 112). Hillier and Hanson (1984) manifests this structuralist viewpoint as follows: “Spatial organisation is not only a means by which collection of individuals can constitute society, but because space has its own laws and its own logic, it can also act as a system of constraints on the society. Space, because its laws of pattern are independent of human wishes, has at least a dialectical relation with society” (Hillier et al., 1984: 199). As seen, this view does not offer an orthodox structuralist position: “Human activity [including design and making] is never actually structured by space. In structuring space by physical objects we suggest possibilities by eliminating others. Within these limits, the infinite structurability of space still prevails.” (Hillier, 1996: 270). According to this ‘liberal structuralist’ perspective to the creative free will, spatial logic is external to human mind. Spatial structure unfolds out of the local (socio-cultural) rules in relation to the micro-economic processes within the limits of the autonomous spatial laws (Hillier, 2002). The global form precedes the syntax of space to be recognised by the individuals and to be acted upon within its (configurational) limitations (Hillier et al., 1984: 205-207). In Hillier’s structuralist theory, the only categorical relationship is between society and space, or in other words, between the individuals and configuration of space. The antagonistic relations between the individuals (and the groups) in society are not taken into consideration as a factor of spatial pattern formation.

Different from the accumulative perspective, the underlying assumption of the school of emergent urbanism is that the driving force of spatial formation is basically preceded by the social consensus rather than the conflict. This point, in fact, can not exclude itself from the Marxist critique. Accordingly, in his comprehensive review of urban design theory Cuth-
bert (2005) accuses this perspective of being apolitical and devoid of any basis in economics or ideology (pp. 202).

Within the contemporary urban theory, one of the most influential manifestations against the total (compositional or regulative) control in urbanism has come from Rem Koolhaas, the leading Dutch architect. Reacting on the dynamic nature of the modern metropolis, Koolhaas et al. (1995) argue the ‘self-organising power of the cities’ and claim the renewed position of man toward the city, “not as its makers but as its mere subjects, as its supporters”. (p. 971). In their critical reflection on urbanism, Koolhaas et al. (1995) pointed out the generic transformation of the cities which are not controllable (and even not desired to be controlled) at all. In this context, their conclusion on the new way of designing cities represents the fundamental understanding of emergent urbanism: “If there is to be a “new urbanism” it will not be based on the twin fantasies of order and omnipotence; it will be the staging of uncertainty… it will no longer aim for stable configurations but for the creation of enabling fields that accommodate processes that refuse to be crystallized into definitive form.” (p. 969). Though being conflicting with his large-scale master plan projects (mainly in the rapidly developing countries) Koolhaas’ projection on the contemporary urban form ideologically signifies the end of the compositional approach in urbanism[52].

Finally, as a champion of ‘emergent urbanism’, M. Héile currently suggests an updated outlook for a possible link between complexity and urban design. In his attempt to conceptualise the principles of emergent urbanism, Héile (2009) argues a kind of spontaneous spatial order to be achieved by the continuous feedback loops through the small additions to the existing urban tissues. In this view, there is no room for a large-scale geometric control over the network structure and the built-fabric, but for the generative rules of incremental growth (Héile, 2009).

4.1 A critical reflection

To draw the main difference between the interventionist (individualist) and structuralist positions, we would suggest that the former tends to reinterpret the urban condition, whereas the latter more focuses on explaining it. Nonetheless, this doesn’t mean that the design discipline has nothing to do with the structuralist school of thought. It is possible to suggest alternative design strategies with reference to the basic premises of accumulative and emergent urbanism. Yet, inarguably there are more common and concrete bases between the interventionist schools and the urban design practice. This might also because of the fact that the authors who involve in actual planning and design practice (with a firm theoretical [social] perspective) represent the general profile of the founders of the interventionist school in urbanism.

[52] Complimentarily, in the definition of so-called ‘generic city’, Koolhaas et al. (1995) depict quite a bottom-up perspective on the control of urban formation: “Generic City has been ‘planned’ not in the usual sense of some bureaucratic organization controlling its development, but as if various echoes, spores, tropes, seeds fell on the ground randomly as in nature, took hold-exploiting the natural fertility of the terrain and now form an ensemble: an arbitrary gene pool that sometimes produces amazing results” (pp. 1253-1254).
Figure 2.33. Typology of urbanism: the mainstream approaches to urban formation.
On the one hand, one can easily argue that structuralism offers no more than a reductionist view on urbanism by portraying the human agent either as a mere ‘information processor’ or as the servant of its class interests. On the other hand, in consideration of its absolute trust in individual action and free will within the broader sociopolitical structure, such a substantial critique would be applied for the interactionist approach as well. Surely, that meta-theoretical discussion is out of the current framework of the research. Yet, from an urbanist point of view, the relevant question would be about the position and the role of design and planning argued within those theoretical viewpoints. With regard to this, below, we will tend to evaluate the mainstream approaches with regards to their intrinsic assumptions on urban formation, planning and design. Putting them in one comparative framework (see Figure 2.33), we can even recognise that those views do not necessarily contradict with each other. Through a constructive manner, some complementary aspects can be potentially incorporated for the future conceptions of urban design.

Within the interventionist school, compositional urbanism offers an elitist stance by relying on the creative imagination, individual skill, and the (so-called) universally postulated artistic taste of ‘the designer’. With regards to the contemporary understanding of planning based on collective mind and strategic (procedural) thinking, the underlying assumption of the school does not entirely fit into the current pluralist political/urban context. The time dimension lacking within the compositional theory is the weakest part of the approach, in this sense. Nevertheless, the contemporary design practice cannot ignore the fundamental knowledge on form-composition elaborated within that literature since the prominent design schools like Beaux-Arts and Bauhaus.

Among the others, the generative approach represents the most promising view on future design practice in terms of its relevant conceptualisation on urban formation based on incremental interventions within the built environment. Nonetheless, the major drawback of the generative approach is that despite the decreasing weight of the conventional master plans in the contemporary practice, most of urban projects, today, are still in the form of large-scale developments (or transformations), which can not be easily managed by the user-oriented, small-scaled ‘form making’ methods of generative design approach. In this regard, the school needs to develop new tools and techniques to be operational within the larger contexts (i.e. urban ensemble and street) while still keeping its intrinsic bottom-up perspective on urban formation.

Reclaiming the position of planners in the design-based production of urban form (Talen, 2009) regulative urbanism in general offers another relevant view on the contemporary role of urban design. Considering the multiplicity of forces and stakeholders involved in the production of contemporary city fabric, the shift in emphasis from design to control sounds relevant and operational in real context. Bringing the social and environmental issues into urban design (Gunder, 2010), which was used to be dominated by the compositional approach lacking a thorough social agenda, regulative urbanism has a real potential to link the major concerns of social planning and physical design. Nevertheless, due to the enduring ignorance on the qualitative aspects of the small-scale urban form, the inherited weakness of spatial planning in the skilled representation of urban space -especially in the third dimension- is yet to be resolved by regulative urbanism.

There is no doubt that, being constructed on the grand social theories (i.e. neoclassical
or Marxist school), the theories of accumulative urbanism provide a strong interpretation on socio-space and the development processes. However, limiting the evolutionary nature of city building to the conceptual framework of the capital accumulation and the social conflicts (as the primary issues of political economy) essentially represents a reductionist view to the physical being of the city. Since it derives from the ‘big questions’ such as class struggle, circulation of capital or the domination of state; the conception of design, in this sense, falls behind its actual context. Therefore the creative power of design and its potential role in problem solving in the production of the built environment is dismissed within the vague meta-theoretical frameworks of the school. Then again the analysis of urban design is ended up with an unrealistic definition of its so-called disciplinary mission[53], which is even not claimed by the original design theory at all. Moreover, the major claim of the ‘spatial form as the expression and the interest of the dominant class’ (Castells, 1983) has never been justified with reference to the explicit basis of urban morphology. After all, though it is yet to suggest an operational basis for designers and planners[54], accumulative urbanism still suggests a significant political perspective to interpret the contemporary spatial planning and design, critically.

Finally, with its clear recognition of the notion of design within the overarching context of complexity, emergent urbanism offers a closer connection with urban design and planning practice. The most promising feature of the ‘emergent’ theory is its research agenda exploring the insight of ‘urban complexity’, which is still an ambiguous notion for designers. The conceptions borrowed from the complexity science such as unpredictability and uncertainty, ambiguity and nonlinearity (Batty, 2007) have a potential to act as a shock doctrine for many ordinary urban designers who would not know how to conceive complexity in the context of urban form and formation. Therefore, the theory of urban complexity needs to build more explicit links up to the field of urban design methodology and morphology. That would bring a responsive theoretical recognition of urban design to the actual dynamics of socio-spatial complexity. For such a positive transformation, a close-collaboration between the generative and emergent urbanism seem promising for the near future. (see Chapter 6)

5. Concluding remarks

In the introductory chapter of the research we basically focused on the twin-notions, ‘concept’ and ‘conception’. It is believed that in order to come up with a true theoretical perspective, it is crucial to construct a firm terminology. This requires a clear set of concepts to explicate the basic assumptions. However, classification of the main concepts is not merely enough to come up with a well-established theoretical understanding on a given phenomenon. The related conceptions as the ideas formed through the deliberately selected concepts have to be clarified as well. From this view point, the research problematized the concepts of urban form as well as the major conceptions on urban formation. While the former was


54 Despite the current lack of a systemic design approach in accordance with the idea of political urbanism, Aureli’s (2011) critical overview of the ‘dialectical approach’ in urban design in the way of taking separation, fragmentation and contrast as a source of urban architectural composition—as in the case of O. M. Ungers’s urban projects—suggests a promising introduction.
aimed to elucidate the fundamental aspects of collective urban form, the later introduced the prominent viewpoints on the process of urban pattern formation from a critical perspective.

The theoretical introduction presented here does actually offer more questions and remarks than full-fledged conclusions. The comprehensive review made on the different aspects shows the difficulty to construct a single perspective on the phenomenon, ‘urban pattern formation’. As seen in the discussions, physical formation of cities entails a series of aspects which somehow conflict with each other: Though urban form(ation) is complex, it embeds control even through multiple hierarchies. Though it is collective, it is not a product of a centralised rule-system. Though it is typological implying endurance and permanence, it is also evolutionary. Though it is law-governed, it is still open for many different comprehensions.

In this context, one could question the substantial role of planning and design in the face of such an inherent intricacy of the phenomenon, collective urban formation. Given the fact that there are many dynamics (i.e. political, economic and social) used to shape urban form through different syntheses in history (see Table 2.4), the position of design and planning design as professional acts [of creation and control] in the large scene is rather vague, and even dubious. Urban planners and designers could easily face the questions as such: “Within such a big, complex and wicked process called physical formation of the built environment, how do planners and designers act? Architects design buildings; industrial designers develop products. What is the work product of ‘urbanists’? What is the original intellectual property them? City, region, territory?..”

The answer to that question could be given again with reference to the idea control. The artefact, on which the profession has the upmost control with its specialised knowledge, should be considered as the main production item of a profession. In this regard, urban fabric could be considered as the main outcome of urbanism, the interdisciplinary field of planning and design.

Looking at the literature of the filed, we can see that ordinary urban fabrics, for a long time-period, were yet to become one of the central issues to theorise in its own right. Until the development of urban morphology as a research field, the issue of pattern formation in urbanism used to be on the horns of a dilemma between the conceptualisations of ‘space’ of political geography, the ‘zone’ of spatial planning and the ‘composition’ of urban architecture. The conventional conceptualisations in those fields, which were either ambiguous or ambitious, could not respond to the intrinsic nature of urbanism, as an applied field controlling the generation of collective urban forms.

As response to this point, the suggested theoretical framework in the current chapter is believed to contribute to a holistic and clear understanding of urban form and formation in our disciplinary knowledge. With the historical framework suggested, the critiques of the contemporary interpretations of urbanism and future trends would be more substantive and conscious. Moreover, with the concepts clarified, it would be easier to abstract the layers of analysis, units of planning and the aspects of design to address the relevant strategies in the contemporary urbanism. In this regard, within the following chapters, the author will take those points into consideration. For this purpose, the overall discussion will continue with a comprehensive inquiry on morphology, the knowledge of urban form as the basis of planning and design. Then with the next chapter, it is basically aimed to provide a substantial body of knowledge on the basic categories, analytical approaches and indicators of urban form.
3 UNDERSTANDING the MORPHOLOGY
1. **The Basic Categories of Pattern Recognition**

In order to gain fundamental insight into urban morphology, it would be useful to briefly clarify the basic categories of pattern recognition in general. Such a conceptual introduction is believed to enable us to recognise the intrinsic distinctions between the different approaches and the models in the field. Since the distinctions in the morphological approaches are mainly based on the ways to perform abstraction, classification and typification, the three cognitive operations are respectively discussed as the basic categories of spatial morphology.

1.1 **Abstraction**

Once man tended to represent his settlement with the elementary figuration capacity, he has involved abstract thinking of the built environment. Through finite repetition of the basic elements and diagraming their non-precise relative positioning within the perceived environmental setting were signifying the first abstract thinking on space organisation. (see Figure 3.1, above) In this sense, abstraction can be considered as an innate capacity of human kind. As argued by Nisbett (2003) from the perspective of evolutionary psychology, abstraction as a way of thinking has remained dominant in Western thought. Through establishing mental and physical control over the external reality, the culture of classical antiquity was developed on the basis of abstract thought. Accordingly, the object was used to be withdrawn from its instant context in order to achieve its rule-like intrinsic features, which would be applied for the other instances in a predictable way. In this regard, abstraction cannot be considered only as an act of comprehension, but also control; the systemic control of social, natural and built environment.

![Figure 3.1](image-url) The known oldest spatial abstraction, a graphic representation of a settlement plan, dated in 6200 B.C. in Çatalhöyük, Turkey: the basic shape and order of building blocks and the settlement’s relative position to the nearby volcano is diagrammatically depicted above. A fragment from the iconographic Nolli Map (1748) as the first systematic abstraction of urban form based on the
distinction of private and public spaces: Note that all the internal private spaces shaded dark to reveal the web of public spaces –below-.

Mapping the built environment in general can be considered as the very basic act of spatial abstraction. Depending on the purpose to provide the visual information selected from a multiple set of spatial elements, maps basically abstract urban landscape via key spatial symbols. The way to abstract the actual fabric in mapping, in turn, conditions the common perception of collective urban form. From this perspective, with its original (purposel) reduction in the representation of space, Giambattista Nolli’s map of Rome (1748) would lead to a certain morphological cognizance which still dominate the spatial research and design field. (see Figure 3.1, below)

In addition to its basic connotation to withdrawing something from its larger context, abstraction cognitively means the process of isolating properties or characteristics common to a number of diverse object or events without reference to their peculiar and accidental properties (OED, 2012). This means revealing the essential properties of something -an object or an event- (Arnheim, 1969: 172) without a need to consider its characteristic details that would be observed in each particular instance [i.e. defining a column with its constituent parts and their necessary structural relationships without the relative proportions and surface treatments]. Elimination of the instantaneous properties of the large number of individual cases derives from the need for economising our comprehension of the world (Ibid, p. 158). Reducing the amount of information about the class of objects basically serve for characterising many others sharing the same set of properties. This is actually the source of producing general knowledge of a specific domain applying for many individual instances.

Both in the practise of design and morphological research, abstraction has a key role to cope with complexity. The designers tend to swing between the different levels of abstraction during their dynamic design processes (see Chapter 5). The spatial analysts manage the large amount of visual (and numerical) information by sorting out the relevant set of data into specific layers. Then they select the relevant data layers to analyse in accordance with the initial research question. This can be considered as the very basic level of abstraction in terms of the withdrawal of some properties by purpose. Nevertheless, if we take abstraction as revealing the essential properties of a form, layering would not be enough for morphological abstraction in a real sense. Then what would be the way of abstracting the spatial patterns?

The answer to this question in architecture was given long ago with the concept of parti. Introduced by the school of Beaux-Arts in the late 18th century, ‘parti’ is the reductive scheme or the simplified diagram of a given architectural design (Farrelly, 2008: 15). It basically aims to uncover the underlying compositional idea of a design through graphical abstraction. Nevertheless, in the context of urban patterns, the idea of abstraction by diagramming is doubtful with regards to the level of complexity involved.

As originally revealed by D’arcy Thomson (1917) and argued by Ball (2009), the patterns in nature can most successfully expressed by the algorithms that generate them. Defined as the sequential mathematical description, generative algorithms reveal how the patterns grow as opposed to the diagrams showing ‘what goes where’. (Ball, 2009: 28-29). This point is also relevant for urban patterns on which the schematic (graphic) abstraction reveals only a limited part of the complete phenomenon, whereas the abstract definition of urban
patterns via parametric algorithms potentially provides a better morphological comprehen-
sion. (see Chapter 6).

In a literary sense, abstraction has somehow a negative connotation. In the context of urbanism, it is occasionally associated with the disregard of the concrete qualities of urban space, which is subject to the direct experience in everyday life (Kallus, 2001). Considering the cognitive use of abstraction with its purposeful limitation on focusing to understand a complex phenomena or a sophisticated object, it is hard to validate this sceptic viewpoint. It is due to the fact that every theory needs to use abstraction to designate the relevant aspects of the scale of inquiry considering the limitation of the domain-knowledge, the tools and active cognitive capacities.\[1\]

The critical point is that despite the tacit tendency for abstracting the real world, the act of abstraction is always conditioned by a purpose or interest varying in the give context. This point proves itself in the distinct modes of abstraction made by the different disciplines in the same context. For instance, given an urban pattern, the transport modeller might see a ‘hex-nodal network’, while a planner might see a ‘triangular tessellation’ of land parcels (Marshall, 2005: 83).

In this respect, the way and the level of abstraction according to the purpose and the interest of the inquiry basically characterises the types of morphological researches. As we discuss more in detail below, while some approaches focus on the compositional properties of urban form, some others suggest higher levels of abstraction and examine the structural properties of urban patterns. Though we should note that low levels of abstraction in spatial representation do not necessarily imply something inferior. Each level of abstraction basically reveals a different set of properties of urban form that we argued in the previous section.

### 1.2 Classification

The world around us makes human mind compulsory to find some organising principles for the comprehension of various objects and species in an easy way. In this sense, our common tendency is to represent different instances around some abstract clusters based on the shared properties. We call those representational clusters ‘class’. As a cognitive concept, a class is system of ordering things in a general theme or description, which applies for the various members of the conceptual cluster (OED, 2012). Classification as an act of defining classes is interchangeably used with ‘taxonomy’, the branch of botany that determines the place of the species within the overall evolutionary hierarchy.

‘Similarity’, in this sense, is the basic organising principle of making classes. However, considering the possibility to suggest almost an unlimited number of shared properties of entities (Medin. al., 1999: 104), we can realise that a certain selective filter is needed to designate the limits of each class. In this regard, as much as similarity, difference also performs as the complementary principle for classification. As Jong (2010) argues, equality (the maximum similarity condition) is widely used for the generalizations in various domains like verbal language, logic, mathematics and applied sciences. Nevertheless, even equality [within a class] supposes differences (p. 15). We can even define equality as ‘minimum difference’ (Ibid, p. 46). The critical point is that to designate the level of similarity and difference in a class, we

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need a frame of reference. This is what we call ‘category. Category, as a system of division in
the classification basically structuralises our various acts of comparison (of similarity and vari-
ance). A category is the basic criterion of classification. From this perspective, one can realise
that for picking up particular objects to classify; an a priori generalisation is needed [to avoid
irrelevant selections]. The generalisation to achieve a category of classification essentially re-
quires abstraction. In this context, any classification presupposes abstraction. (see Figure 3.2)

**Figure 3.2.** ‘Modern’ versus ‘traditional’: A very basic classification of urban form. Note that the
classes, in this case, are based on the implicit category of (geometric) ‘order’ as the abstract signifier of

A set of relevant categories are applied for the classification of people, species and
artefacts (i.e. race, gender and occupation for the classes of people; or material, form and
function for the classification of artefacts).

Despite mainly being based on similarity, any class of entities admits variance within
the limits of certain categories initially set by the class-maker. The limits of variation involved
in any class basically make classification a purposeful act as in the case of abstraction. Within
the bounding context of a certain category, generalization is made by the comparison of the
qualitative differences and organising them within a quantitative border that is broadly de-
fined with the implicit expression of *more or less* (Ibid, pp. 45-46). Arnheim (1969) calls it
differentia, the extent of differentiation in the refinement of the initial abstraction.” (p.166)

In the broad framework given above, classification can be argued as an act of general-
ization of the differences within a sampling universe and reducing them in an abstract
set based on the categories constructed. Considering the nature of theory that relies on the
generalised knowledge of the scrutinised phenomenon, we can characterise any theoretical
research field with its own set of classes. Explicitly manifested or not, the classes involved in
a specific theory essentially depicts its limits of interests in inquiry. This point does not rep-
resent an exception in morphology.

As the study of shape or form, morphology, in general, concerns the structure and
composition of the parts of any systemic whole or the gestalt. The object of a morphological
research can be physical (i.e. biology, geology, astronomy), social (i.e. folkloristics) or mental
(e.g. linguistics) (Ritchey, 1998: 3). In this respect, whether it questions material or abstract
systems, morphology is basically constructed on the classes of form and structure. In this
sense, morphology differs from its neighbouring fields of *physiology*, the study of the physical
functions in the living systems, and *anatomy* considering the structure of living systems.
Noting this point, we can argue that if the object of the morphological inquiry is ‘urban form’, the research field (called ‘urban morphology’) does not have to squirm itself out of the accusation of being ‘formalistic’ (Badcock, 1970: 191) due to its original scientific position in the large context.\[2\]

From this perspective, while the basic categories of classifications in urban geography are the socioeconomic profile of the cities (i.e. third-world city, post-industrial city) (Hall, 1998: 6), those would be the production mode, class-structure, or ideology within spatial-political economy —i.e. the city of advanced capitalism, space of resistance— (Cuthbert, 2006). In the context of urban morphology and physical design, ‘linkage’ (flow system), ‘figure-ground’ (space) and ‘place’ represents the main categories for various classifications [i.e. grid city, nested city, linear city] made in the literature (Trancik, 1985; Lynch, 1981; Lynch and Rodwin, 1958).

1.3 Typology

Mostly used interchangeably with classification, typology is the systematic study of classes with common structural characteristics (OED, 2012). In other words, typology is an act of defining types by comparing the classes of the formal systems like cities, languages, organisms and artefacts. In this respect, typology is a very core part of morphological researches.

Collection of a large number of instances in the classes is not a sufficient condition for typology. To call a study ‘typological’, Whaley (1997) argues the two basic conditions with reference to linguistics as the origin of the concept, as follow:

- Examining the shared formal characteristics of the systems based on the data, which is gathered from the adequate representative samplings,
- Classification of the systems or the system components through cross-comparison of the formal features (pp. 7-14).

As seen above, typology is more than merely listing the instances in the manner of taxonomy. Instead, it requires an active involvement in the classes examined through associative thinking. In this framework, while taxonomy can be considered as the full description of the things in consideration (with reference to a category), a typology describes the subset of a class as a higher level of abstraction.\[3\] In Jong’s (2006) terms, classification (or taxonomy) is defined based on the principle of ‘less difference’ according to a preset criterion; however typology would be that of ‘minimum difference’ through a higher level of abstraction.

The relation between classification and typology, in this regard, is a subtle one. Considering that a type is the combination of certain categories [i.e. form, function and materiality] (Jong, 2009: 6), we can claim that the prerequisite of any typification is having classes for which the categories are applied. In this regard, typification can be seen as a mental act, which is always empirically based on the classes of the existing patterns. Though this is practically a common case, typology is not necessarily an empirical mode of research. Methodologically,

\[2\] Marshall (2011) subtly reacts that critique as follows: “.. it seems unjustified to criticise the built environment professions for focussing on physical aspects, since their job is dealing with the things that can be built. (One would not criticise a surgeon for ‘only’ treating the physical part of a person: that is their job)” (pp. 13).

\[3\] For instance, while the taxonomy may classify the geometric shapes according to the number of their sides (i.e. triangle, square, pentagon, hexagon, heptagon etc.), its corresponding typology would suggest the types based on the common formal features within the class -i.e. triangular, rectangular, polygonal, and circular-. (Marshall, personal communication 2009)
it is rather possible to deduce a typology from a set of hypothetically generated forms and patterns. We can ground this argument on the description of type made by Moneo (1978): “Type is neither a spatial diagram nor the average of a serial list. It is fundamentally the possibility of grouping objects by certain inherent structural similarities” (p. 23). This definition of type involving the notion of ‘possibility’, essentially addresses the broad context of the notion, which welcomes the non-empirical morphological researches studying the possible forms rather than the actual ones. We will call this group of researches constructive (exploratory) typology. However, due to the dominance of the descriptive mode of thinking in morphological research, the field of urban morphology is mostly associated with the empirical analyses.

The true understanding of typology can be consolidated with the definition of ‘type’, originally made by Quatremère de Quincy (1778) as follows: “The word ‘type’ presents less the image of a thing to copy or imitate than the idea of an element. … The model as understood in the practical execution of the art is an object should be repeated as it is. All is precise in the model; all is more or less vague in the ‘type.” (p. 618).

From this definition, we can infer that type is the upmost abstract level of comprehension characterising a set of objects. It is a rule-like flexible description that can be applied in different contexts (i.e. ‘Roman grid’ as generic type implemented in different forms throughout the vast area of empire). In this respect, type is not only general like a ‘class’, but it is also generative - unlike a class.

In Arnheim’s (1969) terms, ‘it should be possible to develop from the concept a more complete image [of the model] than that offered by the concept itself” (p. 174). This statement implies the capacity of a typology to develop the types that would be interpreted through the different applied models. This basically makes typology perform as one of the key linking aspects between morphology and design process. (see Chapter 5) In this framework, unlike taxonomy that is merely oriented to understanding, typology would be about application of morphology in/to the real world.

As also seen in the definitions cited above, type discards the formal (external) image of the artefact while emphasising the main organising idea (Argan, 1963: 244). Then typology performs at the very abstract level of order comprising rule and structure. Being constrained by the material, technical and cultural limitations, the specific sets of rules define particular spatial configurations that we eventually call ‘type’ (Gauthier, 2005: 89). In this context, a morphological type is achieved by the abstraction of form-compositions and expressed either as a structural diagram (parti) or a theme [i.e. the rules of ‘adjacency’ for type of ‘row house’].

Finally, returning back to Jong’s (2009) argument of the type as the combination of categories, we would conclude that each typological field has its own set of categories in the specification of types. For instance, while (ground) plan, structural system and surface treatment are the major categories of architectural typology (Argan, 1963: 244), their counterpart would be layout (linkage), figure-ground and massing (composition) in urban typomorphology.

4 S. Marshall, through personal communication 2009
2. The Main Approaches in Urban Morphology: the modes of inquiry and representation

The field of spatial analysis in general can be categorised in two sub-fields that represent the different ways of thinking and representation in spatial morphology: **constructive (exploratory) morphology** and **reflective (descriptive) morphology**. With the categorisation originally suggested by the author, a better insight on spatial morphology is basically aimed to provide on the basis of the substantial difference between empiric/experimental and theoretical comprehension of physical phenomena.

By the term constructive, we basically mean analysing the forms which do not actually exist, but conceptually generated within a finite set. Therefore, constructive morphology is basically the study of possible forms. Conversely, reflective morphology implies the empirical research. All the conceptualisations are driven from the direct investigations of the existing forms and patterns. Making this classification, one should bear in mind that the authors considered in that framework might not engage in one way or another of morphological thinking. Yet the argued classification is made with regards to the dominant perspectives and the major theoretical contributions they have suggested.

2.1 Constructive (exploratory) morphology

In the first class of analyses, the spatial object or the pattern to be analysed is fictitious. It is derived from a certain set of rules about configuration. By setting the system components of the form generation [i.e. the generative codes and constraints], the researcher explores the limits and variations in certain forms. Based on a systemic search for the vocabulary and rules of possible form-compositions, the method is purely heuristic. Due to the constructive and inductive reasoning applied, constructive approach seems contradictory with the common definition of morphology in science, which is mainly on existing (organic or inorganic) forms and structures.\(^5\) The original interpretation of (spatial) morphology from a constructivist perspective can be seen in Steadman’s (1979) definition of morphology as (p. 235). In this description, morphology is not purely descriptive, but exploratory by the study of possible forms or the conditions of[configurative] existence based on the system of transformations (Ibid, p. 236). Through the form explorations in constructive morphology, the basic question is how the design or growth could have been realised within the experimental program set initially.

The constructive approach in architectural morphology can be traced back in the formalism of ‘shape grammar’ introduced by Stiny (1980a, 1980b). Utilising a simple set of Boolean operations (i.e. union, intersection, difference) and transformation rules (i.e. translation, rotation, reflection and scale) applied to the primal-shapes (building-blocks), the model presents a finite set of configurations which are algorithmically ‘designed’ in a generative manner. Though it is mainly suggested for a constructive basis of design, shape grammar also provides an analytical basis to reveal the rule-based properties of generative configurations (Stiny, 1980b: 460). Since the main emphasis is directed to design, the use of

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\(^5\) The study of ‘a particular shape, form, or external structure, esp. of (a part of) an organism, landform’ (OED, 2012)
3. UNDERSTANDING the MORPHOLOGY

shape grammar in spatial morphology has not been truly explored in the literature.[6]

In the 1980s, we see another attempt to construct constructive morphology in a different field: evolutionary biology. In ‘The Blind Watchmaker’, Dawkins (1986) explored the fundamental mechanism of the cumulative formation processes based on a simple rule-set and the nonrandom selection. In his experiments, he generated numerous fictitious forms via recursive computer programming. Then he demonstrated a kind of ‘mathematical space’ revealing the orderly morphological variation within hypothetical structures (pp. 43-74). (see Figure 3.3, above) By this means, he basically proved the possibility to analyse a certain class of forms without any need to collect actual samplings’ data. That clearly implies the scientific relevance of constructive morphology.

Figure 3.3. The orderly varied ‘biomorph models’ algorithmically generated by R. Dawkins. - above- and a section from the set of Palladian villa plan-layouts generated by ‘parametric shape grammar’ (Source: Dawkins 1986: 68; Mitchell, 1990: 177)

Utilising the same method of shape grammar in a similar manner as Dawkins (1986) Mitchell (1990) explored the possible derivations of the Palladian villa plans by means of the basic shape grammar rules and dimensioning variables. By instantiating the types, Mitchell (1990) illustrated the different level of flexibility of certain layout typologies. (see Figure 3.3, below)

Within the constructive school of spatial morphology, Steadman (1983) suggested the most explicit discussion on the logic of the possibilistic thought in morphology. By means of the ‘dimensionless’ representation of the ground plans, in his book, ‘Architectural Morphology’, Steadman (1983) showed the topological limitations and possibilities of the spatial configurations in architectural level.

Topological conception of spatial morphology was also developed by Steadman (1998) by introducing the concept of ‘the archetypal building’. With the concept, Steadman (1998) asserts that all the applied building typologies basically derive from a certain archetypal form. Once the instances are examined with reference to the diagrammatic archetype, the proposed (abstract) model would be instructive about the effects of the built form and the programme -mainly in terms of FIS and daylight- (see Figure 3.4, left) The same idea, then, was applied in urban context in the name of ‘archetypal layout’ by Steadman and Marshall (2005). Coding the position of building in a cell-configuration of urban block, in the constructive model, the building typologies and land-use properties are aimed to be correlated (see Figure 3.4, right).

This approach has actually strong echoes of another constructive interpretation of urban morphology. By introducing computation into modelling of building forms L. Martin and L. March played a pioneering role in constructive urban morphology in the 1970s. In ‘Urban Space and Structures’, Martin et al. (1972) demonstrated the critical link between the building form and land use by combining analytical geometry with mathematical modelling. Under the title of ‘speculations’, they modelled different form typologies (i.e. pavilion, street,
court) as the fictitious abstract models while discussing their relative performances [in terms of open-space, daylight etc.] as if they are real. (see Figure 3.5) Probably, more than their actual findings, the original way of thinking that combines speculative and rational reasoning represents the main contribution of the authors in the dawn of constructivist approach in urban morphology.\[7\]

In the period after Martin et al. (1972), M. Batty has brought the constructive approach to morphology into another level by applying simulation models to reveal the growth patterns of urban form in general. Since he utilises various generative models (i.e. cellular automata, agent-based systems), Batty (2007) suggests a scale-free conception of urban morphology. Behind the ambiguity in the representation of physical form and use in various scale-levels (Kropf, 2008: 110), there is an explicit assumption on the fractal quality of urban form discussed by Batty (2007). According to Batty et al. (1997), the emergent order, which envisages discernible structural hierarchies within urban form, derives from the fractal (self-) organisation of the local components reproduced recursively across scales and time. Though the level of abstraction suggested by Batty (2007) provides a strong theoretical basis between the form and emergent form processes, this quality basically represents the intrinsic drawback of the model(s) to represent the palpable nature of intermediate-scale urban form as the central focus of urban design.

As a recent example to constructive morphology, Marshal’s (2005) work on streets and patterns, in this sense, suggests a proper basis on both design and morphology. Applying his structural analyses on various hypothetical street layouts and typologies, Marshall (2005) truly proves the possibility of an operational co-existence of the factual (concrete), fictional (abstract) and the ideal (conceptual) modes of thinking in urban morphology.

### 2.2 Reflective (descriptive) morphology

As the second major school in urban morphology, the reflective approach performs as the dominant style in the research field. Compared to the former approach, reflective morphology is not open to the speculative interpretations of alternative compositions. The most crucial feature of the approach is that the object of the analysis is not constructed abstractly. It exists in the real context. What the morphologist has to do is to select the instance in a certain frame, and to reflect on it through his/her own way of abstraction. Therefore framing and abstraction are the two key instruments in reflective (urban) morphology.

The main concerns of reflective urban morphology are to understand the intrinsic relations between the elements of urban form, the sociocultural or legislative rules and the principles underlying the structure of form, and the mutual relations between the spatial form and people in terms of, for instance, perception, movement and use.

The overall level of abstraction in reflective morphology is relatively lower than the constructive approach. However, reflective morphology has various degrees of abstraction in form representation within itself. This point actually enables us to designate the different schools having the same basic approach. The methodological differences this approach will be discussed under the titles of typological, historico-geographical, perceptual and structural.

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7 Martin and March (1972) consciously express this point as follows: “That, translated into architectural terms, is equivalent to saying that the rational understanding of a problem and the extension of thought and intuition are not opposed but complementary” (pp. 30).
schools of morphology.

2.2.1 Typological morphology (typomorphology)

Typological morphology (or ‘typomorphology’) is the study of urban form based on identification of the compositional properties of collective forms by means of architectural and spatial typologies. ‘Type’ in typomorphology is rooted in architectural typology as the underlying idea of the conventional forms and spaces. As a descriptive tool, it is reutilised in urban morphology to understand the physical city (Hwang, 1994: 196).

The idea of type in urbanism originally represents the ideological rejection of the discourse and practice of modern architecture and planning originated from the 1960s in Europe. Reacting against the purely functionalist productions of the built environment, a number of urban architectural theorists pursued a highly normative theory to reconstruct the traditional codes of the city for future designs (Francescato, 1994: 256). Among the most influential ones, Rossi (1982) put a bold argumentation on the issue and asserted that the type as a product of collective memory is the knowledge of both object (artefact) and its manufacturing process (i.e. structuring rules and principles). Beyond its common use for classification, type was supposed to be operational in architectural design process. In this regard, the prescription to restore the tradition in urban context was actually based on a strong analytical viewpoint. That perspective was seen vital to understand the typical forms and processes, which had generated the traditional urban fabric. Therefore it would not be wrong to claim that typological urban morphology (typomorphology) school is originally rooted in the field of design.

As the founder of the Italian school of (urban) morphology, Muratori (1952) originally introduced morphological analyses into his architectural design studio in the academia and practice. He created a strong notion of building typology as the essence of a built fabric and that of the typological processes for a proper comprehension of urban formation (Moudon, 1994: 291).

Figure 3.6. An example from the Italian school of morphology: P. L. Cervellati and his colleagues documented the building typology in relation to the disposition on the plot and the block fabric composed. Note that the analysis proceeds from the elementary to the whole within a meticulous level of detail (Source: Cervellati et al., 1973)
As an architect and the student of S. Muratori, G. Caniggia followed the same line of reasoning about the city. With an evolutionary language of mutations and adaptations, Caniggia et al. (1979) analysed a number of Italian towns and revealed the constitutional role of building typology on urban (trans)formation. By doing that, they revealed the typological continuity in time and scale. The point is that they pursue a very inductive way of reasoning through the definition of typological processes. Their analysis respectively follows the ‘modules’ of building (element), tissue (structure), district (system) and town (organism) (p. 74). Considering within the limits of its internationally known literature, we could say the Italian school did not provide a clear methodology to be applied in different contexts, but a consistent terminology and a way of thinking in urban typomorphology.

Figure 3.7. The typological matrix drawn by Krier (1979) as a-posteriori analyses of the existing urban spaces in traditional European cities. (Source: Kier, 1979: 23)

Though he has never claimed this point,[8] Rob Krier, a Luxembourgian architect urbanist, implicitly suggests a methodical framework for typomorphology. In ‘Urban Space’, Krier (1979) sketched the ground plans of the numerous public spaces of European cities and derived its typology by classifying them according to their geometries. Their regularities in shape, angularities and closeness are the main criteria of his typology (pp. 15-62). (see Figure 3.7) As understood with the introductory chapter of the book, ‘Typological and Morphological Elements of the Concept of Urban Space’, Krier (1979) can be regarded as one of the founding fathers of typological morphology. Though the level of abstraction involved in the analysis would be considered superficial and insufficient for an adequate generalisation, his framing technique still suggests a relevant a model for further typological analyses.

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[8] From a personal interview with the author in his masterclass at TU Delft, Faculty of Architecture in 10th December 2010.
Figure 3.8. A conceptual framework for the typomorphological analysis based on the elements and the rules at different scale-levels (Source: Moudon, 1986: 124).

Though it is originated as a continental movement, typological morphology has also developed in the States. Moudon’s (1993) seminal work on San Francisco, in this regard, can be taken as a protagonist one in its field. Beyond a mere classification of the historical patterns, Moudon (1993) traces the intrinsic relations between morphological aspects (i.e. building types, plot geometry, façade composition) changing in time. Unlike her European counterparts, Moudon’s (1993) typology is deliberately structured to uncover the morphological rules applied to all type of physical elements from room to city fabric. (see Figure 3.8) Her critical research questions are mainly about how the different elements (i.e. plot and building) are combined, and how a certain element of one scale fits into the next scale level (p. 132). By this means, Moudon (1993) provides a very evident perspective on the incremental nature of change in the built environment as well as the corresponding lessons for design.

With an initial objective to determine the (ideal) architectural form in the context of urban fabric (Leupen et al., 1997: 139), the typomorphology school currently represents the major approach in urban morphology. Compared to the other approaches, typological morphology is the only one addressing all the elements of urban form, the plot, building and street within a multi-scalar framework. However, while doing that, it fails to develop an abstract language of spatial representation. This unavoidably prohibits it to offer a kind of generic methods to be reproduced in different contexts. Nevertheless, the architectural sensitivity to the elementary units composing large-scale compositions fits well to the contemporary understanding of urban complexity, which is keen inductive reasoning. Finally, it can be argued that the restricted interest of the school to historical urban fabrics by disregarding the modern tissues (Levy, 1999) is yet to be revised with a renewed theoretical discussion on the idea of modern type and typology.[9]

9 For a new typological perspective to the contemporary urbanism, see: Lee, C. C. M. (2012) The Fourth Typology: Dominant Type and the Idea of the City, PhD thesis, TU Delft Faculty of Architecture, Delft, the Netherlands
2.2.2 Historico-geographical morphology

Historico-geographical morphology is a branch of urban research comprising the techniques and terminology of urban geography and history. It studies urban form with respect to the socioeconomic forces operating in a certain historical context. Inspired by the early German tradition of human geography in the 1920s, M.R.G. Conzen is accepted as the founder of the British school of urban morphology (Whitehand, 2001). The most original contribution of Conzen (1960) to the field is his conceptualisation of urban form based on the distinction between town plan (ground plan), building fabric and land (and building) utilisation (p. 4). The town plan, in turn, is divided into three basic morphological elements: streets, plots and buildings (Ibid, p. 5). Those plan elements are still considered as the main layers in any urban morphological research including the current one.

In his classical work on Alnwick, a historical market town in England, Conzen (1960) mainly analysed the fringe-belt development of the town and its inner transformation. This would actually set the major agenda of the Conzenian school of urban morphology even today.[10] The prime feature of the Conzenian approach is the cartographic analysis on the cadastral maps and the ordnance survey plans representing the basic method of the research. Combining mapping with the information on the complementary aspects (i.e. site condition, land-use and socioeconomics factors) in an historical context, the morphological characteristics of urban (trans)formations are aimed to be identified. Calling his rational method ‘an evolutionary approach’, Conzen (1960) traces existing forms back to the underlying formative processes (p. 7)

Figure 3.9. Characteristic areas (development units) of urban fabric designated as ‘town plan’ –left–, and their pattern of distribution on the plan of the town (Source: Conzen, 1960: 101, 109-10).

In accordance with the disciplinary background of the school (geography), the mode

of morphological representation in historico-geographical approach is based on the two-dimensional orthographic projections of urban fabrics. This signifies the lack of interest to the three-dimensional characteristics of the built environment as in the case of typological morphology that we discussed above. Then instead of analysing the intrinsic relations between the architectonic elements, and inferring the morphological typologies from part to whole, the historico-geographical morphology tends to define the ‘morphological regions’ in urban fabric with reference to their global (homogenous) characteristics in the ‘town-plan’ recognised with the perceived repetition of standardised buildings and a street-system\(^\text{[11]}\) (Whitehand, 2001: 106). (see Figure 3.9) Conzen (1960) calls this analytical process a ‘visual experience’ on ordnance maps (p. 6). The areas called ‘plan units’ also signify the intention of morphological analysis to be utilised in area conservation and planning. Historical juxtaposition of the plan units, which are essentially different in layout, building typology and density let Conzen (1960) come up with the idea of ‘compositeness’ (p. 11), which is still a key term in urban morphology.

In collaboration with the research community of typological morphology, the Conzenian school is currently represented by a large multidisciplinary community called the International Seminar on Urban Form (ISUF).\(^\text{[12]}\)

### 2.2.3 Perceptual morphology

Perceptual school of morphology concerns the built environment with a direct reference to the sensational experience of man in space (Carmona et al., 2010: 111). Finding its theoretical basis in Porteous (1977), the perceptual morphology basically assumes the cognitive capacity of human mind, which processes, interconnects and structuralises the environmental stimuli received from the built environment. Accordingly, the original analytical language is defined by the image-like representation under the dominance of visual perception. Therefore, legibility, variety, permeability and identity are the key concepts leading the research agenda of the school.

![Figure 3.10. The five fundamental elements of macro-urban form defined by K. Lynch as the constitutional aspects of urban image (Source: Lynch, 1960: 47-](image)

In this framework, Kevin Lynch represents an iconic figure who has even created a shared morphological language for urban design theory. The reflective approach of Lynch (1960) is an indirect one. Rather than putting a tracing-paper on the map and recognising

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11 The terms, ‘zone’, ‘region’, ‘belt’ and ‘boundary’, which are widely used in the Cozenian literature, implies the intrinsic way of thinking about morphology which is highly conditioned by human geography.

12 For the theoretical insight about the movement, see: http://www.urbanform.org/, accessed in November 2012
the five elements of urban form (*paths, edges, districts, nodes* and *landmarks*) via direct analysis, he conducted field researches including a series of interviews with the citizens and observers. By means of the cognitive mapping technique, called ‘image analysis’, *the hypothetical element types were confirmed* and conceptualised by him (pp. 140-56).

As another prominent author in perceptual morphology, Gordon Cullen (1961) argued the visual impact of the built fabric in the name of ‘townscape’. Relying on the innate ‘faculty of sight’ and concerning *optics, place and content* [i.e. texture, scale, style] (pp. 8-13), Cullen (1961) explored the temporal relations between the elements of the town fabric. (see Figure 3.11) With the analysis of ‘serial vision’, Cullen (1961) basically argues for a reflective kind of analysis of urban form via involving into the urban pattern through direct observations. This obviously suggests an alternative way of thinking unlike the deskjob of the conventional cartographic analyses.

![Figure 3.11](image)

The original synthesis of the two methodological approaches to perceptual morphology exemplified by Lynch (1960) and Cullen (1961) can be seen in the classical work of Appleyard et al. (1964) who analysed the city fabric with reference to the perceptual elements of urban form through a series of panoramic views taken from the vehicular trips on the road. Two years after Appleyard, et al. (1964), Halprin (1966) re-evaluated the idea of freeway as a form of high-speed motion through the space, and created his own notation technique for analysis of the perceived urban form. As a catalogue of the mobility panorama of 10 different urban regions with an improved visualisation representation technique, ‘Mobility: A Room with a View’ (Houben and Calabrese, 2003) can be regarded as the revival of the perceptual morphology again in the context of mobility. As a recent example to that approach, the author of the thesis elaborated the method to analyse the perceptual effects of the underpasses on the image of the city (Çalışkan, 2011).
2.2.4 Structural morphology

Structural morphology is a field of spatial research identifying the intrinsic relations between the elements of form with reference to the basic structural characteristics like connectivity, hierarchy stability and growth (Pultar, 1977: 205).

Also called as the ‘configurational approach’ (Kropf, 2009; Karimi, 2012), Space Syntax can be considered the leading method in structural morphology. The reason why it is called ‘structural’ is the explicit focus of Space Syntax to the structural stabilities behind the surface regularities observed within physical environment (Hillier, 1996: 50). This refers to a strong theoretical belief for the possibility of revealing the underlying (structural) qualities of any phonotypical reality (like material urban form) through abstraction (Hillier and Hanson, 1984: 205-206). In the light of the basic structuralist assumptions (see Chapter 2), B. Hillier and his colleagues have set their research agenda by studying urban form in terms of the configuration of open spaces mainly in the form of streets (Hillier et al., 1983, Hillier, 1996; 2005, Turner, 2001). In this framework, they deliberately abstract urban form as the network of axial lines defining the alignment of convex spaces (Turner et al., 2005). This enables them to analyse the mathematical structure of the networks in the light of graph theory. Integration (to-movement potential), choice (through-movement potential) and intelligibility (correlation between integration and connectivity) are the key concepts discussed in the Space Syntax analysis (Hillier, 1996; 2005). With the same set of concepts, various spatial researches are conducted on the socio-spatial aspects such as spatial cognition and wayfinding, pedestrian and vehicular movement, distribution of land uses, social segregation and crime.\[13\]

Nevertheless, Space Syntax does not represent the unique approach in the structural morphology. Batty’s (2004) suggestion to represent the network distances in association with the points (junctions) rather than the lines (streets) can be considered as a remarkable alternative to the conventional Space Syntax methodology. Likewise, with a different mode of network representation (‘primal approach’), Porta et al. (2006) reproduces the same approach with another set of centrality concepts, closeness and betweenness. Moreover, with the concept of ‘route structure’, Marshall (2005) suggests an alternative definition of the street network based on routes rather than axes and segments. By this means, he has also brought the concepts of complexity, recursivity and regularity into the context of structural analysis.\[14\] (pp. 107-156). All those views essentially prove the very open nature of the structural approach, which cannot be reduced into a single method.

Yet in general, what Hillier and Hanson (1984) put as the major aims of ‘a syntax model’ below can be taken as the fundamental research agenda of structural morphology in general:

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\[14\] As another example, with so-called ‘route structure’ analysis (the routegram), Marshall (2005) discusses the fundamental configurational concepts like connectivity, continuity and depth and illustrates another structural approach to urban morphology (pp. 107-131).
• To define the basic objects and relations (‘elementary structure’) of the human spatial systems,
• To represent the elementary structures in a certain kind of conceptions as an alternative to the clumsy verbal narratives,
• To show the conditions of spatial coherence defined by the elementary structures,
• To show how the possibility of new combinations to form more complex structures. (Hillier and Hanson 1984: 52).

As you may note, the last statement indicates the innate possibility of structural morphology to be re-developed from a ‘constructive’ perspective that we discussed above.

Figure 3.12. An integration analysis by Space Syntax –left- and the map of ‘reach’ by Urban Network Analysis –right-: Note that in both cases, the fabrics are represented with their structural properties. (Source: Space Syntax Limited, 2012; Sevtsuk et al., 2011: 7)

More recently, the City Form Research Group at MIT has contributed to the development of structural morphology with a new method called ‘urban network analysis’ (Sevtsuk et al., 2012). By relating the building setting with the street network, the group basically improved the research questions of Space Syntax and expanded its field of application. With reference to the fundamental concepts of network theory (i.e. reach, straightness, closeness and betweenness), the method tends to analyse large-scale urban patterns in terms of buildings and their relative positioning on the network (Sevtsuk et al., 2011).

3. The Major Analytical Methods in Urban Morphology

Following the definition of the overall framework of urban morphology in terms of the modes of thinking and representation, we can briefly discuss the prominent types of analysis in the field. This is essentially necessary to suggest a comprehensive definition of the basic morphological concepts to be given in the last section of the chapter. It is believed that each method has its set of concepts in relation to the certain levels of scale in which the method is applied. In this context, we can classify the major urban analyses into the three levels of scale, district, neighbourhood and ensemble. The nominal radii of each corresponding scale-levels are determined with reference to the ranges defined by Jong (2005: 37) (see Table 3.1)
Table 3.1. The scale levels and the corresponding methods of urban analysis

<table>
<thead>
<tr>
<th>The level of scale</th>
<th>The type of morphological analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>District level (R= 1 km)</td>
<td>Street network analysis (<em>Space Syntax</em>)</td>
</tr>
<tr>
<td></td>
<td>Block size and grain analysis</td>
</tr>
<tr>
<td>Neighbourhood level (R= 300 m)</td>
<td>Route structure and network analysis (<em>Netgram</em> and <em>Hetgram</em>)</td>
</tr>
<tr>
<td>Urban ensemble level (R= 100 m)</td>
<td>Intervisibility analysis (<em>Isovist</em>)</td>
</tr>
<tr>
<td></td>
<td>Urban density analysis (<em>Spacematrix</em>)</td>
</tr>
<tr>
<td></td>
<td>Topological analysis of street constitution</td>
</tr>
</tbody>
</table>

Practically, some morphological analyses perform independent of the scale-level. For instance, Isovist or Space Syntax can be applied both for the building complex and for the whole district (Batty, 2001; Hillier, 1996). However, this point cannot prevent us to consider those analytical methods with regards to the most relevant scale-levels to operate in. This is due to the fact that every method has limitations to achieve a proper set of conclusion on applied units (grain) within a specific global setting (frame).

The terms, ‘macro’, ‘mezzo’ and ‘micro’ used in the classification below imply the relative ranges within the intermediate scale-level, which is subject to consideration in our research.

3.1 Macro-scale (district-level) urban analyses

The reason why the district is selected as the largest scale-level is that the grain of the fabric on that scale still gives the relevant information on buildings, blocks and street, which are the fundamental components of urban morphology. At macro level, the network analysis of Space Syntax, and block size and grain analysis are involved in the consideration. While the former aims to reveal the structural characteristics of the settlements, the later examines their composition in terms of the block layout.

3.1.1 Street Network Analysis: Space Syntax

Even applied for the whole city-form, Space Syntax analyses scrutinise the structural properties of the spatial patterns by computing each network component in relation to all others in the system. Doing that, the method aims to reveal the characteristics of the underlying *spatial order* of the physical form rather than the *geometric order* perceived explicitly (Hillier et al., 1983: 50).

The analysis requires drawing the minimal set of the longest and fewest lines, called axes, covering the whole network of (convex) public spaces in the fabric. Since linearity is taken as the key aspect to cognise urban space (Hillier, 2004: 510), Space Syntax is operated on *axial maps* ¹¹⁵ (Hillier et al., 1984: 91-92). Reducing the street pattern into syntactic (configurational) structure eventually enables us to represent the physical street network as

a topological structure on which we can calculate different structural variables. (see Figure 3.13 and 3.14) While an axial map disregards the shape, size and the dimensions of the street segments, its corresponding graph converts each axis into a node (vertex) connected by the links (edges) topologically. Since several axial lines are drawn for a bending curve of the street, the intersections in the axial-map do not necessarily imply the actual junctions of the street network.  

(see Figure 3.13)

**Figure 3.13.** A simple example of mapping in Space Syntax: The street layout is converted into the axial map (Source: Google Earth, 2011; Adapted from Nes, 2011: 168)

**Depth** is the fundamental concept in Space Syntax analysis. Defined as the number of turns (steps) to reach a space from the reference axis, depth is calculated with respect to the every axial line in the network (Ibid: p. 104). By this way, the average depth value provides a global index as the indicator of integration of a network structure. The notion of shallowness or deepness implies the relative distances of a line to the others in the network (Ibid, pp. 94, 108). Thus the integration value of an urban network corresponds to the average depth of all lines to all the others in the system. Represented in the global integration maps, the most segregated lines are the deepest ones, topologically far away from all other lines in the network (Hillier, 1996: 99-101).

‘Integration’ in Space Syntax is defined based on **metric**, **geometrical** and **topological** distances. While the metric distance means the closest distance measured by the shortest path in length, the geometric distance refers to the least angle change from an axial line to the other. Finally, the topological distance is a measure to calculate the fewest turns through a movement from one point to another in the network. According to Hillier (2005), the metric distance offers the lowest correlation between the real movement (pedestrian or vehicular) and the urban grid compared to the others. (pp. 16, 27).

16 C. Ratti fundamentally questioned the reductionist approach of Space Syntax. According to Ratti (2004), disregarding the metric spatial information of urban textures results in certain inconsistencies within Space Syntax. To demonstrate the limits of the configurational approach of the method, he examines two urban compositions having the same configuration topologically, but producing conflicting results when analysed by Space Syntax. Therefore, Ratti (2004) addresses the necessity of involving metric properties of urban form (i.e. size, shape, height and volume) in urban analysis.
In order to reveal the different configurational characteristics of the networks in terms of the level of the precision in analysis, *global* and *local* integration are calculated based on the different scale factors called *radius*. In global integration analysis, the model calculates how the lines spatially—either in three factors—close to all the others in the whole street pattern. Unlikely, local integration calculates how close an axis is to the others when changing the direction up to three times from that point\(^1\) (Nes, 2011: 169). Calculation of the local integration of each line enables the analysis to map the integral variation in integration throughout the complete networks since the global integration analysis is not sensible to the partial differentiation while highlighting the single (dominant) integration core. The difference is supposed to be crucial. According to Hillier, the commercial activity concentrates in the most globally integrated web of streets, while the busiest pedestrian movement usually locates on the most locally integrated streets. Correspondingly, while the vehicular traffic is sensitive to the global properties of the network, the pedestrian density is much more correlated with the local integration values (Hillier, 1996: 101; 1999: 345-46).

\(^1\) Three is the amount of topological distance, which is usually taken as the radius for the calculation of local integration.
In addition to ‘integration’, choice is the other key concept of the configurational analysis of Space Syntax. Hillier (2005) defines choice as the degree to which line lies on simplest paths from each line to all others (p. 12). While integration is about closeness, the choice implies betweenness. The degree of choice, in this regard, corresponds to the concept of ‘through-movement’ indicating the elements locating on the paths between the other elements rather than ‘to-movement’ implying the closeness of the elements. Based on the least angular change, the fewest turns or the shortest paths, the chose value of a street basically indicates how likely the segment is to be chosen from all points to all others within the given network (Ibid).

Figure 3.15. The street networks of the sampling areas—the top row-, their global choice patterns—the middle row-, and the local integration patterns—the bottom row- via Space Syntax analysis.
At the district level of analysis, the most relevant issues to be searched by Space Syntax are the potentiality of through movement within the residential tissue, and the potentiality of local centres, which would attract pedestrian movement. For those aspects, respectively, ‘global choice angular analysis’ and ‘local integration angular analysis’ are run. (see Figure 3.15) To measure local integration, 350 meters is determined as the metric radius, which corresponds the neighbourhood unit. Due to the angular analyses, street lines are converted into the segments rather than the axes.

The first point to be mentioned is that in the comparative analysis with Space Syntax, the weight of the highlighted areas in the map does not give the information comparable with the other cases. They do just specify the internal variation within the given areas. In this respect, we can state that while the typical British suburban layout tends to create internal loops for through traffic, the Dutch tissue comprises spinal axes. Whereas, the Turkish planned development is based on a series of super-blocks capturing the local network inside. In local integration, both the British and the Dutch case reveal relatively more decentralised patterns than the Turkish urban tissues. While the concentration is based on the network intensity in the British case, it is mainly formed on a number of routes extensively in the Dutch context. Though in the Turkish case, the tissue has an extensive and ill-defined local integration pattern, which has a low potentiality for the emergence of the centralised facility zones.

With its own software applications, Space Syntax is currently one of the most common analytical techniques in the contemporary urban morphology. However, its limited scope to the street configuration is yet to be improved with parallel application considering the building setting of urban fabrics.

3.1.2 Block-Size and Grain Analysis

The optimum size of urban blocks as a parameter of good urban form is not a recent argumentation in the literature of urban design. In her seminal book, *The Death and Life of Great American Cities*, Jane Jacobs (1961) devotes a chapter on this issue. Her main concern on urban blocks was primarily about the street vitality through easy pedestrian movement via permeable block layout (Jacobs, 1961: 178-86). That obviously entails the consideration of block size.

Though he did not claim in that way, Siksnas (1996) has originally introduced urban block analysis, systemically. Comparing twelve North American and Australian cities’ urban blocks and their evolution with respect to their size, structure and shape, Siksnas (1996) addresses the key role of block formation played for the performance of urban form (i.e. pedestrian circulation and land-use). His normative conclusions on ‘good urban block form’ are derived from an evolutionary perspective by mapping the transformation the block layouts to reveal the adaptation and robustness of the pattern afforded in time. Siksnas’s (1996) inquiry is constructed on a kind of typology classifying urban blocks in terms of their size:

- small (under 10 000 m2),

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18 The three different softwares are currently open for the public by the Space Syntax Network. See: http://www.spacesyntax.net/software/, accessed in May 2012.
19 More recently, The City Form Lab at the Singapore University of Technology & Design in collaboration with the School of Architecture & Planning at MIT has developed a GIS application called ‘Urban Network Analysis’ challenges that point by correlating the physical fabric with urban structure. See: http://cityform.mit.edu/projects/urban-network-analysis.html, accessed in May 2012
• medium (between 10 000 - 20 000 m²)
• large (over 20 000 m²) (pp. 20).

Although such a classification is mainly done for the blocks in the central business districts, they also provide a relevant analytical framework for the block layouts in the residential areas. Since the urban layouts in CBD zones are mostly the product of successive transformations within the ex-residential areas, such a shared classification is not supposed to result in the misleading conclusions, morphologically. However, the analysis for the residential areas in different cultural contexts should be calibrated. As an exemplar case, the comparative analysis for the residential districts in Essex, Almere and Ankara are analysed with an updated range in which the small blocks are taken as the ones less than 7500 m² (see Figure 3.16).

**Figure 3.16.** The building block layout of the case study areas from Essex, Almere and Ankara in terms of the size of the residential blocks. Note that the block layout of the district in Ankara is based on the existing development plan of which implementation is still in progress.
Table 3.2. Average number, size and perimeter of the residential blocks in the sampling cities

<table>
<thead>
<tr>
<th>Districts</th>
<th>Average number of blocks / ha in built-up area</th>
<th>Average size of urban blocks (m²)</th>
<th>Average perimeter of urban blocks (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essex (UK)</td>
<td>0.67</td>
<td>14 000</td>
<td>530</td>
</tr>
<tr>
<td>Almere (NL)</td>
<td>0.90</td>
<td>11 000</td>
<td>486</td>
</tr>
<tr>
<td>Ankara (TR)</td>
<td>0.68</td>
<td>17 000</td>
<td>553</td>
</tr>
</tbody>
</table>

Though it can also be applied at the level of neighbourhood, the most relevant scale-level of block size analysis is district with a nominal radius of 1 km. This frame gives a proper basis to see the characteristic variations of block layout in size and grain. The analysis at the district level potentially provides a clear view about the design control systems in terms of urban block as a module of pattern formation. The average size of the blocks and their distribution over the whole fabric gives a preliminary idea about the design policies applied in relation to the variation in building types, land-uses and density. In the given contexts, where the land subdivision is considered as a design aspect, block distribution may expose a regular and consistent pattern of clustering in size. Yet, in the contexts where the street and block are not the design control aspect in area planning, the block layout may reveal a course and irregular character.\textsuperscript{20}

To analyse the sampling patterns, Siksna (1997) basically defines four morphological aspects: mesh size of the circulation network (pedestrian and vehicular), subdivision and amalgamation of lots, land-use and activity patterns within blocks, building form in blocks (p. 254) While the first parameter conditions the size of urban block, the second is mainly about the grain. Though they may be considered as the result of block size, the last two aspects can be considered as the factors affecting the average size of blocks in a certain context. In this sense, Siksna’s (1996) classification on mesh size provides another typological range to be considered by further analyses.\textsuperscript{21}

Though it has not been a widely used method compared to the network analyses, if combined with some complementary issues like ‘cellularity’, ‘block-connectivity’ etc. (see ‘the basic indicators of urban form’, below), block size and grain analysis has high potential to be utilised more in urban morphology. The GIS applications, in that sense, currently provide a practical platform for the wider use of the analysis.\textsuperscript{22}

### 3.2 Meso-scale (neighbourhood-level) urban analyses

Although there is no common consensus on its precise definition in the literature, neighbourhood is generally considered as the smallest unit of community organisation limited to the size of 5-minute walking-distance (400 m) in radius, usually with its own commu-

\textsuperscript{20} The variation in the case of Essex, the UK is much more based on the morphological differentiation between the historic tissues and the new modern development areas in-between. However, in the Dutch residential fabric dated in the 1990s, the layout represents the common characteristics of a controlled fine-grain fabric.

\textsuperscript{21} Accordingly, four types of block layouts are specified in terms of route spacing: very fine meshed (60-70m - optimal for pedestrians), fine meshed (100m - very convenient for pedestrians), very coarse meshed (200m - inconvenient for pedestrians) (Siksna, 1996: 24).

\textsuperscript{22} For some recent applications, see: http://www.spacesyntax.com/downloads/image-archive/urban-planning-design/block-size/, accessed in November 2012
nity facilities in the centre (Cowan, 2005). Despite the ambiguity in its spatial definition,\textsuperscript{[23]} neighbourhood is quite a common notion as a nominal scale-level in spatial research. In the context of urban morphology, Marshall’s (2005) route structure and network analyses will be reviewed as the types of neighbourhood level analysis.

### 3.2.1 Route Structure and Network Analysis (Netgram and Hetgram)

Despite having a similar (structural) perspective to morphology, Marshall’s (2005) route structure analysis represents an alternative to Space Syntax, which to a large extent, disregards the geometry and the (compositional) hierarchy of the street networks. The street pattern analysis of Marshall (2005), mainly considers the routes, rather than the links as the basic unit of the street pattern. Unlike the link defined between the two nodes, the route is a single or conjoint street segments which may be continuous through junctions (Marshall, 2005: 115). Though there is no certain protocol provided for the designation of a route, a sort of ‘contextual interpretation’ (Ibid, p. 118) is addressed as the way of representing the route structure of a street network. The specification of a ‘meaningful’ route in the overall pattern is basically made according to the compositional (geometric) characteristics of the constituent street segments, their linear continuance and width [i.e. decisive continuity of the segment through the junctions, and its identical street profile].

The alternative representation of structure based on route essentially derives from the argued limitation of the graph theory-based network analyses, which fall insufficient to characterise the different street compositions having similar topological structures -i.e. different street compositions having the same numbers of nodes and links- (Ibid, p. 111). As response to this point, Marshall (2005) suggests considering the linear (geometrically continuous) aggregation of the links as the elementary components of the system. This (analytical) unit definition essentially differs from the \textit{axis} designated by sight lines in Space Syntax.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure3.17.png}
\caption{A sampling road network (from Delft, the Netherlands) and its route structure. (Source: Google Earth, 2011).}
\end{figure}

In this framework, **continuity**, **connectivity** and **depth** are considered as the basic structural properties of the route structure analysis. Among them, depth is the key figure in drawing a route-structure map. (see Figure 3.17) As in Space Syntax, depth represents the number of steps (turns) away from a starting point. It basically informs the topological distance from the principal route (datum). **Continuity**, on the other hand, means the total length of a route measured in links (the segments between the junctions). Simply as the total number of links on a route, continuity represents the geometric determination of a route through a number of junctions. Finally **connectivity** means the total number of routes connected to the route examined (Ibid, p. 120).

Regarding the relative continuity, contiguity and hierarchy of routes, the main connectors or the high streets in a neighbourhood are selected as the datum of the network for the analysis (Ibid, pp. 120-21). Then in addition to the structural properties of each specified route, their types are characterised in terms of how they are configured by the other routes conjoint. Though Marshall (2005) classifies seven basic types of route based on their singular configuration - i.e. collector, connector, spine or corridor- (pp. 124), most of the routes actually represent hybrid kind of typologies. To clarify the definition of a route structure and its basic properties, the measures of the sampling network in Figure 3.17 is given in Table 3.3 below.

**Table 3.3.** The continuity, connectivity, depth values and the types of routes in the sampling network.

<table>
<thead>
<tr>
<th>Route</th>
<th>Continuity</th>
<th>Connectivity</th>
<th>Depth</th>
<th>Route type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>a</td>
</tr>
<tr>
<td>1.1</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>b</td>
</tr>
<tr>
<td>1.2</td>
<td>11</td>
<td>11</td>
<td>2</td>
<td>b</td>
</tr>
<tr>
<td>1.1.1</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>c</td>
</tr>
<tr>
<td>1.1.2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>d</td>
</tr>
<tr>
<td>1.1.3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>e</td>
</tr>
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<td>1.1.4</td>
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<td>7</td>
<td>3</td>
<td>f</td>
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<td>1.1.5</td>
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<td>5</td>
<td>3</td>
<td>g</td>
</tr>
<tr>
<td>1.1.6</td>
<td>8</td>
<td>10</td>
<td>3</td>
<td>h</td>
</tr>
<tr>
<td>1.1.7</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>i</td>
</tr>
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<td>1.2.1</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>j</td>
</tr>
<tr>
<td>1.2.2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>k</td>
</tr>
<tr>
<td>1.2.3</td>
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<td>d</td>
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<td>1.2.4</td>
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<td>l</td>
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<td>1.2.6</td>
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<td>3</td>
<td>n</td>
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<tr>
<td>1.2.7</td>
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<td>3</td>
<td>l</td>
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<td>1.2.8</td>
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<td>q</td>
</tr>
<tr>
<td>1.1.1.3</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>r</td>
</tr>
</tbody>
</table>
3. UNDERSTANDING the MORPHOLOGY

<table>
<thead>
<tr>
<th>Network total</th>
<th>100</th>
<th>128</th>
<th>118</th>
<th>29 types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted values</td>
<td>0.30</td>
<td>0.36</td>
<td>0.34</td>
<td></td>
</tr>
</tbody>
</table>

The accumulative properties of the routes are supposed to result in a distinctive quality of the total network structures. It means different aggregations (configurations) of the route types give rise to the different characterisations of the networks, accordingly. To represent the overall structural characteristics of a network, relative weighting of the network properties is calculated and plotted on a triangular diagram called Netgram. (see Figure 3.18)

![Netgram Diagram]

**Figure 3.18.** The Netgram and the relative position of the sampling case given in Figure 3.17 with reference to three basic types of street patterns (After: Marshall, 2005: 284, based on the revision by T.M. de Jong)
The ratios between the single property value and the total network value give the relative weightings for each structural properties of a network. Each point in the triangular diagram of the Netgram represents a unique combination of the indicators. As demonstrated via different street patterns, the zones within the generic frame of Netgram characterise the different network typologies such as tributary, griddy and mixed structures (Ibid, pp. 139-45). The way to plot a sampling street pattern on the Netgram can be seen in in Figure 3.18. The main idea here is that adding different parents in to the model can provide a typological framework for analysis. This is actually the point where structural morphology meets typomorphology.

In relation to the basic structural properties of continuity, connectivity and depth, it is possible to improve the network analysis by taking the concept of route type into the consideration. Involving the route types in analysis basically enables us to measure structural complexity of a network. In terms of the amount of differentiation in route types within the network, complexity demonstrates the level of structural heterogeneity within street network. In this context, complexity is represented on another triangular plot called the Hetgram, consisting of the other structural properties of regularity and recursivity. (see Figure 3.19)

Figure 3.19. The Hetgram and the relative position of the sampling case given in Figure 3.17 (After: Marshall, 2005: 151, based on the revision by T.M. de Jong)

In this context, the irregularity of a network is calculated with the ratio between the total number of route types and total number of routes in the network. [Extracting the value

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24 In the protocol of the construction of triangular graphs, Marshall (2005) does not follow a regular continuation for the (scalar) valuation of the sides. This results in a kind of confusion. For this reason, the graphs are reproduced with a small revision of the counter-clockwise variation in side-values.
from 1 gives the value of the complementary concept, regularity. In our case; the irregularity of the network is $26/35 = 0.74$. So the value of regularity is $1-0.74 = 0.26$. As another indicator of heterogeneity, recursivity connotes the regular repetition of a specific configuration producing certain depth value during the pattern formation (i.e. fractal-like branching patterns). It is calculated as the number of maximum depth divided by the number of routes. [The recursivity level of our sampling network in Figure 3.17 is $5/35 = 0.14$.] Finally, complexity is the diversity in route types and the types of depth. It is calculated as ‘the number of distinct type of routes present over and above the number of distinct types generated by difference in depth alone all divided by the total number of routes’ (Ibid, pp. 146-48). [For the sampling network, this value is $(26-5)/35 = 0.60$] (see Figure 3.19)

Marshall considers the use of the Hetgram to distinguish the structural characteristics of the ‘less planned’ (emergent) urban patterns and the regular/ordered structures of the ‘planned’ patterns (Ibid, p. 151). There is no doubt that, the Hetgram has a potential use in the analyses of the same type of planned urban structures, which are subject to the different levels of design control. Since each spatial planning system is supposed to end up with the generation of different morphological variations in certain scale-levels (see Chapter 4), the heterogeneity analysis would provide a firm analytical basis to characterise the structural diversity within different planned urban formations.

