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Specific realities and new hypotheses for urban analyses and urban design. Tirana as a case study

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Specific realities and new hypotheses for urban analyses and urban design

Tirana as a case study

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Cycle XXX

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Prof. Aliaj Besnik and Prof. Marzot Nicola

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Thesis Title

Specific realities and new hypotheses for urban analyses and urban design
Tirana as a case study

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Research Title:
Specific realities and new hypotheses for urban analyses and urban design -
Tirana as a case study

Research question:
Can the transformation of Tirana's urban morphology be understood from a theoretical perspective in order to outline new hypothesis for city design?

This basic question involves urban analysis, urban observation methodologies, paradigms under which the observations are conducted, and finally contemporary debate on urbanism and architecture roles in shaping the city.

Abstract
This research is a reflection on how we think about cities, observe, analyze and transform them. Cities along their history develop unique characteristics. Often, these characteristics tend to be simplified or sterilized because they do not comply with our predisposition about how the world should be. In this concern, this research is an effort to explore on how to "extract" specifics from a given reality and how to regenerate and give them life, as an alternative to the city suffocated by the mechanic thinking and constant exclusion of the organic and natural phenomena. The underlying patterns of these phenomena are futile and may pass unseen or unobserved unless we change the way we see them. For this the research identifies the main urban patterns in Tirana and their essential qualities trying to outline a methodology for observing, analyzing and potentially designing the city.

In this concern, the research calls to enlarge the focus of observation for a more profound and holistic understanding of the physical form and the underlying formative principles. The analytical process tries to interpret the meaning of parts and wholeness in the urban realm under the quantum perspective. This conceptual shift involves more sensitivity to interpret the latencies and multiple reality of a world where *both/and is the rule*. As Zohar and Marshal (1994, p. 54) say, this kind of wholeness is an *unbroken web of overlapping internal relationships* created by the wave aspects which give rise to new systems with a *new corporate identity*. It is in this sense that in the quantum world the new emergent reality is not the sum of its parts, because interrelationship is involved in its creation. In parallel to that, the research tries to see the urban patterns as an unbroken wholeness in time-space, aroused from relationships of present and previous elements, being those material or non-material (particle-wave). This means that *apparently separated "things" are aspects of some larger whole* (Zohar and Marshal 1994 pp. 59-60), because of the arousal effect of the interfering patterns from different space(s) and different time(s) that affect the local temporal environment, as no space and time between them exist. In this research, this kind of unbroken web appears under the label of *society-space-time (SST) continuum* (Arida, 2002 p. 157*) as an energy field of potential events*. It is this concept that correlates the different events in the specific history of Tirana, the different anthropological cultures, the different places, or the different times in a web of wholeness which exists beyond the local SST. Based on this logic we can reach a deeper understanding of the urban patterns and see their emergent qualities as horizons (territorialities) aroused from different space time societies, interfering with each other and the local temporal environment. The created

emergent quality is similar but different from the original ones. Therefore, patterns are considered as manifestation of territorialities (horizons) “caught” in the SST web of wholeness.

The research tries to explore the wholeness of urban patterns also under the concepts hired from *fractal city* (Batty and Longley, 1994) and *complexity* approaches (Mitchell, 2009). According to the former, patterns contain in their internal an invisible (underlying) structure of relations. Thus, the degree of order we see in the external form is deeper and comes out from relationships and hierarchy contained in the internal form that manifest properties of a system with structure: with its static, understood as aggregation of elements in subassemblies; and its dynamic, understood as recursive behavior at which base stays the repetitive nature of irregularities across scales. This complex behavior involves a *large networks of individual components* that enter in relationship through *signaling and information* exchange (Mitchell, 2009 pp. 12-13). Thus, even in this case, the wholeness poses qualities (and identity) that arise only through relationships and interactions that evolve from self-organization to self-regulation.

In order to understand the statistical model of this complex behavior the research undertakes an observation and measurement process of the system-form (pattern), and analyzes the *algorithmic information content* (Mitchell, 2009 p. 111) contained in the recursive regularities that characterize a range of forms relative to the essential qualities of space. This information is a number of steps and sequence of actions that involve repetition of operations to be performed, and that serve as input for the modeling process (of the pattern) through generation techniques. Therefore, considering patterns as an *invisible structure of relations* (Batty and Longley, 1994 p. 47), which underlie the external form, was crucial to approach their holistic dimension by adding the meaning deriving from quantum, fractal and complexity approaches. This is directly reflected in the way we see order and chaos, or planned/unplanned and organic etc.

The research starts with historic analyses and conclude with an attempt to organize the data in a model that emphasizes the characteristics of a specific reality. The proposed methodology contains a strong historic and anthropological idea, touching upon important issues such as how to transform organic or spontaneous (informal) in urban quality; or how to give space to a system of apparently irrational rules within a rational system; and have not only a top-down approach, but also a real bottom-up process. Throughout the research I try to bring evidence that the information for city design and/or city self-regulation is contained within the city itself, but we should refine the lens of observation to see the full picture. This is my clear position related to the research question. For this I propose a methodology where the computational nature of urban phenomena goes along with the historic anthropologic idea. They do not exclude each other, contrarily, they are part of the unbroken SST web.

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1. Motivation and introduction to the research

The main guiding principles and theoretical lens

The research is conducted within a system of inquiry that builds on the fact that Tirana is a specific urban condition. Tirana, is a reality where people (often) better than architects understood the sense of the city and contributed to shape the urban form. Historic data and field survey bring evidence about this reality. At the glance Tirana looks like the city of thousand designers: it seems that users are more protagonist in the design of the environment than the professional team is. In fact, this condition is the result of the creative and transformative role of the user's mind. On the other hand, the seriality and deterministic approach to planning and regulations used in Albania (and in many other countries) proved to be unappropriated and contributed more than any informal process in the sterilization and eradication of the idea of the city. Nowadays, most of the real city is spontaneously developed and not fully accepted by authorities, which makes it subject to an open and continuous transformative process and prey to a precarious equilibrium.

Field survey and data analyses already bring considerable evidences that support the idea to classify the urban condition of Tirana under the driving concept of *open* and *self-regulated* system. In many cases, we see a large number of people that tend to solve their problems outside the authority control, and to *organize themselves into a collective whole that creates patterns, uses information, evolves and learns* (Mitchell, 2009 p. 4). These two concepts that belong to the science of complexity are used as an initial point to start reasoning about the real city from a different point of view in order to understand some underlying rules that guide this phenomenon. Thus, in order to deal with Tirana atypical urbanism, not only from the formal point of view but spatial and inter-relational, the alternative conceptual base is invoked in the paradigm preannounced by *relativity,* continued with *quantum theory and the new sciences of chaos and complexity*, *as well as their interaction with the practical life*. As Arida (2002 p. 68) argues, these are components of a new *quantum world view*.

In this concern, in order to go further with the research question and remain in focus with the inquiry process, an important part of the research is dedicated to the exploration of the main urban design theories in relation to the scientific knowledge, not only from the formal point of view but most importantly from the relation with the concepts of space and time; as well as to the exploration of important paradigmatic transitions such as, the shift from the believe in classic determinism supposed to predict the state of a system in the future, to relativism, and even further to uncertainty and indeterminacy to calculate the state of a system in the future; or the transition from reductionist and exclusionist to a comprehensive nuanced both/and complementarity of an inter-relational probabilistic and statistically based complex reality; or the transition from a mechanic reality considered as sum of its individual parts, to a quantum reality where "things" are *correlated in an unbroken web of relationships as aspects of a larger whole* in Time-Space (Zohar and Marshall, 1994 pp. 57, 60, 62), etc.

These important shifts influenced all life aspects and reframed the way we see and observe the world through additional lens, bringing into a more conscientious sphere those parts that were excluded or were not clearly visible. Most importantly, this reasoning drove me to further explore a potential shift from the fixed and deterministic methodology of looking at the city to a more opened, co-relational and nuanced transitional variety; and yet, how Tirana (or any other

city based in its specific properties) could help to elaborate a series of these kinds of relations; how the creative and the transformative role of the user's mind could be counted and influence a reality of both/and tolerant complementarities; and not only informally.

In this respect I also investigate a possible conception of the urban morphology based in the so called fractal paradigm as an inherent part of the quantum worldview. However, I imply throughout the observation and the analytical process that Tirana could be understood by merging a Cartesian paradigm of observation with a Quantum worldview as the one that *reconnected the world and recombined objectivity and subjectivity into one model of reality* (Arida, 2002 p. xviii).

Therefore, a consistent part of the research is dedicated to argue the relevance of the above concepts in the concrete place of Tirana, combining with historic and morphological analyses. Some of the most important issues that are treated under this perspective include the way Tirana has been transformed and evolved through time and by different social mentalities (anthropological motives); how the organic processes in different scales of urban hierarchy and in different times played an important role: first, as a foundation devise in the patterns of the origin, and second, as a blurring devise of the informal peripheries, or as a carving devise of the rigid blocks built during the dictatorship; the behavioral motives beyond these processes and how these motives were transformed in modalities according to which things happened; etc.

Urban patterns as they emerged from the field observations, as well as historic and morphological analyzes, are qualified in order to refine and/or reinforce the initial assumptions. In this research, "pattern" is considered as a regular and intelligible sequence that stays at the base of the city, neighborhoods, or of the system-form creation in general. In addition, under this research patterns are also considered as a structured logic that can help to give life to a model, that can be used for further understanding beyond a concrete specific pattern; and most importantly, as wholeness that could be "decomposed" in underlying triggering factors and specific ordering principles, to be potentially used as formative principles during the urban design process. This was the main motive and the way how it was approached the understanding of the essential qualities of Tirana's patterning models.

In this logic, the research argues to some extent how some concepts related to typology such as, Rossi's concept of "*type*", or Unger's "*rationalization of the existing*", Rowe and Koetter's *formal analyses*, Alexander's "*a pattern language*", or more recent ideas about the *reinvigoration of the concept of type as a need for more rationality* and order in our cities (Lee & Jacoby, AD guest-editors, 2011), etc. are related with the concept of hidden "ordering principles" and their potential to be used as formative principles during the design process. This is also something that I am looking for in this research. Related to this issue, other important contemporary positions, such as Kostov's (2003) morphological *city shaping*, *typological urbanism* (Lee & Jacoby, AD guest-editors, 2011), Arida's (2002) *Quantum City* worldview, Batty and Longley's (1994) *Fractal City*, Mitchell's (2009) *Complexity*, Zohar and Marshall's (1994) *Quantum Society*, are part of my bibliographic research. In parallel, the CompleXCity observatory workshop, and survey sessions organized in Tirana under the frame of this research, supported and fed with concrete site specific details.

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The inquiry process goes from induction to deduction. I start from specific observations and analyses in Tirana to see whether or not the observed phenomena meet any theoretical preconception, assess and tune the theoretical lens accordingly in order to evaluate the hidden qualities of the environment, translate and express those qualities in a set of regularities and use them to outline a model based in the deep understanding of the specific urban phenomena.

Quantum city and quantum society since a while are urging to understand that *a new paradigm is emerging in the way we describe the reality, and* as Zohar and Marshall argue, (1994 p. 22) *this paradigm is radically changing the perceptions about ourselves and the way we relate to each other* and to the world. According to these authors and many others cited in this research, the *revolutionary nature of the quantum reality* can give us a conceptual leverage for a positive move in the city and society. This worldview gave me some principles to understand and value the reality without excluding some previously unconsidered phenomena, and to better understand the way people *dwell together* in the society, which includes what Durkheim calls "*the collective patterns of thinking, feeling and action*" (Durkheim in Zohar and Marshall, 1994 p. 23); This worldview helped also to understand how people unconsciously are part of a behavioral statistical model. From this point of view, such model, that in our case reflects the specific Tirana's *pattern of thinking*, can be a laboratory to analyze and search for the specific ordering principles. As Alexander says in the "*The city is not a tree*" (1965), these principles *embody the properties that give life to the existing city,* and we can *get them back to the design process of "artificial" city*. A model conceived like this, can be subject to a wide range of manipulations, including testing its performance under different *society-space-time* (SST) (Arida, 2002 p. 155) conditions. In addition, this methodology can be a starting point to potentially understand, predict and influence events and occurrences apparently chaotic beyond Tirana. In a more generalized framework, this methodology embodies the idea of a recent tendency for a more flexible urban planning through utilizing pliable instruments to inform the evolution and the formative principles of the city. This is the way how specifics may influence the general beyond a site specific case.

2. Historical considerations: attempts to describe and map Tirana's ID

2.1 Transformations and events
The main outlines of Tirana's portrait: a continuum discontinuous; fragments interlocked in an intricate and complex space

Tirana is a city beyond many "curtains": fragments of city representing different characters, are hidden and wrapped inside each other, starting from the outer space along the main streets, to the most hidden and secret hart core of the neighborhoods (*mehalla*). Remaining pieces or traces from previous periods interlock in an intricate and complex mass, resulting sometimes in mechanical accidental remnants and sometimes in a more consolidated urban fabric, but always full with unexpected surprises.

Tirana can be characterized as a city not easily shaped through plans: a blurred or fragmented condition created by the continuous interaction between spontaneous developments and planning decisions is typical in Tirana. While the authoritarian power design is unambiguously legible in many parts of the city, or at different scales of the city's hierarchy, traces of recording over from people who invaded or took over the control of the city in different phases, are also visible.

Currently Tirana is a mix between organic and "artificially" planed city. Tirana was "restarted" several times throughout the history, by authorities that always pretended to re-initiate the city, or by ordinary people that *de facto* spontaneously set their own rules. The same is true at the architectonic scale: Tirana is also characterized by a wide variety of architectonic languages including many "architectures" built *without architects* (Rudofsky, 1964).

This chapter analyzes the fluctuations of Tirana's urban fabric in relation to the main historic events, as well as in relation to the social and political changes. For this purpose, Tirana is seen from the genesis when the first organic layers were created, to the explosion of the urban form and the creation of the dissolved vaporized city. This trajectory includes also the continuous efforts to move from spontaneous to organized urban planning.

Genesis: Initial nucleus/nuclei and the first layer of the city
(the beginning of the 17th century, 1614)

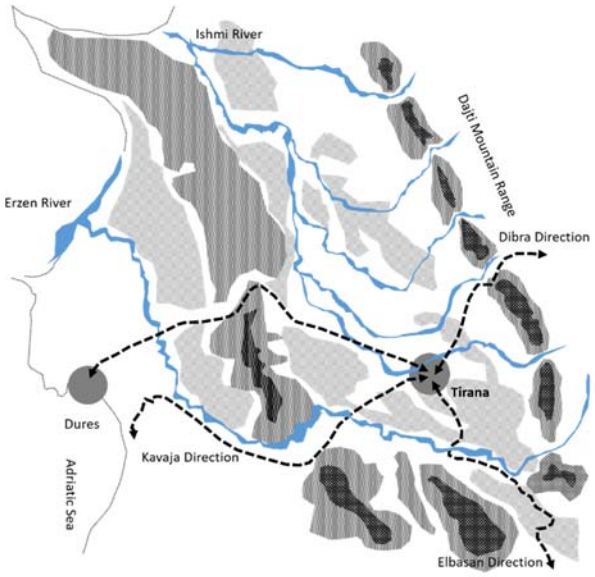
Evolution of the organic patterns guided by *physical determinants, topography, and land divisions* (Kostov, 2003 pp. 53-59) as preconditions of irregular city form

Intertwining of the regional commerce routes and the generation of the old Bazar;
The system of *Imaret* and *kulliye* (Ingersoll and Kostov, 2013 p. 439) as a city foundation devise during the Ottoman Empire: religious nucleus and the related urban areas

The process of *syenoicism* as merging and cohesion of the several urban nucleuses; *Urban improvisations* based on the *social structure* and the lack of *public control* (Kostov, 2003 pp. 59-64)

The *persistence of the plan* (Rossi, 1984 p. 51) as a morphological originating element: the generation of centripetal, centrifugal and string-form forces (fluxes), to and around the regional intersection of the Old Bazar

In the 4th chapter, generations and traces formed under this condition are analyzed under PATTAERN 1: Historic Organic

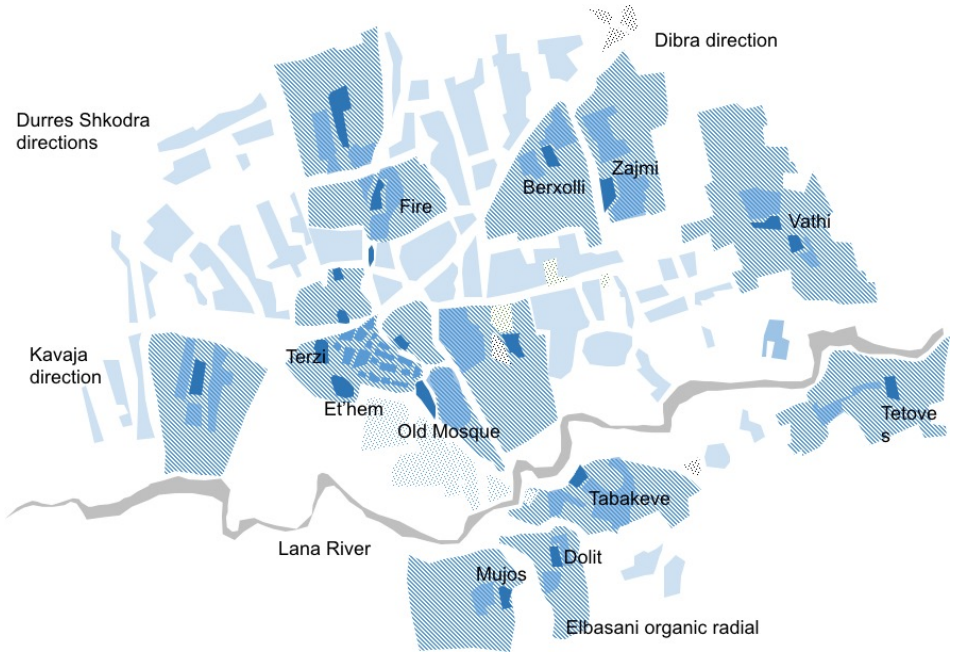


2. 1 Territorial container – "Eden"; The intersection of regional trajectories

Tirana started as an organic settlement at the beginning of the 17th century (Frashëri, 2004 p. 17), when this territory was under the domination of the Ottoman Empire. It arrived as a small organic town until it was declared the capital of Albania in 1920. Starting from a regional overview, it becomes clear that the first settlements in Tirana appeared in the intertwining area

of the commerce routes generated from the more important centers of the region at that time, such as Durres where the main port was located, Dibra, Elbasan and Shkodra (Figure 2.1). As already historians and scholars agree, the very first urban nucleus in Tirana valley settled precisely in the intersection of the above mentioned regional trajectories, and was positioned in proximity to Lana river. According to Aliaj et al., (2003, pp. 14-15), and Frashëri (2004, pp. 161, 67, 71-72, 169-173), this first nucleus was founded around the "Old Mosque" of *Sulejman Pasha* (demolished in 1944), and included some other important services such as, the bakery and the *Hamam* (demolished in 1938), the inn (demolished in 1958) and the Old Bazar (demolished in 1958). Other nuclei started to be developed: they settled in a relative proximity, within a radius of approximately 1km from the first one, in order to respect the privacy principle and independence (Figure 2.2).

