

# Depth Configurations

**Proximity, Permeability and Territorial Boundaries in Urban Projects**

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# Introduction

## Thesis

The thesis considers depth configurations and access control the main parameters of academic research. The investigation domain is defined by an intermediate and alternating scale, associated with the complexity of urban projects. The thesis pronounces a theoretical and conceptual discourse about depth, tested by re-reading historical and contemporary projects that used various models of proximity and accessibility. The academic investigation includes references about proximity, permeability, territorial boundaries and the study of depth configurations, together with its spatial, social, cultural and environmental conditions.

The present thesis is a result of a systematic study of urban projects at different scales: from the domestic scale, to the scale of the neighbourhood till the dimension and complexity of urban development areas. The thesis studies and compares depth configurations that determine linear and multiple movements between public and private realms, between spaces with individual or collective use. Collective space and its related systems of relative distances are considered the *file rouge* of investigation.

The present dissertation redefines and frames the concept of depth and explains, classifies and compares different models of accessibility and their very social or cultural meaning. Different ways of defining boundaries, together with new concepts of public space are studied and linked with the discourse about proximity, depth and accessibility. Using re-reading of both theoretical models and built projects, the thesis describes different ways of application and suggests possible guidelines for urban design projects.

## Hypothesis

The objective of the thesis is to proof the following hypothesis:

The parameter of depth can be used to describe, frame and explain historical and recent phenomena in the field of urban projects, next to the use of more traditional parameters. During the recent history of urban projects, there has been an increasing importance of depth as an implicit or explicit design parameter, independently of the used scale.

Depth is not a quantitative linear measuring device but a complex configuration, depending on proximity, permeability and ways of delimiting boundaries on a physical, visual and territorial level.

Depth is not based on the traditional private/public distinction but depends on the amount, the nature and the structural qualities of collective space, together with several spacing mechanisms.

STREET    SIDEWALK    GARDEN / P    HALL, 24 HALLDOORS    ELEVATOR    HALL, 4 DOORS    APARTMENT

STREET    ENTRANCE DOOR    HOUSE

STREET    SIDEWALK    ENTRANCE DOOR    ELEVATOR    APARTMENT

STREET    SIDEWALK    P    HALL, CONCRETE    GARDEN    SWIMMING POOL    GARDEN    HALL    HOUSE

STREET    SIDEWALK    GARDEN    HOUSE

STREET    SIDEWALK    PRIVATE STREET    PRIVATE GARDEN    HOUSE

BEACH    WATERFRONT BORDER    LEISURE TERRACE    SQUARE    PASSAGE    ENTRANCE

BEACH	WATERFRONT BORDER	LEISURE TERRACE	SQUARE	PASSAGE	ENTRANCE
	HOUSE		STREET	PRIVATE PER.	BOAT

## Index

- I. **The concept of territory.** pag. 5-45
  - 1. **Hierarchical understanding of territory.**
  - 2. **Territory: adaptability, multiplicity and overlap.**
  - 3. **Non-hierarchical understanding of territory.**
  - 4. **Configuration and complexity.**
  
- II. **Proximity. Private and public use of space.** pag. 46-76
  - 1. **Studies about proximity. Redefining territory.**
  - 2. **Proximity, changing distances and depth in urban models: spacing mechanisms.**
  - 3. **From public and private spaces to collective spaces.**
  
- III. **Boundaries.** pag. 77-134
  - 1. **Crossing boundaries.**
  - 2. **Changing territorial phenomena, changing boundaries.**
  - 3. **Filter tactics: physical, visual and territorial boundaries.**
  
- IV. **Territorial meaning: social and cultural conditions.** pag. 135-173
  - 1. **Cultural understanding.**
  - 2. **Depth and restricted access, social dimensions.**
  - 3. **Space codification: understanding/readability/visibility.**
  
- V. **Shared spaces in depth configurations.** pag. 174-238
  - 1. **Domestic sequences: configurations, distance and depth.**
  - 2. **Clusters and streets: configurations, distance and depth.**
  
- VI. **Depth configurations. (conclusions)** pag. 239-250
  
- VII. **References.** pag. 251-256

## Graphic documentation

- 1. **Illustrating case studies of physical, visual and territorial boundaries in NYC/BCN. Collective structure.**
- 2. **Illustrating case studies of collective structure at domestic scale.**
- 3. **Illustrating case studies of collective structure at urban scale.**

# I. The concept of territory

## 1. Hierarchical understanding of territory

### i. Territory and accessibility

According to N.J. Habraken, each built environment has a specific **territorial organisation**. It should be seen as a multilevel “*live configuration*” with various control mechanisms. He defines territory as a result of acts of occupation. Territory is more than a formal understanding of space: form is controlled by various agents, exercising spatial control. As a consequence, control of space, seen as a territorial fact, is different and more complex than strict control of form. N.J. Habraken argues that territory is linked with accessibility: “*Territorial control is the ability to exclude, to shut the door, selectively admitting only who and what we desire. (...) Territorial control is the ability to close a space, to restrict entry. It is the most instinctive way by which humans have learned to understand the built environment*”<sup>1</sup>. He refers to basic human needs to understand the notion of territory: “*At the scale of human inhabitation, territory seems to segregate what physical forms leaves open.*”<sup>2</sup> Territory is not seen as an abstract, big scale area, as a container of program and form, but as a spatial organisation, defined by various agents.



Figure I.1: sequence of pictures showing access control, Mexico DF, pictures by Solange Guaida (2002)

“*Territory as a token of inhabitation is always an interpretation of a given physical organisation. When a culture is familiar to us, we are very adept at reading territorial clues. We read easily sign of inhabitation such as plants placed on a doorstep, the room’s door ajar, the towels and umbrellas arranged on the beach and avoid the embarrassment of trespassing. We know instinctively the difference between a ceremonial gate and one that defines a territorial boundary*”<sup>3</sup>

The author acknowledges three orders that structure the built environment: form and space control, understood as a **physical order**, seen as place-making, located within a **territorial order** and finally the understanding of space which helps to determine a more **cultural order** within the structure. The value and the understanding of space, its program and its inhabitants depends on this triple set of concepts. By stating this, the author widens the area of study of the built environment.

Besides this multiple reading of space, change and renewal are considered main **agents of transformation** of the urban fabric. “*Built environment, in all of its complexity, is created by people. Yet it is simply far too complex, too large, and too self-evident to be*

1 N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.126

2 N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.141

3 N.J. Habraken, “The Control of Complexity” in Places, volume 4, number 2, 1987, p 14

*perceived as a single entity, an artefact. (...) Built environments have lives of their own: they grow, renew themselves, and endure for millennia*<sup>4</sup> The ever-changing condition of territory in which agents act simultaneously and therefore transform territory, adds another dimension to the concept. As a consequence, territorial control changes continuously, as *“forms that seem to indicate territory are constantly tested”*<sup>5</sup>. The author adds: *“Territory is an independent variable relative to the physical arrangement it inhabits”*<sup>6</sup> The widening of the concept of territory does not only involve a preoccupation for a more complex definition or an adjustment of its scale application. It is definitely related with a concern about the very nature of the contemporary territorial fabric.

This temporal and more volatile vision on territory is similar in André Corboz’s concept of *“palimpsest”*, seen as an ever changing territorial system of differences and variable accessibility. The palimpsest contains the idea of ongoing modifications and transformations of a manuscript, producing a document with different superposed layers of contents, comments, footnotes and questions. Corboz<sup>7</sup> links the idea of the palimpsest to the concept of ‘refondation’ of the city that exists out of *ex novo* creations and some planned sequences, spontaneous development, displacements and transformations, taking the idea of data accumulation as a main reference.

He places the notion of territory at a bigger scale than N.J. Habraken, leaving behind the rather domestic or urban scale and pointing at a more regional study area.

Corboz adds the idea of a *“territorial city”* as a heterogeneous place of discontinuities, fragmented and in process of an uninterrupted transformation. The author tries to redefine the notion of territory as a result of various processes. *“Territory is not a given, it contains both spontaneous developments and human interventions with an increasing control”*<sup>8</sup>. He defends territory as a not objective issue, but as a project, due to physical, mythical and political appropriation. Complex, never ending stratification, more than a planned configuration, can be seen as a main quality.

Both theories of time-dependent territories reinforce the dynamic qualities of the built environment as an ever-changing entity, defined by multiple simultaneously operating agents.

## ii. Territory and hierarchy

According to N.J. Habraken’s, territory is defined by the ability to exclude, generating **asymmetrical relationships** of selective entry and unrestricted access. The mentioned asymmetry implies hierarchy. Within a horizontal relationship, each owner, each inhabitant or visitor has the same possibilities of entry and exit (like the example of two students sharing an apartment they rent together). A vertical relationship however implies restrictions for certain users of space to enter an area, a house or a room (like the example of someone subletting part of an apartment). The author claims horizontal relationships to be unstable, as dominance unsupported by form is unstable: the built environment tries to avoid horizontal relationships by default. Indeed, *“When configurations on the same level relate horizontally, the rules of territory take over, continuing separation by means of boundaries (...) When the higher-level configuration does not separate live configurations on the lower level, territorial structure will. The separation has no technical or functional rationale, it is a matter of control. Territorial order maintains vertical organisation where physical order leaves of. (...) At the scale of human habitation, territory serves to segregate what physical form leaves open. (...) Asymmetry gives hierarchy.”*<sup>9</sup>

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4 N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.6

5 N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.126

6 N.J. Habraken, “The Control of Complexity” in Places, volume 4, number 2, 1987, p 14

7 A. Corboz, “ Le Territoire Comme Palimpseste et Autres Essais”, Paris, Les Editions de L’Imprimeurs, Collection Tranches de Villes, 2001.

8 own translation from A. Corboz, “ Le Territoire Comme Palimpseste et Autres Essais”, Paris, Les Editions de L’Imprimeurs, Collection Tranches de Villes, 2001.

9 N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.141

There exist two ways of keeping live configurations apart, of avoiding horizontal relationships, both by creating **hierarchy of levels**. The first one is a formal way: separation by virtue of shape and organisation of higher level forms (for example the partition of rooms) while the second one is a social form, conditioning access. N.J. Habraken uses the example of the building lot to explain: horizontal relationships are limited by territorial boundaries. *“Territory and its markers subdivide space, allowing similar configurations to coexist on the same level. Good fences make good neighbours”*<sup>10</sup>



Figure I.2: Avinyonet de Puigventós, Catalunya: a divided territory  
(image from Research on Isolated Low Dense Units in the provinces of Girona, Lleida and Tarragona, Spain, for the Generalitat de Catalunya, by Architects Joan Barba, Kris Scheerlinck and Geographer Montse Mercadè, 2007)

As a result of this, N.J. Habraken calls horizontal control the control of access or of the change within one single level, as opposed to vertical control, control within various levels. Mind that levels can (dis)appear during processes of transformation and that ownership not necessarily has to be congruent with control. Besides that, having one agent controlling different levels does not always mean a reduction to one configuration but one agent controlling different configurations in one same level may merge different configurations into one.

Christopher Alexander and Serge Chermayeff presented a similar approach of hierarchical understanding when locating the need and search for **privacy** highest in ranking of territorial design parameters. They see the need for privacy as the main motor of territorial organisation. *“(…)only through the restored opportunity for firsthand experience that privacy gives, health and sanity can be brought back to the world of the mass culture. Privacy is (…) most urgently needed and most critical (…)”*<sup>11</sup>



Figure I.3: a beach as a laboratory of initial horizontal relationships, resulting in vertical territorial hierarchy

<sup>10</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p. 34

<sup>11</sup> S. Chermayeff, C. Alexander, “Community and Privacy” Doubleday & Co Inc. USA 1963, p. 37

They continue saying that in the 60's an entirely new anatomy of urbanism was needed, built of many hierarchies of clearly articulated domains. That anatomy had to provide special domains for all degrees of privacy and all degrees of community living, ranging from the most intimately private to the most intensely communal. They argue that to separate these domains, and yet allow their interaction, entirely new physical elements had to be inserted between them. These new elements of separation would emerge as vital and independent units in their own right that a new urban order would have developed from the **hierarchy of domains**. In other words, they related success of territorial structure to clear hierarchical set-up with clear demarcations of physical boundaries.

The territory's flexibility and the possibilities it allows for intervention, depend on the very character and relative position of the level: lower level configurations transform more easily than higher level ones. Baron Haussmann's interventions in Paris (1852-1870) have to be situated on the highest level of intervention, as big scale infrastructures were inserted into the urban fabric. N.J. Habraken points out that till World War II, most urban growth was situated on different lower levels with a scale explosion from the '50, when planners started acting within higher levels.

The same author points out that "*form, more than size of parts, material expression, or even intensity of control, distinguishes levels*"<sup>12</sup>. However, besides form, levels can be revealed as well by use. To explain this statement, N.J. Habraken refers to the classical Greek city of Olynthus (destroyed 348B.C.) in which it is possible to reconstruct forces responding to gravity, territory and social agreement, all located in higher level forms. Archaeologic excavations revealed three generic kinds of constraints: control distribution, type of control (agreement or dominance) and universal preference: apparently there was a shift of control to inhabitants subsequent to completion of an entire block. One could read this as an appearance of new levels or a shift of levels during urban growth, as a result of its use and less as a result of initial planning.

Habraken's theory of territory's hierarchy continues with the mentioning of **levels** in the built environment: acts of in-fill, of constructing buildings and the level of urban design: the last two levels are characterised by asymmetrical relationships. N.J. Habraken lays out a double structure to cross-check these mentioned levels: he starts scaling down from Urban Structure to Fabric, to Building, In-fill elements till the level of Furniture, all five levels within a group of Physical Systems. These physical elements are linked with a territorial equivalent that defines levels from Town to Neighbourhood, to Dwelling till the level of the Room: all recognised as Territorial Systems. Hierarchy within this double system is defined by who decides on accessibility within each level or sub-level.<sup>13</sup>

### iii. Rank, position and order

Besides the idea of different recognisable levels, N.J. Habraken presents a more detailed theory on hierarchy when he refers to concepts of **dominance, rank and order**. The example of the tree is used to explain different levels and element classes within certain hierarchy: the shape and size of a tree leaf, defining **rank**, can define the **position**, as there is an order of which kind of leaf can grow on the stronger branches. Rank is defined as a hierarchical order of element classes, defining a **nominal order** (classes of elements that make the hierarchy are nominal classes, occupying nominal levels in the ranking order of the hierarchy), while position within a configuration defines a **location order** (position 1,2,3,4,5..., sometimes skipping classes in the nominal order), related with form. In this way an element of a low ranking class may be located at a high level in the form. As a consequence, location relates to a hierarchical order of form. The author concludes that order and form have different measuring conditions. It is possible to have a configuration with two nominal classes (two systems to differentiate) but have a five level form. "*The hierarchy is established by means of interface on distribution rules for each move, but not necessarily by means of a nominal hierarchy of element*"<sup>14</sup> The relation to more urban settings

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12 N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p. 44-48

13 N.J. Habraken, "The Use of Levels" keynote Address Unesco Regional Seminar, Seoul, 1988, re-issued Open House International, volume 27, n°2, 2002

14 N.J. Habraken, "Notes on Hierarchy in Form", edited version of paper for project on form hierarchies, Department of Architecture, Massachusetts Institute of technology, January 1984, p 12



is direct: shared elements within a structure can be seen as public facilities. N.J. Habraken emphasises on the hierarchical notion of territory because of the belief that every urban element have their **logical position**: from a wooden door to an individual porch, from a sidewalk to shared facilities within a neighbourhood.