### 3.3 Micro-scale (ensemble-level) urban analyses

According to the scale articulation made by Jong et al. (2005), ensemble is a meaningful spatial unit with the nominal radius of 100 meters between the units of building complex and neighbourhood. While naming it ‘fabric’ incorrectly, Pont and Haupt (2010) defines urban ensemble as the collection of islands as well as the network that surrounds these islands (p. 101). To overcome the ambiguity of the definition, we can define ensemble as a unit of urban fabric, which has an internally homogenous and characteristic building setting and layout within the radius value between 30 and 300 meters. This definition also corresponds to the plan unit discussed by Conzen (1960). In this framework, the research introduces urban ensemble as the frame of micro-level analysis, in which a number of methods of morphology are applied. Then, in the context of micro morphological research, the analyses of inter-visibility (Isovist), density (Spacematrix) and street constitution will be included in the overview.

#### 3.3.1 Intervisibility (Isovist) Analysis

While the previous structural analyses mentioned above consider the link as the fundamental element of morphology Isovist as another structural analysis takes the enclosed space as the basic analytical unit. Isovist in general is an analytical method examining the geometric properties of space in relation to the degree of visual fields, which are perceivable from inside. According to Benedikt (1979) who originally introduced the term, isovist is ‘the set of all points visible from a given vantage point in a built environment’ (p. 47). In another words, an isovist is the ‘area in a space directly visible from a location within space’ (Turner et al,

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25 The ‘nominality’ in this context means that the frame has a radius between 30 meters and 300 meters according to the factor value of 3.
The concept basically questions the view of an observer from a particular vantage point and its transforming pattern of visual field throughout the movement in the built environment. Via the Isovist analysis, it is basically aimed to quantify the degree of concealment and isolation created by the blocking elements within a given architectural or urban setting (Benedikt, 1979: 52). Those physical elements in distorted repetition ultimately create a certain pattern of visibility, which is supposed to affect the human perception in a given spatial structure (Turner, et al., 2001).

Figure 3.20. The visibility graph by Batty (2001): the Isovist polygon generated with a viewpoint inside the open space (a); a typical edge and vertices of the Isovist imposed on a grid tessellation (b); the grid polygon defined on the grid centroids (c); and the perimeter marked at the edge of the Isovist field to interpreted the overall geometry (Adapted from Batty, 2001: 126).

The complete intervisibility pattern of a spatial setting is illustrated by the visibility graphs. In the visibility graph analyses, the geometric properties of an Isovist field are taken into consideration like area, circularity or skewness (Benedikt, 1979: 53-54). In the analysis, the space surface is defined with a dense grid tessellation. To build a graph, each grid cell is associated with a point as the Isovist location. On the grid, every point is given an Isovist value. The zones of different Isovist fields intersected are recorded by those cell-points and they are valued to form the graph (Turner et al, 2001).

According to the model, the mutual visibility between the locations is the determinant factor of the graph. The value of visibility basically depends on the position of the vantage point in relation to the real surfaces of exposure in the environment (Benedikt, 1979: 50). Accordingly, the Isovist model calculate the cumulative value of visibility from each and every point in the field with reference to the number of turns from a vertex to the other vertices in the system. In other words, the model calculates the topological relationship of each point with all other points in the system. Then the visual accessibility of the every location in the fabric is illustrated as a graph. (Figure 3.21)

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26 These measures are revisited by Batty (2011) via focusing on the measures of distances (the minimum and maximum distances seen from the vantage points) and compactness to characterise the complex geometries of buildings and urban tissues (pp. 127-129).
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Figure 3.21. The visual field analysis by the Depthmap at the level of urban ensemble: The sampling residential tissues from Essex, the U.K. –left-, Almere, the Netherlands –middle- and Ankara, Turkey right-. The hot colours imply the spaces with high level of intervisibility within the urban tissues.

Once the intervisibility of the spaces is illustrated, one can easily figure out the pattern of visual fields in an urban fabric. The areas which are visually blocked by the solid objects are designated as the concealed fields, while the most visible ones are much more highlighted in the graph. Accordingly, two aspects can be figured out by means of the visibility graph. First, the variation within the fabric in terms of the distribution, size and intensity of the visual fields becomes explicit. This provides an idea about the diversity of open spaces in the city fabric with regards to the hierarchy in public space. Since the visual accessibility can be taken as a fundamental condition of the publicness, the visibility pattern of the spaces between the buildings in a fabric implies the system of hierarchy in the structure of a public space network. The higher the visual variation in space, the higher the potential of different uses occurs in the fabric.

Secondly, the correlation between the visibility pattern and the morphological layers of an urban fabric, which can be made via the visual field analysis, potentially suggests a firm conclusion about the spatial design approach in a given context. For instance, as we see in Figure 3.21, the morphological compatibility between the visual fields and the building setting with the circulation system may differ in the different spatial cultures. As in the case of Essex, the UK, the open public space within the tissue may not suggest high intervisibility, but a street junction instead. Conversely, as in the Dutch case, the designation of the public
space may reveal a legible and high visual accessibility within the planned urban ensemble. Or in the case of a typical planned residential tissue in Ankara, Turkey, a kind of open-plan modernist layout may be ended up with a clear visual field, which coincides with the major traffic artery rather than a pedestrian-oriented public space. There is no doubt that such correlations indicate the characteristics of a design control system in terms of the conscious motivation to create safe and visually accessible public spaces within the planned urban settlements.

The applicable use of the Isovist also includes the exploration of the morphological performance of space in orientation, walkability and wayfinding. In terms of urban design, Isovist has a potential to be utilised as a supplementary tool in design process to test the resultant visual impacts of the new configurations suggested and the compositional interventions in the existing urban settings.

3.3.2 Urban Density Analysis (Spacematrix)

Measuring density represents one of the core topics in spatial analysis. The ongoing emphasis on the relationship between density and the key issues of sustainability (i.e. walkability, mixed-use) makes the concept more critical in urban morphology. In the context of morphological research, such a relationship has originally constructed by Radberg (1996) with a systematic correlation between the main density indicators, land coverage, floor area and the building height. The matrix of density indicators suggested by Radberg (1996) was basically aimed for a clear typology of the urban patterns. (see Figure 3.22, above) By this means, the patterns which were used to be defined generically (i.e. ‘traditional blocks’, ‘garden suburbs’) would be described by the metric parameters of density.

M. B. Pont and P. Haupt (2010) later on elaborated the idea of the typomorphological analysis based on the density indicators with the concept Space-
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matrix, the descriptive interface for ‘quantitative urban design’. (see: Figure 3.22, below) The major aim of the model is to create a generic outlook for the comparative analyses of different form typologies.

For the density analysis, Radberg (1996) initially identifies three basic parameters as follow: 1. *residential density*, \([e= \text{ratio of total residential area to the area of land}]\), 2. *building height*, (average number of storeys) \([n]\), 3. *percentage of the built-up area* \([v]\). The mathematical relation between the parameters is given as \((p. 390)\). The basic idea is that the registration of the different types of urban patterns into the graph of the density parameters would provide a kind of typological map for the evaluation of urban patterns in terms of the certain aspects of sustainability -i.e., energy consumption and waste production- (Ibid, p. 392)

With the same motivation, Pont and Haupt (2010) suggest six basic indicators of urban density: *building intensity (bulk)*, *coverage*, *building height*, *spaciousness*, *network density* and *tare*. (see Figure 3.23)

![Figure 3.23](image)

**Figure 3.23.** Basic density indicators utilised in Spacematrix -Fx: gross floor area, Ax: area of aggregation x (m2), Bx: building footprint (m2), x: aggregation (lot, island, ensemble or district)- (After Pont et al., 2010: 107-9)

In this framework, **floor space index (FSI)** is the measure of the building mass on its own plot. It is simply calculated by dividing the total floor area of the building to the area of the building plot. FSI is actually a widely used zoning parameter in modern planning of which version in the States is known as **floor area ratio (FAR)**.\(^{[27]}\) The complementary measure of FSI is the coverage of building on the plot. Called as **gross space index (GSI)**, coverage is the ratio between the footprint area of the building and the area of its plot. It basically quantifies the figure-ground relationship of the building settings. In relation to building bulk and coverage, the other major density indicator is **building height** in terms of the number of storeys the building has. The ratio between FSI and GSI gives the average building height of a fabric. Mainly affecting the three-dimensional quality of the building setting, height is a major factor on the construction and management cost of the vertical

\(^{[27]}\) As one of the major design control tool in planning, FSI is also called ‘kat alanı katsayısı’ (KAKS) -floor space coefficient- in the Turkish development law.
access to the dwelling units. Interchangeably used with spaciousness \[28\] the other major density concept introduced by Pont and Haupt (2010) is open space ratio (OSR). Being calculated as the ratio between the non-built space and the floor area of the buildings, OSR is an operational measure to optimize open public space as opposed to the private domain pressuring on the non-built space in a development area (p. 108). Finally, in addition to the concept network density, the amount of network length per unit area, Pont and Haupt (2010) introduce the concept of tare as a complementary indicator urban density. Being calculated as the difference between the net and gross density, ‘tare’ basically refers to the open space left when one subtract one unit of a certain scale level from the other on the larger scale. -i.e. the left [over space when you subtract block are from the overall area of the ensemble] (Ibid, p. 109).

In order to construct the diagram, Spacematrix, it is necessary to calculate the each indicator based on the sampling area designated. Specification of the area border is the most critical point in density analysis, which essentially changes the results in calculation though different demarcations. Instead of utilising a fixed range of frames for the different scale-levels (i.e. ensemble, neighbourhood), Pont et al. (2010) suggests to determine the borders of the sampling tissues with reference to the local morphology while ensuring the internal homogeneity and consistency within the designated frame (p. 100). In order to transcend the heuristic ambiguity in border definition, we exemplify the model with the fixed-framed samples providing the internal compositional consistency at the ensemble level. (see Figure 3.24)

**Figure 3.24.** Solid models of the sampling urban ensembles produced by Modelur© for the calculation of building density.

The sampling fabrics basically comprise the characteristic tissue of the case study areas in terms of the typical building, street and plot layouts. The density measures separately calculated \[29\] are plotted together on the Spacematrix to typologically characterise the ensembles in comparison to each other. (see: Table 3.4 and Figure 3.25)

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28 As stated by the authors the concept is initially introduced by the German author, A. Hoening in 1928 as ‘weitraumigkeit’. See: Hoenig, A. (1928) Baudichte und Weitraumigkeit, Baugilde (10), pp. 713-15
29 For the preciseness of the analysis, Modelur, the parametric application for Google SketchUp can be utilized.
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Table 3.4. Density measures calculated for the sampling urban ensembles.

<table>
<thead>
<tr>
<th>Ensembles</th>
<th>Building block area (m²)</th>
<th>Built-up area (m²)</th>
<th>Gross floor area (m²)</th>
<th>FSI</th>
<th>GSI</th>
<th>OSR</th>
<th>L</th>
<th>Tare</th>
<th>Total Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essex (UK)</td>
<td>71326</td>
<td>19561</td>
<td>31702</td>
<td>0.35</td>
<td>0.22</td>
<td>2.22</td>
<td>1.62</td>
<td>0.21</td>
<td>90.000</td>
</tr>
<tr>
<td>Almere (NL)</td>
<td>65359</td>
<td>20765</td>
<td>41130</td>
<td>0.46</td>
<td>0.23</td>
<td>1.68</td>
<td>1.98</td>
<td>0.27</td>
<td>90.000</td>
</tr>
<tr>
<td>Ankara (TR)</td>
<td>47303</td>
<td>16076</td>
<td>1,17</td>
<td>1.17</td>
<td>0.18</td>
<td>0.70</td>
<td>6.53</td>
<td>0.47</td>
<td>90.000</td>
</tr>
</tbody>
</table>

Figure 3.25. Relational density figures plotted on the Spacematrix.

As we see in the simple demonstration in Figure 3.25 the different building settings end up with a certain typological variations in urban density. While the typical Dutch residential tissue corresponds to the class of ‘low-rise’ in the typological matrix suggested by Pont et al., (2007) (also see Figure 3.22, below), the semi-detached typical British suburban tissue in Essex suggests a close figure to the typical Dutch low-rise. The hybrid type from Ankara, however, coincides the typological location between ‘high-rise’ and ‘open block’ in the matrix, while it would be expected to locate between ‘high-rise’ and ‘low-rise’. This basically represents the limitation of the model to identify hybrid typologies in specific contexts.

Apart from this limitation, to evaluate the proposed form-compositions in terms of the already existing form-typologies, Spacematrix suggest a relevant analytical basis for design as well. Nevertheless, in order to perform as a common method -like a GIS application-, it still needs to provide a firm protocol in the designation of the sampling areas to analyse.
3.3.3 Topological Analysis of Street Constitution by Buildings

With regards to the behaviour of people in the interface of public and private spaces, the spatial configuration of urban form is a prominent issue in critical urban theory. In this regards, the topological relationship between the buildings and street is one of the main aspects of micro urban morphology. Originally introduced by Hillier and Hanson (1984, pp. 92) and elaborated by Nes et al. (2007), the concept of street constitutedness basically considers that relationship by defining the street segments with reference to building entrances. Accordingly, the basic condition of ‘constitutedness’ is the level of access to street (public space) from building (private space) via direct entrances. The constitution of street, in principle, depends on the different configurations of the buildings on the street segments. (see Figure 3.26)

Figure 3.26. Different forms of street constitutedness (Adapted from Nes et al., 2007: 23)

As seen in Figure 3.26, close positioning of the buildings on the street is not enough to ensure constitutedness. If the building series lack direct entrances to a street segment, the street is not considered ‘constituted’ despite the dense composition of the building setting along the sides.

To determine the level of the constituentness of a street pattern, the amount of the total network length and the total number of the buildings having direct access to the street have to be registered. The ratio between the values gives the level of street constitutedness. (see Table 3.5)
3. UNDERSTANDING the MORPHOLOGY

Table 3.5. Number of building entrance facing the street per 10 meters as the average value of street constituents of nine sampling urban ensembles.

<table>
<thead>
<tr>
<th>Ensembles</th>
<th>Total number of buildings with direct access to the street (n)</th>
<th>Total length of street segments (l)</th>
<th>Average value of the street constitutedness (n/l)*10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essex (UK)</td>
<td>245</td>
<td>2690</td>
<td>0.91</td>
</tr>
<tr>
<td>Almere (NL)</td>
<td>416</td>
<td>3191</td>
<td>1.31</td>
</tr>
<tr>
<td>Ankara (TR)</td>
<td>50</td>
<td>3327</td>
<td>0.15</td>
</tr>
</tbody>
</table>

In addition to the overall value of constitutedness, its distribution on the overall pattern is involved in analysis. To map the pattern of street constitutedness out, each segments of the street network is highlighted according to the number of buildings having direct street access, per 10 meters.\[^{31}\] (see Figure 3.27) The basic aim of the map is to figure out the intrinsic relationship between the street segments in varied depths and the level of constitutedness.

![Figure 3.27. The patterns of street constitutedness within five degrees in the sampling residential tissues from Essex, the UK, Almere, the Netherlands, and Ankara, Turkey](image)

As seen in Figure 3.27, the higher the total number of entrances on a series of buildings located on the narrow plots, the higher the level of constitutedness is specified on that street segment. The pattern also reveals how a ‘high-street’ or deep access paths are interpreted in terms of the street vitality through active building frontages. In this regard, the correlation between the depth of a street and its level of constitutedness can be considered as a complementary issue of analysis. In this context, the deeper street segments (far from the principal street) are theoretically expected to have lower level of constitutedness through higher topological depth -the total number of steps taken from public to private space (Hiller and Hanson, 1984: 105)- between the private and public space (Nes et al, 2007: 023-10).

Though that assumption sounds relevant, it is not always the case in the real context where the residential clusters are composed as closed enclaves [as in the Turkish case] or the cul-de-sacs are configured as semi-private residential zones [as in the British case]. (see Figure 3.27)

In addition to street constitution by direct accesses from buildings, Nes et al. (2007) introduces ‘intervisibility’ as another concept of the micro spatial analysis of street network. What they point out here is not only the existence of direct accesses from buildings, but also their configuration with reference to each other as located on either side of the street. Then the level of intervisibility is calculated by the ratio between the total number of the frontal facades (with windows and entrances) visible from the buildings located on the other side of the street (also with the direct access), and the total number of houses on the street segment. For the intervisibility measure, the number of the direct-accessed buildings has to be registered separately for each side of the segment (Ibid, p. 023-08). (see Figure 3.28) The practical result of high intervisibility is that the more entrances directly connected to the street, the higher the possibility of pedestrian movement and occurrence the street affords through close surveillance of residents.

Figure 3.28. Various degrees of intervisibility with reference to the orientation of the main facades of the buildings (Adapted from: Nes et al., 2007: 023-08)

Figure 3.29. Some generic examples to the different types of intervisibility and constitutedness: (1.) both intervisible and constituted, (2.) constituted but not intervisible, (3.) and (4.) neither constituted nor intervisible (Source: author’s personal archive, 2011)
The point is that constitutedness of a street is not always a sufficient condition for intervisibility. The relative positioning of the buildings in configuration is a key aspect in the characterisation of a street segment. (see Figure 3.29) In this regard, the highly intervisible street configurations do not always ensure the street vitality unless the building composition achieves a certain level of density on the street. That’s the reason why, any intervisibility map has to be accompanied by the data on entrance density in order to provide a better understanding on the issue. (see Figure 3.30)

Figure 3.30. The maps of intervisibility with respect to the entrance density in the sampling ensembles from Essex, the UK, Almere, the Netherlands, and Ankara, Turkey

As demonstrated with the sampling patterns in Figure 3.30 above, what we see is that a segment with low level of constitutedness [with few building entrances on the street] can exhibit a high value of intervisibility [as in the case of Ankara, above]. This is quite a matter of the grain of urban fabric. If the large building types with single entrances (i.e. apartment blocks) dominate a fabric, it is highly possible to come up with a controversial coupling between constituentness and intervisibility. To overcome this conceptual drawback, the idea of intervisibility is elaborated with the concept of ‘counter-position’, which measures how intense the intervisible buildings are located on the segment. (see: ‘building setting’, below). While keeping the main idea of relative (reciprocal) positioning of the buildings on the street, the author suggests to replace the percentage-based calculation of intervisibility, which would be configurationally misleading, with the multiplication-based measure.
4. A Concept-Framework for Urban Morphological Analysis: the basic indicators of urban form

4.1 Introduction:

The ever-growing interest on urban morphology has resulted in many spatial researches asserting their own set of methodologies and conception. While this situation signifies the increasing richness of our understanding of urban formation as a complex phenomenon, it also signifies the necessity to have an integrated framework reflecting upon the individually well-defined but disconnected research themes while placing them on a common basis. Such a framework would also provide a conceptual foundation for the new studies considering the different elements of urban form such as streets, plots and building typologies (Batty, 2004: 32).

Considering the difficulty of the selection of the relevant morphological aspects in a spatial analysis, the author hereby suggests a concept-framework to conceive all the form-concepts on a unified basis. (see Figure 3.32) Yet this framework should not be taken as an ultimate set, but as a kind of open-system into which any other researchers would adapt their own new concept definitions. In this regard, the comprehensive review of the existing indicators in the literature has gone hand-in-hand with the definition of the originally new concepts. The shared feature of the indicators is their mathematical accuracy, which has been lacking for some of them in the current literature.

4.1.1 Scope of the framework:

The proposed framework covers the three basic morphological components of street, plot and building. Each component is organised as the constitutive layers of the urban fabric, which are street pattern, plot layout and building setting. As seen in the selection of the layers, the proposed framework, in this regard, partly follows the basic terminology of the Conzenian school of morphology discussed above. (Conzen, 1960). Furthermore, each layer is represented at different levels of abstractions. The gradual abstraction let us reveal the different typological levels, which are form, structure and rule. Those categories are the ones specifically delineated as the basic aspects of urban formation in the introduction of the thesis. While in that framework (see: Figure 2.9), the categories were connoting the different states in (urban) formation, in the current context, they refer to the different levels of abstraction in the comprehension of collective urban fabrics. Despite having the same meanings clarified in the early framework before, the categories of form, structure and rule here are re-introduced to represent an urban pattern through different set of morphological indicators in analysis.

As discussed in the Chapter 2, each level of abstraction is supposed to comprise of different intrinsic qualities of an urban fabric. Briefly given, the formal qualities of an urban pattern can be perceived in an explicit manner [mainly through its massing, texture and orientation], however the topological qualities of a fabric cannot be conceived merely by visual observation. They require a certain level of abstraction to be comprehended. This basically goes along with Lozano’s (1990) point arguing that ‘the raison d’être of spatial forms lies hid-
den below surface’ (Lozano, 1990: 73). In this regard, the raison d’être of the urban pattern is defined by structure and rule at the deeper typological level of analysis. While structure informs of the intrinsic topological relations (connections and separation) between the units of the form, rule determines the types of the units and their ordering condition(s).

This categorisation is congruent with that of Marshall (2005) who suggests a systemic representation of street patterns by three-step progressive abstraction. Accordingly, Marshall (2005) specifies three fundamental levels of analysis (and/or design) of street patterns: composition, configuration and constitution (p. 167). Together with their own corresponding aspects and the mode of visual representation, the levels are respectively preceded from concrete to abstract. (see Figure 3.31)

![Figure 3.31. Three levels of abstraction by Marshall (2005) and some sampling applications for different street patterns –Note that each level has its own mode of visual representation- (Adapted from Marshall, 2005: 167).](image)

In this framework, composition of an urban form implies the geometry of the settlement pattern. Size, shape and orientation are the main aspects of a composition. Therefore the area, length, width, height and angular sitting of the elements are the basic properties of an urban composition. Composition is represented by the real footprint of the scaled ordnance maps and valued by the real numbers (Marshall, 2005: 167). As the second level of abstraction, configuration of an urban pattern captures the topological characteristics of a spatial form with reference to the basic structural properties of continuity, connectivity and depth. Through a kind of dimensionless representation, it is given by integers and ratios (i.e. number of nodes, depth of links). Finally, constitution reveals the types and hierarchy of the composing elements and the relational rules between them. In this sense, type, rank, variation and allowable (or necessary) connections are the basic aspects of constitution (Ibid). In our framework, these triple concepts correspond to the categories of form, structure and rule, and they are elaborated with the specific indicators of the other morphological layers [of plots and buildings]. (see Figure 3.32)
Figure 3.32. The concept-framework of urban morphological analyses: the modes of representation of the morphological layers based on the three typological levels and the corresponding indicators listed.
As seen in the key diagram, each typological level of the layers is differentiated with a certain mode of representation. The first level of representation (form) involves only layer exclusion. That means without changing the geometric qualities, the abstraction is executed by omitting the other layers (or keeping them as just a referential background) and emphasising the one in consideration.

In the second level (structure), the composition of the fabric is reduced to a kind of configuration. By disregarding the metric properties of each layer and reducing them into the map of nodes and links, configuration of the pattern in Marshall’s (2005) term (such as subway maps) can be considered as a kind of ‘dimensionless representation’ as argued by Steadman (1983: 7-19). Yet, the configurational representation I proposed here is not fully free from the composition (form) by purpose. Unlike the ‘dual network representation’ (as in space syntax) by which the links of the street network can be turned into the nodes in graph (as might be done inversely for the nodes as well), the configurational map in the current analysis is based on the ‘primal representation’. Instead of representing the network as a dimensionless topological graph, the network configuration created according to the ‘road-centre-line-between-nodes’ rule by which the map is defined via the continuous polygons (through the vertices) and the two end-nodes (of the street junctions). In this context, the edges (links) of the structure/configuration map follow the real footprint of the streets throughout their centrelines. As argued by Porta et al. (2008), this mode of representation provides a kind of opportunity to facilitate the same map in analysing both the formal (extrinsic) and structural (intrinsic) characteristics of the networks. Likewise, symbolising each plot and building unit as a node and their direct relation with the other units as a link is the way to define the structure of plot layout and building setting.

Finally, the organisation of the pattern at the level of constitution is represented by mapping the types and ordering rules that involve in the establishment of each morphological layer. For street pattern, order is defined with reference to the typology of route structure, network hierarchy and assembly rules (Marshall, 2005). While the typology is mapped on the links, the rules are determined for the whole pattern without mapping. Nevertheless, the ordering rules of the plots and the buildings are mapped out based on the building blocks in which the units (plots and buildings) locate.
Table 3.6. The list of indicators sorted according to their originality.

<table>
<thead>
<tr>
<th>The morphological indicators borrowed from the existing literature</th>
<th>The morphological indicators originally defined within the research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straightness</td>
<td>Rectilinearity</td>
</tr>
<tr>
<td>Network density</td>
<td>Cell properties (depth-to-frontage ratio)</td>
</tr>
<tr>
<td>Angular diversity</td>
<td>Block connectivity</td>
</tr>
<tr>
<td>Sinuosity</td>
<td>Cellularity (of network structure)</td>
</tr>
<tr>
<td>Closeness</td>
<td>Nodality</td>
</tr>
<tr>
<td>Continuity (of street)</td>
<td>Perviousness</td>
</tr>
<tr>
<td>Route connectivity</td>
<td>Coverage (plot)</td>
</tr>
<tr>
<td>Integration</td>
<td>Variety (in depth and frontage)</td>
</tr>
<tr>
<td>Route types</td>
<td>Granularity</td>
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<td>Types of assembly rules</td>
<td>Type of block organisation</td>
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<td>Average plot size</td>
<td>Subdivision types</td>
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<td>Types of plot</td>
<td>Contiguity</td>
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<td>Density</td>
<td>Continuity (of building)</td>
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<td>Compactness</td>
<td>Intermediacy</td>
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<td>Closeness</td>
<td>Verticality</td>
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<td>Porosity</td>
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<td>Rugosity</td>
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<td>Betweenness</td>
<td>Orientation</td>
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<td>Unit types</td>
<td>Counter-position</td>
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<td>Ordering rules (of building setting)</td>
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<td>Typological variation(s)</td>
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Within the proposed concept-framework, 40 indicators have been involved. 19 of them are compiled by a review of existing literature, and 21 of them are originally introduced by the author. In the later class, while some indicators are fully conceptualised by the author, some others are suggested via explicit (mathematical) definition of the concepts generically used in common. (see Table 3.6)

4.1.2 Glossary:

- **Block**: The group of adjacent building plots circumscribed by streets.
- **Building envelope**: The maximum habitable volume of building group in which a certain set of form of building regulations are executed.
- **Building unit**: The independent volume of building having its own circulation system and external access, which can be shared by the various dwelling units inside.
- **Capacity**: The width of a road represented as an edge or route, enabling certain level
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of movements.

**Cell:** Area enclosed by the (street) edges.

**Centre-line:** The hypothetical line of the street lying alongside the midpoints of a street-section.

**Datum (stem):** The route with the highest rank in the road order within a defined area.

**Depth:** The number of turns (on the vertices) taken from the datum (stem) to a certain point in the network.

**Dwelling unit:** The smallest unit of building occupied by single user (family or person)

**Floor area:** The total area of all floor-levels measured to the external walls of the building.

**Geodesic distance:** The actual distance from one point to another in the network by following the real geometry of the street segment.

**Junction:** The point where street segments intersect to turn direction in the flow of the traffic.

**Link:** The constituting line of a street segment which lies between the two vertices.

**Node:** The point representing the street junctions on a network. It is defined by at least two segments. [Valence > 2]

**Nominal number:** A number (i.e. R or r = {... 1, 3, 10, 30...}) used as the name for a range of values until 3 times larger or smaller than R (radius of frame) or r (radius of grain).

**Party wall:** The wall adjoining the neighbouring building units.

**Plot series:** The group of adjacent plots, which is not defined by any street segment at least from one side of the cluster.

**Plot:** The smallest unit of ownership on which the building is located according to setback rules.

**Route:** The elementary path of the street pattern defined by single or various segments, which have a geometric continuation and the consistency in profile (section width). [Topological condition for the definition of a route is to have the minimum valance degree of 1 and the maximum depth of 1]

**Segment:** The path between two junctions.

**Shortest path:** The minimum sum of the segment lengths throughout all the possible paths on an overall street map.

**Turn:** The change in direction within a section indicated through a junction.

**Valance:** The number of edge ending at a vertex in the graph.

**Vertice:** The point where the centre-line of the street is bended in a different angle.

4.1.3 Abbreviations:

**Ai:** area, **Vi:** volume, **Ni:** number, **Li:** length, **Di:** geodesic distance, **Di\text{Eucl}:** Euclidian distance, **Hi:** height, **Wi:** width, **Pi:** portion (relative number of an entity within the category i), **Pr:** perimeter
4.2 The Layers of Urban Pattern and the Morphological Indicators

In the following part, the basic morphological layers of urban pattern are described in terms of the corresponding morphological indicators sorted out within the typological levels of composition, configuration and constitution. The sequence of the layers, street, plot and building, given basically refers to the degree of their robustness, respectively.

4.2.1 Street Pattern

As the frame of an urban form [in an analogy of the skeleton of a body], street layout basically connects the form-elements whining a fabric. For Trancik (1986), the system of linkage is the spatial datum of the urban form on which the buildings and spaces relate each other (p. 106). For Maki (1960), the prime function of linkage is to combine discrete forms within collective fabric. It is concerned with making the overall form and activities comprehensible in design terms (p. 29). Though they specifically focus on urban block in the morphological research, Panerai et al. (2004) admits that block is not the primary element in the production of urban form, but the streets that structure the tissue of a settlement (p. 168). This view is also shared by Caniggia et al. (1979) who prioritise buildings in urban morphology. For them, the ‘built-up route’ is the module of urban aggregates generated (p. 133). As Conzen (1960) also argues, given this fact, is the street pattern the most robust element compared to the building and plot layout (p. 7).

As a connecting network, a street pattern is usually represented in links and nodes (or axis and vertices). Nevertheless, in addition to the function of connection, it is possible to consider the street pattern as a web of separators designating the internal segments on ground surface. In this sense, depending on the focus of interest, it is possible to represent urban street patterns as either the network of routes or the tessellation of land parcels defined by the closed street segments (Marshall, 2005: 83). Each type of abstraction offers different set of conclusions. In this regards, the morphological framework that we suggest includes block layout in the street pattern analysis by considering the cellular characteristics of a network in parallel to its axial nature. Such interpretation is also consistent with the Conzenian perspective which calls urban block ‘street block’ as a group of plots bounded by the street lines (Conzen, 1960: 5). This definition is also similar with that of Panerai et al. (2004). For them, block is the by-product of the street layout, the space between the streets occupied by private space of plots, semiprivate space and, sometimes, public space and buildings (p. 168).

Figure 3.33. The basic elements in the representation of street pattern in morphological analysis.
Within our analytical framework, the street network is regarded with the six constituent elements, which make the pattern a measurable entity within its relational context. Basically, the street composition is designated by the street side-lines as the border of a road and lane surface. While street side-line designates the whole paved surface of the road including parking areas, line-surface is the segment on which the traffic follows. While the former informs the density measure, the later is used for the designation of the centre-line. Thus, each segment is configured by the nodes as junctions and the links as centre-lines of the street. The continuous series of links between the nodes is called segment. The segments and the nodes are basically the elements utilised to characterise the pattern topologically. Each segment is composed of the links connected to following one via a series of vertices. By taking the vertices into consideration, it becomes possible to make compositional analysis based on metric distances and angular variations within a network. Each segment also preforms as a reference line for measuring the other layers’ properties like those of plot and buildings. The embedded elements together basically makes the pattern a measurable system in itself.

### 4.2.1.1 Composition of street pattern:

Composition of a street pattern is characterised by the indicators of straightness, network density, rectilinearity, angular diversity, sinuosity, closeness and cell properties.

#### 4.2.1.1.1 Straightness:

Straightness is the measure of deviation of the shortest path, which connects the two nodes in a street network, from the virtual straight line (the beeline) between those two (Porta et al., 2009: 453). It is calculated by the ratio between the Euclidian and geodesic distances (see Figure 3.34) The more the length of the real route from destination to the origin gets closer to that of the virtual line, the more the value of straightness converges to the maximum value, 1.

Figure 3.34. Two types of distance in the calculation of straightness virtual line (d1) and the geodesic line (d2) following the real footprint of the shortest path between the two nodes.

Straightness of a street network is calculated as follows:

\[
\frac{\sum_{j \in N; j \neq i} \frac{d_{ij}^{Eucl}}{d_{ij}}}{(N - 1)}
\]

where \(d_{ij}\) is the shortest geodesic distance between the two given nodes and \(N\) is the number of nodes in the network. (Porta et al. 2006: 710)
The degree of overall straightness of the routes would enable the network to operate in a ‘legible’ way in terms of easy wayfinding through maximum (angular) linearity. This is based on the argument on the common tendency of people to conserve the angular linearity of a route [through minimum deviations] when choosing the route for the final destination in a network (Conroy-Dalton, 2001).

### 4.2.1.1.2 Network density:

Considering the network as the configuration of nodes and segments, we define the density of a network in terms of links (segments) and junctions. Besides, the segment density is divided into two: linkage (axial length) and surface (area) density. Such a distinction is made to distinguish the urban compositions with the same network densities.

#### 4.2.1.1.2.1 Linkage density:

Calling it ‘network density’, Pont. et al. (2010) defines the linkage density as the network length per sampling area (p. 107). The higher the network density, the more the circulation space is created within the fabric.

![Figure 3.35. Road centre-lines in the calculation of linkage density.](image)

Linkage density factor has the following expression:

\[
\frac{\sum_{k=1}^{K} L_k}{A_{neigh}}
\]

where \( L_k \) is the length of the segment \( k \), \( K \) is the total amount of the segments, and \( A_{neigh} \) is the total area of the neighbourhood.

Implying the opportunity of reaching diverse destinations, the linkage density can be one of the factors of accessibility. In relation to the profile of the streets, it also indicates the service capacity of a network (i.e. proximate surface parking, shared-spaces).
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4.2.1.1.2.2 **Surface density:**

The capacity of the network in terms of the amount of parking space and the lanes of flow accommodated depends on the coverage area of the street network (Ibid, p. 206). In this regard, the surface density of a street pattern is the ratio between the road-space to the total area.

![Figure 3.36. The coverage area of a network defined by the edges of the street profile.](image)

More precisely, it is expressed as follows:

\[
\frac{\sum_{k=1}^{K} L_k \cdot W_k}{A_{neigh}}
\]

where \(L_k\) and \(W_k\) are the length and width of segment \(k\), \(A_{neigh}\) is the total area of the neighbourhood, and \(K\) is the total amount of segments in the network.

In the calculation, the privately owned paved surfaces or the pedestrian paths in green areas are excluded. The areas developed by the generous highway standards are supposed to reflect high surface network densities. Depending on the surface treatment by design, the network area density can be an indicator of the public space oriented planning approach in certain contexts.

4.2.1.1.2.3 **Junction intensity:**

Junctions on a street pattern are the basic elements regulating the system of the internal movement and the speed-control regime of the network (Bach et al., 2006: 111). For both vehicles and pedestrians, the higher amount of junctions on the routes entails more layovers through the continuous flow on the network. Nevertheless, the same amount of junctions can be composed in different relative distances (see Figure 3.37) and that would change the flow pattern remarkably. In this sense, while the number of interchanges on a given network implies the junction density, the average distance between them gives the measure of intensity, which is relatively more significant compositionally.
The factor for the overall network is calculated as follows: where \( D_{ij} \) is the total shortest (geodesic) distances from the junction \( i \) to \( j \) and \( n \) is the number of junctions in the network. This measure gives the average possibility of passing through the junctions over the network.

The less the value of junction intensity of a network (with the same junction density as another one) means higher deconcentration of the junctions dispersed towards the edge of the area. It can be suggested that junction density does not only imply the route choice in the network (avoiding detours), but also the probability of the encounters per unit area (Southworth et al., 1993).

4.2.1.1.3 Rectilinearity:

Like in the case of straightness, rectilinearity of a settlement network has a deep-rooted connotation based on the contrariety between the rational city model with the orthogonal land subdivision and the organic one with angular diversity through the absence of sharp corners in the street pattern (Kostof, 1991: 69-82). Beyond all the symbolic connotations in urban design, rectilinearity of a street pattern derives from the implicit aim of maximizing land utilisation. Furthermore, the emergent hierarchy of roads oblige the most efficient hexagonal pattern to turn into an orthogonal one in favour of fast through-traffic (Jong, 2007: 451).

Rectilinear layouts are composed of the links meeting at right angles and creating the closed polygons of which the interior angles at each vertex are either 90° or 270°. Though the total value of the interior angles within a closed polygon always equals to 360°, any irregular change in its shape has certain potential to differ the rectilinearity of a pattern.

Figure 3.38. An exemplar street pattern composing various building blocks within different interior angles.

---

The tolerance in this calculation is designated as plus or minus 5 degrees.
The overall rectilinearity of an urban pattern is calculated by the ratio of the interior angles of all the blocks that are either 90° or 270° to the total amount of interior angles. It is expressed as

\[ \frac{N_{\text{int.ortho}}}{N_{\text{int.ang}}} \]

where \( N_{\text{int.ortho}} \) is the amount of orthogonal interior angles, \( N_{\text{int.ang}} \) is the total number of (interior) angles.

### 4.2.1.1.4 Angular diversity:

Each angular change in a given route can be regarded as a kind of cost factor for any movement on a network by causing detours and speed reduction. Therefore, angular composition is an influential factor of pedestrian movement in public space. In opposition to the orthogonal streets, oblique streets are considered as the disorienting factor (Montelo, 1991). Therefore the angular deviation within a network implies the (dis)integration of the axial system and the degree of the movement potential, accordingly. (Turner, 2001)

![Figure 3.39. The angular change on a route based on the series of links composing the road-centre-line.](image)

In addition to the intersection angles between the links, the angular variance of the routes depends on the geometry of the segments. Representing the route as a polyline composed of various lines and the vertices the bending points, (see Figure 3.39), it is possible to measure the overall angular diversity of a street pattern.

\[
\frac{\sum_i \beta_i \cdot L_i}{\sum_i L_i}
\]

where \( \beta_i \) is the amount of change in orientation on the segment \( i \), \( L(i) \) is the length of segment \( i \).

Angular diversity can be taken as the indicator of the context sensitive formation of an urban pattern under the influence of existing site conditions including the irregular property pattern in the development area.

### 4.2.1.1.5 Sinuosity:

Although the angular diversity reveals the dynamic change in orientation on a network, it does not inform about the directionality of the street pattern and its weighted value in terms of the length of the street segments oriented towards a certain direction. In this sense, sinuosity factor characterises the level and distribution of the angular change within the street alignment according to a given direction. It basically quantifies to what extent the
street pattern has a dominant orientation with its diverse set of routes and the constituent links on them (Adolphe, 2001: 189)

The relative sinuosity factor of an urban pattern has an expression as follows:

$$S(\theta) = \frac{\sum L_i \cos^2 \beta_i}{\sum L_i}$$

where $L_i$ is the length of the link $i$ on the street segment and $\beta_i$ is the angle between the link $i$ and the given primary direction (Ibid).

The accumulated value of $\beta$ in range gives the pattern of relative sinuosity of the network, which can be plotted on a polar diagram (Ibid). The more the routes set against the main direction, the less the relative value is obtained. Being correlated with the local wind diagrams showing the direction and speed of the wind, sinuosity of a network would give an idea about the overall performance of the tissue especially on the corridor effect of the streets.

### 4.2.1.1.6 Closeness:

Geodesic (metric) distance (the segment length) between the junctions (nodes) on a network is the basic factor defining the closeness index of a network. Closeness of a street network basically captures the sum value of the shortest (metric) distances from one node to all others. It is the inverse value of the average shortest distance from one to every other nodes in the system (Porta et al., 2006: 709).

Therefore, the function of closeness has an inverse relation with the relative distances between the nodes in the system. Accordingly, the indicator is expressed as follows:

$$\frac{Nn - 1}{\sum_{i,j; i \neq j} D_{ij}}$$

where $Nn$ is the number of nodes in the study area, and $D_{ij}$ is the distance of the shortest path between the two nodes in the network $[i \neq j]$ (Ibid).
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Figure 3.41. Some selected shortest distances from one junction to the others. The iterative measurement for all the nodes in a system gives the value of closeness factor for the given street pattern.

The higher the number of nodes within a proximate position, the higher the closeness factor of the network measured. Along with the other centrality indicators (i.e. straightness and betweenness) the overall closeness of a street pattern can be claimed to have an operational effect on the densities of commercial and service activities in the city fabric (Porta et al., 2009).

4.2.1.1.7 Cell (block) properties:

As a form of enclosure, the closed blocks defined by the streets segments perform as a spatial container of plots and buildings (Habraken, 2000: 119). In this sense, urban blocks can be considered as the ‘cells’ within a network. This view lets us define the following compositional aspects as the cellular characteristics of a network.

4.2.1.1.7.1 Depth-to-frontage ratio:

The relevance of the cell-dimensions directs from the opportunity to be created by the block geometry for the alternative building compositions. For instance, the closer the ratio between the depth and width of the block to the value 1, the more square-like building blocks are to be generated in the fabric. This usually lets the blocks be accommodated with the perimeter building typologies consisting a shared space (courtyard) in the middle. Contrarily, the building types based on the detached units on the single plots in a block, (i.e. single family-houses or apartments) are usually generated within the urban grids composed by the narrow blocks with long frontages to optimise efficient use of land. Characterisation of an urban pattern in terms of depth-to-width ratio would also provide an idea about the typology of a built fabric.
To get a consistent conclusion, the calculation of the ratio as an index value of the pattern is weighted by the area the blocks. Then the factor is expressed as:

\[
\frac{\sum_{i=1}^{n} \frac{L_i}{W_i} \cdot A_i}{\sum_{i=1}^{n} A_i} = \frac{\sum_{i=1}^{n} L_i^2}{\sum_{i=1}^{n} A_i}
\]

where \(L_i\) is the length of the equivalent rectangle of cell \(i\), \(W_i\) is the width of the equivalent rectangle of cell \(i\), and \(A_i\) is the area of a cell \(i\). In the formula, the term ‘equivalence’ means the uniform rectangular shape of the block. If the block has an irregular shape, the average value of the depth and width is calculated by approximation of the block turning it into a regular rectangle while having the same area and perimeter (see Figure 3.42).

**4.2.1.1.7.2 Mean cell size:**

Composing urban grid in urbanism is usually considered in term of the average size of the cells created by the streets as well as their dimensions in relation to the built form to be generated inside. Setting that contrariwise, we could claim that the cell size of a network conditions the possibility of the certain types of built forms within the street pattern (i.e. campus-like forms that are built within large urban blocks).

Mean cell size factor is given as;
\[ \sum_{i=1}^{n} A_i \]

where \( A_i \) is the area of cell \( i \), and \( n \) is the amount of the cells in the network.

**4.2.1.1.7.3 Distribution in size:**

Though the overall ratio of the dimension and the mean cell-size provides a global idea on a block layout defined by the street pattern, in order to have a complete morphological understanding on the cell properties of the urban network, the internal variation of the block sizes should be measured as well.

![Figure 3.43. Three actual urban blocks in different size-ranges, small, medium and large respectively. (After Siksnas, 1998: 256-57)](image)

This is due to the reciprocal relationship between the built form and the ranges of block sizes argued by Siksnas (1997, 1998). According to Siksnas’s comprehensive analysis of a number of North American and Australian cities, it is possible to classify urban blocks according to their sizes. (see Figure 3.43), Since his research is based on the inner city urban fabric, we suggest decreasing the lowest band in the original range (from 10.000 m² to 7500 m²) for the residential tissues to be analysed, and put as follows:

- **small blocks**: \( n < 7.500 \text{ m}^2 \)
- **mid-size blocks**: \( 7.500 \text{ m}^2 < n < 20.000 \text{ m}^2 \)
- **large blocks**: \( n > 20.000 \text{ m}^2 \)

For each size-range, the distribution is calculated as follows:

\[ P_j = \frac{N_j}{N} \]

where \( N_j \) is the amount of the blocks in size range of \( j \), \( N \) is the total amount of the cells (blocks) in the network.

**4.2.1.1.7.4 Cell size diversity:**

The entropy as the degree of randomness (or disorder) within the pattern of cells (the block layout) in size is supposed to reflect the internal variation of the blocks layout. This is what can call cell size diversity. The higher the diversity, the higher the potential for the alternative building compositions occurs within the neighbourhood. Therefore, any case of a uniform building typology despite the highly heterogeneous block layout in size would mean
a kind of missed opportunity for the diversity by design and/or a real potential for the future transformation towards the formal variation on this structural basis.

The cellular heterogeneity of a network can be given as follows:

\[
\ln(J) \cdot N \cdot \left( \sum_{j=1}^{J} (P_j \cdot \ln(P_j)) \right)
\]

where N is the amount of cells (blocks), J is the number of ranges in size (in our case, it is 3).

The value is minimum in case of complete homogeneity, and maximum in case of the complete heterogeneity in cell sizes.

4.2.1.2 Configuration of street pattern:

Configuration of the street pattern is characterised by the concepts of continuity, connectivity, integration, cellularity, nodality and perviousness.

4.2.1.2.1 Continuity:

As a configurational network property, continuity is the aggregate feature of a route structure. Implying the decisiveness of the movement through the successive junctions on the route, continuity in street network can be considered as ‘the length of a route measured in links’, configurationally (Marshall, 2005: 120). The total number of segments on a route gives the value of continuity of the route. Then, the level of continuity of the overall street pattern is calculated by the ratio between the sum of the segments on each route and the total amount of routes in the network.

Figure 3.44. Node-link map as the basis of the continuity factor calculation. -Note that the routes composed by the segments are specified with the base street-map.

Continuity factor is basically expressed as Ns/ Nr, where Ns is the amount of segments on the routes and Nr is the total amount of the routes in the network (Marshall, 2005: 140).

The asymmetrical definition of the route to calculate continuity is subject to the hermeneutic analysis. Though Marshall (2005) does not explicitly discuss in the route structure analysis, a route is determined by the continuation of the same profile of street segments.
conjoining with the least angles, through noticeable smooth line-geometry. This gestaltic continuity is supposed to create meaningful segmentations in the overall network structure.

### 4.2.1.2.2 Connectivity:
Perhaps being the most referred structural property of urban form, connectivity can be described in terms of cells (block) as well as routes. Connectivity in general is the number of routes connected to a given route, cell or an external reference frame. The route connectivity, in this context, will be defined with reference to the internal and external connection of the network.

#### 4.2.1.2.2.1 Route-connectivity:
As in the case of continuity, the connectivity of a network depends on the structure of the routes configuring the network. Yet rather than links, nodes are taken into consideration for the measure of network connectivity. As defined by Marshall (2005), connectivity of a route refers to the number of times routes join to a given route in the network (pp. 292). This implies the valance of each node in a system. Valance is a value calculated as the number of edges joined on each vertex in the graph. If we represent the network in terms of the basic elements of a graph (i.e. edges and vertices), we would come up with four degree of valances: the valance 1 for the cul-de-sacs (pendents), the valance 2 for the links locating on the segments, the valance 3 for the links intersecting with t-junctions, or the valance 4 for x-junctions. (see Figure 3.45) The valance values in the system basically determine the degree of connectedness of a network.

**Figure 3.45.** A hypothetical network having four types of vertices according to valance: V1 (yellow), V2 (blue), V3 (black) and V4 (red).

In urban morphology, network analyses normally take the vertices with the minimum value of 3 into account. In the current framework, the author suggests to consider the ones with the valance of 2 (the blue ones in Figure 3.45) only if they are located on the frame of analysis. This is supposed to lead us another measure called ‘external connectivity’.

#### 4.2.1.2.2.1.1 Internal connectivity:
The relative internal connectivity factor of a network takes every node in the street configuration into account. It is simply the ratio between total amounts of the connected routes on each and every routed to the total number of routes in the network.
Figure 3.46. The diagram showing the nodes to be taken into consideration for the calculation of the internal connectivity of a hypothetical network.

It should be noted that in the calculation, the routes intersected at a certain node are considered as the basic unit of connectivity rather than the links.

$$\sum_i N_{sci}$$

The internal connectivity factor is given as follows: $$N_s$$, where $$N_{sci}$$ is the amount of segments which is connected to the segment i at least at one node, and $$N_s$$ is the total amount of segments in the street network.

4.2.1.2. External connectivity:

Despite having high internal connectivity, a network can have little connection to the outside of the settlement area. This would imply a high local and low global integration pattern within the fabric. To reveal such cases, the access points at the edge of the tissue can be taken as the indicator of external connectivity (Southworth et al., 1983: 280) The higher the value, the more open and generative the system is characterised [as opposed to the closed and conservative networks].

Figure 3.47. The diagram showing the external connectivity pattern of a hypothetical network. –Note that only the nodes at the edge of the analytical frame are taken into the consideration.

Set against external frame of analysis, the external connectivity factor is simply expressed as $$N_{rc}/N_r$$, in which $$N_{rc}$$ is the amount of routes connected to the external border and $$N_r$$ is the total number of routes on the network.

Needless to say, the factor value is sensitive to the shape and the size of the frame.

---

34 The terms in italic are originally argued by Hillier and Hanson (1984: 28, 164-169).
4.2.1.2.2. Block-connectivity:

Conceptualising the network with cells beside routes makes us to revisit the idea of connectivity in the context of urban blocks. An urban block can be defined by minimum one link bended on a single node. Nevertheless a block may have many junctions on its edge. Depending on the location in the network, the number junctions on the edge segments of a block simply suggests the block-connectivity.

Figure 3.48. Sampling cells in the street network and the nodes on the edges determining the block connectivity: The connectivity of the blocks I, II and III are 8, 7 and 8 respectively. –Note that only the links joining the blocks from outside are taken into consideration. The residual areas outside the closed network cells are also excluded in the calculation.

The mathematical expression of block connectivity is

$$\sum_{i=1}^{n} \frac{Njnc_i}{N}$$

where Njnci is the amount of junctions on the edge of the cell i and N is the amount of the cells in the network. If one makes a dual graph to figure out the topology of the connectivity pattern, each block should be converted into vertices. Then, the connectivity value of a block layout can be called the ‘valence’ of the blocks as well.

Connectivity of a block is subject to change over time with the internal links added into the web of streets. This can also be taken as a factor affecting the type and intensity of the land-use located in the urban block.

4.2.1.2.3 Integration:

As a topological term, depth is the number of steps taken from a reference point in the network (Hillier et al., 1984: 104). As defined by Marshall’s (2005) for network analysis, the depth of a route is the number of turns at the nodes from the principal route, datum to the ultimate point of the move (p. 120). The principle route can be regarded as the ‘stem’ of the network from which the foremost traffic is distributed to the near surrounding.\[35\] Departing from the datum, the more turns to be made to access another route makes the target route

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\[35\] The selection of the datum calls for another heuristic analysis. We should bear that the definition of the datum for the people living in the neighborhoods would be sensitive to the location of the address within the network. Nevertheless, we can still consider the influence of the network hierarchy as an essential factor on the selection of the datum, which is to be common for the average.
deeper in the system. The selection of the datum in the street pattern can be based on the strategic linkage to the wider network (Ibid, p. 121) or on the principle of good continuation (Thomson, 2994 cited in Porta et al. 2006: 714). The total depth value is calculated by sum of the individual depth values assigned to each route in the network. The mean depth is equal to total depth divided by the number of segments in the network. (see Figure 3.49)

![Figure 3.49. The hypothetical street network map showing the relative depths of each route.](image)

The mean depth is average value of the sum of each single depth value.

In consideration to the number of axes in the street network, the mean depth enables us to calculate the integration factor. Defined as the fewest changes on the links between all the nodes in a network, integration is a fundamental index of urban configuration. On that sense, it is also argued as Network integration based on the topological distance is argued as fundamental factor of environmental psychology and spatial cognition (Hillier et al., 2005).

Different from closeness, which is based on metric distances, the step-length distance is the basic factor in the calculation of integration. Without considering the metric length of the each step taken, the measure of integration illustrates the amount of topological deviation from the original location on the network.

Division of the mean depth with the number of links in the in the system basically gives the relative depth or the value of integration (Hillier and Hanson, 1984: 108-109). In this framework, the integration factor is expressed as $I = \frac{2(MD-1)}{(k-2)}$ where MD is the mean depth and k is the number of links in the network (Ibid). Taking on a value between 0 and 1, the fewest changes in various directions to the nodes, the higher the network integration is. This implies a ‘shallow’ type of configuration.

The author suggests measuring the integration of a street pattern based on the route map and the depth values derived from its structural hierarchy, unlike Space Syntax analysis based on axial map. Despite its impracticality for the large scale analyses, route-based calculation of (network) integration provides an alternative relevance for the indicator (as well as the representational consistency ensured with the other indicators in our framework). By considering routes as the basic unit of analysis rather than axes, one could involve the compositional characteristics of a street patterns more into the consideration of network integration as a supplementary factor. This alternative measure would be still congruent with the original idea deriving from the notion of configuration as the simultaneously existing relations among the parts, which make up the whole (Hillier, 2005: 5).
4.2.1.2.4 Cellularity:

We have already argued about the cellular quality of the street networks. This perspective is based on the assumption that representing a network as the configuration of links (edges) and intersections (nodes) or that of the closed polygons (cells) highly depends on the purpose of the abstraction involved (Marshall, 2005: 83). If the occupation of land by subdivision is the main issue to be considered -rather than the flows and movements-, then the cell can be taken as the basic unit of the network. For spatial design, this is basically a common way of thinking about the street patterns.

![Figure 3.50](image). The street pattern represented as the composition of the cells –building blocks- (left) and the diagram showing their configuration as dimensionless representation.

When we represent the cellular composition of a network with a dimensionless diagram, it is possible to recognise the basic spatial relationships intrinsic within the pattern (i.e. adjacency, interlocking-space, space-within-space), which were originally conceptualised by Ching (1979). In this framework, the ‘cell generating capacity’ of a network can be defined as the maximum number of cells (potentially defining various spatial relations) to be created with the minimum amount of segments. This is what we simply call ‘cellularity’ of a network. Its expression is \( N_{\text{cell}}/N_{\text{s}} \) where \( N_{\text{cell}} \) is the total amount of the blocks in the street pattern and \( N_{\text{s}} \) is the total amount of the segments in the network.

The cellularity factor can be an indicator differentiating griddy layouts from the tributary ones while the former principally offers a high level of place-making through the street segments defining closed-blocks in the network.

As another relevant issue about cellularity, the amount of the possible combination of the cells to be designated as the possible design areas can be considered as a critical factor of street configuration, in design terms. The amount amalgamation possibility within the cellular configuration (to be articulated as different design ensembles within the whole tissue) can be called the ‘cellular capacity’ of a network. Since the value of possibility depends on each specific spatial configuration of the cells, defining a deterministic math formula is not applicable. Therefore the calculations could be done via the spatial algorithms run in a GIS platform on the given network configurations.
4.2.1.2.5 Nodality:

Defined by Lynch (1960) as one of the five basic elements of urban form, node is a kind of *strategic foci* and the transition point on which the observers concentrate their attention and make decision about the further move. The nodes are usually in the form of junctions as the breaking points of transportation accompanied by the perceptually significant places and elements nearby (Lynch, 1960: 72-73). In this sense, the pattern of streets is a conditioning factor on the distribution of nodes in the city. Each junction on the network has a potential to function as nodes perceptually. In their typological study of urban tissue, Caniggia and Maffei (1979) suggests *nodality* as one of the basic qualities of a route structure (p. 126).

![Diagram of different nodality values](image)

Figure 3.51. Different hypothetical configurations having different factor values of nodality. –Note that the calculation is not based on the routes, but the segments intersecting. -

Since each configuration may have a different pattern of junctions (see Figure 3.51), the nodality value they offer can be measured by the number of intersecting links (valance) in the system with an expression as follows: \( \sum S_{\text{int}} / N_{\text{jnc}} \) where \( S_{\text{int}} \) is the amount of street segments intersecting at the junction and \( N_{\text{jnc}} \) is the total amount of junctions.

In addition to its stimulating effect on the cognitive maps of people (Lynch, 1960), nodality of street pattern potentially acts as a factor conditioning the hierarchal formation of a public space system, and the use and activity pattern, accordingly.

4.2.1.2.6 Perviousness:

The term perviousness implies the degree to which a solid allows passages through it (OED, 2012). In urban context, it may refer to the degree of allowance of a built fabric to permeate from outside to the deep inside through covering the internal space via a continuous web of public spaces (streets, squares). Designating a virtual buffer on each side of the streets, we can calculate the adjacent area within the visual and physical reach of the net. (see Figure 3.52) Total area of the buffers represents the penetrable surface within the settlement unit.
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**Figure 3.52.** The different hypothetical street patterns with the same linkage density creating different levels of perviousness with a certain width of the virtual buffer –Note that the buffer zones in the first case (left) overlaps and that diminishes the total surface area of perviousness unlike the other one (right)–

In the neighbourhood context, the bandwidth of the buffer would be set for 15 meters (from one side-line of the street) with regards to the nominal mesh of the residential access street, which is 30 meters in average. (Jong, 2007: 453). Then the factor is basically calculated by the ratio of the total coverage of the buffers (excluding the overlays) to the total area of the settlement. The higher the value, the more penetrable the interior of the fabric is.

The function of urban perviousness is given as follows: \( \frac{A_{\text{pervio-buffer}}}{A_{\text{neigh}}} \) where \( A_{\text{pervio-buffer}} \) is the total area of the virtual buffers set by the open web of public spaces and \( A_{\text{neigh}} \) is the area of the sampling neighbourhood.

In accordance with the definition, only the paths and open spaces connected to the open network (having an access to the outside of the area) are taken into account, and the segregated open spaces (i.e. the internal courtyards) are excluded in the calculation.

As a morphological factor, perviousness implies the concept of permeability, which is an indicator of ‘good urban form’ in terms of the rich interaction between the private and public spaces -or between the insiders and outsiders- (Bentley, et al., 1985: 12). In this sense, perviousness provides a relevant basis to analyse different patterns by questioning to which extent they offer a surface for external reach through the fabric.

### 4.2.1.3 Constitution of street pattern:

Constitution of the street pattern is characterised by the range and variation in route types, and the ordering rules, which are the two basic parameters of a network organisation.

#### 4.2.1.3.1 Range:

Under the title of range, mainly the route and assembly rules of the route structure are discussed. The typology of the route is defined with reference to the hierarchy of access control and to the singular structure of the routes within a whole network.
### 4.2.1.3.1.1 Route types in access control hierarchy:

Classification of the routes in a typomorphological analysis is conventionally set upon the theme of access control as widely accepted by the planners and highway engineers (Marshall, 2005: 46, 47). Such a classification is supposed to make a link to urban design via morphology. In this context, a set of existing road hierarchies reviewed by Marshall (2005) can be synthesised with the classification of Jong (2007), in which not only the traffic considerations (i.e. access, safety), but also the formal characteristic of road types are considered.

#### Table 3.6. The order of road/street hierarchy (After: Jong, 2007: 453; Marshall, 2005: 47)

<table>
<thead>
<tr>
<th>Road/street type</th>
<th>Nominal mesh/exit interval (km)</th>
<th>Nominal width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local distributor (major arterial district road)</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>Collector street (main street)</td>
<td>0.3</td>
<td>30</td>
</tr>
<tr>
<td>Access street (residential street)</td>
<td>0.1</td>
<td>20</td>
</tr>
<tr>
<td>Access lane (path)</td>
<td>0.03</td>
<td>10</td>
</tr>
</tbody>
</table>

In this framework, the road/street order implies the relative capacities of the routes measured by nominal width. (see Table 3.6) In accordance with the nominal mesh size given, the local distributor/district road is excluded from the neighbourhood level analysis. In comparative research, the ranges of route typology are given in percentage within the whole network length. By this way, the relative levels of road dependency in neighbourhood tissues are aimed to reveal.

### 4.2.1.3.1.2 Route types in structure:

The second constitutional typology of street pattern is based on the classification of routes in terms of their internal structure. The classes suggested by Marshall (2005) provide a relevant basis for the structural typification of a street pattern. According to the configurational relations with the other routes connected, each single route can be characterised as a specific type (see Figure 3.53).

**Figure 3.53.** The route types categorized by Marshall (2005) (Adapted from: Marshall, 2005: 124).

Since various combinations of street segments generate various characteristic route structures, it would be hard to name the route types according to the categorisation given above. In these cases, their singular graphs allow us to distinguish and typify them as 'hybrid' (Ibid, pp. 125). Since each route-type suggests a specific pattern of continuity and connectivity within themselves. The cumulative application of the specific route types in a network potentially ends up with distinguished macro-morphologies emerged.
4.2.1.3.1.3 Types of assembly rules:

Table 3.7. The types of constitutional rules for route structure and their condition (Adapted from, Marshall, 2005: 173)

<table>
<thead>
<tr>
<th>Assembly rules</th>
<th>Dendritic</th>
<th>Conjoint</th>
<th>Mosaic</th>
<th>Serial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural conditions</td>
<td>Access constraint on the intersected routes and serial continuity</td>
<td>No access constraints on intersections, but and serial continuity</td>
<td>No access constraints and serial continuity</td>
<td>Access constraints only serially.</td>
</tr>
<tr>
<td>Applied models</td>
<td>Modern distributory urban layouts</td>
<td>Traditional settlements</td>
<td>Non-hierarchal contemporary urban design tissues</td>
<td>Incompletely implemented systems</td>
</tr>
</tbody>
</table>

In addition to the types of routes of a street pattern, the rules of their morphological relations represent another constitutional aspect of urban patterns. Since the application of different assemblage rules leads to distinctive collective form typologies, theoretically (Ibid, pp. 225-41), the determination of the constitutional rules within existing patterns [the other way around] can be suggested as an alternative way to typify the different urban patterns. In this context, the basic constitutional rules defined by Marshall (2005) for the street pattern formation are involved in our concept-framework. (see Table 3.7)

Since each added line into the network is based on a specific assembly rule, mapping the constitutional rules of a street pattern formation can be specified on the level of street segments.

4.2.1.3.2 Variation:

Diversity within the route types and the configuration rules basically define the level of variation within a given street pattern.

4.2.1.3.2.1 Typological variation:

The level of diversity in the type of elements is taken as the first indicator of the morphological diversity. In this context, the unitary typological variation in the street pattern is calculated as follows:

$$
\sum_{j=1}^{m} P_j \cdot \ln(P_j) / \ln(m)
$$

where m is the amount of the street types (see: table 2) in a given network, Pj is the portion of the street routes in type-j within the neighbourhood. In the case of homogeneity, the entropy value is assumed to be minimum.

Typological variation in the street pattern basically measures the degree of typological
disorder in a network structure. In the areas where design control has a flexible character, it is supposed to obtain higher values of typological variation.

4.2.1.3.2.2 Variation in ordering:

Structural variation factor basically aims to reveal the diversity of the constitutional rules and their specific applications in a given pattern.

The calculation of variation in ordering rules uses the same formula as typological variation above. By calculating the degree of disorder within the application of the types of rules, we can also figure out the incremental or holistic nature of any sampling settlement formation. In the case of high entropy value, the factor would indicate that the area was developed in different periods of time with different rule-sets, or conversely, by a single scheme with different sets of design codes.

4.2.2 Plot Layout

Though the street pattern as the most robust element of urban form (Sheer, 2001: 29) provides the necessary framework for urban formation, plot can be considered as the basic module (or cell) of the fabric (Caniggia and Maffei, 1979: 125; Moudon, 1986: 144). Within the most fine-grained configuration, block is subdivided into the parcels called plot (or lot), which can be released to the different sub-developers and property owners (Love et al., 2011: 96). This is actually what makes urban form a collective artefact in a socio-economic sense. Sociologically, it can be considered as the basic unit of control in terms of the micro-relationship between the public and private domain (Meyer et al., 2008: 27). In the local contexts, where the developers’ production capacity is limited, plots perform as the main element of urban development and transformation (Ünlü, 2011).

![Figure 3.54. Plot, block and plot series as the three elements of parcellation.](image)

In the analysis of plot layout, *block*, *plot* and *plot-series* are determined as the basic morphological units. While plot is the smallest piece of a developable land (Cowan, 2005: 297), which has a direct access to the street from at least one side, block is a group of contiguous plots (or a single land parcel) bounded by the streets (Conzen, 1960, p. 5). The alleys crossing blocks in the middle, in this context, can be taken as part of a block. Finally, plot-series is a group of adjacent plots that share the same building line (Larkham et al., 1994). Unlike block, plot series does not have to be defined by streets on all sides.
Within the embedded hierarchy of morphological elements, the compositional and configurational features of a plot layout have a conditional effect on building typologies. This can be taken as the most crucial point for the characterisation of the plot layout in urban morphology. As argued by Kropf (1996), the morphological classification can be made based on the three aspects: position [i.e. orientation to the street, relative position to the sides of the block and to the other plots], outline [i.e. shape, size and proportions], and arrangement [i.e. type of components like building and boundary walls, the number of parts and their relative position] (p. 254). In the context of our analytical framework, the author suggests the typification of plot layout in terms of the first two aspects (position and outline) while regarding their possible consequences on the arrangement of the buildings on a given plot layout.

4.2.2.1 Composition of plot layout:

Compositional indicators of plot layout covers the basic aspects of size and proportion. Since plots usually have a regular outline with right-angle vertices (in order to maximize the efficiency in the use of space with orthogonal building units), shape is kept out of the consideration in the analysis.

4.2.2.1.1 Coverage:

Without considering the functional pattern on it (i.e. retail or residential), the total area covered by the individual plots in a settlement can be taken as a morphological factor indicating the level of private occupation on an urban land. Excluding the road surfaces, block-based single land-uses and parks, the coverage area of a plot layout is calculated by the sum of subdivided blocks and plot-series.

Figure 3.55. The plot surface -in red- in consideration of the calculation of all morphological factors on plot layout. –Note that the areas like roundabouts, parks and parking lots are excluded-
The factor of plot coverage is given as: 

\[ \frac{\sum_{j=1}^{J} A_{plj}}{A_{neigh}} \]

where \( A_{plj} \) is the area of the plot \( j \), \( J \) is the total amount of the plots in the neighbourhood and \( A_{neigh} \) is the total area of the neighbourhood. The value also implies the ratio of publicly owned land in the whole neighbourhood.

In order to draw consistent conclusions on the other morphological factors [including the ones on street pattern and building setting]-, the plot coverage should be maximised in the designation of the frame of a sampling area to be analysed. By this way, large portion of mono-functional urban blocks, the exceptional units within the overall subdivision pattern would be avoided.

### 4.2.2.1.2 Average plot size:

The calculation of the average block size made in the context of street pattern [discussed above] may not be enough to inform about the scale of private ownership and control in a given site. In this regard, the average subdivision size of the blocks gives more reliable input on the ownership pattern in a neighbourhood. Yet, we have to remind that in the countries where more than one person can share the same plot [in the form of freehold flat], even this measure would be misleading too. Nevertheless, the factor definitely implies the grain of the built form via designating the maximum size of the ground coverage of a building-unit to be located in the plot.

\[ \frac{\sum_{j=1}^{J} A_{plj}}{N_{pl}} \]

In this context, the factor is measured: where \( A_{p(j)} \) is the area of the plot \( j \), and \( N_{pl} \) is total amount of the plots in the sampling area.

### 4.2.2.1.3 Variety:

Variety in plot layout as a compositional category considers the shape of plots in terms of their frontage and depth. These two factors are considered as the parameters that ultimately characterise the building setting and the facility distribution within an urban fabric. For measuring variety in plot layouts, standard deviation in the width and depth of plots are calculated. Since each side of the street might have different plot compositions, the variety factor should calculated based on both two sides of the street segments.

#### 4.2.2.1.3.1 Variety in frontage:

Differentiation of the plot frontages in length on the same street does not only affect the rhythm of the street façade composition perceived along the side-street, but would also potentially vary the ground-floor facilities. Therefore a regular block layout (i.e. regular at neighbourhood or district level) composed of various sizes of plots at the street level (as in the case of the ‘Cerda’s grid’ in Barcelona) facilitates remarkable diversity in architecture and use.
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**Figure 3.56.** Variations in plot layout based on the lengths of frontages, and their possible influence on building setting with different ordering rules (semi-detached –left-, detached –middle- and attached –right-) -Note that the same ordering rule on a various sized plot series ends up with emergent variety in building layout-

The average aggregated degree of variation in plot frontage is calculated by the standard deviation in the length of plot frontages. The overall variation could be mapped out based on the street segments in order to see its distribution on the whole pattern.

4.2.2.1.3.2 Variety in depth:

With regards to the possible transformation of the built fabric in time, the depth of the plots varying within an urban block is a critical factor in urban morphology. If the building codes are based on fixed setback rules, arrangement of the buildings on different depths of plots would still yield certain compositional variations within the blocks. (see Figure 3.57)

**Figure 3.57.** The same irregular pattern of plot layout in urban block may create characteristic building compositions based on the different setback rules: the building order via the fixed distance to the front-line –left-, the fixed distance to the back and front-line –middle-, and the fixed proportion –right-.

The average aggregated value of variation in plot depth is calculated by the standard deviation in the depth values on a plot layout. Unlike the variation in plot frontage, variety in depth should be mapped out based on blocks to see the pattern of the variation within the overall pattern.
4.2.2.1.4 Granularity:

Referring to the smallest possible quantity within any composite form (OED, 2012), granularity means the extent to which a composite form can be divided into small parts. While coarse-grain fabrics have larger components, the fine-grained compositions consist of relatively smaller partitions. In the context of urbanism, the granularity of an urban form can be revealed in terms of plot layout. In compression of the two different patterns having the same size of surfaces, which are subdivided into the different amount of plots, the one involving lesser amount of plots can be regarded as ‘coarser’ in grain with the less relative granularity factor value.

In this regard, granularity of a plot layout can be calculated by the average number of subdivisions per area covered by the plot layout in a given site. Then, the factor is expressed as follows:

\[
\frac{N_{pl}}{\sum_{i} A_{pl_i}}
\]

where \(N_{pl}\) is the total number of plots in the sampling pattern (i.e. block, ensemble or neighbourhood) and \(A_{pl_i}\) is the area of plot \(i\).