The location of the first nuclei in Tirana Valley and their gradual growth, visualized the qualities of the geographic container: central positioning in relation to the natural elements such as, mountain ranges that offered protection and a natural enclosure, as well as a very clear space orientation and identification; a series of river neckless, something related to the water abundance in the area, as a very important source for life. From this point of view this territory represented a kind of "*Eden*": the selected site, was the "center" of the territory and at the same time the center of the entire universe; it was the "holy" place, and it contained the full potentials to become the future city (Figure 2.1).



2.2 Diagrammatic scheme:

First nucleus of *Kulliyes* and mass gravitation;

The outline of the first Layer

From another point of view, this process was not entirely casual. As mention before, in the 17th century, this territory was part of the Ottoman Empire. There is evidence that the settling process happened in accordance with the ways of organizing the social and cultural life in the Ottoman Empire during this period, which was also reflected in the urban structure. The above mentioned organic process was nourished and combined with a premeditated strategy based on the system of *Imaret* as a *charitable institution*. This system, embraced by Ottomans in the 14th century, was a form of *Muslim propaganda to a predominantly Christian population … for*

promoting Islam and the Ottoman way of life … through devote and moral religious conduct and works of welfare (Ingersoll and Kostov, 2013 p. 439). This was a way how the Ottomans promoted the urban life through building markets, baths and religious complexes. According to these authors (2013), *Imarets* usually included a *cami* (mosque), a *turbe* (tomb of the donor), one or more *madrassas* (religious schools), a *hammam* (bath), sometimes a *hospital*, sometimes a *tekke* for *dervish monks*, and a *public soup kitchen*, or *imaret which gave its name to the institution*. *Scholars in the 20th century introduced the new term kulliye to signify the community function of this complex*, in order to dissociate its name from the soup kitchen.

As Ingersoll and Kostov, (2013 p. 439) argues, from the city formation point of view, *as the institution evolved, the Imarets became centers of well-defined neighborhoods, which were held together through family bonds, shared professions, or places of origin*. According to this tradition, a donor (including each ottoman sultan), could create a foundation of *waqf*, in order to finance and administer an *Imaret* in his name, and *to preserve his memory for posterity*. Like Christian monasteries, the *waqf possessed extensive revenue-producing estate* (Ingersoll and Kostov, 2013 p. 439). Most importantly, besides being a "waqf", an *Imaret* or a *kulliye* was a complex where around the mosque were grouped services, administrations, economic activities, or other buildings. Even in the case of Tirana, these first public buildings, once distributed over Tirana valley, served as pre-urban nuclei around which aggregated the residential areas (Figure 2.2). Dwellings, barns, courtyards, wells, green groves, lanes square, and graveyards aggregated around these pre-urban nuclei and the mosque, by *forming an entity of sociological, property and family connections* (Aliaj et al., 2003 p. 18).

The first buildings of the *imaret* nuclei settled nearby some pre-existing natural or artificial physical determinants, such as river, water springs or wells, shadowing groves, etc., or pre-existing religious buildings, sanctuaries, graveyards, water canals, etc. In a second phase, the aggregation of buildings around these pre-urban nuclei extended according to the specific natural and other morphological factors, such as the modality of territorial extension, the existence of territorial emergencies or other kind of focal points, etc. Thus, after the first nucleus of the *Sulejman Pasha*, other nuclei were created in a similar logic (Figure 2.2). The second nucleus was created around a mosque of *Fire* at the beginning of the 18th century, the third nucleus around the mosque of *Zajmi*, the fourth nucleus around the mosque of *Haxhi Et'hem*, the fifth nucleus around the mosque of *Stermasi*, the sixth nucleus around the mosque of *Karapici* and *Kokonozi*, the seventh nucleus around the mosque of *Berxolli*, the eighth nucleus around the mosque of *Mujo*, and the ninth nucleus around the mosque of *Reçi* (Aliaj et al., pp. 19-20).

The city grew around these initial points, or *primary elements* as Rossi (1984 p. 82) calls them, being those a single artifact or a nucleus. Interesting is the fact how these nuclei were settled in the entire configuration structure of the city. According to Ingersoll and Kostov (2013 p. 437) *Ottoman urbanism displayed a preference for local symmetry* which was limited within parts of a larger whole. Public buildings such as markets or *imarets* were organized into *self-contained symmetrical compositions* floating in a totally *casual* urban *fabric* and meandering streets, however, remaining in equilibrium. This was characteristic for the urban fabric in Tirana too.

The next step in the urban generation process of Tirana relates to the cohesion of the community clusters grown as part of the *kulliye*, into a bigger and more consolidated urban core around the most important public buildings of that time, such as the old mosque and the old

Bazar. This process is somehow similar with what Kostov (2003 pp. 59-62) describes as a *settlement coexistence* or the first phase of "*synoecism*". He hires this term from Aristotle (*living together*) that intends with that *the administrative coming together of several proximate villages to form a town*. According to him, *this process enables people to transcend their tribal or pastoral ways and join up in a pact of self-government. This moment of becoming urban is sourced by a conscious desire to replace the common law of tribe with institutions of polis*. *Synoecism,* that is typical not only for the western world (but also for Islamic or African countries), is one of the most common processes for *towns coming out from the rural context* (Kostov, 2003 pp. 59-62).

This *synoecistic* center absorbed the scattered pieces located within the original settlement and the open spaces in between that gradually filled, however living some open spaces for communal activities such as markets, bazaars, graveyards, etc. The cohesive nucleus was characterized by an organic layout and low density, conditioned by the feudal fragmentation of land ownership and the absence of a centralized institutions to enforce the laws. However, as already mentioned, more than laws guiding the process, it was the system of *Imaret* as a *waqf* institutions imposed by the Ottoman Empire that influenced the urban structure and the main characteristics of Tirana at that time. In the 4th chapter these characteristics imported from the Ottoman culture are used as a baseline to compare with the main characteristics of Tirana's urban fabric established under this historic period and under similar social conditions, in order to understand if there are some interfering patterns (or influence) in the further city developments.

Rossi's reference (1984 p. 51) to Lavedan, related to *the plan as an originating element*, may help to go further in the logic of city formation. According to Lavedan, *persistence is the generator of the plan …* through these analyses we can *rediscover the spatial formation of the city* (1984 p. 51). It is equally important the reference to what Rossi considers the most valid Poete's point related to the city basic layout and plan: *cities tend to remain on their axis of development, maintaining the position of their original layout and growing according to the direction … of their older artifacts … often deformed but … not displaced* (1984 p. 59). For him *the persistence of the plan* is at the bases *of the collective organism* that is the city (1984 p. 51).

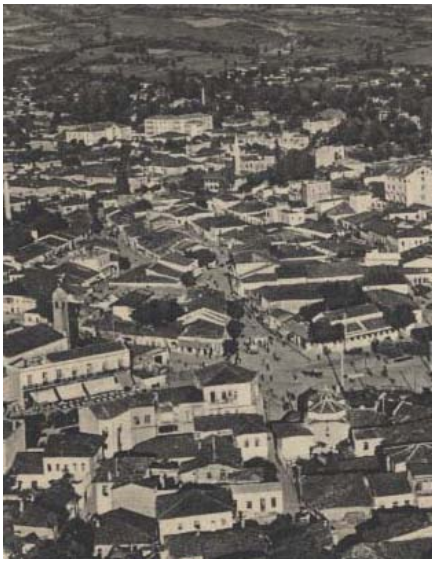
Based on that we can analyze how the characteristics of the plan as an originating element and its persistence played a role in shaping Tirana. From the morphological point of view, there were three main tendential (vector) forces in Tirana that contributed to create the future skeleton, where the entire urban tissue knitted: the centripetal regional fluxes which collided in the center and created the old bazar, and the secondary centrifugal and centripetal fluxes from and to the Bazar. This energy created the third tendential force which wrapped like a magnetic field around the main nucleus of the Old Bazar (later I will consider this phenomenon as the *event* and the *event horizon*). The interaction of these forces, in close relation to the preexisting physical determinants, shaped the modality of growth of the city that was being created. For this reason, the first nuclei (including *Imarets*) settled not only along the main centripetal radials but also along the wrapping waves around the Bazar. Filaments in the form of strings, following the rotating force lines, and intersecting with the centripetal and centrifugal fluxes, knitted the urban mass with a tendentially round shape (Figure 2.3). This modality of growth is further analyzed in the chapter dedicated to the Historic Organic pattern.

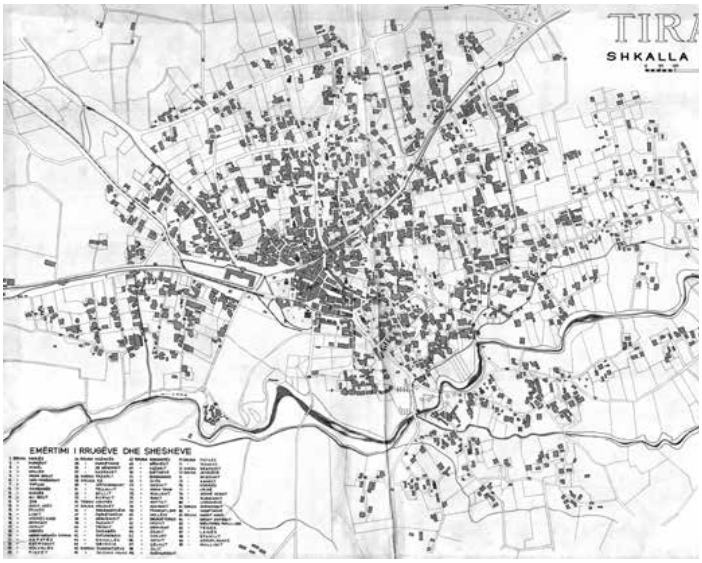
2.3
Diagrammatic scheme drawn on the map of 1921 showing the centripetal regional fluxes, secondary centrifugal and centripetal fluxes, and the wrapping lines around the main nucleus of the bazar

The scheme of Tirana shows that the primary streets (vectors) leaded to the Old Bazaar where the retail and wholesale trade, and the craftsman were clustered based on streets (Figure 2.4). The production and the storages were located in close proximity, interlocked within the structure of the neighboring residential units. Secondary streets flanked by residential and commercial activities run through the *mëhallas* feeding the dead-ends tertiary or lower level streets. The later ones penetrated the secret core of the *mëhallas* and could be even closed off to the general circulation by doorways at the intersection with the main streets. The irregular space resulting from the crossroads of two or more streets, created kind of open-air rooms which were in contrast with the tiny space of the urban fabric.

Conclusion for this phase
The first layer of the palimpsest laid down
Organic city

At this stage of the city shaping process, some important aspects that influenced Tirana geneses and the initial growth became clear. These aspects include: the main natural values and historic conditions that guided and influenced Tirana urban morphology; the modality of growth and the specific nature of the first nuclei that gave birth to Tirana; the combined nature of spontaneous processes with a premeditated strategy based on religious practices nourished by the Ottoman culture of that period; the existence of cultural bases and the underlying anthropological factors that guided the birth and the city shaping process; the potential influence and the persistence of these factors in the future of the city. This is a good base to be further investigated and analyzed in the following chapters of the research.





2.4 The old Bazar in relation to the City: above, panoramic view of the Old Bazar; on the left, aerial view of the Old Bazar and the central district; on the right, map of 1921 with Old Bazar in the center (the synoecism process completed); below, partial view of the Old Bazar and the craft streets sheltered there

Source National Technical Archive

1920-1944
From the system of *Imarets* to the attempts for Europeanization of Tirana: the first layer of "disturbance" to the continuity of organic structures

King's Zog "*Grand Travaux*"

Fascist Italian occupation and the import of "*Stile Littorio*": monumentality separated from the social reality (Frampton, 2007 p. 215)

The grand Boulevard as generator for a new restart of Tirana

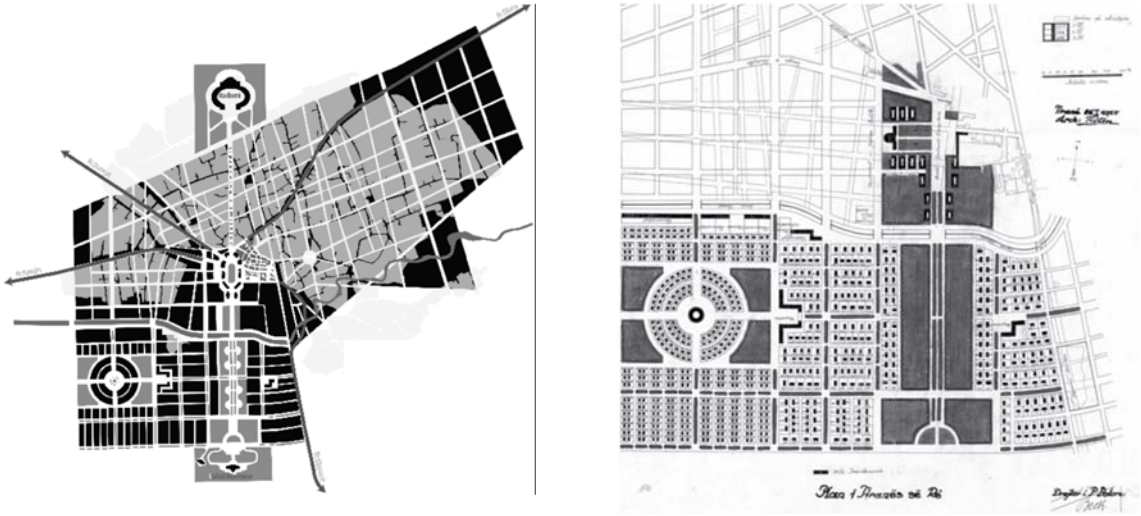
The creation of Two Tirana(s) (Figure 2.12)

Structures and traces formed under this condition constitute the first base for PATTERN 2: Recording Over

The first attempts to **move from spontaneous to organized urban** planning started at the beginning of '20s, under the monarchy period. This process was initiated in Tirana by opening and enlarging some avenues such as Rruga e Durresit, Rruga e Kavajes, Zogu i Parë Boulevard, etc. (Figure 2.5). Therefore, aside to the organic pattern, a premeditated designed one and substantially different from the previous was laid down. In fact, Tirana started the tradition of opening and stretching of the new avenues quite late in comparison with other capitals in the region. This was part of the King Zog's projects for Europeanization of Tirana. No doubt, the most significant project under this philosophy was the ceremonial complex of the ministry square, and the central axis of the boulevard, designed first by Armando Brasini in 1925. It was a majestic design redundant with excessive historic language. This project was also included as the most important central element, and as the symmetric axis of Tirana in the regulatory plan formulated during the King Zog period in 1929, and in the following plan formulated during the Italian Fascist Occupation from 1939 to 1943 (Figure 2.6; 2.7). Most importantly, the design of these plans that was based on a completely different philosophy and mentality from what the Ottoman heritage of Tirana was, laid down a very important base for a new urban shape and further developments. For the first time, these plans established a zoning structure and the principles for a shape based on the combination of rings and radials, which aimed to create a continuous urban tissue not only in the new areas but also in the historic ones.