In this theory, N.J. Habraken defines three generic forms within the built environment: tree-forms, mostly found in nature, networks, found mostly in human artefacts having to do with circulation and communication, and enclosure-forms. A network, for example, can be a group of elements from the same nominal class operating on the same nominal level, like an independent network of pathways in a neighbourhood.

Later we will compare this hierarchical theory with different territorial approaches.

#### iv. Dominance and enclosure

The very relation between N.J. Habraken's mentioned territorial theory and the built environment is further clarified with the concept of **dominance**: the case of an element that is dependent on others. This is recognised as a basic mechanism of territorial control. *"When it appears that when (element) A changes, (element) B always changes to adjust to this new situation, but when (element) B changes, (element) A does not necessarily respond, we say that the form A is dominant over B"*<sup>15</sup> N.J. Habraken introduces the concept of **dominance hierarchies** within the discourse on territory: we may find a dominant activity within a neighbourhood, a dominant building or dominant entrances to it, conditioning all other buildings. We can think about a dominant building in a neighbourhood of which the main entrance conditions the functioning of the whole area. Dominance can be imposed by both form and behaviour. Hierarchies of dominance are mainly related to size mechanisms: many urban projects use the idea of bigness to make an area work. Historical as well as contemporary architecture and urban design projects take advantage of the tension created by dominance, to control space.

Besides hierarchies based on dominance, N.J. Habraken refers to hierarchies of **enclosure**: territorial organisation is founded on the principle of inclusion within other territories: he refers to **included territories**. *"One configuration is frequently enclosed by another: furniture is enclosed by partition walls, city blocks by a circumference of roads. In such cases, enclosed configurations can transform independently within the space enclosed. However, transformation of the form that encloses will require adjustment of whatever is enclosed"*<sup>16</sup> This statement defines privateness and publicness as more relative conditions for urban projects.



Figure I.4: London, Kensington neighbourhood: gates as dominant entrances to mews

<sup>15</sup> N.J. Habraken, "Notes on Hierarchy in Form", edited version of paper for project on form hierarchies, Department of Architecture, Massachusetts Institute of technology, January 1984, p 3

<sup>16</sup> N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p. 56

The author describes two types of hierarchies: hierarchical forms that are made out of one nominal class, as it is the case of dominance hierarchies, and hierarchical forms that are constituted of more than one nominal class, the last one defining enclosure hierarchy. One public space can enclose private properties that on their turn include small enclaves or micro-climates: all defining an enclosure hierarchy.

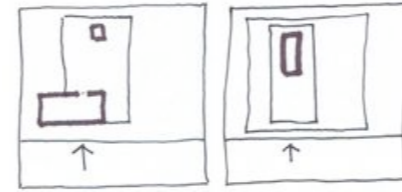


Figure I.5: models of dominance (left) and enclosure (right)

*“Enclosure comes in many forms, from the walled compound accessed through a gate, to the roof held aloft by columns.(...) Space traced within a larger area provides a hierarchical depth and context, not offered by fully segregated space”*<sup>17</sup> With this statement, enclosure is likened with systems of control: to clarify the author illustrates nine modes of dwelling, related with five different levels ( body and utensils, furniture, partitioning, building and road network), leading to a variable control on transformation. Some examples are the furnished rented apartment, a hotel room or a traditional Japanese house in which control mechanisms of enclosure are different. This leads the author to establishing hierarchies of enclosure forms in which he distinguishes nominal classes (body and utensils, furniture, partitioning, building elements, roads or major arteries) from configurations (interior arrangements, floor plans, buildings, districts or city structures) and from the very space within (“place”, “room”, “built space”, “block”, “neighbourhood”). The precise terminology, together with the level classification helps to re-read territories in a more structural way.

The most interesting part of the theory of enclosure hierarchies is that they have a dynamic nature: N.J Habraken describes cases in which **levels emerge** within an enclosure hierarchy: he refers to the transformation of the sleeping alcove into a bed (going from a building element to furniture), the use of clothes drawers instead of dressings (going from furniture to a building element). Within an enclosure hierarchy, levels can emerge or disappear with time. *“As a general principle, in both physical and social organisation, increasing complexity eventually leads to deeper hierarchy. As (new levels) emerge, control patterns will adjust accordingly”*<sup>18</sup> In a similar way, the author mentions the disappearance of a level, like when street and block are designed as a rather unified and integrated form (he refers to the Berlage Amsterdam South extension).



Figure I.6: Amsterdam stoops

This is equal to a two-level-integration or disappearance of one level. Another interesting example for the disappearance of a level is the (no-)existence of sidewalks: N.J. Habraken describes how 1890’s Amsterdam initially had no sidewalks incorporated in the urban landscape: transition zones were marked by “*stoops*”, located within the private property.

<sup>17</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p. 57

<sup>18</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p. 74

However, with the introduction of the car, sidewalks were introduced as pedestrian protection area so roads acquired a formal expression of their own, as N.J. Habraken argues. As a consequence, the net-form of roads started to abandon the hierarchy of enclosure and to join with rivers, ridges and alleys to become part of the landscape while maintaining its own presence as artefact. In a way, tertiary scale was created: enclosure hierarchy no longer includes the road network.

#### v. Control hierarchies: morphological issues

Territory depends on hierarchy of spaces and **access control**: in other words, hierarchy of control patterns defines territorial meaning. Hierarchies are composed out of different **control units**. A control unit is a configuration of parts that can be independently composed of smaller parts, that can be independently transformed by combining its parts in different ways. For example, the porches of different houses in a street can be seen as a configuration itself but it can not be a control unit: the larger control unit a porch is a part of, is the house it belongs to. Various agents intervene simultaneously within different territories: multiple sets of parts, combined with different possible configurations (by different agents) define multiple scenarios for the built environment. According to N.J. Habraken, there are three ways agents can intervene or act: by eliminating, introducing or displacing, all being called moves or arrangements. The important part about these moves is control: the ability to decide on the amount and *modus operandi* of the arrangements, sometimes conditioned by a social agreement.

N.J. Habraken explains the concept of **control hierarchies**: hierarchies in which all parts are control units, mostly the hierarchies we consider when designing all building complex artefacts. *“In a control hierarchy each agent can assemble its own configuration from parts it can select and arrange.”*<sup>19</sup>

The author studies various control hierarchies by establishing three different kinds: first, the existence of **assembly hierarchies**, where *“a unit on a higher level of the hierarchy is composed of parts we find on the lower level. Control is one of assembly of smaller parts into a larger one and the process is a sequence of assemblies”*<sup>20</sup> The other two control hierarchies share the relation between levels that is not one of assembly but of dominance where the transformations on the lower level are constrained by the ones on a higher level. The first one of them has to do with the control of physical elements and is called **dependency hierarchy** while the other is about control of spaces in which we distribute our physical parts, called **territorial hierarchy**.

N.J. Habraken uses a theoretical model to prove that sometimes the systematic and morphological conditions of an urban configuration are such that whoever controls one set of elements will dominate another or that, to put it another way, the condition of control of one set is to dominate the other. In a way, we see the emergence of a **dependence hierarchy** with greater depth. Depth depends on the configurations of control units. The author calls it dominance by forms of enclosure.

The pronounced territorial discourse defines a very structural and hierarchical set-up: *“When a higher level form transforms and lower level forms must yield, we speak of a “structural” problem. What we call ‘frameworks’ or ‘infrastructures’ are usually higher level forms in a dependence hierarchy. We can change and rearrange these objects without disturbing the framework, but, when we redesign the framework, the distribution of lower level objects is disturbed and must follow the new arrangement”*<sup>21</sup>

To conclude: *“General Principles of Organisation: the architecture envisaged in an organism is typical of a pattern which is of wide occurrence not only in the biological but also in the psychological and sociological fields. It can be called hierarchical order. Systems of action, such as the locomotor system consisting of bones, muscles, and nerves, are intelligible only on the way they interact”*<sup>22</sup>

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19 N.J. Habraken, “Control Hierarchies in Complex Artefacts”, original paper published in Proceedings of the 1987 Conference on Planning and Design in Architecture at the International Congress on Planning and Design Theory, Boston, MIT, American Society of Mechanical Engineers, 1987, p 7

20 N.J. Habraken, “Control Hierarchies in Complex Artefacts”, cfr previous note, p 3

21 N.J. Habraken, “Control Hierarchies in Complex Artefacts”, cfr previous note, p 13

22 L. von Bertalanffy, Problems of Life, 1952, quoted by S. Chermayeff, C. Alexander “Community and Privacy” Doubleday & Co Inc. USA 1963, p116

## vi. Territorial hierarchies: territorial issues

The value of N.J. Habraken's theoretical model depends on its territorial dimension: where the author formulates the idea of **territorial hierarchies**. As mentioned before, control of space (with morphological implications) differs from territorial control, that not necessarily obliges physical implications. In this way, N.J. Habraken links this theoretical model of enclosure hierarchy with the idea of public space and private space, the latter being included in the first one, constituting included territories which turns the concepts of public and private space into relative notions. The author stresses that territorial boundaries can be **invisible**, although clearly defined, like on a beach or campers on a campground. On the other hand, walls and gates may not define any territorial meaning at all: a door leading from a house into a garden within the same property, does not define territorial meaning. The same morphological configurations can have different territorial interpretations. One possible interpretation could assume that an area is fully occupied by territories of the same depth, all territories have their gates at the periphery of that area. This implies a larger territory containing the first one: N.J. Habraken mentions the example of an urban block surrounded by public streets. An alternative interpretation follows the same organisation but here, the outer boundaries of the territories are found as well outside the first ones: we can relate this to front yards and a group of territorial gates outside that very area.

According to N.J. Habraken, knowledge of hierarchical properties of environmental forms and other complex artefacts is of great value to designers. *“Control hierarchies help us understand how the artefact predetermines the relation between those who act upon it and how, in turn, the way agents relate to one another, shapes the artefact. The hierarchies we see in our artefacts are the result of explicit tacit agreements among those who act upon them.(...) Understanding the hierarchical structure of (the built environment) and the control distributions exercised upon them, will help us to organise ourselves when making complex artefacts(...)”*<sup>23</sup>

The above mentioned theory on territory has obviously a very hierarchical and structural approach: the built environment is seen as a result of included territories, forming various control hierarchies having morphological implications sometimes but not necessarily coinciding with territorial meaning.

## vii. Models for urban growth

Recognising the territorial structure of the built environment allows a more profound understanding of urban growth models. Difference in territorial structure and scale explains existence of different urban growth models. N.J. Habraken refers to the example of the *“row house urban tissue”*<sup>24</sup> as a simple territorial structure: in this case, spatial hierarchy is more complex as opposed to the flat territorial structure. He mentions the repetition in Amsterdam of the *“Canal House”* as a single territorial configuration, nevertheless allowing varied territorial use. (see figure of territorial interpretations of the row house) The first case describes a single house in a single territory, followed by the second typology of a single house that is not a single territory. The third diagram shows the back house with access to the street that exists at the same territorial level as the other house. The final one describes the case of the back house comprising two territories with a common entry garden. The back house in this case consequently has more territorial levels than houses on the street: it means it has a **deeper structure** than in the other scenarios. Even so, this Dutch *“row house urban tissue”* is generally characterised by a flat territorial structure.

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<sup>23</sup> N.J. Habraken, “Control Hierarchies in Complex Artefacts”, original paper published in Proceedings of the 1987 Conference on Planning and Design in Architecture at the International Congress on Planning and Design Theory, Boston, MIT, American Society of Mechanical Engineers, 1987, p 22

<sup>24</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.144

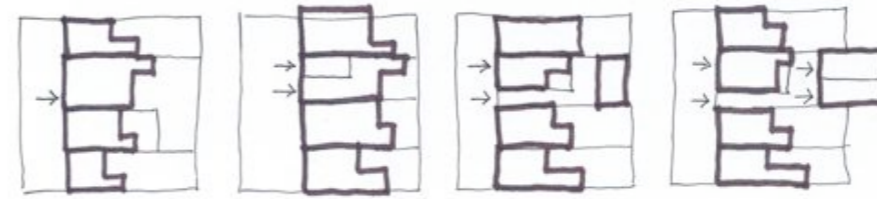


Figure I.7: Varying territorial interpretations of the row house.  
 (diagram made after fig. 8.3: N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p146)

He compares this model of urban growth with the traditional Middle-Eastern tissue, characterised by an overall deeper territorial structure, meaning a more complex successive inclusion of territories (see figure). Both models of urban growth however show a lack of isomorphism in the relationship between built form and fluid territory: in both cases there may be no obvious physical signs of a highly complex reality.



Figure I.8: Tunis Medina - Urban fabric with superimposed house plans: deep territorial structure as a consequence of successive included territories. (cfr. fig. 8.4: N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p147)

### viii. Territorial depth

According to N.J. Habraken, the built environment, defined by territorial organisation, is founded on the principle of inclusion within other territories, as mentioned before (see figure). The author presents a diagram to relate this very principle to the transition between private and public spaces. Imagining different accessibility patterns within this theoretical model of inclusion, that is, different ways of entering those territorial scenarios, N.J. Habraken defines in a clear way the concept of **territorial depth**.

*"Territorial depth is measured by the number of boundary crossings (...) needed to move from the outer space to the innermost territory"*<sup>25</sup>.

<sup>25</sup> N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p.137

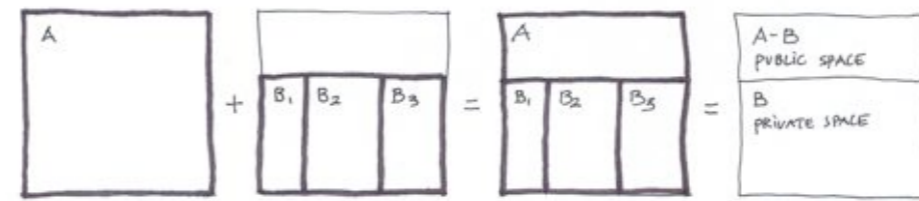


Figure 1.9: The territorial principle of inclusion: the existence of included territories in A also results in the presence of public and private spaces. (diagram made after fig. 7.3: N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p137)

As a consequence, we could say that from the above mentioned “*row house urban tissue*” a lower territorial depth can be extracted than the traditional Middle-Eastern tissue. Besides that, territorial structure has a multiple set-up. The example of Tunis Medina (see figure) shows dead-end streets with their own gates. N.J. Habraken describes that a number of individual houses are reached via each of these streets with the establishing of a **bi-level territory** within urban space as a consequence, as some houses can be reached directly from the street without entering those alleys. Besides that, the plan shows the houses themselves as almost perfect territorial forms in plan: the courtyard is entered through a gate, from a street or dead-end alley. Individual rooms cluster around it. The author mentions that those courtyards can be read as the public space of the house’s territory.