Figure 3.58. The coarse -left- and the fine-grained plot layouts –middle and right-. -Note that although the block in the middle is less divided in amount of plots, the average size of the individual plots in the second and the third layout is the same-.

The fine-grained plot layouts are supposed to facilitate small enterprises in retail and diversity in local facilities (i.e. corner shops, groceries, movie houses), which are considered as the source of urban vitality (Jacobs, 1961: 146-47). From the same perspective, Lynch (1981) argues fine-grain as follows: “...These smaller parts can be more closely fitted to the varying activities of occupants, more completely under their control. And more easily sensed as connected to individual values and experiences” (p. 269).

4.2.2.2 Configuration of plot layout:

Configuration of a plot layout is characterised by the concept of frequency as the sequential distribution of the plots conceived as single rhythmic units.
4.2.2.2.1 Frequency:

Although plots usually tend to orient their short sides to the street (Caniggia and Maffei, 1979: 125) in order to maximize the amount of individual accesses from block to street (or to minimise the shared cost of public space in some cases), this condition is not always the case especially after the amalgamation of the smaller plots into the larger ones in time. The emergent irregularity in plot layout, then, basically characterises the frequency of change in building facades and entrances located along the street.

Implying the number of occurrences of a repeating event per unit time (OED, 2012), frequency is basically a temporal concept. Converting the actual length of the paths into time intervals, we can apply the concept in space. The average walking speed of man (1.4 m/s) provides a relevant reference to such conversion with regards to the actual movement of man in space.

\[
\text{Frequency} = \frac{1.4 \cdot \sum N_{pl_i}}{\sum L_i}
\]

where \(N_{pl_i}\) is the amount of plots on the segment \(i\); \(L_i\) is the length of the segment \(i\).

In this sense, frequency as an indicator of plot layout can be given as follows:

Figure 3.59. Some hypothetical options in plot layout: the same frequency and rhythm despite the different length of side-lines –above- and the same frequency with different rhythms on the same length of the side-lines -below-.
in the configuration of plots. If the change in the plots along the side of a blocks is exposed in regular repetitions or through ordered alternations, the people moving on the street in one direction may perceive the specific rhythm in street frontage, even implicitly. Since the presence of the rhythm yields predictability in a pictorial composition (Jirousek, 1995), the cumulative application of the rhythm in plot layouts on the larger scale potentially triggers the spatial legibility within urban fabric. Considering in that way, we can argue the frequency of plot layouts and their internal rhythm as one of the major factors for the image of cities.

4.2.2.3 Constitution of plot layout:

As in the case of street pattern, the constitutional factors of plot layout are classified into two: the range in elementary types and rules, and the variation within the given set of types.

4.2.2.3.1 Range:

The range in typology of plot layout is basically the two kinds: the types of units and the types of subdivision rules. The units are in turn classified as plot and block.

4.2.2.3.1.1 Plot types:

As argued by Kropf (1996), a plot can be described in terms of its position relative to the other plots in the block, and to the adjacent street (p. 252). In this framework, it is possible to distinguish the type of a plot without considering its outline (i.e. shape, size and proportions) and (internal) arrangement.

![Figure 3.60. The basic plot types according to their positioning within the block (After: Meyer et al., 2008: 26)]
plot may build various forms of connections with the streets and neighbouring plots. (see Figure 3.60)

### 4.2.2.3.1.2 Types of block organisation:

Typification of the plot layout based on the elementary plots would not be enough for illustrating the subdivisional characteristics of an urban pattern. Since plots are basically produced by subdividing the land into functional segment [mainly in terms of ownership and control], the emergent pattern on urban block, the basic unit of subdivision, can be typified as well. In this respect, in addition to the typology on plot—above—, we can suggest another typology based on block organisation. The six parcellation form are determined as the basic type of block organisation. (see Figure 3.61)

![Figure 3.61. Basic types of organising plot layout in block](image)

We can evaluate the typical block organisations in terms of the spatial relations perceived from inside and outside. Only ‘close-court’ block suggests a kind of shared space inside. The rest can only provide some semi-public passages in the form of back-alleys. Moreover, each subdivision implies different magnitudes on orientation. While the core and closed-court has a balanced orientation on different sides, the other subdivisions create frontal and lateral edges in consideration to the buildings to be located on the designated parcels. The specific application of the types in real potentially ends up with characteristic street profiles to be identified on the edge of the blocks—within different magnitudes of orientation—.

### 4.2.2.3.1.3 Subdivision types:

The development and transformation of the plot layout follow certain subdivision rules as the basic operations of designating urban land. The five basic operations can be suggested as the basic types of subdivisions creating individual plots on the land (see Figure 3.62)

![Figure 3.62. Basic subdivision types.](image)
Respectively, *division* is the rule, which splits the whole unit into minimum two separate parts. Division normally creates alley or rear pedestrians access in the middle, and after the division, the block is still taken as one. Unlikely, *dissection* divides the parcellation unit into two (horizontally or vertically) by a borderline without creating any internal access into the block. *Insertion* designates a new plot within the larger one (space within space), while *subtraction* defines a discrete internal space in the subdivided unit. This space is usually designated as a common space within the cluster of individual plots. Finally, *amalgamation* implies unifying two or more adjacent plots within one parcel. For all cases, the unit of operation would be either plot or block depending on their actual position.

### 4.2.2.3.2 Variation:

#### 4.2.2.3.2.1 Typological variation:

Typological variation in the constitution of plot layout illustrates the morphological richness within the collective fabric of private land parcels. As a measure of the average rate of occurrence of the information (or message) in a system (OED, 2012), entropy measure gives the rate of typological variation in a plot layout as well. The higher the entropy, the higher the level of disorder in plot typology is determined on the given pattern. In this context, the factor of variation—as the average entropy—can be calculated as follows:

\[
\frac{\sum_{i=1}^{n} \sum_{j=1}^{m} P_{ij} \cdot \ln(P_{ij}) / \ln(m)}{n}
\]

where \(P_{ij}\) is ratio of the parcel type \(j\) in the cell \(i\), \(m\) is the total amount of the types of plots, and \(n\) is the total amount of the cells in the overall plot layout.

Since the plot typology is defined in the spatial context of urban block, the calculation of typological variation is made based on the cells of the network, which represent the blocks and plot-series in a given fabric.

#### 4.2.2.3.2.2 Variation in ordering:

Calculated in the same way as that of the typological variation discussed above, the degree of variation basically implies the level of regularity in the application of the parcellation rules within a given development unit.

Since each rule can be applied successively on an existing plot layout in time, it may be difficult to specify the exact types of rules especially in the rapidly transforming urban contexts. Though the rules seem simplistic, the successive application of them has a remarkable potential to create complex urban forms as we observe in the context of traditional settlements. In this sense, the structural variation in a plot layout—in terms of the rules applied—would be taken as an indicator about the temporal condition of the settlement analysed.
4.2.3 Building Setting

Building setting is about the manner of composition in which buildings are co-positioned in certain spatial relationships (i.e. adjacent, detached, interlocked) regarding the other morphological layers (i.e. street, block and plot). The morphological factors of building setting are all relational. They cover both the three-dimensional (compositional) and the dimensionless (configurational) features of the built fabric.

The basic elements of the building setting are classified as dwelling unit, building unit and building envelope.

![Building Setting Diagram](image)

**Figure 3.63.** The basic elements of the building setting.

The dwelling/occupation unit is the minimum habitable division in the building setting. The building unit is the independent module having its own circulation system and external access, which can be shared by the various dwelling units inside. Finally, the envelope is the one contiguous unit composed by a number of building units [either under the same roof system or not]. As defined by Lehnerer (2009), the building envelope is the maximum developable volume in which all form determining regulations (on the component units) are applied (p. 20). In accordance with this definition, all the inhabitable spaces are included in the frame of envelope for morphological analysis. (see Figure 3.63)

4.2.3.1 Composition of building setting:

Compositional factors of a building setting covers the formal characteristics of the buildings including mass, volume and footprint, which can be observed without high-level abstraction. They basically reveal the collective behaviour of the urban fabric, which is hard to be perceived by the observer beyond a certain scale level (i.e. district and city). Compared to the other type of form indicators, composition of building setting represents the most comprehensive section within our framework.
4.2.3.1.1 **Density:**

The term ‘urban density’ may cover the size of population, the number of building units or the habitable rooms per unit area, in general. Among them, though it morphologically sounds more relevant, the habitable room or building unit density may be misleading for comparative typo-morphological researches. Since the average size of the same unit-types would differ in different contexts, unit density is also excluded in our concept-framework. For this reason, only the coverage and floor area are suggested as the reliable density factors for the morphological analyses.

4.2.3.1.1.1 **Ground coverage (percent):**

Ground coverage is the portion of an individual plot covered by the building ground floor. It is measured by the ratio between the building footprint and the plot area.

\[
\text{Ground coverage factor} = \frac{\sum_i A_{cv_i}}{\sum_i A_{blk_i}}
\]

Here, \(A_{cv_i}\) is the footprint area (coverage) of the buildings in the building block of \(i\) and \(A_i\) is the area of the cell (block or plot series) \(i\).

Disregarding the setback conditions of the buildings, ground coverage is the factor quantifies the figure-ground relationship within an urban fabric.

4.2.3.1.1.2 **Floor Area Ratio (FAR):**

Floor area ration (FAR) is quite a common planning code especially in the countries where zoning is the basic design control tool (i.e. the US, India, Turkey). Beside its use in planning, indicating the ratio between the built-up space and the individual plot area, FAR is also used as an indicator for typomorphology with the name of floor space index (FSI) (Martin et al., 1972: 33; Radberg, 1996; Pont et al., 2007).

**Figure 3.65.** FAR on the basis of block as the net area of construction. -Note that only the habitable floor spaces are counted on for the FAR index.-
In the context of urban fabric (beyond the level of individual block), FAR is calculated based on the net area of building blocks. (see Figure 3.65) In this context, the common spaces out of the individual parcels are excluded in calculation. Then the block-based measuring density is expressed as follows:

\[
\frac{\sum_i A_{fl_i}}{\sum_i A_{blk_i}}
\]

where \( A_{fl} \) is the floor area of the block \( i \), \( A_i \) is the area of the block \( i \).

If there is no extra rule on height and setbacks, the FAR divided by the built-up area or the ground coverage illustrates the height of the bulk in terms of the plot on which the building locates.

### 4.2.3.1.2 Contiguity:

The same levels of density can be theoretically composed in different ways (Urban Task Force, 1999: 62). For this reason, in order to typify the composition of urban forms, the supplementary indicators are needed. As one of them, contiguity refers to the condition of uninterrupted surface relation between the elements of a form-composition. In urban context, it refers to the state of direct contact between the building units within one envelope. (see Figure 3.66)

![Figure 3.66. The party walls between the buildings in a building block as the basis of the calculation of contiguity factor.](image)

Contiguity factor is calculated by the ratio between the area of party walls (the wall adjacent to the neighbouring building) and the total area of external walls open to the outdoor spaces. In this context contiguity is expressed as follows:

\[
\frac{\sum_i A_{adj_i} \cdot A_{fl_i}}{\sum_i A_{vert_i}}
\]

where \( A_{adj} \) is the surface of the shared party walls between the adjacent buildings, \( A_{fl} \)
is the floor area of the building\textsuperscript{36} –envelope-, and Avert is the exterior area (vertical walls) of the given building –or envelope- i (Adolphe, 2001: 191).

Contiguity measure has direct implications to heat transmission within the fabric (Ibid). The higher the value is, the higher efficiency in passive heating is to be expected. Nevertheless, contiguity theoretically has an inverse relation with the daylight performance of the buildings’ interior.

\subsection{Compactness:}

In a broad framework, urban compactness covers a large set of spatial indicators including centrality, coherence, density, diversity, intensity and fine-grain (Çalıskan, 2009). To narrow the concept down and bring it into the domain of morphology, we can consider compactness with its basic implication as a measure of shape. In the context of three-dimensional form, compactness is the function of the surface area and volume of an object. As a measure of the collective form, urban compactness is the ratio between the total external wall areas of the building envelops to their total volume.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure367.png}
\caption{The area of the exposure walls –in red- with the building volume as the basis of compactness factor. –Note that the non-habitable roof-floors are excluded in calculation-}
\end{figure}

For a precise definition, compactness factor is expressed as
\[
\sum_{i} \frac{A_{\text{env}i}}{V_{i}^{2/3}}
\]

where \(A_{\text{e}} (i)\) is the external surface of the building –envelope- i and \(V (i)\) is the volume of the enclosed space of the building\textsuperscript{37} (Adolphe, 2001: 191).

Though it is accepted as an indicator of urban sustainability in general (Frey, 1999; Masnavi, 2000), the compactness of the intermediate scale urban form itself can be considered with both positive and negative implications on environmental performance. While it is favourable in terms of energy conservation via passive heating of the close-connected units

\textsuperscript{36} In order to lessen the relative effect of the large buildings, the factor is weighted with the floor space area.

\textsuperscript{37} The reduction in the power of \(V\) is for reducing the relative influence of the volume to area in the formula.
within one building complex, the densely clustered arrangements may cause some problematic conditions for the efficiency of solar access.

### 4.2.3.1.4 Closeness (proximity):

Closeness is originally claimed as a network centrality index indicating the degree of proximate distancing of a node to the others along the shortest paths on the network. It captures the extent to which a node is close to another one on the shortest path between the two points on the web (Porta et al., 2009: 453). In terms of the relation between the buildings located within urban network, Sevtsuk et al. (2011) introduces the concept to calculate the centrality of a building measured by the shortest path to the nearby nodes by which the other buildings locate (pp. 8-9). In this way, the internal pattern of integration could also be mapped out by means of the relative degree of closeness of each building.

**Figure 3.68.** The shortest paths from one building to the others in the network. The average distance gives the relative proximity index of the singular building unit. The aggregate calculation for all the buildings in the area gives the global index value.

In order to typify the overall urban fabric with the global index value of closeness, we calculate the factor in terms of the global proximity of the buildings to all others in the area. This simply means the average total (shortest path) distances between all the buildings in the fabric. In this context, closeness captures the notion of accessibility. The closer the buildings are located in a located network, the higher the proximity of the urban pattern is.

The closeness factor can be given as follows:

\[
\frac{1}{\sum_{i,j \neq j, d(i,j) < r} d(i,j)}
\]
where $D(i,j)$ is the shortest path between $i$ and $j$; $r$ is the radius of the study area (Sadbussi 1966 cited in Sevtsuk, 2010: 10).

To adapt the factor into the built fabric, Sevtsuk (2010) suggests the weighted measure based on the gross area of the buildings. Then it is expressed as follows:

$$
\frac{1}{\sum_{i,j,i\neq j,d(i,j)<r} d(i,j) A_f(i,j)}
$$

where $A_f(i,j)$ is gross floor area of the buildings adjacent to the shortest path between $i$ and $j$; $d(i,j)$ is the shortest distance between $i$ and $j$.

The proximity of an urban pattern can be considered as a factor of geometric centrality, which would affect the accommodation of the local retail activities and clustering of the compatible land-uses within a certain area (Sevtsuk, 2010)

### 4.2.3.1.5 Intermediacy:

The term intermediacy refers to the state of being in a middle position, acting between two points. The buildings encountered along the route from an origin to destination while moving on the network can be regarded as the intermediary / transitional units which potentially change the purpose of the trip. The units in consideration can be either occupation units (i.e. dwelling or facility) or buildings. In each case, the amount of the units possibly confronted through the shortest path between any origin and destination could have certain implications in the utilisation of space structure (i.e. the level of social and commercial interaction within the settlement).

![Figure 3.69](image.png)

**Figure 3.69.** Two sampling shortest distances from one building—middle— to the two others, and the buildings captured by the virtual lines of shortest distances as the input of the intermediacy factor.
Intermediacy factor (either with reference to building or occupation unit) is calculated by the sum of the dwelling units passed by along the shortest path from one building to all others in the network. The function is defined as:

\[
\sum_{i,j,i \neq j} \frac{Ndu(i,j)}{d(i,j)}
\]

where \(Ndu(i,j)\) is the number of dwelling units located on the shortest path between \(i, j\); \(D(i,j)\) is the shortest distance between \(i\) and \(j\).

Especially considering the multi-purpose trips in an urban area, we can take intermediacy as a key morphological factor for the efficiency of local retail and service facilities to be potentially caught by people choosing the shortest paths in their daily movements.

### 4.2.3.1.6 Porosity:

As in its original meaning in geoscience [‘the fraction of the total bulk volume of the rock not occupied by solids’ (OED, 2012)], porosity refers to the occupation of the internal void within the total volume of a solid mass. In the context of urban form, porosity denotes the volume of the open space within the built fabric (Adolphe, 2001: 188). Since Adolphe (2001) suggests the concept specifically for the ‘useful’ open spaces within an urban area [in order to calculate the airflow through the open street network], he deliberately excludes lateral, nearby and internal spaces in the built fabric. To generalise the concept to the whole fabric, we include all types of open-spaces in the calculation of urban porosity. In this framework, the porosity of a given fabric is calculated by the ratio of the total volume of open spaces to that of the building mass.

**Figure 3.70.** The red areas indicating the volume of the open spaces in the built fabric. –Note that the volume is determined based on the minimum height-level within the groups of the buildings facing each other.
Within a formal expression, porosity is

\[
\frac{\sum_{i=1}^{n} V_{\text{non-blt}_i}}{\sum_{i=1}^{n} V_{\text{non-blt}_i} + V_{\text{bltmass}_i}}
\]

where \(V_{\text{non-blt}}(i)\) is the volume of the non-built space in segment \(i\), \(V_{\text{bltmass}}\) is the volume of the buildings in the neighbourhood. The calculation is done according to the segments created within the blocks and on the streets. The height of each segment volume is determined by the minimum height of the facing buildings. In this sense, \(V_{\text{non-blt}} = \text{MinHi} \cdot A_{oi}\) where Min Hi is the minimum height of the buildings within the segment \(i\), and \(A_{oi}\) is the area of open space in the segment \(i\).

Though the figure-ground relation of urban form in terms of the balance between building mass and open space is one of the fundamental conceptions in urbanism (Trancik, 1985: 98-101), it is not operational enough to characterise the three-dimensional quality of the solid-void relations within an urban fabric. In this respect, the porosity factor can be taken as the supplementary concept to the conventional figure-ground analyses.

### 4.2.3.1.7 Verticality:

One of the most fundamental aspects that would differentiate the alternative urban forms is verticality, the state of rise in the composition. Considering the vagueness of the term ‘high-rise’ thorough its generic use in urban design\[38\], verticality index would provide a quantitative basis for characterising the existing and alternative urban tissues in terms of their bulk or slimline massing.

Figure 3.71. The different type of urban compositions within the same net density level (70 building units per hectare) suggest different values of verticality. Note that the deviation ratio of verticality for the point-block is significantly high.

38 “Generally, structures exceeding 240’ or over 20 stories tall”, http://urbandesignla.com/UD_pdf/Definitions.pdf, “Whether a building is “high rise” or not, a building may appear relatively “tall” when it is significantly higher that the surrounding context, or it is taller than the width of the right-of-way that it faces.”, http://ottawa.ca/en/city_hall/planningprojectsreports/planning/design_plan_guidelines/completed/high_rise_housing/index.html, accessed in April 2012
composition, eventually creates a cumulative (morphological) effect on the vertical image of the massing. To measure fabrics in this sense, verticality index is introduced. The indicator can be basically defined as the proportional relation between the total floor space area and the ground coverage of the bulk. The point is that since the same ground coverage buildings might occupy on different perimeter of ground plans, the effect of the verticality of each building would differ from each other. Therefore, in calculating the verticality of a collective urban form, the measure is weighted by the perimeter of each individual building’s footprint in order to take the relative height difference of the large buildings into account. In this context, the factor is expressed as:

$$
\frac{\sum_{i=1}^{N} P_{ri} \cdot H_{i} \cdot A_{cv_{i}}}{\sum_{i=1}^{N} A_{cv_{i}}}
$$

where $P_{ri}$ is the perimeter of building i, $H_{i}$ is the height of the building i, $A_{cv_{i}}$ is the coverage of the building i.

As seen in Figure 3.71 above, the verticality of a 2-storey single-unit fabric can be equal or higher than that of a mixed compact-tissue which involves one to four-storey buildings. It means that the more compact urban formations have a tendency to decrease the average verticality of the tissue used to be resulted with other types of building compositions. This would be an important factor especially in the case of controlling urban skyline through alternative building setting by design.

4.2.3.1.8 Rugosity:

Rugosity means the state of corrugation and roughness (OED, 2012), the variations and amplitude in height on a solid surface. The surface quality of a form can be considered as a morphological factor of urban fabric as well. In the context of urban form, rugosity implies the mean height of the buildings (divided by the total area including the non-built spaces), which act as the obstacle in the airflow throughout the settlement surface (Adolphe, 2001: 187).
The definition above gives the absolute rugosity expressed as:

$$\frac{\sum_{built} A_i \cdot h_i}{\sum_{built} A_i + \sum_{nonbuilt} A_j}$$

where $A_i$ is the coverage of the building $i$, $h_i$ is the height of the building $i$, and $A_j$ is the area of non-built surfaces in the fabric.

In addition to the absolute one measuring the global surface roughness factor, it is possible to compute the height deviation based on certain directions within the fabric. In this sense, relative rugosity factor gives the mean square deviation of building height in a certain direction (Ibid), and it is expressed as:

$$\left[ \sum_{i} (h_i - h_{\alpha})^2 w_i^2 \right]^{1/2}$$

where $h_i$ is the mean height of the element $i$ (built or non-built), $h_{\alpha}$ is the mean height in direction $\alpha$, $w_i$ is the width of the element on the cross-section plane (Ibid).

The higher the rugosity, the more dramatic changes in the building heights results in a kind of rough urban surface in different directions of the settlement. By this calculation, the relative deviation in rugosity can be represented with a polar diagram. By correlating the rugosity diagram with the local wind diagram of the site, the operational implication of rugosity on the wind regime within a fabric [associated with the air flow over building arrays- (Oke, 1988)] can be evaluated.

4.2.3.1.9 Frontality:

From an urbanistic point of view, streets can be considered as the linear spaces defined by the vertical planes of the building facades (County Council of Essex, 1973: 67). This view suggests representing a street with the frontal facades of the buildings locating along the each side of streets.

*Figure 3.73.* A street segment composed by the buildings. The facades facing the street -in red- are assimilated as the vertical planes for the calculation. -Note that the buildings out of the buffer are not taken into account, and the façade widths are calculated by projecting them on the street sideline.
Frontality factor is defined by the area of the vertical plane of the street façade and expressed as follows:

$$\sum_{i=1}^{N} \frac{L_{prj_i}}{\sum_{k=1}^{K} L_k}$$

where $L_{prj_i}$ is the projected length of the facade of a building within the buffer of sightline, $N$ is the total amount of buildings in neighbourhood, and $K$ is the total amount of street segments (numbered by $k$ (small letter) ranging from 1 to $K$) in the neighbourhood.

As seen in the formula, the effective length of the facade is taken into calculation, rather than the absolute length. That means, in case of being located towards the street with an oblique angle, the building facade is projected to the road sideline and the effective length defining the street is determined. In this context, only the buildings within a certain distance to the sideline are included into calculation. The distance represented as a virtual buffer is suggested as 10 meters in length, which is the nominal distance for the effective human sight and other kind of perceptions. As pointed out by Gehl (2010), at a distance of 20-25 meters, we can decode the facial expressions. Yet, for a comfortable conversation between the two persons, the required distance should be between 7.5 and 10 meters. Beyond the 10-meter distance, the other senses are involved for an adequate perception of space (pp. 34-35) [This involves the visual information about the building façade (i.e. material details, expressions of the people in the balconies (Ibid, p. 40)].

Considering the diverse spatial effects created by the different building settings on the street sections, we can assume certain implications of the frontality factor on environmental psychology in terms of the experiential notions of the ‘sense of space’ (i.e. enclosure, oppression or exposure).

4.2.3.1.10 Reciprocity (confrontation):

Though it is rarely mentioned as a form concept in urban morphology, ‘street wall’ is quite a common morphological concept in urban design. Defined as ‘the walls to a street as made up of buildings addressing that street’ (Nottingham City Council, 2009: 71), street walls are considered as an important element of street vitality mainly in terms of pedestrian comfort and safety by the enclosed and continuous visuality of space. While the concept entails the buildings to be ideally lined up with an equal distance from the street building, it also addresses the complementary composition of height differences along the building lines (Department of City Planning City of Los Angeles, 2009: 26-28; Wellington City Council, 2009: 44). The higher the street walls are composed [without a step-back above the ground floor], the more the view down to the street conveying collective visual control can be ensured.

There is no doubt that such a positive effect would be increased by the amount of buildings facing each other on both sides of the street. By revisiting the concept [the street-wall effect via the continuous and high frontage facades of the buildings] in consideration of the oppositionary positioning of the buildings on the street, we can come up with the idea of ‘reciprocity’ of the street walls.
The concept as a measurable factor can be defined as follow:

$$\frac{\sum_i H_i \cdot L_{rec_i}}{\sum_i A_{s_i}}$$

where $H(i)$ is the average height of the reciprocal buildings on the street segment $i$, $L_{rec}(i)$ is the length of the reciprocal street walls facing the segment $i$, and $A_s(i)$ is the surface area of the segment $i$.

Figure 3.74. Front facades of the buildings defining the reciprocity of the building setting on the street segment.

In this sense, reciprocity factor tends to reveal the extent to which the street frontages are composed by buildings in relation to the opposing facades along a same street segment.

Since the step-back building walls above the ground floor may not be perceived on the ground level of the street, only the walls which recedes less than 5 meters from the ground floor wall (Ibid, p. 28) are considered to be part of the street wall in the calculation of reciprocity.

4.2.3.1.11 Orientation:

Solar orientation of the buildings has always been a major consideration in architecture and city building (Vitruvius, 1998: 17). As observed in the traditional settlement forms, the principal facades of the buildings are ideally faced south with the allowed variations up to $30^\circ$ to the southeast and southwest (Olgyay, 1963: 54). For all the individual buildings designed, maximising the advantage of the sun’s value for the thermal effect is a primary concern. Nevertheless, in most cases, the actual urban patterns suggest an irregular character in terms of the multiple orientations juxtaposed on the same site. While some ensembles may have an advantageous orientation towards the preferred directions, some others may have lesser degrees.
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Figure 3.75. The portion of the building facades facing towards one direction specified in a building fabric. Application of the same calculation to the other directions would give the relative value of orientation for the whole site given.

The emergent response of the builders to the different solar conditions within the complex fabrics is usually in the form of alternative alignments and massing on the individual plot [in addition to the internal organisation of the ground floor plan]. Each urban fabric, therefore, would offer a different pattern of solar performance within itself. To make this performance assessment explicit, the orientation of the building setting of the neighbourhoods should defined as a measurable factor. In the factor definition, the exposure walls are taken as the basic unit for calculation. In this context, the relative orientation factor could be given as follows:

\[
\frac{\sum_i Afcd(\alpha)}{Aex}
\]

where Afcd (\(\alpha\)) is the total area of the exposed walls of the building facing to the given range of angle \(\alpha\), and Aex is the total exposure surface area of the buildings in the sampling area.

As in the case of the other relevant indicators, sinuosity and rugosity, the orientation factor can be plotted on a polar diagram showing the relative level of exposure to the certain orientations within the given neighbourhood.

4.2.3.2 Configuration of building setting:

The configurational analysis of the building setting involves the concepts of continuity, betweenness and counter-position. While the former two ones can be known from the literature, the final concept is originally suggested as the reinterpretation of an existing morphological notion, constitutedness.
### 4.2.3.2.1 Continuity:

As one of the prominent aspects of configuration, continuity can be applied in the context of building setting in a similar way to the street continuity. Like a route in a street pattern, the smallest composite unit in a building setting is the building envelope. While a route is composed of street segments, an envelope consists of the building units. Either of them can be composed by one single link or building unit, respectively. As the continuity of a route depends on the number of links connected, the building continuity can be defined by the amount of building units adjacent to each other in a given envelope.

The aggregated value of the ratio between the total amount of the building units and that of the envelopes gives the measure of continuity. It is expressed as:

\[
\frac{\text{Nbld}}{\text{Nbe}}
\]

where \( \text{Bu} \) is the total amount of building units, and \( \text{Be} \) is total amount of building envelope in the study area.

**Figure 3.76.** An exemplar building block composed of two building envelopes. Note that independently of their size, each building unit is counted as an equal node determining the level of continuity of the building cluster.

In this respect, continuity within building setting may also refer to the grain of the fabric.\(^{39}\) Since each building unit is ultimately supposed to be laid on the ground plane – according to the ‘*the law of contiguity of building with the ground*’ (Steadman et al., 2005) -, any adjacency of the building unit is inevitably perceived as the continuity of the built fabric on the ground level.

---

\(^{39}\) In this definition, the higher continuity would imply the building envelopes composed by many small units. Nevertheless, the same grain level can be composed in a different way within a detached configuration. In that sense, we would rather call the measure as continuity rather than the grain.
4.2.3.2.2 Betweenness:

Originally defined by Freeman (1977) in the context of social networks, the concept is first employed for the street network analyses by Porta et al. (2009) to figure out the centrality of nodes locating on the shortest path(s) in a given network. The concept is reutilised by Sevtsuk et al. (2011) with regards to the building pattern in an urban network. In this context, they define betweenness as the number of shortest paths passing by a building that locates between the other pairs of the buildings in an urban fabric (p. 8).

In order to reveal the extent to which the buildings locate on numerous shortest paths in an urban fabric, we can introduce betweenness as a global factor measuring the centrality of all buildings in the system in terms of the network structure. Accordingly, the betweenness is expressed as:

$$\sum_{j,k,d(j,k) \leq r} \frac{N_{jk}(i)}{N_{jk}}$$

where $N_{jk}(i)$ is the amount of shortest paths passing on the street segment on which the building $i$ locates, and $N_{jk}$ is the total number of shortest paths in the network\[40\].

Figure 3.77. The shortest paths between the buildings 1.1 and 1.2, and 2.1 and 2.2 going along the same segment. In terms of the given shortest distances, the buildings locating on that segment have the same centrality configurationally.

Unlike the closeness factor computing the intensity of the buildings with a certain distance along the shortest paths in the network, the betweenness factor calculates the acces-
sibility of buildings in terms of the number of shortest paths between the other buildings in fabric. Capturing the potentiality of the passersby of the buildings, betweenness centrality of an urban pattern can be utilised as an indicator in relation to the pedestrian traffic and the spatial structure of the local activities within the neighbourhoods (Sevtsuk, 2010).

4.2.3.2.3 Counter-position:

In design terms, a street is principally considered as a linear space defined by the buildings located along its length (Larkham et al., 1994). In this regard, a street is not configured only by the links, but also by the buildings located on either side of the street segment. Conceptualising the building setting as the collection of streets configured by the buildings, which are linearly aligned and commonly faced, we can come up with another configurational factor called counter-position.

The concept, counter-position refers to the state of building setting organised on a street [or in public space] in the form of the buildings locating evenly on both sides of the space through facing each other. It is originated from the idea of ‘constituentness’ defined by Hillier and Hanson (1984) as the condition of accessibility of public space from buildings (private space) via direct entrances (pp. 92). The concept is later elaborated by Nes et al. (2007) with the concept of intervisibility introduced to reveal the relative positioning of the buildings configuring the street with reference to one another. What the concept basically suggests is measuring the constituentness by calculating the ratio between the numbers of building entrances visible from any other building entrance located on the other side of the street, and the total number of buildings on the street.

![Figure 3.78](image.png)

**Figure 3.78.** The same amount of building units locating on the same length of street segments and suggesting different levels of counter-positioning according to the organisation of their frontal accesses to the public space.

Though the concept is relevant on building configuration, it is not illustrative enough
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to reveal the actual relative positioning of the building units on a street segment. In this regard, the concept of counter-position suggests calculating the constitutedness of the building setting on a street by multiplying the number of building entrances locating on each sides of the segment. (see Figure 3.78) By this means, the relative counter-positioning of the buildings can be represented more precisely.

In this context, the factor called counter-position is expressed as follows:

$$\frac{\sum_i Ns_1(i) \cdot Ns_2(i) \cdot L_i}{\sum_i L_i}$$

where Ns1(i) is the amount of the building entrances on the first side of the segment i, Nsni is the amount of the building entrances on the second side of the segment side i, Li is the length of the segment i.

The more even the distribution of the buildings on the sides of the given segment occurs, the higher the value of counter-positioning is expected. The practical implications of high intervisibility by counter-position would be on spatial vitality in terms of the higher pedestrian movement safeguarded by safety condition through direct visual access on the street (Nes et al., 2007: 23).

4.2.3.3 Constitution of building setting:

The constitution of building setting is primarily characterised by the typology of building units and their ordering rules in formation. Then as in the case of the other layers, the level of variation in typology is calculated via the entropy measure.

4.2.3.3.1 Range:

4.2.3.3.1.1 Unit types:

Though building typology is a very common concept in architectural design, there is a lacking concern about the issue of the generative influence of architectural typology on collective urban form. The question of how the elementary building types influence the characteristic emergence of the built fabrics is yet to be explored on a morphological basis in the urban design literature. In this regard, the morphological classification of building types done by Steadman et al. (1991) provides a relevant base for the characterisation of urban

41 Imagine that there are ten buildings half of which locates on one side of the street; and in another case, the same number of buildings are arranged in the way of which only one building locates on one side by facing the other nine buildings on another side. According to the measure suggested by Nes et al. (2007), the both cases would suggest the same intervisibility value without regarding the distribution pattern of the units through the different sides of the street.

42 In case of the meandering geometry of the street segments, which would enforce the intervisibility of the buildings -despite the high counter-positioning rate-, the calculation is made based on the straight links rather than the segments.

43 This provides a proper condition for the idea of ‘eyes on the street’ which is championed by Jacobs (2000/1961) in order to ensure safety of public space via the indirect control by the dwellers living on the street.
Fabrics through the typology of building units.\textsuperscript{[44]}

**Figure 3.79.** The principal types of building units based on the exposition of sides. –Thin lines are window or entrance wall, heavy lines are party walls - (After: Steadman et al., 1991: 92).

For the classification, the main criterion is the number(s) and the location of the exposed walls consisting of either windows or entrances. Despite mainly being applied to the functional issues of access, lighting, outlook and circulation (Steadman et al., 1991: 98), the typology also suggests a direct connotation to the configurational possibilities of the building unit within a collective urban form.

In this framework, instead of employing the building types in a conventional terminology based on the concepts like row-house, apartment or terrace, which indirectly inform about the possible structural organisation of the building at larger scale, the dimensionless typological representation suggested by Steadman et al. (1991) would help us to understand the constitutional nature of any building type composing the urban fabric.

### 4.2.3.3.1.2 Ordering rules:

Whether they are intrinsic within social conducts (Hakim, 2008) or explicitly determined as the legal design codes (Lehnerer, 2009), the ordering rules of urban formation is the major constitutional factor of urban morphology. Though there are several ways to define ordering principles of a building setting (i.e. according to the relations to the street, backyard or side-garden), the building-to-building relation is the primary ordering-rule factor to typify any urban fabric.

**Figure 3.80.** The basic ordering rules based in the relations between the building units.

In our framework, four basic ordering rules are determined to characterise the constitution of a building setting. While *alignment* and *attachment* represent the relative positioning of the buildings in relation to the neighbouring units, *linkage* and *interlock* involves the...
supplementary units (i.e. depots, garages or extra dwellings), which connect the individual buildings. The repetitive applications of the certain rules in pattern formation basically characterise the level of continuity and contiguity of urban form. The display of the distribution of the rules on the overall street pattern potentially maps out the system of ordering in a given area. Depending on the regularity of the specified rules’ disposition in the whole fabric, the specific domain(s) of the applied design control system can be revealed. (i.e. the control over ensemble, block, street or plot).

4.2.3.3.2 Variation:

4.2.3.3.2.1 Typological variation:

As in the previous variation factors (i.e. street pattern), we introduce the entropy measure to illustrate the average typological diversity within an urban setting. Since each building type has a certain capacity to be reproduced within a collective form through various assemblages, the variation of building types is assumed to have an implicit effect on the diversity of the built form. In this sense, the higher the entropy in building typology is measured, the higher the possibility of variation in space organisation throughout the neighbourhood would be expected.

The level of diversity in types in the building settings can be calculated as follows:

$$\sum_{i=1}^{n} \sum_{j=1}^{m} P_{ji} \cdot \ln(P_{ji}) / \ln(m)$$

$$\frac{n}{m}$$

where $P_{ij}$ is the ratio of the building type $j$ in the cell (block) $i$, $m$ is the total amount of the building types and $n$ is total amount of the cells in the neighbourhood.

Since in most cases, the design control on building typology is based on urban blocks rather than the street or plot, the entropy measure on typological variation is operated based on the cells in the network map of a given area.

4.2.3.3.2.2 Variation in ordering:

Within the limits of an existing building typology, variety in ordering rules applied has a remarkable influence on the type and quality of a composite settlement form. By applying the same entropy measure on the types of ordering rules, the level of variation in building coding within a sampling area is aimed to reveal. The higher entropy (disorder) in ordering rules, therefore, would imply the existence of the sub-areas within the same settlement developed through the different periods of time or by the different agents adapting different design codes in a certain time period.
5. Concluding remarks

The current chapter covered the first major theme of the research, *urban morphology*. Within the limits of the section, the prominent morphological approaches and methods have been discussed in the light of the basic categories involved in the recognition of urban patterns. The fundamental concepts (i.e. form, structure, pattern) were utilised to determine the underlying differences between the prominent schools in morphology with regards to their modes of spatial representation originally pursued (i.e. compositional, structural). The critical review of the methods, in this sense, are aimed to provide a necessary basis for the mathematical definitions of the morphological concepts to be eventually combined within a comprehensive framework. The precise definitions of the form indicators and their relevances in design are basically supposed to contribute the development of morphological design approaches in urbanism. Especially, the incremental nature of urban morphology, which studies the small-scale relationships of form-components have a true potential to provide operational input for the emerging techniques in generative urbanism, which will be thoroughly discussed in the final chapter.

Formulation of the major morphological properties (form indicators) within one conceptual framework, which is defined by three ‘typological levels’ (*form, structure and rule*) and the three ‘morphological layers’ (*street, plot and block*), could be considered as the main contribution of the research within this chapter. Putting all the basic parameters together along with a critical review of the prominent analytical methods in morphology, the new researchers could be provided by a comprehensive introductory framework. This is believed to increase the efficiency of the future researches without investing too much time to select the most relevant approach and analytical method for their own purpose. Regarding the enduring fragmentation in the literature of (urban) morphology, one could see the critical importance of the studies in this genre.

By positing the main ‘typological levels’ and the ‘morphological layers’ together in one framework the author suggests an original synthesis in the context of the contemporary morphological literature. By this way, Marshall’s (2005) original conceptualisation on morphological abstraction [based on *composition, configuration* and *constitution*] has been coalesced with the classical definition of ‘*plan-elements*’ made by Conzen (1960). It is worth to mention that the whole framework offers more than the sum of the singular concept definitions listed. The various combination of the levels and the layers in the matrix is essentially open to so many additional concept definitions to be developed by further studies. Considering them along with the relevant discussions on related performance factors (i.e. legibility, diversity, coherence), we can argue the critical contribution of the study to the fields of morphological research and design.

Moreover, one of the upmost theoretical contributions of the research in this section can be argued about the original categorisation on spatial morphology suggested based on an the cognitive distinction between *construction* and *reflection*. By the review of the schools in morphology, we could recognised that in addition to abstraction, as the shared domain of the two fields [discussed in the very beginning of the thesis], morphology and design could share another aspect, which is constructive reasoning. As in the case of theoretical physics which is based on abstract rationalisation, explanation and prediction; constructive (explorative) morphology does not perform on the actual phenomena to analyse. As opposed
to pure empiricism, it examines what it constructs as a set of imaginary forms. In other words, constructive morphology operates within the world of ‘the possible’. In this sense, just like designers, a ‘constructive morphologist’ generates possible forms. Unlike a designer, (s) he does not try to optimise what is generated in a certain context, but reflects on the imaginary forms and structures in an analytical way. In this regard, they also act like ‘reflective morphologists’ after a certain period of inquiry. Yet, unlike the reflective morphologists, a constructive morphologist does not collect the form-set from the real world, but generate them theoretically like in design.

Revealing the possibility of morphological thinking based on a ‘possibilistic’ logic rather than empirical reasoning, we can recognise that morphology and design could operate on the same way of reasoning. This recognition basically provide us a complementary perspective on a common basis between urban morphology and design, which was suggested in the introduction of the thesis. Last but not least, this view offers a strong potential to formulate some alternative methods to integrate morphological understanding into design processes. The mainlines of these presumptions, in this sense, would be concretised by pushing the limits of the settled empiricist conception on (urban) morphology to the realm of constructive (possibilistic) thinking which is the original domain of design.[45]

4 PLANNING the MORPHOLOGY
1. Introduction:

For the last two decades, especially with the emerging discourse on the ‘post-industrial city’, the transformation of old city fabrics has been a dominant topic in the contemporary urban planning and design. Nonetheless, the ever-lasting need to accommodate the increasing demand for housing is still a hot topic for many countries\(^1\), which requires further perspectives on the design quality of the new developments. From this perspective, the research aims to relate planning and morphology as the two interdependent domains in urbanism.

Comprising many sub-operations within itself [i.e. projection, programming, implementation and monitoring], planning is mainly considered with reference to its control function within this research. In spatial planning, ‘control’ implies the regulation of various individual design actions in accordance with a certain legal framework. The significance of the control on the planned urban developments derives from the emergent nature of urban form generated through the successive applications of the urban rules in a given context. In order to condition the emergent features of the collective urban form in a desirable way, the individual implementations are framed within a definite morphological control system comprising certain types of plans and urban codes.

The question of how the form of developments are characterised by codes through the limitations and the incentives adapted is not a new one in the planning and design literature. The topic has already been explored from a historical and social perspective in the recent period (Ben-Joseph, 2005; Hakim, 2008; Marshall (ed.), 2011; Talen, 2012). In this respect, the research asks the question with a specific reference to the morphological quality of urban tissues generated at the levels of urban ensemble and neighbourhood. The basic argument is that the already established standards and codes have a certain potential to be applied in different forms through the different regimes of design control in planning. That means the same set of tools in urbanism, the plans and codes, could result in different forms through different applications. It is like composing the distinct quality of narratives using the same language. In this regard, the author believes that in order to achieve a sufficient grasp on the morphological performance of any physical planning system, the application of language (the rules, codes and legends) and the narratives (the emergent fabric of the designed tissues) should be considered in relation to each other. This can be taken as the basic premise of the research method applied in the current chapter.

In the specific context of the research, coherence will be discussed as the prominent morphological quality. For this purpose, the UK, the Netherlands and Turkey are selected as the case study areas. While delineating the evolving approaches to housing design and planning in those countries, the current part of the research scrutinises the changing types of the planned urban patterns and their intrinsic quality of morphological coherence. By doing

1 The need for further housing supply in the Netherlands has been addressed by the report Structuurvisie Randstad 2040 published by the ministries of environment, transportation and agriculture in 2008. The plan vision states that 500,000 new dwellings are foreseen in the Randstad, the hub-region of the country, sixty percent to be realized as new developments outside of the existing cities. See: De Rijkoverheid, ‘Speerpunten Randstad 2040’-Randstad 2040 Priorities-, http://www.rijksoverheid.nl/onderwerpen/randstad/randstad-2040/speerpunten-randstad-2040, accessed in March 2011
that, the level of morphological coherence of the planned neighbourhoods will be discussed in terms of the development plans and local codes involved in the design control processes. The selection of the two countries having different system approaches in planning is supposed to enable us to reveal how the morphological quality differs according to the changing approaches in design control.

For each country case, three planned residential districts, respectively developed in the 1980s, the 1990s and the 2000s, will be presented as the typical sampling areas for the plan analysis and the morphological study. Within the twofold analysis, first, the major design control tools [i.e. master plans, design guides, codes and standards] will be discussed on real basis. Then, the actual consequences of the planning applications will be examined with regard to their morphological quality of urban coherence. Following the plan analysis, morphological layering and correlation analysis will be suggested as a method to reveal the degree of urban coherence at the level of urban ensemble and neighbourhood. Eventually, the necessary conditions in design control to ensure morphological coherence will be argued in terms of the application of the codes and plans in different scale-levels.

2. Design control in planning: regulating urban form

The question whether the planners should control the form of the development or not—in addition to the aspects of the location and programme—(Carmona, 2001: 58) is a critical one in the contemporary urbanism. Our initial response to this question would be that the spatial quality and local identities can not be ensured only by the architectural concerns, materialization and landscaping, though they are very crucial for the genius loci of an urban space. From this point of view, ‘planning the morphology’ is considered as a key field of public regulation controlling the morphological characteristics of collective urban form.

In most countries, the current market conditions of housing sector are constructed on the basic motivation of responding to the speculative preferences of the developers while meeting the rapidly increasing housing demands of the society. Although a serious majority of land development is realized by the private sector in many liberal economies, public sector is still authorised with the control of land allocation, design and construction process via their planning agencies (Carmona, 2003: 9). In this context, design control mechanisms have a key role to guide the quality of urban form for the sake of public interest. Within different forms and processes, making development plans and adopting design guides to control the developments through planning permissions still represent the major task of the local authorities in many countries.

Design control and guidance in planning are actually quite generic terms, which are mostly referred interchangeably. Operating at the intermediate levels of urban scale (from building group to urban district), these two mechanisms are functional with a set of planning instruments steering the production of urban form. All the instruments involved (i.e. guidelines, plans and codes) are primarily aimed to offer an operational basis of negotiation for stakeholders (i.e. local authorities, landowners, developers or community organisations) participating into the design and development processes (Cowan, 2002: 10). In morphological terms, the importance of design control lies at the use of standards and codes, which characterise the generic types of urban elements and their configurations. The provision of principles, norms and standards for individual design applications at different levels (i.e.
building, street, ensemble or neighbourhood) can be considered as the central function of urban design control and guidance in planning.

According to Dahl and Lindbloom (1957), “control is implicit in the functioning of a society, in which individuals are engaged in certain stable, persistent and repetitive relationships” (p. 94, cited in Ünlü, 2005: 2). In this sense, control supposes stabilisation and reconciliation of the conflicting interests. In general terms, control is a mechanism linking policy with action. In the urban context, control essentially performs as the linkage between the planning policies and the individual design applications for the development and change in built environment. In this sense, the terms development control and design control are homonym concepts in the literature. Development control means the system of issuing permits for area developments (Booth, 1996: 1). By definition, development control covers the act of design control as the regulation and discretion on the qualitative aspects of the development in order to ensure the tactile quality of the public realm and urban space (Ünlü, 2005: 3). In the limits of the research, the use of development control implies the control on urban design (product and process) for the new developments.

The systemic control of urban form goes back to the idea of social order and harmony in space with the emergence of design as a discipline in the Renaissance. (see Chapter 2) The concern for a unified aesthetics of urban form was largely evolved into the functional and economic ones with the development of industrial capitalism. Through the increasing level of complexity in the production of urban form in the modern city, development control on health, aesthetics and society was pursued to safeguard the local economies and civic identity in the 19th and the early 20th centuries in the urbanised Europe (Booth, 1996: 2- 4). The pre-modern conception of design as the artistic expression of the designer’s personal vision [mostly being responsive to the desires of central authority] was replaced by the contemporary conception of design as a creative act operating in the context of (public) ‘control within laissez-faire’ (Lehnerer, 2009: 244). Such a significant shift in perception on design is mainly conditioned by the emancipation of design domain (architecture) from the field of art and redefining itself with its own societal programme (Schumacher, 2011: 146-155). This transformation would eventually lead to the emergence of modern town planning in the early century to regulate and control the design act in urban context. Ensuring continuity and coherence of collective form and space can be regarded as the underlying motivation of modern spatial planning. The intrinsic relationship between urban morphology and planning could be read on this basis.

### 2.1 The major design control mechanisms in planning

Since the main task of urban design is to coordinate the production of the built form subject to the operations of various private actors\(^2\) (George, 1997: 143), urban design control is founded on the systemic rules and mechanism regulating the relationships between the stakeholders. In this context, different types of design control mechanisms have been evolved within the modern planning systems. Unlikely applied in different contexts, the main control mechanisms are zoning, guidance and coding in modern planning (Meyer et al., 2008: 115).

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\(^2\) This is actually the point differentiating urban design from ‘big architecture’.
2.1.1 Zoning

As an old regulation technique, zoning covers identification of the programmatic content, the functional properties and/or the building conditions (i.e. setbacks, height and massing) within a designated development area (Ibid, p. 115). The main feature of zoning is its absolutist character concerning the spatial position and volume of the buildings to be encoded. Despite its negative connotation in the contemporary land-use planning, zoning is an established design control technique in physical planning. Abstract specification of the building envelopes and massing, in which the different design solutions could be explored, basically suggests a flexible control method in urbanism\(^3\).

2.1.2. Guidance

Design guidance in planning basically implies setting policy frameworks for urban design to control the developments without involving unnecessary levels of detail (Cowan, 2002: 10). It serves for providing principal indications on the spatial composition of buildings, such as positioning, size and visual characteristics (Meyer et al., 2008: 122). It is the linkage process between the global intentions of the local governments and those of the developers for a desired spatial quality, and the subsequent design solutions. Mainly written by the project supervisors or the design-control commissions, design guidance process aims to provide a structural sketch giving an indication of the future spatial image and quality by design (Ibid, p. 124).

2.1.3. Coding

In general terms, the design control by coding implies ‘detailed guidance’ (CABE, 2003a: 4). By means of relatively more precise parameters, measures and instructions, coding specifies the morphological characters of the desired architectural and urban form (Ibid). Since each code specifies the elementary features of the form, urban codes are piecemeal by definition. Therefore, coding is essentially in opposition with the idea of designing form-composition presented as the ultimate image of a future development. In current practice, coding is mainly concerned with formal typologies rather than the functional ones (Carmona et al., 2006: 225).

No local planning system can be based on the unique type of a control mechanism. Every system creates its own combination of the different mechanisms via a special set of tools. For instance, if zoning involves codes, the zones of applied ‘principles’ might imply guidance rather than conventional zoning.

2.2 The tools of design control

The regularity power of planning is exercised by a certain set of tools, which in turn characterise the degree of the control itself. (see Table 4.1) Beside plans; doctrines, norms, standards, guides and codes can be cited as the major tools of design control in planning.

\(^3\) For a good example to zoning in urban design, see: Wijnhaveneland Rotterdam transformation project by KCAP in 1996, [http://www.kcap.eu/nl/projects/v/wijnhaveneland/](http://www.kcap.eu/nl/projects/v/wijnhaveneland/), accessed in May 2011
### Table 4.1. The matrix of the design control tools in planning.

<table>
<thead>
<tr>
<th>Control tool</th>
<th>Definition</th>
<th>Forms of expression</th>
<th>Characteristics</th>
<th>Examples</th>
</tr>
</thead>
</table>
| **Doctrines** | *A body or system of principles or tenets; public instructions* (OED, 2010)  
*Interrelated and durable notions in planning about spatial arrangements, development and how they are to be handled* (Faludi et al. 1994). | Charters  
National policy notes  
Memorandums | Politically constructed  
Comprehensive  
Substantial  
Paradigmatic  
Normative  
Ideological  
Self-justifying  
Conjectural | The Athens Charter  
Charter of the New Urbanism  
The Dutch national spatial planning reports -Verstedelijking nota  
‘Towards an Urban Renaissance’ (Urban Task Force, 1999) |
| **Norms and standards** | *The quality of a model, pattern or type. A level of excellence, or as the measure of what is adequate for some purposes – i.e. judgement*– (OED, 2010)  
The source of how communities are designed and built. … define how places can and can’t be developed, and how controls shape the physical space. (Ben-Joseph, 2005: xx)  
“… specify precisely quantifiable measures on how a development is to be designed” (DETR, 2000: 10, 98) | Development laws  
The model bylaws  
Standards handbooks | Generic  
Absolute  
Precise  
Universal (context free)  
Explicit  
Proscriptive  
Utilitarian  
Formal | The design manuals for highways  
The American zoning ordinances and neighbourhood standards  
The Model Bylaw of Development for Planned Areas -Planlı Alanlar Tip İmar Yönetmeliği- in Turkey |
Since spatial planning is a sociopolitical activity, which is based on social consensus and negotiations out of conflicting interests and motivations, planning doctrines can be considered with the negative connotation of the term, the corpus of dogma or belief. Though that view could be relevant in the context of social ideologies—including religion—, it would not be a correct consideration in the disciplinary context of planning. Through the rational and democratic debate, the contemporary societies set some political agendas and principal frameworks on different sociopolitical issues. As a prominent one, spatial planning does not represent an exemption in this context. With the changing social and political paradigms, modern planning is always subject to be (re)defined by the overarching set of principles applied to the national or international contexts. Though they are usually manifested by public

<table>
<thead>
<tr>
<th>Guides</th>
<th>Urban design guides</th>
<th>Universal (in principles) Local (in application) Instructive Advisory Promotive Value-laden Flexible Strategic</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Guides” are “An indication or outline of policy or conduct” (Merriam-Webster Dictionary, 2011) “A guideline that describes in words and illustrations the principles for achieving quality urban design and a consistent approach on the projects.” (Ministry for the Environment, 2006: 62)</td>
<td>Design briefs and frameworks</td>
<td>Planning Policy Guidance Notes (PPGs) Local authority design guides Village/ Urban Design Statements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Codes</th>
<th>Design codes</th>
<th>Prescriptive or proscriptive Elementary Specific Discretionary Thematic Typological Tactical</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Codes” are Any system of symbols and rules for expressing information or instructions in a form usable for processing or transmitting information and to secure brevity. (OED, 2010)</td>
<td>Urban codes</td>
<td>The local land development codes Subdivision codes Form –based codes (i.e. SmartCode) Pattern books</td>
</tr>
<tr>
<td>“Codes” are A system that specifies the attributes of urban components or building components to influence the character or function of the whole urban development. (Carmona et al., 2006, p. 241)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
institutions (i.e. governmental agencies or the professional groups), the planning doctrines are, in essence, socially constructed or at least socially agreed upon. Otherwise, they cannot be operational in real (Faludi, 1994: 18-23). In terms of design control, we can consider planning doctrines as design policy frameworks giving a normative direction to the overall practice. In the countries where spatial planning is subject to be updated according to the changing global contexts (i.e. market conditions, changing political aspirations etc.), the planning doctrines act as a kind of conjectural policy directions.

Regarding the scope of application, standard rules are the other ‘universal’ tools for planning regulating all the individual building acts in the regional or national context. Unlike plans, standard rules set a general condition and indirectly specify the design forms and patterns. Zoning and subdivision rules, which were introduced with the rise of modern planning in the early-20th century, are the most common regulation instruments in planning[4] (Ben-Joseph, 2005; Lehnerer, 2007). In this context, the prominent types of rules are norms and standards. Since they do not require any instantaneous reformulation for each specific design implication, the spatial standards provide a generic framework for urban design. It is relatively easier for public authorities to control diverse form of design actions via a generic set of standards. They are mostly numerical in expression, and either universal or conditional [i.e. ‘if A exists, B will apply’] (Hall, 1996: 12). The regulations like the minimum area of green space per inhabitants, minimum setback distances or building height limits are the typical standards in physical planning. In this context, urban standards are essentially output-oriented through delineating the limits of the potential form rather than providing generative inputs for design.

As opposed to the standards, design guides are the proactive control tools in planning. Instead of setting out the predetermined rules on form, the guidelines outline the major principles of design that would be, in turn, subject to the review process. Therefore they are in a bridging position between the design policy and practice. They do not stipulate specific design solutions, but instead provide a flexible framework in which the designers can perform. With reference to general objectives and prescribed images presented in a guide, the designers are expected to suggest various solutions in the defined framework.[5] Having no standard format or content, design guides might be written for the development of a specific site or for the thematic transformation of an area (Cowan, 2002: 12).

Finally, codes are the most precise descriptions of morphological parameters in spatial planning. As ‘illustrated compendiums of the necessary and optional design components of a particular development’(Carmona et al.; 2006: 286), design codes function as instructions about how the elements relate at the levels of plot, block and the street. Rather than providing a

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4 The emergence of the systemic rules for the built environment goes back to the rise of the city-states governed by the central authorities. When human settlements has turned into the complex spatial systems, the control over further developments and transformations within urban form via laws became mandatory for the early city governments (Ben-Joseph, 2005: 6). The earliest known systemic urban rules were introduced by the Indus Valley civilization (2600–1900 B.C.) and the major aspects covered by the laws are suitability of the site for building construction, layout of the town and its street, and relationships between streets and buildings (Ibid, pp. 6-7).

5 For instance, a design guide may state that “the new buildings should establish visual links with neighbouring buildings” (Wellington City Council, 2009: 14). Within such a statement, there is no precise formula about how a visual link should be actually established in design. The actual solution(s) is/are expected from the designer(s). For this reason, design guides can pursue a function to advance the quality in a context where the design practice is highly rely on the routine interpretation of formal norms and standards.
generic guidance, codes provide an operational framework, which behaves more flexible on larger scales. Though they are mostly associated with the special design applications, codes might be also in the form of standard urban rules. In conformity with the zoning ordinances, the land subdivision or local development codes utilised as standard applications can be considered in this context. Yet, unlike standards, codes are more responsive to the local context, and unlike guidelines they are more definitive with precise instructions open for individual interpretations by design.

3. Development control and design guidance systems: the UK, the Netherlands and Turkey

The performance of any planning system is not independent from the legal and administrative context in which the system components operate. There is no doubt that the overarching context is conditioned by the sociopolitical culture of societies.

Given the fact, we would argue that

- the degree of public control over the individual act in general,
- the (de)centralised structure of the public administration,
- the common understanding of the mutual relationship between private rights and public interest, and
- the juridical system in which the planning actors operate

substantially characterise the mode of control in spatial planning. In this framework, the last factor, the legal system, has a direct influence on the type of plans and codes involved in design process, which is our main concern within this chapter.

The principal distinctions between the Anglo-Saxon legal system based on the Common/Case Law (or precedents), and the ‘Continental’ legal systems based on the civil code\(^6\) should be taken into consideration to distinguish the distinctions between the spatial planning systems in different national contexts. In the countries having the continental law system, the development proposals are assessed against the common codes, whereas in the Anglo-Saxon countries (i.e. the UK, the States and the Commonwealth countries) embracing the discretionary system, any proposals are considered against their own merits and limitations as precedents (Kropf, 2011: 158-59). Within the regulatory planning systems in the continental Europe adopting the Germanic and the French Napoleonic Codes in their legal frameworks, the plans are drawn in accordance with the standard planning rules (Booth, 1996). Performing under the control of development bylaws and master plans, Turkish planning practice exemplifies a typical regulatory system. Unlikely, the Dutch urbanism exhibits a hybrid model in practice. While the spatial planning law and development bylaw regulates the system mainly in terms of plan making process, the plans are considered as a kind of decision-making interface without a predetermined set of quantitative limits and rules.

Despite the enduring impact of globalisation in favour of so-called ‘harmonisation’ of different local regimes, the peculiarities of the legal and administrative frameworks in different nation-states are still valid and observed in practice. Especially in the zone of Napoleonic legal system in Europe, there are different interpretations varied within the peculiar cultural

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\(^6\) A civil code is a systemic formulation of laws, which aims to control all the spheres of social life rationally unlike the common law based on the decisions of the courts with reference to the body of cases and precedents.
contexts of the countries (Newman et al., 1996: 28; Knieling and Othengrafen (ed.), 2009). Since it is not likely to change in near future (Ibid), this situation represents the relevance basis of our comparative analysis on the UK, the Netherlands and Turkey, which represent the different, (Anglo-Saxon and Napoleonic type of) legal traditions. The difference in traditions is mainly based on the regulative authority of administrative bodies.\(^7\) The variations in plan types that we subsequently discuss can be regarded on this basis.

3.1 The United Kingdom

In the UK, local authorities have legal responsibility to prepare local plans, which determine the land-use policies within their administrative areas. Although they are not legally obliged by a national development law, local governments are expected to provide a flexible framework for decision making in development applications. At this point, central government’s policy directions [in the form of ‘planning policy guidance notes’] play a significant role on development control by local planning authorities (Newman et al., 1996: 42).

The production of the planned urban form is controlled by the three types of instruments in the UK: the design policies set by the local plans, the design guides and standards outside the plan, and the site-specific development briefs, design codes and frameworks (Carmona, 2001: 212). Majority of the development control process is performed by the area-wide local development plans in the form of Local Development Frameworks (LDFs) prepared by the district/borough planning authorities\(^8\) (Frankland, 2009). They are usually called ‘area action plan’ (AAP). Performing as the local development plan documents, AAPs are the mediums for the detailed design guidance influencing urban morphology (Stones, 2009). They may cover either a specific area (i.e. town centre) or a particular area to be developed. In consistency with the regional spatial strategies (RSS) developed by the county councils, local plans mainly provide a design framework for the future allocation of land for specific purposes (Punter et al, 1997). With their diagrammatic visual language, local plans (AAPs) do not directly control the morphological dimensions of the developments, but provide a general aspiration about the morphological character of the planned settlements (Carmona, 1999: 818-19).

In addition to the city and district-wide guidance with local plans and local design guides, site-specific guidance plays the main role to control urban form in the UK. The intermediate-scale of urban form is mainly characterised by a series of supplementary planning documents. Though they are not binding in the British legal system, supplementary planning documents are widely utilised to guide the future design proposals taking place within the local plans (Ibid, pp. 511-13). Due to the lack of an official definition, the titles of the document types are somehow used interchangeably by the local planning authorities in the UK. Nonetheless, it is still possible to make a general classification of the supplementary planning documents as follows:

\(^7\) In the Anglo-Saxon system, local authorities function as the agents carrying out the central policies and regulations defined by the central governments. Whereas, the Napoleonic style is constituted on the Civil Code, a comprehensive statement of the legal principles by which local governments are not solely the agents of the central authority, but the actors of local (political) representation under the strong central control of a uniform political system (Newman et al., 1996: 30-33).

\(^8\) Local Development Framework is a portfolio of documents, produced by the district/borough planning authority, comprising Development Plan Documents (DPDs) Supplementary Planning Documents (SPDs) and Statement of Community Involvement (SCI).
**Urban design frameworks** as the set of area-specific design rules to be applied in strategic (re)development sites from ensemble to neighbourhood level. They translate the abstract design policy and principles into the sketch-like two or three-dimensional schemes to be elaborated by master plans and briefs. They mainly include new infrastructure requirements, strategic public spaces and facilities, and the heritage buildings to be protected.

**Master plans** as the physical plan to specify the urban layout of any development or renewal area. They are the final design schemes, which characterise the building massing/envelopes, structure of the streets and public spaces, land use pattern in terms of urban form in detail mostly with a programme covering the implementation issues (i.e. costs, phasing and timing).

**Design/development briefs** as the detailed guidelines describing how a particular site is to be developed in response to the design frameworks, which preliminarily define blocks and public spaces in the development area in terms of density, building typology and public facilities. They are applied for the sites where more specific guidance with detailed illustrations is required.

**Character/area appraisals** as the analytical scheme of the visual, formal, functional and environmental features of a given context, which is subject to be transformed or preserved within the local plan.

**Concept/design statements** as the brief declaration of the proposed characteristics and performance of the design layout of any development site. They are prepared by the developers in order to let the local planning authorities give an initial response to the application.

**Local/village design statements** as the advisory document expressing how the proposed development can be applied in harmony with the existing urban or rural setting.\(^9\) (Cowan, 2002: 12-13; Hall, 2007: 46; Carmona, 1999, Carmona et al., 2003: 27-28, Walters, 2007: 117-121)

The development plan typology in the British context can be given in terms of the applied scale-levels, major planning themes, the main control items and the tools involved. (see Table 4.2)

Table 4.2. Types of local development plans and codes in the UK

<table>
<thead>
<tr>
<th>Plan Type</th>
<th>Level(s) of Scale</th>
<th>Plan Theme</th>
<th>Control Items</th>
<th>Control Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area Action Plan (AAP)</strong></td>
<td>Town / district</td>
<td>Landscape character, local distinctiveness and accessibility-based flexible area definition.</td>
<td>Site boundaries, size and centrality structure of the area housing types, principal routes and zones.</td>
<td>Site-specific spatial strategies and strategic objectives, delivery and monitoring statements and phasing programs.</td>
</tr>
</tbody>
</table>

\(^9\) ‘Village Design Statements’ are produced by local communities such as parish councils and are not statutory planning documents although they may be adopted as guidance by a planning authority (Frankland, 2009).
## 4. PLANNING the MORPHOLOGY

### Development and Design Framework

<table>
<thead>
<tr>
<th>District/Neighbourhood</th>
<th>Structural designation of design area by means of connections and divisions.</th>
<th>Major access points, spinal axes, green corridors, and (re)development sections of the area.</th>
<th>Key diagrams and site specific principles and norms to be applied in keynote design projects.</th>
</tr>
</thead>
</table>

### Master Plan

<table>
<thead>
<tr>
<th>Town/District/Neighbourhood</th>
<th>An overall impression of the physical character of the plan proposal and the structure of the built form.</th>
<th>Street and block layout, building density and uses.</th>
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### Design/Development Brief

<table>
<thead>
<tr>
<th>District Neighbourhood</th>
<th>Special characterization of the design area in terms of land uses, layouts, design provision of open space, access and landscaping and materialisation.</th>
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<th>Detailed design principles and codes illustrated for the final design scheme required by local planning and highway authority.</th>
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### Design and Access Statement

<table>
<thead>
<tr>
<th>Neighbourhood/Ensemble</th>
<th>Arrangement of the buildings and spaces (public and private) spaces on the site which is subject to be (re)developed.</th>
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<th>Specified design concepts applied in development in relation to the principles and norms adopted from the framework and master plan.</th>
</tr>
</thead>
</table>
In the UK, each major development is expected to have a master plan in advance to outline the formal and functional characteristics of the future development site. The design briefs and master plans together determine the basic layout and types to be built before the developer initiate the development process. In the British legal framework, though master plan is not legally a pre-requisite, it is usually advised when the local government aims to set up a detailed control on the physical quality of urban form in certain developments (Stones, 2010). Ideally accompanied by the codes within design briefs, the master plans are mostly made by the developers for a particular site, as the main part of the planning application.

In the case that the county councils aim to translate the design principles set by the area action plans into a set of prescriptive statements to be applied within design frameworks and master plans, they publish design guides. Design guides can be regarded as the key documents linking general design policies to the site-specific plans. Although the early design guides were mainly dealing with the visual aspects of the developments [i.e. facades, shop fronts etc.] (Hall, 1996: 13), the contemporary design guides in the UK comprises more morphological aspects [i.e. relationships between mass, space and the network].

The share of morphological issues in design policy documents stands for an important level at the major policy documents, which represent the current perception on urban design. Nevertheless, according to his comprehensive research on the national design control policy, Carmona (2001) states that most of the British borough and district councils poorly define the morphological aspects and principles within their guidance documents (p. 214). Another important finding of the research is that, morphological design issues are highly concentrated on easily observable physical phenomena such as building lines or massing, instead of the structural properties of urban form. In addition to the poor definition of the morphological elements and concepts, most of the discussions focus on building–space relationship within a limited scale level (Ibid, p. 216) rather than the large-scale qualities of collective urban form.

Within the current context, in favour of a design-led planning approach, which was flourished especially after the publicity of Urban Task Force in the 1990s, the use of codes and the code-based design guides is getting more prevalence in the urban planning practice in the UK. Defined as the ‘illustrated compendium of the necessary and optional design components of a particular development with instructions and advise about how these relate together in order to deliver a master plan or other site-based vision’ (Carmona et al., 2006: 286), design code was officially accepted as a planning tool within the national design policy declared by the Planning Policy Statement (PPS3) in 2006. In this framework, the current understanding of code in the design control processes is based on master planning through designing parcels in the light of the plan’s main spatial vision and the detailed design codes (Carmona, 2008). This is basically the characteristic relationship constructed between the plan and the code in the British urbanism.


As one of the prominent publications on design policies, By Design presents four morphological concepts (character of distinctive patterns of development, continuity and enclosure, legibility and diversity through a mix of compatible developments) within the list of the objectives of urban design -the other two items are quality of public realm and adaptability- (DETR and CABE, 2000: 15).
3.2 The Netherlands

Since the developable land is scarce and artificially produced to a large extent, design and its public control has a significant role in the tradition of Dutch spatial planning. The ownership of the huge portion of the developable lands are under the control of the municipalities in most Dutch cities. This gives a privileged power to the system of design control on a well-defined design framework in planning. This can be the reason why the Netherlands is perceived as ‘one of the most planned country in Europe’ (Dutt et al, 1985 cited in Newman et al., 1996: 49).

The tradition of the development control by planning in the Netherlands goes back to the beginning of the 20th century. Until the nineteenth century the issue of urban development was under the responsibility of autonomous local authorities. In 1851, the development control by municipalities was regulated by the central legislation (Hobma, et al. 2008: 97). On this legal basis, with the first Housing Act (Woningwet) in 1901, the expansion plans to be made by the Dutch municipalities were introduced (Hobma, 2007: 3). Providing urban plans a legal status within the land-lease system basically enabled the municipalities to control the developments effectively. By the Housing Amendment of 1921, urban plans expanded their scope from physical (i.e. rules on building lines, building heights and block depths etc.) to the functional aspects (i.e. land-use). Thus, a strong basis of regulation was established in the Dutch planning system (Hobma, et al. 2008: 98). Although the Second World War badly influenced the fabric of some major cities in the country, there was no radical change in the instruments of planning until 1962 when the Law on Spatial Planning was enacted. The law extended zoning to the peripheral urban areas (Ibid). Since then, the long-standing tradition of space production by design on the scarce developable land has been consolidated and created a strong disciplinary culture in practice.