It is worth to analyze the design concept of the main axis of Tirana boulevard, as well as the new urban structure and meaning related to it, in order to understand its generative capacity in terms of architecture and city scale. This axial scheme can be analyzed in relation to the topography, and in relation to the political power, as a structure representing a political diagram. In terms of topography, the boulevard alignment makes legible its specific extension along Tirana valley: a north-south parallel to the Dajti Mountains (slightly inclined to the west), gradually descending towards a sequence of river necklaces (Lana, Tirana, Tërkuza river, etc.). Therefore, the chosen location and the direction of the boulevard seems to be a perfect interpretation of Tirana's valley topographic features; not only because it became the generator axis for the future development of the city based on a new and different mentality, but most importantly because of the reinforcement effect on the identity and orientation of the entire city.

2.5 the map of 1921 and the map of 1936 showing the new avenues: Tirana *Grand Traveaux*

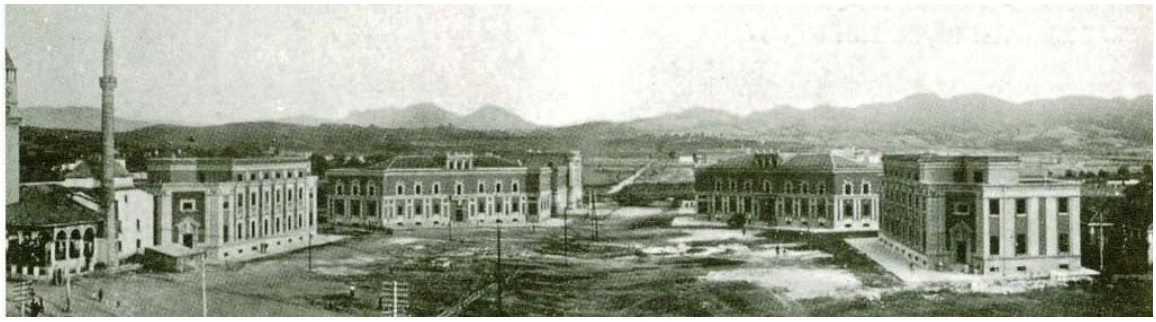


2.6 On the left, plan of 1929, Authors: Frashëri, Di Fausto, Kohler; Redesigned based on the sources of the National Technical Archive, in "*Tirana Qyteti i Munguar*", Dhamo, Thomai, Aliaj; on the right, The Plan of New Tirana, 1928 Designed by Kohler

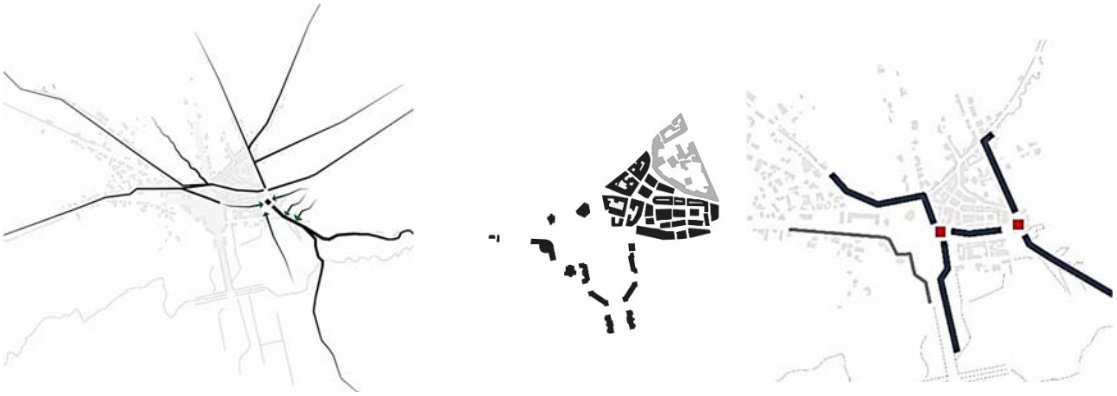
2.7 Plan of 1939-1943, Authors: Bossio, G. completed by Lambertini, I and Poggi, F.; Redesigned based on the sources of the National Technical Archive, in "*Tirana Qyteti i Munguar*"

Related to the axis as a *governmental linear system* or as a *political diagram*, as Kostov argues (2003 p. 174), it (the boulevard) *celebrates monocentric domination*. In a similar way with what he describes for the use of these schemes, the axial alignment in Tirana was used in association *with an overall urban diagram that upholds its premises and highlights its effects*. In the case of Tirana, this was guaranteed not only because it clearly contrasted with the existing organic structure of the historic city, but also because of the way how it was inserted in the framework of the general scheme of the future city by the regulatory plans previously mentioned.

Describing the axial diagram and its relation with the political power, Kostov (2003 pp. 176-178) uses the scheme of New Delhi built during the '20s. Some of the characteristics he describes may be worth for analyzing that part of Tirana which was designed and built during the same period under King Zog's project. Among other things, he argues about an *elaborate hierarchic spatial structure based on occupational rank and socio-economic status*, such as: the *hierarchical housing that fanned out from the axis along avenues*; *the rank was precisely indicated by the altitude and size of the compound and its proximity to the government palace, the size of the dwelling, the width of the road, the name of the road, the number and index of the house type.* In a similar way, this is also true for that part of Tirana that was built as a political power diagram. If we refer to the first design versions, the King's / Zog's palace was in the dominant hill at the south end of the axis (later substituted with "*la casa del Fascio*") and the land along the axis, designed according to an orthogonal layout, was distributed to the higher rank clerks (see Figure 2.6: plan of 1929 in relation with the axis).



2.8 The "ideal city", view from the central axis (Source National Technical Archive)

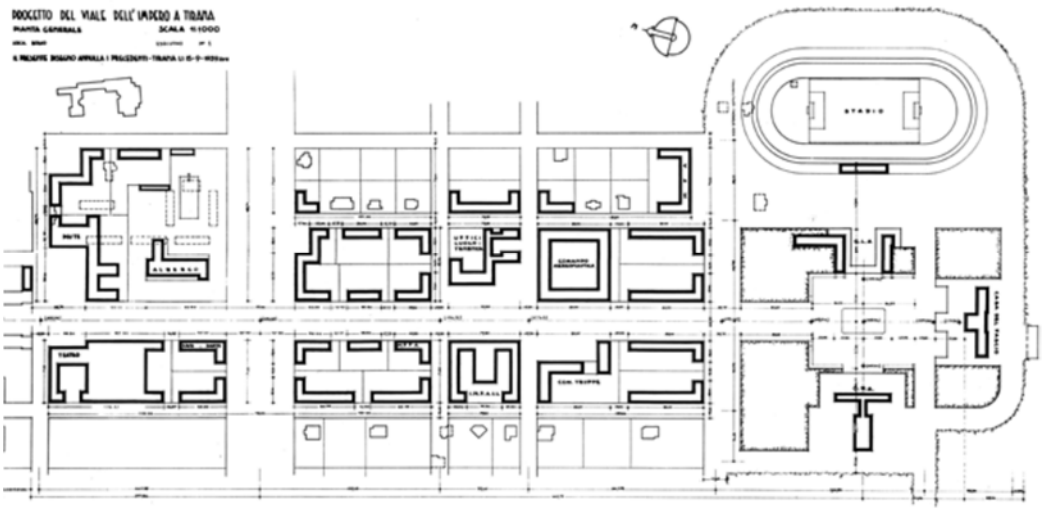


2.9 The organic intersection of the regional trajectories and the old mosque; the ministry square in relation with the Old Bazaar and the two central mosques (source Forum A+P 10, Dhamo)

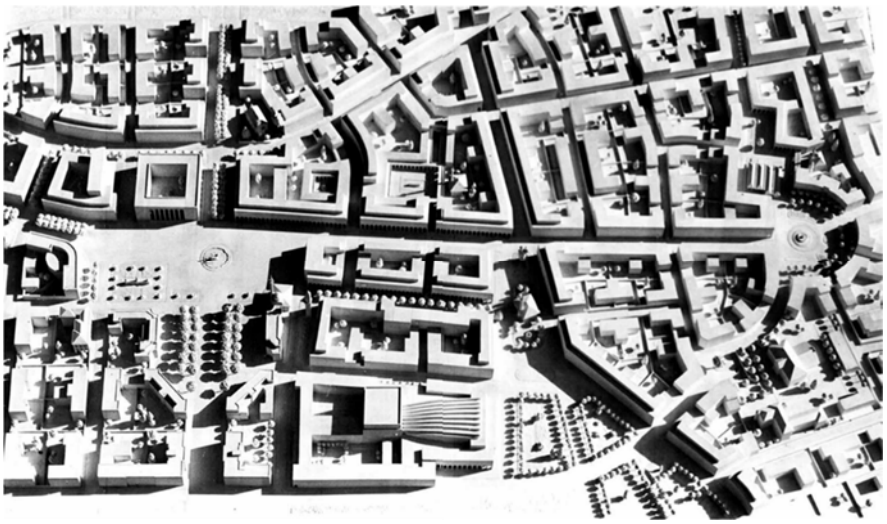
This part of Tirana rooted in the central axis, a kind of "ideal city" next to the organic one is an example of how architecture and urban design were used by the monarchy to demonstrate its power and to legitimate a newly created nation. As part of the main axis project, the Ministry Square, redesigned after Brasini by Florestano De Fausto in the neo-classic style (Figure 2.8; 2.9), represented the most imposing complex in Tirana because of the decorations and ornaments, decorative cornices, sculptures, and pompous entrances. Despite the fact that this language was outdated in comparison with many other European countries, and it was like an alien aside the organic Tirana, this urban design and architectonic representation fulfilled the political goal. It also left one of the most important traces in the city which no longer was part of the previous Ottoman tradition. As we will mention in the following paragraphs this area became also the ground for the modern expression in architecture before the end of the Second World War, especially for housing and residences.

After the boulevard was included in the 1943 plan as the main centrality of the city, later developments reconfirmed the importance of such a decision. The area still is perceived as one of the most "privileged" ones in Tirana and the land prices are the highest in the city. There are two main reasons why this axis was so successful and went far beyond than merely being a ceremonial or a political diagram: firstly, this axis reconciled the organic city of the origin with the "artificially" designed one: "*Tirana e re*" (The New Tirana). In this respect it represented the "meeting place" between the spontaneous city and the designed one, between the city of everyday and the ideal one. Secondly, it was the visualization at the city scale of two important geographic features: Tirana valley, and the mountain range in its background. This way, the boulevard was mediating a dialog between the geographic scale and the human scale.

The urban and architectonic interventions in Tirana were significantly intensified during the period of Italian fascist occupation (1939-1943). The main public buildings designed and built in Tirana during this period were strongly influenced by "*Stile Littorio*", or the Italian current of *New Tradition*, as Frampton (2007 pp. 204, 214-215) calls this kind of architectures born in close relationship with the political power. The most typical expression of the *New Tradition* in Tirana was the new complex of "*Piazza Littorio*" (Figure 2.10), forming a quadratic square in the southern part of the city and at the end of the main boulevard (described in the previous paragraphs). This complex included "*La casa del Fascio*" in the center of the axial perspective, the "*dopo lavoro complex*", the stadium, the gym, etc. Here we can clearly see the typical program activities for these kind of complexes and also the typical lexicon of "*Stile Littorio*," such as the stripped and simplified classicism, the lithic solidity, the marble and travertine covering, the repetition of simple elements, the use of "*basso-relievo*", the decoration of the square with statues, which in Tirana could never be completed, etc. From the urban point of view, the foundation of this new complex outside the existing city was a parallel of EUR in Rome, but in a much smaller scale. What Frampton (2007 p. 215) says for EUR that it was a utopia and a monumentality separated from the social reality, was also true for Tirana. This new square together with the boulevard (named by the fascist administration "*Viale dell' Impero*") and the ministry square, introduced a new tension and a new dialectic between organic and designed parts of Tirana (Figure 2.9; 2.11). They also brought a new public dimension in the life of the city, and most importantly made the planned city a tangible and concrete reality. This was like the beginning of a new age in Tirana.



2.10 "*Viale dell' Impero"* and "*Piazza Littorio*" (from this project only the buildings of Piazza Littorio were realized); designed by Bossio, G. and finalized by Lambertini, I. and Poggi, F.



2.11
Plan for the systematization of the ministry square and the Old Bazaar

Source National Technical Archive

It is important to see also what happened with housing during the same period. While the new typologies of public buildings were an alien body at the architectonic and urban scale, the typology of the new houses mostly followed a different logic. There was a binary relationship between the new typology of the urban villas and the urban morphology: in some cases, the urban villas were successfully adapted in the existing organic structure, but in many other cases they were used to start and to shape the new parts of the city, like in the case of "Tirana e re". Thus, not only could they follow the historic traces, mediating the need for transformation within historic organic areas, but they also demonstrated to have founding properties in the formation of the new neighborhoods in Tirana (Figure 2.14). The investors of these villas represented a specific social status in Tirana: the middle / small "bourgeoisie". Most of them were educated abroad and prone to change the feudal and oriental image of the country. It is meaningful also that most of these villas were located in the southern part of Tirana, on both sides of the new boulevard extending from Elbasani Road to Sami Frasheri Road (the area that King Zog designated for the government clerks). During this period that lasted up to the end of the Second World War, in the course of 15-20 years Tirana was transformed because of this progressive move. From the urban point of view, if we refer to Rossi's statement that *the house represents the manifestation of a culture* (Rossi, 1984 pp. 77-82), it is clear that the urban villas built during this period contributed to create a new (European) culture in Tirana aside to the organic (Ottoman) one. While the former were mostly located in the southern part of the city (the New Tirana), the later were mostly located in the northeastern part of the city (The Organic Tirana). This typological difference is still visible nowadays.