In a way, the flat territorial structure of the Dutch “*row house urban tissue*” urban fabric can be seen as the opposite of the deep and multiple territorial structure of the case of the Medina. “(...) *The Middle Eastern form is more ‘territorial’ (...), while the European model seems more governed by geometry and building structure*”<sup>26</sup>

#### ix. Increase in territorial depth

Territorial depth is not a static parameter: within a time framework, after the intervention of various urban agents, depth can increase or decrease, according to the specific characteristics and dynamics of the built environment.

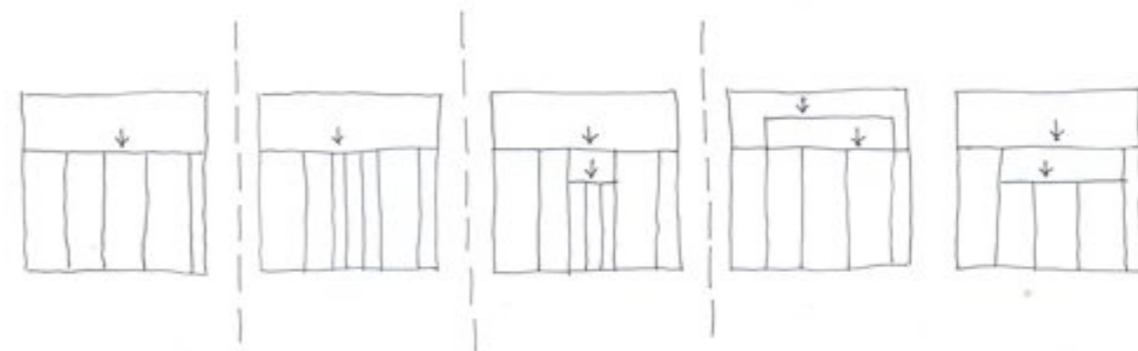


Figure 1.10: Increase in Territorial Depth, principle schematic diagrams. (diagram made after fig. 12.8: N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p215)

N.J. Habraken relates the possible increase in territorial depth to changing density (see figure). The diagrams above describe different scenarios of increasing depth: the first one represents a system of simple included territories. Starting from this basic territorial division, different scenarios are explained.

<sup>26</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.148

Increasing density sometimes leads to nothing more than an intensification of available private space (second scheme to the left): territorial depth is not increased, unlike the process of densification. However, in some cases, densification does generate an increase in territorial depth (third scheme to the left). Besides intensification of use, meaning subdivision of territory, a zone of **shared or collective space** was created before entering those new individual territories. In this case, territorial depth increases as you cross more boundaries when you “*move from the outer space to the innermost territory*”.

In the following scheme (second to the right) we see how included territories occupy public space to make it their own, while the last diagram explains how included territories sometimes sacrifice some of their own space to create shared space. These two scenarios do not contemplate densification of the urban system to increase depth.

The author mentions two ways of increasing depth: the first ones are **top-down actions**: the transformation of a single-family mansion into apartment buildings or the example of courtyard houses that become small villages, containing a number of individual households. The second one describes bottom-up transformations, where neighbours decide to change the configuration of territorial boundaries without imposing this change from above.

Increasing depth is directly related to the creation of collective or shared spaces on different levels within the territorial hierarchy. Shared spaces can be common courtyards, neighbour-shared vestibules, gardens, storage or parking spaces, common playgrounds, corridors or passages.

Territorial depth is strongly related to the property structure within the hierarchy, even not exclusively dependent on it.

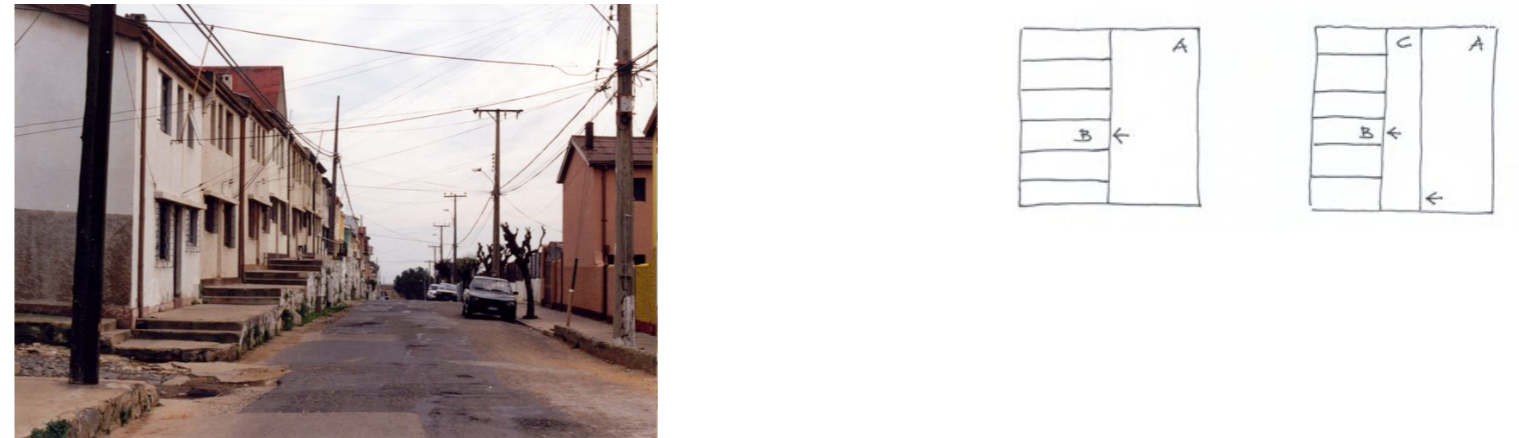


Figure I.11: An example of increased territorial depth in Valparaíso, Chile. The diagrams show the depth generated if the houses would have obtained a direct access from the street level and the existing situation (right) that generates higher territorial depth. Territorial depth is the result of the very relation and position of in-between spaces, territorial boundaries (gates) can be considered invisible though increasing depth. (diagrams made after photographs in situ, Valparaíso, Chile, 2002)

The idea of increased territorial depth is visible and readable in many urban projects, at a small scale as well as at a bigger scale, within different cultural contexts. In some cases, projects are designed or laid out in an intentioned way to increase or decrease depth, while in some other cases depth is a consequence of external factors like existing site conditions. A case where topography or the absence of rational planning regulations caused an increase of territorial depth, is in some neighbourhoods in the city of Valparaíso, Chile, as shown in the image and diagrams above. The attached houses in this particular street were built before mobility needs obliged to cut through the neighbourhoods and trace wider streets. Obviously, the position of each house is in a specific relation to topography. To have access to one of the houses situated in the middle, one has to walk up a flight of stairs and pass by the neighbour’s windows and front doors to enter the house. We could say that the proportion of shared space within this sequence is getting higher by this configuration. The chance you meet a neighbour or a visitor on a smaller distance is relatively higher than when the houses would have been built on a flat surface, creating in that case a more direct relationship between private and public zones. This particular model of accessibility can be found in many streets in the city of Valparaíso: because of topographical conditions, shared space is a structural element within the urban fabric. It is important to mention that in this case no gates or fences appear to increase depth: they can be considered **invisible territorial boundaries**.



Figure I.12: Shared sidewalks in Valparaíso, Chile (pictures in situ, Valparaíso, Chile, 2002)

Another example of increased territorial depth can be found in traditional patterns of lot occupation, in Bratislava (Slovak Republic), ca. 1850-1950. Increase of depth is the result of internal subdivision which forces a more generous shared territory for its occupants. With each generation, as the respective sons of the family extend the house by aggregation in a linear form, the structure of the shared side garden gets deeper and more complex, while its morphological relation with the public street stays almost intact.

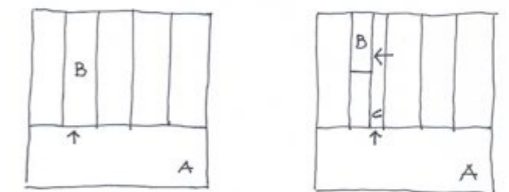


Figure I.13: Bratislava (Slovak Republic). Traditional pattern of lot occupation, ca. 1850-1950. The diagrams show a traditional subdivision of building lots and the particular model as shown in the image where depth increases by aggregation.

#### x. Decrease in territorial depth

N.J. Habraken mentions bottom-up actions as a cause of a decreasing territorial depth, that is when lower level agents invade shared public space and re-appropriate that space in its entirety to enlarge their own territory (see second diagram in figure). As a result, access loses depth as the in-between space gets lost in this action. However, this practice is not very common in urban settlements.

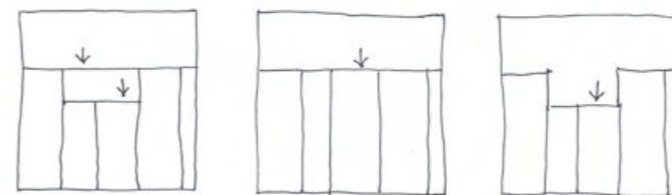


Figure I.14: Decrease in Territorial Depth, principle schematic diagrams.

(diagram made after fig. 12.10: N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p219)



The mentioned top-down equivalent, however, is applied more often with a decrease of depth as a result: “*a greater territorial power appropriates public space common to territories on the level now removed*”<sup>27</sup>. This means that encompassing territory invades or annexes included territory, as can be seen in the third scheme. The author refers to the case of Tunis where gates in dead-end streets were systematically demolished or to the case of El Cairo where the French occupants, under Napoleon, took down the gates of all dead-end streets to control occupied territory more easily.

### xi. Territorial depth and density

The value of depth is related with the structure and the amount of collective space within a project. Taking several housing typologies as a base to measure the value of depth, we detect several typologies: the apartment within a multi-family block with many shared facilities gives a different value than a detached single family house with a private front or a back garden: the amount of crossed territorial boundaries to go from a more public area towards a more private area varies. Here however, the depth structure is represented based on a simple private/public distinction. As a result, this traditional representation still emphasises exclusively the quantitative dimension of depth.

TRADITIONAL SCHEME OF APPROPRIATION

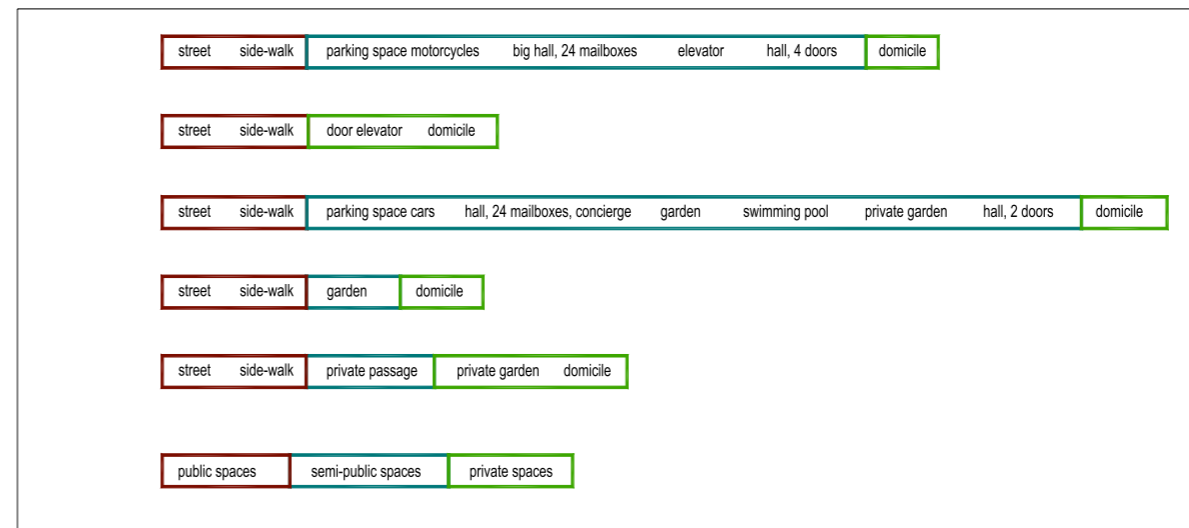


Figure I.15: different sequences of housing typologies with correspondent territorial depth, based on public/private distinction

To describe the parameter of territorial depth as the “*process of increasing the number of public to private boundaries within a territory*”<sup>28</sup>, T. Chastain and R. Chow made a comparative observation of American residential settings and linked depth with density. The authors studied examples in Charleston, South Carolina, within a 19th century context of “*zero lot line housing*”, or settlements in Pueblo Ribera, Santa Monica, California (USA), as opposed to contemporary residential projects in Clayton, Northern California (USA).

They first describe and explain Californian preference for low density landscapes which is the basic territorial reference for the investigation: “*the automobile, the open landscape and the ability to construct relatively cheap and quick have given rise to low-density patterns*”<sup>29</sup>. The research starts with a defence for densifying the existing fabric to avoid problems of abusive land occupation, of unnecessary energy consume and of decreasing accessibility.

27 N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.218

28 T. Chastain, R. Chow, “Designing Density”, in Transformations of Urban Form, Firenze, Alinea Editrice, 1999, p. FK2.5

29 T. Chastain, R. Chow, “Designing Density”, in Transformations of Urban Form, Firenze, Alinea Editrice, 1999, p. FK2.3

The results of the study show that when density is increased within an existing neighbourhood or within a pre-existing pattern of land division, often only the program gets bigger, without changing the structure of the settlement. In other words, higher density is often achieved by packing program, which means larger houses on smaller lots, mostly after a subdivision of the existing lots.



Figure I.16. Levittown, Long Island, New York State (USA), 1950's (image right from <http://tiger.uic.edu/~pbhales/Levittown> by Peter Bacon Hales. Image right: Tony Linck, for Life Magazine, Aerial View of Levittown, June, 1948)

The authors refer to post-war Levittown housing development in Long Island, New York (USA), that was based on mass production of repetitive houses on subdivided lots of former farmlands.

However, even contemporary projects follow the same logic: increasing density by enlarging programs and increasing the number of houses per acre, the collective structure maintaining its minimal level as in the Levittown model in the 1950's. Contemporary suburbs extend the model of low cost housing for middle class developments and epitomise the suburban context with its uniformity and low density: rising costs of land and increased programmatic expectation result in larger houses on smaller lots. This tactic of increasing density sees dwellings as masses that are aggregated without a corresponding increase in the complexity of the collective structure. As a result, backyards take on a minimal dimension for outdoor activities, the front yard just deep enough for a car and the side yards act as a minimal buffer from the neighbouring house. This buffer space is left over from the positioning of the house on the lot and reinforces the isolation of the houses from the fabric of spaces around them.

The authors compare the process of densification of Clayton with the one of Charleston and Cambridgeport (USA): in the last case, groups of houses have different types and lot positions, producing a structure in which dimensions, privacies, access and open areas are organised across a complex fabric of discrete buildings. This is in stark contrast to Clayton where each attribute is organised on a house-by-house basis.



Figure I.17: comparative study San Francisco, Charleston, Levittown<sup>30</sup>(images from posted web presentation by R.Y. Chow)

<sup>30</sup> R. Chow, "Suburban space: the fabric of dwelling", University of California Press, 2002

T. Chastain and R. Y. Chow argue that by increasing the **systematic sharing** within a setting, ways that residents can appropriate space are expanded and choices for interaction increased. As a result, individual identity and autonomy are achieved through variations within a system rather than house-by-house distinctions.