Within the binding condition of Napoleonic legislative style, the spatial planning system in the Netherlands has evolved at the three operational levels: national, provincial and local (municipal). While each level has its own legislative power, they are under the supervision of central government in a certain degree of influence. In this context, the central supervision is pursued by the periodically publicised planning acts called ‘nota’. National planning agendas and their principles translated into the regional-level structure plans prepared by the provinces that provide frame of reference for the local development plans (bestemmingsplan) to be prepared by the municipalities. The operational autonomy given to the municipalities by the constitution ensures certain freedom to define and apply their own development control policies as long as the local policies conforms with the national and regional policy frameworks. (Ibid, pp. 47-48). This can be taken as a significant point that explains the actual reason behind the existence of a strong design notion at the level of local plan discretion in the Netherlands.

Despite having scale-hierarchy in plan making, the Dutch planning system does not strictly exhibits the Napoleonic characteristics in planning. Unlike the case in France or Turkey, there is no comprehensive national code of planning regulations in the Netherlands. The Law on Spatial Planning (Wet Op De Ruimtelijke Ordening – WRO) is the only overarch- ing legal document, the abstract framework of the system providing the minimum standards common in practice. Accordingly, the Dutch urban plan typology can be given as follows. (see Table 4.3)
Table 4.3. The major types of the spatial plans in the Netherlands

<table>
<thead>
<tr>
<th>Plan Type</th>
<th>Level(s) of Scale</th>
<th>Plan Theme</th>
<th>Control Items</th>
<th>Control Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structureplan</td>
<td>City or district</td>
<td>City structure and macro-urban form and land-use</td>
<td>Road network development boundaries, land-uses, population densities and pattern of sun-centres</td>
<td>Zoning, implementation of large scale technical and social infrastructure</td>
</tr>
<tr>
<td>Structuurvisie</td>
<td>District</td>
<td>Structure and functional programme of development zones.</td>
<td>Housing mix (social or owner occupation), central zones and major access points and lines, gross building densities, type and location of the public facilities</td>
<td>Phasing development, programming, local infrastructure</td>
</tr>
<tr>
<td>Ontwikkelings Plan</td>
<td>District or neigh-</td>
<td>Spatial layout: Street pattern and building setting, green structure</td>
<td>Designation of public and private space, building types, dwelling unit densities, road network and street typologies</td>
<td>Land allocation for partial implementations and their own development programmes.</td>
</tr>
<tr>
<td></td>
<td>bourhood</td>
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</tbody>
</table>
### Structural visions

*Structural visions (structuurvisies)* are basically a scale-free type of planning documents, which outlines the future development scheme and the scenario of the province.\(^{12}\) Even though it is defined as a policy document to be prepared by the provinces for the whole planning area, we can see some examples, which were made for the districts that have strategic importance for the city. The structure visions can be regarded as the concept-plan for the development and transformation areas, which are already defined within *structure plans* at the level of city.

Following the public consensus achieved on the type and the characteristics of the

---

\(^{12}\) The right to define regional vision by *structuurvisies* to the provinces is given by 2006 Spatial Planning Act (VROM, 2006).
areas in the structural vision and plan, the form of the developments are defined by the supplementary plans called ontwikkelingsplan –development plan- or stedenbouwkundig plan –urban design plan-.\[^{13}\] The major morphological aspects such as building types, settings and densities are specified in the development / urban design plans (Dijk, 2010). With the three-dimensional form-parameters envisioned, development plans are the major instruments for the articulation of the designed urban morphology in the Netherlands. Depending on the size of the project area, the Dutch urban design may function as a master plan in terms of its determinacy and coverage (Hobma, et al. 2008: 98). Urban design/development plans in the Netherlands usually act as the compositional framework plans in which the different architects are commissioned for the separate ensembles within the single plan-scheme\[^{14}\].

With 2007 Housing Act, the municipalities were obliged to adopt the policies on urban and architectural aesthetics. Accordingly, if the local planning bodies want to secure the quality of the architectural implementations within a development plan, they provide another supplementary document called beeldkwaliteitsplan –visual quality plan- or inrichtingsprincipes –(architectural) design principles- (naming depends on the municipalities)\[^{15}\]. A quality plan sets the basic conditions for building on the private plot in relation to urban landscape. Although it cannot be utilised as a basis of refusal of a building application, the visual quality plan provides a design perspective for the local authorities for the negotiation with the private developers on the issue of urban and architectural aesthetics (Nelissen et al., 1993: 152).

Finally, zoning plans (bestemmingsplan) draw the definitive condition of design form prior to the implementation. The basic design aspects to be controlled within the bestemmingsplan are land-uses, building lines (rooilijnen), sightlines (ziehtassen) and the building regulations like maximum building heights, setback and massing (Hobma, 2007: 6, 21). Bestemmingsplan is the only plan type, which is legally defined as obligatory by the development law (WRO). Therefore it is the sole legally binding document for all the stakeholders in a planning process. Though the basic building conditions are codified in bestemmingsplan, the design morphology is preliminarily formulated by design guidelines, which have a wide area of application in the Dutch urban design practice (Meyer et al., 2008: 115). The design guidelines functioning as a plan document (in the form of development and quality plans) basically provides a real ground for the consensus among the stakeholders and essentially plays a key role in the development of a strong design culture in the Dutch urbanism.

In addition to zoning plan, the design control at the plot level, in some places, is coordinated by the kavelpaspoort (‘plot passport’) by which the entrance to the parcel, setbacks, the exact use of colours and materials or the garden landscaping are coded. The kavelpaspoort –in some cases for the entire block- is required to get the building permission from municipality (Dijk, 2010). By this way, the general design principles are concretised and fixated through the detailed building codes.

The design criteria involved in any plan document above the zoning plan are not defined as form-based codes to be applicable as standards and norms, which would be uni-

\[^{13}\] Naming is varied within different municipalities.

\[^{14}\] For a good example to the multi-architect urban design programme. See: Ypenburg, Den Haag new settlement, http://www.architectureguide.nl/project/list_projects_of_architect/arc_id/1099/prj_id/1702

\[^{15}\] In case of Almere, the Netherlands, the ‘visual quality plan’ is named as ‘urban preconditions (stedenbouwkundige randvoorwaarden) or the ‘design principles’ (inrichtingsprincipes) comprising the same content.
versally valid for different contexts. Instead, they are taken as the aspects to be (re)considered by designers or by the committees of design control for the local development applications (Nelissen et al., 1993: 147). The Dutch local design control system is highly characterised by the active discretion of planners (urban designers) without any central orientation of formal frameworks. There is no doubt that this point offers a remarkable room for a dynamic design reasoning process in planning.

The critical point is that urban design does not actually have a legal status in the Dutch spatial planning system. Neither the development plans (ontwikkelingsplan) nor the visual quality plans (kwaliteit plan) has a legal force, but only the zoning plans (bestemmingsplan) (Hobma, et al. 2008: 98). That means it is pretty possible for any Dutch municipality to keep the development control practice at the level of zoning with a set of simple control aspects such as density, height limits and setbacks. Nevertheless, in practice, no zoning plan is produced without any design control process guided by the urban design plans. Such a characteristic tradition in the Netherlands basically signifies the possibility of a design-led planning approach without a centrally defined strict legal framework.

Despite the freedom of local governments to adopt their own urban design policies via different types of codes and plans, this situation is not valid for the design control at the building scale. The municipalities in the Netherlands have no freedom to impose new technical standards for buildings\(^{[16]}\) (Hobma, et al. 2008: 105). This can be regarded as a factor ensuring the diversity within urban morphology in different local contexts while keeping the architectural standards unified for the whole country. This point is compatible with the enduring neo-liberal tendency in land development based on the involvement of private sector searching for the apparent and competitive variations within their projects. We can argue that the flexible framework of the plan typology of the Dutch urbanism has enabled the system to adapt into the new sociopolitical conditions. As stated by Dijk (2008), the Dutch local governments still have a significant influence on the functional programme and the location-choice of the future developments in the questions of ‘what can be built and where’. Then what essentially changes in time are the guiding principles, which were used to be cohesion and unity until the mid-1990s while they have turned into diversity and freedom of choice for the last decades\(^{[17]}\) (pp. 7-9).

### 3.3 Turkey

Though it is historically rooted in the early building regulations introduced with the 19\(^{th}\) century modernisation of the Ottoman Empire, the legal framework of the modern Turkish urban planning system was constructed in the 1930s with the comprehensive modernisation programme introduced by the Kemalist regime. After the first legislation of the Municipality Law (Belediye Kanunu) in 1930, The Law of Building and Streets was enacted. Accordingly, all the municipalities were obliged to prepare maps and plans in accordance with the major development control aspects specified by the law (Özcan et al., 1995: 5-9, cited in Baş, 2003: 54). The rapid urbanization phase after the Second World War neces-

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16 All types of new buildings are subject to be regulated in accordance with the national document Het Bouwbesluit (the Building) which contains structural rules for safety, health, utility, energy and environment.

17 Such a conceptual shift in design inevitably has certain morphological implication observed with an apparent transformation from rational regularity and uniformity [via standardized buildings and lots] to higher variety in the Dutch residential landscape (Meyer et al., 2008: 16).
sitated a new comprehensive development law issued in 1956. The new legislation prioritised the notion of development planning with the association of the master plans and the detailed implementation in accordance with the modernist idea of zoning (Bas, 2003: 55). While the master plans were aimed to control macro-structure of the cities, the bylaws were supposed to determine the basic standards for the small-scale implementation plans controlling the formation of individual plots. Basically, this is still the general framework for the contemporary Turkish planning system.

The current town planning/development law in Turkey (the Development Law, no.3194) mainly specifies the plan hierarchy, the plan making procedures, and land allocations (i.e. amalgamation and subdivision) in full-detail (Bayındırlık ve Iskan Bakanlığı, 2009). Though the development law does not determine the definitive codes of the plans, there are series of bylaws specialised on the different aspects of planning. Among them, the Standard Development Bylaw (SDB) specifies the basic standards of the organization of a building parcel mainly in terms of size, depth, area, building lines, and height and floor space area (Ibid). SDB automatically rules if a development plan does not specify the building conditions within the blocks since in many cases, the plans only indicate the building lines, FSI and GSI. In these cases, the bylaw standards perform as the design codes in their own right.

Although they are not under the direct control of central government, all the procedural aspects of development control and decision making in planning, which the municipalities execute, are strictly bounded by the national law and the bylaws. This condition limits the introduction of new control tools (i.e. guidelines, area or theme-specific design codes) by local planning departments. All the plan types, their format and legends are pre-defined by the law. Therefore, the act of design in development planning remains as a kind of interpretation of the preestablished rules and legends in different contexts. Then, the role of the local planning authorities in Turkey is highly limited to the inspection of the plan proposals made by the developers in accordance with the minimum standards defined by the bylaws, rather than controlling design acts through guiding principles in the search for better design solutions.

In the Turkish spatial planning system, the plan types are officially classified as ‘regional plans’ and the ‘development plans’. According to the national planning legislation, all the plans are defined through the scales of implementation. Accordingly, 1/5000 and 1/1000 are considered as the main the scale-levels for shaping the built environment. The higher levels in the plan hierarchy implies strategic planning for the regions covering the province(s) within administrative borders or river basins and natural catchment areas (Keleş, 2002: 215-219). After the legislative regulation enacted in 2004, the metropolitan municipalities have been authorized to make large-scale master plans for the metropolitan regions.18 This basically shifted the notion of physical planning above the limits of the city footprints.

However, the ever-changing legislative regulations on the authorisation of plan making, control and approval have not changed the conventional plan typology for the production of intermediate-scale urban form. Within the overall (legal) framework, the physical

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18 With the recent regulation enacted in 2011, the newly established Ministry of Environment and Urbanism has been officially eligible to make development plans for the lands subject to public ownership (Resmi Gazete -The Official Bulletin-, 2011).
(trans)formation of Turkish cities is mainly controlled by *master plans* and local *development/implementation plans*. In order to make implementation plans executable, the *parcellation (alotment) plans* regulate the property patterns according to the physical structure defined by the development plan(s). Finally, the plan hierarchy is supplemented by the *site plan*, which is essential for the official permission for the new buildings or building clusters. (see Table 4.4)

**Table 4.4.** The major types of the spatial plans in Turkey

<table>
<thead>
<tr>
<th>Plan Types</th>
<th>Level(s) of Scale</th>
<th>Plan Theme</th>
<th>Control Items</th>
<th>Control Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/5000 Nazım İmar Planı</td>
<td>City or district</td>
<td>City Structure and Macro-Urban Form</td>
<td>Settlement boundaries, road pattern, land-uses, population density distribution, urban blocks</td>
<td>Zoning, implementation of large scale technical and social infrastructure</td>
</tr>
<tr>
<td>1/1000 Uygulama İmar Planı</td>
<td>District or neigh-</td>
<td>Block Formation of Urban Dis-</td>
<td>Urban block formations, building types, order, density (FSI/GSI) and height, setback distances, road widths, size and form of public space, car parking.</td>
<td>Development rights by building condi-</td>
</tr>
<tr>
<td></td>
<td>bourhood</td>
<td>trict</td>
<td></td>
<td>tions</td>
</tr>
<tr>
<td>1/1000 Parselasyon Planı</td>
<td>District or neigh-</td>
<td>Property Pattern</td>
<td>Plot size, shape, dimension and location; number of share holders</td>
<td>Unification</td>
</tr>
<tr>
<td></td>
<td>bourhood</td>
<td></td>
<td></td>
<td>Expropriation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Land re-adjustment</td>
</tr>
</tbody>
</table>
As stated in Table 4.4, the 1/5000-scale master plans determine the overall structure of the settlements. The term structure here involves main connections (the road network), divisions (distribution of land-use and densities), open-space system and the overall boundary of macro-urban form. Master plans in Turkey typify the total control approach of compressive planning. As a kind of blueprint, the planned urban form are not structured strategically by means of the key intervention areas and the corresponding programming. Instead, they are defined by formal subdivision of land slightly informed by existing topography. Though the plan schemes are supplemented with a comprehensive analytical report on the plan context that covers various aspects (i.e. the history, culture, demography and climate), the underlying design principles of the urban form is not usually given in relation to a systemic analysis. The network structure designated by a master plan involves the access streets usually with a nominal mesh of 100 meters. Therefore; the overall street pattern of the fabric is extremely predetermined by the master plans without leaving a room for designing the street layouts at the local-level with regards to the building setting.

Subsequently, the development planning is localised with the 1/1000-scale implementation plans. Prepared on the cadastral maps, implementation plans determine the basic conditions of building composition within urban blocks in terms of buildings and their configuration types, (i.e. attached, row, block), building lines, maximum building heights, floor space (FSI) and coverage (GSI) and parking. In spite of the critical role of the implementation plans in the formation of urban space and fabric, the plans do not involve any three-dimensional design analyses and guiding solutions on building envelopes urban blocks. Though the indicators of FSI, GSI and $h_{\text{max}}$ are given as the basic building rules on the plan scheme, they are not utilised as the flexible parameters in which different design alternatives could be formulated. This is essentially due to lack of a strong morphological perspective in planning even at the local scale.

The development of urban land in Turkey is highly based on the formation of privately owned individual plots. In this context, the allotment/parcelisation plans regulate the readjustment of the property rights in the planned developments through land subdivision. The parcellation process is based on the urban layout predetermined by the implementation plan. However, parcellation plans are not only critical for land ownership, but also for (planned) urban form. If the implementation plan does not specify the internal subdivision of the planned urban blocks, preliminarily. A parcellation plan basically shapes the plot layout on
which the individual buildings are constructed. In most cases, the cartographers make the allotment plans independently from the planners of the development plans. While the main objective is minimising the possible conflicts between the landowners in parcellation, any design criterion on plot layout (i.e. grain, variation or frequency) is not usually involved in the technical process of land subdivision.

Finally, for each building project on its own parcel, a site plan is required. In the case of mass housing designed and built by single developers within a single (super) block or on ensemble, site plans function as composing the collective building setting. Presented with structural design of the building(s), site plans are mostly made by the architects without a constructive collaboration with urban designers.

After the plot layout determined by the allotment plan, the building setting within urban blocks emerges in accordance with the limited set of norms cited in the Standard Development Bylaw. In this context, the dynamic relationships between the morphological layers in urban formation are highly disregarded within the planning processes in Turkey. Once the master plan gives the exact form of a network structure in a top-down manner [even in the detail-level of access streets], all the other layers of urban form such as building setting and green system have to be adapted into the already given block layout through individual implementations. Thus a kind of ‘fill-the-gap’ process is realised within urban blocks during the formation of urban patterns. In this regard, Ünlü (2005) argues the lack of strategic design thinking in planning as follows: “urban development plans in the Turkish planning system are detailed end-state blueprint plans, which envision that a time would come and the spatial development of any city would be completed in the specific planning period” (p. 1). This point indicates the underlying assumption of compositional approach in urbanism, which conceives the city as a mere product of ‘the plan’, as discussed before.

Although the development bylaws can be formally utilised as the special supplementary design documents for local plans, the municipalities do not use this control and guidance power. Instead, they mostly adopt the national standard bylaw into their local contexts without any substantial reinterpretation (Baş, 2003: 8). Furthermore, the Standard Development Bylaw provides a legal basis for planners to define their own design codes in relation to the local contexts. Nevertheless, Turkish planners do not usually enjoy this opportunity in practice. They extensively prefer to designate the overall geometry of the planned forms and to define the built-fabric by means of the standards provided by the central development bylaw. This can be considered as the prominent factor behind the homogenization of urban form in Turkish cities.

4. **Plan Analysis: progress in design control for the planned residential developments in the UK, the Netherlands and Turkey**

After a brief introduction on the planning systems in the UK, the Netherlands and Turkey, we can continue our discussion with the plan analysis in consideration to the specific features of the actual plans, which have been transformed in time.

‘Plan analysis’ would have two different connotations: analysing a plan document with regards to its vision, principles, strategies, rules and norms; or analysing a plan layout with reference to the physical quality of the area projected by the plan itself. In the current context, we take the term mainly with its former implication. Since the main aim of the
research is to reveal the morphological way of thinking in planning with reference to the local development plans, the current part of the chapter will focus on the system features of the plans (i.e. design rules, scale levels, modes of representation) and their characteristic applications with changing policies. For this purpose, both the plan schemes and their supplementary written documents are examined. In addition to the plans, the design guides and the development briefs, which influence plans are also involved in the review.

The comparative review consisting of the six sampling (housing) development plans from the UK, the Netherlands and Turkey, is defined in ten-year time series. Each plan selected is aimed to represent one ten-year-period since the 1980s respectively. By this means, the author mainly aims to trace the transformations in the design control approach in those countries within the designated period of time. For the selection of the sampling settlements, the author has been collaborated with the local planning departments in order to choose the most relevant implemented plan area representing the typical characteristics of their corresponding periods.

4.1 The British Case: Essex, The UK

In order to elucidate the insight about the main design control tools in the British local planning system, Essex is chosen as the case study area. As one of the administrative counties in northeast of the city of London, Essex represents a special context in the recent history of British urbanism. Having originally introduced the first design guide for the planned residential areas in 1973, Essex County Council has developed a firm constructive basis on urban morphology and planning (Shaw, 2009). Bearing this point in mind, we cannot claim that the development projects discussed below represent the typical examples within their time-periods. Nevertheless, they are the cases typifying the actual relations between the design guidance and implementation within the planning processes in the UK.

4.1.1 South Woodham Ferrers, Essex, the 1980s

Unlike the new towns of the post-war period in the UK (i.e. Milton Keynes, Cumbernauld), which were planned and built by single development corporations, the new development of South Woodham Ferrers was planned by a local authority, the county. After the first development phase planned in the mid-1970s, the whole settlement was developed in two phases during the late eighties\(^{19}\) (Smales et al, 1989: 95).

The first indications about the expected form of the new settlement is found in the written statement by the Essex County Council dated in July 1973: “the replacement of the present scattered and uneconomic layout with a new pattern of development based on modern planning thought and practice” (Jennings, 1973). In this statement, a clear intention to apply a new urban pattern as a tool for community development is evident. In the early 1970s, the improvement of the poor design quality of the speculative housing developments, which were conflicting with the local characteristics, was the prominent policy agenda in the UK. In this context, Essex Design Guide, published by the county in 1973 is one of the first policy documents responding that issue. (see Figure 4.1) The design approach for the development of S. W. Ferrers was actually specified in the design guide.

\(^{19}\) Even though, the planning process of the town goes back to mid-1970s (Neale, 1984), the major development of the settlement is occurred between 1980 and 1986.
With highly structured and rich conceptualizations on the design aspects of urban form, the guide represents more than a standard-handbook. It suggests a set of design principles, which are, in turn, classified as the ‘visual’ and the ‘physical’ criteria. The principal approach of the guide is highly influenced by the townscape tradition based on the perceived quality of urban setting (i.e. the rhythmic richness and balance). In this regard, the Essex Design Guide suggested an alternative approach to the ruling dominance of the highway standards utilized for the space production in the British suburbs. The Essex Design Guide conceptualised the building to be ‘designed to form part of the larger composition of the area in which it is situated’ (County Council of Essex, 1973: 15). Therefore it provided a fresh practical link between architecture and planning by suggesting the building as the initial element of urban morphology. With a diverse set of design concepts such as additive form, duality of volume, visual ambiguity or effective height, the guide still represents a high intellectual quality in the urban design literature (Shaw, 2009).

The major physical criteria cited in the guide are position of the building on plot in relation to the neighbouring parcels, extendibility of houses, privacy, sound insulation, daylight, garden size, access conditions of pedestrian and vehicular system (i.e. pedestrian movement, road hierarchy, car parking and servicing) (County Council of Essex, 1973: 25-59). The visual criteria are the principles of spatial organisation (rural and urban setting), the basic spatial design principles (human scale, static vs. dynamic space, contrasting space, proportions), architectural composition for spatial enclosure, and the use of local materials (Ibid: 61-81).
The application of townscape principles presented by the guide let a new urban typology emerge in the 1980s in Essex. With a stronger sense of place by spatial enclosure, the new spatial typology was realised as ‘mews courts’, the shared pedestrian and vehicular surface, in Essex (see Figure 4.2) As opposed to the conventional British suburban type of cul-de-sac layout deriving from highway standards, that new type at the block level would lead to the generation of higher urban coherence at the macro level than before.

In this framework, the actual planning process of the South Woodham Ferrers started with an amendment of the Essex County Development Plan in 1973. Accordingly, about 300 hectares of land around an existing village settlement was designated as the ‘comprehensive development area’ (Frankland, 2009). (see Figure 4.3)
The initial scheme, which would be referred as the master plan for the later period, is a simple land-use plan with a short written statement about the intended housing programme to be accommodated in the area (Ibid). The plan does not specify the internal layout of the new development zones; instead it leaves the articulation of the built-fabric to the subsequent design applications under the influence of the design guide.

Rather than one single development brief to be applied for the whole new town, the development of the urban fabric as separate parts to be controlled by a series of individual design briefs. The total number of briefs prepared during the 1980s is about thirty for the whole area (Ibid). The scope of the design briefs was not limited to townscape principles. While determining the main design aspects of the residential fabric (i.e. building layout and accesses, road geometry, squares and shared surfaces), the design briefs articulated the ‘initial layout’ of the ensembles as character areas. However in the briefs, it is rather hard to follow an explicit description on how the different phases compose the whole urban form in relation to each other. Although the briefs are highly elaborated about the internal layout of each development section, there is no indication detected on the external connections of the tissues at the larger context. (see Figure 4.4)

4.1.2 Great Notley, Essex, the 1990s

The second-half of the 1990s signifies a breakthrough for the design control system, which gained its prestige back after a long neo-liberal period since the early ‘80s in the UK. The systemic will to create connected, pedestrian friendly and legible urban environments triggered a search for an alternative approach in planning which would be much more design oriented than before (Carmona, 2001: 89). Within this climate, the second Essex Design Guide (Essex Planning Officers Association, 1997) presented the new perspective of the central design policy concerning the various morphological aspects such as density, physical
scale, and accessibility (Punter et al., 1997: 166). The second guide also made a substantial critique against the previous applications in Essex for their insufficiency to address the issue structural aspects of urban form (i.e. network structure) and over-relying on the conventional cul-de-sac layouts (Essex Planning Officers Association, 1997: 2).

From this point of view, the guide adapted a wider scope perspective on design control in terms of the scale of control area. For the large development sites, the principal aspects addressed by the 1997 Essex Design Guide are recognizable landscape structure, legibility and permeability of the layout. (Ibid: 9-14). Then the principal layout of the development sites, which were larger than one hectare were advised to be in the form of permeable and well-integrated grid-networks in contrast to the tributary street pattern type (Ibid, p. 2). The through traffic, in that context, was to be avoided by the meandering road geometry rather than the conventional branching network-hierarchy (Stones, 1997: 33).

Figure 4.5. Some sections from the Essex Design Guide (1997): a hypothetical layout indicating the key principles for the future design applications in Essex, the UK (Source: Essex Planning Officers Association, 1997)

Unlike the previous guide, the form typologies in different layouts (i.e. formal square, boulevard planning, arcadia and urban village) were given with corresponding design codes via conceptual case studies (Ibid, pp. 79-102). (see Figure 4.5) With a series of axonometric details, the categorisation signifies a clear concern about the three-dimensional quality of urban form and its layout by building composition (Goodey, 1998).

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21 Despite its assets, the second Essex design guide was criticized in different respects. To Tollit et al (1998), the guide did not provide enough arguments about how to turn the inspirational design principles into operational design tactics (pp. 11-12)
Nevertheless, the development process of Great Notley, which would be designed according to the principles of the second Essex Design Guide, was initiated in 1991 with a master plan proposed by a single developer. (see Figure 4.6) Covering the 190-hectare urban land, the new settlement was supposed to be a ‘free-standing garden village’ (Countryside Properties, n.d.). Integration with the neighbouring settlement was to be realised via necessary network connections and the characteristic building typologies to be proposed. These two morphological aspects were to be ensured by a development brief, which was issued by the district council in 1991. (see Figure 4.7)
With the main objectives of ‘providing high standards of design in terms of overall composition of layout, fabric, scale and density’ (Braintree District Council, 1996: 3), the brief involved a series of sketchy urban tissues to give a rough idea about the future definitive designs for the area. However, the brief fails to define the quality standards of the layout in terms of the relations between buildings, blocks and streets.

Since the master plan provided a flexible framework for the further elaboration of urban ensembles, this basis was successfully managed by the local planning department through the gradual development permissions given for the small pieces of land comprising about 100 dwelling units (Brooks, 2009).

Figure 4.8. The ‘house layout’, of one of the phases in Great Notley plan development area (Source: Braintree Borough Council, The Development Control Service Archive, 2009)

The significant point is that only by fixing the main access points to each ensemble developed; the planning department controlled the overall integration of the numerous design applications (around twenty in total) throughout the whole settlement. Each individual developer was expected to make a site plan for the singular ensemble in consideration to the surrounding tissue (Ibid). (see Figure 4.8)

That corresponds to a detailed review process through constant negotiation. In the name of ‘conveyance plan’, each phase was formed with their internal layout and building setting at the scale of 1/750 which involved quite a lot of architectural details like building entrances and roof structures in addition to the functional aspects like amenity spaces and on plot-parking. (see Figure 4.9)
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Figure 4.9. The sketches from the plan application file of a site: The revisions on entrances made by the planner –above, right- and axonometric sketch made by the designer to convey the proposed image of the proposed layout. –above, left- The implemented layout in real comprises the townscape features aimed by the Essex Design Guide. (Source: Braintree Borough Council, The Development Control Service Archive, 2009; Personal archive, 2009)

The development process of Great Notley, Essex essentially demonstrates the possibility to realise the bottom-up urban pattern formation mainly in the light of a few design principles, even within the fixed framework of a master plan.

4.1.3 New Hall, Harlow, Essex, the 2000s

Under the title of Urban Renaissance, the new policy orientation was manifested by a series of urban design guides sponsored by the central government in the 1990s. Those had a remarkable influence on the contemporary understanding of spatial planning in the UK in the 2000s. The third Essex Design Guide (2005) brought about in this context upon an already established experience on local design control processes in the county. As a response to the recent central planning policies adopted, the previous guide was basically restructured for more effective use of the developers. In this regard, the new guide started from the general (i.e. the broader environment) and came to the particular (i.e. the building form, layout and individual building) (Essex County Council, 2005). After specifying the spatial context of the plan proposal, the designers were expected to use appropriate design elements and criteria given in the guide in order to shape their development statements.

A strong emphasis on the concept of permeability via grid-like street layout to offer a greater choice in route structure is given in the new design guide. This principle is basically consistent with the national policy perspective on network design, which was addressed in the major design policy documents.[23] Besides, enabling mixed-use and safer social-environmental conditions are the main design motivations, which were not seen in the previous guides. However, like in the previous ones, 2005 Essex Design Guide lacks the structural aspects of the macro-urban form (i.e. connectivity, integration) and a clear rule-sets on morphological elements to articulate the desired form-compositions.

The actual performance of the third Essex Design guide can be discussed in the context of New Hall, one of the prominent contemporary development projects in Essex in the 2000s. Being located near Harlow which was designed in 1947 as a model new town having a series of neighbourhoods located between the ‘green wedges’, New Hall is one of the contemporary housing development area in Essex. Without an explicit statement on the point, we can see a quite a similar way of space organisation in New Hall Master Plan with that of Harlow which was based on a neighbourhood clusters concept on easy walking distances (Gibberd et. al., 1980: 43-44). (see Figure 4.10)

Figure 4.10. The master plan of New Hall, Harlow, Essex (By the courtesy of Roger Evans Associates, 2004)

However, the New Hall case suggests some new attitudes in master planning which is different from the conventional approach as experienced in Harlow. With the political influence of PPG3 -Planning Policy Guidance Note 3: Housing- introduced with a special emphasis on design codes in 2000, the New Hall development process has been controlled by a master plan supplemented by the design codes specified by the complementary design briefs. Associated with a ‘framework plan’ envisioning and programming the new development on

[23] The most clear view on network design in favour of grid-like layouts versus cul-de-sac type of network structure can be seen in ‘Manual for Streets’, a national policy document published by the Department for Transport and Department of Communities and Local Government in 2007.
the given site, the design briefs were approved in 2004. Consequently, the overall plan area was divided into separate phases to be developed with their own specific briefs. Through the selected set of codes involved, the briefs were supposed to support the definition of the characteristic areas within the overall planned urban fabric. (Studio Real, 2010).

During the control process, the planning and design briefs were accompanied by the design codes that followed the ‘framework plan’ envisioning the new development on the site. Each design area was subdivided into the land parcels, which were allocated to the different architects coordinated by the common urban design codes (Studio Real, 2010). In comparison to the previous case of Great Notley, New Hall project offers a clear idea on how the design codes can be utilised in the whole control process. The coding technique was applied in each phase from urban to architectural level of design. The codes involved in the design brief cover various aspects including the street pattern, blocks and parcels (in terms of community and privacy), housing typology (in terms of density and mixed-use) and architectural typology (with regards to landmark and corner buildings, roofs, walls and openings) (Roger Evans Associates, 2003). Unlike any ordinary residential development in which highway standards determine the street geometry without any reference to building setting, New Hall project managed the integration of the street and building design by urban design coding (CABE, 2009). The principle of diversity within unity was mainly ensured by the participation of several architects to the development of different ensembles under the supervision of collective codes. (see Figure 4.11 and 4.12)

**Figure 4.11.** New Hall planning and design brief and the architectural codes (Source: (Roger Evans Associates, 1999; Proctor and Matthews, 2002)

**Figure 4.12.** The street profiles in New Hall demonstrate the possibility of architectural diversity within one urban design framework (Source: Personal archive, 2009)
The plan process of New Harlow represents an alternative approach to the use of plan in association with the code(s). Throughout the process of partial implementation, the master plan provided a very flexible framework for different alternatives within the specified land-parcels. As long as it satisfied the basic density requirements, each building block was subject to the negotiation between the master planner and developer coming up with the alternative building settings within the same block layouts (Aldred, 2009, Roger Evans Associates, 1999). In this sense, the master plan was perceived as a kind of future simulation of layout in which the alternative (partial) proposals were to be tested according to the already given urban design codes. This, in fact, enabled the project exemplify a good model to provide a specific freedom to architectural design and individual expressions within an urbanistically well-defined framework.

4.2 The Dutch Case: Almere, The Netherlands

In order understand the basic features of development planning in the Netherlands, three districts from the city of Almere, the planned new town next to Amsterdam, are chosen. Since the first development phase in the late-1970s (Constandse, 1989), Almere has been the ground for a series of different interpretations of design and planning. With this respect, Almere is believed to represent the typical characteristics of the mainstream approaches in the Dutch urbanism for the last three decades.

4.2.1 Almere Stedenwijk, the 1980s

The idea of the development of Almere as a new town coincides with a critical shift in the national spatial policy. The new policy direction declared in the Second Report on Physical Planning in 1966 was based on the decision to generate new growth centres in the form of ‘clustered dispersal’ to curb the overspill of the urban agglomeration threatening agricultural land. (Ibelings, 1999: 105). During the 1970s, the policy of controlling the decline of large cities [due to suburbanisation] was pursued by the ‘growth centres’ created as the new settlements to attract future population within their regions. In this period, the new town of Almere was projected to accommodate 250,000 people.

The first construction started after the initial structural plan was introduced in 1977. In accordance with the new policy orientation, the future form of Almere was projected as a polycentric structure. Accordingly, the macro-form of the city was aimed to consist of six nuclei, each of which would have a population between 20,000 and 90,000 (Constandse, 1989: 237). The structural vision has basically determined the morphological character of Almere, which would differentiate it from any Anglo-Saxon and American counterparts.24 After the initial phase of the development in Almere-Haven (the southern edge of the urban plan) started in 1977, the development of the central city went parallel to the creation of the periphery from 1981 (Dijk, 2007). This is actually the period in which the planning process of Almere-Stedenwijk, our first case study area, was initiated.

24 The current urban image of Almere is traditionally Dutch in the sense of moderately composed collective urban form while at the same time modernistic with regards to the urban and architectural image which was produced with a comprehensive process totally controlled at the every levels of scale.
Following the first structure plan in 1977, the establishment of the Almere Municipality resulted with a plan revision in accordance with the new administrative conditions plan established in 1983 (Constandse, 1989: 240) (see Figure 4.14). The structure plan determined the footprint of the settlement to be realised in the next twenty years. Though presented in a fashion of a master plan with a fixed image of future urban form, the pattern of the secondary district roads and the outlines of the neighbourhood were subject to be revised, with the subsequent (partial) implementations. Providing only the overall structure of the new town with a number of development sections, creation of the final form on the whole was to be fulfilled by various urban projects to prevent the possible visual monotony (Berg et al., 2004: 178). This can be considered as the common characteristics of the structure plans in the 1980s, comprising both the nature of a blueprint and strategic planning.

Since its location, size and the external relations had already specified by the first structure plan, the design studies on Stedenwijk started in 1978. Accordingly, the first phase of the development was projected for 2500 housing units with the community facilities as a transition zone to the new town centre. (Gemeente Almere Department of Urban Development, n.d.) In the first development plan of Stedenwijk, a clear statement was made on the desire for creating a recognizable quarter based on architectural and environmental characteristics (Ijsselmeer Polders Development Authority, 1978). For this purpose, six zones were designated to be composed as different character areas (see Figure 4.14). The underlying intention here was to create structural unity while ensuring the compositional diversity at the level of district.
Figure 4.14. Sections from the 1/5000 Ontwerp Eerste Fase Almere-Stad Woon-en Centrumgebied -Design of the First Phase Almere City Centre and Residential Area- (1979) Major layers of the planned urban fabric: roads, bicycle routes, organized special spots and zones. (Source: Almere Municipality Department of Urban Development Archive, 2009)

As seen in the first-phase plan, of which implementation started in 1981, a large area of urban land (about 400 ha.) was developed based on a single urban design programme and holistic composition. Such a total design control on urban form was actually thanks to the enduring mode of production of housing at that period when the housing associations were active through close-collaborations with the local planning departments. (see Figure 4.15)

Figure 4.15. The aerial view from Almere Stedenwijk: Unlike the subsequent examples from the 1990s and the 2000s, the internal diversity in urban form is based on the neighbourhoods rather than smaller ensembles. (Source: Almere Municipality Department of Urban Development, 2010)
Yet beyond a mere compositional approach, which mainly aims a harmonious fabric with internal diversities at the ensemble level, there is a systematic functional correlation between the layers such as circulation system and open spaces. This can be considered as an emerging design strategy to consolidate the fabric as an integrated ‘net of public spaces’ with streets, squares and courtyards of the housing clusters, which was lost as a typology with the open-plan schemes applied within the post-war housing estates (Berg et al., 2004: 120-163). In this regards, there are two underlying characteristics are observed: a new design approach to morphological variation in order to attract people with a broader palate of choice within residential landscape (Ibid, p. 177), and the everlasting tendency to comprehensive planning for controlling the total area with a complete-set of design elements. We would argue that such a special synthesis (diversity within larger unity) acquired within the so-called post-modernist period of the 1980s still represents the enduring approach in the Dutch urbanism.

4.2.2 Tussen De Vaarten, Almere, the 1990s

After the initial development of Almere Stad, the nucleus of the new town, the construction of the direct public transit link to Amsterdam in 1986 enabled further expansion of the city. This extensional development would be completed towards the end of the 1990s. Locating in the expansion zone, the district called Tussen de Vaarten can be taken as a typical example reflecting the common design control approach within the period. Covering a 400-hectares of urban land within a programme of 5500 housing units and working spaces (RMV-SV Ontwerp, 1995: 6), the development area was primarily designated by a structure plan schema called ‘structuurschets’ ['structural sketch’ in Dutch] (see Figure 4.16)

![Figure 4.16. Some selected layers of the structuurschets (structural sketch) of Tussen De Vaarten development: land-use, water channels and roads, and spatial centrality (RMV-SV Ontwerp, 1995)](image)

While the structural sketch plan kept the basic decisions of the Structure Plan (1983) about the area, it elaborated the ground plan by further subdivisions, and the internal structure of the road and water system added. Nevertheless, its sketchy plan-language designating the areas of housinge as flat surfaces within super-blocks basically allowed the introduction
of further design proposals in the next phase of the design control process. Such an in-between position of the sketch plan actually provided a sort of continuity between the strategic decision-making within the structure plan and physical design of the fabric.

Following the ‘local structure plan’, the development plan (ontwikkelingsplan) came to circuit as the next step of the design control process in 1996. (see Figure 4.17)

![Figure 4.17. Some sections of the development plan (ontwikkelingsplan) of Tussen De Vaarten: figure-ground, green structure, ground plan and the typology map (RMV-SV-Ontwerp, 1996)](image)

In the development plan, the scheme was articulated with the footprint of urban setting and its corresponding network. (RMV-SV-Ontwerp, 1996). As a result of the negotiation on the previous structural scheme held between the developer and the municipality’s planning department, the internal network of the neighbourhood was also changed in the development plan. The housing typology in terms of the mode of supply (i.e. social or private housing) and size to be allocated in the area was determined by the plan as well. The form-language of the plan enables the typological allocation (zoning) to be made at the level of street. This essentially served for the composition of a socioeconomic mix within a coherent morphology.

The major factor, which differentiates the morphology of the new developments in
the nineties in Almere, was the new national policies adopted with the 4th Fourth National Physical Planning Report - *Vierde Nota Over de Ruimtelijke Ordening* - in 1988. Since the new memorandum addressed the ‘compact city’ policy to intensify urban growth throughout the country (Altes, 1992: 110-111), the new development plans were formed as tighter tissues with higher building densities and less amount of green space as opposed to the common case in the 1970s. The simplification of form language as a strategy to minimize development costs was also another aspect introduced by the central policy direction (Constandse, 1989: 240-41). In this regard, the reflection of the national design policy of that period is observed in the plan of *Tussen De Vaarten* through the use of a linear and regular street pattern and tight repetition of basic housing types within a simple overall geometry.\(^{25}\) (see Figure 4.18)

![Figure 4.18](image-url)  
*Figure 4.18. An aerial view from Tussen de Vaarten, Almere. Note the regularities in form-compositions along with a simpler geometry of layout. (Source: Almere Municipality Department of Urban Development, 2010)*

The design process of the district coincided with the period when the Dutch municipalities made use of the design guidelines which were much more detailed than before. The new urban design plans started to control a variety of small-scale aspects such as facade composition, materials and landscaping of the design area. This is basically due to the emerging concern on the creation of distinctive local identities for the new districts and neighbourhoods in the 1990s (Ibelings, 1999: 154). With a set of simple design codes, the plan apparently offered certain sensitivity to the principles of architectural design for the sake of individual variations within neighbourhood as well. (RMV-SV Ontwerp, 1996: 21).

\(^{25}\) This point basically demonstrates the characteristic influence of the national spatial policies on the nature of urban design in the Netherlands. Due to that active relationship between national policy framework and the local level design practice, it is quite possible to follow the dynamic change in the mainstream approaches within the Dutch urbanism through the last century (Ibelings, 1999).
It is possible to follow a very detailed form control in the case of Tussen de Vaarten. Prior to the final document of the plan process, another supplementary document was published to define the ultimate morphology of the design area in 1997: the urban design programme -stedenbouwkundige programma- (Dienst RMV et al, 1997). The purpose of the programme was given as the enrichment of the development plan (Ibid, p. 6). The public spaces designated (i.e. squares and playgrounds) and the subdivision of the blocks in accordance with the building types are the two main control items in the programme. In this sense, with a deliberate use of the term ‘patterning’ (Ibid, pp. 20-23), the consistent relationship between the private and public space over the whole fabric was aimed. The same approach to the characteristic details considered at the level of neighbourhood can be followed within the final document called, ‘inrichtingsprincipes’ (design principles) providing the architectural and townscape details for the definitive urban design. (see Figure 4.20)

Figure 4.19. The sections from the urban design programme (stedenbouwkundige programma) for one of the ensembles in the development area: The carpet and patterning as a design metaphor –left- and the final building setting associated with the design principles. (Dienst RMV et al., 1997)

Figure 4.20. Some key diagrams from the ‘inrichtingsprincipes’ (design principles) of Tussen De Vaarten: material details for the streets –left- and the open spaces –right- (Dienst RVM et al., 1997)
The guideline, in this context, aims visual harmony at the level of neighbourhood. A perceivable variation between the different street sections via shape, material and colour were required from the architects and developers through the implementation phase (Di-enst RVM et al., 1997: 2) Landscaping (i.e. ‘plantation hierarchy’), boundary treatment (i.e. height and transparency of the hedges), the location of public service spaces (i.e. containers), the street furniture, lighting and pavement were coded within the guide. That makes the designed morphology of the area ready for a series of individual implementation based on quality standards on townscape.

4.2.3 Almere Stripheldenbuurt, the 2000s

As the eastern edge development of the new town, Almere Buiten [buiten means ‘outside’ in Dutch] was originally considered as one of three main nuclei of the city form covering a 1600 hectares of reclaimed urban land in the Structure Plan of Almere (Ministrie van Verkeer en Waterstaat, 1983). (see Figure 4.21, left) Though the structure plan projected the complete realisation of the district (with the total population of 51,000) for the year 1999 (Ibid, p. 25), the last phase of the area development had to wait till 2001.

The district called Almere Stripheldenbuurt that we choose as the case for the final period locates in that (ultimate) phase of the development, Almere Buiten Oost (east). Rather than relying on the early structure plan, the planning department of Almere decided to make a local structure plan for this section of the area in the early-2000s before initiating the partial development plans. While the local structure plan kept the initial idea of the early district plan [a district composed of the multi-cellular neighbourhood units (Ibid, p. 11)], it tended to reorganise the neighbourhoods in different compositions (Gemeente Almere, 2001). Without making any statement on the internal patterns [except keeping the existing structures], the plan basically specifies the allowable access conditions within the neighbourhood units. (see Figure 4.21, right)

Figure 4.21. Almere-Buiten Structure Plan (1982) -left- and structuurvisie (structure vision) scheme of Almere-Buiten Oost / eastern part of the development (1999) –right- (Sources: Ministrie van Ver-keer en Waterstaat, 1983, Gemeente Almere, 2001)
In the peculiar market conditions of the period, the development plan of Almere Stripheldenbuurt gives priority to the consumer-oriented single-family housing. Nevertheless, such a programme, which is considerably different from the former applications, was compensated by the morphological diversity and integration adopted in the new district. (see Figure 4.22) In this respect, the plan principally demonstrates possibility of providing an open, diverse and integrated pattern even for the high-income residential profile. As seen before, each division within the plan represents a kind of characteristic area having its own housing programme providing a flexible framework for the individual developers.

**Figure 4.22.** The development plan schemes of Almere Stripheldenbuurt: the road network elaborated based on the structure plan –left- and the proposed urban composition according to the housing typology and use –right- (Source: Gemeente Almere, 2001)

In this context, the plan shows a responsive behaviour to the flexibility and freedom of choice as the popular tendency in the period, even at the building level (Ibid, p. 23). In order to allow the individual design of the buildings according to the user preferences, some section of the plan scheme was devoted to the issue of plot layout specifying the limits of variation in size. Nevertheless, the morphological limits of the individual freedom within the plots were not explicitly defined at the current phase of design control.

Following the approval of the development plan, the supplementary guideline called *Stedenbouwkundige Randvoorwaarden* (Urban Design Boundary Conditions) was issued (TKA, 2002). Taking the ‘the construction fields’ designated within the plan (see Figure 23, left), the guideline basically specified the major metric parameters for future implementations by various designers. Those mainly include the ground coverage, number of dwellings, height limits and the amount of parking space required (Ibid, pp. 54-83). The codebook also provided a number of cross-sections to typify the critical street segments as the interface between different ensembles. (see Figure 4.23, right) In its own right, this technique can be regarded as an original approach to the morphological coherence at the level of neighbourhood.
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Figure 4.23. Fragments from Stedenbouwkundige Randvoorwaarden (Urban Design Boundary Conditions): The encoded sections of the development plan –left- and the model-like cross-sections of the streets lying between the development sections -right- (Gemeente Almere, 2001; TKA, 2002)

Figure 4.24. The design areas within a neighbourhood in the district in which certain individual designers were commissioned for the architectural design of ensembles (Source: Inbo Stedenbouwkundigen & Landschapsarchitecten, 2004)

Once the design principles set for the typological zones in the neighbourhood, the different architects were commissioned for each building ensemble, then a review process was realised in 2004. As seen in the comparison between Figure 4.22 (right) and Figure 4.24, the building setting already proposed in the development plan was still subject to the substantial changes during the negotiation between the municipality and the developer. This is essentially due to the non-definitive character of the development plans in the Netherlands, which is always open for revision until the ultimate planning phase [with the zoning plan (bestemmingsplan)]. The participatory design process is actually observed within the collective form as the generated outcome of Almere Stripheldenbuurt come on view so far. (see Figure 4.25)
Just after the zoning plan, approved for the actual building permits, the construction process within the ‘experimental plots’, on which the owners were to build up their own house with the personal architectural taste, was to be controlled by the ‘plot passports’ (kavelpaspoort). Each plot-passport gave the detailed construction rules to be applied on the individual (owner-occupied) parcel. In the limits of the rules (i.e. front building line, set-back, maximum height), the owners were expected to come up with the recognisable variations in individual architecture (Gemeente Almere, 2011).

In a plot-passport, construction rules to be applied on each individual (owner-occupied) plot are given in detail. In the limits of the rules (i.e. front building line, set-back, maximum height, front-façade orientation, frontage zone, height and location of the auxiliary buildings, minimum parking lot), the owners are expected to come up with the recognisable variations in individual architecture (Gemeente Almere, 2011).
4.3 The Turkish Case: Ankara, Turkey

In the comparative analysis, the Turkish case will be typified with three planned residential districts selected from the major development areas in Ankara, Turkey. As one of the newly planned capitals in the last century [with Brasilia, Islamabad and Canberra], Ankara has always been an attraction point where both formal and informal urbanism has been realised (Çalışkan, 2009). Under the influence of the macro-economic conditions ever-changing since the neo-liberal politics in the 1980s, the new housing typologies emerged in due course in the context of planned urbanism. In the current part of the chapter, we basically question the adaptation of the design control mechanisms to the changing housing typologies in the way of controlling urban form.

4.3.1 Batıkent, Ankara, the 1980s

With reference to its size (1034 ha in total), programme (55,000 du) and scale (of control by a single plan), Batıkent represents one of the early experiences of modern new town planning in Turkey\(^{26}\) (Eryıldız, 2003: 58). As a typical example for the cooperative housing developments, Batıkent suggests all the basic quality indicators of the middle-class residential developments during the 1980s and the early-1990s in Turkey.

![Figure 4.27. The first master plan of Batıkent (1976) –left- and the second one dated in 1979 –right- (Source: Keskinok, 2006: 127, 130)](image)

The development process of Batıkent was started with a comprehensive programme of land acquisition in 1977. From this year onward, we see several plan proposals for the new settlement. In order to lead the land expropriation process, the first plan scheme was developed in 1976. (see: Figure 4.27, left) After three years, the second master plan aiming to provide more insight about the planned formation was commissioned to another planning group. (see: Figure 4.27, right) While the first plan designated the main development sections with a series of housing clusters and the district network, the second plan came up with a more co-

\(^{26}\) The reason why the planned mass-housing developments had not been a real agenda in the Turkish planning practice until the late-1970s is the land policies and the legal instruments to acquire and control urban land was lacking. The late institutionalisation of metropolitan planning from the mid-1970s was also a complementary factor for the weak development control mechanisms in the Turkish cities (Keskinok, 2006: 121).
herent and fine-grained urban composition for the whole planned urban fabric. Nevertheless, without getting a chance to be implemented, the plan was invalidated by the local government and replaced with another one, which would be the final development scheme before the construction phase started (Keskinok, 2006: 130-31). (see Figure 4.28)

Figure 4.28. 1/5000 Master Plan schema (1983) –below- and its land-use scheme –above- (Source: Keskinok, 2006: 137; Yenimahalle Municipality Plan Archive, 2010)

The final master plan dated in 1983 reflects the mainstream approach to master planning in Turkey. The plan determines the overall structure of urban form at the level of access roads. In this regard, it differs from its British and the Dutch counterparts that both apply the techniques of structure planning at that period of time. In this framework, each block was supposed to be developed by different housing cooperatives with their own housing layouts in accordance with the density margins adopted by the plan. However, despite the density gradients roughly determined with reference to the main housing types [i.e. single family and multi-unit housing blocks] (Eryıldız, 2003: 66), the actual developments of the urban blocks were realised mainly based on the incremental preferences of the housing cooperatives. (Keskinok, 2006: 138). In most cases, the applied layouts diverged from the original density levels as well. In this sense, the master plan failed to control urban form with the density factor [as the major design aspect of the plan] to ensure morphological coherence.

Such a quasi top-down approach in master planning remained ineffective on the intermediate scale-level within an ill-defined design framework to guide the housing cooperative’s design layouts encapsulated within each super-block. Within that context, the development of Batıkent was coordinated by a series of site plans commissioned by the individual cooperatives. (see Figure 4.29, right) The link between the master plan and the site (housing layout) plans was provided by the implementation (development) plan defining the build-
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Planning urban blocks in terms of the building lines, the types of building configuration (i.e. attached, detached), FSI and GSI. (see Figure 4.29, left) The function of implementation plan was limited with the translation of the master plan’s vague density decisions into the quantitative parameters applied for urban blocks.

Figure 4.29. Sections from the implementation- development plan of Batıkent –left- and a typical layout plan from the area –right- (Source: Yenimahalle Municipality Plan Archive, 2010)

Figure 4.30. The view from the area of which the development plan is given in Figure 4.30 (Source: Personal archive, 2010)

It is observed that the oversized road profiles adopted by the master plan was transferred to the local scale without any substantial change and fine-tuning in accordance with the basic design concerns of placemaking\(^\text{27}\). Linking the districts and the neighbourhoods through the wide traffic arteries would, in fact, result in a clear morphological fragmentation in the residential environment. (see: Figure 4.30) More importantly, this point signifies the lack of coordination between the scale-levels in planning, from which the new design measures are expected to come into play through the scalar shifts during the control process.

\(^{27}\) The road profiles determined for the district and local distributors, and access roads are respectively 35, 20, 15 meters in width (Eryildiz, 2003: 70), which are very abundant dimensions for the residential tissues.
In accordance with the development law, the cooperatives submitted their development proposal within a file containing a number of thematic supplementary documents like architectural implementation project, the projects of heating, sanitation, electrification and landscape design in addition to the site plan. In the files examined, there is no urban design measure has been detected neither on the surrounding context nor on the spatial and three-dimensional quality of the collective built-form.

In the light of the design control mechanisms given above, the overall process is reflected on by Günay (1999) as follows: “...the control of space was lost to the cooperatives, each dealing with its own property. In the case of Batıkent in Ankara, although the original planning principles reflected the modernist attitude of ‘sun, space, greenery’, the result was a chaotic production of space, because of the weak control over the real property distributed to the cooperatives” (p. 239). This critique broadly indicates the incompetence of the design control mechanisms to organise multiple stakeholders [on a fragmented ownership pattern] in the production of urban space and form in Turkey.

4.3.2 Çayyolu, Ankara, the 1990s

The city of Ankara continued to extend over the outskirts of existing city especially through the new development corridors in the 1990s. While Batıkent had become an attractive location for the middle-class until the mid-1990s, the southern corridor of the city provided another alternative for the high-middle class since the early 1990s. As a prolific zone for the housing industry in Ankara, Çayyolu is still in a rapid phase of development, which has already turned the area into a scattered region.

![A panoramic view of the development corridor in Çayyolu Ankara: an extensive and fragmentary urban pattern through the rapid development process (Source: Personal archive, 2010)](image)

Çayyolu, Ankara cannot be considered as a typical western suburban extension in terms of the typological character symbolised with single-family housing. Instead, due to actual economic capacity of the Turkish middle-class, the housing market supplies a mixture of typologies including both high-rise apartments and single-family houses. This suggests a hybrid character in urban morphology. However, it is barely possible to assert that this condition has been managed successfully by the planning system for the production of compositional richness in urban context. Instead, a highly fragmented urban fabric has emerged in a very similar way observed in the case of Batıkent. (see Figure 4.31) The question is that how come the planning process ended up with the same result in spite of the previous experience of planned (mass) housing development being highly criticised? After an early start with the end-result mentioned above, now we can trace the answer by briefly looking at
the design control process for the Çayyolu development.

The first master plan of the area was officially issued in 1986 in order to steer the emerging tendencies of housing cooperatives and construction firms to develop new mass-housing estates in the site (Karataş, 2010). Unlike the case in Batikent, the municipality did not aim to direct the whole production-process by land accusations in Çayyolu. Rather, it preferred to coordinate the private developments within a single infrastructural framework defined by a master plan. As a typical blueprint without any supplementary design guide, the master plan specifies the distribution of the public facilities, the overall road network and the block layout. (see Figure 4.32)

Figure 4.32.
1/5000 Çayyolu Mass Housing Area Master Plan (1986)
(Source: Yenいまhalle Municipality Plan Archive, 2010)

Covering 550 hectares of urban land, the plan does not consist of any character area to create controlled typological variations within the district that would create an intelligible urban form. Rather than character areas, the plan designates five generic types of building blocks in accordance to the building height. Accordingly, 2, 3, 5, 12 and 16 storey-buildings are supposed to be composed in a range of specific density levels between 87 and 180 dwelling units per hectare. Nevertheless, the morphological logic behind such a precise determination is not informed in the plan notes.
by an axial network structure, the plan stays modest and creates a quasi ‘organic’ kind of form-language. This is mainly due to the common tendency of the Turkish planners not to ‘disturb’ the existing [mostly fragmented] land ownership patterns in order to keep the costs of land expropriation minimum through the provision of public infrastructure.

The block layout composed in the master plan was taken for granted by the development plan of the area at the lower scale-level. (see Figure 4.33, left) Despite being called as ‘the parcellation plan’, the implementation-development plan does not tend to make subdivisions within urban blocks. Instead, it takes each block as one development unit, called ‘block-parcel’ and redefines it by means of extra control parameters on building setting. (see Figure 4.33, right) The standard parameters are the type of buildings configuration, maximum height, setbacks, FSI and maximum number of dwelling units in the block. The ultimate composition within the limits of the parameters was to be decided by the developer itself.

![Figure 4.33. Some selected sections from 1/1000 Çayyolu Mass Housing Area Parcellation (Development) Plan (1996) (Source: Yenimahalle Municipality Plan Archive, 2010)](image)

The standard visualisation technique applied for both the master plan and the development plan is not good enough to grasp the main idea behind the future form-composition. Mono-colour two-dimensional drawing solely based on line-hierarchy and hatches (without any layer-based abstraction and diagraming) makes the design morphology hard to conceive. This point on design communication can be also regarded as a problem for plan democracy to efficiently involve all the stakeholders into the control process.

As the final phase of design control, the site plans have also been instrumental to articulate the urban form of the development. Since site planning is highly regarded as a part of the architectural design in practice, designing urban layouts within (super)blocks is mostly reduced to the optimum allocation of the already designed building module without any constructive feedback between urban and architectural composition. This point is also observed in the site plans made for the building estates in Çayyolu. In this regard, the ignorance about the plan to its surrounding context is also quite evident in the actual plan schemes. (see: Figure 4.34, left)
4.3.3 Türkkonut, Ankara, the 2000s

As the final example to the typology of design control in Turkey, we will have a look at a district called Türkkonut in Ankara. Aiming to build up new ‘satellite towns’ around the cities (Türkkonut, 2007: 8), Türkkonut is currently one of the active housing-cooperative associations in the housing market in Turkey [beside the private construction firms]. The building typology provided within the settlement is quite similar to that of TOKİ (The Mass Housing Administration)\(^\text{[29]}\), which extensively produces middle-class housing estates in every Turkish cities. Therefore, the underlying design approach in Türkkonut is very representative for the current planned-housing typology in Turkey. (see Figure 4.35)

The prominent feature of the contemporary housing developments in Turkey is the increasing scale of production. Unlike the singular superblock-based developments by the

\[\text{29} \quad \text{The central agency responsible for the mass housing developments in Turkey}\]
cooperatives as in the previous decades, most of the housing developments have been realised at the level of urban ensembles since the 2000s. This is especially owing to the incentive of the central government facilitating the provision of urban land for housing [mainly for the sake of macro-economic development] (Örf, 2009). This transformation might directly result in an evidential change in the planned urban morphology. Delaying this question to the morphological analysis below, we would rather turn our attention to the issue of design control process, which would be expected to differ with the changing conditions.

Allocating 3300 dwelling units on the 170 hectares of land, the Türkkonut urban project of officially started with the approval of its master plan in 2001. The 1/5000 scale master plan of the area described the main road network along with its internal hierarchy, and the block layout with its corresponding land-use. (see Figure 4.36, left) Based on the same street and block configuration, the subsequent development plan did not provide more morphological input apart from the standard building parameters specified for each block. (see Figure 4.36, right) Despite the changing condition in the production mode, this is quite a similar situation to what we observed within the previous examples of design control in Turkey.

With its purely quantitative coding technique, the development plan did not suggest any design criterion on how the buildings would be composed in relation to each other in the actual context. Especially on the sites having severe terrain conditions, this situation eventually created quite a lot of problematic actual design applications. (see Figure 4.37)
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Figure 4.37. The parametric notification within a section from the 1/1000 implementation plan –left- and a typical end-result based on the ‘flexible’ codes applied on the actual site condition –right- (Source: Yenimahalle Municipality Plan Archive, 2010; Personal archive, 2009)

After setting the development framework with the implementation plan, the process of pattern formation is ended up by site (layout) plans to be implemented within each (super) block or ensemble. Since in most cases, implementation plans are made without any in-depth field survey or topographical analysis, they are hardly congruent with the existing site conditions.[30] Though such a deficiency would be compensated at the level of site planning, it has not been the case in Türkkonut development. Within the given block orientations predetermined by the master plan, in most cases, the urban setting does not fit to the real (topographical) context. As observed in the site, the actual implementations of the plans are usually in the form of odd relationships between the block and the street in addition to the inefficient allocation of space (see: Figure 4.38)

Figure 4.38. A 1/500-scale layout plan of a housing site in Türkkonut and a plan application with height lands cuts based on the road structure defined by the implementation plan having no precision on site conditions. (Source: Yenimahalle Municipality Plan Archive, 2010; Personal archive, 2009)

30 Since the author of this research has visited a large number of sites developed with the same plan techniques in Turkey, he has been able to realize the lack of the relationship between the processes of design and planning.
This point basically indicates the need for the design-based bottom-up feedback mechanisms during the preparation of large-scale development plans. Yet, most importantly, the overall review on Turkish case signifies the endurance of the settled conventions (tools and techniques) despite the radical changes in the type and the scale of housing production changes in the course of time in Turkey. The possible implications of that issue on morphology with regards to urban coherence will be discussed in the following part.

5. A Quality Assessment for the Planned Urban Fabrics: Morphological Coherence

In the current part of the chapter, the morphological quality of the planned urban fabrics, which has been produced by specific planning processes, will be examined with reference to the concept of ‘coherence’. For this purpose, a simple analytical method will be suggested to assess the level of urban coherence to be applied for the case study areas discussed above.

In ‘Good City Form’, Lynch (1981) argues vitality, sensibility, fit, accessibility and control as the major performance criteria of urban space and form (pp. 109-235) Before him, Jacobs (1961) argued density, diversity and fine-grain as the main quality indicators of cities. For Bentley and his colleagues (1985), a responsive urban environment should contain the physical qualities of permeability, variety, legibility, robustness, visual appropriateness, and richness. Looking at the argued definitions closer, we can realise that the spatial quality, in general, is the product of the complex interactions between the elements of urban form. This is a common condition whether the form is created by conscious design act(s) or generated via the emergent processes. In this respect, one can assume that the quality urban space as the interface of certain elements (i.e. buildings, access system or green areas) principally depends on the quality of morphological interactions within urban fabric. With regards to the conditions, interaction and interface, another key concept comes to the fore in discussion: coherence. We can argue that in order to reveal the potentiality of any urban form to deliver spatial quality, its morphological coherence needs an explicit specification.

In ‘A New Theory’, Alexander and his colleagues (1987) originally discussed the idea of coherence as opposed to the notion of (spatial) fragmentation. The idea of wholeness represents the ideal state to be achieved by morphological coherence. From the same perspective, Salingaros (2000) defined urban coherence with reference to the idea of coupling. For him, the coherence of the complex large-scale wholes is generated by the interaction of the diverse elements at the lower scale. Therefore, the large varieties of connected elements creating strongly coupled modules is argued as the basic condition of urban coherence. Though Salingaros (2000) brings the concept to a certain level of theoretical clearance via the relational terms and the abstract/conceptual models; his discussion on urban coherence essentially lacks the definition of an explicit method to apply the concept within morphological analyses.

With reference to the basic definition of coherence, the condition of harmonious connection of the several parts that keeps the whole together (OED, 2010), we can also argue that to make a firm definition of urban coherence, we first have to designate the constituent elements of urban form. Considering the complexity of urban formation involving numerous components into the process of (designed or emergent) interactions, it is obvious that we
need a kind of abstraction to make the parts comprehensible in classes. In this regard, we
tend to organise the urban elements in layers.

Decomposing urban form into layers is a common technique in urban morphology. The main aim with layering is reducing formal complexity into the non-hierarchal overlays constituting the total collective form.\(^{31}\) Since the cartographic images have huge amount of spatial information, which are composed of a series of legends projected on a two-dimensional plane, it is hardly possible to fully conceive the morphological interactions between the different sub-systems (i.e. network, footprint, subdivisions). For this reason, layering the classes of elements, thematically, enables an analyst to recognise the meaningful correlations between the systems and to derive relevant conclusions about the underlying logic of formation. (see Figure 4.39)

![Figure 4.39. The transparent plates of the cities in the cartographic inventory of McGrath (1994) –above- and some corresponding layers of analysis –below- (Source: McGrath, 2008: 56, 59)](image)

Layering a given composition can be either in the form of superimposition or juxtaposition depending on the purpose and scope of the visual research. As argued by McGraths (2008), superimposing various layers and relating them with different combinations ultimately conduces to ‘a simultaneous perception of different spatial locations’ (p. 58). Such an analytical process basically requires an active cognition of the researcher for the recognition of the critical correlations through the construction of intrinsic (morphological) relations between the layers.

There is no doubt that GIS applications in the last decades have enabled the spatial analysts to control a huge amount of information, which can be sorted out and recombined in ‘data layers’ to be visualised and correlated in different ways. Nevertheless, just as a data-processing instrument, GIS in its own right is not able to make meaningful correlations between the spatial layers. For that purpose, an algorithmic definition of the pattern recognition based on the spatial layers is required.

The proposed analytical framework for an explicit definition of urban coherence consists of the two scale-levels, neighbourhood and urban ensemble. The nominal radii of each

\(^{31}\) The notion, ‘total form’ here does not necessarily imply the static whole.
sampling frame (or the scale-level) are determined as 350 meters (within the nominal R=300m, ranging from 100m to 1000m) and 150 meters (within the nominal R=100m ranging from 30m to 300m) meters, respectively (Jong, 2005: 37). We determined the exact size of the frame by examining the typical planned neighbourhoods in the case study areas. The selected frames are aimed to contain the most consistent and internally homogenous patterns to represent the typical urban tissues at that scale-level. Following the designation of sampling tissues for analysis, each fabric is decomposed into layers, building setting, block layout, road network, green structure and pedestrian network. Once the layers are juxtaposed, the correlation analysis starts to reveal the level of urban coherence.

Implying the condition of necessary and intimate connections between the elements of a multi-unit system (OED, 2012), ‘correlation’ is the key aspect in measuring urban coherence. With the correlation analysis for the assessment of urban coherence, we basically tend to reveal a sort of reciprocal relations between the morphological layers. As originally used in statistics, by calculating the correlation coefficient of each tissue is claimed to show the interdependencies between the layers in course of pattern formation. That means, the more the layers are correlated, the higher the coherence is to be observed morphologically. This analytical technique is congruent with the idea of coupling [of the interconnected elements of urban form] conceptualised by Salingaros (2000).

The factor value mathematically represents the linear interdependence of two variables. In statistical calculations, correlation coefficient takes a value between −1 and 1. Yet in morphological analysis, since there could be no negative relation specified, the correlation coefficient in the analysis of urban coherence theoretically varies between 0 and 1. The higher the value of correlation coefficient calculated, the higher the level of coherence is indicated. In this framework, two types of relationships between the constitutional layers are introduced: causal and conditional. On the basis of causality, the strong associative relation is observed. In that sense, the components of the system temporarily follow each another [i.e. the presence of x necessarily implies the presence of y] That means, when the existence of any layer represents a necessary condition for the formation of another layer, then the relation between those two layers is called ‘causal’. However, a morphological correlation does not always imply causality. The components can be linked to each other within a conditional relationship. As a weaker condition in terms of coherence, conditionality does not imply a necessity condition, but that of sufficiency in terms of two entities. That means though the existence of x is not necessarily dependent on the existence of y, the presence of x provides a sufficient condition for the presence of y. In this case, the occurrence of layer x only increases possibility of the occurrence of the

32 As we discussed in the previous chapter, the designation of the border of analysis in the morphological research is a critical issue. In the comparative analyses, the optimum frame-sizes should be determined by the cross-comparisons between the different contexts. Since each city, region or country may have different socio-economic profile, the dispersal tendencies in each context essentially influence the nominal sizes of ensembles, neighbourhoods and districts as the spatial units.

33 Unless a spatial use of any morphological element results in distancing or non-existence of any other layer (i.e. a motorway making the buildings be kept in a larger distance -due to negative externalities-), the correlation would not get negative values.
layer, without any causation.

From this theoretical perspective, for our analysis of urban coherence, we examine the cross relations (the links) between the five constitutional layers of morphology and specify the type of each linkage based on the distinction between causality and conditionality. The correlation coefficient of each urban tissue is calculated by giving a score to each link of relation. The links could be either two-way (reciprocal) or one-way (unilateral). While the strong (causal) relations are plotted with the continuous lines, the dotted lines represent the weak (conditional) relations. In this sense, one-way causal relation gets the value of 1, and a conditional link is valued as 0.5. If the relation is reciprocal, the type value is multiplied by two. The ratio between the actual total value of correlation and the maximum possible value gives the correlation coefficient so that the level of coherence of the urban tissue.

The point is that the determination of type and degree of the correlations between layers are subject to a kind of heuristic analysis. Correlation are determined based on a visual interpretation of the patterns. The repetitive geometries (i.e. partitions, propagations and coverage) observed within a pattern in a close relation with another one are taken as the indicators of an inter-dependency condition between the two layers. The strength (geometric) regularities recognised in each pattern of the layers in relation to the others in the analysis basically determine the type of the linkages to be measured (i.e. conditional or causal relations). Responsive repetitions, local symmetries and overlaps are the key properties for the correlative recognition in the analysis of urban coherence.\[34\] The overall correlation score that will be given for each tissue analysed, is significant due to its role to represent the the level of coherence observed within this fabric. The higher the score, the higher the correlation between the layers are meant to be provided by each design control system applied within that planning context. In this sense, the higher correlation coefficients are taken as a positive indicators in the performance of the design control mechanisms discussed before.

5.1 Coherence at the level of neighbourhood

As the first scale-level of analysis, the coherence levels of the neighbourhood morphology of Almere, Ankara and Essex is examined through the six layers; building setting, block layout, road network, green structure and pedestrian network. (see Figure 4.40, 4.41 and 4.42) Followed by a brief evaluation of the analysis, each case is presented in ten-years period of time series to make us reveal the changing characteristics in the planning for urban coherence. In type and intensity of the links between the layers are aimed to illustrate the internal variation in the pattern of morphological coherence within each sampling tissue.

\[34\] Though it is not involved in the current work the author and Bardia Mashhoodi (TU Delft) has improved the heuristic correlation analysis with a GIS-based mathematical one based on the same presumptions provided in here. See: Caliskan, O. and Mashhoodi, B. (2013) ‘Urban Coherence: A Morphological Definition’, forthcoming
The most obvious characteristics of the typical neighbourhood tissue in Essex-1980s is that the road structure is the major organising element of collective urban form with its identifiable geometry unified within the entire surface. This could be an expectable condition regarding the established tendency of ‘designing the road network first’ in the school.
of British town planning. However, it is pretty hard to claim that the road structure has a coherent relationship with the other layers. Only the layout of pedestrian system is directly affected by the overall street geometry. The conditional influence of the street layout can also be observed on the building footprint in which the buildings located on the neighbourhood collectors noticeably follow the street lines. This can be the result of the principle of ‘linear spaces’ within building composition, which was addressed by *1973 Essex Design Guide* (County Council of Essex, 1973: 71). The main function of the green structure, in this context, seems to confine the built-up area of the neighbourhood.