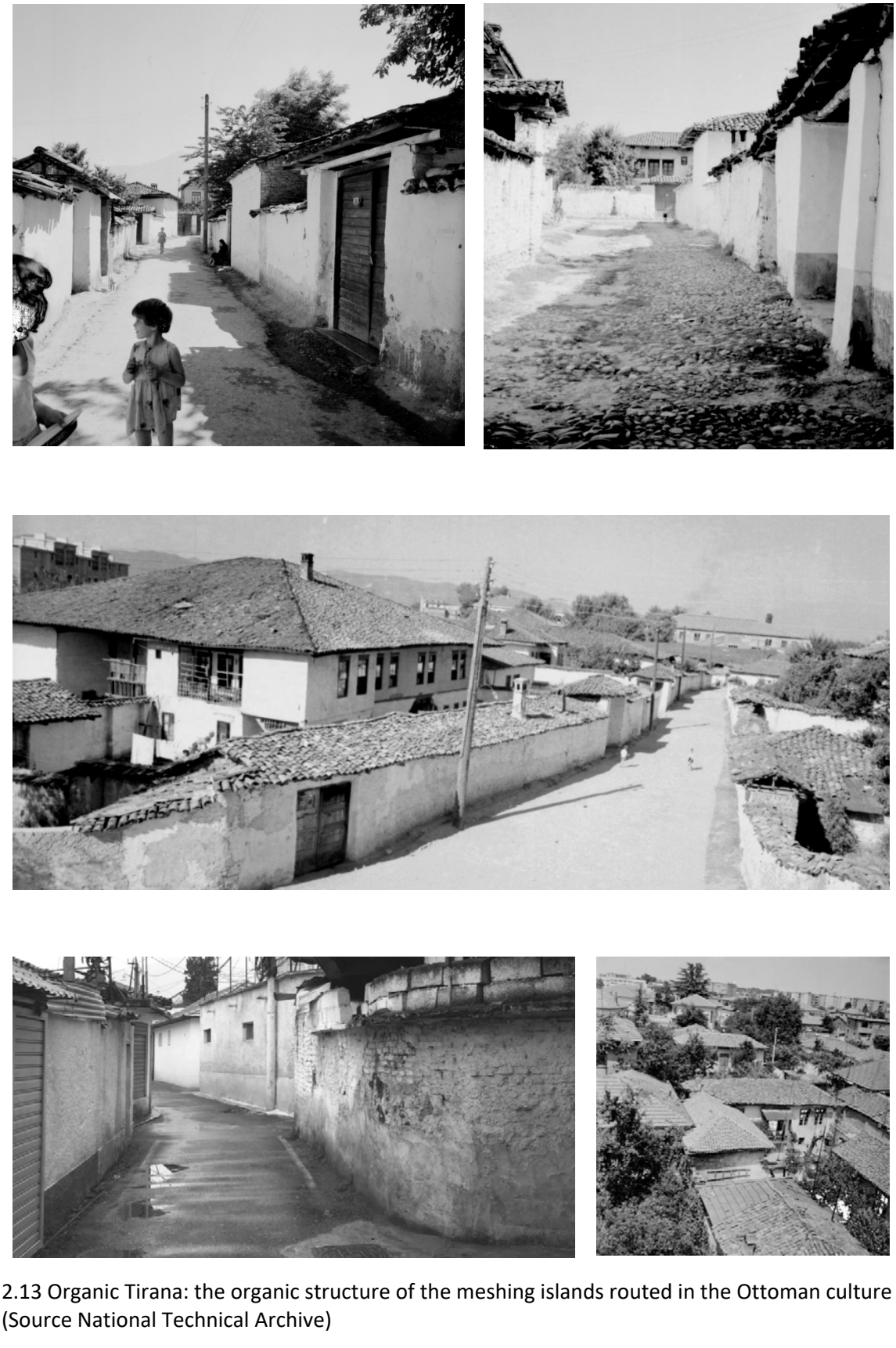
Conclusions for the period from 1920 to 1944: a double play in the city morphology organic + orthogonal-monumental

At the end of this period two different Tirana/s (Figure 2.12; 2.13; 2.14) with legible architectonic and urban differences were created: one rooted in the organic radials and the other one rooted in the re-foundation axis of the boulevard. The organic structure of the meshing islands routed in the Ottoman culture (Fig. 2.13), was in a drastic contrast with the orthogonal grid and prospected avenues inspired from the European renaissance, or some years later also with the "new" interpretation of the historic tradition according to the Fascist principles imported from Italy (Fig. 2.10; 2.11; 2.14). The new parts of the city, designed and developed during this period expressed the will towards progress, in clear contrast with the oriental organic ones. They brought a drastically different approach to city design and perception: from dead end labyrinths and closed perspectives, to open and continuous perspectives designed and built mostly under the influence of western culture. What happened during this period can also be interpreted as a clash between Ottoman and Western civilizations, represented in the diametrically different ways of living and reflected in the respective space anthropologies. Despite serious attempts to decrease or dilute the ottoman influence, this remained strong because it was niched in the visceral parts of the city and was sleeping there since five centuries. Most importantly, these operations were mostly limited only at the image level and physical structure of the city, rather than in education or other aspects of the civil life. However, after that period Tirana was no longer the same.

The architecture and the urban traces from this period played an important role for the future urban structure and city shaping. A new urban scale, and most importantly a new typology of the public space appeared in Tirana. However, this relatively short period that lasted from the

beginning of the ‘20s till the end of the Second World War could not fully give to Tirana the aspect of a European historic city. Despite these planned interventions, and the appearance of some new buildings in historicist expression, the real history of Tirana still remained in the organic town of the origin, which was intimately embodied in its old neighborhoods, and in some public buildings such as the old bazaar, the old mosques, etc. Such buildings (monuments) were inexorably demolished after the end of the Second World War, which is the subject of the next section.

2.12 Two Tirana(s): organic + orthogonal
Organic city Vs Designed axes
Boulevard as a generator for the restart of Tirana



2.13 Organic Tirana: the organic structure of the meshing islands routed in the Ottoman culture (Source National Technical Archive)

2.14 The project along the main axis of the boulevard according to the regulatory plan of 1939; Redesigned based in the idea of Kohler; Urban villas built in Tirana

1945-1990
Killing the differences and "building" the isotropy; city designed by demolition: the second layer of disturbance;

Architecture and urban planning embraced ideological principles to support the so called revolution and social progress … from the influence of the Eastern Block to a totally self-isolation;
The creation of new collective residential blocs in the center and in periphery next to industrial zones (Figure 2.15);

These housing blocks were supposed to bring in the city a new model of life that in fact was never born; Within the frames of the new housing blocs (Figure 2.16) were created the condition of emptiness as the main base for PATTERN 2: Recording Over

2.15 Collective residential blocs defining new limits for the city center (end '60s-beginning of '70s); (Source National Technical Archive)

From 1945 to 1990 under the centralized economy significant changes happened in the city structure. Architecture and urbanism became part of ideological instruments to support the power of the state and the so called “revolution” for transformation of the country. As such, they engaged in a social experiment to influence the creation of a new physical and social reality. The construction activity in general, architecture and urbanism in particular, were considered as important components to lead towards the “social progress” and to the ultimate goal the “construction of the socialist and communist society” in Albania.

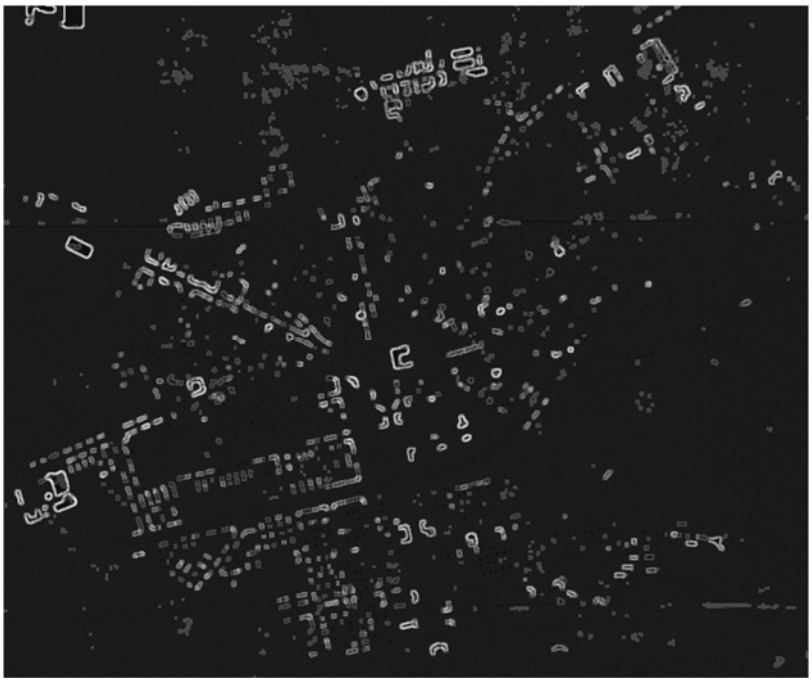
Despite the isolation that followed this period, in terms of architecture and urban development Albania followed a similar track with the Eastern Bloc, but in the framework of a very poor economy, limited technological and theoretical know-how, and most importantly, under an aggressive ideological pressure and dogmatic limitations. This was also reflected in the models of reference that in many cases were copied from the Eastern Bloc and badly adapted in the Albanian reality. Therefore, the “spirit” of the proletarian culture that flourished in the Soviet Union (SU) during this phase and in the rest of the East Communist Bloc (especially Bulgaria, Romania, etc.) was what mostly influenced Albania too. The inertia of this influence lasted even after the relationships with SU were broken, because people educated there under the same ideological and theoretical framework were integrated in the administration and education systems, including architecture and urban planning sectors. Even the Albanian school of architecture was under the strong influence of this dogmatic culture.

Regulatory urban plans based on zoning as the main regulation criteria, were the main instruments for large scale urban transformations. These plans were considered also as “ideological instruments”, because of the obligation to link the territorial development policy with ideological objectives at national scale as they were proclaimed in the congresses of the communist party. The city was considered almost a mechanic collection which pieces could be removed or dismantled according to the needs for space and services. The historic city was meant to be diluted in order to gradually sever ties with everything from the compromising historic and capitalist past. Therefore, bazaars, religious centers, urban villas, and many other artifacts were considered to be the evils for the so-called new society. Their massive erasure left the place for the construction of modest housing blocs considered as incubators for the “new” collective proletarian life. Clearly, it was a preference for erasing the old neighborhoods rather than enhancing them**.** Under this strategy were demolished in Tirana the historic objects that created the first urban nucleus (the old bazaar, the old mosque, the *hamam*, etc.); important commercial streets (such as *Rruga e Barrikadave*), and many other residential areas belonging to the organic period. As such, Tirana was becoming an example of a city designed by demolition where the alienated space of oppression was gradually becoming dominant. Therefore, a new city was about to come (Figure 2.16), and along with it a new “human creature” was appearing, a “real superhero” deprived from any luxurious pretentions and “clean” from vicious of a capitalist society.

What mostly transformed Tirana during this period were the so called new housing blocks (Figure 2.15; 2.17; 2.18). They were low-cost collective apartments, 4-5 stories standardized a-stylistic buildings designed according to a very strict and basic normative. With few exceptions, they represented very poor freestanding apartment blocks, morphologically in opposition with the historic traces. Sometimes they were violently implanted in the middle of historic organic patterns, cleaning up only the footprint needed for the buildings and for the access roads (Figure 4. 54). The infiltration of these alienating viruses was another way how the organic

neighborhoods were heavily damaged and in many cases even diluted. In most of the cases the new blocs were never completed with the required services and playground equipment supposed to be the social catalyzers for the new life.

In fact, the urban space created by such collective blocks induced just desolation and the sensation of being in a condition of emptiness (Figure 2.18). This was one of the most inhuman things that was created during the communist regime. The everywhere present and uniform ghost city, deprived from human expression lost any attractiveness that may come from differences. The effects of such environment lasted beyond the collapse of the system that created them, causing serious consequences for the Albanian society. Loss of identity and social depression that followed the collapse of the communist regime, were also due to the alienation of public space created by such constructions.



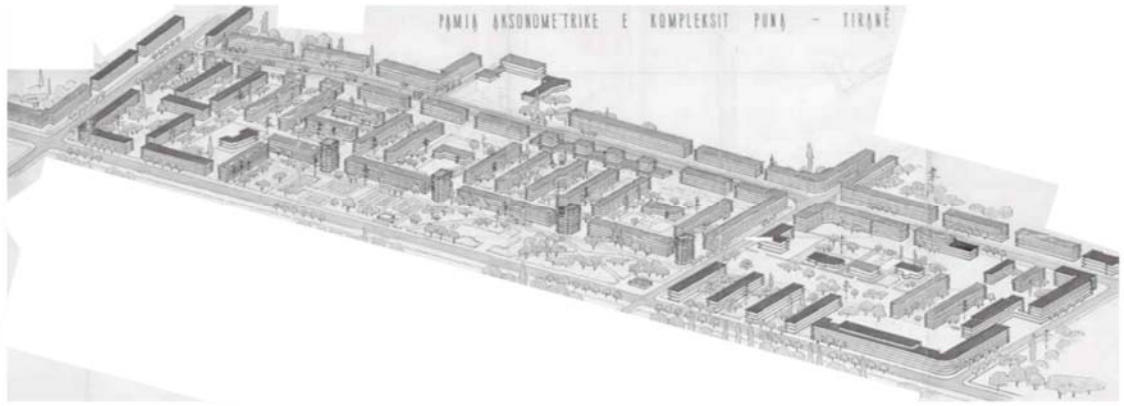
2.16
New portrait of the hollowed Tirana;

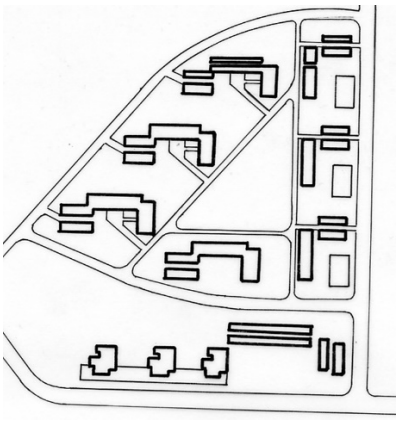
The creation of the frames of emptiness;

Interventions up to 1970 (Source National Technical Archive);

The condition of emptiness

Ghost space with frames in evidence





2.17 Typical residential blocks in Tirana: above "*Puna*" ('60s and '70s); down, "*Partizani*" ('70s); (Source National Technical Archive)

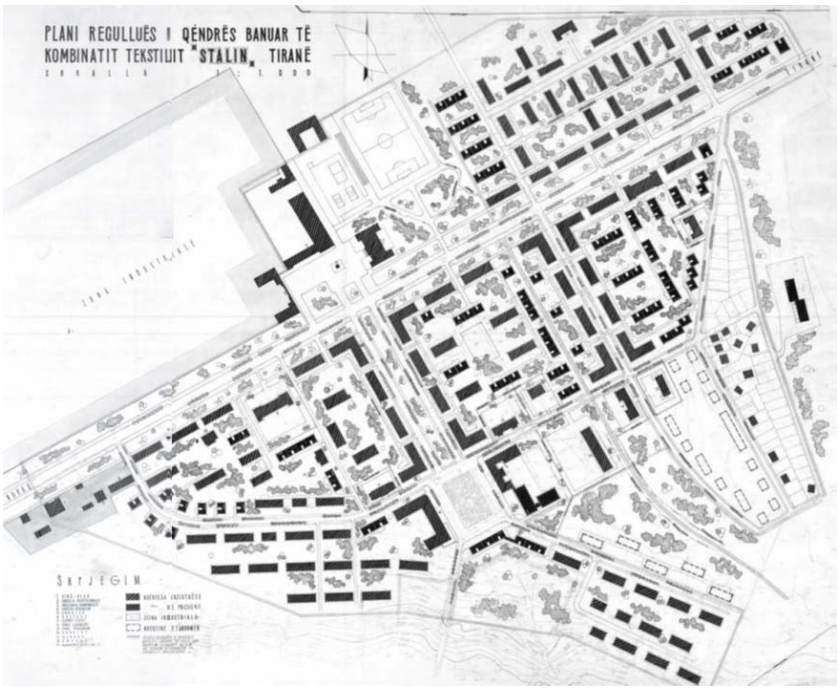
2.18 Typical residential blocks: instead of a collective life, they gradually created the condition of emptiness

Despite the claims for an equal society, there were also some discriminations on how different categories were treated from center to periphery, from city to city, or by the rank in the nomenclature of the communist party. These differences were visible in the variation of architectonic typologies, including housing blocks, or in the quality of the urban environment surrounding these special typologies, which was in contrast with this of the ordinary residential blocks. Some distinct public buildings such as government buildings, museums, hotels, train stations, etc. represented a special treatment. From architectonic point of view, they were based in the so called socio-realism principles which in many cases were reduced in a pragmatic fulfillment of the functional program requirements, considered as the most important; and in a mechanical and superficial agglomeration of pieces ranging from revolutionary symbols to historic or folkloric motifs.

The monumental Socio-Realist line is quite visible in buildings such as, the Palace of Culture, the Museum of the dictator (the “pyramid”), the Central Comity of the Communist Party, the National Museum, etc. These buildings also created identifiable urban environments: they were massive in scale and often organized around central axes in a symmetric layout (typical is the pyramid, the national museum, etc.); they stayed on pedestals and could only be approached through a series of triumphal stairways; in many cases they were adorned with stylized folkloric or revolutionary motifs which attributed to these structures quite an archaic character and also reinforced the iconic aspects. In contrast, we can distinguish the standardized public buildings such as schools, kinder-gardens, commercial services, cultural centers, etc. Also in this case there are huge differences from center to periphery, or from Tirana to other smaller centers.

The central axis of the main boulevard, and its absolute symmetric structure created by the King Zog and reinforced during the Fascist period, was also used by the communist government. They imposing along it the main political hierarchy. As explained in the previous paragraphs this was not occasional, the axis as a political diagram perfectly adapted with a hierarchically organized society and administration. Ironically, under an ideology that was propagating the idea for an egalitarian society the most important people of politburo were living in the same area and the same villas designated for the bourgeoisie of the previous monarchic structure. During this period, this area was even closed to the public and was symbolically called “the bloc(k)”. There are no substantial interventions during this period along the axis except the “Skanderbeg square” that was totally redesigned, and was increasingly becoming bigger.

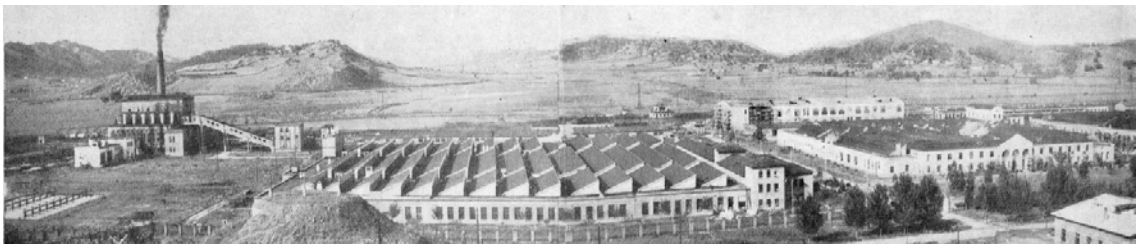
The industrialization programs enacted during this period drastically changed the shape of Tirana. The city was stretched in some new directions, for example in the north towards the train station and the nearby economic area, in the east and in the west towards some new mechanical industry factories, food processing industries, etc. The development of the new industrial or economic zones was always combined with the development of low-cost residential areas built in their proximity. However, the distance from the historic center in all cases did not exceed 2-3 km. Exception was made only for the textile factory complex, named “Stalin”, which was built as a separate satellite outside the existing city. In this case the industrial zone was combined with a bigger residential and service area, including a public square (Figure 2.19).