The authors defend that when designing density, the morphological structure of the neighbourhood should be changed as well: they prescribe a simultaneous increase of the shared structure, besides packing functional activities.



Figure I.18: comparative study of depth in residential neighbourhoods  
(images from posted web presentation by R.Y. Chow)

*“In Charleston, the access not only organises the movement through the house, it also structures the connection from the street to the territory deeper within the lot and it is defined through the orientation and position of the house. (...) Access becomes increasingly collective as the density increases. When moving along the streets (...) there is a steady rhythm of house and side yard that provides views into the depth of the site. As one moves through the front door and into the porch and side yard, you are directed to move into the depth of the site. Along the way, you can move into the house, into the yard, or continue on, deeper into the site, arriving in a rear patio that organises more activities around it. These may be activities of one household, or the lot can collectively structure several households. (...) territorial depth is accommodated through building rather than subdivision.”<sup>31</sup>*

As N.J. Habraken does, T. Chastain and R.Y. Chow see the urban fabric as an always continuous system in which density should be designed in a morphological way by augmenting the proportion of collective spaces, generating a higher territorial depth, that is the gradual relation between public and private zones within residential projects. As a result, territorial depth is about structure, not about quantity. It defines permeability and the transformational potential of density, as the authors mention in their study.

*“Our analysis assumes the position of looking at the built environment as a field, as a continuous fabric. (...) We also take the position that built fields develop over time through the collaborative actions and are typified by transformational forces.(...) Designing density requires the design of the morphology of a field, not a packing of program areas. (...) Increasing density requires a shared structure to organise spatial relations as well as a permeability and territorial depth within a fabric. In this way, built fields develop over time through the collaborative actions of many individuals.”<sup>32</sup>*

Indeed, the exponential growth of single-family based suburban neighbourhoods asks for a critical review of the relation between sustainable growth, construction and maintenance costs and territorial implantation. Newly built neighbourhoods often get reduced to a superficial marketing image, denying the many structural problems of its maintenance on a long term. These contemporary phenomena of fast space production have a global dimension and seem to define an important economical sector on a global scale. Recent residential projects share the same characteristics in Bratislava, Murcia, Beijing or Vancouver.

<sup>31</sup> T. Chastain, R. Chow, “Designing Density”, in Transformations of Urban Form, Firenze, Alinea Editrice, 1999, p. FK2.5

<sup>32</sup> T. Chastain, R. Chow, “Designing Density”, in Transformations of Urban Form, Firenze, Alinea Editrice, 1999, p. FK2.4

Using territorial depth as an investigation parameter or even as a design tool is an interesting approach. However, limiting the concept of depth to small-scale morphological issues and exclusively depending on simple public/private distinctions, might not offer enough insight into this subject.



Figure I.19: Bratislava (Slovak Republic). Contemporary residential suburbs, applying the success recipe of endless repetition of huge single-family houses on small lots, without guaranteeing the well functioning of privacy sequences and without defining the structure of the collective system as whole. Strong is the contrast with the former applied housing typologies during a different political regime.

## 2. Territory: adaptability, multiplicity and overlap

### i. Live configurations

N.J. Habraken describes territory as a result of offering **variety**, with a certain **adaptability over time**: “(control hierarchies, territorial organisation and division between public and private space...) can be brought into a new perspective by applying two interrelated concepts not normally equated with design: change and control. By looking at the architectural form as an instance of a continuous process of change, we become interested in the mechanisms of transformation (...) In all observations, scientific and otherwise, change and movement reveal the structure of what is observed. (...) Change is brought about by people designing, making and inhabiting the environment. (...) The structure we find is a reflection of patterns of control. We begin to see the complex form as a social artefact, and its hierarchical and territorial structure is, ultimately, a product of convention”<sup>33</sup>

In other words, the very structure of territory depends on change and control by different agents. As mentioned before, this statement recognises the temporal dimension of the built environment and places complexity even within a social framework: all change, all transformations as a result of multiple actions upon territory. With this idea, the reduced morphological understanding of complexity is abandoned: form can look very simple but have a very complex territorial organisation. At the same time, a very simple and flat territorial structure can be read in complex form.

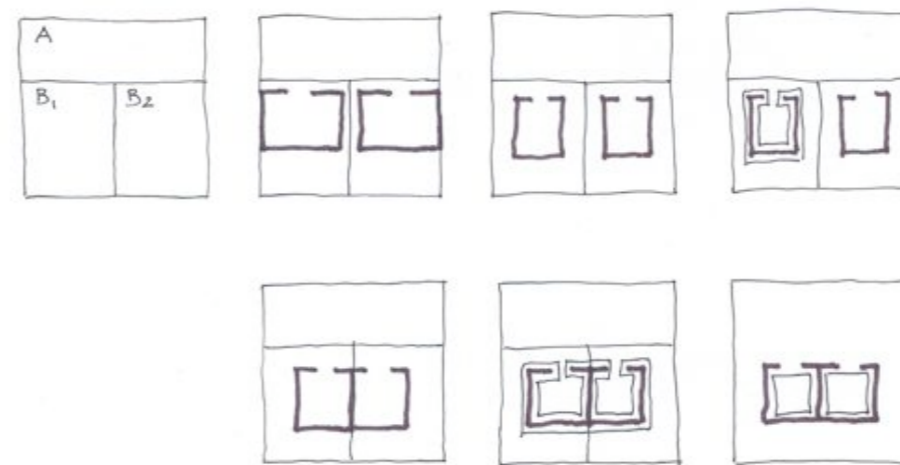


Figure I.20: A single territorial diagram representing varied buildings and rules.

(diagram made after fig. 9.5: N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p170)

Territory is seen as a “live configuration”<sup>34</sup>, argues N.J. Habraken, and adds that “Living environments can not be invented, they must be cultivated. (...) This requires proper use of levels, judicious articulation of territory, and creative application of types, patterns and thematic systems.”<sup>35</sup>

The author continues the definition of territorial configurations by looking at varying form with a fixed territory (see figure). He puts the examples of building forms that lay within a defined territory B and that constitute part of it, a common form of the free-standing house or the townhouse with its own party walls. Other examples are a whole duplex house under control of an absentee landlord etc. Territorial meaning does not change while form does.

<sup>33</sup> N.J. Habraken, “The Control of Complexity” in Places, volume 4, number 2, 1987, p 15

<sup>34</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.236

<sup>35</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.326

The second series of examples describes the case of the city block as a fixed form with a variable territorial structure. Starting from a continuous street wall with internal open space, invisible from the street, the author shows many variations generating different territorial meaning. (see figure)

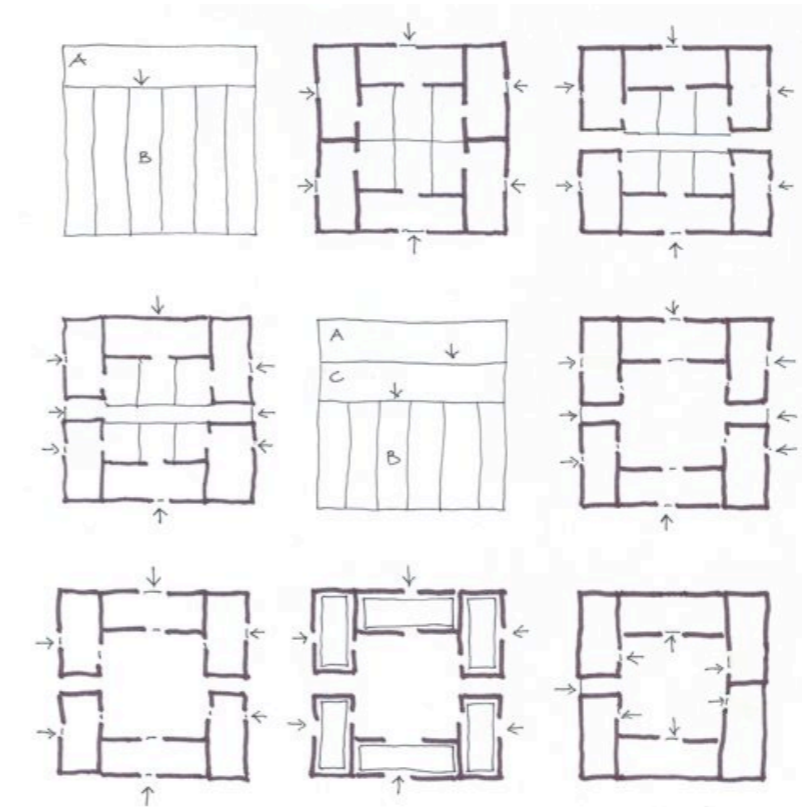


Figure I.21: Territorial variations on the urban block: pictograms diagramming houses around a block. All have access to the surrounding streets from that block.

(diagram made after fig. 9.6: N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p173)

The first territorial diagram can be applied to the first, second, fifth and sixth case: no additional depth available within the theoretical hierarchy. The second diagram showing added shared space in between the public space and individual property can be applied to the third, fourth and the last case. Examples could be internal open space subdivided into private gardens (first case), a fenced back alley (third case) or a communal yard forming a courtyard between house and street.

## ii. Dual orientation

Multiple access within a territorial hierarchy can be seen as another model of accessibility. Considering N. J. Habraken's concept in the figure above, the second, the fifth and the sixth case show house territories with dual orientation. This means that within the urban schemata, public space can be entered in two ways. The author mentions more sophisticated cases by referring to the British terraced housing, where the mews were specially designed to provide access to carriage houses built in the back of private yards. Another given example is the case of Bath, where the section shows the mews as secondary streets behind the main street.



Figure I.22: Residential project in Chicago, Richard Neutra, 1942.  
 (image reproduced in “Las Formas de Crecimiento Urbano”, M. de Solà-Morales, Edicions UPC, Barcelona, 1997, p193)

Another example of dual orientation could be Richard Neutra’s residential proposal in Chicago (USA), 1942, that incorporated a double access to public space from the individual property. This double system of access constituted a more complex use of space, as the motorised and principal entry formed a coherent urban network, independent from the second, more green and open space related grid, leading in a green park to decongest the urban lay-out. A similar application can be found in Clarence Stein and Henry Wright’s Radburn project in New Jersey, when they presented a dual orientation to all dwellings, converting this idea even into a coherent urban system. They laid out a double access-system to warranty certain complexity within the project.

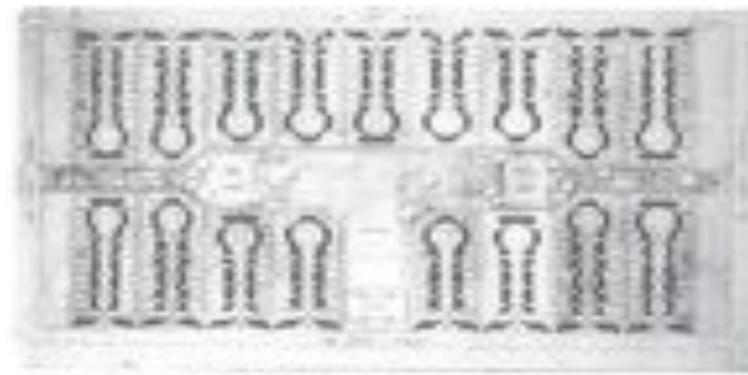


Figure I.23: Radburn principle, New Jersey, Clarence Stein and Henry Wright, 1929  
 (image reproduced in “Las Formas de Crecimiento Urbano”, M. de Solà-Morales, Edicions UPC, Barcelona, 1997, p193)

Dual orientation can be the Leitmotiv for urban growth and transformation. F. Candaş Bilisel studied historical urban growth of the Frank Quarter in the city of Izmir (Turkey).<sup>36</sup> She describes the area as a unique urban fabric within the overall morphology of the 19th century Ottoman city, an area formed on a particular location between the sea and the city. The district, as the author describes, being a narrow strip between the coast and “Frank Street”, a merchant’s street connection parallel to the sea, was distinguished by extremely narrow lots divided by many streets and passageways opened to the sea and by its particular building types. An extreme mixture of commercial and residential uses characterised the Frank district and contrasted with the organisational logic of the Ottoman city. According to F. Candaş Bilisel, the Frank district showed a different understanding of space production, based on dual orientation, shaped by a

<sup>36</sup> F. Candaş Bilisel, “A Specific Urban Form between Sea and City: The Frank Quarter of Izmir” in “Transformations of Urban Form” ISUF 1999, Alinea Editrice, Firenze 1999, p P.8

different culture in the Ottoman city. The configuration of this district was produced in a particular way of life and a dense commercial activity. That mixture of residential and commercial uses is characteristic to European pre-industrial conceptions of urban space, but, according to F.C. Bilsel, is also an outcome of the limitation of a piece of land on which the European merchants had to settle in Izmir in the beginning. The constraints of the site and a variety of functional requirements produced, in fact, the specific urban fabric of the Frank district.



Figure I.24: The city of Izmir, 1854-1856 after the plan of Luigi Storari  
(image reproduced from “Transformations of Urban Form” ISUF 1999, Alinea Editrice, Firenze 1999, p P.9)

The urban fabric of the mentioned area is formed by a multiplicity of small streets and passageways perpendicular to Frank street, which connect this very street to the sea and divide the area into extremely narrow building lots. *“The reason of this particular morphology can be searched in functional requirements: as the districts constitutes an area of transition between the port and Frank street, the access between the two is maximised by the multiplicity of streets connecting the two. However, the most important reason seems to be the landownership pattern of the area. (...) The need for each parcel to have access both from the main street and from the sea seems to be the main motivation behind these divisions. The comparison of the maps with the 19th century plans of the city, shows that these parcels were extended on the sea while access from both sides were conserved. This process resulted in the formation of elongated plots”*<sup>37</sup>

The author continues by explaining that the majority of streets connecting Frank street to the port, were *de facto* private passageways, called “*verbanes*”. Buildings within each parcel were arranged around these private inner passages, there were only a few public streets among these. Interesting to see is that even the churches were inserted within the same arrangement. The quays served as private ports, connected to the sea as main public space. Each merchant house disposed of a small quay, mostly in wooden structure, to provide access to the sea.

37 F. Cànâ Bilsel, “A Specific Urban Form between Sea and City: The Frank Quarter of Izmir” in “Transformations of Urban Form” ISUF 1999, Alinea Editrice, Firenze 1999, p P.10



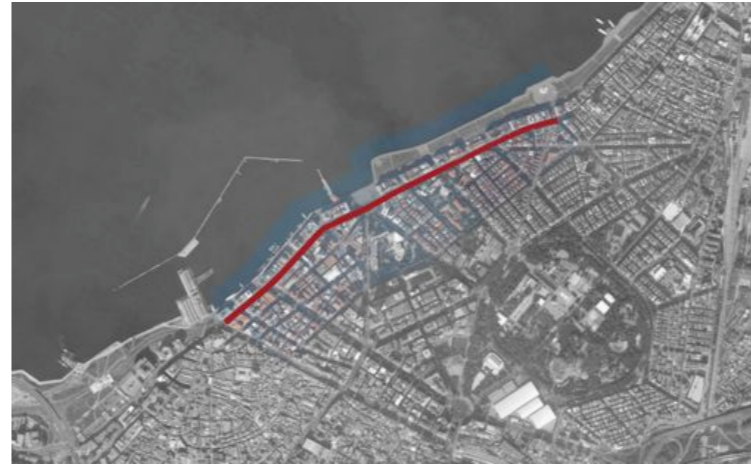


Figure I.25: The city of Izmir, Turkey, base google earth image 2009, indication of former Frank Quarter

This dual orientation of the urban fabric was destroyed with the construction of the modern port from 1860 after long debates and conflicts. The modern port and especially the continuous strip of newly created urban lots obstructed the relation of the existing Frank quarter with the sea.