In the sampling of Essex-1990, we see a similar governing role of the road structure in pattern formation. With an overall formal geometry, the street pattern determines both the internal structure and the external outline of the neighbourhood. Though the whole neighbourhood is characterised by a homogenous fabric in terms of the evenly distributed grain of building setting, it consists of a number of clusters embodied within an irregular block layout. Except the long promenades aligned through the green wedges, the pedestrian network does not constitute a pattern to perform as a complete system in urban form. Therefore, the continuity within the green system is another morphological property of the sampling tissue, which is not observed in the previous case.

In Essex-2000s, we see a radical break from the conventional forms of the planned residential developments in the UK. The tissue contains legible group formations defining clear edges of street frontage and common spaces within the blocks. In this sense, the new building composition is conditioned both by the pedestrian system and the street network while it influences the geometry of the block layout. The subtly interrupted continuity of the network without any strict access constraints reminds the intrinsic (syntactical) characteristics of the traditional street patterns, which maximise the pedestrian-friendly interactions between the street and the building, and the interior of urban blocks.

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35. The critical point is that the speculative housing developers are obliged to build all roads within housing developments in the UK. That’s the reason why, in most cases they first plan the roads to meet the highway standards in order to guarantee the development permission of highway authority and the local planning body (Stones, 2010).

36. In this case, since there is no specific correlation between the routes of the network and the building setting specified, the type of relation is identified as ‘conditional’ rather than ‘causal’.
In the case of Almere-1980s, the perceived regularity and the cohesive order in block layout, building setting and the street pattern let us perceive them as the major design elements for the formation of neighbourhood tissue. The dominance of the loose reciprocal relations between the layers signifies that although one of the layers conditions the other one, it still keeps some free variations within itself. This makes the coherent form rich through compositional diversity. The fine-grain of the building tissue, besides, enables the setting to have a high correlation with the other systems, like streets and (semi) public spaces. Although the main road passing through the area breaks up the built tissue, it does not work as a segregating element owing to a series of conjoint links crossing the axis. In the form of footpath or bicycle routes, pedestrian network is one of the most articulated morphological layers of the pattern. Due to its connective tissue, the green structure is not just a complementary aspect of the neighbourhood form, but also an active layer of it.

The overall pattern of the neighbourhood in Almere-1990s is characterised by low diversity within its internal layout. The apparent geometric regularity is ensured by the relational links, which are less in total number, but higher in average degree. The road network...
offers a strong basis for the characteristic form-language of the fabric with a series of narrow rectangular blocks having the same orientation. Such a repetitive structure is strengthened by the pedestrian system as an open and permeable network of sidewalks and alleys. The coarser grain of the green structure results in a much weaker correlation with the other layers than before.

As observed in Almere-2000s, the strict segmentation within the building setting is observed with a clear border condition of the footprint. The ‘grand formalism’ within building composition makes the early design idea, a connected tissue on the neighbourhood scale secondary. Due to the limited number of access points to the closed pedestrian system, the pattern represents a segregated settlement form unlike in the previous Dutch cases.

Figure 4.42. Morphological layers [building setting, block layout, road network, pedestrian system and green structure] of the sampling neighbourhoods in Batikent –above-, Çayyolu –middle- and Türkkonut –below-, and the correlation coefficients they have. The constitutional layers are respec-
Layering urban form effectively reveals the fact that the typical neighbourhood tissues from Turkey exemplify an extreme version of road-based urbanism. As seen in the layer correlations, the most dominant layer on the pattern formation is road structure. In the case of Ankara-1980s, the clear clustering of the building groups encapsulated in urban blocks is mainly characterised by the road structure. The fragmented structure of the green and pedestrian system is far from performing as an independent pattern supposed to have a unified internal fabric.

With the abundant use of passive green areas and an extensive network of the wide-profile roads, the sampling tissue of the Ankara-1990s represents a significant decrease in urban coherence. Building setting is composed of disconnected housing clusters. This composition is quite typical for the speculative housing developments in Turkey. The overall logic of the internal layout of the housing sites has nothing to do with the collective form of the neighbourhood. It is also difficult to define a system of pedestrian network, which is merely determined by the roads as sidewalks.

Finally, Ankara-2000s represents a kind of morphological dissolution at the neighbourhood level. Building composition is only conditioned by the layout of building blocks segregated by the green strips and roads. Large building blocks are not articulated by any public space structure with a connected pedestrian system. With its largest coverage area, the dominance of the road structure performs as the separator even within building blocks.

### 5.2 Coherence at the level of urban ensemble

The author basically assumes that the relative performance of a design control system on the formation of urban coherence may vary on different scales depending on the special tools and rule-sets involved. To test this basic assumption, we repeat the same analysis on morphological coherence at the level of urban ensemble as well. At that time, we have four layers to correlate: building setting, plot layout, street pattern and pedestrian system. (see Figure 4.43, 4.44 and 4.45)
Despite being different from any typical (conventional) British suburban tissue, Essex-1980s comprises an intensive building setting with the influence of celebrated 1973 Essex Design Guide calling for an ‘architectural composition within the discipline of spatial enclosure’ (County Council of Essex, 1973: 69-70). However, it is still possible to observe that the main organising element in form composition is the street pattern and the mews-courts rather than the building composition itself. The road hierarchy also characterises the levels within contiguity of the building settings. Such a correlation is not applicable for the plot layout. The main geometrical properties of the plots (i.e. size and shape) are highly independent form the network structure.

In the case of Essex-1990s, we see a clear intention for formalism in design as opposed to the conventional tendency for so-called ‘organicism’ with meandering road geometry of the British (sub)urbanism. Therefore, with its clear geometric order, the street pattern is determined as the predominant design instrument in form composition. Along with the pedestrian and shared-surface system, the street layout rules the formation of building setting. All the buildings are configured along the street space or around the shared space. The location of the private parking plots is also weakly influenced by the layers of the network.
What we see in Essex-2000s is the emergence of reciprocal-causal (strong) relations between the constitutional layers unlike the previous cases. This results in a serious shift in the level of overall coherence. The design principle to keep street frontage tight and continuous, which was suggested by 2005 Essex Design Guide, is ensured by the plot layout. The overall setting of the buildings are pretty responsive to the street pattern. The apparent design objective to cover the whole tissue with an accessible pedestrian network is realised by a strong correlation between the road surface and the shared spaces. Finally, the correlation between the shared spaces and the buildings create a different spatial typology based on inner court-like streets within urban blocks.
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Figure 4.44. Morphological layers [building setting, plot layout, street pattern and pedestrian system] of Almere Stedenwijk –above-, Tussen De Vaarten –middle- and Almere Stripheldenbuurt –below- urban forms at the ensemble level, and their correlation coefficient respectively.

With its highest value of correlation coefficient, the sampling ensemble from Almere in the 1980s represents the most coherent form among all the other model tissues. The main reason is that almost all the links between the layers are mutually correlated within the tissue. It means all the related layers morphologically determine or condition each other. In this context, the most ‘interacting’ layer is the building setting composed of short slabs of row houses. The orientation of the rows is in close-relation with the street pattern in accordance with route hierarchy. Rather than configured by the segregated dead-ends, the street pattern has an open composition with the cul-de-sacs integrated with the finely meshed pedestrian system, the back alleys passing through the neighbouring blocks. This apparently increases the overall coherence of the pattern.

In Almere-1990s, we see that the former strong connection between the building setting and street pattern is diminished. There is no tendency to characterise the streets via building composition with reference to the street hierarchy anymore. The over-repetition of the parallel lines within the horizontally aligned street pattern is intersected by the vertical and diagonal links of the pedestrian system, which makes the tissue rather permeable with alternative accesses to the ensembles. This can be taken as a common characteristic feature of the Dutch residential tissues pursuing a certain level of coherence perceived in the level of ensemble.

In the final sampling of Almere-2000s, though the total number of linkages is almost the same with that of the previous cases, the average strength of the correlation is less than the other ones. Along with the previous example (of the 1990s), this typological pattern proves that higher regularity in one layer decreases its potentiality of active interaction with the others. Though it is possible to diversify the building composition within the same type of urban block [as seen in the current example], the two layers do not necessarily condition each other thorough thematic variations. This also decreases the overall coherence.

ANKARA, the 1980s  [correlation coefficient: 0.25]
Figure 4.45. Morphological layers [building setting, plot layout, street pattern and pedestrian system] of Batikent –above-, Çayyolu –middle- and Türkkonut –below - urban forms at the ensemble level, and their correlation coefficient respectively.

Focusing on the level of urban ensemble, we can recognise a higher variation in building setting than in the case of Ankara-1980s. Nevertheless, such a variation is not supported by the composition of any other layers except plot layout. There is no apparent relation determined between the plot type and the hierarchy in the road layout, which is the most governing layer of the ensemble tissue. The diverse form of the pedestrian paths and streets, which have little or no correlation with the road structure and building setting, is also evident at that scale-level.

The same characteristics are observed in the following period with a decrease in morphological coherence. In Ankara-1990s, all the layer relations are weak and mostly one-sided. This means almost every layer has its own formal logic without being conditioned by the other layers. Since there is no public space system binding the housing estates together, no correlation is detected between the pedestrian system and the building layout. The coarse segmentation of the plot-types, closed segregation of the building clusters and the disconnected pedestrian network are also the factors of the fragmentary nature of urban ensemble.

As the least coherent tissue in the analysis, the urban ensemble of Ankara-2000s proves a very coarse grained urban tissue, which even hardly fits into the analytical frame. This basically signifies the current trend of the Turkish housing sector, which produces ex-
tensive residential tissues larger than the generic scale-frame. This point also implies that when the compositional elements get larger, they tend to lose their potentiality to interact with the others to generate urban coherence.

5.3 Evaluation of the comparative analysis

The internal and cross-comparison of the analytical findings can make us reveal the relative performance of the design control approaches applied within their specific context. For this purpose, the three case studies are compared with their the overall correlation scores. (see Table 4.5) Considering their general characteristics in design control that have been transformed in time, we will briefly discuss the average coherence values generated and their internal deviations will be related to evaluate the findings.

Table 4.5. The average values of the correlation coefficients measured in the cases of Essex, Almere and Ankara at the two scale levels.

<table>
<thead>
<tr>
<th></th>
<th>Essex, the UK</th>
<th>Almere, the Netherlands</th>
<th>Ankara, Turkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbourhood level</td>
<td>0.25</td>
<td>0.51</td>
<td>0.26</td>
</tr>
<tr>
<td>Ensemble level</td>
<td>0.39</td>
<td>0.57</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Accordingly, in the British context, the average value of coherence at the ensemble level is remarkably higher than that of the neighbourhood level. This can be explained with the common concerns of the three Essex design guides about the townscape principles rather than the macro structural characteristics of urban form. In other words, although the guides have provided a sufficient basis for the control of meso-scale morphology (from street to ensemble), it remained incapable of controlling elements of macro-morphology (from neighbourhood to district). Despite a slight fluctuation, the levels of the neighbourhood coherence in Essex stand in a certain range. Nevertheless, we see a remarkable change in the coherence of ensemble especially within the last period. This could be mainly due to the principle shift from the conventional suburban form-approach to the grid-based design approach in urban structuring, which was realised in the context of New Hall. That means integrated network structures potentially generate more interaction with other constitutional elements at the lower scale-level of urban form.

As seen in Table 4.5, the average urban coherence of the Dutch neighbourhoods is twice as the British and the Turkish average. However, in both scale-levels, these values tend to decrease in time. An apparent decrease in the number and the strength of correlations between the layers are observed in both the sampling neighbourhood and the ensemble tissues. In due course, not only the number of the correlation links, but also their strength decreases. It means that the elements in one layer become less responsive to the existence of the other elements in the corresponding layers through the form generation. This is basically a negative indicator about the design performance of the Dutch planning. The underlying factor behind that fact might be the decreasing interest to the issue of large-scale coherence of urban form with the growing emphasis on diversity and individual choice in the contemporary urbanism in the Netherlands.
Finally, the typical sampling tissues from Ankara signify a serious loss of average morphological coherence within the last thirty years. Although the initial value found at the neighbourhood level is higher than its British counterpart in the 1980s, it eventually falls about one third of the initial level, which would be ultimately less than the British average. This is not because of any substantial change in the design control perspective, but mainly due to the changing housing typologies generates more fragmented and coarser grained tissues in the larger context. Moreover, as seen in the table above, the average coherence at the level of ensemble in Ankara represents the lowest value within the overall analysis. This can be taken as a result of the necessary coordination lacking between the large and small-scale hierarchies in the Turkish spatial planning system based on a conventional master planning approach, by which the incremental development dynamics can not be managed at all.

6. Conclusion:

In this chapter, we tended to make a link between planning and morphology with reference to the two key issues, design control and morphological coherence. Within the limits of the paper, we tended to depict the general framework of the three design control systems from the UK, the Netherlands and Turkey having distinct space and planning cultures. While doing that, our intention was not to provide the full-description of the planning systems, but to delineate their systemic differences in the way of controlling design in/by planning. Such a comparative study would let us reveal the intrinsic relationship between morphology and planning in terms of design control and urban coherence. To that end, we have introduced the morphological analysis of urban coherence.

The findings of the analysis show us the obvious supremacy of the Dutch planned urban fabrics over its Turkish counterparts examined with regards to morphological coherence. In this context, what is the source of that qualitative difference indicated? Is it simply the cultural tenets differing on the production of space? There is no doubt that such an answer would too broad to make precise a inference on the issue.

As recently argued by Acemoglu and Robinson (2013) the developmental indicators of inequalities between the different nations are not cultural (or geographical), but chiefly institutional. That means the institutional frameworks constructed perform as the main quality factors conditioning the social (and spatial) inequalities. From this perspective, in order to see the material conditions behind the difference in morphological qualities of the Dutch and Turkish residential tissues examined, we will reconceptualise the structural approaches to design control in the two countries.

Within his own typology, Lang (2005) classifies urban design according to the holistic or incremental nature of the ‘form making’ process within a planning system. With this regard, he defines four types of urban design: total, all-of-a-piece, piece-by-piece and plug-in (pp. 28-33). Though this typification sounds relevant for urban design in general—in terms of the flexibility and the level of control in design—, it is not fully informative on (urban) design control, framing the designs in/by planning. In this regard, in the light of our comprehensive review and considering the other contemporary approaches in planning (Carmona et al, 2006; Marshall ed., 2011; Talen, 2012), we suggest the three types of design control approach in urbanism:
• structural control by master plans,
• compositional control by development plans,
• generic control by codes and guidelines. (see Figure 4.47)

In this conceptual framework, each approach in design control essentially corresponds to a certain combination of tool (i.e. plan, code, guideline) and scale-level (i.e. ensemble, neighbourhood, district). While master plans tend to define the overall structure without specifying the compositional features of urban fabric, the development plans specifically articulate urban form, while codes and guidelines offer a generic framework in which the designers can perform. The critical point is that, depending on the level of flexibility involved, what a plan defines as the ‘structure’ with the street network can be taken as the definitive ‘street composition’, if it configures all the access streets on the large scale –as in the case of Ankara, Turkey-. Likewise, a development plan may perform quite flexibly by utilising only codes, instead of a ultimate form-composition. The different cross-combinations, in this sense, are supposed to be ended up with different results morphologically.

Bearing these in mind, we can now characterise the principal control approaches of the three planning systems examined. The characterisation made in time-series would let us see the actual tendency for a systemic change in each context. (see Figure 4.47)
As we see in Figure 4.47, each control system is characterised by a unique combination of the control tools applied in different frames. In the case of Essex, the UK, the development is controlled via a close coordination of the prescriptive design guidelines at the district level and the compositional design schemes as the actual application of the principles suggested by the guidelines. Compositional design control made by briefs covers either neighbourhood or ensemble level. Though the coverage of the compositional control significantly increases in the 2000s, form-compositions are defined in the light of contextual design codes. In the British case, the master plans have no determinant effect on urban fabric, but only on the area designation and the delineation of the major network.

In the Dutch context, though it was not determined for the period of the 1980s, structural plans at the district level play a major role in the large-scale morphology. Unlike the British case, the design guidelines are introduced for each local design application at the level...
of neighbourhood. The design codes included in the development plans basically to guide
the next step of the design process taken into the smaller scales [of ensemble or block]. From
the 1990s, the plan-code coordination can be followed even at the level of urban ensemble
to guide the architectural design of the blocks or buildings. That implies an intrinsic design
control process ensuring a high morphological coherence.

Unlike the British and the Dutch cases, the design control approach in Turkey exhib-
its a very static nature within the same legal framework applied in the course of time. While
the overall structure of the district is determined by the master plan and the implementation
(development) plans, no design codes are applied with reference to the local context. The
compositional design is executed by the site plans either at the level of superblock or ensem-
ble if mass housing is the case. That results in a significant scale-gap between the structural
and the compositional design control, which is supposed to be regulated by the standard
codes of the national development bylaw. Considering the results of the morphological anal-
ysis, we can hardly claim that it ideally works. That condition implies the state of planning
without design guiding, which is the actual motive behind morphological monotony and
incoherence.

Nonetheless, the illustration of the type and extent of design control would not be
enough to reveal the systemic background of urban morphological coherence. For a com-
plete view, we have to figure out the intrinsic (relational) structure of design coding in the
planning systems as well. It is quite possible that in some cases, the plan applications might
be limited with the capacity -the range and variety- of the design codes utilised in the plan-
ning process. In this respect, the maps of the codes used in design control would provide a
clear idea about the rule-oriented bases of urban morphology.

For this purpose, each planning context involved in our analysis are re-examined
with regards to the codes of the elementary aspects of urban form (i.e. building, building
configuration, parking lots. The maps are drawing by examining the legal documents (i.e.
development bylaws) applied into the control processes, and the guidelines and plan docu-
ments, which are all included in our comparative research . Through mapping, the two types
of codes were identified, indicative and generative. While indicative codes directly refer to
the output with an exact metric value (i.e. the width of the plot, the number of parking
space), the generative codes specify the desired neighbouring relations between the constitu-
ent elements (i.e. maximum ratio between the building coverage and the plot) by which the
designer can come up with different design solutions. The codes clustered around the main
aspects are linked according to the relations specified in actual use. The more links plotted
between the nodes of the codes, the higher the capacity of design control system is assumed
to be practiced in the way of coherence. (see Figures 4.48, 4.49 and 4.50)
The map of major design codes involved in the British residential development/design control system represents a very cohesive web of relations. (see Figure 4.48) This scheme depicts the existence of a very interactive coding system developed in the UK. The generative design codes to enable the various design solutions around a certain theme occupy quite a small portion of the entire set of codes. The clear dominance of the indicative codes in the
British system basically signifies the current understanding of coding solely as a supplementary tool to support the ideal realisation of the desired urban forms and images rather than a tool to generate collective forms without a fixed plan. The map also shows the relative dominance of building and building configuration as the elementary aspects utilised in the design control processes in the UK.

**Figure 4.49.** The web of urban design codes specified in the context of the Dutch planning system
The map of urban design codes involved in the Dutch development control system (mainly within the development plans) displays a relatively looser structure compared to the British case. (see Figure 4.49) If we consider the highest average value of urban coherence that the sampling Dutch tissues pursued in our analysis, this point could be rather confusing. Actually, this situation does not suggest a kind of a contradiction, but mainly reveals the intrinsic nature of the Dutch urbanism. As we pointed out above, in all phases of the compositional design processes, the codes and guidelines are formally involved in the design control process of Almere. Nevertheless, as also observed by the author through the interviews, the negotiations in the design control processes held between the planning body and the designer are not usually based on the formal codes in the Dutch urban design practice. Instead, the analogue codes (visual images and graphics) comprising many implicit design ideas play the most central role in the design assessment in the Netherlands. The intensive review process based on a rich set of drawings and images associated with the written codes, in that sense, can be considered as the actual basis of the planned urban coherence in the Dutch context.

Figure 4.50. The web of urban design codes specified in the context of the Turkish planning system.

In Turkey, the official (urban) design codes are mostly the procedural ones determining the rights and duties within planning processes. Along with the current lack of local form-based codes for different cities and project areas, the codes do not consist of a rich set of morphological components. The analytical scheme given above essentially demonstrates this point. The analytical scheme given above essentially demonstrates this point. (see Figure 4.50) Although the existing codes on the web are pretty related with each other, they would not be enough for the generation of coherent urban tissues as figured out in our correlation analysis. (see Figure 4.42 and 4.45) Between its two European counterparts, the Turkish
planning system is the only one that uses the density measures (FSI and GSI) as the formal design codes. Nonetheless, the applications of those flexible codes are made without any supplementary guidance to ensure compositional design quality. Considering the other codes requiring extra guidance, we can hardly expect the generation of coherent urban fabrics from the existing coding system in Turkey.

7. Concluding remarks

In the second chapter of the thesis, we have briefly discussed the notion of control and its relevance with urban pattern formation. As stated there, the system of control in urbanism pursues itself on design act. Design control, in this sense, means constructing a regulative framework for the individual acts of design by means of some constraining or generative principles, standards and codes provided within guidance and review processes. Behind the idea of controlling discrete design acts, there is an underlying belief on the merits of consistent, harmonious and coordinated human action in society through stabilising and reconciling the conflicting interests. This idea basically brings us to the concept of coherence as a state of harmonious unity and holistic consistence. From this perspective, we can claim that though it is not always put through explicit terms, the principal motivation of spatial planning with a systemic control of discrete developments and changes is essentially to ensure coherence in space.

This point basically represents the reason why the current section of our critical reflection has been specifically focussed on the issue of morphological coherence in the context of planning. Since coherence is not a state of single composition, it is mainly subject to the discussion on design control and planning in a larger context. As a feature of multiplicity and recursion in space, coherence is basically a morphological state achieved by the interactions of different urban form-components (layers) over long periods. That is the reason why, urban coherence is not designed in a certain space and time, but generated in the coordination of different form-compositions in the larger context of collective urban fabric. After positing coherence into our initial conceptual framework of urban formation (see Figure 2.9), we can reflect on our analysis (of urban coherence) suggested in the current chapter.

It is worth to restate that the analytical method run for measuring morphological coherence based on correlation analysis is an original one within the current literature. Since the previous discussions on the concept (Alexander et al., 1987; Salingaros, 2000) are lacking an explicit model of analysis, the method discussed within this study is believed to enrich the further discussions on urban coherence from a morphological perspective.

The application of analysis into the case study areas selected for the plan review initially introduced for this chapter basically lets us come up with some critical remarks on (morphological) design control in planing that is the main issue of the section.

As discussed before, urban fabrics are complex systems, which safeguard their inner stability by the various feedbacks from different actors (developers, individuals, planning authorities and designers) through long-term (trans)formations. In this sense, as a system of design control [in addition to its other operations such as projection, programming and monitoring], spatial planning involves various tools and mechanisms to coordinate individual designs in urban development and transformation. The point is that planning mecha-
nisms control singular form-compositions which, in turn, generate the collective body of urban fabric. Looking in this way, we see that design control is essentially one of the input factors of urban complexity. Therefore the system characteristics of planning is quite critical for the performance of urban design control which ultimately aims for spatial coherence out of complexity.

In this sense, with reference to the Ashby’s ‘The Law of Requisite Variety’ suggesting that ‘the variety of the control device must be at least equal to that of disturbances’ (Ashby, 1956: 11 cited in Hall, 1996: 3), we could conclude that managing urban (trans)formation requires diverse types of design control tools and mechanisms acting in the same system. To achieve that end, coordination of policies, plans and codes through different levels of morphological resolution is essential.

In line with the current conception of the contemporary urbanism, we can also argue that no single plan has enough capacity to control the total form of cities for the sake of coherence and harmony. In order to ensure morphological coherence within the controllable scales of complex urban formation (i.e. street, urban block or ensemble), planning should perform via a clear set of formal and spatial codes, which are able to coordinate locally acting individual design operations (Alfasi et al., 2007: 167). Within this ideal framework, while codes could perform with guidelines providing a substantial framework of ‘good urban form’, they would also enable alternative design solutions as diverse interpretations of the principles [rather than a direct application of norms]. By this way, an integration of planning and design could be built upon the emerging field of urban coding (Marshall ed., 2011) supported with the substantial knowledge of urban morphology.

This conclusion does not simply connote the classical discrepancy between top-down and bottom-up design perspectives in the question of managing urban complexity. As observed within the Dutch planning context, despite the very top-down processes implemented from large to small scale-frames, a very flexible basis is still provided for various applications of local form-compositions while ensuring higher coherency generated at the level of collective urban fabric.

Our review and analysis show that the quality of design codes and their relational framework applied along with the structural plans are quite critical factors for the performance of a design control system. The design guidance based on simply formulated, clearly represented, relational, multi-scalar and flexible design codes are potentially the good instruments to fill the critical gap between design and policy in planning. Such an ideal integration is likely to be the shared agenda of different physical planning systems, in near future.

37 Though the analysis of urban codes in the British context proved itself with a highly developed web of (morphological) parameters, we should bear that the richness and complexity depicted within the this case might be specific to the Essex case examined. To make the scheme more representative for the British system as a whole, more comparative reviews are required. Nevertheless, considering the strengthened role of design coding in the contemporary planning practice in the UK, we can still claim the relevance of the representative diagram on the issue.
5 DESIGNING the MORPHOLOGY
1. Introduction

In this chapter, the nature of design thinking in urbanism will be discussed with a particular reference to urban morphology. Bearing that urban pattern formation is a collective phenomenon involving various actors within long-term processes, we will mainly focus on designers as the major actors in urbanism. In terms of Hillier and Leaman’s (1974) conceptualisation, if the formation of urban patterns occurs in evolutionary time through the gradual emergence of socio-spatial morphology, the act of design is concerned with the local time in which the individual imagination is pursued for creating an artefact (pp. 8). In this regard, the current research posits itself within the context of ‘local time’ in which the designer performs. However, that point should not mislead us with a kind of misconception on local/individual act of design. The term ‘local’ here does not connote an instantaneous moment, but an in-depth process through which the designer performs his/her creative reasoning reflectively.

Although an urban design process is usually considered in terms of the individual acts and interpretations of the designers in relation to the external – legal, administrative and fiscal – mechanisms involved (Shirvani, 1985), the main focus of the research will be specifically on the personal cognitive domain of the designer. This approach basically derives from the need to understand the intrinsic qualities of ‘designerly way of thinking’ (Lawson, 1980) in urbanism. Although the user perspectives and the external dimensions of the design process are exclusively discussed in the literature, the issue is rarely considered from the designers’ perspective, and even implicitly avoided under the influence of the enduring socio-political discourse of planning theory.

Since the design methods movement of the 1960s, design studies have made significant progress in our understanding of design thinking in general. Nevertheless, not many studies have considered urban design as a special research topic from this perspective, so far. Urbanism’s enduring lack of interest to the cognitive dimensions of design has also made the field continue to rely on the early procedural models, which have been invalidated by the emerging debates in design studies. The shortcomings of this theoretical condition are mainly proven by the disputable conceptualisations on analysis and design in spatial planning. Under the influence of the early approaches in planning, the conventional (procedural) models concerning urban design are yet to be updated in conformity with the changing paradigms of design thinking.

In this context, the chapter aims to revisit the idea of design process in urbanism from a cognitive point of view. In order to provide a conceptual framework that responds to both

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1 In this research, the author avoids using the term ‘urban designer’. As a consensus on the autonomous theoretical and professional identity of urban design and the urban designer has not yet been reached in the literature, the author prefers to use ‘the designer’ throughout the text. However, the author hopes the research will contribute to the future attempts to formulate a precise definition of ‘urban designer’ from a methodological perspective.
contemporary theories and to the actual process of design, the concept will be first clarified with a review of different definitions. In the light of the definitions, the main characteristics of design thinking will be given in order to build up a firm basis for further discussions. Following the description of the main complexity factors involved in spatial design process, we will briefly have a look at the basic instruments of design cognition in the way of dealing with complexity. Then the concept of design process will be elucidated with a historical review of the descriptive models on design thinking. In addition to the general models argued within the school of ‘design methodology’, the procedural models specifically suggested on urban design will be also reviewed. Before putting a critique of the conventional models in urbanism, a conceptual framework will be suggested with regards to the contemporary understanding of design. Such a conceptual framework, in this sense, will be tested with a focussed design analysis. The aim of the empirical design research here is not only validate the basic assumptions of our conceptual framework suggested, but also to understand the intrinsic features of design reasoning in action. The way of thinking in spatial design, the tools and concepts utilised in the design processes will be mainly questioned within the in-depth analysis. Ultimately, the need for a paradigmatic revision in the conventional understanding of urban design thinking will be argued in the light of the findings of the analysis.

2. Design Thinking: basic definitions and concepts

For many palaeontologists, tool making and the ability to modify natural objects represents the dawn of man and human civilisation about three million years ago (Thomas, 1994: 74-77). This signifies the emerging ability of reflective thought and purposeful control of mind-hand coordination in order to make artefacts. Therefore, design is a deeply rooted and fundamental evolutionary feature of the human mind. Nevertheless, further studies are required in order to achieve a full understanding of design in relation to cognitive insight. The existence of implicit reasoning processes, which is to a certain extent based on tacit knowledge, design remains as a mystical phenomenon yet to be explored more in depth. With the emergence of the research field of artificial intelligence (AI) in particular, the literature on design thinking and methodology has provided a sound theoretical basis for the studies of a high variety of design-based fields. Since the design methods movement of the 1960s, design studies have developed their own remarkable body of knowledge and coherent terminology (Dorst et al., 1995; Cross, 2001).[2] A substantial body of knowledge on industrial and architectural design has been highly elaborated on this basis with an enduring ignorance on urban design.

The ontology of design is founded on our dissatisfactions with actual conditions with reference to our basic needs and future prospects. In other words, “design exists because the world around us does not suit us” (Gero, 1990: 27). In this sense, the recognition of real needs or expectations leads us to create artefacts either to live with (objects) or to live in (buildings and settlements). This makes design a purposeful and goal-oriented activity. The common purpose of design act is to create new functionalities with novel forms to be operated in a specific way to achieve a desired performance. This is what differentiates design from

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2 Since the 1980s, the research field has been institutionalised with its own periodicals, such as the journal Design Studies (published by the Design Research Society), The Journal of Design Research and Design Principles and Practices: An International Journal.
artistic creation, which is essentially independent of any functional or pragmatic incentives. Unlike art, design operates within external social and economic constraints (i.e. technological dependencies and cultural norms) that imply a specific context. Nevertheless, the external context is not the only domain of design. The designer also creates his/her own personal (internal) context in which the design evolves. The external context is reconstructed mentally in compliance with the designer’s own perception developed within internal design environment. The designer identifies the emerging features of the context during the design process through the explorative interaction between the internal and external design context (Ibid, p. 28). This means that (s)he learns by designing. The interactive learning process, which goes beyond the mere imposition of a mental image into an existing context, makes design a complex phenomenon. In this regard, Gero (1990) defines design as a “goal-oriented, constrained decision-making, exploration and learning activity that operates within a context that depends on the designer’s perception” (Ibid).

Such a dynamic and interactive perception of design is fundamentally conflicting with the endogenous understanding of design. As an example of this perspective, Mitchell (1990) defines design as “a firm and graceful pre-ordering of the lines and angles, conceived in the mind and contrived by an ingenious artist” (p. 37). This view is quite an extension of the classical conception of artistic creation perceived as ‘design’. Accordingly, as originally argued by Aristotle, a form first exists in the mind of the artist and is then materialised as a work of art (Ibid). In this view, the design artefact is a mere reflection of the formal image (the idea) already constructed in mind. The contemporary understanding of design thinking basically challenges this view in terms of the functional aspects of involved as well as the basic cognitive characteristics of the design process. Given the characteristics of the complex systems related to the collective behaviour of the individual components that facilitate unpredicted large-scale patterns, information processing and adaptive behaviour in learning processes (Mitchell, 2009: 12-13), design is viewed as a complex, self-reflective and evolutionary creative process (Lawson, 1980; Schön, 1983; Rowe, 1987; Maher et al., 1994; Gero, 1996; Poon et al., 1996; Cross, 2001; Dorst et al., 2001).

After this general introduction to the issue, the following selected definitions of design provide an illustration of design thinking. (see Table 5.1)

Table 5.1. The definitions of design.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Author and Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Decision making, in the face of uncertainty, with high penalties for error.”</td>
<td>Asimov, 1962</td>
</tr>
<tr>
<td>“...an activity that aims at the production of a plan, which plan is intended to bring about a situation with specific desired characteristics without creating unforeseen and undesired side and after effects.”</td>
<td>Rittel, 1964</td>
</tr>
<tr>
<td>“The formulation of a prescription or a model or a finished work in advance of its embodiment. ... not only a prescription or model, but also the embodiment of the design as an artefact.”</td>
<td>Archer, 1965</td>
</tr>
<tr>
<td>“A creative activity – it involves bringing into being something new and useful that has not existed previously.”</td>
<td>Reswick, 1965 cited in Jones, 1970/1992</td>
</tr>
<tr>
<td>“The initiation of change in man-made things (which) implies that there are objectives that must be achieved before drawings can be completed, or even started.”</td>
<td>Jones, 1970</td>
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</table>
Reading the definitions, one could come up with a ‘word-cloud’ involving a series of keywords on design: uncertainty, possibility, creativity, imagination, generation, problem-solving, learning, making, representation, action, communication, information, purpose, artefact, rules, models and constraints.

Reflecting on the set of concepts above, we can formulate our own definition of design as “a creative thought and information processing activity within the condition of uncertainty, involving problem solving and the generative imagination of possible artefacts made in accordance with certain rules represented by communicative models that relate to the given constraints and the purposes of use and function.” Such an overarching definition illustrates the complex nature of design thinking, which prompts scholars to redefine the various descriptive models on its intrinsic process, even those that conflict with another.

### 2.1 Fundamental characteristics of design (thinking): the basic assumptions

To make a much clearer sense about the phenomenon, we can characterise design with seven basic operational qualities, which might be controversial with the ordinary presumptions:

- **Design is (re)combinatorial:** Design thinking is not an act of creation out of a thin air. Through the observation of the external world and via our long-term memory, we (re) construct types. Designers consciously or unconsciously recall those types and make use of them by recombining within different contexts to provide novel solutions for specific problems. The creative link between the source and target form is made by the abstract similarities recognised. (Holyoak et al., 1995: 7, 22). For Ulrich (1988), design is an act of exploring possible combinations of the basic primitive elements forming a functional whole (p. 7). Re-combinatorial nature of design makes it similar with evolution. As the eventual tendency is towards variation in evolution [through the rise of formal complexity out of the combinatoric (and the subdivisional) processes
upon the simpler forms\textsuperscript{3} (Simon, 1969: 165), design also performs with simple elementary forms, which are easy to operate with, and create new complex (artificial) systems through higher internal-variations.

- **Design is gradual:** Levin’s question implies a very basic character of design act: “Why does the (design) solution come into being in stages?” (1966b: 118). The answer is also given by himself: “Clearly because the designer cannot tackle the whole problem in one fell swoop” (Ibid). The final design is formed gradually via partial propositions, modifications, refinement and feedbacks. The reason of gradualism lies in the limitations of our short-term memory on information processing, which compel us to make progress in design through small successive steps rather than a single episode (Rowe, 1987: 55). Within same view, Hillier and Leaman (1974) also argues that design involves sequences of relatively simple operations carried on complex forms and structures (pp. 5). This point is also supported by Kosslyn et al. (1981 cited in Goldschimidt, 1991: 129). For them, design images are constructed from simple units, and transformed in small steps to achieve complex forms.

- **Design is iterative and cyclical:** The iterative nature of the design thinking directs from the new situations emerging after each design move as a new starting point for the next one (Simon, 1996: 163). The procedure uses its own copies and repeats until the ‘satisfactory’ end-result is achieved (Güney, 2008: 22). Each local design solution in the process brings up new problem conditions to be solved by further local solutions. This is basically the driving force of evolution in design. Within its cyclical path, design process has a series of intermediate loops depending on the complexity of the design task. The reason why design iterates itself is that there is no definitive goal like a formal research. Through generating new partial solutions, the problem statement is also transformed and needs to be reformulated accordingly (Poon et al., 1996: 709). With changing requirements through exploration, designer has to understand new problem space till the overall process is terminated (Maher et al., 1996).

- **Design is dialectical:** The design environment can be defined with problem-space and solution-space. While solution-space represents the conceptual sets of design models suggested by the designer, problem-space refers to the specific problem variables in response to the solutions. Acting as the driving factors for the gradual change of the design form, the problem and solution space evolve mutually during this iterative process in design (Maher et al., 1994). As Moughtin et al. (1999) states “clearly the designer, by engaging in this dialectic between problem and solution, clarifies the definition of the problem and the direction of the investigation necessary to seek the solution, as the process itself evolves. The nature of the problem only becomes clear as the iterative process develops” (p. 87). Design has a special dialectic in itself. There is no problem without a solution in design, though the contrary is possible. In the context of urban design, the formation of an urban pattern does not necessarily have to derive from a problem, but from the social requirements or a desire for new forms of living. Then, design reacts on

\textsuperscript{3} It should be noted that recombination in biological evolution is at the genetically level through crossover. Multicellular organisms evolve through multiplication of the cell-systems rather than merging of independent systems. (Simon, 1996: 192)
such a non-problematic agenda. Once a designer puts his/her initial design solution forward, the design creates its own problem with reference to the proposed relation between the solution and the design context.

- **Design is both rational and intuitional:** Considering the globally structured nature of design, which is motivated by the initial goal(s), one can easily recognise the rational nature of design (Simon, 1996: 162). However, the intuitive drives cannot be excluded from design, either. Since the spatial configurations are nondiscursive phenomena that cannot be explicitly cognised by words and concepts (Hillier, 1996: 3), configuring spatial forms by design necessarily belongs to the realm of the nondiscursive creative processes based on intuition. Nonetheless, once the initial design idea—conjecture—is put forth, the discursive reasoning is run with a set of spatial concepts. This means, starting with intuition through the explorations of possible configurations, spatial design proceeds through rational thinking in which the discursive quality of the form is tested against the explicit design concepts. Nevertheless, owing to the limited information processing capacity of human mind (Rittel, 1964: 100), the designer usually cannot come up with the large amount of design alternatives and therefore selects the ‘fittest’ solution out of a limited set. In this respect, like in the process of form exploration, intuition is actively involved in the evaluation phase of design as well.

- **Design is satisficing [rather than optimisation]:** Optimisation can be defined as selection of the best design alternative among all feasible combinations of the parametric values through complete exploration and comparison (Asimov 1962: 29) Regarding the existence of conflicting objectives and the multiplicity of the judgement criteria in design (Rittel et al., 1973), it is hard to validate the idea of optimisation in design (Logan et al., 1992: 4). Moreover, since there is always an inexhaustible number of different solutions, it is practically not possible to examine the whole hypothetical solution space for the search for optimisation. Though the solution space in design comprises many local optima with a number of combinatorial solutions (i.e. on spatial comfort, implementation cost or safety), there is no way for coming up with the ‘best’ solution comprising all the optimality factors in design (Ulrich, 1988: 7; Simon, 1996: 120; Manheim, 1967 cited in Jones 1970: 66). That is the reason why, designers act in an inherited condition of bounded rationality, in which human mind cannot identify all the possible solutions to make a selection from the complete set. Instead (s)he tends to achieve a solution, which satisfies only a limited set of criteria (Rowe, 1987: 39). While Rowe (1987) calls the selected solution ‘suboptimal’, Simon defines it as ‘satisficing’ (Ibid; Simon, 1996:119). In both cases, the selected solution is considered just as the alternative, which satisfies the specified constraints instead of representing the absolute optimality.

- **Design is creation [rather than sole problem solving]:** Design is not necessarily preceded by a well-defined problem as in the case of ‘problem solving’ (Rittel et al., 1973: 161). The point made by Thorndike (1931) provides a clear basis for the argu-

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4 The point is exclusively argued by Jonas (1993). For him, the idea of design as problem-solving is a rationalist misconception. Problem-solving necessarily supposes an objective problem and a formal algorithm for finding the optimal solution. Yet, design operates with neither an objective problem nor the definite algorithms (pp. 166).
ment: “... a problem can be said to exist if an organism wants something” (Thorndike, 1931 cited in Rowe, 1987: 39). This means, when an organism [read as ‘person’] takes action to realise what is aimed by design, (s)he starts facing problems in relation to ‘the design’. In other words, the problem exists once you want something but cannot instantly see the end-state to achieve (Mitchell, 1990: 64). In this sense, the design problem usually emerges when the designer comes up with an initial proposal (conjecture) through imagining the desired situation with a new form and configuration.\(^5\) Lynch (1981) contributes the discussion by introducing the concept of misfit. For him, design does not arise from a problem, but the imagination of form that may satisfy a perceived misfit after observing the existing reality (p. 275). In this definition, there is no predetermined problem to be solved by design, but the recognition of a imagery ‘solution’, which may not fit the existing context. From the same perspective design can be essentially perceived as the imagination of something new that is supposed to be widely needed after its execution.\(^6\) Such an introverted approach to design which priorities the will of designer rather than the external problem situations is clearly seen in Gero’s (1990) arguments: “Design exists because the world around us does not suit us, and the goal of designers is to change the world through the creation of artefacts” (p. 27).

2.2 Design operation in the context of complexity

As seen in the basic definitions and the characteristics given above, the act of design essentially operates in the domain of complexity, which remarkably involves uncertainty and (cognitive) complication.

As Mitchell (2009) argues, there are three common properties of complex systems:

- Collective behaviour: the interactive action of a large number of components allowing large-scale orders, which are hard to predict in advance,
- Signalling and information process: managing the stream of information and signals from the internal and external environment,
- Adaptation: the dynamic change in behaviour through learning within the evolutionary processes. (pp. 12-13).

Considering the very act of designer to synthesise a large amount of partial information continuously received from the external context while transforming both the design criteria and the tactics to come up with novel and unpredictable solutions during design process, we can see relevance of theorising design in the context of complexity.

The major external dynamics in spatial design are the site conditions, the local design codes and regulations, enduring production (construction) factors and the expectancies of the stakeholders, which determine the programme of requirements\(^7\) (Lawson, 1980: 97; Levin, 1966: 116; Erickson et al., 2001: 6). Nevertheless, the richness of the external com-
plexity factors involved does not prevent us to recognise the certain level of autonomy of the designer with a great deal of unconditioned individual performance within his/her cognitive domain and knowledge.

Despite being constructed on the assumption of causality (rather than conditionality which fits better to the idea of complexity), Levin (1966)’s conceptual framework on the external factors and their corresponding effects in design still provides a relevant framework to characterise urban design process. (see: Figure 5.1)

![Figure 5.1. The relationships between parameters, variables, causes and effects in urban design. -The grey cells indicate the aspects, which are subject to design process.- (Based on the conceptualisation in Levin, 1966)](image)

In this framework, design is a complex system of actions managing a series of dependent variables to achieve the desired controllable effects at the end. Accordingly, design parameters (i.e. density, elevation, access) involve measurable physical properties (i.e. area, height, number of connections). Independent variables are the properties of urban context, which are not controllable via physical design (i.e. socio-economic situation, climatic condition). Dependent variables, on the other hand, are controllable properties of the spatial system (i.e. building and network typologies), which are under the influence of both design parameters and the independent variables (Levin, 1966b: 6-7). Controllable and uncontrollable causes are the emergent behaviour of a design solution in relation to the given variables in a specific context (i.e. integration, coherence). Finally, the controllable effects are the ultimate states (i.e. vitality, safety and comfort) which are characterised by the uncontrollable and controllable causes. Considering design in within this relational framework, the complex nature of design can be revealed easily with a series of hard questions like;

- selection of relevant design variables to generate desired effects,
- limits of the capacity to process changing parameters during the design process,
- simulation of the emergent behaviours of design alternatives within the imaginary context of variables.

In practice, designers are usually commissioned with a brief specification of the required impacts of the future design. In this context, the main task of designer is to select the relevant variables and to set their values through various form-compositions in order to come
up with the desired spatial performance. Putting in that way, though it sounds plain and easy, the process of design in fact involves various ill-defined aspects to manage. By transforming the physical structure of the candidate design model, designer creates certain effects on the functional properties of the model. When the structure evolves, the designer re-cognizes the emergent operational attributes and accordingly re-acts on the transforming structure itself. The process continues until the refinement is found satisfactory enough, meeting the initial and updated performance criteria.

![Operational Attributes Diagram]

**Figure 5.2.** The hypothetical relations between the different attributes involved in urban space design.

Multitude of the cross-relations between formal and operational attributes of the emergent design outcome is the major source of design complexity. While formal and structural attributes are about the compositional and configurational qualities of the design (i.e. massing and continuities), ‘operation’ is about how the system behaves depending on the design parameters (Asimov, 1962: 26). In the case of spatial design, each formal attributes of an urban composition implies a certain set of operations (spatial behaviours)[8]. (see Figure 5.2) In terms of form and operation, the complexity factor in spatial design mainly derives from;

- the variety of the performative connotations of each morphological attributes,
- the intricate patterns of the relations between the attributes, which are hardly represented via simplified diagrams
- the actual difficulty to control all the aspects via a convenient test-model unlike in product design.

### 2.3 How designers cope with complexity: cognitive tools to reduce complexity in design

In the context of uncertainties, design is not a linear process proceeding from problem to solution. Rather it is a kind of non-directional conversation with the external (contextual) forces. In this sense, it is not a product of a single strong decision made by the designer, but a result of a series of decisions, which together define the solution space (Logan et al., 1992: 4). Therefore, the interrelated piecemeal decisions can be seen as the intrinsic strategy to cope with complexity in design.

As argued by Maher et al. (1996), a design problem is subject to be transformed with

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8 The terms *operation* or *behaviour* in design, imply the immediate effects of the design variables set by the designer. They are the observed end-results as response to the questions like how the design solution fits to the initial performance, how the solution works within the surrounding context, how it looks like etc.
the changing individual decisions taken continually in design. This is what called ‘co-evolution of the problem and solution space’. According to that view, in parallel to the transformation of the design form (F), the initially set design problem is also subject to be transformed with the changing behaviour (B) of the design form. (see Figure 5.3)

![Diagram](image)

**Figure 5.3.** The co-evolution of form (F) and behaviour (B) in design. Note that the upward arrows basically indicate analysis, while the downward ones imply form synthesis. (After: Poon et al., 1996: 710).

As seen in the simple model, a design solution does not represent the final statement, but the designer’s current understanding of a problem. In this respect, each problem is conditioned by the preliminary definition of the solution and each sub-solution is the provisional response to the transitional definition of problem space, respectively. Thus the earlier decisions indirectly affect the subsequent solutions within a kind of ‘path-dependence’. Gaining new insights on the behaviour of form through successive moves can be also regarded as a kind of learning process intrinsic in complex systems. In this context, creativity is not a sudden leap from problem to solution space, but building successive bridges between the evolving pairs till the solutions satisfactorily respond to the evolved problem space (Dorst, 2003: 17).

The model also implies the unpredictability of the design solution. Like in any complex phenomenon, the generation of design form, is subject to a certain level of uncertainty. The designer cannot foresee the steps taken beforehand. This is mainly due to the ambiguous relationship between form and spatial behaviour. To Lynch (1981), city design, as the creation of the possibilities for use and management via novel forms, particularly operates in the domain of ambiguities (p. 290). Uncertainty in design mainly stems from the dynamic nature of criteria definition. Since a design criterion is the function of (external) constraints and (internal) values, it usually tends to change through the recognition of new constraints during the formation of design solution (Lawson, 1980: 109). A new recognition might substantially change the direction of design exploration making the overall process remarkably unpredictable.

The framework that we have depicted so far implies a kind of reflective process preforming through the internal conversation of the designer. This point is originally conceptualised by Schön (1983). According to Schön (1992), the design process is constructed on the sequential conversational of seeing-moving-seeing. Following the graphical representation of the conceptual design idea by drawing, the designer recognises new and even unintended configurational features [seeing]. Then (s)he manipulates the emerging form –moving– for another step of perception and appreciation –seeing– (pp. 5-7). This cognitive structure is characterised as the dialectic of (design) sketching by Goldschmidt (1991). For her, the designer’s incremental moves in design drawing involve recognition of the emerging qualities
of the form ['seeing that'] and triggering new analogies by reinterpreting the transforming scheme ['seeing as'] (pp. 138-140). This cognitive capacity of the designers enables them to cope with uncertainty in a gradual manner.

Drawing, in this regard, has a significant role in design cognition. To Doğan (2009), design drawing functions as a medium to record tentative thoughts, and provides an interface for the conversational articulation of the design image (p. 24). Performing as the external memory of a designer, drawing is a tool to overcome the inherited limitations of the working memory (Simon, 1996: 92; Holyoak, et al, 1995). Temporarily storing the information about the form, design drawings suggest both a kind of reference source and stimulus for the next incremental moves in design. Therefore it is quite possible to follow the gradually developing reflection process through the successive sketches of a designer. Yet sketching-and other crafting methods (i.e. solid modelling, cut-outs) are not only the cognitive tools of visual-data processing, but also a sort of sensory engagement of the designer through the uncertain exploration of new compositions in design (Kasprisin, 2011: 151).

During sketching, designer cannot specify all the details. However, the intrinsic ambiguity of the sketch is not weakness in design. Incompleteness of design drawing enables the designer to explore more formal possibilities, and to transform the emerging form many times over. Such a ‘speculative’ [rather than a fixed and ‘authoritative’] nature of design drawing (Lawson, 2004: 43, Mitchell, 1990: 57) can be taken as the source of reflective thinking based on numerous iterative moves in design.

Figure 5.4. Ambiguity in design sketching: ready to evolve into the unpredictable complex forms (Sources: C. Forgaci, 2011; Laseu, 2001: 188)

Sketches of designers show us that designer does not have a complete image in their mind before starting design. (see Figure 5.4.) They construct the final image by developing the vague and tentative sketches gradually. By this way, design process does not freeze with an early concretisation of the initial idea (Goel, 1995: 193).

Graphic communication by drawing is a fundamental technique to cope with complexity in design. As argued by Laseau (2001), with its sequential nature in expression, verbal language has certain limitations to represent complex phenomena. Whereas performing with various symbols and relationships, graphic language is simultaneous and open to multiple-readings, therefore capable of representing complex situations (p. 55) such as spatial patterns.

Asking exactly the same question, coping with complexity in design, Jones (1970) addresses, scale drawing [rather than sketch] as the primary tool to manage complexity. For him, enabling the designer to alter the shape of product to manipulate it as a performative
model, scale drawings shorten the time of performative feedback without embodiment of
the project in real (p. 28). Though it sounds correct in principle, we should note that the
flexibility of the design media for a dynamic change in model tends to decrease from scale-
free sketching to definite design drawing (or modelling) remarkably. This means towards the
end of a design process, the capacity of managing complexity is relatively reduced in design
drawing.[9]

Whether they are pre-parametric (sketchy) or parametric (scaled), all design drawings
have a shared property as we have also argued for mapping in the context of morphology:
abstraction.

As argued by Lawson (1980), a designer cannot fully comprehend the various compo-
nents of a design problem until (s)he generates solutions (p. 121). Even after generation of the
solution in a visual medium this cognitive limitation still remains valid. Because the
designer cannot fully control all the variables and their parameters of design. Therefore (s)
he utilises the basic method of abstraction, the purposeful reduction of (visual) informa-
tion to manage the complexity of design process.

**Figure 5.5.** The basic forms of abstractions in
design: the unitary abstraction by showing only
the selected layer of the designed form –above–,
and structural abstraction by highlighting the
critical details of the form operating in different
layers –middle– or by illustrating the configura-
tion of the main structural elements (i.e. nodes,
links and plains). Note that all ignore the vari-
able, which are insignificant for the momentary
purpose. (Sources: Anonymous student work
in TU Delft Faculty of Architecture, 2011,
Coenen, 2001: 10, Kuiper Compagnons, 1988a)

It is possible to classify the modes of
abstraction in design into two, unitary and
structural. Through ‘unitary abstraction’,
the designer leaves out some selected compo-
nents of the form, which are not necessary for
the concerned design operation. It enables
the designer to see only the aspects, which
are critical for the corresponding design
theme –i.e. building setting, landscaping–.
(see Figure 5.5, above) Within the ‘structural

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[9] Whether such a limitation is valid within the emerging techniques of parametric design is one of the
main questions to be discussed in the next chapter.
abstraction’, the underlying logic of spatial organisation (i.e. connections and separations) is delineated. It can be either in the form of showing only the critical details and their coalesce (see Figure 5.5 -middle-) or in the form of reducing the compositional elements (i.e. built fabric, road network) into abstract geometries (i.e. plain, line and point) to see the relative positionings and internal order. (see Figure 5.5, below)

**Figure 5.6.** Abstracting a complex form-composition by reducing it into two layers, the water and street network enables the designer to see the morphological correlation between the network elements. (Source: By courtesy of A. Jordan and R. Bakker, BGSV, 2011)

In all cases, selection of the type of abstraction is made by the designer’s intention and the focus of attention at the specific phase of design (Hoover et al., 1991: 240). (see Figure 5.6.) Yet, in any case, abstraction reduces the size of design space controlled by the designer and accelerates the modification process in form generation (Ulrich, 1988: 22).

**Figure 5.7.** A hypothetical design process evolving from abstract to concrete form-composition (Source: The author’s personal archive, 2005)

The established idea is that design proceeds from the abstract to the concrete (Asimov, 1962: 5; Rittel, 1964: 96). (see Figure 5.7) In that view, a design process is in a linear progress from a simple conceptual diagram to the detailed definitive form. (see Figure 5.7) For Dorst (2003), this is quite a matter of cognitive efficiency, since detailing is a laborious work to achieve pictorial quality in design (p. 56).
Nonetheless, this viewpoint conflicts with the recent design protocol studies showing that designers’ mind performs in a dynamic way by forward and backward movements in terms of the levels of abstraction. That means concretization through detailing is accompanied by the recurrent abstractions in design (Hoover et al. 1991: 242). Though we will test that point in our design analysis below, it would be useful to briefly mention some related arguments. Lynch (1981) claims that design is developed by the sketches, which are loose and unresolved for the whole, and sharp and precise at the critical details (p. 247). That implies whatever found critical in the process, it would be subject to be detailed. This point is supported by Lawson (1980) with reference to Robert Venturi, an American architect: “…sometimes the detail wags the dog. You don’t necessarily go from the general to the particular, but rather often you do detailing at the beginning very much to inform” (p. 39). Then he adds that the common tendency of designers is driving the process by exploring both detail and large-scale configurations in parallel. This is what he calls ‘parallel lines of thought’ (Ibid. p. 212).

In terms of abstraction, diagrams are the prominent tools in design. They represent the design object with reference to the underlying morpho-logical concept(s) without specifying the metric qualities, exact location and material (Baker, 1989: 66). That’s why; diagrams are the scale-tolerant drawings like sketches. Yet unlike sketches, diagrams represent the underlying logic of formation. In this respect, diagrams can be classified into two, static/configurational and dynamic/organisational. (see Figure 5.8)

**Figure 5.8.** Static/configurational –above- and the dynamic/organisational –below- types of diagrams in design (Sources: Berkus, 2001; A student work in UCL The Bartlett MArch Urban Design Studio, 2010)

Accordingly, the static diagrams, on the one hand, designate the fixed configuration of spatial elements in terms of their relative positions. The dynamic diagrams, on the other hand, inform the organisation and the generative relationships between the basic components, the rule(s) of composition. In this sense, they call for unlike compositions by use of the morphological rule-set schematically illustrated. Configurational diagrams illustrate the spatial divisions and connections mostly in the light of external factors (i.e. wind, sunlight). Whereas organisational diagrams mainly involve drawings on form-composition
in terms of sequences and phases. (see: Figure 5.8)

Different diagramming techniques may imply different design approaches (i.e. compositional versus generative). In this regard, the relation between the diagram and the design object is a critical one. In architectural design, a single diagram can be directly converted into the form-composition without any fundamental transformation (see Figure 5.9) In urban design, the situation is substantially different.

Figure 5.9. The typical use of diagram in architecture: There is usually a direct link between the diagram and the architectural design as the indicator of the complete control on design object. (Sources: J. Mayer H. Architects, 2011; UN Studio, 2003)

Figure 5.10. The initial design diagram of the Kattenbroek Master Plan –left-, the design model –middle- and the areal view of the actual development –right- Only in the case of large-scale projects developed by a single authority, the design diagram and actual fabric converges. (Sources: Kuiper Compagnons, 1988b)

Despite the rare examples of ‘compositional urbanism’ (see Figure 5.10), it is hardly possible to construct a direct link between the design diagram and urban form in urban design. This not due to the lacking design skills of urban designers, but mainly because of the collective and complex nature of urban form as discussed before. At that point, the use of diagram as the main tool for urban design might be subject to the rightful objection. As argued by Shane (2010), unless they are used as ‘genetic’ urban codes for the design of new urban patches, the diagrams suggest an obvious risk to reduce the desired complexity of urban form. In this regard, there is a very subtle distinction between the reduction of com-
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plexity in design, and the reduction of the complexity of the designed urban form. While the former is a cognitive strategy to manage design process, the later represents an avoided simplification of the form itself.

Finding a novel solution within an ill-defined problem space (Rittel and Webber, 1973) is a very challenging cognitive task in its own right. So in addition to abstraction, typology can be considered as another fundamental tools to cope with complexity in design. As argued by Jones (2001), during design process, the designer’s imagination acts upon the library of types and precedents, which are constructed through long-term experience, learning and memory. In this regard, types are used to organise design knowledge to generate a solution (p. 52). For Colquhoun (1969), free from the design approaches, the link between typology and design is an essential one. From this perspective, one would argue that the use of existing types in design essentially offers a kind of comfort zone for the designer to rely on the already experienced forms and patterns.

Then the question comes: Just for the sake of managing complexity, do the designers replicate the existing types and precedents? The answer to such a question would be categorically negative unless in the case of ‘routine design’. During the design process, designers implicitly construct creative links between the existing models and the design model by relating different types within single framework (Ulrich, 1988: 149). (see Figure 5.11). The notion of ‘creativity’ here lies in the selection of the relevant attributes of the certain types and their novel combinations within one model.

Figure 5.11. The traces of analogical thinking in urban design: some basic organisational models (above the drawing) and their synthetic application in Bernard Tschumi’s design scheme for Parc de la Villette, (1982) –left-, and as an example to recalling generic and local typologies for novel design solutions: Le Corbusier’s design drawings for Algiers through the analogical reasoning with the local building setting. (1933) –right- (Sources: Tschumi, 2000: 48; Le Corbusier, 1933/1964: 230)
The mechanism behind that creative linkage is not an arbitrary one either. Through design explorations, designers recall their personal repertory, and use analogies (Koberg et al., 1972: 111). As scientists employ analogies making connections with something already known to understand the unknown phenomenon, designers make use of analogies to reach the unknown domain of the new design solutions (Abel, 1988). Therefore, analogical reasoning is considered as a rich source of knowledge for designers in the context of indeterminacy (Holyoak, et al., 1995: 199). It should be also noted that the type of analogical models developed by designers basically characterises the design idea to be synthesised.\(^\text{10}\)

The framework that we have depicted with reference to types and analogies essentially implies the intrinsic relationship between morphology and design. We can easily assume that without looking at the existing forms and patterns, recognising their spatial and operational attributes, designers cannot develop their own design knowledge to be reutilised as precedents within further design operations. This entails the cognitive basis of the operational cooperation between the two domains, design and morphology.

**Figure 5.12.** The basic compositional moves—the first three rows above—, and a hypothetical application of the successive design operations with few design moves composing an urban block through increasing complexity—below—. (Source: Çalışkan et al., 2008)

In the context of morphological thinking, we observe another point about managing complexity in design. In spatial design, whether it is explicitly presented or not, the designers think via the simple units, called ‘primitives’, the elementary graphic symbols such as lines,

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\(^\text{10}\) Within his comprehensive review, Abel (1988) classifies he mostly used architectural and urban design analogies into two: *formal* and *procedural models*. Accordingly, formal analogies are the productive sources for imagery (visual or structural) and the procedural ones are about the conceptions of the form organisation (pp. 164).
surfaces and solids (Mitchell, 1990: 37-52). Such a way of thinking is not up to the personal choice of designers, but in fact, as a result of the complex nature of form-giving processes. [As argued by Simon (1996), via the combinatorics of a few primitive elements, the limitless variety can be created by design (p. 166)] Since complexity evolves from simplicity (Simon, 1996: 216), this is the only way for designer to achieve artificial forms having certain level of complexity. In this sense, like the architectural forms articulated via the simple primitives to be (re)combined through richer compositions (Mitchell, 1990: 49), designed urban compositions are also the product of successive combinatoric operations with abstract primitives. (See Figure 5.12)

The point is that the morphological complexity is not achieved by ‘all at once’, but in sequential stages in design (Goldschmidt, 1991: 130). Generation of a design image via small steps in the form of the simple compositional moves is the very basis of design thinking. The more the designer iterate the small-step moves, the more the design solution may get high coherence.

Figure 5.13. A fragment from the design sketchbook of O. M. Ungers, the German architect urbanist: A conscious morphological way of thinking by deriving the elementary compositional variations for design. (Source: Ungers, 1982: 30)

Slightly contrary to the argument of Simon (1996), despite the rich combinatoric possibilities of abstract compositions, the solution space in design is not unbounded. For Mitchell (1996), the creative capacity of a designer to extend the morphological possibilities highly depends on his/her knowledge of shape vocabulary and the repertoire of basic form operations –i.e. geometric transformations- (p. 128). (see Figure 5.13) The knowledge-based capacity again signifies the necessary relation between morphology and design.
3. **Modelling the design process: major perspectives on design thinking**

Behind all the models built to explore the structure of design thinking, there is an underlying premise: ‘beneath the surface regularities, modes of operation, common information-handling procedures can be identified’ in design (Rowe, 1987: 39). Such a structuralist assumption, in fact, performs as the driving force of all the researches in design methodology.

From that perspective, we can start our review of the early models on design thinking with the first work published in its genre, Introduction to Design, authored by Asimov in 1962. In his book, Asimov (1962) characterised the (engineering) design process as having three phases: the feasibility study, preliminary design and the detailed design. Within his framework, each phase has a cyclic structure consisting of six steps: analysis (of the problem situation), synthesis (of the solutions), evaluation and decision, optimisation, revision and implementation (Asimov, 1962: 42-46). Asimov thus implicitly introduced the notion of iteration in design and provided a dynamic perspective on the common perception of design thinking. In his view, the goals and the criteria of design are formulated by analysis, i.e. the diagnosis of the problem statement and the comprehension of the given situation. Accordingly, design synthesis (the solution) is possible only following a reasonable formulation of the problem statement (Ibid, p. 20-21, 44).

This basic assumption is also observed in all other models of the 1960s design methods movement.[11] From the movement’s technical-rationalist point of view, the ‘optimum’ design solution was believed to be acquired by the explicitly defined complete data and pre-defined relevant parameters (Rowe, 1987: 49).

A few years after Asimov (1962), Archer (1965) suggested another operational model from the same perspective. In his ‘systemic’ model, he defined the sequence of activities in design by emphasising the embedded backward loops in the process. Here, the analysis is preceded by the programme, which in turn determines the quality of the data set for the analysis.

![C. Alexander's conceptual model of design: nested hierarchy of design requirements (in the simple case of a kettle) -left- and the interrelated set of variables designating specific concepts -right-](Source: Alexander, 1964: 62, 65)

In the heyday of the design methods movement, wishing to ground design on a logi-

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cational structure, C. Alexander (1964) suggested his own model. While differentiating modern design from traditional craft, he conceptualised design thinking as a self-conscious process. Accordingly, designers have tended to tackle complex design issues by applying a logical structure to the problem space. To cope with complexity, Alexander suggested that designers decompose the design statement into a tree-like structure consisting of a number of interdependent design variables. Each subset of these closely linked variables designates the partial solution spaces as concepts. (see Figure 5.14) The sole task of the designer is then to synthesise the form by reacting to this pre-formulated analytical and hierarchical structure.

Figure 5.15. The map of architectural design process by Markus (1969) and Maver (1970) (Source: Lawson, 1980: 37)

At the end of the 1960s, Markus and Maver elaborated on the mainstream approach in the context of architectural design. They suggested that the design process is composed of sequential and iterative decisions from analysis to design (Markus, 1969 and Maver, 1970 cited in Lawson, 1980: 37). (see Figure 5.15)

Under the influence of systems engineering, all of the models suggested up to the early 1970s share a naïve tendency of tackling the problem as a whole and controlling the system holistically instead of making separate improvements (Rittel, 1972: 151-153). The underlying assumption was that design proceeds from gathering and analysing information to understanding the ‘problem’ and then generating the ‘solutions’ immediately before the design assessment and test (Ibid).

Nevertheless, from the early 1970s onwards, there has been a remarkable rejection of the ‘scientific’ methods of design formerly propagated by the design methods movement (Cross, 2001: 50). In the emerging period of critical design studies, the noteworthy influence of H. Rittel on design theory was evident. In his seminal article written with M. Webber in 1973, Rittel argued that the information required to define a problem in planning is not always available and complete. Moreover, it does not necessarily guarantee the ideal solution for the parties concerned and their various interests in planning (Rittel et al., 1973). In design terms, this point implies that the necessary information to define a ‘design problem’ is not always available, and the information acquired do not guarantee an ideal solutions for all the parties having different interests on the solution either (Ibid).

Since the ‘design methods’ period, there have been no visible explicit rational formulations of the design process in terms of analysis and synthesis in the literature. By the 1990s,
the focus had shifted to the poorly defined cognitive structure of problem structuring and solving (Goel, 1995). In this context, and with reference to the major evolutions in perspective, Jones (1970/1992) identified three major approaches in design methodology. He categorised the representative designer models as a black box, a glass box and a self-organising system. (see Figure 5.16)

**Figure 5.16.** The main conceptual models of design (After: Jones, 1970/1992: 46-56)

These models differ from one another in terms of the nature of control over design processes. In Jones’ first model, design is a subconscious activity in which creativity is fuelled by intuition and sudden mental leaps. Therefore, a rational explanation of ‘what happens inside’ is not possible (p. 46). In the glass box model, any design operation is inevitably supported by the flow of information from the outside world, and proceeds according to a rational sequence of analysis, synthesis and evaluation. The underlying assumptions here are that objectives and design strategies are fixed in advance, and that the solution is applicable as long as the analysis is completed (Ibid, p. 50). This approach is based on the positivist premise of design being rational problem solving, as supported by the design methods movement discussed above.

Finally, the self-organising system model suggests a flexible framework for design thinking. Recognising the limits of the human mind in exploiting the universe of possible solutions in design, this model views design as a self-reflective process that responds to the actions of designers themselves. Consequently, the designer is able to control the design process by monitoring his/her own actions through the constant evaluation of partial solutions (Ibid, pp. 55-56). Unlike the former approach, this model does not involve a fixed problem structure with a predetermined analytical role.

The self-organising system approach, which is widely accepted within the design methodology circle, was mainly inspired by the paradigm introduced by Schön (1983). Characterising design as a self-reflective practice in which designers think in action, Schön suggested that design is a discipline in which designers have to use argumentative reasoning to deal with uncertainty and complexity (Cross, 2001: 54). By conceptualising design as an open and reflective act, this view represents a compelling counter-argument to the positivist paradigm that envisages design as ‘science of the artificial’ based on instrumental rationality (Simon, 1969).
4. Design methodology in urbanism: a brief overview

The ‘urban’ versions of the methodological design theory are historically rooted in the rational formulation of modern planning made by Scottish urban theorist Patrick Geddes in 1915. Considering the city as an evolving organic system, Geddes defined the plan of the city as the consequence of a systemic survey and analysis. His underlying assumption was that rational solutions to urban problems could be generated by collecting sufficient data and detailed information in order to acquire a thorough understanding of towns and cities (Jones, 2001: 51-52). Geddes stated: “For our survey of things as they are – that is, as they have become – must ever suggest ideas as to their further becoming – their further possibilities… In a word, the survey prepares for and points towards the Plan.” (Geddes, 1915: xxvi) Such a rational approach to planning challenged the conventional views on physical design based on the artistic planning approach (Sitte, 1889/1945). The Geddesian approach replaced the implicitly established perception of design as an intuitive process with the concept of design as a rational problem-solving activity. While the former suggests that design is a rather autonomous act within the real problematic context, the latter addresses it as a linear process that proceeds from the systemic analysis of the environment to contextually optimum solutions (Jones, 2001: 51). Even a century later, Geddes’ simple yet powerful formulation ‘survey before plan’ [like diagnosis before treatment (Tyrwhitt, 1949: x)] remains a powerful doctrine in the contemporary schools of planning.

In the late 1960s, under the influence of cybernetics, the systems view gained a dominant position in planning theory. By conceptualising planning not with ‘the Plan’ as a physical end product, but with the operational mechanisms to control the behaviour of (spatial) systems, the systems planning approach was essentially conceived to oppose the ‘master plan’ approach of the early modern town planning school. In this view, the design operation could only be performed after acquiring a comprehensive understanding of the interacting (economic, social and biological) dynamics of the complex system (Hall, 1975: 212). With reference to urban design, it should be noted that in systems planning ‘design’ is not an act of creating a physical form, but an act of controlling the system in a socio-spatial manner.

Like in the theory of design methods, we see clear rational conceptualisations on planning and design processes in the literature of systems planning. Mentioning two prominent models from the literature would provide a general idea on the perspective.

As an exemplary figure in the systems view, Chadwick (1971) defined the planning process as the optimisation of the system with a predictive model that describes the future

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12 ‘The Plan’ in Geddes’ writings – originally written with a capital P – implies the master plan with a fixed physical design. Such a perspective was also transformed by the emerging views in planning.