2.19
The "*Kombinat*" city, or a satelite neigborhood of Tirana (starting from early '50s)

The living center developed arround the textile factory complex, named "Stalin"

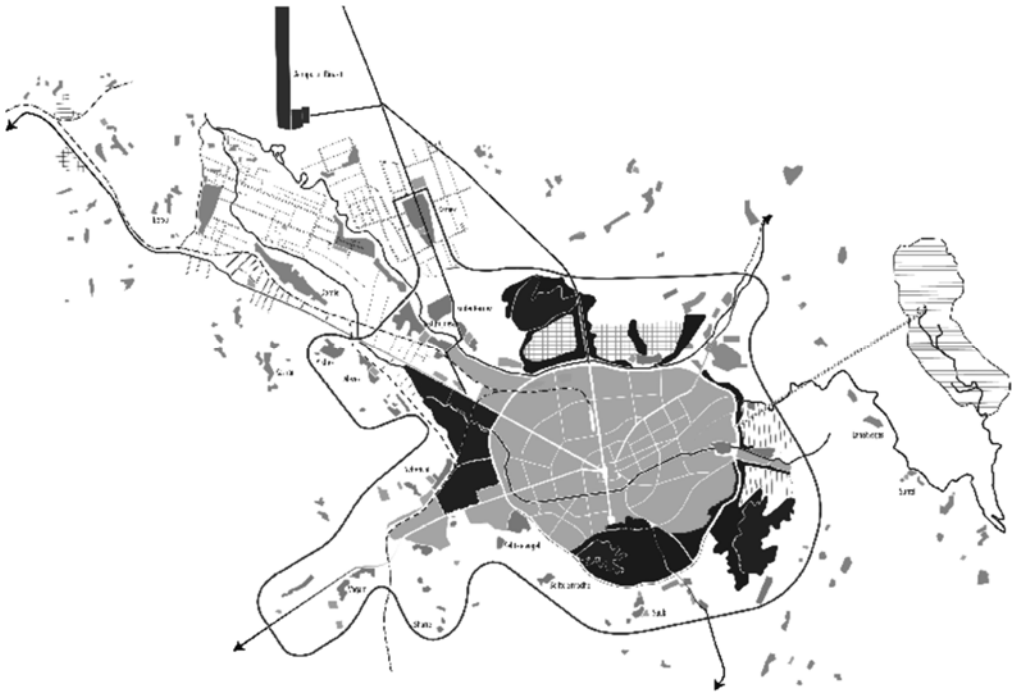
The big industrial complex was built as a separate satellite outside the existing city, in less than 5 km distance



Source the National Technical Archive

The expanding structure of the city was reconnected through a ring-radial road scheme, which was outlined in the regulatory plan of 1958, the first one formulated after the Second World War. This plan, and also the second and the last one formulated during this phase (approved one year before the collapse of the communist regime in 1989) (Figure 2.20), reinforced even more the monocentric features of Tirana, based on the combination of radials and concentric rings. The last plan proposed the third ring level (originating from the plan of '43) and the extension of the existing boulevard as a new access road from the north. The periphery dedicated to economic activity and working areas was limited by a green belt that was planned to follow the third ring level. However, most of the operations proposed by this plan were never completed. They lost their validity after the collapse of the dictatorship, therefore could not be

respected during the period of political and economic transition. The plan proposed also the redevelopment of many central areas which implementation would definitely damage the historic neighborhoods representing the organic origin of Tirana. During the communist regime, we do not see any attempt to set the development of the new housing blocs within the larger morphological urban system; or to explore the binary relationship between the proposed housing typology and the historic urban morphology. Contrarily, the housing system detached from the historic traces of the districts was consciously used to dissolve the historic tissue and definitely divorce from the past.



2.20
The Regulatory Plan of 1989

Above, the main scheme at the city level

Below, the scheme at the metropolitan level

Author of the plan The National Planning Institute, Tirana

Source National Technical Archive

Conclusion for the period from 1944 to 1991:
A triplet combination in the city morphology
Organic + axial monumental / orthogonal + frames of emptiness (Figure 2.21)

The most tangible result of this social experiment was the creation of the ghost city, deprived from any spirit and personal identity. As a result, the new city created the condition of emptiness, from where everybody wanted to leave. With the collapse of the regime, it became clear that the dream towards a city and a society where there were no rich and no poor, gradually was shrunken and reduced in the desolation of the poor housing blocs where everybody was equally poor. Tirana was transformed internally: substantial changes happened in the historic organic structure by inserting totally different urban and architectonic typologies: new standardized housing blocs, or freestanding buildings which were completely detached from the historic traces. This methodology of intervening within the urban tissue, by bulldozing entire pieces of the historic neighborhoods or even single houses, without a clear strategy concerning the entire morphological organism, created the precedent for what happened after 90's up to date. Tirana was transformed also externally because of the extension in new peripheral areas, mostly for industrial purposes, which development was based on the political directives enacted by the Congress of the Communist Party.

In Albania, like in many other totalitarian regimes, architecture and urbanism, allied with the power. The new city was despotically imposed on the previous one. In fact, the Eugène Pottier[1] communist international text seems to be the real guiding principle of this period: *…'This the eruption of the end. / Let's make a clean slate of the past, / Enslaved mass, arise, arise! / The world's foundation will change, / We are nothing, now let's be all! …* Among other, these words can be considered also as a clash between the already existing Ottoman mentality, and the new Stalinist culture penetrating from the Eastern Bloc Countries.

2.21 Tirana at the end of '80s; Frames visible at the city scale
(source National Technical Archive)

[1] *Eugène Pottier, 1871,* Chants Révolutionnaires. Paris, Comité Pottier, [n.d. 1890-1900] (translation is a literal one as Pottier wrote it)

From 1991 to date
Return to the organic city: The third layer of interference, atomization and / or vaporization of the city (Figure 2.22)

From compact urban form to advanced state of dissolution and not continuous urban form
Efforts to stabilize limits of urbanization

Tirana changed from within and from without
Infill densification in the center and sprawled city in periphery

Metropolitan interplays: From Tirana to Greater Tirana, to Parallel Tirana and Durana

The city of separated / isolated projects

In the 4th chapter, generations and traces formed under this condition are analyzed under PATTAERN 2: Recording Over and PATTERN 3: New Organic

2.22 People did their best to survive …

The decay of the communist utopia and the vacuum left behind (not only physical but also psychological) was the origin of the dramatic and uncontrolled political-economic-social collision that happened afterwards. This condition drastically changed the role of the state in all fields, including construction activity and territorial control. Rapid and uncontrolled urbanization in Tirana and in the main urban areas was triggered: the emergence of the first informal suburbs stared, and the public space was gradually reduced through progressive infill. The reform of land and housing privatization that started from 1993 was followed by considerable changes in the economic, social and spatial structure of the city.

There are two main tendencies related to the city shaping during the first decade after ‘90s: the core densification and/or consolidation; and the “foundation” of a new peripheral and evaporated city all around the main core.

Related to the first tendency, there were efforts to improve the living conditions in the central areas of the city mainly through improving the existing infrastructure services (enlarging the main roads, improving the water and power supply, etc.), which contributed to increase the density within the urban structures located along the main roads. A lot of infill development contributed to loose most of the open public spaces and facilities in these areas and to decrease the quality of life. In addition, freed from the previous oppression Tirana was resurrecting from the latent layers of former property, hidden interests, etc. The only legal criteria for this kind of plot based infill development was the "respect" of the normative distances, which were only measured geometrically and calculated arithmetically. As we mentioned, the precedent of intervening without a holistic consideration of the surrounding context and the entire neighborhood, was created since the period of dictatorship. What makes it worst is the bigger mass of the infiltrated volumes: from 4-5 stories buildings they increased to 10-12 stories.

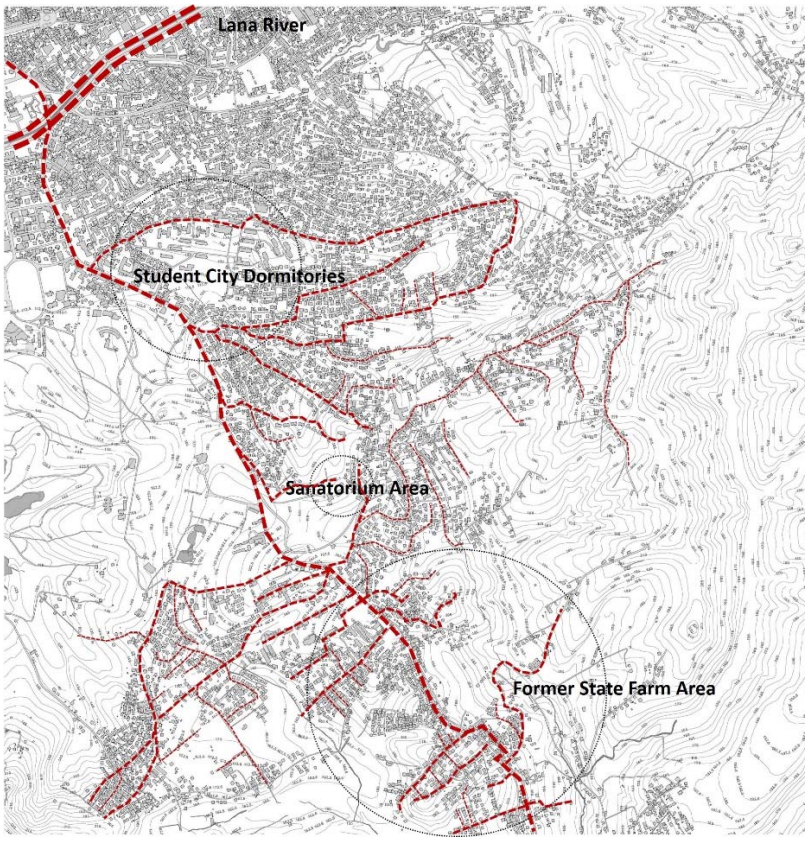
The second tendency is related to the city that was self-developing and finding its own way without being "disturbed" by the government control and assistance: the city outside of the official boundary. This new city was taking place in the nearest periphery, or in some cases in former agricultural fields which were located more distant from the center, already distributed to the farmers by a specific law. It was a kind of shapeless "vaporized city", a second return to the organic process of city creation (Figure 2.23). This kind of "city", extended in endless intricate ramifications in former agricultural land and swallowed preexisting villages, former state farms (*kooperativa)*, or even small towns, resulting in an always bigger, shapeless and unstable organism. However, during the last decade, this kind of informal sprawl is undergoing an organic densification process. Analysis of satellite imagery conducted during 2001 by the team Strategic Planning for Greater Tirana[2] showed a massive population expansion in the Greater Tirana area: from an area of 12 km2 before 1991 to 32 km2 in 1994 and 56 km2 in 2001, or almost a five-fold increase. Tirana, the biggest city in the country, experienced an annual population increase of almost 7% during the first ten years after the political change.

The city reborn: again, Tirana drastically changed from within and from without. Evidently, the "proletarian city" did not fully succeed to sterilize the human and the physical energy of the real city. Life invaded the city again.

Different labels came out to define and characterize this new phenomenon of spreading informal neighborhoods around Tirana: informal, illegal, new-comers' city, sprawl, etc. The main characteristics of these areas in Tirana coincide with what is considered by De Geyter Architects (2002 pp. 21, 23) as the *negative, global and generalizing* idea about sprawl: *chaos, lack of structure or demonstrable catalysts*. In most of the cases, these floating entities are not only physically detached from the center, but they are also morphologically different in their lack of compactness and great voids alongside them. However, while sprawl is a term hired from other cultures and social conditions, the other terms, such as illegal or informal, are mostly related to their legal status and carry a prejudicial connotation. These labels definitely derived to a simplistic reasoning and hindered the deep understanding of the phenomena and the related urban effects. For this reason, while analyzing these areas and the related patterns, I use the term of New Organic, in a direct reference to the historic organic city. In relation to that, in the

[2] Working Report for *Strategic Plan for Greater Tirana*, PADCO, ULMP 2001, Tirana; A project under the framework of the Urban Land Management Program financed by The World Bank.

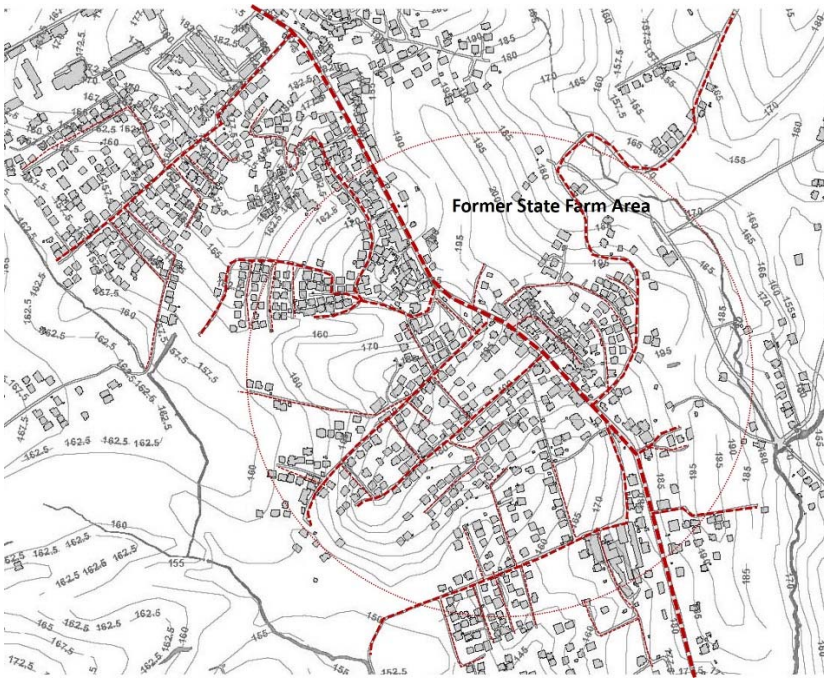
3rd and the 4th chapters I explain more in detail the organic city in itself and how it can be understood under the complexity theory point of view, as well as I explain the main processes and characteristics of the patterns developed under such conditions.



2.23
"Evaporation" of the southeast part of Tirana, near the "Student City"

Extended in endless and shapeless ramifications;

Each of them representing a self-developing informal / organic neighborhood



The distinctive characteristics of urban spread in Albania derive from the specific socio-economic conditions that are different in comparison with those that triggered and motivated sprawl as a phenomenon in western countries. These factors include the high demand for housing combined with the poor economic conditions and the inability of government sector to offer affordable alternatives; the lack of operational and realistic planning system which is more focused on banning, and prohibition rather than on enabling; un-clarity of land ownership; massive dis-respect for the rule of law, etc. The urban spread in Albania, especially in the first period (1994-2000) started as a phenomenon of the poor people, and still they remain the main stratus of society feeding new sprawl contingencies. Only during the last five years, sprawl is also emerging as a phenomenon of the rich people who are "safely isolating" themselves in gated communities around the periphery. This phenomenon is expected to grow in the next coming decade.

The first tentative to create a vision beyond the traditional borders aiming to shape the vaporized metropolitan region, was made by the Strategic Plan for Greater Tirana in 2001 formulated under the Urban Land Management Project with the assistance of the World Bank; in 2004 another inspiring vision called Tirana Metropolis was formulated by Berlage Institute. While the former was based on a more classical planning approach, the later was a strategic vision for the definition of a more intelligible metropolitan geography. Tirana Metropolis aimed to transform the city based on seven projects at the metropolitan and urban scale through reinforcing what already existed by following a super contextual approach. The proposals of both plans better than anything, give an idea about the main problems and characteristics of the urban conditions at that time, as well as the origin of many todays problems.

The Strategic Plan for Greater Tirana among other proposed the compacting of the city to reach a more efficient use of the urban land combined with a polycentric vision around newly created poles such as Kamza, Berxull, Paskuqan, Kombinat, Vora, Rinasi, etc.; the stabilization of physical limits of urbanization through green belts and land reservation; the deviation of the traffic from the center projecting the combination of three levels of concentric rings with two orbitals and two tangentials; two light rail trains connecting the center and the airport; They proposed also the establishment of Metropolitan Authorities for transportation and other services; etc. But the professional and administrative mentality was not yet prepared to absorb these ideas. Due to disagreements between local and central institutions this plan was never fully approved. At the same time, this failure was a clear sign that Tirana could no longer be managed by traditional city planning instruments.