The previous examples all show multiple orientation models, generating different depth configurations. Dual or multiple orientation can be seen as one of the parameters of territorial complexity at different scales and can define a **structural quality** of an urban area. It should be mentioned that dual orientation is no equivalent for higher territorial depth, but it does generate a higher urban complexity.

### iii. Territorial overlap

In the previous chapter on the notion of territory, a comparison was made between different models of urban growth, indicating different levels of urban complexity. N.J. Habraken's also mentions territorial complexity when he describes systems of **territorial overlap**: this is the case when a certain area is included in more than one territory. However, the author clearly makes a difference between a hierarchy of streets, of open spaces or form and the actual territorial structure with changing accessibility, which defines territorial overlap. This phenomenon does not exclusively depend on morphologic lay-out or distribution of activity but has **integration** characteristics: overlap is the result of a specific territorial scenario, with a specific functional program and its location, and an even more specific configuration of access, which defines a different model of territorial depth. We could say that dual orientation is based on included territories while overlap scenarios share that characteristic but that as well a higher level of complexity is detected, together with the presence of 2 territories with each a different level of privacy.

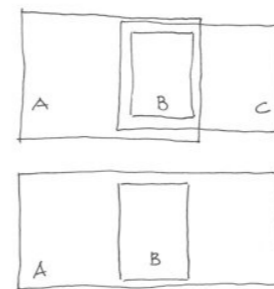


Figure I.26: Territorial overlap (above) versus dual orientation (below).

N.J. Habraken gives the example of a corner house that fronts a major and a minor street. If the latter exists behind a gate, it constitutes private space relative to the major street. He indicates that because there are entrances on both streets, a similar territorial overlap occurs. In Western growth models, this overlap is less common than or example in Middle Eastern fabric with cases of houses connecting to two different gated dead-end streets. Traditionally, Mediterranean settlements present more cases of territorial overlap than Northern European urban cultures, even if this is a changing tendency (see later). The author explains the case of Tunis Medina, an urban fabric with superimposed house plans. (see figure) *“The first territorial layer is indicated, showing hole-in-the-wall-shops, houses entered directly from the streets, and territories constituting a dead-end street together with those houses accessed from it. (...) The houses bounded by the rue de la Kasba and the rue de Tamis connects to two impasses, Bou Machem and la Paysanne. This is an example of territorial overlap.”*<sup>38</sup>



Figure 1.27: Territorial overlap in Tunis Medina.

(originally reproduced as fig. 8.4 in: N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p147)

The importance of the concept of territorial overlap lies in the possible rich ambiguity of an urban project: besides having multiple options to access a building or an area (as in dual orientation), the location of the private property here obtains as well an increasingly relative character. This allows different users of space to interpret and appropriate projects in a more flexible way. Territorial overlap can be defined in a fix morphological way or can depend on time-related space appropriations, spontaneous or not. We will later describe and explain various cases of territorial overlap at different scales.

#### iv. Chain of public spaces

The idea of a **sequence** through different areas is mentioned by N.J. Habraken when he describes the idea of **(dis)continuity of territorial depth**. The figure below represents a shared, communal space, totally separated from the street network. N.J. Habraken calls it *“a purely theoretical design, unobserved in real life”* He argues that there is little reason for inhabitants living on four different streets to share space within a block. The author sees this example as anomalous because it would suggest *“discontinuous territorial depth”*: its backyard public space is nowhere connected to a more public space. *“Coming out of the house into a shared communal space, one can only go back, but not to a more general territory. This violates the territorial structure. Environmental order, regardless of its particular form, is always a continuous chain of public spaces on increasing territorial size. We either go continuously up in the territorial chain or we go continuously down. All environmental space, in fact, is one.”*<sup>39</sup>

<sup>38</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.147

<sup>39</sup> N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998, p.178

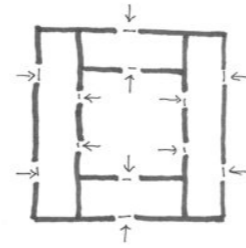


Figure I.28: Discontinuous sequence of territorial depth.  
(diagram made after fig. 9.10: N.J. Habraken, "The Structure of the Ordinary" MIT Press Cambridge 1998, p178)

N.J. Habraken defines territorial depth as a not questionable continuous transition of included territories with a certain systematic change in dimension. Besides that, the author argues that if this would not be the case, inhabitants would have no reason to share space. Whether the built environment indeed has an overall continuous dimension, will be studied in the following chapters with more detail.

The previous chapters explain, compare and offer a critical view on the concept of territorial organisation and offer a hierarchical and structural understanding of depth.

### 3. Non-hierarchical understanding of territory

#### i. Space as a system

Bill Hillier and Julienne Hanson<sup>40</sup> describe how architecture structures the systems of space we inhabit and how those systems are related with a social life: movement, encounter of social relations or avoidance are part of architectural social vocabulary. Apart from theoretical models that deal with space without a social context or studies of society without a spatial context, they propose a new model to understand the built environment, starting from applied disciplines. First, this means that a **social context of spatial patterning** is studied with a simultaneous analysis of a **spatial context of social patterning**. Second, they suggest a new method of analysis of spatial patterns: one that concentrates on the relation between **local morphologic relations** and **global patterns**. This includes a theory of **pattern types** and a description of a method of analysis. Above all, they believe in the **non-hierarchical, abstract notions of spatial relations** between buildings or other elements, defining the environment. They point out that syntactic generators of space are shape-free: **the study of space as a system is not about shape**. Besides that, they dedicate a limited role to “distances” or “location” and focus on simultaneously existing relationships that are ever-changing. In other words, they are interested in rethinking the concept of proximity at an urban scale.

According to the authors, buildings define empty volumes of space in between, which can be seen as ordering space. They mention that buildings seem to be physical artefacts, but that this is illusionary: transformations of space through objects means ordering relations between people. In other words, this constitutes a **system of social relations**.

Their theory refers to previous anthropological and architectural studies where space production is seen as an empirical and a theoretical problem respectively. B. Hillier and J. Hanson as well refer to concepts of territoriality, as studied in previous chapters, where space production is reduced to the idea of individuals having the need to mark territory or to group dynamics. In that way, Oscar Newman<sup>41</sup> mentioned: “*Healthy societies will have a hierarchically organised system of territories corresponding to socially defined groups*”. However, the authors question this theory of territoriality as there exist social groups that have a spatial dimension through co-residence or proximity and groups whose purpose it is to cross-cut spatial divisions and to integrate individuals across space. This last group is characterised by a non-spatial sodality and use insignia, ceremonies, statues or mythologies to evolve. In other words, social identification and spatial integration can work in contrary directions: territoriality is not a universal group behaviour but a limiting case, according to the authors.

B. Hillier and J. Hanson see territoriality as a theory of fundamental similarity. “*Through its ordering of space, the man-made physical world is already a social behaviour! It constitutes a form of order in itself: one which is created for social purposes, whether by design or accumulatively, and through which society is both constrained and recognisable: space (...) is a system.*”<sup>42</sup>

They describe a series of urban settlements like the appearance of “*urban hamlets*” in Vaucluse (France) where they discovered that local rules defined global settlement forms. Certain rules of building aggregation is repeated several times and defines a global pattern for the region. They look for the nature of the restrictions within the system, as the result is not random.

Further study results in a remarkable distinction: in many cases global form is not the result of local **aggregative forces** but by **superimposition on those cells of higher order**. We could relate this to the previously mentioned idea of dominance, even if in this last case the traditional location-based logics of rank and hierarchy are left out.

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40 B. Hillier, J. Hanson, “The Social Logic of Space”, Cambridge University Press, Cambridge UK, 1984, p 9

41 O. Newman, “Defensible Space”, Architectural Press, London, 1973.

42 B. Hillier, J. Hanson, “The Social Logic of Space”, Cambridge University Press, Cambridge UK, 1984, p 9

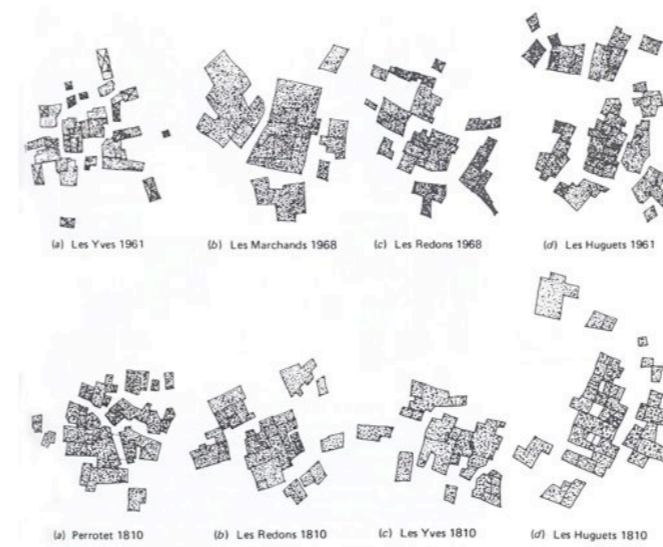


Figure I.29: Vacluse region (France), beady ring hamlets pattern  
 (image from B. Hillier, J. Hanson, "The Social Logic of Space", Cambridge University Press, Cambridge UK, 1984, p 59)

They describe a case that is defined by surrounding cells, creating a hierarchy of boundaries: one contains many. We might refer to the idea of included territories. One cell defines space bound together: the authors call it **distributional**. The second case however focuses on the space between cells: more than one space defines space: it is as if the different cells are glued together: here we call them non-distributed cells. It is interesting to see how B. Hillier and J. Hanson define the relationships between cells in the case of the distributed cells as **asymmetrical**, while the non-distributed ones as **symmetrical**. In a way, this can be related to N.J. Habraken's theory on (a)symmetrical territorial relationships. The authors add that the problem of identifying morphological form has to do with identifying the combinations of elementary generators that yielded a particular form. They prefer to talk about abstract rules underlying spatial forms instead of studying spatial forms. They mention that in different societies, different ways of restricting rules are defined and accepted: highly ordered form has many restrictions while lowly ordered form depends on less restrictions. We could speak of more or less randomness, more or less order, more or less meaning.

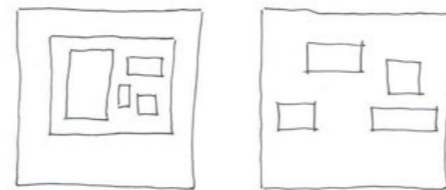


Figure I.30: B. Hillier and J. Hanson's idea of distributed versus non-distributed cells in a configuration

The authors detect another characteristic: in some studies they find that all cells are **interchangeable**: the pattern does not change when houses are interchanged within a street. But in other cases, this is not the case: each is specific: all cells are **particular**, have a label, a certain function or activity. Here, the authors focus less on the importance of the very rank or position but at the role an element has within a system of social relations. This implies the introduction of a **non-spatial factor**: because of labels, the very project does not depend on the place but on the very combination of particular cells.

As a result, different situations are detected: starting from random, non-distributed, non-order and non meaning set-ups till all-label based, distributed, non-interchangeable order. Though, both extremes share the framework of the conception

of order in space, as restrictions or as an underlying random process. The next step within B. Hillier and J. Hanson's study is quantification: here they refer to the **permeability** of the system as a pattern property. This is related to the arrangement of cells and entrances for controlled access and movement and leads towards patterns of permeability. The idea of permeability undoubtedly is linked with the concept of depth.



Figure I.31: B. Hillier and J. Hanson's idea of permeability

All previously mentioned spatial characteristics define what they call **space syntax**: a system of spatial relations. Indeed, it is different to consider a deep form than a shallow form: this is a matter of quantification. The authors study 2 types of relations: the ones among occupants and the ones among occupants and outsiders: resulting in a study of social relationships built into spatial form. The dimensions of the syntax model are defined by social factors: the dimension of asymmetry was related to the importance of categories of **integration**. The authors argue that social meaning of spaces are best expressed in terms of the relationships in physical configuration. They define open space as a continuous space, having a regular or an irregular rhythm. Some parts of that open continuum is defined by **convex space**, as a two dimension-based picture of space structure, while other parts obtained a more **axial structure**, where movement is defined by only one dimension.

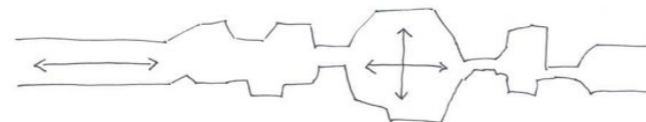


Figure I.32: Hillier and J. Hanson detect axial and convex structure of space.

They propose to treat public space as a kind of interface between the dwelling, the domain of the inhabitant, and the world outside that settlement as the domain of strangers. They mention that axial structure of space invites people to move through it in a relatively fast way while convex space tends to invite people to inhabit space, to stay and appropriate it in a more static way. In the last case, control of the mentioned interface is more important than in axial spaces. The authors illustrate with various examples, like some European market places where space syntax shows that strangers are speeded on their way to the central market square, defined by axial spaces, but once they arrive at the convex place, they are slowed down. They explain that in the city of London one can see the principle of urban safety: accessing strangers everywhere and controlling them by immediate adjacency to dwellings of inhabitants.

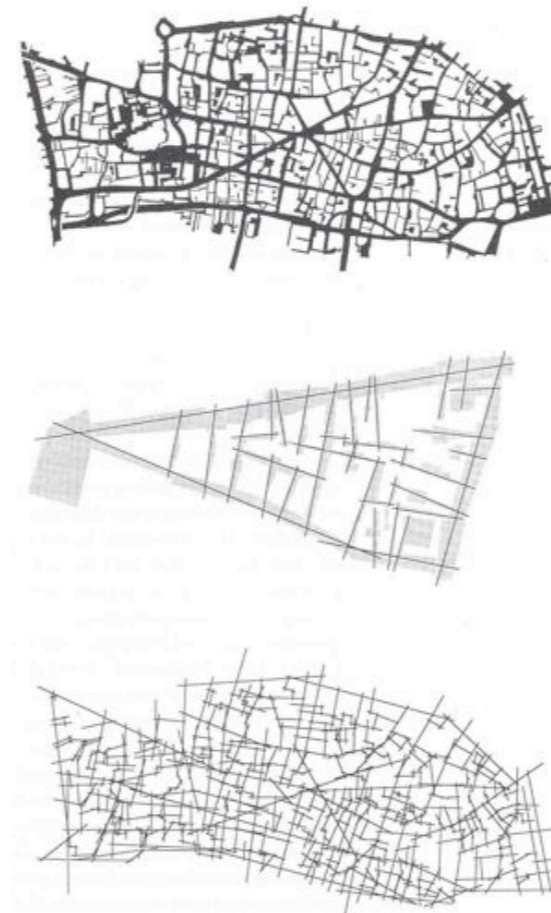


Figure I.33: Hillier and J. Hanson detect axial and convex structure of space: mapping of the city of London.  
 above: Black and white illustration of the public open space, today's situation  
 middle: Close-up of the one- and two-dimensional space structure of the area between Cornhill and Lombard street in 1677  
 below: Axial map of the City of London, today's situation  
 (originally published in B. Hillier, "Space is the Machine", Cambridge University Press, Cambridge, 1996, p157).