13 By saying that, the author does acknowledge the complex understanding of societies, environment and cities originally introduced by Patrick Geddes (Meller, 1990). The point is that ‘survey, analysis and plan’ (S-A-P) model associated with him did not originally imply a strict model by Geddes (1915). Following his arguments, one can see his main focus to understand the contextual dynamics and shape the planning solutions according to the complex web of local inputs (i.e. the geography, climate, the economic life, and the social institutions in a planning context). Nevertheless, many planners in the course of time, interpret the model as a kind of methodology to be followed [without the original intention seen in his early writings]. The latter perspective left little room for various interpretations (i.e. different procedural models, design programmes) based on a flexible approach to design process in modern urbanism [as opposed to a linear model of ‘analysis before design’]. In the context of the thesis, the critique is specifically directed to this point.

14 Originally defined by American mathematician N. Wiener in 1948, cybernetics is the science of information that studies regulatory control systems and their operations.
change by understanding the past. He therefore started the process by problem finding, and constructed his model based on a series of system analyses conducted in parallel with consecutive decision-making (pp. 63-66). By ending the process with feedback, the systems model presupposes the cyclical characteristics of design. (see Figure 5.17)

![Figure 5.17. The ‘rational model’ of planning process by G. Chadwick (1971)](After: Chadwick, 1971: 68)

From a similar perspective, another conceptual framework on planning is offered by A. G. Wilson (1968). His model takes the form of a relevance tree in which the tasks are given sequentially in phases. In the interest of ‘understanding’, the entire planning process is initially built upon the prediction models of the system before it is designed. While design is triggered by the problem formulated by the predictive models, policy is regarded as the consequential execution of the design after the evaluation of the plan.

Table 5.2 The design process in planning according to Levin (Source: Levin, 1966: 9)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The identification of design parameters</td>
</tr>
<tr>
<td>2.</td>
<td>The identification of independent variables</td>
</tr>
<tr>
<td>3.</td>
<td>The identification of dependant variables</td>
</tr>
<tr>
<td>4.</td>
<td>The identification of relationships among parameters and variables</td>
</tr>
<tr>
<td>5.</td>
<td>The identification of values of independent variables</td>
</tr>
<tr>
<td>6.</td>
<td>The identification of constraints governing dependant variables</td>
</tr>
<tr>
<td>7.</td>
<td>The identification of constraints governing design parameters</td>
</tr>
<tr>
<td>8.</td>
<td>The identification of values of the design parameters</td>
</tr>
<tr>
<td>9.</td>
<td>The identification of expected values of the dependent variables</td>
</tr>
<tr>
<td>10.</td>
<td>The investigation of the consistency of values, relationships and constraints</td>
</tr>
<tr>
<td>11.</td>
<td>The comparison of, and selection from, alternative sets of parameters values</td>
</tr>
</tbody>
</table>

With his two seminal articles that discuss urban design from a methodological perspective with an explicit conceptual model on design, Levin (1966) represents a pioneering
5. DESIGNING the MORPHOLOGY

position in the field. In light of the external factors involved in the planning process, Levin describes urban design as a long series of sequential activities. (see Table 5.2)

Still maintaining the same assumption of design as a cyclical process (Ibid, 10) based on the sequential actions above, the overall process is supposed to result in the optimal solution being achieved from a complete identification and selection process. The enduring belief in optimisation here is a direct result of the conception of design in which the design solution follows a long period of information processing for the identification of variables and parameters. Nevertheless, by prioritising the act of designing as the identification of parameters prior to analysis, the model suggests an alternative perspective compared to its counterparts at that time.

After the long-enduring influence of the systems view in spatial planning, Lynch (1981) put forward a design-oriented procedural approach to planning after Levin (1966). Unlike Levin, Lynch took a similar standpoint to that of the design methods movement and prioritised analysis before design. Nevertheless, considering that “each problem has its own set of peculiarly relevant data, which will not be completely revealed until the design is complete,” Lynch defined design analysis as a general exploration and information inventory of the plan-site for the formulation of design objectives, rather than the initial phase of problem definition. In this context, the site analysis, along with the definition of the objectives and the detailed programme, leads to ‘the heart of the matter’ – the design (design development, review and definitive drawings) (pp. 244-246).

A few years after Lynch, the first book on the urban design process was published in 1985. In reviewing all the major views concerning design methods and processes – i.e. incremental, pluralistic and radical – Shirvani (1985) defined a ‘synoptic method’ of design in detail (see Figure 5.18). With this model, he addressed data analysis as an

![Figure 5.18. The ‘synoptic’ urban design method by H. Shirvani (Source: Shirvani, 1985: 111)](image-url)
important (and initial) step that is “often necessary to stretch the imagination, improve the perspective and obtain technical expertise” (p. 112). Such a technical-rationalist perspective consistent with the mainstream movements of 1960s goes along with the basic dictum that “the formulation of goals and objectives for urban design should be based on facts rather than on a designer’s interests and values” (Ibid).

As one of the few authors to discuss the urban design method in the contemporary literature, Moughtin et al. (1999) adapted the architectural design models of Markus (1969) and Maver (1970) to urban planning and design and described the process as the consecutive application of analysis, synthesis, appraisal and decision (pp. 5-6) (See Figure 5.19). Although not characterised as a linear process as conceived by Geddes (1915), but as a cyclical process compatible with the feedback-based systems approach, the model proposed by Moughtin et al. is based on four steps, starting with analysis in the form of accumulation and assimilation of problem-related information (p. 5).

![Figure 5.19. Planning and design model proposed by Moughtin et al (1999: 5)](image)

Finally, in his recent book on urban design as the composition of complexity, Kasprisin (2011) defines the design process with an initial step of ‘understanding of reality’ through an n-dimensional matrix of cultural, spatial and historical variables of the context (a). By deducing a specific urban meaning and functionality from the matrix (b), the designer should come up with a programme accordingly (c). After establishing a coherent spatial order in accordance with the programme (d), the design proceeds with the imposition of the spatial organisation in the context (e). The overall process is concluded with compositional decisions for meaningful patterns and forms (f-g) (p. 7). (see Figure 5.20)

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15 In their complementary arguments, Moughtin et al. (1999) applied a flexible approach to the actual process of design. For them, designers may start the entire process with ideas for change and intervention – similarly to the hypothesis in the scientific process – or with surveys and data collection (p. 7) as in the Geddesian model.

16 Note that the method of defining the programme before the design is similar to the early decomposition approach by Alexander (1964).
5. A critical reflection on the conventional approaches to design thinking in urbanism

The review of design methodology in urbanism provides us a series of problematic points, which would be subject to the critique from the contemporary design paradigms’ point of view.

As we seen in all the models depicted above, there is a hidden supposition on a specific relation between analytical knowledge (i.e. morphology) and design. In that view, the act of decision-making in design is simply assumed to be the product of linear information processing, which is systematically conducted by the designer with a complete data-set primarily constructed. The most influential critique on that assumption is originally found in Hillier, Musgrove and O’Sullivan’s (1972) seminal article on ‘design and knowledge’. Their main argument is that induction and verification\(^{17}\) as the predominant methods of positivist science had already been replaced by the logic of hypothetico-deductive schemes (pp. 2-4).

Unlike the early conception of the designer who collects data about the problem statement and verify his/her solution through optimisation, designers, in fact, initially construct a cognitive-map via approximation of a solution to pre-structure his/her understanding of the problem. Thereafter they tend to organise only the (contextual) information needed. Then again, the information collected is not for developing the solution, but for testing the rough conjecture made at the outset of the design process (pp. 9-10).

The paradigmatic shift on design thinking that Hillier et al. (1972) suggested originates from the theory of Karl Popper, an Austrian philosopher. In his influential article, Popper (1956) introduced the concepts of conjecture and refutation. Accordingly, he defined

\(^{17}\) Verification is the action of demonstrating or testing the correctness of a theory or statement by means of evidences and circumstances. Induction means deriving theories from the facts acquired through observation (Chalmers, 1978/2010: 54),
conjecture\(^{[18]}\) as the source of scientific inquiry and suggested refutation as the sole method of science. According to him, observation requires interest and orienting perspective as a framework. That is the reason why, scientific theories cannot be developed via mere observations but the presuppositions to be tested by observations. In this framework, he concludes, “…the success of science is not based upon rules of induction, but depends upon luck, ingenuity, and the purely deductive rules of critical argument. The actual procedure of science is to jump conclusions often after one single observation” (p. 7).

If we replace science’ with ‘design’, we would essentially come up with the same conclusion. This point essentially signifies the idea of design as a solution-led activity, rather than being preceded by systemic analysis (Lawson, 1980). As argued by Cross (2006), designers do not take analysis as a means to fully understand the problem space, but that for the evaluation of solutions [in relation to the context] during the design process (Cross, 2006: 78).

Bamford (2002) revisits this point by questioning the positivist approach to design assuming the priority of analytical observation in design process. Jones’s (2001) proposition of design solution as ‘an early hypothesis to be tested, drawing on pre-existing models, rather than the end-point of the long accumulation of facts’ (p. 52) basically supports this idea as well.

The ‘empirical orthodoxy’ in modern town planning that dominated the 1950s is based on the strong belief in comprehensive measurement and analysis of society and space as a reliable (scientific) basis of instrumental action [the design intervention and policy formulation] (Rowe, 1987: 161). However the renewed conception of design and the role of analytical knowledge in design process let us question the fundamental postulate of planning on the relation between scientific inquiry and design.

The so-called rationalist tendency to precede any planning and design process with an in-depth analytical endeavour disregards the underlying cognitive distinction between scientific research and design. As demonstrated by the comparative analyses, scientists tend to focus on the underlying structures of an existing phenomenon from a problem-oriented point of view. Whereas designers are keen on thinking in terms of solution-oriented strategies and conceptualisations (Lawson, 1980: 43). In the context of urban design, though understanding the real problems of the cities is a crucial part of the field, assuming a one-way link between analysis and the design decision actually suggests serious risks to suppress the intrinsic nature of ‘designerly way of thinking’ (Lawson, 1980) requiring certain disconnection from the real context with a constructive perspective.

As Gordon (1961) argues, detachment and involvement are the two fundamental actions of creative thinking in terms of getting outside and inside of the problem space during the design process (Gordon, 1961 cited in Koberg et al., 1972: 114). In spatial planning, the common inclination to dismiss any mental disconnection from the real context and the creative speculation mainly directs from the settled conception of design as problem solving to be led by a true association via comprehensive analysis.

The point is that though Rittel and Weber (1973) have radically challenged that old idea of scientific optimisation in planning, such a paradigmatic shift has not been influential on the conventional understanding of design in planning. As argued by the authors, in the context of ill-defined (wicked) problem-spaces within social planning, not only solution but also the definition of the problem is disputable (pp. 161). With reference to the systems ap-

\(^{[18]}\) Conjecture is the act of supposition or guessing conclusion, which is likely or probable, based on insufficient information. (OED, 2011)
approach that assumes a comprehensive information processing for a so-called optimum solution, Rittel et al. (1973) clearly argued that;

“… For wicked problems, however, this type of scheme does not work. One cannot understand the problem without knowing about its context; one cannot meaningfully search for information without orientation of a solution concept; one cannot first understand, then solve.” (p. 162).

Regarding spatial design with its intrinsic societal content, we can also view design from the same perspective. If this is the case, then how the designers respond that given condition? As clearly argued by Cross (2006), the ill-defined problems of design cannot simply be solved by absorbing information for analysis. Quoting British architect R. MacCormac, “… what you need to know about the problem only becomes apparent as you are trying to solve it”, Cross (2006) argued that design is an ‘opportunistic’ activity, which requires information only if exploratory directions are taken. Rather than accepting the problem given, designers tend to understand the problem by framing the design statement by means of the adopted design conjectures (pp. 32, 79). This point, which is based on the idea of wickedness of design problems (Rittel and Webber, 1973), is as relevant to urban design as it is to architecture.

In the context of the inherited uncertainty in design, this view signifies the incompetence of the exhaustive analyses aiming to define problem before achieving the ‘correct’ solution. That brings the idea of design as a solution-focused strategic way of thinking (Cross, 2001: 7). Yet, such a conception should not mislead us to perceive analysis as a redundant act in design. The contemporary understanding of design has already excluded the old-cliché of ‘science is analytic; design is constructive [or synthetic O.C.]’ (Gregory, 1966 cited in Cross, 2001: 7). Analysis and synthesis are not separable in design (Rittel, 1964: 50). Considering both the need for understanding the design context and the solution-led nature of designing, urban design professions operationalize the analytical procedures in their design process differently from the way in scientific researches, which prominently are conditioned by problem statements. This point will be thoroughly discussed in our design analysis below.

6. Urban design process revisited: an evolutionary perspective

As depicted so far, under the theoretical influence of the early physicalist and later on the systems approach in planning, the procedural models in urban design are highly influenced by the inductive and technico-rationalist views on design process. That perspective essentially represents a stark contradiction with the contemporary understanding of design, which is quite shaped by the idea of self-organisation. The current paradigmatic view categorically rejects any deterministic conception on design (Hillier et al., 1972; Rittel and Weber, 1973; Rowe, 1987; Lawson, 1980; Cross, 2006). Nonetheless, in order to alter the conventional stance in urbanism fundamentally, we need to revisit the epistemology of spatial design, beyond merely relying on the contemporary theories of design thinking.

For that purpose, in the current part of the research we will tend to construct an alternative conceptual framework on the process of spatial design to update the settled perception of design thinking in urbanism. First, we will develop an evolutionary perspective on the phenomenon of design in general. By this means, the author basically aims to come up with a consistent theoretical background on design process, which would be eventually utilised to gain more insight on urban design as a cognitive process.
6.1 Evolution and design: the basic mechanisms and principles of evolution and its relevance with design

As the pioneer of modern planning, Geddes (1915) is the one who originally related the idea of (social) evolution to the emerging act of systematic planning and design. Steadman (1979) originally introduced the macro-perspective to the issue of design and evolution within the general context of design theory. Marshall (2009) put the same perspective into the context of urbanism with an updated evolutionary understanding of cities, planning and design [mainly established by Geddes (1915)] in the light of the contemporary theories of complexity and emergence. However, even though the micro evolutionary approach to design has been developed by design studies in the last decades (Maher et al., 1996; Gero, 1996; Poon et al, 1996; Dorst et al., 2001), urban design theory has remained highly ignorant to the evolutionary dynamics of spatial planning and design thinking. In other words, the macro evolutionary perspective of Geddes (1915), Steadman (1979) and Marshall (2009) has not been ‘localised’ [in Hillier and Leaman’s (1974) term] into the specific context of (urban) design cognition.

In this regard, the author attempts to respond this point by suggesting a design cognition-oriented, micro-evolutionary outlook to urbanism, which was briefly introduced by Jong (2009) before. To that end, some essentials of the concept of evolution and its relevance with design will be initially discussed. Clarifying the main concepts, the author aims to come up with a detailed descriptive models of spatial (and urban) design process. The original contribution of the model(s) is aimed to be a specification of the cognitive components [and their intrinsic relations] in consideration of urban/spatial design.

Though originated from life science, the notion of evolution has a wide area of application from computer science to medicine, philosophy and social sciences. With its original connotation, we can define evolution as the recognised transformation of living organisms into different forms by the accumulation of random changes over the heritable characteristics of the successive generations (OED, 2012). The simplest and most overarching form of the definition comes from Charles Darwin, the founder of the modern evolutionary theory: ‘descent with modification through natural selection’ (Darwin, 1859: 435 cited in Marshall, 2009: 161).

We can define evolution with reference to its three basic mechanisms inheritance, variation and selection, through their connotations in design.

*Inheritance* in evolution means continuity between the generations via the genetic instructions of organisms which are transmissible to the offspring (Evans et al., 2001: 27). The genetic code of the parental forms is reproduced via the replication of DNA, which specifies different protein molecules forming the bodily characteristics of an organism (Ibid: 49). This leads to the fundamental difference between genotype and phenotype. The genotype of an organism is the underlying genetic structure, the inherited genetic code instructing the formation. Phenotype is the observable traits of an organism (i.e. its form, physiognomy and behaviours) as the expression of its genetic instructions (Miller et al., 2006: 156; Mayr, 2002: 19). With his article, though Jong (2009) subtly relates the major evolutionary dynamics like combination, mutation and selection, he does not put forward an explicit model representing the characteristic relations between the (evolutionary) factors in the context of spatial design. Moreover, he disregards the role of inheritance as one of the most fundamental evolutionary mechanism in design thinking for the sake of a conscious emphasis on the notion of diversity by design.
5. DESIGNING the MORPHOLOGY

In the context of making artefacts, the mechanism of inheritance is also valid in different means. The basic know-how of the artefact is transmitted as the abstract (design) codes to the future generations (Steadman, 1979: 78). This enables the typological continuity of the design product. In this sense, while the design instructions and conceptual models derived from the precedents function as a genotype, the observable morphological attributes of the artefact can be considered as the phenotype in design. As phenotype is the result of interaction between the genotype and the environment (Mayr, 2002: 98), design is the product of the reflective communication between the abstract design knowledge and context.

While population of organisms make copies of themselves through reproduction, the copying process is not perfect (Evans et al., 2001: 27). Though the species tend to preserve a certain standard form via inheritance, the genetic recombination processes are always inclined to the structural deviations (Miller et al., 2006: 169). The random ‘errors’ causing changes in genome during reproduction are called variation. In the context of design, though the basic (typological) information of the artefact is inherited, its physical exposition of the design is always subject to the certain deviations from its original code. This basically leads to variation in type (Steadman, 1979: 78). The purposeful variations in the overall ‘artificial evolution’ process can be called ‘design’.

As the third mechanism of evolution, selection is the survival of the fittest formations adapted to the given environmental conditions. If the deviated traits of the individuals gained through variation adapt to their environment, they will have a better chance to be selected for survival. (Pallen, 2009: 50). When the selective factors in natural evolution are the environmental forces, their counterpart in artificial evolution (in design) is the actual user performance (i.e. needs, expectations and appropriations). In addition to the selection pursued by the third parties after the production of designed artefact, designer’s purposeful selections made through the individual design process can be regarded as a part of the artificial selection as well.

Reconsidering variation and selection together, we would say evolution has both contingent and necessary characteristics. While genetic variation is a random (accidental) process, natural selection is a non-random (conditional) phenomenon depending on specific selection functions of environmental factors (Mayr, 2002: 133-34). In terms of necessity and contingence, design exposes the same characteristics as evolution. While the intuitional search for novel compositions may represent the chance-factor of design, the purposeful selection of the ‘fittest form’ against the initial intention (the design criteria) and the constraints (the programme of requirements) basically characterise the conditional nature of design.

To Lynch (1981), “design is the playful creation and strict evaluation of the possible forms of something, including how it is to be made” (p. 290). In the definition, while the former implies random variation, the latter one connotes selection in evolutionary terms.

After specifying the shared mechanisms of evolution and design, we can continue with tracing the evolutionary features of design thinking.

We can specify evolution with the phenomenon of emergence, the state of gradual

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20 The sudden and spontaneous changes in genomic sequence are called mutation as the major source of variation. Variation by mutation is triggered by the environmental factors (Miller et al., 2006: 54). Nevertheless, mutation is not the sole basis of variety for organic evolution. Even without mutation, regular reproduction of genes provides an unlimited source of genetic novelty (Miller et al., 2006: 161).
outgrowth observed within self-organising living (biological), non-living (physical) and artificial systems lacking any central control system. Since emergence as an unforeseen phenomenon arising from the local interactions of the elementary units (Poon et al., 1996: 711), it does not require any blueprint of the final global form, but the simple ordering rules conditioning the individual actions. As discussed by Marshall (2009), though the local actions might be purposeful within themselves, the global pattern is non-intentional in emergent systems (pp. 151-61). Additionally, emergence per se does not involve the mechanism of selection, unlike evolution (Ibid). Then, considering the basic motivation of planning and design to meet certain fitness criteria (i.e. cultural, economical), what is the relevance of emergence in the context of design?

As Batty (2008) argues, one can consider design as ‘an incremental growth or change process operated from the bottom up in the same way that cities grow as some synthesis of multiple quasi-interdependent actions’. Parallelly, we can claim that design thinking has very emergent properties. More specifically, designing large-scale spatial patterns inescapably involves a series of piecemeal accumulations, local adaptations and incremental transformations. (See Figure 5.21)
Figure 5.21. The sequential fragments from an urban design drawing: emergence of the design composition can be observed through the piecemeal additions and local changes which are not preconceived at the outset (Source: The author’s personal archive, 2010)
Designers cannot control the multiple-variations and the overall system coherence at once within one design move. As discussed by Schöns et al., (1992) they rather develop the overall design form through reflecting upon the ‘evolving’ intermediate forms as the products of their successive design moves. Each incremental design move basically steers the next one in a gradual manner (Schön et al., 1992: 154-55).

Then the evolutionary gradualism in design can be taken as a tool to cope with complexity. As opposed to the non-projective explorative trials in the manner of big intuitive mental leaps, designers have a common adherence to the small-step moves in design process for the sake of cognitive efficiency. As originally argued by Perkins (1981), effectiveness of the gradual procedures directs from the fact that a ‘large number of small steps may cover more ground than a leap’ in design cognition (Perkins, 1981: 151 cited in Rowe, 1987: 61).

As emergence might involve the individual acts of conscious will without the overall outcome having been intended (Marshall, 2009: 170), design also implicates many incremental conscious moves towards the ultimate form, which may not necessarily be as an exact response to the final-image initially set by the designer. Finke et al. (1992) argues the issue in terms of the relevance of anticipation in design: “during the design process O.C. [ … unexpected features and relations appear in the preinventive structure. By definition these features and relations are not anticipated in advance and become apparent only after the preventive structure is completely formed” (Finke et al., 1992 cited in Poon et al., 1996: 705). In this sense, the emergent features of design directs from the non-deterministic explorations within design thinking. Although designer’s particular moves can be the product of particular conscious intentions, the emergent form is not always how (s)he anticipates at the outset of the design process. Therefore design is not a predictable, but a loosely-structured emergent process comprising the sequences of situated acts based on a series of design statement evolved during the process itself (Gero, 1998).

One of the key concepts linking evolution and design is exploration. As there is no termination point in evolution through which the species evolve in an open-ended—uncertain-process, design exploration is not constructed on a certain trajectory to follow for a desired end. Likewise, there is no identifiable end in design. There are always better options to come up through further explorations. While exploring new form-structures, new concepts are introduced though they might not fully presumed beforehand (Hertz, 1992: 397). Then again, design has no definite boundaries (Logan et al., 1992). Many aspects about the design problems emerge only after some attempts made for the generation of a solution (p. 3). This usually makes the final design form of design unexpected within the context of uncertainties.

With his seminal article, Gero (1996) is the first author who relates evolution and design within single framework. Involving the concepts, genotype (design rules), processes (combination and mutation), phenotype (structure) and fitness (behaviour), he basically addresses the emergent nature of design based on evolutionary continuity. For him, while the

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21 The use of the term, ‘evolution’ is in a generic way implying the substantial transformation of the form. Otherwise, as I pointed out before (see Chapter 2), the individuals (phenotype) do not evolve, but their genotype (S. Marshall, 2011), through a private communication).

22 Dorst (2003) contributes to that argument by indicating that design is not a sudden mental leap from problem to solution, but a matter of evolutionary exploration through constant shuttling between transforming problem definition and corresponding solutions (pp. 17).

23 The term ‘preinventive’ implies here the design form in progress.

24 Time, budget and information are the only practical factors of limitation in design.
intermediate forms acting as the commencing seed for the next generation in design process, the emergent (unexpected) structures and behaviours provide an opportunity to extend the solution space of design (pp. 445-46).

Evidences suggest that designers are continuously inspired and conditioned by their own working drawings rather than imagining the end product in advance. Lawson (2004) describes the implications of design drawing as such: “...It is almost as if the designer were putting something down in order to ‘stand back and look at it.’” (p. 46). This signifies the emergent quality of design process in which, the designer may follow different paths (ways of exploration), which are not preconceived at all.

As Dawkins (2006) argues, “natural selection, the blind, unconscious, automatic process … has no purpose in mind. It has no mind and no mind’s eye. It does not plan for the future. It has no vision, no foresight, no sight at all” (p. 5). If so, then what is the relevance of all the evolutionary argumentation made on design as one of the most purposeful actions of human mind? [25]

At first glance, the analogy between evolution and design can be seen rather controversial in consideration of the notions of purpose and conscious will, which are lacking in evolution. Design and invention, in general, are categorically regarded as the consciously preconceived, purposeful acts of creation, though the aggregate outcome is impersonal and non-directional in a wider context (Marsh, 2009: 169). Despite the fact, we do not have to consider design processes contrarily to evolution. Regarding the purposeful but still the emergent [in the sense that there is no predetermined image to create] nature of the different domains of evolution [i.e. cultural transmission, genetic engineering etc.] (Ibid, p. 173) we can surely place urban planning and design into the general framework of evolution. This is clearly true when considering the collectiveness of urban form as the subject of various purposeful designs in the large context. Nonetheless, what still needs to be argued is that to which extend this point applies for design thinking on the scale of human cognition. This requires a shift from the macro-perspective of Marshall (2009) and Steadman (1979) to the scale of individual design process. [26] For that purpose, a closer look at the design process by evolutionary terms would potentially provide us a renewed conception of design(ing) in urbanism.

Consequently, after constructing the conceptual framework of the evolutionary nature of (spatial) design in general, we can elaborate the idea by mapping the design process mainly in terms of the fundamental mechanisms that we discussed above.

6.2 An evolutionary model of (spatial) design thinking

Based on the conceptual framework of the evolutionary mechanisms, variation selection and inheritance, the author suggests a comprehensive model to describe the cognitive morphology of spatial design. (see Figure 22)
Figure 5.22. An evolutionary framework of spatial design process.
As we discussed above, the precedential knowledge is intrinsic in design thinking. As the DNA of living organisms is replicated for the offspring in organic reproduction, the existing built environment provides designers with the ‘genetic codes’ for the new design synthesis. Deducing the rules of spatial compositions and the basic knowledge of typological elements [of urban form] to recombine them, in turn, for the new variations can be regarded as the mechanism of inheritance in design thinking. Tzonis (1990) addresses the exploitation of precedents as the models to be synthesised as novel solutions in design. Lynch (1981) clearly asserts that ‘no one creates form without precedent’ (p. 289). In this framework, what we call type in design is a set of ‘genetic instructions’ transmitting the information of certain class of artefacts to the future generations (Steadman, 1979: 77). Therefore, existing built fabric composed by various urban types can be regarded as the ‘gene-pool’ for the recombinant act of urban design. In urbanism, whether systematically held or not, recognition of the compositional logic of urban form (morphology) can be seen as the first step in design. Recognition of existing patterns principally provides a foundation for diversity which is the prominent aim of design act. Such a way of thinking via the memory of previously solved similar problems is called ‘cased-based reasoning’ (Schmitt et al., 1991: 248). In this sense, morphology can be regarded as the essential part of design thinking rather than just an autonomous field of inquiry.

Variation is usually taken for granted in consideration of design. Doubtlessly, it would be a kind of tautology to argue variation for design of which the ultimate objective is creating novel forms. However the forms of variation is the critical issue to discus, at this point. Acting upon the inherited design typologies, variation is the central phase of design process. Based on the acquired (‘inherited’) precedential design knowledge, variation in design analogically involves the two basic evolutionary operations, recombination and mutation. While recombination implies synthesising the already known typological rules and elements, mutation refers to the purposeful or accidental transformations occurred in the basic aspects of the design instructions during the generation of new design forms. The richness of the generation through form exploration is up to the limits of the morphological vocabulary of the designer and his/her cognitive skills of synthesis. While the former represents the declarative knowledge of ‘what’ (i.e. propositions and images on elements and materials) the later implies the procedural knowledge of ‘how’, the techniques of the creative procedures (Stillings et al., 1987: 18-19; Logan et al. 1994: 13)

In design variation, exploring new form-compositions is not a deterministic one if not blind and arbitrary. What make design as a kind of creative exploration is the rough image initially constructed in designer’s mind (Rittel, 1964/2010: 99). The phase of forming an initial concept-like image can be called ‘pre-parametric design’, which deliberately disregards the metric properties of the forms and patterns. It basically specifies of the constituent elements of the design and the interconnections within an abstract fashion (Ulrich, 1988: 15). Such an abstraction makes the diagrammatic conceptual forms manageable for further articulations through design. To Hybs et al. (1992), the existence of such a pre-conception of the design solution (as ‘the seed design’) is consistent with the evolutionary nature of design in terms of the conversion from simple to the more complex forms p. 282).

Goel (1995) calls the transformation of the conceptual (pre-parametric) form in design ‘lateral transformation’ which means the modification on a design form through the changes in structure rather than the metric properties of the form itself (p. 210). In this context, the following step in variation is called ‘parametric design’. Introducing the measurable attributes of urban form (i.e. the actual setting, layout and massing), parametric design basically translates the conceptual form to the definitive design by means of a series of iterative assessments and metric elaborations. Though it is essentially a generative process, parametric design also involves a kind of selective self-reflection on the design form. Once the parametric design scheme emerges with its tactile qualities, it tends to expose its compositional (i.e. size, shape, coverage) and the configurational properties (i.e. hierarchy depth) to be transformed by further design moves. According to the observed performance of the parametric design form, the iterative transformation is run. Throughout a self-reflective process, the designer is not completely independent. The operation is guided by the existing set of design codes and regulations in order to make the design proposal ready for the external (public) control process.

During parametric (trans)formation, the designer tends to relate the design model to existing context. This is what we could call, the ‘consistency test’ in design. Via the testing feedback-loops, the designer revisits the constraints and the potentials of the given context as well as the initial conceptual scheme (the pre-parametric model) accordingly. Feedbacks required through the analytical reflections are utilised as new inputs for the further operations during parametric design. In this regard, the designer does not look at all the aspects of the design environment beforehand, but basically selects the relevant ones, which would be beneficial and critical in his/her design decisions. Therefore, the complete definition of ‘problem space’ in design occurs only after the construction of the ‘search space’, not the other way around. That implies the ‘solution-oriented’ nature of design. Then again, such a reductionist reasoning is not a weakness, but the necessary cognitive condition due to the limits of working memory, which hardly manages a large amount of environmental information.

As seen in the diagram, selection in design process is realised not via the self-reflection of the designer within his/her individual (cognitive) domain, but also through the external communication process pursued with the stakeholders involved. Once the parametric design scheme is proved as satisfactory by the self-reflective process, it is put forth as the candidate solution to be negotiated with the external participants. For that purpose, the parametric design scheme is simulated against the future context to be tested by the third parties. In the light of the critical feedbacks received, the design scheme is mostly subject to ‘vertical transformations’, in Goel’s (1995: 210) terms, without any substantial change in the primary structure. Then following the revisions made in accordance with the iterative (external) feedback, definitive design is ideally accomplished.

Regarding the overall context, we can base our main argument of the evolutionary nature of design on the five major premises as follow. Design thinking is evolutionary, in essence, owing to;

- the conditional influence of the context on a design concept (genotype) and form (phenotype) – environment-,
- the perceived typological continuity between the design instances and existing forms utilised as precedents for the individual design solutions – inheritance-
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- the intrinsic tendency for diversification, and form generation through purposeful or accidental deviations from the given typologies – variation –
- the test and control mechanisms acting upon the intermediate and final design solutions – selection –
- the unpredictable trajectory of transformation based on local adaptations and gradual (trans)formations – emergence –.

Thus, according to the conceptual framework depicted above, each design process operates with a series of interrelated and iterative moves, which are characterised according to their relative position within the whole procedural context. The moves discussed here are described and interrelated via the analogy of the basic evolutionary mechanisms. Such an analogical framework is believed to provide us with a better insight about the common structure of design thinking, which would be experienced through different forms by different designers. In this sense, the scheme is not intended to be perceived as a fixed procedure to be followed, but a descriptive (procedural) model representing the underlying operations of (spatial) design.

6.3 A procedural model of urban design

In order to delineate the specific characteristics of the operations in urban design process, a step-wise model will be suggested in the current section. (see Figure 23) The model is believed to be supplementary to the conceptual framework discussed above. The model is aimed to provide a compact description of the internal operations of urban design to be organised in sequential phases.[28]

![Diagram of urban design model](image)

**Figure 5.23.** The conceptual model of urban design: Fa: actual form, Oa: actual operation (behaviour), Pa: actual performance, Pe: expected performance, Ea: actual environment, Es: simulated environment, I: initial design idea, C(∑Fn): conceptual (re)combinant form, Fs: simulated form, Os: simulated (emergent) operation of the form, Ps: simulated performance, D: definitive design, Fa1: actualised design.

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28 The evolutionary model suggested here is not originally the first in its genre. The first attempt to build up a comprehensive model of design process from an evolutionary perspective was made by Hybs and Gero (1992). Re-conceptualising design with reference to the major mechanism of biological evolution [i.e. cross-over, mutation and inheritance], they basically relate the basic terms of design within one procedural model. What the author basically tend to do here is to propose a model in the specific context of spatial design by revisiting some original concepts argued by Hybs and Gero (1992).
As seen in the diagram, the whole design process comprises various feedback and feedforward moves in an iterative fashion. The internal loops and the parallel processes embedded truly make the design process complex to be modeled. Regarding this point, the author tends to define the overall process by means of the brief descriptions of the steps cited in Figure 5.23, above.

(a) Form analysis:

The first phase of design process can be considered as a kind of task definition via form analysis (a). Since urban design is basically a kind of task-based public service, definition of a design task is mostly made by the design control agencies as a result of monitoring the built environment. Likely, the individual designer drive his/her own analytical process [not necessarily prior to a certain design decision] in order to recognise the intrinsic morphological qualities of existing forms and patterns in terms of the actual operation (Oa) and performances (Pa) (Tzonis, 1990: 7-8).

The term, ‘operation’ implies possible functioning of a form; and ‘performance’ entails the fulfilment of the claimed functioning of a design form in a given context (Güney, 2008). In this sense, performance of the form (P) is the function of design parameters (i.e. size, shape, structure) and object parameters (i.e. view, shading, circulation) manipulated by the designer (Rittel, 1964: 113).

![Urban Pattern Diagram](image)

**Figure 5.24.** An exemplar case for form analysis (F-O-P) in urban design

Reconsidering a street pattern in these terms would clarify the concepts in urban context. (see Figure 5.24) In this sense, *form* of a street pattern indicates the compositional or configurational characteristics of the network. (i.e. network density, mean depth etc.) *Operation* of the street pattern is about the basic aspects of functioning (i.e. access and movement) afforded by the form. (i.e. taking a number of turns to access from major to the local routes) Accordingly, the concept of performance informs of the level of specific user operations that the street pattern affords. (i.e. permeability in terms of access, and integration in terms of movement). (see Figure 5.24)
Whether it is realised systematically or not, form analysis, in a way of learning from precedence is essential for creative design process (Tzonis, 1990: 13). The point is that the initial phase of from analysis does not necessarily have to be in the form of problem definition. Though the designer may recognise some situations that would be improved by design, (s)he might also make this analysis tacitly to recognise the actual morphological relations inspiring his/her own design solutions.

(b) **Design briefing:**

The critical move from the actual performance (Pa) of an urban form (or space) to the expected one (Pe) implies the formulation of the criteria of a new design. This is what we can call *design briefing*. In most cases, the designers receive the programme of requirements from the project developer or the design control agency who determines the main design objectives and performance criteria. In cases of design tasks lacking a programme that involves any a clear performative definitions, the designer make his/her own design briefing. This is done by establishing the goals, uncovering test concepts and determining the needs and the requirements to be met in design (Pena and Parshall, 1969 cited in Dubberly, 2004: 21)

If so, is the sole task of a designer to search for the physical expression of the design solution meeting the requirements of the programme given within the design brief? The principal answer to this question would not be positive. Performance criteria of an urban form are numerous and in some cases, conflicting with each other. In this sense, even after receiving (or composing) the design brief, the designer has to prioritise and redefine the initial performance criteria mainly through his/her subjective evaluation. This ultimately makes design an argumentative reasoning process in the context of the intrinsic wickedness of planning and design problems (Rittel, 2010: 189). Furthermore, a design brief is not a fixed framework. It is usually subject to a dynamic change during design development. In this sense, the designers’ task is not an absolute obedience to the programme, but mainly the exploration of possibilities within the limits of the framework given in the programme (Palmboom, 2010: 39). Last but not least, design briefs may not always fully explicit about the design objectives. In that case, the designer has to formulate his/her own set of performance criteria, in the light of his/her initial intentions (I)[29].

(c) **Concept formation (cross-over):**

Once the expected performance from a desired form-composition is specified by the brief, primary design operation starts with the definition of the conceptual form. The concept-form is a kind of prototype on which the further design operations are to be successively realised. It is initially supposed to satisfy the expected performance (Pe) set by the brief. Guided by the personal intentions (I), which are informed by the analogical models, the designer comes up with one or alternatively several recombinant form-concept(s) \([C(\Sigma F n)]\) through crossing over certain typological elements (vocabulary) and the compositional rules (grammar) in mind. Selection of the rules and elements for concept formation is not a random process. It is a rough hypothetical response to the desired performance (Pe). (see Figure 5.25)

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29 The design intention (I) here means the identified need and purpose of the design (Hybs et al., 1992: 284).
Figure 5.25. Novel conceptual combinations in design: construction of a new kind of screw in mechanical design –above– (Ulrich, 1988: 137) and a composition of a street in urban design –below–

The recombinant definition of the form-concept signifies the use of analogical reasoning in design.

As the process of genetic crossover is potentially open to various mutations in biology, re-combinatory formation of the design concept comprises various (potential) deviations from the existing form-types. As seen in the hypothetical design scheme below (see Figure 5.26), the possible ‘mutations’ through crossing over different elementary form types, as ‘design codes’, might involve some removals of the existing code factors (rules or elements) or insertion of the new ones as occured during genetic variations of the life forms (Pallen, 2009: 136).
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**Design gene:** \((e_1, r_1)\)  
*design code*  
\(e = \) element, \(r = \) rule  

\(\{(\text{building, disjointed}), (\text{building, on the ground})\} \)

**Design genome:** \(\{(e_1, r_1), (e_2, r_2), ..., (e_n, r_n)\}\)  
*gene-complex*

\(\{(\text{path, disjointed}), (\text{path, suspended})\} \)

**Crossover**  
\(\{(\text{building, disjointed}), (\text{building, jointed})\}\)  
\(\{(\text{building, on the ground}), (\text{building, on the ground})\}\)  

**Mutation**  
\(\{(\text{path, jointed}), (\text{path, jointed})\}\)  
\(\{(\text{path, suspended}), (\text{path, sunken})\}\)

**Prototype**  
\(\{(\text{building, disjointed}), (\text{building, suspended})\}\)  
\(\{(\text{building, jointed}), (\text{building, sunken})\}\)

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**Figure 5.26.** A hypothetical example to the ‘genetic crossover’ in design.

Expected frequency of mutation in design is far more than those in biological evolution.\(^{30}\) This is mainly due to the purposeful motivation of design to generate novel form compositions.

Within this framework, after the process of recombination (cross-over), a new set of design codes are composed. Then, the abstract schema storing the combined design information is accordingly called *prototype*. A prototype basically performs as a tool to convey the basic design idea to the next phases of design. As argued by Gero (1990), prototypes are *‘the generalised heterogeneous groupings of elements derived from alike design cases that provides the basis for the start and continuation of a design’* while creating new instances (pp. 30-31). Since a design prototype is the product of a new set of abstract design codes acting like *genome*, it is still at the conceptual level without any metric property involved. The degree of mutational change in recombination basically characterises the type of design in terms of the degree of novelty, the level of deviation from the existing form-typologies (i.e. *routine* or *innovative design* (Gero, 1990)).

Before discussing the concept of prototype in more detail, it would be useful to men-

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\(^{30}\) In organic life, the probability that a gene will mutate is often less than one in a million. (Dawkins, 2006: 57)
tion a possible question, which was already asked by Marshall (2009): “After all, a single human designer, for example, could create a series of designs that could be said to evolve, from one to the next. Can this case be called evolution, when the transmission is not genetic?” (p. 171). Due to the indeterminacy in the definition of the ‘units of transmission’ in design [unlike the biological evolution], Marshall (2009) does not give a precise answer to that question. In our framework, we assume that the design codes are the basic transmitter of the design knowledge, which are explicitly expressed or implicitly utilised in design process. From this perspective, Hybs and Gero (1992) discusses the use of ‘design genes’ as the complete information required for generating design form(s) within the subsequent phases of the design process (p. 286).

That assumption on design thinking can be based on the idea of ‘meme’ argued by R. Dawkins (2006) in the context of cultural evolution. As the abstract knowledge of the cultural ideas, behaviours, values and rituals; memes are supposed to act as the transmitter of the cultural codes like in the fields of language, fashion, art and architecture. They are the basic unit of imitation being transferred among the individuals through communication as if a DNA transferred from one individual to another. Like biological genes, memes are also open for mutations through diverse interpretations in the long run (pp. 189-201). Then, design codes comprising the basic instructions for prototyping the design idea can be also considered as a kind of meme, the generative cultural replicator. Sharing the similar features with the existing form-types design codes perform as instrument for the typological continuity in collective urban form.

![Gene pool (instances) Prototype Genotype (g-model) Design phenotype (p-model)](image)

**Figure 5.27.** Transmission of the genetic design code from precedent to a particular solution.[31]

To clarify the concept, ‘prototype’, we have to revisit the idea of ‘type’ in design. According to Schön (1988), who originally brought the concept into design thinking, design operates on rules. The rules are basically derived from the underlying types (p. 181). The basic function of type in design is to provide a full generic description of a particular model guiding the design process. Through certain types derived from the actual precedents (*the gene pool*), the designer structures his/her form exploration, frame the problem space and then sees how a certain rule matches with the design situation[32] (Ibid, p. 183). This conceptualisation entails that while *genotype* is a set of initial design concepts (the codes) derived

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31 The project represented as the ‘design phenotype’ is urban design project, ‘The Wall’, authored B. Van Lakwijk, H. Pel and J. Nijveldt (2011) for the Vertical Cities Asia Competition

32 Use of type is a kind of ‘safe-lane’ in design. It enables designers to avoid unintended results, since the existing typologies already prove themselves as the reliable models for the specific contexts.
from the existing (built) environment, *prototype* is the schematic image of the recombinant code used to produce concrete design image (*phenotype*)[33] (see Figure 5.27).

From the same (evolutionary) perspective, naming it ‘prestructure’, Hiller and Leaman (1974) define design prototype as a kind of connection between the genotype `-g-model-` and the design phenotype `[p-model]` (p. 5). While design genotype corresponds to the information transferred as codes, phenotype is the observed layout and the behaviour of a physical design solution (Ibid). In our model, design phenotype is the simulated form (Fs) translated from form-concept to the executed form.

The point is that the abstract nature of a prototype potentially affords high level of variation in phenotype through various parametric solutions.[34] It should be noted that transformation of a prototype into the design-form (phenotype) occurs in the phase of ‘design synthesis’ that we are going to discuss after the ‘model formulation’ below.

**(d) Model formulation**

As Lawson (1980) argues, designers usually develop their own organising principles to direct decision-making process in design (pp. 159). Comprising either aesthetic, symbolic, ethical or functional aspects, the basic design principles are involved in the model formulation of design as initial ideas (I). Originally coined by Darke (1979), the term ‘primary generator’ means very simple initial design idea that influences the main route of design search and narrows down the possible solution space.

The imagery sources of organising principles are usually the application of existing models in form of analogical reasoning. The models shaping the main design idea can be either on the form-language of the design form [i.e. organic, machine-like] or about the characteristics of design formation [i.e. contextual, bottom-up] (Abel, 1988).

The issue of diagraming that we discussed above, corresponds to the model formulation phase of design process. Both in architecture and urban design, diagrams have an extensive use to organise design ideas to express them in a simple way. For Vidler (2000), ‘operating between form and word, space and (textual) language, diagram is both constitutive and projective; it is performative rather than representational’ (p. 6). In this statement, we see the instrumental role of diagram to convert the initial design ideas into abstract spatial organisation (prototype), which is, in turn, undergoes further transformations.

As stated by Lawson (1980), the primary ideas as organising principles are not necessarily noticeable in the final production of a design (p. 47). Although the main tendency of the designers is clinging to the initial idea throughout the process (Ibid), the first design idea is always subject to loose its influential power with the successive feedbacks in the course of design.

In our model suggested, once the conceptual form prototype `-C(∑Fn)`- is generated as a prototype [in accordance with the primary design idea (I) and the expected performance (Pe)], design synthesis begins in the search for candidate design solution (Fs).
(e) Design synthesis:

Synthesis in general is regarded as the core operation of design (Alexander, 1964). As you will see in the following discussion below, design synthesis comprises various key aspects, which substantially characterise design thinking.

Synthesis in design means the act of fitting separate concepts together into an integrated whole (Asimov, 1962: 20). Once the designer starts applying an abstract design model (prototype) on the actual design context, (s)he begins to synthesise the design form through its parametric attributes.

While the medium of representation for a form-concept is diagram, design synthesis is pursued by sketches representing shape, approximate size and orientation in a quasi-pictorial way. At this stage, design moves back-and-forth between the conceptual form (the diagram) and the pre-parametric form (the design sketch). In this context, the initial design idea is also subject to change during the explorative search (design synthesis) by sketching. (see Figure 5.28)

![Figure 5.28](image)

*Figure 5.28.* The base-map of the given design context –left-, and the designer’s first design sketching –right-: Once he puts the initial design ideas on the ground, the actual design context, he came up with a new supplementary design idea. He discovered a new typological solution to be introduced. –Notice the small note signalling the emergence of a new prototype, which was not existing in the beginning- (Source: The author’s personal archive, 2010)

To clarify the process so far and to relate the idea of conceptual design within design synthesis, it would be useful to focus on the continuous relations between spatial performance and form. (see Figure 5.29)
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Urban Pattern searches for

\[ P(a) \]

Low level of permeability and connectivity on access and low axial integration and intelligibility through movement.

Potential for social segregation and insecurity.

Urban Pattern asks for

\[ P(e) \]

Permeable access on a highly-connected network

Intelligible movement pattern with with a clear integration and centrality.

Sense of security through an open network.

Urban Pattern recalls

\[ C(\Sigma Fn) \]

A conceptual design model of open grid-network structure offering space(s) at the central intersection(s).

\[ F(s) \]

The parametricized design scheme as the candidate solution to be revised through designer’s self-reflection.

**Figure 5.29.** Transition from actual (Pa) and expected (Pe) spatial performance to the simulated form (Fs) via the conceptual form \(-C(\Sigma Fn)-\) during design synthesis.

As seen in the hypothetical process depicted above, the designer is asked for a permeable and legible street network as response to the low performance of an actual pattern. Accordingly, (s)he constructs a conceptual model via recalling relevant precedences in an analogically. The concept-form is characterised as an irregular grid having central space locating in the intersection of the main axes. After the image-like construction of the idea (prototype), the designer is ready to apply it into the given context. For the compositional application, the designer has to involve parametric calibrations (i.e. sizing, angling) to fit the idea into the site. While doing that, (s)he also reflects on the original idea of central public square, and replaces it with a new one, the serial spaces on the main axis. This signifies the ongoing change in prototype as pointed out above.

The step from the concept-form to the design synthesis is called ‘instantiation of a prototype’ by Logan et al. (1992: 9). The act of synthesis here also entails knitting all the pieces of design based on their mutual dependencies (Dubberly, 2004: 22).

The critical point is that concept-form (prototype) \(-C(\Sigma Fn)-\) leading to the simulated design form does not necessarily be in the form of a fixed diagram. The concept-form as a rough image can also be expressed as a set of generic design rules rather than a parti-like diagram to be imposed on the site. While the former method suggests a kind of rule-based generative approach, the latter represents a kind of compositional approach in urban design. (see: Chapter 2)

Whether it is exposed explicitly or not, each move of design synthesis involves a series of generation (divergence) and evaluative selection (convergence) of the alternative solutions. Instead of a single step, this process is realised through multiple repetitions (Liu et al., 2003). (see Figure 5.30)
According to the first model called ‘broad-band search’, the size of solution-space is increased from abstract to the detailed form. Eventually, one concrete solution is selected. In the ‘synthetic search’, all the alternative solutions are diverted from the intermediate solutions and then they are synthesized till the satisfactory form is achieved\(^{[35]}\) (Liu et al., 2003: 252). Finally, according to the third model called ‘pre-selective search’, design synthesis is realized with the consecutive steps based on singular selections. The theoretical models on design synthesis depicted here, shares the same rationalist assumption about the relevance of alternation in design.

Exploring alternatives are somehow considered as a weakness or a sign of doubt of the designer on solution (Lawson, 1980: 208). This view considers the generation of alternatives only as a tool for convincing about the design idea or explication it for the external parties. Nonetheless, alternative thinking in design is not necessarily taken as a cognitive tool to pursue design synthesis within the individual domain of the designer. Rather, it can be explicitly used as a tool for communication to enhance the argumentative process either held with the stakeholders or within the (design) group itself.

In addition to design alternation, articulation of form-composition through layers is another core aspect of design synthesis. Through form synthesis, designers develop multiple (or parallel) lines of thought to manage different compositional aspects within one spatial frame. Then, in order to resolve the possible conflicts between different components, designers tend to articulate design form through different morphological layers referencing to each other. (see Figure 5.31)

\(^{35}\) Fricke (1996 cited in Liu et al., 2003: 352) originally suggests these two models with different names – “excessive expansion of the search space” and “balances search” respectively. The author renamed them within our own framework.
Figure 5.31. The hypothetical design drawings illustrating the design synthesis by layers: Note that the specific type of layer primarily introduced influences the ultimate form-language. Starting design with street structure –left column-, building setting –middle column- and block layout –right column-.
As illustrated in the figure above, one would argue that the order of designing the constitutional layers of urban form has an implicit effect on ultimate form. That means, for instance, if the designer prioritizes road layout in designs, the resultant form would be ruled by the composition of axes rather than the building setting or the subdivision of blocks. (see Figure 5.31) This is what we can call ‘path dependence’ in urban design.

This point is also supported by Rowe’s (1987) with a corresponding argument that the order of heuristic devices applied in design affects the ultimate form (p. 107). Likewise, as Logan et al. (1992) argues, the later decisions are constrained by the earlier decisions in design (p. 5). Considering the characteristic differences of the outcomes, one can easily take this point as an issue of style.

According to Levin (1966), the question of how urban designers choose a variable to start with is not a matter of style. It is not basically subject to the easy choice of the designer. For him, designers tend to start with a variable [read as ‘layer’], which offers the least room for the unnecessary variations in design (p. 10).

Figure 5.32. A typical design scheme by Rob Krier as a pure compositional approach to urban design -left-, and one of his preliminary design sketches composing only the network structure –right- (Source: Krier, 2006: 164; The author’s personal archive –from The masterclass at TU Delft, Faculty of Architecture dated in 10th December 2010-)

In the author’s view, designers in urbanism are mostly inclined to define the network structure primarily within their design process. The ones who principally prioritise the space quality of built form might compose the built-form even with regards to the structure of public spaces. (see Figure 5.31) This general tendency cannot be taken arbitrary. It could be related with the assumption that the syntactic structure, which is easy to visually construct, comes first before the form-composition. Lynch (1981) supports this view, by arguing that designer usually define the pattern of circulation (the structure) first, just after the

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36 In a personal interview, Rob Krier told the author that he always started urban design by drawing the main network structure as a frame of reference. Considering the authors personal style prioritising the three-dimensional quality of form-composition, this point can be considered unexpected. (The masterclass at TU Delft, Faculty of Architecture, 10th December 2010)
definition of the main spatial pattern (i.e. focal points, main entrances). Then, alternative form-compositions are studied accordingly (p. 246). In this framework, the common priority given to network structure in design is not a matter of style, but a matter of cognition.

Nonetheless, Simon’s (1996) premise that the process determines the style (p. 130) is worth to be reconsidered in terms of the procedural relationship between the part and whole in design synthesis. This point implies the discrepancy between top-down and bottom-up, a classical dilemma in design theory. In the former case, design synthesis may be pursued by controlling the whole design composition geometrically by some ordering devices like generic structural grid (Habraken, 1996: 33-35; Martin, 1972) and/or sub-divisional zones (Leupen et al, 1997: 64). Accordingly, articulation of the entire composition is directed by an overall structure. (see Figure 5.33, above) Contrarily, the designer can pursue the bottom-up formation by assembling the basic building blocks/compositional elements (i.e. building units, street segments) incrementally to achieve larger form-compositions without any overall (syntactic) structure imposed. (see Figure 5.33, above) The piecemeal growth with local articulations can be either via the rule-based transformations [i.e. elementary patterns of Alexander et al., (1977) or shape grammar by Stiny (1980)] or non-systematic compositional moves. (see Figure 5.12)

Figure 5.33. Two types of design in terms of the priority of part and whole: top-down design synthesis by determining the overall setting at the outset –above- and the bottom-up approach generating the whole without any pre-determined structure –below- (Sources: The author’s personal archive, 2008; Alexander et al., 1987: 45-49)

Without relying on an essentialist standpoint about the so-called top-down (Hillier,
f) Refinement:

Once the simulated form (Fs) is synthesised as the candidate solution, designers need to refine the emergent form and structure in terms of its operational and performative features revealed. In this regard, an intensive self-reflection is run through relational inquiry between form, operation and performance. This would also be called testing the design conjecture, which finds its expression with a solid model or sketchy drawing.

Putting in that way, we come up with the same conclusion as that of Hillier (1998) on spatial design. As he argues, “you can not know if you are likely to achieve form-function aims [performance criteria O.C] until you have a notion of the whole configuration, at least its essentials” (p. 40).

This implies in order to reflect on the original design idea analytically, the designer first has to come up with the formal manifestation (phenotype) of the design idea (genotype). This point essentially differentiates our model from the conventional ones, which ideally precedes design with analysis in the very early stage of the process.

Since the spatial behaviour (operation) of a conceptual design form cannot be predicted beforehand, emerging features of the form can be unexpected and even surprising for the designer [this is actually what makes the act of design attractive for many people]. Although (s)he has a rough intention about the expected performance (Pe), the designer can not totally foresee the possible functioning of the design form in detail. Taking in this way, one can claim that form precedes operation in design, not the other way around.

Searching for the satisfactory performance, the designer is the one who both proposes the partial design solutions and the one who judges them during the stage of refinement. During this parallel process, (s)he exercises his/her discretion by choosing a certain set of design parameters. The parameters are not systematically imposed into the design form during synthesis, but they are inferred from the emerging form reflected upon through refinement.

![Figure 5.34. The trial-and-error structure of the form elaboration in design](After: Mitchell, 1990: 180)
That process corresponds with Mitchell’s (1990) description of design as a trial-and-error process initiated by the generation of candidate solution (Fs), and continued with evaluation of the design form and structure (p. 180). (see Figure 5.34)

Note that the predicates in Mitchell’s (1990) model, which are defined by the performance criteria of the form, and subject to change through recognition of the emerging form and pattern in design.

In both design synthesis and refinement, the level of abstraction involved is always subject to constant shifts till the satisfactory form is achieved. (see Figure 5.35)

**Figure 5.35.** A focussed view on a design synthesis and refinement: The successive moves in the design process comprise a series of shifts in the level of abstraction. –the competition entry by D. Çimen and S. Erten (2005)-  (After: By courtesy of Sekiz Artı Mimarlık ve Kentsel Tasarım, 2010)
Designating the exact location of the joints as nodes on the network... Testing their frequency in overall pattern...

Reflecting on the transforming composition via partial design investigations...

Applying the emerging building-block typology through the overall design area...

Incremental transformations of the building form while keeping the already designed block layout intact...

Applying the concept roughly in a wider context.

Going back to the idea of configuration again... Recognising the focal points embedded in the structure... Coming with a new idea another building type...

Definitive design with the specified building setting, heights and depths.

A hypothetical perspective to test the emerging idea of utilising the new building type on the specified nodes...

Figure 5.35 Continued
As observed in the successive phases of the design process illustrated above, through composing and transforming the designed urban form, the designer has to operate with the different levels of abstraction simultaneously while relating the various morphological components. Such a laborious cognitive process basically requires a dynamic visual representation whether in the form of freehand or digital drawing.

The designer reflects upon his/her creation as if (s)he faces the object for the first time and explicates the parameters, which are implicitly embedded in the design form. During refinement, the designer does not only search for the consistency of the design form with the parameters, [explicitly given in the design brief beforehand], but also introduces his/her own parameters through reflecting on the emerging design form.

(g) Evaluation:

While refinement process (f) generates new information about the design, in order to transform the design solution, the received information is evaluated against the initial design intention (I) and the expected performance (Pe) provided by the brief. As discussed by Beheshti (1993), through the iterative generation and evaluation of the design form, the set of criteria and their relevant priorities are subject to transform (p. 91). In this regard, though they are the main tools to control the overall design process, the design criteria provided in the brief are not fixed, but subject to be revised in a dynamic process run by the feedback loops. Thus, briefing is essentially a continuous operation in design (Lawson, 1980).

When the design solution is developed along with metric properties, it also provides a fresh basis for the designer to recognise new relationships between the design form and given criteria. During evaluation, the designer redefines the priorities of the given program of requirements according to his/her own interpretive filter.

Though the initial concepts and design intentions are subject to be examined during the evaluation process, the general tendency of the designers is to adhere the early ideas and conceptual schemes rather than radically discarding the original scheme and developing a new one during the (re)evaluation of the design form (Cross, 2006: 83).

(h) Context analysis:

While the evaluation of the design solution(s) against the primary intention (design idea) and the expected performance goes on, a parallel feedback process is run between the simulated operation of the design form and the actual design context (the site). Testing design phenotype against the external constraints within the context is called context analysis. As a matter of fact, positioning the contextual analysis in the middle of the entire design process essentially differs our explanation from the early conventional models in urbanism. This stems from acknowledging a certain autonomy of the concept-form (design prototype) from the real context. Due to the necessary level of abstraction involved into the prototype (for the sake of creative flexibility), the designer tends to construct a direct link between the design and the context only after the design form emerges with its (sketchy) concrete formal qualities.

As argued by Schön (1983), designers shape the design situation with an initial appreciation of the context (p. 79), rather than a systemic analysis for a full understanding just in the beginning. In this context, though the impact of the (social and physical) environment
on the operation of existing forms in given context are taken into consideration in the early phase of design (i), the rather more systemic and focussed analysis has to wait till the design form is generated. The analysis involves specific design aspects such as climatic conditions, sociocultural patterns and so on.

By imposing his/her own intention to the design statement, the designer sets the boundaries of the ill-defined design problem and specifies the critical aspects of attention (Cross, 2006: 80, 91) in the analysis. Otherwise, s(he) can hardly deal with the multiplicity of the environmental factors (i.e. cultural, socioeconomic, ecological) without a frame of reference.

(k) Design description:

Once the simulated form (Fs) is elaborated by a series of feedbacks through refinement, evaluation (against the design intention) and the context analysis; and assumed to satisfy the expected performance (stated in the brief), it is explicitly described with its formal qualities. The explicit description of a design form is necessary for the required efficiency of the design communication, which involves the external review process. The variation of the forms of visual representation (i.e. perspectives, sections, solid models) involved determines the quality of the design description and the efficiency of design communication.

When the satisfactory (parametric) design scheme is selected after a recursive testing process, it is described as ‘the design’ solution (D) with the definitive parameters of space and form. Definition of the design is also guided by the official building codes and regulations. In the contexts, where the main emphasis in design control is given into the formal description of the design [rather than the concepts shaping the (prototypical) design ideas], design description occupies a central position by ignoring the preceding aspects of design thinking. [like in the case of Turkish design control system, see: Chapter 4]

Design description has to ensure the comprehensibility of the design idea by the ordinary people to whom the scheme is presented. This basically is assumed to enhance the participatory processes in planning (Lynch, 1981: 287).

(l) Design simulation:

Before being concluded as the guiding document, the design schema is always put into the context of the simulated environment (Es), as the visual representation of the future context under the influence of the designed urban form.

As discussed by Simon (1996), simulation is a technique to imitate a (designed) system to understand and predict its (emergent) behaviours according to the diverse external factors (pp. 13-14). In this sense, it is a process to obtain the knowledge about a design artefact in an imitated environment while observing the unpredictable behaviours of the design form (Ibid).

Simulation of the engineered systems involves crucial abstraction in the form of simplified models consisting well-known (mechanical, chemical) laws of behaviour [i.e. wind tunnel simulations] (Ibid, pp. 15-16). The relevance of the notion of simulation in engineering is questionable in urban design that operates in the context of high complexity. The complexity of the built environment that is hard to be represented via simplified models, makes design simulation quite a rare operation in urban design. In order to reduce urban...
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complexity and to predict the behaviour of particular spatial settings, the computerised models that represent the intrinsic macro relations between urban travel and land use patterns have had an extensive use in planning studies since the 1960s (Wadell et al., 2004: 203). Nevertheless, the use of spatial simulations has remained limited area of application in the context of urban design. Though the models such as cellular automata -based on the simple behavioural rules applied on the generic grid system- have already overcome the theoretical question of complexity to a certain extent (Batty, 2005), it is still yet to inform the design processes in urbanism.

Presently, simulation in urban design has a generic meaning based on some assumptions on environmental conditions (Es) that is supposed to exist in the projected time-period of any definitive design solution (D). The behavioural features of the simulated environment (Es) provide the basic inputs for the external evaluation of the overall design morphology. In the form of dynamic (digital) simulations or the solid models, simulation in urban design today is mainly performed as a tool to justify the design idea to the third parties to prove how the design would fit into the future contextual framework.

(m) Guidance:

In the context of planning, we discussed ‘guidance’ in terms of controlling different design applications via setting a framework of urban design principles. (see: Chapter 4) In the context of an individual design process, guidance implies controlling the implementation phase of the definitive design according to the explicit codes on different design aspects. In other words, it is conversion of the definitive design scheme (D) into the actualised design form (Fa). Coding, in this sense, is not only a pre-design act managed by the planning bodies, but also one of the core tasks in an individual design process. It is basically the concrete specification of the form-elements for the creation of built fabric in the construction phase. At that point, we can define this design phase as oppose to the process of abstraction, which mainly characterises the concept formation (c) and model formulation (d) in design.

Depending on the flexibility of the design approach experienced, the design form can be coded by abstract rule-sets, which enable further interpretations of the other designers within one structural framework, or it can be presented as one blueprint scheme with a series of definitive parameters to be applied by one developer in the construction phase. In the former case, the term, ‘designers’ would imply the architects who are commissioned for designing the buildings within the framework of a project area. In the later case, the term implies urban designers commissioned to compose different parts of the whole in accordance with the design codes provided.

We can state that the issue of guiding the construction or post-design phase in urbanism is highly disregarded in the literature (Marshall and Çalışkan, 2011: 420-21), though it is one of the fundamental phases in design process.

(n) Incorporation:

Realisation of a design scheme with the application on site does not mean the termination of the process in the larger context. As each design act is categorically informed by the morphological codes of the existing built environment, realisation of any individual design solution can be regarded as an involvement into the existing environment, which in turn
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informs the forthcoming design solutions. Usually without direct involvement of the designer, this phase is realised once the constructed settlement takes place in the actual context. Therefore, the design solution supports permanence and changing nature of the built fabric performing as the ‘gene pool’ for the future designs within the same context. Depending on the type of design (i.e. routine, innovative, or experimental), each incorporation might result in certain deviation from the existing typologies in the given context, as well.

According to the actual performance of a design form in its larger context, the actual(ised) design form is subject to the ultimate selection by the environment (Hybs et al., 1992: 288). More specifically, as soon as it affords the basic conditions of environmental performance (i.e. accessibility, comfort and security), the design form endures within surrounding urban context. Otherwise, it is transformed or redeveloped with a renewed set of performance criteria. In any case, incorporation of the design form adds further information into the collective body of knowledge on city building and place making.

7. **Designerly way of thinking in urbanism: a focussed analysis of design process [an inside view]**

The theoretical framework of (urban) design thinking we constructed so far will be tested against a design analysis involving two urban design projects. While the first project is conducted by a senior designer, the other one made by a beginner-level designer. By monitoring the patterns of action in design (i.e. reasoning, reflections and feedback) performed by designers with dissimilar levels of experience, the research aims to reveal the fundamental mechanisms, which are (structurally) common for all in urban design thinking.

The method of analysis is based on in-depth interviews with the designers and evaluation of the original drawings made during the design process.\(^{37}\) Therefore, in addition to the retrospective insight provided with the interviews, the sketches as intermediate materials of the design process enable us to follow the overall process of development and transformations in designers’ cognition.\(^ {38}\) All of the design sketches analysed were originally produced by the designers or by others working under their direct supervision. Although the designers provided many more drawings than those presented below, only the most representative ones have been included in the analysis due to space limitation.

7.1 **Case-1: design for a post-Soviet neighbourhood in St Petersburg, Russia**

The project for the first case was commissioned by a private land developer as a redevelopment scheme for a deprived neighbourhood in St Petersburg, Russia. Directed by Jason King, a British architect with ten years experienced specialising in urban design, the eight-member project team includes architects, a planner, urban designers and a landscape designer. It represents a typical size and composition of an urban design team in the United

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\(^{37}\) As argued by Cross (2006), retrospective analysis of design sketches is a prominent method of acquiring an understanding of the nature of design thinking (p. 35).

\(^{38}\) Because the size of the original images has been reduced due to space limitations, not all of the images are fully legible. However, the details of the drawings are not essential for the understanding of the phases of the design process depicted. The relevant notes from the drawings have been provided separately in the text.
Kingdom.\[^{39}\] The design process is run mainly by the architect – J. King – and a planner, and involves constant communication by means of the design sketches presented below.

01. Framing the problem-space: conjecturing:

As explained by King (2010), the design brief provided by the developer prescribes an urban regeneration programme based on development intensification within the social housing estate.\[^{40}\]

After receiving the brief and the commission, the design team commenced the four-month programme with a site visit. The aim of the visit was to observe the site conditions within the broader context and to become acquainted with the applications of local regulations (King, 2010). In this sense, the site visit by the designers revealed the preliminarily role of observation in framing the solution space in design.

The observations made during the site visit enabled the designers to identify the intrinsic patterns of local life in the housing estate conditioned by the existing modernist building types, which are incompatible with those in the fabric of the city centre. This led the designers to focus on the historical building types, which is based on the urban courtyard blocks designed in the 19th century. Because current daylight regulations inherited from Soviet urban laws inhibit the construction of the same typology for new developments, the design team concentrated on searching for alternative building typologies, which would regenerate the poor urban vitality in the area. The team combined the design goal provided in the brief, the knowledge gained with regard to legal codes and an understanding of the local context gained during the site visit to formulate the idea of an urban courtyard block and street type, which would meet the local daylight standards as well as the defined design objectives (Ibid).

This can be referred to as the conjecture of design in the form of a prototype to be elaborated by further analysis. In this sense, the designers’ initial observations cannot be characterised merely as analytical reasoning but also as synthetic and constructive. Based on this initial conjecturing phase, the whole design process could be initiated by a single idea that serves as the foundation for subsequent steps, including analysis and synthesis.

02. Explorative analysis: probing the site and design research:

The early conjecturing through constructive observation in the light of the design brief and the urban regulations was followed by the simultaneous introduction of two types of analysis: site analysis and precedent analysis. Site analysis at this stage has an explorative nature. It is not well-structured, but consists of various drawings that are not necessarily interrelated. Redrawing the existing elements and the forces within the site by means of serial abstractions enables the designers to identify the unexpected potential of the context and to introduce new concepts for the future phases of the design (see Figure 5.36).

[^39]: According to a current comprehensive urban design study as part of on-going PhD research involving fifteen design offices in the United Kingdom, the Netherlands and Turkey, the average numbers of designers in the project teams are 8.2, 4.8 and 3.4, respectively.

[^40]: The programme provided by the brief asks for 18,000 new dwelling units to be added to the neighbourhood with an area of ninety hectares.
Figure 5.36. Preliminary analyses via structural abstractions: the existing network, parcel layout and the main nodes and connections (Source: By courtesy of PRP Architects, 2010)

Through precedent analysis, the designers examined the figure ground of the existing city and the typical block layouts of cities with similar climates in Sweden and Canada in order to discern alternative public-private relationships that could potentially be introduced by the design. Through this analysis, the designers explained that they had inferred their own set of rules in addition to the regulations imposed by the city. Accordingly, one could argue that analysis in design is not solely oriented towards understanding the problem space (or context), but is also used to define possible solutions (for the context).

03. Modelling the form-concept:

Figure 5.37. The ‘development sketch plan’ as the first model of design conjecture. (the one drawn first –left- and the one proposed to the developer –right-) (Source: By courtesy of PRP Architects, 2010)

After coming up with the initial concept of courtyard blocks with internal private gardens – set as a design prototype or ‘primary generator’ – the designers had to apply this concept to the actual context in order to commence negotiations with the client. This phase is referred to model building and follows the conjecture and analysis phases (see Figure 5.37). After presenting the scheme to the developer, the design team received a positive response with regard to the proposed pattern and type.
Alternative compositions within the same typology were sought by introducing the new design strategies, i.e. ‘shifting the grid’. (see Figure 5.38)

**Figure 5.38.** The progressive sketches for the elaboration of the first model approved by the client (Source: By courtesy of PRP Architects, 2010)

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**04. Re-framing the problem-space: the implicit conjecture:**

In the last drawing above (see Figure 5.38), there is a particular emphasis on one element, namely the green corridors. This emphasis appears to be the factor behind the actual shift in design perception. A subsequent sketch includes a designer’s note: “Could we divide the site into 4 clear zones?” (see Figure 5.39). From this stage onwards, the designers conceptualised the design area in terms of the four districts. The emergent feature of their design composition conditioned their view of the existing pattern.

**Figure 5.39.** Designating the design area in zones: a new design conjecture out of the model in progress (Source: By courtesy of PRP Architects, 2010)
05. Re-analysis: morphology of the context:

**Figure 5.40.** The layers of progressive morphological analysis: pedestrian paths, roads, open-spaces, green spaces with buildings, public squares with schools and green corridors and the public squares with green and roads—from top-left to bottom-right—(Source: By courtesy of PRP Architects, 2010)

A series of (well-structured) morphological analyses were introduced. (see Figure 5.40) Contrary to common practice, the morphological research was introduced after the elaboration of the design idea. Through the progressive drawings with the gradual clarification of the existing nodes in the site, the layer-based analysis appears to be decisive in consolidating the initial concept of design areas within zones, as illustrated above. This signifies the purposeful nature of abstraction within the analytical thinking in the design process.