In the vision of Berlage Institute (2004), Tirana was a metropolis still under formation and not in transformation. The city was seen as an archipelago, or complementary centralities outside the city center. Among the most distinct proposals of Tirana Metropolis are those of "*Parallel Tirana*" and "*Durana*". The former was proposed as a *mirror* ring city, offering a provocative vision reflecting on the *epidemic of sprawl* in Tirana (pp. 22, 114-118). Following a similar logic, "*Durana*" was used as a tool to think about the metropolitan region: *an eventual fusion of Tirana and Durres into a new Metropolis with a green heart* in between (pp. 22, 126-131)

From 2010 up to date, the trend in the construction industry and urbanization calmed down. A new plan could be officially approved, only in 2012, however, it was substituted by a new one only after five years, in 2017. Both plans do not represent a real qualitative shift in methodology

and in what they propose. Contrarily, they are prey to the developers' interests being mostly focused in increasing intensities and buildable areas, including in the historic parts of the city.

Meanwhile there is a tendency to develop and transform the city through isolated projects. The most emblematic one is the extension of the 3 km Northern Tirana Boulevard and the organization of a 7 km river side park that is supposed to give a new dimension to the city. While too much effort is spent in the redesign of the central areas especially those located along the main axis of the boulevard, the periphery and the newly created suburbs are totally neglected. The lack of willingness to treat the urban problems in a systemic way is gradually driving to the creation of double standard parallel cities: the "city of appearance" where the legislation and other living standards and services are supposed to be applied, and the "hidden city" where there is an implicit compromise that the application of the same legislative standards is not obligatory. This is because no further steps have been taken to create legal opportunities for affordable housing.

Conclusion for the period from 1991 to date
A quadruple combination in the city morphology:
Organic + axial monumental / orthogonal + frames of emptiness + spontaneous new organic

In two and a half decades Tirana changed more than ever: the city changed from within and from without; in its internal structure and in its size; in its typological structure and in their relationship with the city. Despite several attempts during the last ten years to reconfigure a cohesive city shape at the urban and metropolitan scale, they failed because of the lack of professional know-how and administrative capacities to cope the city growth at the metropolitan scale.

The uncontrolled urbanization as a reaction to something that was denied to Tirana occurred in some different ways: in the center through infill densification (infiltration of massive or smaller volumes mostly through corruptive practices) and in periphery emerged the shapeless "vaporized city" showing characteristics of chaos and apparently lack of structure.

Albania, Tirana especially, is entering in a phase where there is no trust on regulatory instruments to solve the real problems. The instability of planning instruments reflected in the abolishing of plans after the change of political mandates, clearly demonstrates a non-functional planning system. The last regulatory plans approved in 2012 and in 2017, both formulated with international assistance, are only the last evidence of an ill planning system. The validity of this kind of regulatory planning instruments has also been questioned in many cases and in many other countries. In fact, there are still relatively standard and similar procedures acting in many different social contexts and countries. In a city like Tirana, where the organic origin of the city is still legible, where planning instruments were used or misused mainly for political capital or as ideological power instruments (Zog, Fascism, Communism); where planning was almost totally abolished after the collapse of the dictatorship and the city went again through an organic and rapid process of urbanization; where people implicitly know that planning serves only as alibi to support the land speculation but not to solve the real problems of the city; alternative ways need to be explored within the planning system. Most importantly, the planning practice in countries like Albania shows that there is a need to totally repair and to introduce new

methodologies. This renewal should start from the observation and analytical instruments, in order to better understand the real city, up to the design and implementation phase.

2.2 Why Tirana is specific?

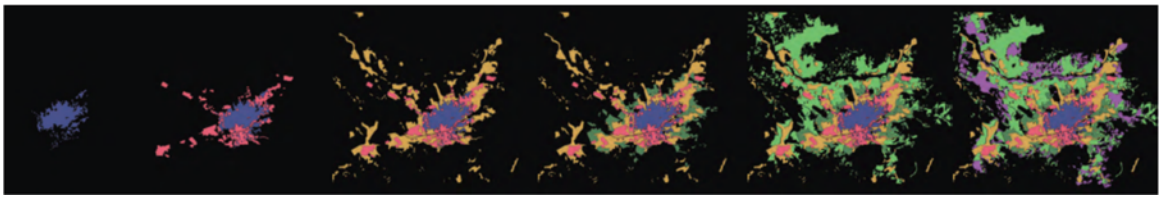
The natural city of individual arrangements

This brief historic overview helped to understand that Tirana like many cities around the world is a multifaceted reality. However, in the previous paragraphs I tried to show the specifics of Tirana starting from geographical and historical circumstances, their relationship to social structures and how they are reflected in the morphology of the city. Tirana moved from the organic nucleus created in the middle of agricultural fields to the urban abstract axis of the boulevard; from the system of *imarets* disseminated form the Ottoman culture to the straight line open perspectives that pierced the city in the name of Europeanization; from a solely spontaneous entity to also a designed/structured city; from concentric rings to the dissolved vaporized archipelago city; from dictatorial interventions to spontaneously self-made incremental housing and neighborhoods; from big scale interventions to small scale pixelated infill(s); from single reality to multiplex reality, from linear to complex, from founding to re-founding; from extremely strict application of rules to the total abolishment of rules; from clear to unclear and clear; from "Tirana" to "Durana", from small to big.

These apparently contradicting dualities constitute the specifics of Tirana, which are different from many other European capitals, but rather similar with other Balkan cities. Three are the main points of difference: the city foundation under the Ottoman culture that lasted in Albania up the end of the first decade of the 20th century; The long period of dictatorship and absolute self-isolation that started after the Second World War and lasted for more than four and a half decades; The violent spontaneous waves that exploded after the collapse of the dictatorship and lasted for more than two decades. This specific social condition created also quite a specific urban condition that is analyzed into more details in the following chapters.

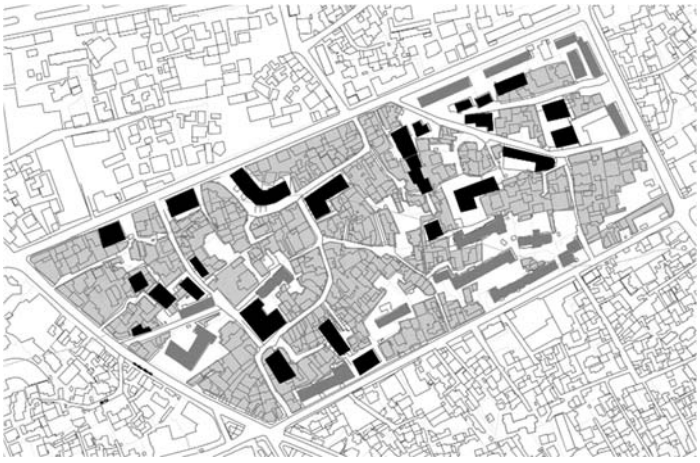
In Tirana there is a great proportion of the city which is "designed" and made by people that falls out of the authority control. The traces of this *natural city*[3]**,** can be seen at different stages of the city history and at different scales, starting from single buildings, neighborhoods, and up to the entire city shape. As we noticed from the historic analyzes, Tirana initially started as an organic city, and returned to the organic spontaneity several times, including the last twenty-five years. From another point of view, these developments that reflect more the natural properties and the concerns at the local level, are related to the interpretations of the *organic city* understood as individual arrangements *at the smaller scale*, as Batty and Longley argue (1994 pp. 8, 28, 31). I will come back to these concepts further in the research. This spontaneity tide, at the city and neighborhood scale, is visualized in the Figures 2.24 and 2.25

[3] Expression hired by Alexander Ch. In the paper *The city is not a tree*, 1965



2.24 Expansion of Tirana from 1936; with green color is marked the expansion from 1993 to 2003 (source Aliaj, Dhamo, Shutina, *between vacuum and energy*, 2010)

2.25 The birth and the expansion of an informal neighborhood, from 1993 to 2003 (source Aliaj, Dhamo, Shutina, *between vacuum and energy*, 2010)



2.26
Erosion of an Historic Organic area through infill densification with multistory collective apartment buildings
(with black are marked buildings added after '90s; with dark grey are marked buildings added before '90s)

2.27
Recording Over, mostly through infill low rise developments

At the glance the urban condition of Tirana can be perceived as lack of continuity or incoherence of the urban environment. In fact, as we already described in this chapter, this is due to the overlapping and interlocking of actions (or suspended actions) undertaken during the different phases of history. However, observing this condition more carefully it can be interpreted as diversity and richness of the urban text at different scales of the urban hierarchy: single building, neighborhood, city and metropolitan levels. From this point of view more than opposing notions (*either/or*) they constitute complementarities (*both/and*) or transitional (*indeterminate*) conditions of elements (*propensity*) [4]. In the next chapter I will classify these notions under the quantic *indeterminacy* and the *nuanced complementary* based on the quantic particle-wave duality. The following table summarizes some of these key characteristics resulting from Tirana's urban condition.

Interlocking of unrelated fragments and uses rather than adhesion of elements or layers Public and private rather than public or private
Imposition or superposition of object(s) / urban artifacts rather than stratification or duplication, triplication, quadruplication … of layers
Interference and intrusion of pieces rather than combination of elements
Invasion of elements rather than mediation or negotiation between different parts
Perceived admissibility rather than clearly written rules

While observing Tirana's urban condition there is always a degree of indecision how to classify some fundamental categories, such as public-private, designed-non designed (even in the legal sense), or different functional uses, relationships, etc. These categories contain simultaneously some states in-between: what you see may become or leap to another state in-between of this category depending on the specific circumstances. For example, the parties test permissibility to approach (or to touch) one or the other "extreme" status of a category by perception (after each step they undertake). This indeterminacy is related to a mentality that consciously generates unclearness and blurred situations in order to create more personal freedom through widening the space in-between two corresponding categories: private-public; invasion-mediation; interference-combination; imposition-superposition-stratification-du(tri)plication; interlocking-adhesion; etc. These characteristics make the legibility of Tirana urban condition a very challenging exercise.

The above characteristics are also reflected in the continuous erosion (Figure 2.26), or parasiting and filling-in (Figure 2.27) of the urban spaces according to a pixel-ized plot base logic, always unfinished and waiting for some equilibriums to change. Elements interlock in an intricate and complex space made of many kinds of "urban curtains", creating a continuous discontinuity of spontaneous and "planned" spaces, a succession of "friendly" occupied public spaces, outer and inner spaces, etc. This situation reflects a specific urban condition (if we want: ill-functioning), which more than ideas coming from architects and planners includes the "imagination" coming

[4] These expressions that will be explained in the next chapter are hired from Arida A. (2002) *Quantum City*

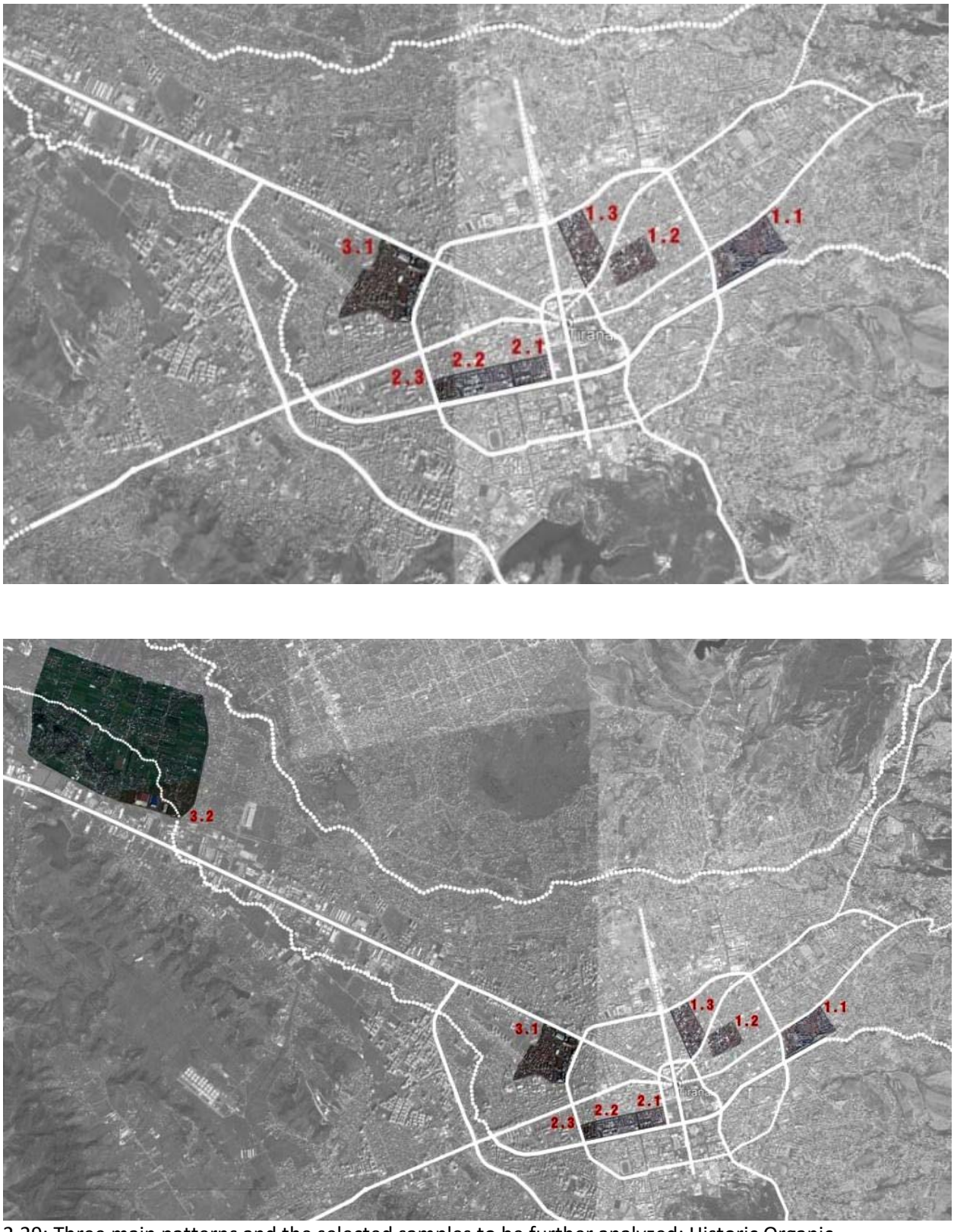
spontaneously from ordinary people. *De facto* they played an important role in shaping Tirana as a physical and "ideal" structure. This energy is an important generator for the city's existence and transformation, and makes Tirana a city "moving" between dreams and a difficult to manage reality; a city where users (unofficially) are more "important" than designers.

Because of this, Tirana lives in a specific situation where there are no clear "limits" and differences between planned and unplanned (Figure 2.28), designed or un-designed, and where the geometrically designed city is organically deregulated (Figure 2.27). Under this urban and social conditions, identifying alternative design methods that are sensitive to place and process becomes important. Here we come again to an important issue: what kind of planning and urban design methodologies we need in order to cope with the reality? This research is a reflection in this direction too. We have to identify instruments nearer to what people need, not only through classic participatory processes, typical of '70s, and '80s, but most importantly through trying to realistically understand their "instinct" of city-making and identify methodologies that make this "instinct" part of the design input. Clearly, participatory processes focusing mostly in the organization of the community, trying to give a voice to people (mostly or exclusively in the poor areas) without spending much efforts in the design logics and processes, are not enough. Methodologies that try to combine better these components with their city-making logics need to be identified.