They look for social references of these spatial patterns and refer to Emile Durkheim<sup>43</sup> who in the 19th century pointed out that there are 2 fundamental principles of social solidarity or cohesion: first, an organic solidarity, based on interdependence through **differences**, linked with an integrated, dense space. Second, there is the idea of a medieval solidarity, with spatial transformation mechanisms based on **similarities or the belief of a group**, that results in segregated and disperse spaces. B. Hillier and J. Hanson build on this idea to further lay out their theory and method of space syntax: all spatial configurations can be divided according to this principle: different cells or similar cells, integration or segregation phenomena.

Another important factor related with this is the **inside-outside relationship**: an elementary cell within a spatial configuration can **subdivide or aggregate**, which explains the 2 possible ways of growth. The first one, subdividing cells, illustrates the idea of the building that from one moment to the other can be used by more than one owner. The growth dynamics are interior-related while maintaining interior permeability. Aggregating cells refer more to the idea of the settlement with less control of the very structure: there is only an accumulation of boundaries: accumulating spaces into one continuous system with more equality of access and fewer differences between cells. Using this distinction, they try to explain different inside/outside relationships. This can be related to the previously mentioned idea of increasing density: we mentioned 2 ways of increasing density: dividing existing parcels in smaller parts, which can be related to

43 E. Durkheim, "The Division of Labour in Society", The Free Press, New York 1964, origin. 1893

aggregation, while the idea of increasing territorial structure might relate more with B. Hillier and J. Hanson's idea of subdividing cells. In this case, there is no accumulation of boundaries but a reorganisation of space. The model of aggregation refers as well to the idea of accumulative transition of spaces within a sequence, while subdividing cells might relate to the concept of territorial overlap.

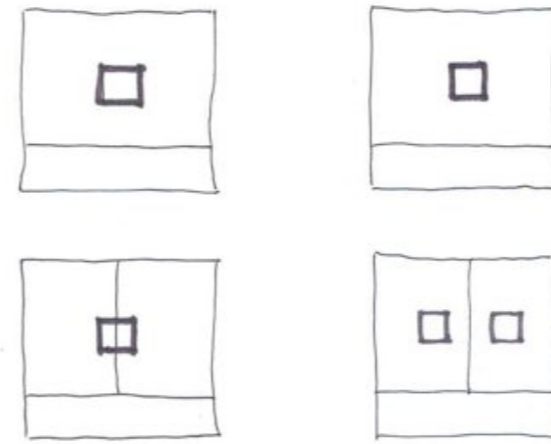


Figure I.34 : B. Hillier and J. Hanson: subdivision (bottom left) versus aggregation (bottom right)

## ii. Configurations

Bill Hillier<sup>44</sup> continues the analysis of space syntax and tries to define the concept of **relations**, by quoting B. Russell<sup>45</sup>: “(...) relations, especially spatial relations are very puzzling entities. (...) We must accept that (...) the relation, like the term it relates, is not dependent on thoughts, but belongs to the independent world which thought apprehends, but does not create.” This independent world is full of complex relational schemes, between areas, buildings, users, voids and program define **configurations**. A configuration is “a set of relationships among things all of which interdepend in an overall structure of some kind.(...) If we define spatial relations as existing when there is any type of link -say adjacency or permeability- between two spaces, then configuration exists when relations between two spaces are changed according to how we relate one or both to at least one other space”<sup>46</sup>

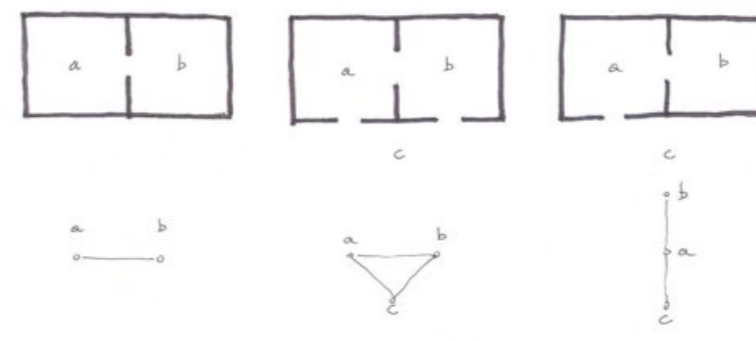


Figure I.35 : B. Hillier: depth configuration

(original diagrams in B. Hillier, “Space is the Machine”, Cambridge University Press, Cambridge, 1996, p 34)

<sup>44</sup> B. Hillier, “Space is the Machine”, Cambridge University Press, Cambridge, 1996.

<sup>45</sup> B. Russell, “The Problems of Philosophy”, Home University Library, Oxford, 1912

<sup>46</sup> B. Hillier, “Space is the Machine”, Cambridge University Press, Cambridge, 1996, p 33



The author explains this idea by a simple graphic example. The first diagram shows a cell divided by a partition into two, sub-cell “a” and sub-cell “b”, with a door creating a relation of permeability between the two. B. Hillier notices that the relation is formally “symmetrical” in the cell that “a” is to cell “b” as cell “b” is to “a”. The same would be true of two cells which were adjacent and therefore in the relation of neighbour to each other. This symmetry is clearly an objective property of the relation “a” and “b” and does not depend on how we choose to see the relation. In the two following figures the author added a third space “c” (which is in fact the outdoor space), but in a different way so that in the second both “a” and “b” are directly permeable to “c”, whereas in the third one, “a” and “b” are different in relation to “c”. This means we have to pass through “a” to get to “b” from “c”. In other words, in relation to “c”, the relation has become asymmetrical. This is called a **configurational difference**, as a configuration is a set on interdependent relations in which each is determined by its relations to all others. In the last case, the configuration acquired some depth with respect to each other, in that their relation is indirect and only exists by virtue of “a”.

B. Hillier mentions that these spatial phenomena are based on **collectivity**: encountering, congregating, avoiding, interacting, dwelling or conferring are not attributes of individuals, but patterns, formed by groups or collections of people. They depend on an engineered patterns of co-presence, and indeed, co-absence, as the author mentions. As a result, the relation between people and space will be found at the level of the configuration of space rather than the individual space: it lies in the relations between configurations of people and configurations of space. The author explores this idea by making a systematic study of hypothetical courtyard buildings with small access variations. The basic physical structures and cell divisions of the buildings are the same and each has the same pattern of adjacency between cells and the same number of internal and external openings. All that differs is the location of cell entrances. This shows, from the point of view of how a collection of individuals could use the space, the spatial patterns, or **configurations** are about as different as they could be. B. Hillier mentions that the pattern of permeability created by the disposition of entrances is the critical thing. One lay-out is a nearly perfect single sequence, with a minimal branch at the end, while the other is branched everywhere about the strong central spaces. We know it is difficult for more than one person to use a single sequence of space: it would offer little possibilities of community or privacy, but much potential intrusion. However, the branched pattern offers a definite set of potential relations between community and privacy, and, as the author says, many more resources against intrusion. It is here that the idea of depth is introduced: *“It is the fact of connection that matters. (...) The resulting j-graph is a picture of the depth of all spaces in a pattern from a particular point in it”*<sup>47</sup> We can distinguish linear sequences, branched-tree structures, ring structures, etc.

Important to mention is the fact that we do not need to use the outside space as the root: this is only one way at looking at the depth configuration. We can look at the project from any space within it, and this will tell us what layout is like from the point of view of that space, taking into account both depth and ring properties. Showing the same depth sequence, taking another base point, can change the way the sequence(s) appear. It is here that the traditional non-spatial characteristics of configurations are more evident.

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47 B. Hillier, “Space is the Machine”, Cambridge University Press, Cambridge, 1996, p 32



Figure I.36: B. Hillier: left, access configuration and depth. Right: representation of one depth configurations but seen from a different starting point. (after image in B. Hillier, "Space is the Machine", Cambridge University Press, Cambridge, 1996, p 30)

### iii. Integration value: a new dimension for depth

Hillier studies ground floor plans of French houses to deepen the analysis of depth configurations. Comparing schemes and depth graphs show that, unlike the geometrical differences in the houses, there are strong similarities in the configuration. This can be seen by concentrating at the "*salle commune*", which is the everyday living space, in which cooking also occurs and everyday visitors are received. In each case, we can see that the "*salle commune*" lies on all non-trivial rings (a trivial ring is one which links the same pair of spaces twice), links directly to an exterior space -that is, it is at depth one in the complex- and acts as a link between the living spaces and various spaces associated with domestic work carried out by women. B. Hillier also detects that the "*salle commune*" has a more fundamental property, one which arises from its relation to the spatial configuration of the house as a whole. If we count the number of spaces we must pass through to go from the "*salle commune*" to all other spaces, we find that it comes to a total which is less than for any other space, that is, it has less depth than any other space in the complex. The general form of this measure, the author argues, is called **integration**, and can be applied to any space in any configuration: the less depth from the complex as a whole, the more integrating the space, and vice versa. This means that every space in the different examples can be assigned an "integration value".

This theory adds a very important facet to N.J. Habraken's original concept of depth: the value of depth depends on the chosen movement within a relational configuration, relative to the position we choose to start measuring. Depth is not only about the absolute amount of boundaries to be crossed from public to private areas within a linear static sequence, but is related to the structure of the configuration and the integration value of all constituting elements. This reinforces the importance of collective spaces within a configuration, having high or low integration values within the system. **The quality of the configuration does not depend on the length of the studied sequence but on the integration value of the shared spaces.**



Figure I.37: residential neighbourhood in Montreal (Canada): seeking shorter linear sequences with no shared spaces (shared entrance hall), avoiding integration values by adding external staircases to a multi-family housing project. (image from [www.bricoleurbanism.org](http://www.bricoleurbanism.org))

All these results flow from an analysis of space-to-space permeability. B. Hillier concludes there is a common pattern to the way in which different functions are spatialised in the configuration: he calls them “inequality genotypes, because they refer not to the surface appearances of forms but “to deep structures underlying spatial configurations and their relation to living patterns.”<sup>48</sup>

The author adds that configurations have a non-discursive dimension: configurations are easily recognisable intuitively, not analytically. However, it is exactly through non-discursivity that the social nature of buildings is transmitted, because it is through configuration that the raw materials of space and form are giving social meaning.

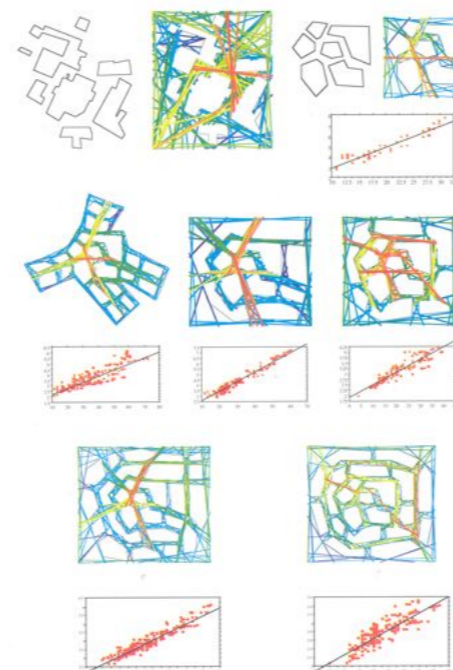


Figure I.38 : B. Hillier: space syntax analysis of a ring settlement in Vaucluse France, indication of integration values (image from B. Hillier, “Space is the Machine”, Cambridge University Press, Cambridge, 1996, plate 6 p 211)

48 B. Hillier, “Space is the Machine”, Cambridge University Press, Cambridge, 1996, p 38

## 4. Configurations and complexity

### i. An evolutionary understanding

When Giovanni Battista Piranesi drew the series of “*Carceri d’Invenzione or Imaginary Prisons*”<sup>49</sup>, the main theme was the visual complexity of the set-up, besides the idea of representing inaccessible towers within an imaginary prison. The prints show enormous subterranean vaults with stairs and mighty machines, seemingly erecting fantastic labyrinthian structures, epic in volume, but empty of purpose. They can be seen as urban *capricci* -whimsical aggregates of monumental architecture and ruin. In this case, urban complexity coincides with **visual complexity** and representation of **multiple systems of accessibility**: stairs running up or down, crossing fly-overs, superposed levels, overseeing the complex scenography. Clear logics were left out as the illusion of accessibility was the main subject. The drawings illustrate an early interest for complexity and started a discourse on how to organise space, starting from the idea of access configuration, even if territorial schemata were left out in this artistic approach. Complexity is based on **aggregation of many singular elements**, providing multiple options within the urban lay-out.



Figure I.39: Giovanni Battista Piranesi, “The Round Tower Plates of Carceri” 1745-1760 (image from [www.img10.imageshack.us](http://www.img10.imageshack.us))

Steven Johnson<sup>50</sup> offers an interesting review of different ways of understanding complexity. First, he mentions the common association of complexity with **sensory overload** that positions the concept in a certain aesthetic level. We often associate complexity with an extreme accumulation or superposition of things we see, hear, feel, smell and taste. The author quotes Walter Benjamin and the unfinished work “*Arcades Project*” to illustrate this idea: “*Perhaps the daily sight of a moving crowd once presented the eye with a spectacle to which it first had to adapt... (T)hen the assumption is not impossible that, having mastered his task, the eye welcomed opportunities to confirm its possession of its new ability. The method of impressionist painting, whereby the picture is assembled through a riot of flecks of colour, would then be a reflection of experience with which the eye of a big-city dweller has become familiar.*”<sup>51</sup> Indeed, within territorial configurations, one absorbs or reflects many cues while being conscious of

49 G. B. Piranesi, “*Carceri d’Invenzione*” a series of drawings made in between 1745-1760. The first state prints were published in 1750 and consisted of 14 etchings, untitled and unnumbered, with a sketch-like look. The original prints were 16” x 21”. For the second publishing in 1761, all the etchings were reworked and numbered I - XVI (1-16). Numbers II and V were new etchings to the series. Numbers I through IX were all done in portrait format (taller than they are wide), while X to XVI were landscape (wider than they are high).

50 S. Johnson, “*Emergence: The Connected Lives of Ants, Brains, Cities and Software*”, Touchstone, New York, 2001

51 W. Benjamin, in “*The Arcades Project*” quoted in S. Johnson, “*Emergence: The Connected Lives of Ants, Brains, Cities and Software*”, Touchstone, New York, 2001, p 39

own or other user's movements and purposes. When they add up during a certain amount of time, a sensory overload can occur.