06. Re-conjecturing: generation of the design strategy:

**Figure 5.41.** The conceptual diagram representing the emerging design strategy (Source: By courtesy of PRP Architects, 2010)

After ensuring the relevance of the new perception of the design area through the morphological analysis above, the designers explicitly presented the design idea with a diagram showing the relationship between its key elements. (see Figure 5.41) The diagram served as an organising principle for the overall urban pattern to be generated in the design (King, 2010).
07. Thematic analysis: getting insight about the key design element:

Figure 5.42. The analyses on the schools and kindergartens in the site and in general (Source: By courtesy of PRP Architects, 2010)

After defining the key concept, clearly displayed in the conceptual diagram above [with corresponding statements such as “create school and kindergarten in each quarter” (see Figure 5.42)], the designers introduced another set of analyses. The purpose of these analyses was to test and consolidate the emergent design idea based on the schools and kindergartens in the site.

08. The model synthesis: composition:

Becoming more confident about the type of the design element (building block) and the organising principle of the overall urban pattern, the designer starts synthesising the emergent aspects of the designed urban form with various options. (see Figure 5.43) The preferred form is designed as the synthesis of these alternatives.

Figure 5.43. The design options and the ‘proposed illustrative master plan’ scheme—at the bottom-right- (Source: By courtesy of PRP Architects, 2010)
09. The model synthesis: articulation

Synthesising the model by composing the overall pattern is followed by the articulation of the form. In this regard, the designer combines and recombines the different compositional elements, form-types and morphological aspects to articulate the design form. (see Figure 5.44)

Figure 5.44.
Building typologies and their proposed applications within the overall design pattern (Source: By courtesy of PRP Architects, 2010)

10. The model synthesis: refinement:

Figure 5.45.
Refinement by the precision of the building setting within the critical sections of the overall composition (Source: By courtesy of PRP Architects, 2010)
Once the design model has emerged with its principal structure, the local transformations reinforcing the overall design pattern through precise adjustments and detailing are presented. This is referred to as ‘refinement’ of the design model. The notes on the drawings hint at the language of refinement: “we can remove the building”, “we can expand the square”, “this size can be smaller”. (see Figure 5.45)

11. Testing the emerging performance:

Figure 5.46. The thematic analyses to test the emergent performance of urban form: Permeability test by eye-level perspectives for one of the building clusters –above-, functional analysis of the squares to test the spatial opportunities provided –middle-, testing various geometries in the building setting against the daylight regulations via the ‘sun-diagram’ adapted into the CAD software –below- (Source: By courtesy of PRP Architects, 2010)

Without producing a compositional (parameterised) design model, designers cannot anticipate the actual performance of the form in various respects (i.e. visibility, integration and air and light). Once the model starts being refined, it reveals its spatial performance in a number of ways. As explained by the serial drawings, the designers reflect on their own design form by testing their emergent performance with regard to permeability, functionality and daylight. (see Figure 5.46)
12. Final conjecturing: *operation of the space:*

During the refinement phase, the designer starts thinking about the operation of the space in terms of the size, shape and configuration of the public space and the possible activity patterns. In this regard, in order to refine the final model on a smaller scale, the possible activity patterns must be specified for each public square in the design area. The final design conjecture characterises each node by allocating the facilities compatible with the local climate conditions (King, 2010). This would lead to another cycle of analysis.

13. Analysis for the final conjecture:

Figure 5.47. The climate analysis based on the monthly seasonal differentiations in average sunlight, temperature, solar radiation, rainfall, rain speed and rose –left-, and the socio-cultural analysis based on the (culture, art/leisure, sports and business) events throughout the whole year in the city. –right- (Source: By courtesy of PRP Architects, 2010)

In order to determine the responsive design schemes for public spaces, the design team determined the average weather conditions for the city throughout the year and the city’s complete activity pattern for a one-year period. (see Figure 5.47) Note that a comprehensive analysis such as this is conducted towards the end of the design process. It is added to the design team’s agenda only after the conjectures on the urban space have been completed.

14. Modelling the operation in space: *spatial articulation:*

In order to select the correct indoor and outdoor activities for the final spatial articulation of the design model, the team correlated the analytical data on the average weather conditions with the ‘culture map’ of the city (King, 2010). This enabled them to allocate the relevant set of facilities (community buildings and zones for arts and leisure) with a direct reference to the activities, i.e. festivals and games specified for each square in accordance with the analysis. (see Figure 5.48)

41 One of the drawings for model refinement (see Figure 18) contains some notes on the performative aspects of space: “quiet space-relax (sound of water),” “meeting space-parents, sports,” and “resting space.”
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Figure 5.48. Allocation of the facilities to the public spaces in the design area –left- and their detailed configuration in space (Source: By courtesy of PRP Architects, 2010)

15. Testing for fine-tuning: the definitive design scheme:

Figure 5.49. The local transformations in the design tissue –left- and the final design scheme – right- (Source: By courtesy of PRP Architects, 2010)
According to the articulation of the major focal areas in the site, the adjacent building layout was adapted locally before the design scheme was finalised. (see Figure 5.49) In this phase, the design team retested the emerging performance of the block morphology against the daylight regulations\(^{42}\) (King, 2010) and finalised the master plan. The form is subject to local transformations and fine-tuning until the very last step in the design process.

### 7.2 Case-2: design for a post-industrial zone in São Paulo, Brazil

The second case concerns a project by Claudiu Forgaci, a 26-year-old Romanian architect pursuing his MSc in the European postgraduate Master’s programme in Urbanism at TU Delft in the Netherlands. Having developed the basic skills of design and the knowledge of urban space and form, C. Forgaci represents the advanced beginner level in urbanism. The project in which he is involved is part of a design exercise coordinated by the Urban Region Networks Studio of TU Delft’s Department of Urbanism in the autumn of 2011.\(^{43}\)

In the context of São Paulo, the design task is to define individual strategic design projects that consider the future impact of the *Rodoanel*, the city’s new ring road (Balaoura et al., 2012: 11). It should be noted that the studio programme imposed no strict methods on the design process. After conducting some introductory research on the city, students were free to choose their own paths from strategy definition to the final design. In this context, C. Forgaci started the project in a design group whose task was to define a spatial strategy for the metropolitan region based on the findings from a site visit and brief preliminary studies.

As the preliminary analysis involved an introductory framework on the city’s history and key social indicators, the overall design process started with the phase of strategy definition as set out below.

Without going into the details of the project, it is possible to follow the emergence and elaboration of the design idea from the sequence of drawings provided by the designer. By selecting the most representative drawings – again due to space limitations – and observing their original time sequence dated by the designer himself, the author arranged them according to content and their implications for the thinking process as it applied to the initial analysis above. The drawings are accompanied by brief descriptions, which were provided during the interviews with the designer (Forgaci, 2012). (see Figure 5.50)

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\(^{42}\) According to the information provided by King (2010), the regulations are based on the minimum distances between the blocks, ensuring at least one habitable room with a minimum of two and a half hours of daylight through at least one window.

\(^{43}\) D. Zandbelt and Dr R. Rocco are the coordinators of the programme.
Figure 5.50. The drawings of the designer sorted according to the original time-sequence and categorised according to their intrinsic design content (Source: By courtesy of C. Forgaci, 2012)
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Figure 5.50 Continued.

10. The model synthesis: refinement

11. The definitive design

12. Design communication

0.6 Testing the model

Formulating a new set of codes on the various urban elements to be utilised in the articulation of the model of design composition.

[Figure showing urban elements and codes]

0.7 Re-conjecturing

Analysing the composition of the road and rail network and the functional zones in the site through searching for the alternative layouts.

[Figure showing road and rail network]

0.8 Design-based site analysis

Abstracting the relation between the design area and the surrounding fabric. Superimposing the existing and the proposed elements within one drawing.

[Figure showing design area and surrounding fabric]

0.9 The model synthesis: composition

The final composition that synthesises the new and existing morphological elements in the whole design area.

The design layout refined according to the precise border conditions and the network connections.

[Figure showing refined design layout]

The final design scheme presented as a bird-eye view collage in order to make a clear sense about the morphological continuity proposed from the very beginning.

[Figure showing final design scheme]

Simulation of the designed form to communicate with the third-parties with reference to the internal space-quality that the design scheme suggests.

[Figure showing simulation of designed form]
As far as the role of the site visit and the direct observations in the city and the project area are concerned, the characteristics of the design project process are the same as in the first case. During the interviews, the designer stated that, due to the difficulties of managing large amounts of quantitative data (on the city’s population, employment and traffic) for consideration in the design, he constructed a design framework (the solution space) based primarily on the knowledge acquired during the site visit and the visual data maps and satellite images provided by the city.

In the sequence of the progressive drawings above, the overall design process starts with the conceptual framing of the overall context. This analytical framework served as a basis for the global strategy and was conditioned by an early design conjecture by the designer (Forgaci, 2010). It can be inferred that the initiation of the design process did not take on the form of all-encompassing data analysis as suggested by Shirvani (1985), but instead followed a conjecture-based analytical framework. The same applies for the other analytical phases integrated into the process. It is apparent that the designer acted purposefully and selectively within the analytical studies in the design process. He focused only on the key elements and aspects for the design conjecture defined beforehand. For example, the configurational analysis (by Space Syntax) was not introduced until the composition design was ready for structural testing.

As seen in the previous example, the designer employed various emergent design statements within the analytical drawings made in order to understand the context. This demonstrates the unavoidable association between analysis and design. All of the analytical drawings contain elements that are not found in the existing context, but are superimposed by the designer as if they represent the given condition at the site.

7.3 Findings of the analysis: the shared patterns in design thinking

Considering the two examples together, the following conclusions can be drawn:

- Evidently, by going back and forth between conjecturing, modelling and testing throughout the design process, both the designers exhibit the same behaviour in design thinking. The similar patterns of the transitional phases in their design processes signify the fundamental structure of design cognition, which is assumed to be more or less the same for all designers. In this context, the designers seem to conduct an iterative, cyclical process for urban pattern formation rather than engaging in a linear approach of information processing based on successive yet essentially separate steps.

- The design elements incorporated in the analytical drawings and the speculative comments on the ‘future form’, such as “we should use it in a pavement and in the organisation of ‘rooms’” (referring to the existing footprint of a demolished building) and “consolidating development by integrating greenery into the new centres!” (regarding the existing green corridors) signify the designerly way of thinking in analysis. Unlike scientists, designers do not take an objective approach to real phenomena. They are essentially biased in their preliminary conjectures on their designs. This goes along with the argument about designers having a pragmatic and solution-oriented nature of thinking, which follows abductive reasoning (Cross, 2006; Lawson, 1980).
Nevertheless, despite having a conjecture, which implicitly conditions how one views the existing context to be designed, designers act in a non-deterministic manner through the formation of patterns. Although they have a vague image of the final form in mind, this does not prevent them from creating the unforeseen forms and patterns that cannot be holistically controlled in design. This means that, rather than mentally constructing the final design form in advance, designers are highly influenced by their own working drawings during the design process. Lawson (2004) argues this point: “...It is almost as if the designer were putting something down in order to ‘stand back and look at it’” (p. 46). In this sense, the emergent nature of design is very evident within the two examples above. For example, in his personal reflections on his own design process, Forgaci (2012) confirms Lawson’s arguments:

“The basic idea – keeping the existing heritage in the design area – was valid from the beginning, but its form emerged when I applied the abstract diagram to the site.”

“I usually draw and see what happens” – while reflecting on his own process.

The point here is that within design’s emergent and explorative nature, the practical position of analysis in design is a subject to be revisited. What is actually observed in design practice is that analysis does not play a determining role in the definition of design ideas and forms beforehand. It basically aids synthesis of the design model and the defined contextual basis and tests the emergent form. In that sense, analysis plays an intermediary role, which is key to composing and elaborating the designed form and pattern, rather than having an exclusive preliminary position from which to proceed with the rest of the design process, i.e. synthesis, appraisal and decision.

The final point is that design thinking in urbanism involves sudden shifts in scale and the level of detail. This is probably not so apparent in industrial design (of objects). As each design intervention has certain connotations for the other scale levels, designers tend to alternate between various levels of scale and detail. In some cases, the designer skips the step of considering the overall pattern, and instead concentrates on the individual building type before going back to the collective form defined by the typological unit. This implies the dynamic nature of design cognition in urbanism. This should be taken into consideration for any application of the analytical methods to respond to the designers’ way of thinking.

8. Conclusion

According to Cross (1990), designers “produce novel unexpected solutions, tolerate uncertainty, work with incomplete information, apply imagination and constructive forethought to practical problems and use drawings and other modelling media as a means of problem solving” (p. 130). This definition also applies to urbanism as an act of designing the built environment. In the cases analysed, the designers applied a pragmatic response to uncertainty by mainly acting upon the conjectural solution. They did not tend to control the complete datascape of the design context in order to ensure the achievement of the ‘optimum’ solution through comprehensive analysis. This fact should not be taken as a kind of deficiency, but as the very nature of spatial design thinking. This is the key factor that has caused us to update the conventional definitions of the design process in urbanism.
In light of the existing models discussed above, the established mainstream approaches in an ideal design process in urbanism (the Geddesian model and the systems planning approach) can be represented as an inductive and technical-rationalist approach (see Figure 5.51, left and centre). While the application of the Geddesian model (survey, analysis and plan) to urban design implies the linear production of a plan, the systems planning view suggests a cyclical mechanism for decision making in general. In both models, the role of analysis in the definition of a design solution is prioritised in an inductive manner. This is said to maintain a rationalist perspective on the epistemology of planning and design. Nevertheless, with regard to the changing paradigms in the philosophies of science and design as discussed above, the theoretical shortcomings of these approaches can be easily recognised. Moreover, considering the cognitive structure of the designers in action as mapped out above, the models’ currency in practice is also disputable.

In this context, the author suggests an alternative conceptual framework for the urban design process. Unlike the inductive and technical-rationalist background of the early models, the alternative model is based on the conceptualisation of design as a reflective (Schön, 1983), conjecture-led (Hillier et al., 1972) and solution-oriented (Lawson, 1980) practice based on abductive reasoning (Cross, 2001). From this overarching perspective constructed by the early substantial theories on design thinking, the proposed framework is defined by the four major system components: conjecture, analysis, model and test (see Figure 5.51, right).

As seen in the scheme, instead of analysis or survey, the process is generated by an initial design idea called a ‘conjecture’ (‘prestructure’ (Hillier and Leaman, 1974), ‘prototype’ (Gero, 1990) or ‘primary generator’ (Darke, 1978)) which frames the problem space and designates the focus area of analysis within design. The explorative analysis about the design idea and the context, respectively called design research and site analysis, is followed by the formulation of the model, which is the embodied (parameterised) form of the design concept (conjecture). The process ultimately ends with the phase of re-conjecturing about the other (complementary) design aspects after testing the model synthesised by means of the performative analysis. Unlike the previous schemes, the ‘self-reflective’ scheme is not linear or circular leading towards a single direction, but is essentially cyclical with the iterations embedded.
in between. This means that design proceeds not by the discrete steps from analysis to design, but through the recursive feedback loops occasionally repeated between conjecturing, analysis, modelling and testing. In this sense, analysis is diffused into the overall design process and employed according to the emergent and momentary purpose of the designer. From this perspective, when the overall design form is satisfactorily composed, articulated and refined against the initial design criteria (defined by the brief and the designer), the iterative process terminates and the design task is accomplished. In that model, morphology as an analytical endeavour is not apart from the design process to supposedly lead the design act, but on the contrary, an essential internal mechanism operating in parallel to design synthesis.

Such a descriptive model is built upon the conception of design as a reflective practice in which the designer continuously argues within himself/herself while gradually transforming and refining his/her statements on the problem and the solution-space (Rittel, 1988/2010: 188-189, Schön, 1992). Therefore, in the proposed conceptual framework, the distinctive boundaries between the fundamental design operations of analysis and synthesis tend to become blurred. This contrasts with the early conceptual models, which give analysis an over-structured and deterministic role in design. This alternative approach to the relationships between analysis and design calls for a revision of the orthodox conception of the designer as a problem solver who is supplied with clear-cut problem definitions to be solved with the necessary information that is analysed holistically in the early phases of the design process.

What is critical point here is that such a viewpoint should not mislead us into perceiving analysis as a needless act in design. Contemporary design theory has already eliminated the old cliché of science being analytical whereas design is constructive (Gregory, 1966 cited in Cross, 2001: 7). Analysis and synthesis are both indispensable parts of the design process (Rittel, 1964/2010: 50). The author’s claim is that, in consideration of the need of designers to understand design environments and the conjecture-led nature of thinking, the use of analytical procedures in design practice should differ from their use in research. Instead of utilising analysis to process design decisions, urbanists should integrate analytical methods into the very core of the design process in order to test tentative design decisions through conjectural abductive reasoning. This would make morphological perspectives far more effective within the strategic decision-making processes of urban design.

9. Concluding remarks

The current chapter of the thesis can be considered as an attempt to provide an in-depth comprehension of the fundamental relationship between morphology and design in urbanism. The term, ‘fundamental’, here connotes the cognitive performance of human mind mainly realised in perception, information processing and imagination. In this context, the research focuses on the individual domain of the designer in order to understand the basic mechanisms of design process in the way of designing spatial forms and patterns. While the main objective here was to clarify the relation between design and analysis, it has been recognised that such a cognitive question could not be answered without a comprehensive outlook on design thinking in general. From this perspective, following a comprehensive review on the theory of design and design methodology, the author suggested a conceptual framework on the process of spatial design in the light of the contemporary conceptions on
design thinking. By means of the framework constructed, the author conducted a focussed analysis of the creative processes performed by real designers. Reflecting on the findings of the analyses with reference to the conceptual framework formerly suggested, the research has been concluded with a new model of design process argued in the context of urbanism.

Within this framework, the upmost contribution of the research has been on the development of an evolutionary perspective to design thinking. Regarding the enduring ignorance on the cognitive aspects of design in urbanism, we can claim the importance of such an attempt in the way of building a disciplinary awareness on design methodology. By doing this, the author basically believes that a better insight on the evolutionary nature of design thinking would yield new methodical approaches in education as well as the practice of urban design. This would ultimately result in a perceived transformation in output quality in urbanism.

This primary motivation, in fact, led the author to focus on the very incremental aspects of design such as feedback processes, conjecturing, abstraction, exploration and selection. While doing that, the evolutionary nature of design process has been essentially revealed. The significance of the point about the evolutionary characteristics of urban design thinking derives from a broad theoretical context.

We should remind that evolutionary design approach is not something new in the theory of spatial planning and design. P. Geddes (1915), the founder of modern planning founded his whole argument about cities and planning on the basis of evolutionary thinking manifested in ‘Cities in Evolution’. P. Steadman (1979) explicated the creative relationship between biological (evolutionary) thinking and design with ‘The Evolution of Designs’. In the light of the theories of complexity and emergence, S. Marshall (2005) argued an evolutionary perspective on cities, urban planning and design in ‘Cities, Design and Evolution’. Within this given context, arguably, the suggested contribution of the research is twofold.

Firstly, as mentioned above, the evolutionary dynamics of design has already been explored by several authors before (Hybs et. al., 1992; Maher et. al., 1994; Gero, 1996; Poon et. al, 1996; Dorst, 2001). However the common perspective developed in these researches has never been revisited in the special context of urban design so far. That means the opportunities to initiate systemic discussions on alternative design methodologies based on a renewed idea of ‘evolutionary design’ have been considerably missed. This inevitably endures the status-quo of the conventional conceptions of design in urbanism, which are essentially conflicting with the contemporary understanding of design thinking as we discussed in the current chapter.

Secondly, with regards to the early ‘classical’ works cited above, the author’s attempt to model urban design process can be taken as the prominent contribution to the theory in terms of an alternative conception suggested on evolution. As argued by Marshall (2009) in his own evolutionary treatise on cities and design, one could regard evolution either as an effect or process. While former entails a consideration of the observable states (such as adaptation, speciation or specialisation), the later applies to the internal mechanisms of variation, selection and reproduction (pp. 171-73). In his own framework, Marshall (2009) suggests to interpret evolution as an effect rather than a process. He basically regards the individual design process with its own product (effect) in relation to the larger (evolutionary) context of society and culture. In the current research, the author defines the individual design (process) as an evolutionary process itself. The internal

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44 As an introductory study made by the author as the part of this research, see: Çalıskan, O. (2012) ‘Design Thinking in Urbanism: Learning from the Designers’, Urban Design International 17, pp. 272-296
environment structured within the designer’s mind, here, represents the active evolutionary context of design involving the fundamental (cognitive) mechanisms of reproduction (inheritance), variation, inheritance and selection. In this sense, through altering the notion of effect to that of process, the conceptual model of spatial/urban design suggested in the research basically tends to localise the evolutionary perspective of design defined by Marshall (2009). By this means, in a larger framework, the author aims to contribute to the evolutionary understanding of planning and design which was historically founded by Geddes (1915) in urbanism.

Though the following chapter examines the new trends and tendencies in urban design within the larger context of urbanism, the main findings of the analysis on analogue design processes discussed in the current chapter will be revisited in the light of the examined characteristics of computational design thinking.
EMERGING TRENDS and TENDENCIES in URBAN DESIGN
Generative Urbanism by Parametric Design
1. Urbanism in the context of complexity: theoretical basis of the new approaches in urban design

Though the term complexity mostly connotes the natural systems exhibiting multi-layered hierarchies and higher-order behaviours emerged through the accumulated small changes in blind process of evolution (Dawkins, 1986), it can also be associated with the human-constructed artificial systems as initially argued by Simon (1969).

Beyond its visual connotation highly confused with ‘sophistication’ or ‘intricacy’ —the amount of information needed to perceive a relational geometry (Arnheim, 1954: 55-63)—, complex systems are basically considered as the aggregates involving many components generating a recognisable global (collective) behaviour and large-scale order which are not controlled centrally, but generated by many local interactions. By definition, they are adaptive, unpredictable and generative systems up to continuous information processing (Mitchell, 2009: 12-13). In this context, the complex systems are not easily represented by the state descriptions [i.e. blueprints, diagrams], but the process descriptions [i.e. recipes, genetic programs] (Simon, 1969: 210). From this perspective, the idea complexity offers a very relevant basis also to spatial planning and design as the systemic act of controlling and generating complex spatial forms and patterns (Batty, 2007, Portugali, 2011). This point basically represents the baseline of our framework that we keep throughout our discussion below.

As a scientific discipline, complexity is regarded as the third type of physics, an alternative to classical physics that deals with few-variable problems, and modern physics based on statistical mechanics considering numerous-variable problems. By characterising it with the problems through a sizable number of variables which are interrelated in an adaptive manner, Weaver (1947) has been the first arguing the concept ‘organised complexity’ and signified the emergence of a new perspective which would be developed in life sciences.

As an American writer and activist, Jane Jacobs originally interpreted the emerging idea of ‘organised complexity’[1] in the context of cities in the 1960s. According to her, due to their interdepended dynamics spontaneously generating diversity and vitality, cities were subject to complexity as well. This new conception of the city based on the unpredictable adaptation of numerous system components (the urban elements like street, blocks and plots) would eventually overthrow the conventional holistic reasoning about city building. The alternative mode of thinking suggested by her would be basically Jacob’s (1961) prominent influence on the bottom-up generative urban design approaches in the forthcoming years. Those principles can be classified in three: 1.) Thinking about the process in terms of the elementary components of the city, 2.) Reasoning from particular to general (inductively) when thinking about urban processes, 3.) Focusing on small number of factors to understand the way leading to the larger quantities emerged (pp. 440-43).

Forty years after the publication of Jacobs’s seminal book, S. Johnson (2001) argued cities as the system of organised complexity in terms of the global structures self-regulated by the countless individual information processing and decision-making processes. Revealing the structural similarities between the different emergent systems in which local rules lead...

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1 The term was originally coined by W. Weaver with his seminal article called ‘Science and Complexity’ in 1948. In that article, Weaver (1948) presented the complexity as a new scientific discipline altering both classical physic dealing with few-variable problems, and the modern physics based on statistical mechanics considering numerous-variable problems. By characterising the middle area with the problems through a sizable number of variables, which are interrelated in an adaptive manner, Weaver (1947) has been the first signified the concept ‘organised complexity’ as the emergence of a new perspective which would be developed in life sciences.
global order, he concluded that the formation of neighbourhoods is ‘born of thousands of local interactions, shapes forming within the city’s larger shape. Like ant colonies, or the cells of a developing embryo neighbourhoods are patters in time’ (pp. 90-91).

Behind the analogy argued by Johnson (2001), it is possible to see the theory of emergence systemically discussed by Holland (1998). Investigating the complex adaptive systems, which grow and change through the feedbacks-mechanisms between the individual agents/components\(^2\) (i.e. immune system, the Internet, colonies, the global economy), Holland (1998) revealed the ‘rule-governed domains’ acting without a centralised control. Yet, the point is that, unlike Johnson (2001), Holland (1998) does not totally exclude the idea of control from the framework of emergence. This actually provides an operational room for design and the creative capacity of human being within the general discourse of complexity.\(^3\)

As stated by Batty et al. (1997), the mathematical models to predict future form of cities have been unsuccessful during the last century. The limited capability of the models to deal with unexpected, creative and nonlinear dynamics of spatial growth and transformations were even conceived as the crisis of rationality in planning (p. 74). Recognising the limits of the two conventional approaches (the linear/Newtonian science and probabilistic statistics) in understanding urban complexity would lead to the development of new working methods in urban studies.\(^4\) Such a theoretical shift would inevitably trigger the search for new types of planning and design, as well. While the former scientific discourse was engendering a strong belief in the precise control by physical master planning, the latter performed as the legitimacy basis for the functional zoning-plans confirming a kind of global control on the ‘disorganised complexity’ of cities. Both represent a top-down fashion in control by ignoring the agents and generators of urban emergence on the basis of (organised) complexity.

The patterns emerged through the bottom-up growth processes like those in the informal cities or in the traditional towns have already proved the possibility of large-scale order without central planning. Computational techniques performing the simulation of the rule-based bottom-up network growths and spatial aggregations have not only informed about the complex systems (Batty, 2007), but also implied the possibility of spontaneous spatial ordering through the various local design acts in urbanism.

In this regard, the theory of organised complexity has provided us a renewed comprehension on cities. The non-reductionist and non-statistical view basically offers an alternative perspective based on rules and local transformations, which could also be translated into planning and design. The new perspective admiring the generative power of the shared rules of emergent order (Héile, 2007) essentially contradicts with the settled perception on the incremental changes in cities. On this old prejudice, the autonomous acts, which are not subject to the formal planning procedures were considered as the source of untidiness and

\(^2\) The aggregate decisions made by the agents result in unpredictable forms as higher-level order. This makes the operation of the complex adaptive systems as a kind of emergent phenomenon. For the applications of bottom-up adaptation in different domains, see: Holland, J.H. (1975) Adaptations in Natural and Artificial Systems, Ann Arbor: The University of Michigan Press.


\(^4\) As argued by Batty et al. (1997), in the new generation of urban studies the scientific goal has been shifted from prediction to insight. Such a change in motivation is inevitably expected to transform design thinking from making to organisation—or in Marshall’s (2009) term, ordering—.
The scientific basis of the new perspective in favour of complexity can be traced back in the early computational researches on self-replicating life systems. Once cellular automaton has been introduced as the modelling method based on the simulation of cell-based systems with a set of simple transition rules, in the 1960s, rule-based system simulations have been developed as a new branch of ‘complexity science’. In this approach, instead of observing the structure of the real complex systems (i.e. biological, spatial) externally, the emergent complex behaviours are analysed through the simulation of the unpredictable artificial systems based on the enormous amount of iterative applications of the simple rules (Wolfram, 2002).

Development in complexity science flourishing a clear awareness on the existence of emergent systems, which do not need to a central control mechanism system but the individually applied collective rule-system offers a strong potential to challenge the conventional views on planning and design. It would motivate the designers to conceive the collective fabric not in terms of its final geometry, but with reference to the form generating rules and structure. Moreover, since complexity theory demonstrated the possibility of the complex behaviour systems with few simple rules (Wolfram, 2002: 105-06), the applicability of solid principles are demonstrated for rule-based planning and design approaches, as well.

The development of the new scientific paradigm was first conceived and implemented in design by J. Frazer in the late-1960s. By integrating evolutionary systems into digital form-finding studies in architecture, Frazer (2002) has developed the first morphogenetic design application. By using genetic algorithms in a design process, he emphasized the use of local codes to control emerging performances of global/physical order, rather than a blueprint targeting the final form.

From social-science perspective, as stated by Héile (2009), the sociopolitical background of the theory of emergence can be traced back in the writings of Friedrich A. Hayek, the Austrian philosopher and economist. According to Hayek (1973), in many aspects of modern society (i.e. morals, law, language, market), a kind of ‘spontaneous order’ emerges at the societal level as a result of the individual actions without central planning. To legitimise his point, Hayek (1973) argues the fragmentation of knowledge possessed by each member of society, which is impossible to obtain for a total control and planning. Therefore, instead of end-state plans, the social practice of the evolved rules of conduct is the source of order out of end-

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5 Cellular automaton is a simulation model that consists of a finite grid of cells acting as smart agents based on local based on the initial state of the cell and the neighboring cells in accordance to the rules of transition. By cellular automata, the global behavior of emergent configurations is produced by local rules which are completely blind to the end-form as in evolutionary processes (Frazer, 1995: 51, 54).

6 By means of the application of cellular automata in spatial analysis, Batty (2007) provided a comprehensive view on the complexity dynamics on urban growth. By using the agent-based model, he basically shows the non-linear and local dynamics of the bottom-up emergent order at large scale.

7 As a term of bio-science, morphogenesis refers to the developmental process of an organism based on cellular growth and differentiation. In this sense, it connotes a kind of bottom-up process in pattern formation as opposed to the top-down processes in design (Alexander, 2002).

8 The important point is that, the ‘spontaneous order’ is an evolutionary phenomenon involving rule-governed selections. Therefore, it is not the product of randomness, which implies a rule-free situation, but coincidence, which means a notable concurrence of the events having no apparent causal –pre-conceived- connection with each other (OED, 2012).
less local interactions. Thus, in order to cope with complexity, an evolutionary rationalism\(^9\) could be introduced. For him, this would enable us to abstract the rules for the patterns of responses to the certain types of (emergent) situations. (pp. 8-34) That view argues for the reliance on an unconceivable collective order through foreseeable individual actions rather than ‘human design’ at the societal level. Seen paradoxical at first glance, this argument is essentially aimed for extending our power of control on social systems, not by comprehensive plans, but via incremental use of simple (comprehensible) rules (Ibid, pp. 41-42).

In architecture, Venturi (1966) is the one who originally introduced to the concept of complexity into the field. Having discussed the notion in parallel to the ichnographic contradictions [in addition to the notions of hybrid, ambiguity, redundancy and richness], Venturi (1966) restricted complexity into a semiotic framework. Though he did not go beyond the visual connotation of the concept, Jencks (1995) has been the first architectural theorist who took the emergent paradigms of complexity science into consideration. In his polemical treatise, he addressed the concepts of complexity (i.e. organisational depth, fractal self-similarity and emergence) as the architectural design strategies. Nonetheless, in his discussion, there was little about the principles on spatial design in the context of urban complexity.

Following the trajectory of transformation of the design discourse from modernism to postmodernism and finally to hypermodernism, we can respectively conceptualise these three paradigms as design against complexity [via simplicity and reductionism], design for complexity [via hybridity and contradiction], and finally as design with complexity. While Venturi (1966) and Jencks (1995) represent the second phase paradigm, in the current phase, design is conceived as a process of exploration based on emergent variation and rule-based bottom-up control.

The reflection of the basic complexity concepts (i.e. morphogenesis, emergence) are assertively found in the design theory of Christopher Alexander. Observing the adaptive-nature of emergent the physical and biological systems, Alexander (2001, 2002) constructed an overarching phenomenological framework on complexity and consolidated his early arguments on design. Under the title of ‘The Nature of Order’, he fundamentally depicted the formation of the living systems at different scales (i.e. cell structures, growing embryo, natural landscape) and the artificial patterns involving rule-based local transformations. Though its scientific rigor is disputable (Marshall, 2007), such an inclusive outlook provided a series of principles on the form and formation of generative systems, which in turn would be utilised in design.

The critical reflections on urban design from the complexity point of view have apparently provided a new outlook for the contemporary planning as well. As one of them, Salingaros (1997) defined organised complexity as the source of morphological coherence. Arguing coupling as the act of building strong elementary connections for higher-level coherence, Salingaros (1997) basically addressed a procedural statement for designing urban form with complexity. The broader theoretical framework of this perspective is found in Marshall’s (2009) treatise on cities, design and evolution. By conceptualising the act of design within the overarching framework of evolution [instead of putting one against another], Marshall (2009) suggests a new way of correlation between planning and design in urbanism. Accord-

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\(^9\) The alternative view suggested by Hayek (1973) has a serious philosophical potential to challenge the modernist cliché of spontaneity equated with irrationality.
ingly, rather than specifying the final target form-compositions in advance in the name of city design, what he suggests is urban ordering via controlling the individual acts of design within a code-based framework (pp. 253-84). This ‘evolutionist’ approach praising bottom-up dynamics is supposed to allow the long-term adaptations of the small-scale increments of development, which is ‘genetically’ coordinated by the local codes. Considering the generative nature of codes, the notion of ordering as opposed to total design corresponds to the idea of morphogenesis argued by Alexander (2002) for design. (Marshall, 2011: 240)

This view is in parallel to the increasing awareness of the possibility of order out of emergence has shifted the mainstream interest from plan to rule in urban design. Since the enduring paradigm of complexity theory has been highly convincing on the possibility of emergent (spontaneous) order without central plans (but with simple rule-system), the issue of urban rules and planning codes has become one of the central issues in urbanism (Ben-Joseph, 2005; Lehnerer, 2009; Marshall ed., 2011; Talen, 2012). That developing field provides a relevant basis for the integration of rule-based generative approaches into urban planning and design.

The overall trend that we depicted above does actually go hand-by-hand with the emerging idea(ogy) of planning without plan, which eventually points out a generative approach to urbanism. Accordingly, a paradigmatic shift in planning is progressing in favour of diminishing the scale of control even into the level of individual plot for the sake of spontaneity, individual freedom and large-scale coherence.\(^{[10]}\) Though it is not always explicitly formulated with these terms; we can easily trace the influence of the theories of spontaneous order and organised complexity back in the contemporary discourse of spatial planning and design.  

1.1 Generative design paradigm in urbanism

What would be the new role of designers after the recognition of urban complexity? According to Mehaffy (2004), designers would yield two types of reflection: a passive laissez-faire position in the name of ‘genericity’, or a pro-active stance searching for adaptable strategies through learning from the dynamics of complexity itself. The ones in the second group actually established a new trend in urbanism from the perspective of emergence and morphogenesis.

The relevant response to the paradigm of urban complexity from a designerly point of view originates from C. Alexander and his colleagues’ early studies in the mid-1980s. In his seminal book, *A New Theory of Urban Design*, Alexander et al. (1987) addressed a kind of urban growth process, which is piecemeal, incremental and gradual, creating coherent wholes. Though it is not worded explicitly, such a bottom-up position is rooted in his earlier work, *Notes on the Synthesis of Form*, in which he recognises the complexity of spatial form involving various interdependent variables. As a way to cope with complexity, the rational method he suggested was based on decomposition of the requirements in a graph, definition of nested hierarchies that represent sub-design requirements and re-composing them in a bottom-up manner (Alexander, 1964).

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In ‘A New Theory’, such an approach was reproduced in a generative fashion. Accordingly, Alexander et al (1987) asserted that the large-scale order would emerge, organically, from the co-operation of the individual actions (p. 37). For this purpose, they demonstrated the emergent morphological quality with a group experimentation of rule-based generative design. (see Figure 6.1) This proposition which was argued by a group of architects has indeed represented a clear opposition with idea of urban design through total architecture.

Figure 6.2. In a competition entry for Rome, C. Rowe exemplified the idea of ‘collage’ based on the principle of “interactive local incidents and the coalition of intentions rather than the singular presence of any immediately apparent all-coordinating ideas”. (Source: Rowe: 1979: 69, 75)

Again, the term, ‘generation’ is not explicitly used by the author in his book.
Borrowed from Rowe and Koetter (1975), the term, total architecture represents the anti-thesis of generative design. In their polemical article called ‘Collage City’[12], the authors advocated a pluralist approach to urban formation through the multiplicity of piecemeal urban tissues as an assemblage and fusion of different styles and periods. The quotation on the basic properties of their proposal apparently signifies their generative ideas on city form: “it is simultaneously an appeal for order and disorder, for the simple and complex, for the joint existence of permanent reference and random happening, of innovation and tradition” (Rowe et al., 1978: 8). Relating this idea with the C. Lévi-Strauss’ notion of ‘bricoleur’ [the contingent events, tools and materials creating whole structure (Gosling et al., 1984: 139)], the theory of Rowe et al. (1975, 1978) can be considered as the early appreciation of complexity in urbanism and the rejection of total design.

It is also possible to trace the early generative ideas in the definition of ‘site planning’ made by Kevin Lynch (1981). For him, only the main roads, general location of the public facilities and major landscape structure should be planned. Subdivision of the internal areas (i.e. minor roads, plots) should be made according to the performance standards when the actual demand of building within small sectors occurs (p. 232). For a generative design approach he speculates ‘the future techniques’ as follows: “… the computer may allow us to design, display and evaluate streams of events rather than a restricted set of frozen stages” (p. 286).

As a follower of C. Alexander’s theory, M. Mehaffy, one of the leading champions of the generative methods in the contemporary urbanism, describes generativity of design in terms of the lack of master plans, rigid typologies and the ‘design partis’, which reduce the complexity of pattern formation into a simple diagrammatic scheme used for designating the basic partitioning of the plan layout. Instead, he addresses the stepwise non-linear process defined by the designer and driven by the sequential collaboration of the participants (Mehaffy, 2008).

Figure 6.3. Simplified simulation of a rule-based emergent growth by Héile (2009). Note the simple form-generating rules involved: any extension is obliged to place on the existing network and the steps are kept limited to get out of an emerging ‘sector’. (Adapted from: Héile, 2009)

Inspired by the complexity theory in general, M. Héile tends to conceptualise the generative principles as the baseline of a new design approach called ‘emergent urbanism’ (2009). He emphasizes that, emergent urban processes occur though the successive adaptations into the existing networks, rather than the extensive sub-divisions operated on tabula rasa at once in advance. The cellular growth takes place in a flexible grid so long as the individual demands for building appear. Growth is not a matter of the geometry imposed.

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Later on, the extended version of article was published as a book by the MIT Press in 1978.
EMERGING TRENDS and TENDENCIES in URBAN DESIGN

but time through which form emerges as the consequence of rule-based adaptations. (Héile, 2009, 2010). (see Figure 6.3) As he argues in the context of urbanism, the emergent form represents a non-linear system whose overall performance can be controlled by rules, but not created by a single plan.

Simplicity and locality are two fundamental features of the rules generating spatial patterns\(^\text{13}\) (Rezayan et al., 2010). This is not only the case for the system simulations, but also for the actual use of building rules as in the case of traditional (emergent) settlement forms. As revealed by Hakim (2008) the ‘wisdom’ of the traditional code system, which had been influential and widespread for ages after the Roman system, lies in its simplicity and local (incremental) nature that was simply comprehended and applied by people.

More recently, quite a few ideas on the operational scale of a possible rule-based emergent urban design have been discussed in the literature (Love, 2011; Marshall, 2011; Porta et al., 2011). The common emphasis of these discrete researches is that the upmost level for an effective morphogenetic control should be the urban ensemble (block-groups) (see Figure 6.4) Within this range, plot and street is regarded as the most functioning level for generative urban design.

The rejection of top-down planning from the morphogenetic standpoint should not be taken as just a naive ideological critique to modernism. The critique basically constructs itself on the actual shortcoming of the top-down urbanism ignoring the adaptive mechanisms of the emergent systems such as cities (Salingaros, 2004). On the other hand, over-reliance on small-scale incrementalism calling for the long and focused participatory processes is not responsive to the average speed and scale of contemporary mass-production (Mehaffy, 2004). This point still represents the most serious drawback of generative/emergent urbanism in the actual context.

In this regard, while emphasising the unpredictable fluctuations in the housing market, Friedman (1997) addresses flexible design strategies, which can be considered as the principles of emergent urbanism. With his framework proposal, Friedman (1997) suggests the process of development to be held by increments in stages. While the size of each increment is determined just after the completion of the neighbouring one, developers are asked to make plans only for the major roads and infrastructure. The minor streets and the plot subdivisions are designed as soon as the actual development starts at the ensemble or block level (p. 283). From a similar perspective, the more precise method to deal with incremental growth and change is found in the model framework suggested by Hall (1997). Relating the elementary morphological concepts of tissue and morphological region, he advocates defining the devel-

\(^{13}\) The established idea of ‘complex systems require complex control mechanisms’ Hall (1996) basically represents the naivety of the notion of complexity in designers mind despite the incrementalist position they have.
development plans through the *design areas*. Nonetheless, the framework lacks with a concrete method in conjunction with the idea of design area. In this context, despite some model approaches and the principles argued so far, the contemporary literature of urban design is yet to be provided with more operational and full-fledged methods of generative urbanism.

### 2. Parametric design as a generative system

Terzidis (2006) defines complexity as a term to denote the length of a description of a system or the amount of time required to create a system (p. 117). Such a computational account of complexity\(^{14}\) brings us to perceive the concept from the design perspective. Depending on the number of iterative operations in design, the design tends to receive increasing complexity in form. Whether it is a desired quality for the intended result or not, the basic ability to control the different levels of design complexity can be taken as a practical asset of a designer.

![Figure 6.5. A sample of parametric production of complex structure based on a sub-object: With a large number of associative generation and editing operations (i.e. cloning, randomising, scaling, positioning), parametric systems enable designers to create unpredictable complex geometries and control algorithmically (Source: PlugEllo, 2010)](image)

Since the advanced computational techniques assist designers to simulate a high level of artificial complexity through the increasing capacity of information processing, the designers are highly liberated from the early quantitative constrains of human mind in the simulation of complex forms and pattern variations (Terzidis 2006: 117). In this context, as a form of generative design method, *parametric design* suggests very high variations through

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\(^{14}\) The term ‘computation’ used in the text refers to its basic meaning of problem solving, rule-based reasoning and simulation (Terzidis, 2006: 57-58).
the fully controlled algorithmic-systems\textsuperscript{[15][16]}. As a tool that works on generative algorithms creating hierarchal relations and involving a large number of inputs through processing with few simple rules, parametric design models can be considered in the context of organised complexity. Like other types of generative systems\textsuperscript{[17]}, it does not directly specify the design object as a target-form, but instead encodes the formation (the design procedure) that generates the geometric variations within the built constraints (Dino, 2012: 208). Therefore, parametric design essentially corresponds to the idea of ordering [instead of composing] argued by Marshall (2009).

As defined by (Sakamoto et al., 2008), the parametrics is a technique enabling designer to create and manipulate the design objects holistically via controlling the consistent (interdependent) relationships between the parts in whole geometrical system (p. 3). In addition to the easiness of variation by the countless design iterations within the models, the geometric accuracy suggested for controlling the design form is the major strength of parametric design (Gerber, 2007: 6). With the increasing use of parametric modelling in art and design, the designers are no longer expected to present a finished design, but a rule-based system generating the design via a simple set of inputs called parameters (Scheurer, 2011: 269).

From a computational perspective, the most crucial feature of parametric design is the associative geometry generated by algorithms. That means all the parts and the entire sub-systems of the form (i.e. network, envelopes, subdivisions) are correlated with each other and get depended on common parameters. One single change in a component is received as a processing input and triggers a chain of reaction in the other associative parts of the model (Woodbury, 2010: 11, 171). For instance, any change in the value of network density in a parametric urban model may automatically result in a controlled variation within the pattern of plot sizes in the model. This is due to the capability of the model to evaluate a form component as a node in the graph via assessing the properties of all other nodes in the system (Ibid, p. 14).

Patrik Schumacher, one of the prominent thinkers and practitioners in parametric design, has assertively announced parametric design as a new style. Regarding ‘style’ both as a manner of expression and a method of performing design action, he argues that the current design works in the control of advanced computation techniques can be presented under the title of ‘parametricism as a new global style for architecture and urbanism’ (Schumacher, 2008; 2009). The ‘formal’ part of his manifestation is based on a clear rejection of pure tec-

\textsuperscript{15} We should note that the use of the term ‘parametric’ in the emerging discourse of digital design does not truly correspond to the genuine use of the concept in mathematics. Mathematically, parameter is an arbitrary constant or a variable in a formulaic expression. For instance, in $y = ax + b$, $a$ and $b$ are the parameters implying a constant value determining a point on the line (James et al. 1968: 263). That means though every parameter is categorically a variable, a variable would not necessarily function as a parameter. In this regard, what called as the ‘parameter’ as the factor having variational values in a design algorithm should be mathematically counted as the ‘metric variable’. However, for the sake of making our current argumentation communicable within the domain of spatial design, throughout the text here, the author keeps the concepts ‘parameter’ and ‘parametric’ in its current specific use in the circle.

\textsuperscript{16} Algorithm is basically a step-by-step procedure for reaching a decision on ill-defined problems. In of design computation, it is the computation procedure defining the type and quality of the elements and the sequence and timing of the operations involved (Terzidis, 2006: 65-66).

\textsuperscript{17} In addition to the parametric systems, linguistic systems based on the syntactic rules (i.e. shape grammar) and creative evolutionary systems based on genetic algorithms can be also considered within the class of generative design systems (Dino, 2012: 209).
tonic forms composed in fixed proportions as in classical architecture, and the simple order of repetitions and clear difference of the object-like disconnected elements as observed in modernist architecture and urban design (Schumacher, 2011). In contrast, parametric style creates complex and polycentric spatial ‘fields’ generated by dynamic, relational elements (i.e. NURBs\(^{18}\)) and smooth forms. Smoothness is enabled the subtle continuous differentiations and in-between transitions of the field qualities such as grain, density and directionality (Schumacher, 2011: 141, 409). Controlling the countless elements in a pattern-like system while manipulating its configurational properties cannot indeed be easily performed by the analogue design methods.

Having been adapted into architectural design after the first generation applied in engineering –especially on fluid dynamics- (Weston, 2011: 205), parametric modelling is mostly appreciated with its computational power to transform parts within a unified organisational clarity (Meredith, 2008: 6). Such a smooth variation by complex modularity, which cannot be created by hand drawing is basically by virtue of the smoothing subdivision algorithms of the model (Sakamoto et al., 2008: 55).

Scripting-based (algorithmic) design techniques radically alter drafting-based (CAD-like) models in design. Being able to operate with the interactive design components, designers explore a larger area of solution spaces, which involve higher amounts of alternative forms generated by different set of parameters.\(^{19}\) Though they are both in the class of generative methods, \textit{parametric} and \textit{evolutionary design} essentially represent the different branches. In evolutionary systems, generation repeats itself on the populations selected and recombined to achieve optimum solutions in time. A ‘seed-model’ is propagated into the population of alternative models by means of a code. Within the emergent population, the most ‘successful’ ones are selected by means of a fixed fitness-function. Then the process is iterated till the ‘optimum’ solution is achieved\(^{20}\) (Frazer, 1995: 65, Watanabe, 2002: 10). In this method, the designer’s main role is to determine the performance rule (code) system and fitness criteria. Without a need for human input, the rest (generation process) is run out of the direct control of the designer.

Unlike the evolutionary systems, parametric design models exhibits a hybrid nature combining both top-down structuring (i.e. point grids, force-lines) and bottom-up articulation of the form components. Though the parametric variation affords a very large solution space with numerous variations retaining the notion of surprise, the designer has a control over the global behaviour of the system by altering the function parameters. Then again, heuristic still has an active role in parametric design as in the conventional design processes, unlike the fully automated selection processes in the evolutionary design systems (Gerber, 2007: 229). Gane (2004) calls this ‘reasoned ambiguity’ in parametric design, a kind of \textit{systemised emergence} (p. 83).

\(^{18}\) Non-uniform rational basis spline.
\(^{19}\) As argued by Campbell (2010), despite the common understanding, the absolute increase in choice does not represent an ideal condition for efficient decision-making. That point obviously deserves attention with regards to the promoted generative power of parametric design.
2.1 Application of Parametric Modelling in Spatial Design


The first example to be given on parametric design process is an exploratory exercise made in a workshop\(^{21}\) organised by The Why Factory, master’s programme in TU Delft, Faculty of Architecture in 2010. In the project called The Vertical Village, a number of students were asked to compose six design groups representing different design themes as the principal consideration of incremental design interventions. In this context, the bottom-up design rules were introduced to guide the growth of urban villages as a common typology of informal settlements in Asian cities (MVRD/The Why Factory, 2012: 220).

The design process can be considered as an abstract game and the compact simulation of an alternative development strategy to the masterplan-based top-down planning approach. By means of the cubes representing individual building units, the parametric design method was defined based on a series of feedback loops iteratively run by the design groups for each gradually growing village. Starting with 200 cubes, each thematic group reacted on the previous model evolved and added its own configuration in the light of its own interest. Looking at the solid models generated with the different colours of cubes, it is possible to see the adaptive transformation of each ‘village’ through the individual design motivations and parameters. (see Figure 6.6)

![Figure 6.6. Stepwise growth of one village –the dynamic solid modelling-. Note the parametric peculiarity of each design concept involved in the adaptive growth process (By courtesy of F. Parthesius)](image)

\(^{21}\) The workshop is instructed by the tutors, Winy Maas, Daliana Suryawinata, Ulf Hackauf and Jeroen Zuidgeest
Though they are incorrectly called 'parameters', six form-concepts were involved in the design process: 1. structure (construction, material), 2. climate (light, air, humidity), 3. energy (electricity, water and waste), 4. access (lifts, stairs, ramps), 5. collectivity (privacy and shared spaces), 6. economy/cost-efficiency (value-height ratio) (The Why Factory, 2010b). All the aspects were associated with a series of parameters functioning as design rules [i.e. maximum distance between dwellings to preserve direct sunlight and air circulation, maximum depth of the composed units, minimum number of sides open to the exterior etc.] (The Why Factory, 2010a).

The critical point, here, is that the adaptive nature of formation mainly directs from the way to define the design parameters. Rather than imposing the design parameters at the outset, the relevant ones are introduced spontaneously in the meantime of each incremental intervention (Hackauf, 2012). That means not only the form, but also the parameters can be emergent in generative design. This basically proves the possibility of putting parametric model into an emergent framework.

Figure 6.7. Within 10 days period, 36 models were produced with 25,200 cubes by the group of 48 students within the project (Source: The Why Factory, 2010 and the personal achieve)

When the parameters are utilised in iteration based on the responsive reaction on already emerged form, it is possible to observe the structure preserving quality of generative design, which is addressed by C. Alexander (2002: 52-63). Being grown in adaptive manner by re-interpreting the emergent form inherited, the same form evolves in a coherent way without allowing 'big jumps' in structural transformation (see Figure 6.7)

As stated by Ulf Hackauf (2012), the coordinator of the studio, the generated form of parametric design provides an opportunity to see the possibility of some parameters to be conflicting with another as well as being harmonious. This point is understandable regarding the ‘wicked’ nature of spatial design in which absolute optimisation is impossible. In this regard, the experimental parametric design process actually reflects the adaptive nature of urban formation in which different actors involve with either conflicting or compatible parameters as the factors of their own interest.

The importance of the Vertical Village is that the project demonstrates that parametricism might not necessarily based on digital technologies. Beyond its enduring computational
background, parametric design is a way of thinking considering design as a quantitatively controlled generative process.

2.1.2. Parametric Urban Design by D. Stefanescu (2010)

In another example, we will look at the digital application of parametric design in the context of urbanism. As we see in the previous application based on solid modelling, it is possible to see the same rule-based design thinking in the digital version of parametric design. To argue this point, an urban project designed by Dimitrie Stefanescu, a master level architectural student, provides a simple case for an adequate comprehension of parametric modelling.

The design task of the project is to explore the possible configurations of an urban extension parametrically within the existing constraints of a 450-hectare site. The design aim was to create a flexible urban tissue to be responsive to the local inputs such as existing roads and proposed land-use (Stefanescu, 2012). For the project, the designer used a parametric platform, called Grasshopper, which is an application within Rhino, a digital design software.

![Figure 6.8. The visual definition of the design algorithm in the parametric platform of Grasshopper.](By courtesy of D. Stefanescu)

The algorithm of the model can be regarded as a kind of script, which is not symbolically but visually coded. (see Figure 6.8) Operating with the workspace of the drawing software, the parametric platform consists of a number of components representing the basic geometric elements (i.e. line, point, curve) and functions (i.e. multiplication, boolean operations etc.), which are linked by multiple connections. The complete set of relations between

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23 The project is made with the collaboration with D. Mila in the master’s degree studio in Ion Mincu, University of Architecture and Urbanism, Bucharest under the supervision of T. Florescu and S. Guta in 2010.
the system components is called workflow in algorithmic design. It involves input data and operations (processing) and outputs (Khabazi, 2010: 20). Based on the operations defined in the algorithm, a simple set of numerical data is processed as an information generating resultant geometry (Ibid, p. 20). Therefore, instead of drawing the line directly, the designer specifies the modifiable attributes of the line (i.e. the initial point, length and direction) and the model generates its associative geometry by itself.

![Figure 6.9. The initial design sketch designating the border conditions of the parametric operation –left- and the attraction points to be involved in the algorithm. (By courtesy of D. Stefanescu)](image)

In this context, the parametric design process, the core design operation starts with defining the major variables (components) and setting up the desired connections between them. Yet, scripting does not always precede the overall process. As observed in the Stefanescu’s case, firstly putting the actual lines of the roads and the design area border on paper (see Figure 6.9, left), the parametric operation may involve ‘drawing’. However, in order to make it operational in the parametric platform, the lines drafted were to be informed within the algorithm. After setting the constraints, the designer put the generative components such as boundaries and attraction points. Attraction point is a common component to vary the configuration in parametric design. It differentiates the force of parametric values (i.e. length, height, density) of the nearby components. Then, the designer also located a number of attractors within the area, which designated the focal point. (see Figure 6.9, right)

After setting the initial conditions, the designer created a universal grid to be manipulated by two parametric operations, rotation and division. (see Figure 6.10) Having been devised in accordance with the alignment of the existing lines (the main roads), the basic grid is configured to perform as the low-level order of the future form-composition.

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24 Especially in its architectural applications, sketching is an essential part of parametric design. As in Zaha Hadid’s designs, one of the pioneers of parametric design, the designer can define the main lines of the form and then the parametric model operates on these.
Figure 6.10. A section of the parametric model, which shows the setting of the basic grid: The symbolic algorithm involves, lines of the existing roads, origin of the grid, a rotation tool, sliders to control the grid meshing, and scaling and the data-restructuring tool respectively. The sub-algorithm is eventually connected to others through ‘attraction points’ (By courtesy of D. Stefanescu)

Figure 6.11. The conceptual diagram showing the main steps in grid articulation made in D. Stefanescu’s design (Drawn by the author)

The rest of the process mainly represents the articulation of the grid. The algorithmic operation of grid configuration was divided into three: first setting the basic grid and attraction points, secondly deforming the grid via the attraction points, and finally generating the cell/block structure by tessellation. (see Figure 6.11) In this framework, the designer first associated the corner points of the basic grid with attractors. (1.) In accordance with the location of the attractors, the points created a inverse or reverse attraction to the corner points. According to the cumulative effects of the attractors throughout the whole grid a new deformed grid was created. (2.) The vertices of the new grid was utilised as the seeds of the final grid. Based on a special parametric operation called Voronoi tessellation[^25], the optimum cell structure was formed.

With the final operation, designer came up with an internally differentiated lattice-like grid structure, which can be controlled, by the changing location of the attractors. Hence forward, a constant dialogue was run between the design geometry and algorithm. Reconciliation of the visual and symbolic modes of representation within the same domain characterised the procedural thinking of form composition in parametric design. At this phase, during reconfiguring the urban grid, the designer reacted on the emergent form and tested

[^25]: Voronoi tessellation (or decomposition) is a special technique to create cellular in which divisions is metrically optimised patterns in accordance to the objects (called ‘seeds’) randomly distributed.
it with space syntax (by using \textit{Depthmap}[26]) to ensure the maximum integration for the overall pattern, instead of running the parametric model with an initial (systemic) analysis. In this regard, we see the very characteristic relation between analysis and design as argued in the previous chapter on design thinking.

After refining the distribution of the small and large blocks in conformity with the desired centralities in the area [by trial and error], the designer added the final sub-algorithm for the generation of urban blocks as infill within the grid-cells. The setback distance and building depth, in this case, were the two parameters, which created the block structure. Designating the lines of density gradients manually and associating them with the parametric model of the blocks, the designer accomplished the internal differentiation within the built fabric and terminates the design process. (see Figure 6.12)

As we see in this specific application, the generative fashion of parametric modelling was utilised in a different way from the previous example. While in \textit{The Vertical Village} project, the designers act upon the emergent design form, the designer, in the second case, enjoys the generative feature of parametric design in a closed system called design algorithm. Though the design

\footnote{26 The spatial network analyses software developed by the \textit{VR Centre for the Built Environment}, UCL, London.}

\textbf{Figure 6.12.} Three-steps generation of grid structure: basic grid (1.), deformed grid (2.) and the final tessellated grid (By courtesy of D. Stefanescu)
configuration seems quite a top-down imposition, its production implicates a certain degree of emergence in the context of an individual design process. As informed by the designer himself, the actual form of the grid configured by the universal grid and the attraction points was only apparent on the visualisation screen in a very late stage of the process. In this context, instead of an already foreseen visual geometry of the grid system, the relational configuration acts as a form-giving concept for the emergent form-structure.

Figure 6.13. The generated urban pattern as the production of parametric design. Note the smooth transitions in form and density through the whole fabric. (By courtesy of D. Stefanescu)

Though the surprise-effect of the emergent form-configuration is involved in the design process, the designer admits the rough imagination of the overall character of the design form at the outset (Stefanescu, 2012). Such a preconception could be also because of the limited number of parameters and the iterations involved in the process. Therefore, it is fair to argue that the generative component of the digital parametric design in general is more limited than the open-ended and flexible applications like in the former case. Nevertheless, as pointed out by Stefanescu, (2012), the digital parametric modelling enables designers to achieve a total-control on the parameters in a limited number. The models technically allow to change the initial parametric setting and to add new ones throughout the process. In this
sense, it operates flexibly. Yet, the actual performance of the flexibility always depends on willingness and the algorithmic reasoning capability of the designers (Ibid).

It is worth to note in morphological terms that the parametric model examined basically approves the possibility to create coherent urban patterns based on diversity in form parameters within one scheme and their smooth differentiation throughout the whole composition that cannot be achieved by conventional design techniques.

2.2 Parametric design thinking

Design in essence is a parametric act of reasoning. It basically involves variables (i.e. length, colour, material) and their states standing for certain values. Each quantifiable variable, called parameter is applied to the parts of the whole design object and stored within data structures (Mitchell, 1990: 12-16). While designers mostly construct the data structures implicitly during design synthesis, parametric design offers pre-rationalization of the form\(^{27}\) by explicit data-structures at the outset of the design process. Otherwise the model cannot run. This inevitably implies a different way of thinking from conventional design methodologies.

Speculating on the future of simulation techniques in urban morphology and design, Rabie (1991) emphasises the key roles of the representation in design thinking. For the author, while perspective was the basic tool of extrovert design in Renaissance, axonometric was essential for modernist urbanism (to control the standardised large-scale order). On this basis, a design algorithm could be envisioned as the new representational tool for the future mode of design practice in urbanism (p. 60). To test this idea, it is necessary to reveal the fundamental differences offered in parametric design thinking.

Though performing in the same (digital) domain with computer-aided design (CAD), parametric design as the algorithmic method should not be considered in the same class with CAD. CAD is basically a technique of visual representation by which the idea [as an abstract image] is transformed into the metric visual data. However, parametric design systems [like all algorithmic design tools] channel a process into form (Shusta, 2006: 150). In this sense, while CAD is still bounded with the conventions of ‘drawing’, the logical/relational steps expressed as design algorithms set up the ‘process’ which is essentially the point making parametric design something ‘new’. Within this framework, rather than comparing parametric design with CAD, it would be more relevant to compare the analogue and algorithmic modes of design in general. Then we can involve non-digital, drafting-based mode of design into comparison as well.

Beyond its ever-changing software applications being developed very rapidly, parametrics is a particular way of thinking in design (Woodbury, 2010). The underlying idea of a parametric modelling is based on variables, and their measurable relationships, which can be utilised as input data (Schnabel, 2006). In this context, how would the parametric models essentially challenge the current understanding of design thinking?

First of all, parametric design alters the commonly used two-dimensional layering techniques with another mode of thinking based on three-dimensional configuration of the objects and spatial forms in terms of their primitives such as point, lines and planes (Ibid). This basically requires quite an abstract (configurative) way of thinking in design. Moreover,

\(^{27}\) Pre-rationalisation here means making an explicit description on the parameters, elements and the relationships of a design problem prior to the geometric modelling (Gerber, 2007: 139).
assigning certain range of metric values, parametric models entail full precision of the form-components from the first moment of design. That is the reason why, the notion of ‘conceptual scheme’ loses its vital role in parametric design. Even an initial parametric design model is coded by metric relations; and therefore it does not function as a vague image open for creative analogical reasoning.

In the light of a comprehensive overview of parametric design in architectural practice, Gerber (2007) characterises the design process with following steps:

1. Describing the design intentions and constraints (pre-rationalisation of design),
2. Defining the core-setting of the model (‘design engine’) by formulating the associative algorithm visually and numerically,
3. Iteratively testing the engine through manipulating a set of parameters and remodelling the algorithmic setting accordingly,
4. Design exploration open-endedly,
5. Extracting information for the other collaborators involved,
6. Final (cognitive and technological) feedbacks on the design form developed. (Gerber, 2007: 228)

This process definition signifies another point that essentially differs parametric design from conventional design thinking. As we see here, the associative geometry of parametric design requires designers to set the organisational structure at the very beginning of a design process. This is because of the necessary connections and separations to be defined in an algorithm that eventually conditions the design geometry. However, designers usually post-rationalise the structural variables of a form-composition during and after design synthesis [via repeated trials and errors] in analogue design. (see Chapter 5) In this sense, ‘pre-rationalisation of design’, the basic premise of parametricism, essentially conflicts with the idea of spatial design as a non-discursive phenomenon[28] as argued by Hillier (1996: 39). From the overall discussion and observations made, it is possible to draw a general comparative framework on analogue and parametric design thinking. (see Table 6.1)

Table 6.1. Fundamental differences between analogue and parametric design thinking.

<table>
<thead>
<tr>
<th>System properties</th>
<th>Analogue Design</th>
<th>Parametric Design</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode of representation</strong></td>
<td>Visual (drawing)</td>
<td>Algorithmic (scripting)</td>
</tr>
<tr>
<td><strong>Prevailing mode of thinking</strong></td>
<td>Intuitional, analogical</td>
<td>Mathematical</td>
</tr>
<tr>
<td><strong>Type of design knowledge</strong></td>
<td>Tacit and declarative</td>
<td>Procedural</td>
</tr>
<tr>
<td><strong>Basic cognitive operations</strong></td>
<td>Abstraction, conjecturing, recogni-</td>
<td>Abstraction, association (paramet-</td>
</tr>
<tr>
<td></td>
<td>tion, association (analogical)</td>
<td>rical), processing, propagation,</td>
</tr>
<tr>
<td></td>
<td>and synthesis</td>
<td>evaluation and filtering</td>
</tr>
</tbody>
</table>

28 As I discussed in the previous chapter, Hillier (1996) argues that spatial configurations cannot be rationally described by words and concepts in design, but they can only be described by post-design analysis.
<table>
<thead>
<tr>
<th>Properties</th>
<th>Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flexibility</strong></td>
<td>Easy to create the initial model; difficult to make intermediate modifications.</td>
<td>Rather difficult to define the first-model via explicating the associative logic; easy to manipulate once set up.</td>
</tr>
<tr>
<td></td>
<td>Open to involve new parameters and criteria in the course of design process.</td>
<td>Higher dependency to the initial set of parameters in the light of preliminary design criteria.</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Limited range of form variation for establishing alternatives.</td>
<td>Ability to edit via the direct observation of emerging results.</td>
</tr>
<tr>
<td></td>
<td>Design process as a black box unless the constraints and parameters are given as supplementary.</td>
<td>Transparency of the design logic explicitly formulated.</td>
</tr>
<tr>
<td></td>
<td>Direct communication with design geometry through drawing.</td>
<td>Indirect communication with the visual form via algorithm.</td>
</tr>
<tr>
<td><strong>Precision</strong></td>
<td>Sketchy vagueness in the beginning, increasing precision and detail in the course of design process.</td>
<td>Exact quantification of the design variables from the outset of the design process.</td>
</tr>
<tr>
<td><strong>Abstraction</strong></td>
<td>By dimensionless diagram showing necessary connections and partitions.</td>
<td>By eliminating or condensing inessential attributes in the algorithm (Woodbury, 2010: 30)</td>
</tr>
<tr>
<td><strong>Exploration</strong></td>
<td>Few alternations in design configuration due to the limited generative capacity of drawing.</td>
<td>A large solution-space through parametric variations.</td>
</tr>
<tr>
<td><strong>Selection</strong></td>
<td>Need for external support systems to evaluate the structural performance.</td>
<td>Availability of real-time evaluation via embedded ‘fitness calculators’. (Shanbel, 2007)</td>
</tr>
<tr>
<td><strong>Formation of part and whole</strong></td>
<td>Simultaneous transformation of divisions and connections.</td>
<td>Step-by-step form-generation from part(s) to the whole system.</td>
</tr>
<tr>
<td><strong>Level of control on structure</strong></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td><strong>Reliance on conventional form typologies</strong></td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>
6. EMERGING TRENDS and TENDENCIES in URBAN DESIGN

<table>
<thead>
<tr>
<th><strong>Level of formal coherence</strong></th>
<th>Limited number of relations between the morphological elements.</th>
<th>High associative dependencies between the elements.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>End-product</strong></td>
<td>Blueprint</td>
<td>Adaptable (re-parameterisable) ‘frozen’ model</td>
</tr>
<tr>
<td><strong>Act of designer</strong></td>
<td>Shaping specific geometries supposed to capture the desired performance criteria -Design as supposition-</td>
<td>Determination of the local code and the rule-system (algorithm) to generate a set of solutions (patterns) to select the most satisficing one. –Design as proposition-</td>
</tr>
</tbody>
</table>

One of the most important factors that would change the conventional design cognition radically is the designer’s way to communicate with his/her design during parametric modelling. Instead of initiating the process via a schematically abstract idea, called prototype, and elaborating the form by drawing directly [as in conventional design], parametric designer thinks the geometry in terms of the symbols within algorithm. Therefore, the driving force of the design operation is not a visual diagram, but an algorithm expressed in codes. Though it opens up new possibilities in form-finding, this technical flexibility is highly dependent on designers’ basic-knowledge on complex geometries. Nevertheless, unlike product design or architectural design, urban design relies on the archetypally simple configurations at mezzo-scale. Therefore; a possible employment of parametric design in practice is much more easy and likely in urban design than in any other design fields.

The common cognitive operation in both types of design process is abstraction. As abstraction is a very deep-rooted capability of human mind to manage spatial complexity (see Chapter 3 and 5), the choice of relevant variables and building up their dependencies in a simple and effective way by algorithms require a correct level of abstraction in parametric design (Scheurer, 2009: 54). The point on abstraction truly applies to the fundamental relation between structure and form that we discussed in the beginning.

In this context, the active role of the designer in parametric design would be a disputable issue. Watabane (2002) conveys a clear position and credits the human intervention by indicating two fundamental roles of designers: creating the programme [deciding what to generate and control] and setting the condition [deciding the parameters as the standard of value] (p. 68). In the same view, Leach (2009) also claims the changing role of the designer from performing as a form-giver to that of controller [of the generative processes] in the context of digital morphogenetic design (p. 35). In that view, designers involving generative processes are not expected to be scriptwriters, but the one designing the core setting of an algorithmic design programme.

Considering the high-level iterative capacity of parametric models, we would say the dominant question in parametric reasoning is ‘what if’ implying various variations as a response to the changing parameters. Its counterpart in analogue design would be ‘what then’ questions in terms of the successive operations as response to the emergent design image. In this sense, it would be claimed that due to the higher costs of design alternation, conventional design theoretically involves less feedback loops during design synthesis than in
parametric design.

In general, the stepwise procedure of parametric modelling based on designing the parts and sub-systems initially, and then combining them into whole [while maintaining the already established relations] (Woodbury, 2010: 27) is congruent with the way to deal with the systems of organised complexity [based on elementary, inductive and generative thinking] as addressed by Jacobs (1961).

### 3. ‘Parametric Urbanism’

Considering the emerging use of parametric design in urban projects, one could question whether parametric design has a potential to define a new approach in urban planning and design in the name of ‘parametric urbanism’. In order to call a design paradigm ‘new’ in urbanism, both the characteristic of its morphological and sociopolitical assumptions should be clarified. In this sense, the boldest answer to the possible question above can be found again in P. Schumacher’s writings.

With reference to his various experiences with the method in the urban context, Schumacher (2011) tends to conceptualise parametric approach in urbanism. He suggests parametric design as a response to *the need to establish and maintain a complex order within the evolving urban field* (p. 129). Despite the vagueness of the notion, ‘maintaining a complex order’, we can discuss the concept of *field* from a morphological perspective. The term, field, implies a conceptual shift in the perception of urban form. For him, the associative geometry generated by parametric design alters the traditional understanding of ‘space’ based on the binary conception of figure and ground, with the emerging notion of ‘field’ in the form of overlapping the fuzzy domains of parametric associations (Ibid, p. 423). Therefore, the concept inevitably challenges the notion of ‘district’ as one of the fundamental elements of urban image. The conventional perception of an urban district is characterised by the recognisable borders condition featuring the feeling of ‘inside’ and ‘out’ within a fabric (Lynch, 1960: 47). Whereas the smooth transitions and the continuous changes of/in the morphological fields within parametric fabrics are to obscure such a clear demarcation. The settled typologies of urban form defined by the discrete zones and objects are replaced by a new ‘swarm-like’ computer-generated morphology defined by the relational fields of associated urban elements (i.e. paths and building envelopes)\(^{29}\) (see Figure 6.14) The orientation of movement inside the complex fabric is informed by the lawful accentuations of the abstract vectors of (morphological) transformations (Schumacher, 2008). This is basically argued as a positive aesthetic and perceptual quality of the ‘new’ urban form offered by so-called *parametricism*.