2.28 No clear "limits" and differences between planned and unplanned: above, an area considered as informal with some formal buildings in between; below, an area considered as planned, designed and formal, but still under the process of densification

Table 2.1 Three main patterns to be further analyzed

PATTERNS	**PRECONDITIONS** Geographic, historic, social Natural or built elements	**MAPS** The **current status** of the patterns	**Selected SAMPLES**
PATTERN 1: **Historic Organic** Intricate mesh of streets and urban maze resulting from the historic *synoecistic* process and improvisations; Apparently labyrinth and extremely intricate condition, but with clear logic and legible structure;	Physical determinants: topography, land subdivision; and social structures based on group affiliation; The influence of the Ottoman culture: *imarets* or kulliyes; limited public control (Kostov, 2003 p. 62)	Maps 1917, 1921, 1937, 1989, 2005 up to date Areas representing this pattern arrived up do date; despite systematic interventions for high-rise densification, these areas were still able to swallow and to alternate the course of the artificial technocratic planning; In fact, the high-rise interventions look like intruders trapped in an organic maze;	*1. Mëhalla Dibrane* in Tirana East: between *Lana* and *Hoxhë Tahsini* street 2. *Mëhalla* near the "*Red School*" 3. *Mëhalla Dibrane* in Tirana North (central location) Figure 2.29
PATTERN 2: **Recording Over** Individual formal and informal arrangements (organic) gradually parasite-ing or filling-in the emptiness of the geometrically planned city; Apparently, geometrically ordered from outside, but often a labyrinth from inside;	The existence of frames of emptiness: housing structures designed geometrically, rigidly and inhumanly during the dictatorship periods; Social condition in post-oppression trauma; lack of public control;	Maps of 1989 (or previous maps) to see the original design of the "frames" (housing blocks); maps of 2005 and up to date to see the evolution; map of 1937 to check the correspondence with the previous layers of organic city; This pattern started after '90s and evolved by gradually re-appropriating the emptiness; created a more "humanized" but quite intricate urban environment;	The urban stripe (1) *"Shallvare-Palazzine";* (2)*"Puna",* (3)*"Gjykata"* Figure 2.29 Contains three housing complexes representing the full range of issues regarding this pattern; (central location)
PATTERN 3: **New Organic** Housing improvisations spread throughout the periphery, gradually occupying areas with considerable landscape and economic value; Apparently, shapeless and unstructured, but with a clear individualistic surviving logic;	Physical determinants: topography, land subdivision; and social structures based on family ties; unclear legislative framework; preexisting poles / nuclei of attraction (former village, economic zone, natural resources, etc.); Social condition in post-oppression and economic shock; lack of public control;	Maps of 2005 and up to date to see the evolution of the recently occupied areas; Maps of 1989 (or previous maps) to see their origin, physical preconditions, attractiveness, etc. This pattern started after '90s as squatter settlements and evolved up to date; in some cases, densified and consolidated; in other cases coexisted in close relationship with intensive agricultural activities;	1. "*Pallati sportit*" – Former aviation area; (in the nearer periphery) 2. "*Uka Farm*" Former agricultural area; (in the farthest periphery) Figure 2.29, below



2.29: Three main patterns and the selected samples to be further analyzed: Historic Organic (1.1, 1.2, 1.3); Recording Over (2.1, 2.2, 2.3); New Organic (3.1, 3.2)

3. Repositioning Tirana from theoretical perspective
Theoretical lens: summary and interpretation of the main theoretical concepts
Potential applicability in the case of Tirana

The main research question has to do with understanding of the specific urban conditions and the related emergent qualities of cities in general, Tirana in particular, from a larger theoretical perspective. This requires not only an investigation about the most important theoretical paradigms directly concerning the research, but also a deep reflection on urban observation methodologies and paradigms under which these observations are conducted. Sometimes, gross simplifications based on traditional deterministic and mechanistic Cartesian and Newtonian pattern of thinking divert us from understanding the complexity of the real life. Therefore, this chapter not only analyzes some important theories related to urban form, but most importantly introduces some concepts from the quantum worldview and its components such as fractal, chaos and complexity theories, which can help to see a more comprehensive, nuanced, complementary, and inter-relational world. The last part of the chapter is dedicated to the shifts of scientific paradigms in relation to concepts of space, time, object-subject, certainty of scientific knowledge, etc., and their potential influence on the future of architecture and planning.

This means we need to review and rethink a lot from what we know about the shape of cities, urban form, the way cities grow and develop organically or in a planned way, about what we consider regular or irregular, about material and non-material aspects influencing the urban form, etc. In this perspective, the logic suggested by the quantum world view will help to see from a different point of view and with more nuances a lot of interactions already happening in the real life; This is also in line with the inquiry process of this research: the analyses of the specific context require to explore first if the observed phenomenon meet some theoretical precepts, and then re-evaluate and potentially fine and tune the theoretical lens accordingly in order to see “more” things and include some of the so far excluded or simplified phenomenon as part of the analytical and design methodologies. Most importantly, conclusions from this chapter set the theoretical guiding principles for the research and re-position Tirana from the perspective of these theoretical lens.

3.1 Summary of theoretical framework; applicability in the case of Tirana

The theories analyzed under this chapter are grouped under three main topics as presented below. However, these topics quite often interweave and combine.

3.1.a Urban forms and processes; evolution of organic structures

3.1.b Typology and typological instruments; type as a pliable diagram to inform the urban plan; city as an architectural project

3.1.c Complexity, self-organization and self-regulation; a more comprehensive, nuanced, complementary, and inter-relational indeterminate reality

The urban form is not a finite thing; it is never completed and never is at rest. There is a vast literature about how to make and how to read the urban form starting from the generation of the classic utopia, mainly inspired from the platonic cosmology offered as an object of contemplation, and the activist utopia of the post enlightenment period. As Rowe and Koetter argues about this issue, (1978 pp. 14, 15, 21, 28, 31), the ideal city, *as an icon of the good society, … became responsible for the form of cities* and to convert the medieval randomness into a more integrated and dignified world. Latter, the *activist utopia* fueled by *Newtonian rationalism*, reflecting the *properties and behavior of the material world*, made the world explainable and certain. *Measurable could be equated with real*. Therefore, society and human condition (city) could be subject to laws as those of physics. On the other hand, in parallel with the French Positivism (Saint Simon, Fourier, Comte, etc.) in England and Germany it had been obviously clear *the notion of society as organic growth*, and that *society could scarcely be a* mechanism. The decisive contributions here are the conception of *historical dialectic* from Hegel and Burke. The latter, reacting against Enlightenment made *his appeal to imponderable and not-to-be analyzed*. This scenario that combined the *German 'history' and French 'science'*, *people spiritual explosiveness and mechanical coolness* of progress, a group of *ideas relating to change and organism* and another group of *ideas relating to measurement and mechanism*, contributed to modern architecture theory and practice (Rowe and Koetter, 1978 pp. 14, 15, 21, 28, 31). Useless to say how much all that influenced the way of making and understanding the urban form, and how much we owe even nowadays to that tradition. As such, from a natural and organic phenomenon the city was gradually transforming in an artificial process.

As Batty and Longley argue (1994 pp. 25, 28) in the last 50 years a major shift has happened *towards conceiving cities in terms of ideal network geometries* based on large communication systems, organized around new transportation technologies. In addition, according to these authors, architects and urban designers have shown *more confidence to build the city of pure geometry suggesting larger and larger idealizations of the old ideas*. However, the geometry of the ideal city during the last century has been slightly relaxed from perfect geometries combining circles and rectangles to more sinuous and smooth curves, but still remaining *largely visual in organization and intent* and rarely portraying any natural or organic evolution.

At this point, it is worth to speak also about the city of modern architecture. According to Rowe and Koetter (1978 pp. 51, 56, 58), the *ever-evolving-return to nature* vision of the modern city required the *absolute detachment … from any aspect of the existing context*. As these authors

argue, the city was reduced in a transitional status where freestanding and detached buildings *behind the screen of trees* became a collection of *disparate objects* immersed in the isotropic space. The *demand for rational materialization of the object* and *the need for disintegration* was due not only to the industrial logic that implied serial and standard repetitions, but also to the fact that the *space* was considered *more sublime than the matter*. *Plan Voisin* and *La Ville Radieuse* of Le Corbusier maybe are two of the most emblematic statements to illustrate what happened to the city and to its essence. Despite the fact that dilemmas about this kind of vision, especially the dilemmas related to the perception of the public realm, appeared since the early stages, it was the post war reconstruction and other massive developments that mostly compromised and corrupted the main principles of the modern movement. However, this way of thinking had a long inertia, until another generation would come to question that.

K. Lynch, G. Cullen, R. Krier, A. Rossi, C Rowe, O. M. Ungers, C. Alexander, Venturi, R. and many others, scrutinized the existing urban configurations and drawn important lessons from such scrutiny putting under focus elements neglected from the previous phases, such as the importance of history and the tradition of building cities, the attention towards elements such as urban squares, streets, etc., or the role of typologies as the essence for the creation of the urban and architectonic form, etc. They urged for a more human centered design, and articulated principles for a new era in architecture and urban design, open to a larger comprehensiveness and human freedom. While confronting a new reality, architecture was getting free form the ideologies of the avant-garde modern period and identified new instruments. In this context people like Rossi thought about architecture *in the same way as the natural and human sciences*. For him *architecture's territory was the city;* he needed to understand the principles how the city was built in order to *find the keys to explain architecture* (Moneo, 2004 pp. 103, 104); for him the process of architecture stayed in the concept of *type*; others, like Venturi, advocated the communicative nature of architecture, expressing the cultural values latent in social groups and proposed how to *recapture the mechanisms that architects had used to come up with complexity, ambiguity and tension* (Moneo, 2004 p. 55).

This period is intimately related with the waves of vast manifestations for freedom in US and in Europe, including some east-bloc countries, that give life to the aesthetic dimension of the mass and to the pop culture. It was under this atmosphere that a processes of "popular" rediscovering of the new world started. This process included also architecture and arts and took different expressions in different countries. Among other, in 1963 Turner, J. and Mangin, W. described their experience as consultants in the squatter settlements in the periphery of big Latin American cities. With this, they brought under attention a topic that was excluded and not considered under the domain of architecture.

According to Jencks, Ch. (in Saggio, 2010 pp. 284-285), three are the main issues that emerged from this new positioning of architecture and urban design that will be called "*postmodern*": first, the conscious return to the presence of forms deeply rooted in the human memory and tradition, as opposed to abstraction that characterized the previous period; second, the central role of the site, or rather the context, in order to reestablish the connections with the site specific cultural roots, as opposed to the abstraction and "no-place" (*non-luogo*) functionalist logic; and third, the importance given to the topic of the city, as opposed to the radical experimentations of '60s with macrostructures and their abandonment of the city. Because of that, the new proposals shifted to the re-proposal of 19th century urban models with consolidated matrix. Therefore, the context within which the architecture takes place was the

main focus of the debates during ‘70s and the beginning of ‘80s. This is also a moment when people like Eisenman that had an opposite approach with the postmodern all-inclusivism entered in the scene. For example, his idea of *palimpsest* as a dimension of conceptual context obtained through the stratification of territory and its history, to rediscover abandoned or even just imagined geometries, is an alternative to the mimetic approach to the context. During this period and the continuing decade architecture and urban design reestablished also the interest for interventions within the built environment, especially in areas once forgotten or neglected. This is also due to the increasing awareness about the depletion of the planet's resources; at the same time this stimulates a design which tries to generate processes that are similar with the natural logic.

The topic of dynamic interaction that characterize our lives requires to establish new relationships with the reality. To evaluate the current tendencies in the way cities are being developed, where the complexity, subjectivity, personalization, etc. are largely present, would not make sense to use the criteria belonging to the old industrial model. Similar to a machine the system was just a mechanic and absolute aggregation; instead, as Saggio (2010 pp. 431-434) argues the architecture of the *informatic revolution* behave like a *computer*. While the *information* is like the raw material for architecture in this historic period, the interaction is a substantial *catalyzer*, like was transparency during the modern time.

New lens are needed. In this concern, a deeper understanding of what is *the physical form in science*, is having important implications on how we might understand the form of the cities in relation with *process, scale and shape, statics and dynamics*. As Batty and Longley (1994 pp. 1, 7, 8, 10) say, from the *doctrine of visual order* and *physicalism* for cities as ‘*architecture-writ-large’*, our understanding is shifting to cities as systems of organized complexities. Beyond those important issues, there is an increasing interest especially during the last two decades, to introduce in the field of design a new understanding of apparently imprecise and incomprehensible complex systems. There are a number of contemporary authors such as Batty and Longley, Gleick, Arida, Mitchell, Zohar and Marshall, etc. that treated these issues in a conceptual logic and call for the *demise of the reductionist dream* and the importance of *understanding the whole not as the sum of the parts but as complex systems*, as Mitchell says (2009 p. x). That can be a great help to formulate a new vision for understanding the city. In the following paragraphs an attempt to summarize some of the theories that support these ideas is made.

3.1.a Urban forms and processes; evolution of organic structures

Evolution of the city form beyond planned and unplanned; city as a malleable energy field; from physical determinants and social structures to material and non-material aspects
(Under the perspective of: Kostov, S. Arida, A. Batty, M. and Longley, P.)

In this section, I present some concepts related to the organic cities, forces that put them together and their influence in the city shaping, etc.; Then I try to bring additional perspectives of the same phenomena from the quantum worldview, especially concerning the influence of the material and non-material aspects; Finally, I try to go beyond the taboos of the “planned and unplanned” city by introducing the fractal city perspective.

Evolution of organic structures: physical determinants and social structures (Kostov, 2003)
One of my initial concerns in this research has to do with *how and why* the Albanian cities, and cities in general, *took the shape they did*; and what kind of relationships occur between the *urban form and the urban processes*. This is an adaptation to the Albanian context of Kostov's (2003 p. 9) concern expressed in his book "*The City Shaped – Urban Patterns and Meanings through History*". Also, what I refer in this material as *urban process* is hired by the same author. According to him there are two main aspects of urban process: first, *people and forces and institutions that bring about urban form*: the influence of people who designed cities, the procedures they go through, the agencies and laws regulating them, etc. And the second sense refers to *physical change through time*. As we already mentioned, the city is *never at rest*; … *witting and unwitting acts …*, consciously or unconsciously, continuously *alter its lines in ways that are perceptible only over a certain stretch of time.* Both these aspects of the urban process brought by Kostov (2003, pp. 11, 13), that later I will label also under the notion of *material* and *non-material aspects* (Arida, 2002), are relevant for this research.

Related to urban processes, Kostov also describes a series of *earth bound* factors that influence the *evolution of the organic patterns*, or as he calls them *physical determinants of irregular city-form* such as *topography, land division, synoecism* (2003, p. 62). The last concept, which means *living together* (Kostov, 2003 p. 60), as explained in the previous chapter, is important to understand the initial stages in the city creation processes, when several villages or clusters unites in a single and more complex community. As I argued in the chapter dedicated to historic analyzes, these factors apply in the case of Tirana too.

Besides the physical determinants, other factors influencing the irregular city form are also *urban improvisations based on social structure and the limits of public control* (Kostov, 2003 p. 62). These concepts are crucial for the pattern analyses in Tirana and their relationship with the human behavior and/or anthropological factors that underlie such patterns. The idea of the city shape resulting from an intimate relationship between physical determinants and specific social structures is one of the most important issues explored in this research.

Evolution of city form: propensity to change (energy) - material and non-material aspects (Arida, 2002)
The same concepts analyzed above can be seen also from a more generalized perspective of *material* and *non-material aspects* influencing the urban form; or *users' role* in shaping the urban environment; human role as *vehicle for non-locality*; etc. This perspective is hired form Arida's book "*Quantum City*" (Arida, 2002). In the following paragraphs I introduce some more details about these concepts.

Quantum city, among other ideas argues that the city has both its physical and cultural backbone, as well as other non-material aspects influencing it. In the quantum paradigm designers should be concerned with the living city and both its physical and cultural backbone. Arida introduces these concepts while speaking about the need to design '*natural cities'*. In this respect he brings into attention Alexander's concern about the need for '*discovering the property of old towns which gave them life and get it back into our own artificial cities*' (Alexander in Arida, 2002 p. 147). According to quantum city, a *relational principle that includes the cultural dimension of 'natural cities'* … could be that property. Therefore, the list *should be extended to non-material elements: feelings, thoughts, ideas, memories, identity, urbanity, culture, local arts, sounds, smells, views …* (Arida, 2002 p. 147). The Author reminds us that *pre-*

Cartesian societies never restricted themselves to material elements (p. 148). Thus, for ancient Greeks the continuum city-inhabitants, or container-contained was called Polis (pp. 111, 157). Also, for *the quantum worldview, the physical and the mental are interchangeable* (p. 195). Another aspect of designing '*natural cities*' (named organic in the previous section) is the notion that *users are as much 'designers' of the environment as the professional design team is … and it is those users-designers who bring in the 'non-material elements' through their interaction with the place*. If we accept this, *the fear of never being able to design natural cities disappear*. Human user introduces also randomness and overlaps (Arida, 2002 pp. 148, 149). This is so visible in Tirana where there is almost no difference between designers and ordinary citizens (Figures 2.25-2.28).

Arida illustrate the idea of the material and non-material aspects also through the categories of the *event* and the *associated event horizon* based on the particle-wave duality. *The event can be either physical (a building, …) or not (a happening, … etc.) and is more or less punctual in space or time*. However, because of the associated wave effect, *its territory can spread to the limits of its event horizon.* According to this concept, each *event is a source of waves* …, and each of these *sources can have more than one associated type of wave*. For example: a building has different impacts, such as different functions, a visual impact, create microclimate effects, transmit acoustic effects, etc. Therefore, for a building like this, in quantum metaphor the overlap of the associated waves (event horizons) becomes more than spatial systems. They produce *interference patterns … qualitatively and quantitatively different from its parent waves ...* that may create *resonance, interference, or annihilation* (Arida, 2002 pp. 149-151). The concept of event and the associated event horizon is one way of visualizing the non-material aspects.