Second, S. Johnson mentions the idea of a **self-organising system** which redirects attention to the city as a system itself, besides our personal experience: he calls this **systematic complexity**. Neighbourhoods have a way of measuring and expressing the repeated behaviour and sharing that information with the group: patterns turn into shapes, a *barrio*. The author, referring to the work of Warren Weaver<sup>52</sup>, describes three types of complexity: **simple** complexity, **disorganised** complexity and **organised** complexity. Simple complexity is related to simple systems: two or three variable problems, such as the connection between an electric current and its voltage and resistance or the example of an as a simple system of one included territory with abstraction of all other references and possibilities. Second, W. Weaver studied disorganised complexity: problems characterised by millions or millions of variables that can only be approached by the methods of statistical mechanics and probability theory. Examples are behaviour of molecules in a gas, or the patterns of heredity on a gene pool. These studies helped to build statistic theories of probability and increased profits of administrations or insurance companies to predict certain situations. However, W. Weaver discovered a third field: "*There was a middle region between two-variable equations and problems that involved billions of variables*"<sup>53</sup>, S. Johnson writes. He quotes W. Weaver: "*Much more important than the mere number of variables is the fact that these variables are all interrelated...These problems, as contrasted with the disorganised situations with which statistics can cope, show the essential feature of organisation. We will therefore refer to this group of problems as those of organised complexity*".<sup>54</sup> Within this category, variables are interrelated and in a great number, achieving a high-level complexity during the process. S. Johnson illustrates with the example of a motorised billiards table, where the balls would follow specific rules and through their various interactions create a distinct macro-behaviour, arranging themselves in a specific shape, forming a specific pattern over time. That sort of behaviour, for W. Weaver, suggested a problem of organised complexity: how does a seed know how to build a flower?

The concept of complexity has been an constantly reappearing subject during the history of urban planning and design. An important contribution dates from 1965, when Christopher Alexander<sup>55</sup> formulates his theory on complexity. His work can be read as an attack on the sterility of formal "treelike" city plans and its division of activity and an attempt to decipher deep structures underlying human needs. C. Alexander presented a theory on complexity, starting with a distinction in between "*natural cities*" and "*artificial cities*". The first category refers to cities with a built environment as a result of "spontaneous growth": the author mentions cities like Sienna, Liverpool or Manhattan, New York City as examples. Artificially grown cities miss an important ingredient, according to C. Alexander: patina and complexity. To explain better this idea, the author comes up with the concept of a "set": being a few elements belonging together, working together as a system. He describes a dynamic coherence within this unit, based on the physical fixed part of a system.

*"For example, in Berkeley at the corner of Hearst and Euclid, there is a drugstore, and outside the drugstore a traffic light. In the entrance to the drugstore there is a news-rack where the day's papers are displayed. When the light is red, people who are waiting to cross the street stand idly by the light; and since they have nothing to do, they look at the newspapers displayed on the news-rack which they can see from where they stand. Some of them just read the headlines, others actually buy a paper while they wait. This effect makes the news-rack and the traffic light interdependent; the news-rack, the newspapers on it, the money going from people's pockets to the dime slot, the people who stop at the light and read papers, the traffic light, the electric impulses which make the lights change, and the sidewalks which the people stand on form a system - they all work together"*<sup>56</sup>

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52 W. Weaver, "Science and Complexity" in American Scientist, n°36, 1948, p 536

53 S. Johnson, "Emergence: The Connected Lives of Ants, Brains, Cities and Software", Touchstone, New York , 2001, p 47

54 W. Weaver, "Science and Complexity" in American Scientist, n°36, 1948, quoted in S. Johnson, "Emergence: The Connected Lives of Ants, Brains, Cities and Software", Touchstone, New York , 2001, p 47

55 C. Alexander "A City is not a Tree" Architectural Forum n°122 New York 1965

56 C. Alexander "A City is not a Tree" Architectural Forum n°122 New York 1965 in R. T. Legates, F. Stout, "The City Reader", Routledge, London, 1996, p120-121

This idea of an urban set and the very type of relationship between the different parts leads to the formulation of **two opposite ordering principles**, two different patterns of thought: the **tree** structure and the **semi-lattice** structure. The first one is linked with the artificial city while the second one defines the structure of a natural city. The author defines a tree the following way: “a collection of sets forms a tree if and only if, for any of the two sets that belong to the collection, either one is wholly contained in the other, or else they are wholly disjoint”. He adds that, within this structure, no piece of any unit is ever connected to other units, except through the medium of that unit as a whole. In other words, “as if the members of a family were not free to make friends outside the family, except when the family as a whole made a friendship”. On the other hand, a semi-lattice is defined in the following way: “a collection of sets form a semi-lattice if and only if, when two overlapping sets belong to the collection, then the set of elements common to both also belongs to the collection”. We could say that wherever two units overlap, the area of overlap is itself a recognisable entity and hence a unit also. We could conclude that a semi-lattice is a tree but that not every tree is a semi-lattice: a hierarchical distinction is made. The major difference between both structures is the missing of **overlap scenarios** in the tree structure. C. Alexander makes a clear statement by recognising **overlap, ambiguity or multiplicity** as a structural element in the urban environment. Already in the 1960’s, he denounces extreme compartmentalisation and dissociation of internal elements as the first sign of destruction of a natural environment and its social contents.

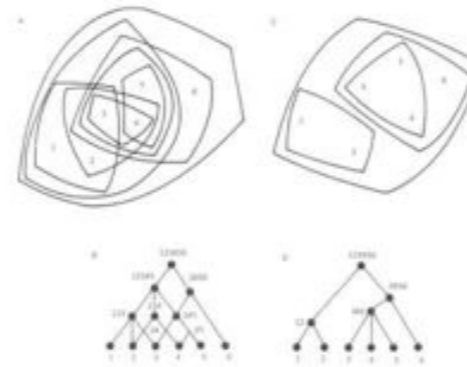


Figure I.40: semi-lattice structure versus tree structure (image from C. Alexander “A City is not a Tree” Architectural Forum n°122 New York 1965 in R. T. Legates, F. Stout, “The City Reader”, Routledge, London, 1996, p120)

C. Alexander’s theory is helpful to understand certain mechanisms of territorial control of spatial configurations. Indeed, we mentioned the idea of territorial overlap in previous chapters and recognised this particular condition as enriching and adding cultural as well as social values to a project. The possibility of the project’s multiple reading still provides space control, even if different scenarios are possible. However, the real value of territories of overlap lays within the flexibility in time it suggests and its value is measured according to simultaneous experiences: C. Alexander only recognises areas of territorial overlap as rather static, independent unit, as a fully recognisable entity, which implies a constant geographical position and permanent definition of its boundaries. Nevertheless, even if territorial overlap in some cases can obtain fix boundaries and position, it is not *conditio sine que non*, as it can refer as well to time-sensitive scenarios.



Figure I.41: 1960s, Greenwich Village, Manhattan, New York City (USA), Jane Jacob's context of "organised complexity"  
(image from www.flickr.com, photograph by Robert Huffstutter)

Jane Jacobs' idea of "organised complexity"<sup>57</sup>, shares great part of the previously mentioned theories, especially W. Weaver's studies of the 1940s. The author links social control of a neighbourhood with the idea of complexity: "Public peace depends on an intricate, almost unconscious, network of voluntary controls and standards among the people themselves, and enforced by them" She mentions the city to be a complex order, of movement and change. Complexity in this case depends on the **integration** of singular elements: mixed uses and interactive diversity guarantee the level of complexity. "(...)But there is nothing simple about that order itself, or the bewildering number of components that go into it. Most of those components are specialised in one way or another. They unite in their joint effect upon the sidewalk, which is not specialised in the least(...)"<sup>58</sup> We already discussed before the importance of integration values and complexity of depth configurations.

J. Jacobs explains that cities present "situations in which a half-dozen or even several dozen quantities are all varying simultaneously and in subtly interconnected ways." In a way, cities do not exhibit one problem in **organised complexity** but can be analysed into many such problems or segments which are also related with one another. She mentions that the variables are many and interrelated into an organic whole. To illustrate, she uses the problem of a city neighbourhood park where any single factor depends on how it is acted upon by other factors and how it reacts to them. "How much the park is used depends, in part, upon the park's own design. But even this partial influence of the park's design upon the park's use depends, in turn, on who is around to use the park, and when, and this in turn depends on uses of the city outside the park itself. Furthermore, the influence of these uses on the park is only partly a matter of how each affects the park independently of the others; it is also partly a matter of how they affect the park in combination with one another, for certain combinations stimulate the degree of influence from one another among their components. In turn, these city uses near the park and their combinations depend on still other factors, such as the mixture of age in buildings, the size of blocks in the vicinity, and so on, including the presence of the park itself as a common and unifying use in its context. Increase the park's size considerably, or else change its design in such a way that it severs and disperses users from the streets about it, instead of uniting and mixing them, and all bets are off. New sets of influence come into play, both in the park and in its surroundings. This is a far cry from the simple problem of ratios of open space to ratios of population; but there is no use wishing it were a simpler problem or trying to make it a simpler problem, because in real life it is not a simpler problem. No matter what you try to do to it, a city park behaves like a problem in organised complexity, and that is what it is."<sup>59</sup>

The notion of integration is important to relate to the concept of depth: crossing a series of boundaries should not be seen as part of a simple, linear sequence but should be part of a complex framework, where integration of different areas and multiple users avoids too simple schemata. However, the idea of designing organised complexity implies a high level

57 J. Jacobs, "The Death and Life of Great American Cities" abstract in T. Legates, F. Stout "The City Reader", Routledge Publ., London, 1996, p 106

58 J. Jacobs, "The Death and Life of Great American Cities" abstract in T. Legates, F. Stout "The City Reader", Routledge Publ., London, 1996, p 108

59 J. Jacobs, "The Death and Life of Great American Cities" abstract in T. Legates, F. Stout "The City Reader", Routledge Publ., London, 1996, p 108-109

of space control. The question could be: how far should planners and designers go to orchestrate complexity? The previously mentioned depth sequences as clearly defined sequences with carefully prescribed levels of sharing space and conditioning all access scenarios, seem to fit within this idea of organised urbanity. When “organised” refers to “controlled”, in a territorial way, multiple scenarios are possible within an urban project. However, if we understand “organised” as predefined and more permanent, contemporary use of space would no more sustain that organisation.

Besides ideas of **sensory overload, self-organisation, aggregation, integration or organisation**, Peter and Alison Smithson<sup>60</sup> refer to complexity as a result of **superposition**, laying one network over another. As it was the case with J. Jacobs’ or C. Alexander’s theory, they question separation of activity and too rational urban planning. Since CIAM X, celebrated in Dubrovnik in 1956, they proclaim identity of a place and a collective use of space to be the main design objectives. They understand urban complexity as a **structural problem** to solve at different scales by **superposing various networks**.



Figure I.42: Image of a street in a 19th century English small town, photograph used by P.&A. Smithson to illustrate their interest in complexity and spontaneous appropriation of the street by its residents.

(original picture by N. Henderson, published in P. &A. Smithson, “Urban Structuring”, Studio Vista/Reinhold, London 1967)

The complex structure of the city at all its scales, depends on association, identity, clusters, mobility and specific open models of urban growth. The idea of **association** is mentioned in relationship with scale and complexity: the more urban the environment, the higher complexity of association is needed. They illustrate the lower complexity of association in isolated suburban settlements as opposed to more central urban areas. This dual model of centre versus periphery and its related complexity can now be questioned, as the grade of complexity has become non-geographical: non-central logistic areas or even residential areas may contain a high level of complexity due to increased mobility and new communication media.



Figure I.43: diagram by P.&A. Smithson to illustrate their interest in complexity and its relation with association

(original image in P. &A. Smithson, “Urban Structuring”, Studio Vista/Reinhold, London 1967)

<sup>60</sup> P. &A. Smithson, “Urban Structuring”, Studio Vista/Reinhold, London 1967



Their idea for the international competition of Berlin Hauptstadt in 1958, as well as the Golden Lane proposal by P.&A. Smithson, in 1952, illustrates the need for urban complexity, achieved by superposing different networks, each for a different type of user, with a different character or associated speed of movement.

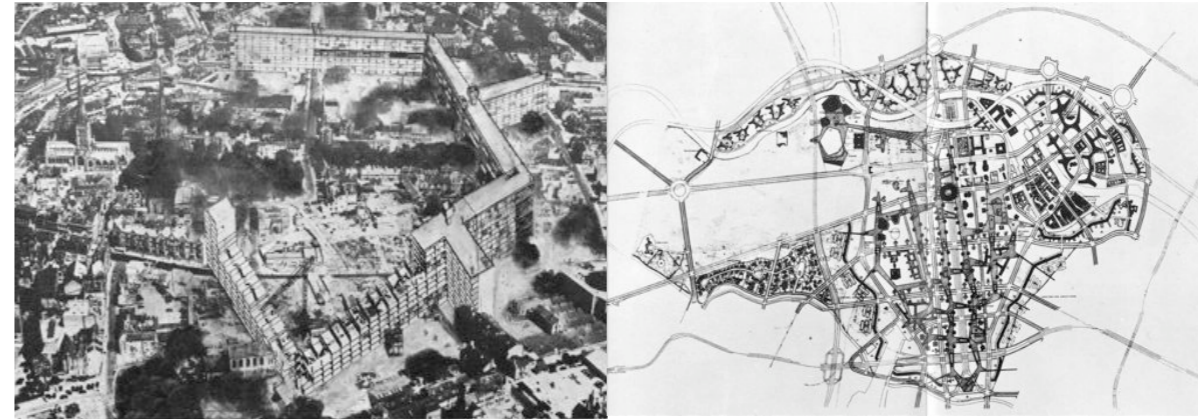


Figure I.44: left: London (UK), proposal for Golden Lane project by P.&A. Smithson, 1952 (photomontage features the bombed city of Coventry). Right: proposal for Berlin as a capital city, competition 1958. Superposition of networks at different scales, overlay of structures at different scales to obtain complexity. (original image in P. & A. Smithson, “Urban Structuring”, Studio Vista/Reinhold, London 1967)

Complexity is seen as the **result of a process**, not the final stage of a rigid lay-out of buildings. Changes in time are important within the growth or transformation of a city, a neighbourhood, a street or a house: the authors refer to living organisms to underline this concept, just as N.J Habraken does when he refers to live configurations.

A few years later, Serge Chermayeff and Christopher Alexander refer in a similar context to organisms to define complexity, referring again to hierarchies and they quote “*An organism displays not only a morphological hierarchy of parts but also a physiological hierarchy of processes (...) It is a system of hierarchies that are interwoven and overlapping in many ways, that may or may not correspond to the levels of the morphological hierarchy*”<sup>61</sup> The authors define a set of hierarchies that create complexity: physical and visual factors define hierarchies of control, while efficient grouping creates hierarchies of technology. Apart from that, hierarchies of obsolescence are the result of how far the solutions reach while hierarchies of attachment organise quantitative program. As mentioned before, C. Alexander emphasises the idea of **transition, overlap and distance** to reach complexity: “*(...) The joints between successive and adjacent domains, the extent of their separation, the precise way they are attached to one another, the kind of transition that needs to occur between them, are all matters of vital importance, irrespective of the particular size and number of domains.*”<sup>62</sup>

In a similar way, Kevin Lynch<sup>63</sup> mentioned 2 kinds of hierarchies within a complex organisation: static hierarchies complement hierarchies based on dominance. These have to be seen from the point of view of a **network of sequences**: the author suggests we look for sequences which are interruptible as well as reversible, which have sufficient imageability when broken up, like a magazine serial. He refers to an organisation of networks of formed sequences, that is supposed to be more than a simple collection of parts.