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\(^{29}\) With the perception motivation behind its definition, the idea of ‘field’ in Schumacher’s theory can be associated with the model of ‘force fields’ in the gestalt psychology of Kurt Lewin (cited in Rittel, H. (1964) [2010]) ‘Environments’, in (eds. J.P. Protzen, D. J. Harris) The Universe of Design: Horst Rittel’s Theories of Design and Planning, pp. 87)
To Schumacher (2011), this signifies a remarkable shift from the traditional idea of the delineation of urban space by composing few objects, to the act of organising and articulation of the complex patterns parametrically generated with uncountable building blocks (pp. 421-23). In a broad view, such an approach is justified with the contemporary socio-economic and cultural dynamics. For him, the city of post-fordist network society requires flexibility and variation in growth and transformation through continuous communication. The control of the self-regulating urban system can only be managed by the rule-based computational methods rather than the compositional blueprints (Schumacher, 2010). Behind this statement, there is an ideal model of the ‘parametric metropolis’ based on an analogy of complex spatiality and the variegated order of ecosystems (Schumacher, 2012). However, as one of the most prominent figures arguing the productive relation between complexity and urbanism within the contemporary architectural design circle, Schumacher (2009) fails to recognise the piecemeal nature of urban complexity, which is by definition contradictory with the idea of large-scale urban-architecture as also championed by him. In this context, the question of how the parametric models can be integrated into the general framework of emergent/generative urbanism yet seems to be elaborated by further discussions. Only after a well-grounded argumentation on the issue, would the notion of ‘parametric urbanism’ be claimed to be a relevant statement on urban design.
3.1. Is it totally something new for urban design?: some (dis)continuities between the parametricism and structuralism

Considering the structural and rule-based thinking in parametric / algorithmic design, one can easily question the novelty of the idea of parametricism: Beyond the technology introduced, is parametric design something new in the field of spatial design? Quite recently, this question was put forward in an international symposium, Structuralism in Architecture & Urbanism Reloaded held in Munich in 2010. Some principal answers to the question are worth mentioning here. Before discussing the point, we could claim that, with regards to the basic premise of structuralist thinking, searching for the ‘deep rationality’ of form with regards to the elements and their rule-based interaction in the whole [30] (Sturrock, 1986: 22), parametric design thinking based on the procedural ‘conceptual structure’ [called algorithm] (Vanucci, 2008: 121) can be classified within the structuralist approach, in principle. [31] This inevitably makes parametricism share the parallel motivations with the structuralist architecture and urbanism that was influential during the 1970s [32]. (see Figure 6.15)

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30 For R. Barthes, the structuralist philosopher, ‘structuralist activity’ entails the reconstruction of the object with the rules of functioning. It may be either poetic (compositional) or reflexive (Barthes, 1964). This essentially makes the idea relevant for both analysis and design.

31 As structuralism supposes underlying structures governing the individual action of agencies, parametricism entails rule-based structures organizing the spatial elements in the whole system.

32 The reason why the author tends to trace the historical continuity in parametric urbanism is that considering the new approach in terms of the previous ones in similar design philosophy would lead efficient future critiques against what claimed to be new.

As Valena (2011) claims, the fundamentals of structuralist design are as follows: a modular structure, clearly pre-determined development principles, extensible configurations [against pure forms], a primary structure as a framework on which the units are inserted (p. 11). On the basis of these principles, structuralist urban architecture would challenge the modernist movement entailing visual dominance of the simple layouts, with complex relational patterns in its due course. Developing a kind of generative approach to urban structure in terms of the relational thinking between the ‘domestic cells’ and urban tissue (Violeau, 2005), the early structuralist movement can be considered as a historical link to the emerging parametric thinking in the contemporary urbanism.

The strong parametric conception in structuralist design directs from the clear emphasis on configurative relations in form-compositions. Unlike their modernist precursors who strived for liberating the constitutional elements of urban form in the name of ‘open plan’, structuralist designers tended to intertwine the elements within their design compositions. Such a design operation was governed by the structure as an organising tool by which the design increments are topologically related. Therefore, the structure itself was essentially perceived as the rule that all the units were to be configured accordingly. (see Figure 6.15) That means, the topological structure in structuralist design [mostly in the form of grid system] corresponds to the organisational structure [in the form of generative design algorithm] in parametric design (Kotnik, 2011: 333).

Unlike the early structuralist counterparts, the initial structure generated in parametric model does not function as a robust primary framework, but it is always subject to parametric variations in relation to the other system components interactively. Rather than a concrete structure governing the combinatoric articulations on itself, the algorithm acts as an abstract generative structure at the background of the design composition in parametric models. Nonetheless the basic design motivation remains the same: weaving the fabric via the rule-based interactions between the modular units.

Though the early structuralist schemes could be regarded as single architectonic systems consisting of many sub-units, the basic premise behind them was creating built fabrics which are capable of rule-based growth, diminution and change (Smithson, 1974 cited in Avermaete, 2011: 129). Such an idea poses quite a generative donee in itself. Accordingly, while the primary structure is regarded as a robust element with longer life cycle, the less permanent infills by the smaller elements (Valena, 2011: 10) represent the generative character of structuralist urbanism.\[33\]

Despite the strong idea behind, it is hard to conceive the early structuralist schemes as emergent morphogenetic design due to the overreliance on the primary structure initially imposed. The reliance on a holistic structure might derive from the basic proposition of the

33 Even in the case Tokyo Bay Project, one of the most monumental iconic structuralist proposals, the large-scale flexibly grown urban structure was proposed to be populated by the large number of individual permanent infills. See: Lin, Z. (2007) ‘Urban Structure for the Expanding Metropolis’, Journal of Architectural and Planning Research 24(2), pp. 109-24
structuralist social-philosophy, *man as an element is dependent on the whole* [structure] (Lüchinger, 1981: 16), which was probably influential in the designer's mind. Since structuralism limits individual freedom within structure, it seems that the philosophy is categorically contradicts with the idea of emergence and complexity entailing bottom-up formations. However, when we take structure as a rule-system, it is possible to involve the structuralist idea into the generative perspective in terms of the active and contingent role of the individual element during formation. That was actually what the structuralist designers proposed:

“…growth and change, the continuation of patterns as result of human action; the way living urban tissues are developed out of many small. Individual entities; and above all, the underlying structure, the relatively constant holding the relative ephemeral; unity and diversity; the beauty of the ordinary.” (Habranken, 1980: 47).

“… This relationship between collective pattern and individual interpretations can perhaps be linked with the relationship between language and speech. (We use language in our own way; both individuals and groups can express themselves with it, and as long as they keep more or less within the framework of recognised rules and use recognisable words, then the message comes across.” (Hertzberger, 1973 cited in Lüchinger, 1981: 64).

In terms of the associative thinking of complex configurations, the parallelism between parametricism and structuralism is also evident:

“A city should embrace a hierarchy of superimposed configurative systems… All systems should be familiarised one with the other in such a way that their combined impact and interaction should be appreciated as a single complex system” (Eyck, 1962 cited in Lüchinger, 1981: 39)

The interesting point is that these lines of thought can easily be incorporated with the new methodological discourse of parametric design. However, it is clearly seen that parametric urbanism is still far from such an argumentation regarding the question of a desired and possible social-production of (parametric) urban form.

Finally, both structuralist and parametric design models share the same form-language through weaving the fabric with the repetition of interrelated modular units. However, unlike in the structuralist examples, the morphology of parametric urban design proposals does not exhibit a space-oriented structuring. While a clear designation of the intermediary spaces within built-up fabric is evident in the structuralist urban architectural projects, the mass is the major figure in parametric form-composition (rather than space). There should be two factors behind: Methodologically, the current parametric configurations are highly based on building-to-building relations leaving the definition of space accidental, whereas structuralist proposals were essentially sensitive to space organisation in design. Theoretically, parametricism regrets the concrete notion of space and tends to replace it with the concept of field.

3.2. Current State of Art: parametric applications in urban design

Figure 6.16. Some sampling projects of associative/parametric urbanism: ‘Cohabitation growth’ designed by using cellular automata and genetic algorithms. The associated ‘morphological landscape’ is generated based on a rule-based system controlling the position and proximity of the modules. (1.)
A parametric scripted model of design through alternative tissues based on the different scenarios, and the building patterns generated accordingly. (2.) (Almasri et al., 2009) (By courtesy of S. Tuysuz and P. Sovinc)

The term ‘parametric urbanism’ is originated from Design Research Laboratory (DRL), a research programme held in Architectural Association (AA), London. Working on the rule-based multi-scalar systems covering both building systems and urban fabric (Verebes, 2009), the methods developed there represent quite an architectural approach to urbanism. Since then, several design schools have been introducing new algorithmic methods into urbanism as an alternative to conventional master planning. In the sampling experiments presented, it is possible to see an exceptional form-language based on the transformation of few components within one scheme, which exhibits a noticeable diversity within unity on the large-scale. (see Figure 6.16) This point basically distinguishes parametric urban design from the analogue urban blueprints based on few standard repetitions. In the projects, density and urban programme are introduced as the main design parameters in the generation of collective form.

What we mainly observe in those examples is a kind of systems open for further growth with blurred border conditions, as Schumacher argues (2009: 23). As long as the systems are responsive to the neighbouring ‘conventional’ urban typologies via parametric adaptations, such a quality can be taken positive. However, a particular method to integrate the new and the old (existing) types in an adaptive fashion cannot be followed in the current parametric applications.

At first glance, the complete parametric control on large-scale urban fabric could be regarded as a positive aspect in terms of the capacity to simulate the results of the basic generative rules applied. Yet, the examination of the publicly accessible parametric design projects shows that the basic design rules involved in the process are not explicitly provided to the third parties. The algorithm itself is not conceived as a final product to be presented along with the design image. Moreover, the coherently configured free-flowing forms are mostly perceived decomposable through the complex whole-part [or system–to-subsystem] relationships. Therefore the projects are hardly informative about the possible post-design partial transformations.

DRL’s systemic search for parametric urbanism is not the first attempt towards a generative approach to urban design. Since the mid-1990s, by using evolutionary systems in design, Watanabe (2002) has developed an inductive method of form generation in parallel with the evaluation programs testing the fabrics and patterns in terms environmental behaviours. He characterises the new approach by designing bottom-up through specifying only the relations between parts (p. 8).

C. Soddu and E. Colabella, the Italian architects, have developed another early generative approach to urbanism on the basis of their researches about algorithmic art and design since the late-1980s. Defining a mathematical system to design morphogenetic codes, the authors basically suggest developing and/or to preserving the morphological identity of the towns. By means of a series of transformation codes and the randomising factors inside the code, they have experimented a series of simulations, and demonstrated endless fractal variations in time-series while maintaining the same algorithm (Soddu et al., 1995; Soddu, 1994; 2002). (see Figure 6.17) Various three-dimensional models generated by C. Soddu basically show urban designers the possibility to design the identity of a town (either modern or
traditional) via deriving the existing urban codes and reactivating them as the algorithmic parameters in a generative design system for the city.

![Image]

**Figure 6.17.** The urban fabric generated via the ‘identity generative code’ and some hypothetical sequences of unpredictably generated traditional building clusters. (Adapted from: Soddu, 2002)

With the widespread use of parametric modelling techniques in design, the notion of *parametric urban design* has become an attractive design research topic in urbanism for the last couple of years. In early applications of the term, parametric control was limited to the quantification of the form drawn manually. In these models, the basic motivation was informing the stakeholders about the changing physical parameters (i.e. built area, FSI) through dynamic 3D modelling, simultaneously[35]. With the following applications, we see that parametric modelling is employed as a generative tool in addition to its control function. In this context, with his experimental design project, U. Brederlau (2009) suggested a model to organise the plots and building volumes by modifiable parameters (i.e. proportion, density, alignment) in relation to environmental factors (i.e. light, wind). With his model, Brederlau (2011) claimed the possibility of high variance in the same structure and dynamic modification of individual components while the total system-relations are maintained (p. 327). (see Figure 6.18, above) As another developed version, the ‘parametric urban design tool’ modelled by Beirao et al. (2011b) offers an interactive interface informing designers with the global output updates during generating and transforming the rule-based urban configurations via parametric algorithm. The major parametric inputs involved are building density, height, grid typologies and compositional elements such as focal points and main streets. (see Figure 6.18, below)

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Figure 6.18. *Parametric urban design* models designed by Brederlau (2009) (dynamic modification of urban structure –top left- and generative development of urban fabric -top right-), and interactive parametric system by Beirao et al. (2011) –network patterns and block envelopes coded by density parameter- (Adapted from: Brederlau, 2009: 347; Beirao et al., 2011a)

Figure 6.19. A snapshot from the interface of CityEngine, which has a wide application including game design and archaeology as well as urban design (Esri, 2011)

As of today, *CityEngine* software system represents the most developed version of the parametric/generative urban modelling.[36] Being operated based on parametric shape gram-

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36 The authors of the software define it as a ‘procedural modelling’. It means “3D geometries and textures are constructed using rules (procedures) instead of labour-intensive manual modelling.” (Esri, 2011).
6. EMERGING TRENDS and TENDENCIES in URBAN DESIGN

mar\(^{37}\), the software allows the user both generating the fabric via large amount of data-input [attributes and procedural rules (i.e. from lot subdivision, size range and irregularity to building height ratios)] and controlling the parameter values by directly manipulating the drawing.\(^{38}\) Nevertheless, despite the wide scope of parametric index it has, the model lacks structural (configurational) parameters and merely operates on the geometry (composition) itself.

Though the early theoretical approaches have paved the way to the use of generative systems in urban design within the controllable domain parametrics, it is difficult to observe a full theoretical consistency between the morphogenetic (emergent) design theory and parametric approaches to urban design. Unlike what the theory entails, the current parametric design models tend to operate on large-scale patterns without providing a generative procedure to simulate piecemeal and successive morphological emergence. In this sense, they fall into the class of determinist modelling as applied for various architectural and industrial design applications (Hanafin et al. 2009).\(^{39}\)

The primary challenge of parametric urban design is to overcome common dominance of design by blueprints in which the rules of the design form are implicit within a frozen image. However, unless the designer explicitly presents the algorithmic definition of design morphology, the parametric logic behind the design proposal remains highly inaccessible by the large public within conventional master plan-base) design processes. In this regard, it should be emphasized that the strongest asset of parametric urban design is its algorithmic form-language, which potentially makes the complex forms comprehensible and manipulatable for everybody. Opening up the design operations to the non-designers, in that sense, would be the most serious contribution of parametric design to urbanism. As we will see in the case of Kartal Masterplan, keeping the parametric form-finding phase ‘mystical’ for the users and planners can be taken as a missed opportunity for the adaptation of parametricism as a new methodical approach to urban design.

3.3. Parametric design in actual urban context: challenges and opportunities

There is no doubt that pronouncing a design method, as a new way of urbanism requires a broad framework beyond mere formalism (Konig, 2011: 277). In its early stage of development, the discourse of ‘parametric/associative urbanism’ requires more concrete argumentations on the possible role of the design method in the actual context of space production processes. As discussed in the early chapter, the complexity of spatial planning and design basically results from the variety of design parameters and contextual variables (Levin, 1966). On this relational basis, while some variables can be steered by the design parameters introduced, some others are out of the control of designers. (See Figure 5.1) By its definition, parametric design can be operational in urban context, only if the relevant parameters

\(^{37}\) Parametric shape grammar is a type computational system of generating shapes by the parametrically defined transformation rules. See: Stiny, G. (1980) ‘Introduction to Shape and Shape Grammars’, Environment and Planning B: Planning and Design 7(3), pp. 343-351

\(^{38}\) Since it is compatible with geospatial data, the model is devised to be utilised in the planning of actual cities as well.

\(^{39}\) Hanafin et al. (2009) differentiates determinist models, which require to start design with a parametrically manipulateable but already given end-product, from the non-deterministic ones, which allow designer start with the algorithm without knowing its physical representation at the outset.
are specified and modelled in a working algorithm. Though it is too vague to formulate concretely, setting the working (parametric) relations in consideration of key variables has utmost importance to create a positive design effect on the dependent variables selected in (parametric) design.

Unlike the static models not considering the time dimension, parametric design suggests dynamic modelling\(^{40}\) that enable us to simulate and observe the changing form and behaviour of the design form in time.\(^{41}\) This point has much potential to challenge the conventional urban design procedures based on static blueprints. By means of the real-time simulations of the generation of urban form based on the actual codes, emergent performance of the existing rule systems can be assessed efficiently. This would trigger alternative planning procedures, which would be operated on ordering (coding) the ‘frame’ at the level of collective urban form, and articulating the ‘infill’ at the level of individual plot, block and streets in different ways. There is no doubt that such an optimist view about the model’s positive impact on design and planning assumes a well-established methodological connection between the actual process of urban land development and design modelling. Though the proposal of such an overarching conceptual model of ‘parametric design-based planning process’ is out of the ambition of this research, the author limits himself with addressing the main aspects on the issue and discussing them with a real case-study given below.

In this regard, the major aspects (and questions) of/on parametric design in the urban context can be cited as follows:

- The ways to benefit from the actual capacity of parametric design, which is highly cost-effective through mass customisation: Parametric design is inherently responsive to the flexible industrial-productions creating customisable variation (Jormakka, 2008: 80). In consideration to the existing building codes and construction techniques, is that capacity applicable for the production of built environment?
- The potentiality of generative parametric systems to change the settled perception of designers on the role of design in the context of urban complexity: Do the designers perceive the new tool with the old conceptions and ideologies?
- The mode of representation that the model possibly suggests for an efficient communication in planning process: Does the algorithmic thinking in design yield a transparent and comprehensible design language that is accessible for all the participants (i.e. designers, planners, developers and people) involved?
- The possibility to construct an effective link between architectural typology and urban form via parametric design (Lee, 2007): Does the generative character of parametric design lead to the production of operative building types which would work for an increase in coherence and diversity in planned urban fabrics?
- The mutual relation between design parameter and planning code: Do the parametric rules in design responsive to the actual urban codes? Does the model enable designers to re-utilise the standard rule-sets in a more creative way increasing the typological variations in a built-fabric?
- Efficiency of parametric models in design control: The model provides a manageable

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\(^{40}\) Rittel (1964) defines model as a means of programming and representation of the design object and process (pp. 108)

\(^{41}\) This can be taken as a positive response to the prognostic statement of K. Lynch (1981) as we cited in the beginning.
and competent procedure for the micro-domain of design through controlling the complex geometries. *Is it also the case in design control process in urbanism through which the various externalities (i.e. property relations, regulative constraints) involved?*

- **The validity of design flexibility in urban context:** Parametric design is technically welcoming for any change in parameter setting. In this sense, it gets along with the nature of design exploration through sudden shifts in design criteria and principal parameters (Stefanescu, 2012). *Are the algorithmic design schemes also flexibly used during the post-design process in planning?*

Each point given above represents a critical issue, which requires in-depth researches, by its own. Assigning the thorough answers to the future studies on them, for now, I will tend to provide a preliminary critical framework on the topic by examining a real case. The relation between parametric design and the actual context of urban design control will be discussed with reference to one of the biggest parametric urban design projects applied so far.

### 3.3.1. The relation between parametric design and urban coding: the case of Zaha Hadid’s Kartal-Pendik Masterplan in Istanbul, Turkey

*The Kartal-Pendik Masterplan* is the winning competition entry for the redevelopment of a post-industrial site on the east bank of Istanbul, Turkey. The project area covers a 550-hectare urban land and it is located between a major international highway and the coastline. Regarding the size of the site and the program of the area (6 million m² including housing, business and cultural facilities), one can easily recognise the ambition of the design task to control a large section of development area via a single scheme. So the use of parametric model in the project has to be considered in this context.

Having been submitted to the international urban design competition organised by the Greater Istanbul Metropolitan Municipality in 2006, the design project basically consisted of a series of schemes based on the idea of ‘soft grid’. Accordingly, the project primarily tended to *tie* the designed network and the existing urban structure together by stitching the major incoming lines of connections from the surrounding area (Zaha Hadid Architects, 2006) (see Figure 11, 1) With the ‘wool-thread’ model[^42^], the lines of the streets were curved, bent and bundled through various locations. The emergent pattern ultimately created the waves of irregular cells (urban blocks) and the nodes (of intensity for the accentuation by height difference). This actually represents the major parametric operation of the design. Via the parametric design tool, the urban pattern was configured through optimisation of the network structure with the minimised average detour factor and a dynamic urban grid (Schumacher, 2009: 19-20)

[^42^]: *Wool-thread* is an optimization method for networks to decrease the overall network length without increasing the deviation/detour factor.
Figure 6.20. The major schemes from the Kartal-Pendik Masterplan designed by Zaha Hadid Architects (2006) (By courtesy of Istanbul Metropolitan Planning and Urban Design Centre, 2011)
The street pattern, in this respect, acts as the basis for the articulation of urban fabric in which the locally bundled lines form the nodes of programmatic intensity. The nodes are emphasised by height differences in the form of rising towers locating on the neighbouring islands (Zaha Hadid Architects, 2006b). In this context, the urban grid provides a flexible and smart framework for the generation of urban composition. The smooth transition of urban fabric throughout the whole design area through the gradual changes in building density and block composition is aimed along with the internal diversity of urban pattern. The basic design idea of ensuring the ‘calligraphy of an urban landscape’ underlies all the compositional tactics involved (Zaha Hadid Architects, 2006a). The urban fabric is considered as a kind of network, which transmutes in itself by the gentle transformation of building types (i.e. from detached buildings to the perimeter blocks). (see Figure 11, 5) Therefore, block typologies are not imposed into the scheme, but emerge out of parametric form-generation. (see Figure 11, 6) The generation of blocks are again based on the principles of associative geometry by which the articulation of building typologies are correlated with the size, dimension and the location of the cells in the fabric (Schumacher, 2009: 21).

With the help of a design script algorithmically controlling the dynamic formation of urban blocks, this is actually what makes the street network a kind of ‘soft grid’. The smooth and subtle transformation of the blocks, which created several peak points through the fabric and faded into open spaces, is essentially compatible with the idea of ‘field’ as the major principle of parametricism (Schumacher, 2011b: 421-33). It is obvious that such a continuous variation in height levels throughout the whole fabric could not be created by the analogue design technics based on drawing. Appreciating the dynamic organisational character of the parametric (algorithmic) network of the design scheme, Stoppani (2011) calls the grid’s capability to articulate the built-up fabric the ‘grid effect’.

In terms of urban coding, the possible question here would be about how to create such a continuous calligraphic effect of the density composition with the conventional Turkish urban codes which are merely based on the regulations of discrete urban blocks. Since the building codes are specified for each singular block in Turkey [mostly without considering the morphological relation with the neighbouring ones], the translation of the dynamic form of parametric design into static descriptions of a master plan through the bylaw codes turned out to be the major challenge in the actual planning process of the development.

In this regard, the Kartal-Pendik Masterplan Project represents a special case in terms of the relationship between (parametric) design and planning. The official development plan of the area has been configured based on the main principles and the architectonic framework of Hadid’s design scheme. (see Figure 12) The following process after the design scheme can be called ‘localising the design concept’ by converting the design parameters into the standard codes of planning (Akın, 2011). Since the different urban blocks were composed in various density levels by the design model, the proposed form-composition was representing a conflicting behaviour with the Turkish planning system that entails an equal distribution of densities within a plan area in the name of ‘equality of development rights’. For one year after the competition held, the Turkish planners worked hard for making the design scheme implementable by re-configuring the internal subdivision of the blocks. While the FSI levels were kept same for each parcel, the density variation within the design was ensured by differentiations in building height (Sönmez, 2011). To manage such a complicated and long
process in coordination with the parametric design scheme, the landowners in the area were organised as a society in 2007. Redistribution of the development rights has been pursued by synchronising the design team in London with the planning department of the municipality in Istanbul (Göksu, 2011). During this process, there have been two major tasks on design coding: First, the dynamic parametric form was requiring subtle height differentiations in each block even on a single plot, which was not a common case in Turkish planning. Second, each operation made by the cartographer during parcelling out the development rights was obliging to drive the parametric model over again in London. Because any particular change in the size of a block were abolishing the overall system of urban layout which was based on an associative geometry (Özkan, 2011). Such an extra workload in the design control process essentially demonstrates the lacking link between the local urban codes and universal modelling in parametric design.

Figure 6.21. The urban composition proposed by the design office (2006) –left- and the official development plan designating the height and land-use zones in accordance to the design scheme (2007) –right- (By courtesy of Istanbul Metropolitan Planning and Urban Design Centre, 2011 and Kartal Kent-Der –Kartal Urban Development Association-, 2012)
In executional terms, the articulated urban fabric that consists of a series of density surfaces differing to each other represented one of the major problems of the design scheme. The design team treated the development site as if a single developer owned the total area. In fact, there were 290 landowners were located in the district, which made such a holistic design scheme impractical for the collective space production\(^{43}\) (Ibid). Those points inevitably led the local government to serious hesitations and uncertainties about the way to utilise the plan in the actual building process. This was due to the lack of adequate tools for morphological control, which would link the dynamic height and massing parameters of the design to the implementable building codes. To overcome this problem, the same design office was re-commissioned to provide a number of design guidelines to coordinate the future individual developments in the area (Ibid). This ultimate result of the process essentially signifies the actual limits of the total-design approach that mainly results from the design tool selected for the production of a ‘big artefact’ called urban fabric.

4. Conclusion:

In the light of the literature put by the ones applying parametric design in practice and the personal insights expressed by the designers involved in the research, it is possible to argue that the generative design methods potentially have a significant impact on the changing role of designers in urbanism.

As Mitchell (1990) puts forth, a design process basically a trial-and-error process that involves generation, test and control mechanisms. When computer both generates and tests, the process is called fully automated (p. 180). Unlike the creative evolutionary systems, parametric design represents a hybrid model that includes human intervention in both mechanisms. That means the craft-like nature of urban design through close examination and the creative dialogue of/with the substance (the urban form), as argued by (Kropf, 2011), is still the case in parametric urban design.

Considering the complexity of urban formation argued, and the position of human intervention within computational design domain discussed, one can claim that the designer’s role is to shift from creating to controlling the form in spatial design. This does not mean that the designers would lose their position, but they might have to transform their role in design decision-making. In terms of the parametric methods discussed, the designers may involve in two basic operations in design:

1. Devising the core setting of the generative algorithms by the design rules,
2. Evaluating the emergent design forms in terms of the constraints set by the context and design criteria.

In this framework, while the first operation implies variation, the second one connotes selection in evolutionary terms as argued before. Therefore, the design profession mainly applies to the specialised knowledge on form (morphology) and its algorithmic description in terms of parameters. In this sense, the author does not believe that the designers should

\(^{43}\) Interestingly, the evaluation committee of the competition states in the jury report that the project offered a potential to make phasing and parcellation easy in the course of implementation. see: Topbas, K., Sorkin, M., Kaptan, H., Tur, E. T., Jumsai, S., Ozkan, S., Inceoglu, N., (2006) Kartal Alt Merkez ve Kartal-Pendik Kıyı Kesmi Kentsel Dönüşüm Projesi, Değerlendirme Karulu Raporu –Kartal-Pendik Urban Design Project Evaluation Committee Report-, Istanbul Metropolitan Planning and Urban Design Center (IMP): Istanbul
behave like programmers writing computational scripts, but they are basically expected to rationalise design via explicit design rules and parameters which can be utilised in writing algorithms by programmers, accordingly. There is no doubt that the new profile of (urban) designer will be required to have the basic operational knowledge of computation for an efficient involvement in programming.

Another point making parametric design significant for urbanism is that the design method suggests a strong typological perspective to urban design (Lee and Jacoby ed., 2007)

Deriving the parametrics of urban types from the existing tissues and utilising them as input-data in generative algorithms would potentially establish a more effective and innovative continuity between urban morphology and design. The explicit (algorithmic) and recordable formulations of the typological design forms would make the traditional typologies highly accessible for many other designers within a specific planning context.

Eventually, the existing capacity of computational design, which enables the designers to control all the parametric dependencies of a complex form signifies a critical question in the context of urbanism: Should designers create ‘complex geometries’ on urban scale by themselves via parametric modelling, or should they define the necessary generative conditions which would ultimately yield the long-term emergent adaptations? Without intending to suggest a conservative position, we could emphasize the design profession's enduring misconception of ‘urban pattern’ as a corporate artefact. The holistic applications of parametric methods in urban design indicate an obvious risk for the convention of ‘new monumentalism’ under the long-standing influence of architectural hegemony on urbanism. Unlike its early version, the new compositional approach would pursued not by a master builder composing large portions of urban fabric with a pen, but by an architect configuring the fields of a parametricised urban landscape with an algorithm.

More essentially, through its pre-rationalised structure (design algorithm), parametric design seems to contradict with the fundamental nature of spatial design thinking as a non-discursive phenomenon (Hillier, 1996: 3), in which the process cannot be entirely codified by the explicable parameters beforehand. Whether all the design intentions are practically quantifiable is highly a disputable point, as well. By its definition, algorithms are constrained with certain set of parameters. For this reason, parametric design models inevitably reduce design into a limited set of working parameters such as density, height, network geometry etc. As we know, spatial design involves too many parameters, which are sometimes contradictory

44 For a comprehensive discussion on the subject, see: the special issue of Built Environment 37(4), -Urban Morphology and Design-, 2011, edited by. S. Marshall and O. Çalıskan
45 For a concise discussion on the substantial difference between a corporate object and a collective entity, see: Marshall (2009: 135)
46 With regards to the emerging capabilities of parametric design in urbanism, the term positively used by P. Schumacher (2011): “… a new monumental synthesis is achieved that combines variegated richness with continuity and coherence: intensive coherence” (pp. 427).
47 In his recent article, Mehaffy (2011), the contemporary champion of generative urbanism, put a bold criticism forward against the artistic use of the new digital form-generating tools in urban design. Arguing that ‘a city is not rhinoceros’, Mehaffy (2011) clearly questioned the top-down conception of the new design techniques. Nevertheless, in his review on parametricism, he reduces parametric modelling into generation of ‘complex flowing shapes’ which has nothing to do with design complexity. In this sense, despite his strong theoretical positioning, Mehaffy (2011) misses the underlying relevance of parametric modelling with urban design (control) [in terms of algorithmic/associative thinking in design]. See: Mehaffy, M. W. (2011) ‘A City is Not a Rhinoceros: On the Aims and Opportunities of Morphogenetic Urban Design’, Built Environment 37(4), pp. 479-96
and irreducible due to the ‘wicked’ nature of spatial planning (Rittel, et al., 1973). Besides, those parameters are always subject to change and to be replaced with the new ones during the process in accordance with the co-evolutionary nature of design thinking (Poon et al., 1996). On this basis, the actual difficulty of recodification of an already established parametric model (Terzidis, 2006: 45) represents one of the most obvious limitations of parametric modelling in the complex and dynamic design processes like the ones in urbanism. This is exactly what we observed in the case of Kartal-Pendik Project as an actual application of the parametric design method in urban context.

After all, does it mean that the ongoing searches for an integration of parametric models into urbanism are useless or even risky? The principal answer to such a question would not be necessarily a positive one by cautiously emphasising the risk. Recognising the drawbacks of the parametric methods in urban design, we can realise the potential use of the models in urban design-control. In urbanism, the real challenge of parametric design does not lie in the playful exploration of complex form-compositions by algorithmic models, but in the intrinsic capacity to control the collective form in a relational structural framework. That means, rather than trying to create a kind of ‘design machine’, we should make use of the algorithmic design methods as a design support system within long-term development control processes in urbanism. By this way, parametric models can be functional to provide necessary conditions for the controlled generation of emergent urban forms, instead of designing them directly in limited time periods. To establish such a perspective, a better integration of the complexity theories of generative urbanism and the parametric design methodology is required.

5. Concluding remarks

In the final chapter of the thesis, the author suggested a critical overview on the new trend and tendencies in urban design to figure out the enduring interpretation of the basic conceptions of urban morphology, planning and design, which were elaborated in the preceding chapters. Within this context, the research designates the emergent and generative paradigms as the most relevant approaches to reconsider the new trends and tendencies in urban design. Since these two schools suggest more responsive theoretical perspectives to the actual condition of complexity from a design perspective [compared to the other mainstream paradigms (see Chapter 2)], their major premises have been specifically revisited with reference to the emerging techniques, methods and manifestations in urban design. The critical review presented here, in this sense, can be regarded as an original contribution of the research due to the current lack of a comprehensive outlook provided on the new design technologies from an urban design perspective.

In the final chapter, the author examined the relevance and applicability of the gen-

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49 Overreliance on the initially set design parameters despite the emerging variables (i.e. property pattern) that subsequently involved in the process and radically affects the design morphology.

ervative methods of parametric design in urban context with reference to the contemporary understanding of urban planning and design. Returning back to the point about comprehensiveness, we could argue that the review covered the major aspects of the issue, which can be summarised with the main titles as follow:

- The basic logic and technique of parametric design
- The main elements of parametric design thinking
- The principle premises of ‘parametric urbanism’
- The current state of art in the applications of parametric techniques in urban design
- The challenges and opportunities of the technique in actual urban context.

Within this context, the author first delineated the theoretical framework of generative urbanism and clarified its underlying assumptions for a better (critical) understanding on so called ‘parametricism’. Then the method of parametric design has been examined with reference to its promising features that would challenge the settled conventions of (urban) design thinking in the way of opening up new possibilities for a generative approach to the contemporary urban design. In relation to the previous discussions on (urban) design thinking, we determined quite remarkable novelties in the method that would alter the applications of the basic (cognitive) mechanisms within analogue design (i.e. abstraction, exploration and selection). In this sense, the intrinsic potentialities and limitations of parametric modelling in spatial design thinking have been addressed. However, the necessity of an in-depth design protocol study as done for the analogue design processes in the previous chapter is observed in the current study on parametric design. The examples presented to get an insight on parametric design modelling seem to fall short, and call for further in-depth researches on the issue. In order to reach more precise arguments on the characteristics of parametric design thinking, further studies are needed.

Most importantly, the critical review on the emerging discourse and the applications ‘parametric urban design’ has shown that despite they fall into the category of ‘generative urbanism’ in general, the current experimental applications and practice of the new approach are yet to meet the basic requirements of the school of generative urbanism. Despite the inductive reasoning process applied in design modelling, the current applications of parametric design fail to provide necessary inputs for a ‘new generative urbanism’ with regards to the basic premises of the school. Despite modelling an incremental and emergent type of urban growth and change, the current applications suggest quite a total-design approach to urbanism. Despite its strong theoretical emphasis on complexity, on the one hand, this point still represents the most critical paradox specified within the current understanding of parametric design.

Our previous review on ‘planning the morphology’, on the other hand, has shown that in practice, its is apparently possible to combine plan and code within the same design control process. This point basically signifies a serious opportunity to utilise parametric models as design support systems. In this regard, the author emphasises the promising use of parametric modelling in urbanism not as a kind of compact design instrument, but as an interface to simulate the incremental growth (and change) of collective urban form in design control. In other words, parametric models can be taken as an instrument for constructive (exploratory) morphology to inform planning and design. We should note that despite the
widening use of design codes in urbanism, the actual planning systems are still lacking with a component methodology to control the incremental changes in city fabrics.\textsuperscript{51} For this reason, a possible improvement in the theoretical assumptions of parametric urbanism is believed to have a true potentiality for a proper integration of the technique into the actual planning and design practice. For sure, as the other movements of urbanism realised in history (see Chapter 2), parametric urbanism has to establish a clear and original standpoint on the issue of controlling pattern formation based on the fundamental distinction between frame (grid) and infill (built fabric), as well. Unless formulating such a morphological (re) conception, the new technique would remain as an avant-garde exploration of shape instead of a systemic methodology on form.

\textsuperscript{51} Even the most systemic approaches to the issue, in this regard, basically falls short to suggest an applied model based on a compatible and accessible technology. see: Hall, A. C. (1997) 'Dealing with Incremental Change: An Application of Urban Morphology to Design Control', \textit{Journal of Urban Design}, 2(3), pp. 221-239
CONCLUSIONS
In the very beginning of the thesis, we opened up the discussion by arguing the possibility of an alternative view on the concept of ‘pattern’ in urbanism. Rather than assigning a central position to the idea of ‘making’ with respect to the activity patterns of people in space, as Christopher Alexander has successfully done within his normative theory, the alternative approach would rather emphasize planning and design in direct relation to morphology. Then, how does the forgoing research, in this regard, suggest an alternative view on the issue of urban pattern formation?

The primary response to this question would be that the research does not offer a full-fledged alternative model at all. As argued in the introduction chapter, claiming a kind of complete applied model to integrate design and planning in a single framework on the basis of urban morphology would be too ambitious for a research per se. Doubtlessly, this would be rather subject to the long-term disciplinary progress as a result of the self-reflective interactions between theory and practice. Moreover, the objective of improving design and planning with a better understanding of morphology is not indeed a new one, since such a demand has already been recognised in the literature. However, the more established links between the domains are yet to be developed while the identification of the potential fields of integration still remains as an outstanding challenge in both theory and practice (Çalıkşan and Marshall, 2011).

In this context, the major contribution of the research is not to offer an entirely new agenda for urbanism. Instead, the proposed work should be regarded as an attempt to organise a large body of knowledge on the issue, urban pattern formation, with new insights and inquiries. This is basically considered vital for a better integration of morphology, planning and design in the light of the critical issues systematically revealed.

As seen in the core sections of the research, the substantial knowledge on urban form and formation has many facets involving history, ideology, cognition and methodology. Since each issue comprises its own particular content, the most challenging task of the research was knitting the diverse aspects closely on a relational basis. Though we tended to make all the intermediary conclusions with reference to the early discussions in the main body of the text, it might be difficult for the reader to connect all those partial conclusions for portraying the overall argument of the research itself. In this regard, within the current section, we will take the opportunity to reflect on the previous discussions and arguments by making cross-correlations between the different issues critically examined.

Accordingly, it is possible to present the principal conclusions of the research as a series of thematic statements as follow.

1. **Need for a common language between morphology, planning and design**

   There is no doubt that any kind of interaction between the different personas requires a common language for an effective communication and exchange. Likewise, the integration of the different disciplines demands a shared terminology in which the basic concepts have the same connotation for all. This is not only needed for an efficient disciplinary integration, but also for the autonomous performance of an academic discipline (Davoudi et al., 2010: 617). In this respect, we could claim that the enduring neglect of the epistemological aspects (i.e. the nature of knowledge, its organisation and validity) is not only evident in the
discipline of spatial planning (Ibid, p. 614), but also in morphology and design. What we specifically mean by the ‘epistemology of a discipline’ here is primarily about the conceptual clarity of the scientific terminology involved.

Making a comprehensive review on urban morphology, one can easily realise that unlike the other fields of morphology (i.e. physical geography, linguistics, biology), urban morphology currently exhibits a lack of a firm terminological basis. In many cases, different concepts are used interchangeably to denote the certain aspects of urban form and formation (i.e. structure, pattern, order). This can be due to the interdisciplinary nature of urban morphology as a relatively young research field (Moudon, 1997). Furthermore, the conceptual ambiguity on urban form and formation is no less valid in the literature of urban design, which has mostly shaped by the terminology of architecture and planning. Designating that point as a problematic issue, the author initiated his research via revisiting the basic categories of morphology, form-composition, structure and fabric. By doing that, the disciplinary terminology of morphology would be more clear and consolidated.

The clarification of the basic categories with reference to their intrinsic properties, applied objects and tools has essentially enabled us to reveal the three corresponding concepts, order, instance and concurrence. (see Chapter 2) Accordingly, rule and structure, form-composition, and pattern and fabric have been characterised as the distinct types of morphological being as respectively the results of the actual processes of ordering, form articulation (or generation) and emergence. That explication firstly entails the impossibility of the use of those categories interchangeably through their distinct connotations. Secondly, it is revealed that each morphological category implicitly refers to a certain type of form-processes (formation), which indicates planning and design. That means the deliberate use of the terminology (of urban form) would potentially link us to the discussions about the different approaches in spatial planning and design.

Accordingly, within the review of the mainstream paradigms of urbanism, it is revealed that the original conceptualisations of form and formation basically determine the fundamental distinctions between the main approaches. While the compositional design approach conceives urban form in terms of articulation and form-composition, the so-called generative urbanism tends to operate with codes and patterns. This is a clear indication that each design approach operates with its own set of concepts and conceptions. This point brings us to the argument that if we ideally address urban morphology to inform the design processes in an efficient way (Marshall and Çaliskan, 2011), we must provide the field with a firm conceptual basis which is rich and consistent in itself.

From this perspective, the research has suggested a unified conceptual framework of urban morphology involving the basic form indicators. (see Chapter 3) By this means, we aimed to elaborate the intrinsic concepts of the main morphological categories cited above. Even though the comprehensive collection of the form indicators was initially aimed for the morphological analyses, the following discussions on the future trends in urban (morphological) design have indicated the actual need for such a conceptual clarification for planning and design. Postponing the detailed discussion about the possible integration between the form-concepts and the metric parameters in design, for now, we can conclude that there is an immense potential to operationalise the abstract knowledge of morphology with the emerging methods of spatial design (i.e. parametric design) through elucidating the basic terms and
terminologies. The conceptual (re)formulations suggested in the early chapters, in this sense, should not be regarded as a purely intellectual exercise, but as an endeavour aiming at new interpretations in design practice.

2. What history teaches us: the fundamentals of form-control in urbanism

What is the use of urban history for urbanists? In author’s view, since the first publication of Spiro Kostof’s two magna opera on urban patterns and the elements of urban form through the urban history[1], the answer of the question has to be approached differently. What Kostof (1991, 1992) has demonstrated is basically the possibility of reading urban history by placing the wilful act of ‘making the city’ into the focus of interest without skipping the constitutive role of the external forces on human act (i.e. society, culture and politics). Such a view beyond the subjectivist nostalgia or the structuralist dullness would actually fit to the common interest of the designers and planners, for whom the main object of thought is the physical elements, spatial patterns and their conscious organisations.

From the same perspective, we devoted the introductory chapter of the dissertation also to a historical typology of urbanism. While making a historical review, our intention was surely not to write the brief history of (western) urbanism, but to read its baselines from a designerly perspective. As mentioned before, via the intensive readings of the main texts on urban history, we specifically searched for the relevance of the two aspects: the relation between code and plan, and that between frame and infill. While the former distinction was explicitly made by Ben-Joseph (2005) and Marshall (2011), the later is inspired by Habraken (1966; 1985). Shortly reciting, what we mean by ‘code’, on the one hand, are explicit rules (i.e. standards and norms) to control design without specifying the exact form given by the designer. On the other hand, ‘plan’ connotes the definitive design scheme designating the future form and structure within a geometric order. Within the other pair of the concepts, ‘frame’ is the network and subdivision of an urban land, which hold the parts together while respectively serving for distribution and containment (Habraken, 1985: 100). Complementarily, infill means the low-level elements configured according to the system of frame[3] (Habraken, 1966). In urban context, while urban grid is the frame of morphology, the built fabric [within the frame of network and the cellular units (blocks)] is regarded as the infill.

Reading the history of urbanism through those conceptual dualities, we recognise that all the historical periods are essentially characterised by the changing relationships between frame and infill and the way to control their particular combination with plans and/or codes. The point is that whether it is configured by local code(s) or a ground plan, the network structure of the city fabrics always acts as the main organisational tool for the control of urban form. Independently of its geometric regularity and the extent of control, which are all up to the centrality of the regime [of spatial control], the frame (grid) performs as the principal factor of ordering collective urban form. In this sense, what we call bottom-up or top-down is mainly a matter of how the infill takes place within the high-level order created

2 We should again note that the brief overview was limited to the Western urbanization.
3 Within their original conceptualizations by Habraken (1961), the terms were introduced in the context of architectural design. In this context, Habraken (1961) used the term ‘support’ rather than frame.
PATTERN FORMATION in URBANISM

by the frame. At that point, the choice between plan and the code gains importance. It is seen that in many periods, the generation of collective fabrics, which are composed of various individual elements (i.e. passages, alleys, outbuildings and extensions) remains too complex to be controlled by a single plan. If not the initial formation, but their consequent transformations are always subject to many individual interventions, which are hardly controlled by a plan scheme.

Nevertheless, this point should not mislead us to a simplistic conclusion that the notion of plan is categorically associated with the top-down control of urban form, and therefore it is outdated. As we figured out in the discussion on planning and morphology (see Chapter 4), the different couplings of the code(s) and the plan brings about the various working relationships between the frame and infill. This means as the representation of a development frame, plan does not have to be excluded from the control process. Even though the frame is set by the plan, the internal embodiment of the built-fabric (infill) can be left to the various design applications to be coordinated by the code(s).

Then the most crucial lesson for the new design approaches claimed to be novel in urbanism is that the each ‘style’ of urbanism throughout the history has suggested its own formulation on the complex relationship between the frame and infill in the control of urban form. Each characteristic formulation lets the periods be recognised as distinct systems, which would be eventually mentioned as different ‘-ism’s. The point is that the transitions between the periods do not essentially represent a radical break with the past, but they essentially inherit some elements of the previous periods while introducing the new ingredients (Bacon, 1967: 87). Considering the emerging design methods (i.e. computational or algorithmic design) claimed to be the new ‘style’ of urbanism (i.e. parametricism), we would argue that unless building up a new clear conception on the mode and level of form-control, no design method could claim an original and promising position in urbanism. Certainly, such a perspective calls for a systemic ‘designerly analysis of urban history’.

3. Urban coherence: not designed, but planned

What appeals most people about the historical cities is essentially their townscape quality, in essence, visually rich, diverse and harmonious. Looking from a morphological perspective, we see that the visual quality observed within those districts mainly derives from the characteristic form and structure they have. The intrinsic structure mainly reveals itself with coherence as one of the most fundamental concepts of physical planning and design. Revealing intimate relations between the components of their form and the layers of their morphology, traditional fabrics prove themselves as the most resilience model in the course of time. Then, as an indicator of working spatial systems, morphological coherence turns out to be a basic principle for sustainable urbanism.

As a matter of fact, those fabrics which are all appreciated by the contemporary planners and designers are not formally planned. If that is the case, then what is the relevance of urban coherence for spatial planning and design as systemic acts of controlling urban form? The answer of the question lies not in the nature of form, but in formation itself. As we discussed before (see Chapter 2), the traditional urban tissues were not subject to the design act at the level of collective form. They are the emergent forms out of a few socially shared
local building codes\(^4\) (Morris, 1979; Carter, 1983; Hakim, 2008). The urban formation by building codes here basically implies the idea of multiple designs within a growing and transforming urban fabric.

We can argue that in the context of the contemporary urbanism, which is highly prone to spatial fragmentation (Loukaitou-Sideris et al., 1998), planning could provide necessary conditions for urban coherence based on the multiplicity of design applications within one (regulatory) framework. Unless they are not made in the form of a master plan designating the complete articulation of future urban form, the urban plans are usually executed by many individual designs. This, in fact, makes urban (development) plans be potentially utilised as a tool for urban coherence for the contemporary city. That is actually the reason why we have discussed the idea of urban coherence in the context of planning rather than design. (see Chapter 4).

Regarding our findings of the plan analysis from that perspective, we can also claim that the more individual designs are involved as infills at the lower-level of the plan layout (the frame), the higher urban coherence is potentially enhanced for the overall urban fabric [from ensemble to neighbourhood level]. Especially, in the case of the Dutch planning system, this is what we specifically figure out. However, we should also add that if there is a gap between the upper scale plans and the individual design applications (i.e. at the level of urban blocks), the basic condition for urban coherence is seriously lost as seen in the case of Ankara, Turkey.

Another condition for urban coherence is the application of the relational codes within the framework of design control in planning. As also revealed within our analysis, the more interacting codes on urban elements the system comprise, the higher the level of coherence is to be achieved. However, we should bear that after a certain threshold, the larger amount of codes do not necessarily offer an extra advantage for the generation of urban coherence. As discussed by Talen (2012) from a historical standpoint, the social systems employing very few simple rule-sets produced favourably robust urban forms, which reveal themselves with high morphological coherence. This point is specifically confirmed by the comparative case studies of Almere, the Netherlands and Essex, the UK in our analysis. Though the average number of design codes is less than that of its British counterpart, the average level of coherence of the sampling tissues in Almere is fairly higher than those of Essex.

Our review of the three planning systems also shows that dependence on plan as a control tool is still enduring within the contemporary practice of spatial planning. That means an alternative approach merely emphasising coding, as an immediate reaction to the blueprint planning seems unrealistic in consideration of the widely use of plans in the actual space production, today. Therefore, the ideal case of any possible system improvement for urban coherence should be complementary with development plans, which are flexible enough to produce variety of form-compositions [at the levels of block, street or ensemble] with the relational design codes and guidelines.\(^5\) How we can relate the guiding principles to the design codes is another issue to be discussed after the concluding remarks on design

\(^4\) The bastides, the new settlements founded according to a single layout plan can be considered as the other type of urban formation in traditional urbanism in the medieval period. Despite the fact, the generation of the built form was driven by the local codes rather than a plan (Carter, 1983: 44).

thinking in urbanism, below.

4. ‘Design thinking in urbanism’ or the recognition of a cold fact: designers do not act upon the theory

Instead of restating ‘how designers think in urbanism’, briefly recalling our main points on ‘how they do not think’ would be much more useful for the overall conclusion of the research. Accordingly;

• Though there is a generic structure in design thinking, designers do not follow the predetermined (linear) procedures like ‘survey, analysis and design’.
• They do not pre-conceive the relationship between the high-level and the low-level orders in design. While constructing higher-level hierarchies (frame), they parallelly articulate the lower-level relations (infill). In this regard, the orthodox standpoints on bottom-up and top-down design do not fully correspond to the actual practice.
• Design synthesis does not simply proceed from abstract to concrete forms. The level of abstraction dynamically shifts in due course.
• More importantly, designers do not first analyse and then start designing. Solution-space and problem-space coevolve in relation to each other, and in most cases, a conjectural solution formerly characterizes the design problem to be analyzed. Therefore, without an early autonomous design idea, there is no use of analysis in design.

Looking from this viewpoint, one can easily perceive that the established (procedural) models in urbanism do not correspond to the actual cognition of designers as depicted within the research. (see Chapter 5) The settled theoretical perspective on the design process in urbanism is deprived of a cognitive insight on design thinking. Therefore, it falls short to reflect upon the intrinsic complexity of the urban design process.

To update the conventional perception of design in urbanism, it would not be sufficient to come up with an easy modelling of the design process in a simplistic way. To establish a firm perspective on the issue, it was fundamentally necessary to construct a fresh theoretical background on design thinking. To that end, the author suggests an elaborated conceptual framework on the spatial design process based on the theories of evolution and emergence, which were slightly argued somewhere else before (Jong, 2009; Batty, 2008).

Within the theoretical framework constructed, we revisited the actual design process in practice. As also demonstrated with a focused design analysis that existing linear models on design need to be revised with a self-reflective (non-linear) approach. In the light of the findings of the procedural analysis, the alternative model that the author ultimately suggest does essentially involve the four fundamental operations in design, conjecture, analysis, model and test within a recursive process.

Then some related questions might come: Why such a paradigmatic shift on design thinking is needed in urbanism? What is the actual significance of that?

First of all, a new conception on design thinking in urbanism would enable urban design to create its own methodological frameworks not necessarily influenced by planning or architectural design theory, which does not somehow fit to the nature of (spatial) design cognition in urban context. New framework definitions would inevitably trigger alternative techniques in urban design education and practice which would yield a perceived change in quality and type of design outcomes.
Secondly, such a update on methodology, would strengthen the claimed condition of urban design in the face of other design disciplines. As argued through a vaguely increasing tone\textsuperscript{6}, urbanism is in a state of crisis (Meyer, 2011). This is essentially the crisis of legitimacy that the field of urbanism has to face up on the actual production of the built environment. More specifically, it is about the relative positioning of the urbanists against the architects who presently claim an extensive role in urban design\textsuperscript{7} (Talen, 2009). In our view, within such an implicit (disciplinary) ‘clash’, planners have no chance without establishing a firm and in-depth theoretical outlook on design process, which is relatively more considered within the architectural theory (Lawson, 1980; Rowe, 1987; Ganshirt, 2007). In that context, the efficient involvement of the planners in the multidisciplinary field of urban design highly depends on the construction of a theoretical perspective to be supported by the creative analogies on the core scientific issues such as evolution, emergence, complexity and cognition. In this sense, (urban) morphological knowledge should be regarded as one of the most essential ingredients of the possible urbanistic perspective on design thinking. Problematising urban morphology with regard to this, the forgoing research can be evaluated as an attempt to provide an updated theoretical basis for such a new perspective.

5. A possible coalescence between design and morphology: parametric design

Returning both to the first conceptual scheme presented in the introduction of the research (see Figure 1.2), we can restate our point on the fundamental relation between morphology and design as follows. As the study of form and structure, morphology serves for the abstract knowledge (of existing fabrics) to design, which in turn re-processes it to achieve the desired spatial form (Marshall and Çalıskan, 2011: 415-19). In that framework, morphology as the ‘raw material’ of design (Ibid) is assumed to have a remarkable potential to improve the ultimate quality of the design output.

Though what we assert above (‘morphology for design’) might sound a kind of truism, looking at the current discussions on the use of morphological knowledge in urban design practice would bring a stronger relevance for this point\textsuperscript{8} (Hayward, 1993; Samuels, 1993, 1999; Kropf, 1998; McGlynn and Samuels, 2000; Maretto, 2004). With a generic observation of the contemporary urban design, one can see that the currency of the major analytical methods and conceptions of urban morphology is quite lacking in practice.\textsuperscript{9} This point can-

\textsuperscript{6} Rem Koolhaas’s early manifestation on urbanism, which involves the so-called claim of ‘the death of urbanism’, can be regarded as the first argumentation on that issue. See: Koolhaas, R. (1994) ‘What Ever Happened to Urbanism?’, S,M,L,XL (with Bruce Mau), New York: The Monicelli Press, pp. 959-971.


\textsuperscript{8} Putting in that way, one could claim the enduring relevance of the model Survey-Analysis-Plan (S-A-P) with our original point, in a general sense. This interpretation would not be wrong in a way. Taking the model as a generic principle to connect what exists with what possible (design) in planning [from an evolutionary perspective as originally argued by Geddes (1915)], rather than a kind of design method itself, we can consider S-A-P as a congruent model with our point of view.

\textsuperscript{9} Despite its apparent relevance, this point requires more explicit and specific research.
not be easily explained with the ignorance of designers about the literature of morphology. This must rather be the result of the nature of the knowledge produced by the research field itself. In this regard, the author believes that the convertibility of the morphological knowledge into design is the prominent issue to be questioned from an epistemological perspective to urban morphology.

Then, how can the operational linkage between morphology and design practice be built? The first argument is that providing a rich set of morphological concepts is necessary for a deeper understanding of the relations between the urban components, but not sufficient for design. The concepts, in this regard, should be elaborated in terms of their relevance with their corresponding (spatial) performances in design. The conceptual framework that we suggested in the research (see Chapter 3) can be indeed considered as an initial attempt to make an explicit link between morphological indicators and spatial performance.

The morphological indicators to be used as design codes should not be organized in the form of simple classification (cataloguing). The possible correlations between the concepts and the set of corresponding design principles would make the morphological knowledge much more accessible for the designers. That would provide a strong evidential basis for the search for a ‘good urban form’ by design. An exemplar scheme based on our conceptual framework would give some idea on that point. (see Figure 7.1)
One of the most crucial points here is that without knowing what the designers need as the ‘conceptual aid’ in design, morphological researches could not contribute to the design field efficiently. Since design is essentially a non-discursive phenomenon in which the designers cannot rationally describe their configurational moves and intentions through the explicit terms and concepts (Hillier, 1996: 39), that point seems rather a hard job for the ‘morphologists’. In this context, ‘parametric design’ as an emerging design method suggests a promising ground for the possible coalescence between design and morphology. Since it operates with
the explicit parameters expressed within the (design) algorithms, parametric design provides an operative basis of ‘discursive’ morphological thinking in design unlike the conventional (analogue) design methods.

Yet such a possible integration on that platform requires even further contribution of morphology. Since the computational design applications operate with mathematically expressible algorithms, the common language between morphology and (parametric) design can only be a mathematical one. Regarding the emerging demand from the design party, we can claim that urban morphology in near future will need to empower its mathematical branch more than ever.

6. Towards a generative urbanism: algorithmic control of urban form

In the last chapter of the research, we tended to reveal the future trends in urbanism in the specific context of emerging techniques in the generation and control of (urban) form. Reviewing the new design methods, which claim a wide application in urban design, we specifically reflected on their fundamental capacity of ‘form generation’. The critical reflection basically let us recall one of the existing paradigms of urbanism that we also discussed in the beginning of the research. With its strong emphasis on ‘organized complexity’ as opposed to top-down planning and total design (Jacobs, 1961, Alexander et al. 1987), generative urbanism seems to suggest the essential theoretical basis that the new design methods currently need to be involved in urban context.

Addressing generative urbanism as a relevant viewpoint for the future design applications has directed from from the enduring discourse of parametricism, which represents the strongest approach to spatial design from a computational and generative perspective. Our critical review has shown that the basic manifestation of so-called ‘parametric urban design’ through the concept of complexity (Schumacher, 2009; 2012) does not conform to the already established theory of complexity in urbanism. As highly elaborated in the literature, complexity in an urban context essentially entails small-step developments, local transformations, gradual (incremental) growth and the successive feedbacks in an emergent pattern (Batty, 2007; Marshall, 2009; Héile, 2009; Portugali, 2011). Nevertheless, conflicting with that theoretical basis, and differing from the basic premises of generative urbanism [based on the piecemeal formation of the collective urban form], the current applications of parametric urban design pursue a very top-down and holistic fashion. On that sense, they exemplify another version of ‘compositional urbanism’ though with the new tools and techniques (i.e. design algorithms and scripting).

Despite making that critical point, the author does not deny the potential use of the parametric models for the definition of a new approach in the contemporary urbanism. We should acknowledge that there is real potential of parametric design with its embedded capacity to generate complex urban forms and associative geometries, which suggest a complete (algorithmic) control for the designer. This is something crucially different from the conventional (analogue) design methods. In this context, the main argument is that such capacity of form-generation should not be misused for the sake of the total production of large-scale urban patterns, which are not proved to be sustainable at all. Instead, the emerging design methodology calls for a different approach in urban context. Rather than designing urban form in the name of ‘parametric urban design’, utilization of the computational models for
controlling the emergent and collective urban formation in the name of ‘algorithmic (urban) design-control’ would be the appropriate way regarding the contemporary understanding of urban complexity.

The point arguing for ‘control’ rather than ‘design’ of the large-scale urban fabrics does not only represent a normative standpoint, but also an objective statement regarding the given social context. As argued by Davis (1999), architects have no longer enjoy the complete control over the design form due to the multi-factored nature of the building industry. Considering the diversity of the external variables and factors involved in the contemporary urban design practice (see Chapter 5), the relevance of Davis’s (1999) argument has no less relevance in urbanism than architecture. In the current context of urbanism, in which many individual interventions seeking their own patchy compositions (Busquets, 2006; Shane, 2011), ‘urban designers’ have to redefine their effective role in the production of the built environment.

With regards to the given condition of urban complexity, the author addresses design control as the core operation of urbanism in near future. Unlike the conventional design control processes, the new control approach would be based on various synchronized ground plans rather than a single master plan. Those plans would mainly specify urban grid (frame) and improvise the local structure in accordance with the existing (larger) network to be adapted. With regards to the emergent nature of urban formation (Mehaffy et al., 2010), the ground plans should limit themselves to the scales that are smaller than the neighbourhood level. Each plan sets the local urban grid by ensuring the global integration in the larger context. While doing that, it leaves the generation of the built fabric (infill) to the various design applications gradually composing the collective urban form. In this framework, the main task of the plan on form-composition would be to define the basic design codes guaranteeing the internal coherence of the urban fabric. The use of the algorithmic models here is considered to be twofold: Firstly, they would be used for configuring the planned (local) network in relation to the emergent body of the city fabric through the (metric) variables of the global network integration. Secondly, the individual design applications would be controlled to provide higher-level coherence by means of the elementary form-indicators (see Figure 7.1) utilized as the relational design codes. In this context, the algorithmic models would also monitor the emergent impacts of all the incremental applications on the global urban pattern. By this means, both the individual diversity and the global integration and coherence would be ensured.

Though the concepts of control and complexity categorically sound controversial, the algorithmic application of planning framework through the adaptive micro-plans and the relational (incremental) design codes, as a kind of hypermodern interpretation of urbanism [in the meaning of high-capacity information processing] would be implemented in conformity with the idea of (urban) complexity.

There is no doubt that within such a new phase of urbanism, urban morphology would inform planning and design especially on the emergent and evolutionary nature of pattern formation in terms of its intrinsic mechanism involved (i.e. typological adaptations, local transformations [subdivision and infills] and grid intensifications).
7. Future implications for research and practice

As a matter of fact, such a loaded outline of urbanism entails a comprehensive research agenda on morphology, planning and design. In the context of the current research, we can briefly classify the relevant future research topics as follow.

Within the limits of the research period, though the main morphological variables have been organized within a unified conceptual framework, they could not be integrated into an applied model like a GIS platform.\(^{10}\) The integration of the form indicators within a single user interface would be beneficial for both morphological analysis and design. Since one of the most challenging issues in morphological research is the enduring discrepancy between the analytical methods [with their own set of concepts and techniques], a joint framework for morphological analysis would practically enable the researchers to select the most relevant analytical parameters for their specific purpose in spatial analysis. A simplified model would also integrate morphological analysis into design processes to the test of the intermediate design solutions instantly during design. Such an active integration would be responsive to the reflective nature of the spatial design process that we argued in the research.

On the question of design thinking, due to the novelty of the issue in urbanism, there are quite a lot of sub-topics yet to be explored by further researches. In the current research, we could only discuss the intrinsic relation between analysis (morphology) and design. The further studies would designate the fundamental differences between architectural, industrial and urban design thinking in terms of the question of scale and complexity involved. In relation to computational design, though we briefly argued the basic differences between computational (algorithmic) and the conventional (analogue) methods in design thinking, one can elaborate this point more with the empirical analyses on characteristic design operations.

Moreover, the current work suggests the most promising future research agenda on modeling algorithmic (urban) design control. By designing a ‘work-flow’ with the defined parameters (see Chapter 3), the author aims to build up an algorithmic model in collaboration with the software engineers writing scripts. By this way, the idea of generating the associative geometries in a bottom-up fashion and controlling the emergent patterns in a larger context is believed to be simulated as a model of ‘organised complexity’. By this means, the most relevant morphological parameters in the use of design control would be identified more properly on an evidential basis.

Finally, regarding the practical implications, it should be noted that the research is considered to suggest its foremost impact on urban design education. In the light of the insight portrayed within the analysis of design cognition, the research corresponds to a certain approach to the design education in urbanism, which comprises a set of commissions concisely given below:

* restoring the constructive, intuitive and even speculative thinking a central position besides the analytical, rational and structural mode of thinking in design,

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\(^{10}\) More recently, The City Form Lab at the Singapore University of Technology & Design in collaboration with the School of Architecture & Planning at MIT has developed a GIS application called ‘Urban Network Analysis’. Within that application, they succeeded to bring five form indicators (reach, gravity, betweenness, closeness, straightness) within one ‘toolbox’. See: http://cityform.mit.edu/projects/urban-network-analysis.html, accessed in May 2012. Nonetheless, there are more indicators yet to be integrated.
7. CONCLUSION

- making analysis an integrated part of the design process, instead of a discrete phase to be fulfilled,
- enhancing the fundamental skills of
  1. designing the analysis,
  2. inferring the elements and rules out of existing typologies within the built environment,
  3. reflecting upon successive design moves and emergent forms,
  4. exploring new design solutions through the interactions between morphological types, operations and the context,
  5. moving across the multiple domains recursively and reflectively.

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SUMMARY

This thesis is all about urban patterns, what we see through the windows of the plane with an admiration of their relief-like scenery covering the land surface. In a sense, the spatial pattern within our cities is the biggest collectively produced artifact of human beings. It is both the originator and the result of human activity. It is not only a product, but also the process itself.

In this regard, the research problematizes the notion of formation, rather than the form. Implying both the process of being structured and the internal arrangement of a product, formation is the main emphasis of the inquiry on urban patterns. With the double connotation of the term, the research is an attempt to reveal the main components of the form-logic (morphology), control (planning) and the creation (design) of collective urban patterns.

On this basis, the author aims to construct a stronger theoretical link between urban morphology, planning and design, which indeed needs to be improved for their own disciplinary performance. While suggesting a comprehensive view, the research also aims to provide a critical insight on the issue by reflecting on the current state of art in the theory and practice.

In that framework, the research firstly constructs a conceptual baseline by revisiting the fundamental categories of urban morphology, the basic types of collective urban form, and the mainstream approaches in urbanism. By this means, the multi-dimensional nature of the phenomenon, urban pattern formation is exposed.

Based upon the conceptual framework defined in the introductory chapter, the research focuses on morphology, and tends to provide the baselines of the main approaches, analytical methods and the basic indicators in urban morphology.

Then, the issue is re-examined in terms of planning as the other factor of urban pattern formation. Being a broad category, planning, in this context, is discussed through its major function of design control. To comprehend the regulative role of design control in the production of urban (morphological) coherence, the research conducts a comparative plan analysis of the cases of the planned residential developments in the UK, the Netherlands and Turkey.

The international perspective constructed on planning is applied to the issue of design as well. Accordingly, in the consequent part, the research delineates the process of urban design by means of a comprehensive and a focussed analysis conducted on the actual projects by the fifteen designers from the three countries. In the light of the critical review made on the existing models in the literature and an alternative theoretical framework, the author ultimately suggests an updated view on design thinking in urbanism.

Finally, the research provides future perspective on morphological design and planning through reviewing the emerging design methods and techniques. For this purpose, the method of parametric design is discussed with reference to ‘generative urbanism’ as the mainstream approach in urbanism. From that perspective, the actual use of the algorithmic models in urban design is critically evaluated in the context of a master planning application in Istanbul, Turkey.

Relating all the intermediate conclusions of the previous discussions, a possible coalescence between morphology, planning and design, and its principles are argued in the conclusion through addressing the critical aspects of the central issue, pattern formation in urbanism.
SAMENVATTING

Deze thesis gaat over stedelijke patronen, het reliëf van het verstedelijk landschap, dat we vanuit het vliegtuigraam kunnen bewonderen. Het is het grootste collectief geproduceerde artefact van de mensheid. Het is zowel de oorsprong als het resultaat van menselijke activiteit. Het is niet alleen een product, maar ook het proces zelve.

Vanuit dit perspectief problematiseert het onderzoek eerder het begrip *formatie* dan het begrip *vorm*. Het impliceert zowel het proces van structureren en de interne ordening van het product. Formatie heeft dan ook de nadruk in dit onderzoek naar stedelijke patronen. Met de dubbele connotatie van de term, tracht dit onderzoek de hoofdcomponenten van vorm-logica (morfologie), controle (planning) en de creatie (ontwerp) van collectieve stedelijke patronen aan het licht te brengen.

Op basis hiervan tracht de auteur sterkere theoretische verbanden te leggen tussen morfologie, planning en ontwerp, die elk vanuit hun eigen perspectief dienen te worden versterkt. Tegelijk met het schetsen van deze veelomvattende benadering, wordt getracht een kritisch inzicht te geven in de huidige state of the art in theorie en praktijk.

Binnen dit kader, zal in het onderzoek eerst een conceptuele basis worden geconstrueerd door het reviseren van de fundamentele categorieën van de stedelijke morfologie, de basistypen van collectieve stedelijke vorm, en de hoofdstromingen binnen de stedebouw. Hiermee wordt het multidimensionale karakter van het fenomeen blootgelegd.

Gebaseerd op dit initieel omschreven conceptuele kader, richt het onderzoek zich op morfologie om een gedegen begrip te krijgen van de belangrijkste benaderingen, analytische methoden en de basis indicatoren in de stedelijke morfologie.

Vervolgens wordt dit onderwerp behandeld vanuit het perspectief van planning, als een van de andere factoren in de formatie van stedelijke patronen. Planning, als veelomvattende categorie, wordt in deze context bediscussieerd vanuit de belangrijke functie in het inkaderen van de ruimte voor het ontwerp. Om deze regulerende rol van deze kaders in de productie van stedelijke (morfologische) samenhang te begrijpen wordt een vergelijkende plananalyse gepresenteerd van geplande woongebieden in de UK, Nederland en Turije.

Het internationale perspectief op planning wordt vervolgens ook toegepast op ontwerp. In dit deel wordt het proces van stedebouwkundig ontwerp geschetsd aan de hand van een uitgebreide en gerichte analyse van concrete projecten ontworpen door vijftien ontwerpers uit de drie landen. Op basis van een kritische review van bestaande modellen in de literatuur en een alternatief theoretische kader, suggereert de auteur uiteindelijk een nieuwe zienswijze op het ontwerp-denken binnen de stedebouw.

Tot slot schetst het onderzoek een toekomstperspectief van morfologisch ontwerp en planning door een overzicht te geven van opkomende ontwerpmethoden en technieken. Hiertoe wordt de methode van parametrisch ontwerpen bediscussieerd met betrekking tot ‘generatieve stedebouw’ als een belangrijke stroming in de stedebouw. Vanuit dit perspectief wordt de feitelijke toepassing van het model in de stedebouw kritisch geëvalueerd. Dit wordt gedaan in de context van een toepassing in de vorm van een masterplan in Istanbul, Turkije.

Door het relateren van alle tussentijds conclusies van de eerdere delen, wordt een samensmelting tussen ontwerp, planning en morfologie mogelijk gemaakt. In de conclusie worden de kritische onderdelen van deze synthese benoemd: *patroonformatie in stedebouw*.

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