Some of the above mentioned concepts of complexity, mainly ideas grown and formulated as a direct result of the ongoing social, cultural and economical transformations during the 1960s, may no more reach to solve all contemporary problems of proximity and accessibility: we might need to actualise these ideas of complexity to contemporary standards.

61 L. Von Bertalanffy, “Problems of Life”, 1952, quoted in Serge Chermayeff, Christopher Alexander “Community and Privacy” Doubleday & Co Inc. USA 1963, p 134

62 S. Chermayeff, C. Alexander, “Community and Privacy” Doubleday & Co Inc. USA 1963, p 136

63 K. Lynch, “The Image of the City” Publ. of the Joint Center for Urban Studies MIT Press Cambridge 1960

A more recent reading of the classical idea of complexity can be found in Annemie Depuydt's and Erik Van Daele's approach to deal with program and form within complex projects: they make a difference between **mixing and weaving** in order to frame the concept of complexity.

*“Mixing comes forth when, coincidentally, different programs, divergent social or economical situations or deviating forms are put one next to the other, without engaging themselves in necessary qualitative interaction. Such a situation can be dense in a geographical sense, but lacks urban complexity. Weaving on the other hand is a strategical concept that brings complexity, and therefore density, into existence through the confrontation of the most diverse situations one another. Geographical nearness is not even a condition for this weaving”*<sup>64</sup>

Depuydt and E. Van Daele try to leave the field of tree-like territorial structures of a perfect manipulative proportion of quantity, to propose a strong interrelation of form and program, using this as a consistent strategy for creating increased urban complexity on different scale levels and in different situations. For the authors, time dependency is primordial to study models of complexity. N.J. Habraken<sup>65</sup> agrees: complexity depends on **variety** and **adaptability over time**: different agents intervening in an ever changing context of territorial space control. In previous chapters, where we studied the ideas of different hierarchies to be detected within the built environment, an underlying interest for complexity showed.

From his non-discursive technique<sup>66</sup> (see previous chapter), B. Hillier approaches complexity from the idea of **configuration** that is linked with the problem of understanding the simultaneous effects of a whole complex of entities on each other through their pattern of relationships. Lack of attention to this central problem is the primary reason why past formalism often seemed to offer mathematical sophistication out of proportion to the empirical results achieved. He mentions that a “simple” relation is defined as a relation, say adjacency or permeability, between any pair of elements in a complex. A configurational relation is a relation insofar as it is affected by the simultaneous co-presence of at least a third element, and possibly all other elements, in a complex. (see figure previous chapters).

## ii. A new understanding of complexity

As C. Alexander proposed the semi-lattice pattern of thought as an alternative for a tree-like structure, Gilles Deleuze and Felix Guattari<sup>67</sup> on their turn formulate an alternative concept for the traditional understanding of complexity, based on tree-like structures. They refer to a “*rhizome*”, as opposed to the model of the root-tree which symbolises hierarchical structures, extreme stratification and linear thinking. A rhizome is a structure without a centralised, hierarchical organisation, that in many ways reflects a more “natural” pattern of geo-organic development. *“Arborescent systems are hierarchical systems with centres of significance and subjectification, central automata like organised memories. In corresponding models, an element only receives information from a higher unit, and only receives a subjective affection along pre-established paths”*<sup>68</sup> G. Deleuze and F. Guattari quote Pierre Rosenstiehl and Jean Petitot<sup>69</sup> who join denouncing arborescent models: *“Accepting the primacy of hierarchical structures amounts to giving arborescent structures privileged status... In a hierarchical system, an individual has only one active neighbour, his or her hierarchical superior...The channels of transmission are pre-established: the arborescent system pre-exists the individual, who is integrated into it at an allotted place”* They refer to an “*acentered system*” from which the principal characteristic is that local initiatives are coordinated independently of a central power, with the calculations made throughout the network: defining multiplicity.

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64 A. Depuydt, and E. Van Daele, in “Save us from Quantities” reader conference “Inside Density”, Network for Architectural Theory and Criticism 24-26 nov. 1999, Brussels, 1999

65 N.J. Habraken, “The Structure of the Ordinary” MIT Press Cambridge 1998

66 B. Hillier, “Space is the Machine”, Cambridge University Press, Cambridge, 1996, p 94

67 G. Deleuze, F. Guattari, “A Thousand Plateaus”, Continuum, London, orig. 1980, ed. 1987

68 G. Deleuze, F. Guattari, “A Thousand Plateaus”, Continuum, London, orig. 1980, ed. 1987, p 18

69 P. Rosenstiehl, J. Petitot, “Automate asocial et Systèmes Acentrés”, Communications, n°22, 1974, p 45-62

G. Deleuze and F. Guattari enumerate certain approximate characteristics of the rhizome. First, they refer to principles of **connection and heterogeneity**: “*Any point of a rhizome can be connected to anything other, and must be. This is very different from the tree or root, which plots a point, fixes an order.*”<sup>70</sup> An “*essentially heterogeneous reality*” is the context for a rhizome.

Second, the principle of **multiplicity** characterises the rhizome: “*Puppet strings, as a rhizome or multiplicity, are tied not to the supposed will of an artist or puppeteer but to a multiplicity of nerve fibers, which form another puppet in other dimensions connected to the first (...) An assemblage is precisely this increase in the dimensions of a multiplicity that necessarily changes in nature as it expands its connections. There are no points or positions in a rhizome, such as those found in a structure, tree or root. They are only lines*”<sup>71</sup> They explain there are no more units of measure, only multiplicities or varieties of measurement. The notion of unity appears only when there is a power take-over in the multiplicity. This is the case for a pivot-unity forming the base for a set of bi-univocal relationships between objective elements or points. As a result, a rhizome never allows itself to be over-coded. Multiplicities are defined by the outside, the abstract line, the line of flight or **detritorialisation** according to which they change in nature and connect with other multiplicities.

Next characteristic is defined by the principle of a **signifying rupture**: against the oversignifying breaks separating structures or cutting across a single structure. “*A rhizome may be broken, shattered at a given spot, but it will start up again on one of its old lines, or on new lines. They give the example of ants that you can never get rid of because they form an animal rhizome that can rebound time and again after most of it has been destroyed. According to the authors, every rhizome contains lines of segmentarity according to which it is stratified, territorialised, organised, signified, attributed etc., as well as lines of deterritorialisation down which it constantly flees.*”<sup>72</sup>

The last principle is the one of **cartography and decalomania**: a rhizome is not open amenable to any structural or generative model. They add that it is a stranger to any idea of genetic axis or deep structure: they argue that a rhizome is a map and not a tracing: a map is entirely oriented toward an experimentation in contact with the real: it constructs the unconscious. It is itself part of the rhizome that operates by variation, expansion, conquest, capture, offshoots. The rhizome pertains to a map that must be produced, constructed, a map that is always detachable, connectable, reversible, modifiable, and has multiple entryways and exits and its own lines of flight. A rhizome has no beginning or end, it is always in the middle, between things, interbeing, intermezzo. G. Deleuze and F. Guattari mention the idea of a plateau, that is always in the middle, not at the beginning or the end. They claim a rhizome to be made of plateaus.

“*Between things does not designate a localizable relation going from one thing to the other and back again, but a perpendicular direction, a transversal movement that sweeps one and the other away, a stream without beginning or end that undermines its banks and picks up speed in the middle*”<sup>73</sup>

### iii. A new understanding of depth

The importance of this theory lies within the possible profound change of observation of the built environment, independent from rank, order, scale or absolute distance. The idea of a rhizome, as opposed to root-tree-like structure of the environment, offers an all-round conceptually reframing what we know and what we see. Related to the discourse of depth, this theory might offer a new understanding of the concept and opens up many possibilities to analyse, design or experience depth configurations.

Besides more philosophical references, the idea might help to question the linear structure of the previously defined concept of depth as the result of a high or low number of boundary crossings from a public to a more private area. First, when studying depth in its physical, visual or territorial understanding, we might consider a less linear structure of one sequence and abandon the forced movement from a public area to a private one or vice versa. To monitor a set of

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70 G. Deleuze, F. Guattari, “A Thousand Plateaus”, Continuum, London, orig. 1980, ed. 1987, p 7

71 G. Deleuze, F. Guattari, “A Thousand Plateaus”, Continuum, London, orig. 1980, ed. 1987, p 9

72 G. Deleuze, F. Guattari, “A Thousand Plateaus”, Continuum, London, orig. 1980, ed. 1987, p 10

73 G. Deleuze, F. Guattari, “A Thousand Plateaus”, Continuum, London, orig. 1980, ed. 1987, p 28

included territories, we might consider a set of possible movements, with no beginning nor end, with multiple entryways, from a public, a private or any other loaded space. Depth configurations can be studied starting from an area defined by territorial overlap, considering multiple options, changing in time, according to the user and its past and future references. These movements can not be separated from other movements, nor can they be positioned above or below another, as a hierarchical set-up might be less important. Relative integration value within the territorial configuration is as important as proximity within the project. Multiplicity and simultaneity are main territorial conditions, as any point can be connected to anything other, only with other restriction conditions. N.J. Habraken's importance given to rank, order and position may lose part of its significance, as pieces within a configuration can obtain time sensitive and relative positions, as the values of an access filter within a certain movement can possess different territorial meaning according to the user's references and itineraries. N.J. Habraken's theory of hierarchy, based on asymmetrical relationships as a result of sets of selected entry and unrestricted exit, generating vertical or horizontal space control, however, might hold its importance. This is because his idea of hierarchy is not based on what is more important than the other but on who controls access and who does not. The mentioned levels within territorial set-up might be like plateaus: that is always in the middle, not at the beginning or the end, not on the lowest level or the highest but always in between or relative. Nevertheless, the temporal and volatile dimension of the hierarchical set-up must be underlined as it does not only depend on fixed features. Indeed, sets of included territories have no static, central lay-out with fixed physical outcome but possess different territorial values. As it is the case with rhizomes, depth lines have no superiors. G. Deleuze and F. Guattari's description of a heterogeneous reality helps to accept and recognise the tolerance for different territorial values, without prejudice.

Depth lines being no continuous, uninterrupted linear sequences can be the result of considering rhizomes as a main reference. Indeed, significant ruptures, breaks, pivoting elements, filter tactics deny a continuous and iso-extruded profile of a depth line and welcome gaps, interference, voids, waiting points, territorially ambiguous areas to join the depth lines. Sterile, pre-planned, continuous territorial transitions, guaranteeing an overall no-risk strategy, might not be the only answer within this new understanding of space and time. The mentioned intermezzos, the spaces-in-between, may need to be recognised as an important part of the depth configuration, seen as a multiple field, abandoning the idea of single linear approach sequences.

#### iv. Depth, complexity and emergence: depth and human behaviour

When studying territorial systems and measuring accessibility through various depth movements, an important issue remains how to understand the mechanisms behind growth of depth structures, how to grasp the very nature of urban fabric. Top-down root-tree structures do not succeed to explain or frame all contemporary territorial phenomena. The subject of this present study should be analysed from a **triple point of view**: the possibilities of **planning, design** or prediction, next to the more **self-organising nature** of the environment, together with **experience** of depth, adding more layers in the understanding of physical, visual and territorial depth scenarios and space control processes.

Steven Johnson<sup>74</sup> focuses on the idea of **emergence** to understand some historical as well as some contemporary organised complex phenomena. According to the author, emergence is change that occurs from the **bottom up**: when enough individual elements interact and organise themselves, the result is collective intelligence, even though no one in particular is in charge. He describes a phenomenon that exists at every level of experience, not necessarily at the level of top-down design. He describes experiments and laboratory studies of slime mold, colonies of ants or bee behaviour to explain his idea of **emerging complexity**. He describes 5 different principles of bottom-up systems. First, the idea that "*more is different*": one should always take into account the entire system and observe the wholeness of a phenomenon. Second, the relative simplicity of the individual within the organised system: the individual having no overall knowledge is important for bottom-up growth. Third, random encounters are important: some decentralised systems such as ants

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74 S. Johnson, "Emergence: The Connected Lives of Ants, Brains, Cities and Software", Touchstone, New York, 2001

colonies rely heavily on the random interactions of ants exploring a given space without any predefined orders. The fourth principle proposes to look for patterns in signs: pattern detection allows meta-information to circulate through the “colony” mind: signs about signs. The last principle suggests to pay attention to your neighbours: local information can lead to global wisdom. The primary mechanism of swarm logic is the interaction between neighbouring individuals in the field. S. Johnson concludes by recommending to think locally, act locally but knowing that collective action produces global behaviour. **Emergence depends on systematic lay-outs and rules:** “*It is the sidewalk -the public space where interactions between neighbours are the most expressive and the most frequent- that helps to create those laws. In the popular democracy of neighbourhood formation, we vote with our feet.*”<sup>75</sup> He refers to the previously mentioned ideas of Jane Jacobs as she agrees sidewalks create the flow of information between neighbours. He argues that sidewalks exist to create the complex order of the city, as they permit local interactions to become global order. Applying this theory to a bigger scale, the author mentions that “*cities learn*”: cities are like an emergent system, a city is a pattern in time, based on self-organisation.

S. Johnson believes emergent complexity to be one of the basic underlying but underestimated forces of urban growth. Emergent growth means that all cells are (relatively) identical and that there are no pacemaker cells, as in root-tree based hierarchies. The final environment is decentralised and based on self-organisation that during the very process obtains higher levels of complexity, based on collective intelligence. The each time more complex behaviour system operates at different scales, without pronouncing any dominance among them.

It is this emergent complex behaviour that explains why a territorial organisation is not a static urban element. A common observation is the change of territorial set-up after a planner, designer or architect delivers a project and the owners or residents start occupying space: doorways in garden walls appear or disappear, extra fences determine previously not considered new territories, while visual obstacisation or camouflage tactics occur as part of an emergent pattern. Many appropriation phenomena within territorial lay-outs, like building in, out or over tactics, have to be seen within emergent perspectives, not always top-down design philosophies. It explains part of the volatile character and provisional status of the environment.

The importance of these ideas of emergent complexity, next to concepts of simple, disorganised or organised complexity, lies within detecting the basic motors of territorial organisation of the environment, and look at it from a higher distance. Next to sensory overload, self-organisation, aggregation or integration, rhizome-based complexity defines our daily movements and explain the very nature of multiple depth sequences, abandoning the idea of single cross-sections through the urban landscape. Emergent processes help to frame this complexity and monitor territorial phenomena at alternating scales.

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75 S. Johnson, “Emergence: The Connected Lives of Ants, Brains, Cities and Software”, Touchstone, New York , 2001, p 91