Under such approach the city is considered as *malleable energy field* and not only as a physical entity to be sterilized by zoning schemes (let's remember Alexander's concern again). This means that each event has in addition to position a number of associated event horizons representing the limits of territory where the event is spread through its respective associated waives; or we can speak about combined spatial horizons (p. 209). Therefore, the territory is *filled with probability wave that describes the propensity of the field to change* (p.150). This is the reason why in the quantum reality, the whole is not simply the sum of its parts, but *is an unbroken web of overlapping or correlated internal relationship* (Zohar and Marshall, 1994 p. 62). It includes also this invisible local/non-local network of relationships.

Under such approach, users acting as designers*, become a vessel for non-locality*. *When* the *effect of an event is felt outside its event horizon, we can think of this as a non-local effect*. As Arida argues, this effect is transmitted most of the time by an important duality: *human user and his or her memory*. This is so because the user stores information, interprets and *takes its effects even beyond its spatial and temporal local* (p. 153). *The brain models the world around us by overlapping two mental constructs*: perceived space, or the mapping of external stimuli; and cognitive space, or a set of internally generated information (p.157). Therefore, shaping of the environment is more than physical. It includes *addition of memory and meaning to it*, and the *shaping of the cognitive space inside our mind*. *It involves the psychological and the physical shaping of our behavior* … because *the environment shapes us as much as it is shaped by us*. In this sense *space is a field of information* (Arida, 2002 pp. 160-161).

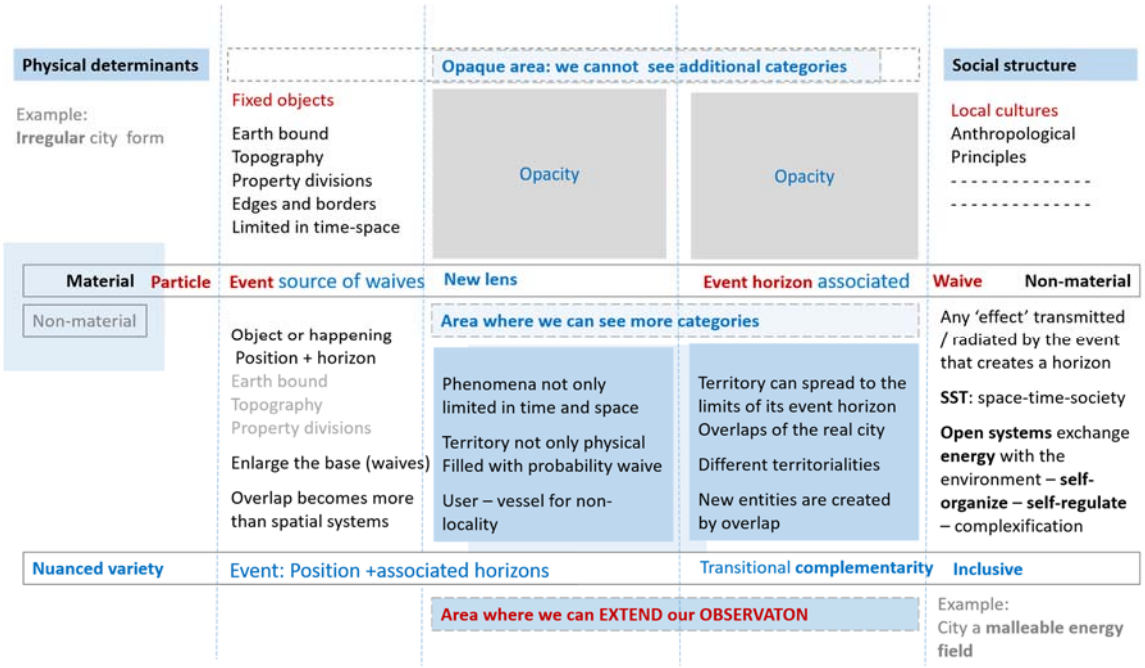
The high degree of incoherency in Tirana, (both, at urban and architectonic scale) is due to the interference patterns of human user coming from different areas of the country with different

cultural background, and the use of their memory store as an *adaptation exercise* (p.161). They carry the memory in the form of information that can be a fixed idea, a frustration, a project, etc. Then the resulting effect is a local interpretation. The exploration of the creative role of the user's mind can help to identify the hidden principles, the order, or the essence of the pattern.

While the shift from physical determinants and social structures to material and non-material aspects may sound only as a matter of jargon, it is in fact an important conceptual shift. This shift to more generalized categories enables to introduce sub-categories (or nuances) which are useful to enlarge the base for better observations and analyzes of urban reality. For example, categories such as those of event and the event horizon, pushes us to look for reason(s) related to the associated wave(s) effect of an event, and most importantly to look for these reason(s) beyond the physical territory, and beyond the current space-time-society of an object. Therefore, the "territory" is not a physically limited entity: it can "exceed" its limits, and it can "exist" beyond the local time-space. It exists in a Society-Time-Space; This is an important shift that considers the city as a malleable energy field that creates the propensity state of the system to change. In the historic analyzes presented in the 2nd chapter, it was presented the influence (or the event horizons of the associated wave effect), from other cultures as a non-local factor (that exceed the time-space), in the foundation and transformations of Tirana. For example, the system of *kulliye* in Tirana was a typical associated event horizon, representing the limits of territory where the waves associated with the Ottoman *kulliye* as the original event were spread. In this case, *Kulliye* understood as an event, has the origin from different societies, spaces and times. The resulting effect: Tirana's *kulliye*, is a local interpretation in terms of Society-Space-Time.

However, in reality most of our thinking is still based in an atomistic approach to planning and design. According to this logic each element is thought as a single particle with one clearly limited position in time and space; Thus instead of speaking about interaction of a multiplicity of factors, we still speak about fixed edges and borders. Shifting to the idea where each event has in addition to its position a number of event horizons representing the effective territories of the different waves associated with it, requires a new mindset based on the logic explained in this section. Most importantly, this new mindset that emanates from the particle-wave quantum duality, adds more significance and meaning to the observed phenomena without denying the importance of the previous analyses related to physical determinants, social structures, etc., Contrarily, by combining both approaches a much deeper understanding of subtle elements, being those material or not, can be reached.

A workshop CompleX_City organized under the framework of this research, experimented about these topics, and their effect on the quality of observations and analyzes. Among other, the workshop insisted to "catch" some traces of the "natural city", beyond official Tirana; The results helped to better define the samples which are analyzed under this research. The observed geometric and morphological "imperfections", the overlaps of human activities, the frequent change and the precarious equilibrium of the samples, to name a few, were some initial elements to trigger a more detailed and focused pattern analyzes carried out during the further stages of the research, presented in the 4th chapter.



3.1 Conceptual shift: enlarging the base of observation

Planned and unplanned cannot satisfy complexity (Kostov, S. 2003)

Organic and planned cities

Let's go back again to the physical city and try to understand some other characteristics of natural cities. For Kostov there are two kinds of cities: *the planned or designed or "created" city* and the *ville spontanee* (Lavedan in Kostov, 2003 p. 43). The first, is mostly characterized by geometrically ordered patterns following *a grid* or *centrally planned scheme*. However, even in these cases we find also a more complex geometry composed by *modulated and refracted combinations*. This kind of city is *set down at one moment* and its pattern is determined by an overall controlling authority. The second kind of city, the *spontaneous* one, unlike the first or the "imposed city", is often called as "*chance-grown*", "*generated*", or "*geomorphic*". Their form is *irregular* and "*organic*", created by a prevalence of the warped curved streets, and a random distribution of the open spaces (Kostov, 2003 p. 43). Another characteristic of unordered arrangements are the *straight street segments crossing at random angles, and linear elements broken with frequent angular* turns. This kind of city is presumed to develop without benefit of designers, but to be guided by some physical determinants and social structures such as the preexisting lay of the land, and the daily life of the citizens. The passage of time gives way to an "*unplanned evolution*" or "*instinctive growth*". We may favor or condemn the characteristics of each of them depending whether we value the discipline of the visual order or the randomness of the unplanned city, responsiveness and *flexible evolution of its form*, etc. However, as Kostov argues the simple formulas about *planned* and *unplanned* cities cannot satisfy a complexity of factors concerning the fluctuation of the urban form (Kostov, 2003 pp. 43, 44). These concepts are quite relevant to observe the organic patterns in Tirana. More details about this are given in the next chapter.

Kostov makes also a nuanced distinction between the *irregular* understood as the *result of development left entirely to individuals who actually live on the land*, and organic unplanned that would be if in the same situation government *would divide the land* and organize it *before it is handed over to the users*. In the second case *a uniformly patterned city would emerge* (Kostov, 2003 p. 43). This situation is somehow similar with some cases of the New Organic pattern analyzed in the next chapter, where government subdivided the land, or set some subdivision rules before distributing to the users.

Continuing with this kind of nuanced distinctions, Kostov brings under attention the expressions of "*planned organicism*", *or less awkwardly* "*planned picturesque*". He argues that similar *deviations* from the geometrically ordered patterns, or *playing* with rules we may find sometimes even in the *intentionally planned towns*. This planned-unplanned duality of the urban form was used since early 19th century to create *artfully designed* layouts and *to avoid the rigidity of geometric abstraction* (Kostov, 2003 p. 44). As such, this kind of *self-conscious* rephrasing of the organic cities that modulated rigid geometric elements with randomness of the organic city, was showing *preference for curvilinear street system* and the *broken line* (Kostov, 2003 p. 45). At this point, it would be worth to clarify that my call at the beginning of this research to overcome or abandon the seriality and rigidity of the planning and zoning systems has nothing to do with this kind of "*planned organicism*" that mainly remains to gestures and formal aspects.

Continuous effort for adjustment and steps in the deregulation process (Kostov, 2003)
Planned and organic *often exist side by side* as interlocked *puzzles of premeditated and spontaneous* sectors. This intimate relationship between them evolves and *metamorphose[s]*. In the *continuous effort for adjustment* there is no permanent dichotomy between *regular from irregular*. As Brownfels (in Kostov, 2003) reminds cities "*are the result of a self-renewing power of design"*. Because of that *the reworking of prior geometries over time leaves urban palimpsests* (Kostov, 2003 pp. 46, 47). The latter is an important expression and used also by other authors such as Eisenman. While in the case of Kostov the palimpsest represents the reworking of urban geometries through urban processes, in the case of Eisenman the palimpsest is a design concept where besides the reworked geometries, or geometries created by territorial field forces, are also included imagined and never existed geometries.

There is an interesting and at the same time problematic legible dialectic in Tirana palimpsests (understood in Kostov's terms): within the organic labyrinth network of cul-de-sac and narrow winding streets, a regular grid plan was unconvincingly (and maybe unsuccessfully also) introduced, especially during the communist regime. However, the reworking of this prior geometry by another totally different and imposed one, couldn't erase the previous geometry. Most interestingly, what we observe nowadays is that the old geometry is reemerging but in a different way and with quite a sophisticated modality (an interference pattern if we want to express in quantic language). In the next chapter I will describe this phenomenon into more details and I will introduce the label of "recording over" to designate this specific pattern. This kind of reemerging has a lot to do with what Kostov calls *steps in the process of deregulation* (2003 p. 48). However, in the case of Tirana, this pattern grew not only where the geometric grid was imposed over the organic areas during the fascist and communist regimes, but also in the cases when the geometrically designed blocks were built ex novo. In both cases what began as a geometrically regulated built form was worn and corroded starting from the uses along the

main formative lines. Kostov describes three main headings (2003 pp. 48-51) for this *disintegration* which is also quite relevant to understand some similar situations in Tirana.

First: people *are not inclined to make right-angle turns as we go about from place to place*, because *the grid is inflexible in terms of human movement*. Therefore, *the freeing of movement from geometric order* is an important de-regulative factor. It is interesting to analyze the influence of this factor in parallel with what happened in Albania after the collapse of the dictatorship in '90s. In a specific section of chapter 4, it is shown how people's tracks, crossing the unused or left-over public spaces formed the Recording Over pattern (Kostov, 2003 pp. 48-51).

Second: deregulations related to the shifts between different cultures. In this concern Kostov compares *Roman* (where families are located in blocks or *insulae*) and *Islamic towns* (where *population is grouped itself into neighborhoods according to kinship, tribe, or ethnicity*). While the Roman grid is *outer-related, the Islamic "block" is involute-d*, because the *through-streets* constituted *the dividing lines among these socially exclusive units* internally closed. Therefore, in the *Roman gridded towns inhered by Islam* (Damascus, Merida) the outer-related Roman grid was transformed in involute-d Islamic block, where the blocks' internal space and the public places were *reduced trough progressive infill*. These concepts are adapted in analyzing the Recorded Over pattern, parallelizing the deregulation caused by the shifts between different cultures with deregulation that happened in Tirana after the collapse of the dictatorship (almost back to 'tribal' communities) (Kostov, 2003 pp. 48-50).

Third: Pressures of *new public foci* (castles, cathedrals, etc.). The emphases of this pressure on the urban fabric *tend to pull the circulation net toward themselves*. As a consequence, the pressure coming from the traffic flow causes *permanent dislocations*. Therefore, *earlier streets* related to previously important foci *will decline or atrophy* (Kostov, 2003 p. 51). The grid as more rigid geometric form is vulnerable to the change of the public foci. Historic and morphologic analyzes, bring evidence that because of an extremely emphasized radio-centric scheme (organically and reinforced by design) the main public foci remained the same for long in Tirana. However, some new secondary public foci were established, and this was what mostly pressured changes in the urban fabric.

Organic city under Fractal city perspective - Beyond the unplanned (Batty, M. & Longley, P. 1994***)***

Emphases on the way cities grow and coordinate at the smaller scale; Scale variance; Organic city and the city of pure geometry

It is important to clarify here that when we say irregular form of the city, *we do not mean that it is disordered or chaotic, but that it is not smooth* (uniform) *in the sense in which Euclidian geometry articulates the world* (Batty and Longley, 1994 p.3). As these authors state in "Fractal City" irregularity conflicts with our predisposition to think in simplistic terms (p.8). These statements are very important to refine the concept of the organic city according to the concepts of the fractal geometry.

From the perspective of Fractal City, defining organic cities merely as unplanned in contrast to the planned ones, is more a hindering factor than a help, as *this represents only the most*

superficial of reactions to the urban form. Beyond the fact that organic cities do not show signs of planned geometry, Batty and Longley (1994) prefer to stress the fact, that they are product of *many detailed and individual decisions which have been coordinated in the small*. In this way they try to *avoid any association between organic cities and the notions of uncoordinated or uncontrolled growth*. As these authors state, they follow the spirit of Kostov, who characterizes this kind of cities as '*chance grown', 'generated'* … (Batty and Longley, p. 28).

Organic cities adapt to individual, social and economic preferences, to the constraints of the natural landscape, and to the dominant technology of the city. In fact, cities in general display a mixture of both, organic and pure geometry. According to Batty and Longley (1994 p.31), despite the fact that more than 95% of cities which exist and have existed are more organic in their form, in the education of the city planners the dominant model is the geometric, and cities planned at the large. However, the different levels of organizational control that exist in the present-day city, create *elements of 'conscious' planning on at least one level in every town …*

Organic cities are inward looking and mostly based on a pedestrian logic. Although they display some regularities due to the straight lines property demarcation lines, as Batty and Longley state, *the visual quality of such organic development … it is in terms of its informality, its idiosyncrasies and its picturesque properties and occasionally in its exploitation of the dramatic natural features, but never in terms of power of its geometry* (1994 p. 35). The paradigm of the fractal cities tries to overcome the concept of disordered cities: this type of form reveals a degree of order which is considerably deeper than the superficial order associated with the city of pure geometry. As authors of this book states principles of fractal geometry are relevant to cities of any time and any culture.

Principle of history and culture
The concept of organic is not independent of history or culture. Before the industrialization period cities were small and compact, in contrast to what was created by the urbanization processes of the two last centuries. During the Middle Ages we began to see a consistent solid organic growth, but *the explosive growth which characterizes present-day cities only began in the early 19th century*. … *In history organic form is associated with slow growth*, *gradual accretion* … and *gradual replacement and renewal* of cells. The present-day cities are *more dispersed* and the use of land represent a real nuanced variety of functions. This changes also our older conception of organic growth as slower growing cells. Countries where *social and economic norms are closer to those of the past* … *still generate cities which are organic* (Batty and Longley, 1994 p. 32). Albania has its own characteristics related to that. As explained in the 2nd chapter, up to the end of the Second World War Albanian cities were characterized by a very slow organic growth and an extensive city structure. This was also due to the fact that Albania didn't go through the industrialization process at the same pace like most of the developed European countries. Up to the collapse of the communist regime in '91, the organic growth was "frozen" because everything was centrally controlled. The organic growth reappeared again at the beginning of '90s, and with a very high magnitude which made it completely different from the historic one. More details about these phenomena will be given in the next chapter under the labels of Historic Organic and New Organic patterns.

Principle of scale
Another important issue for this research is the way haw the *organic and geometric principles of urban form vary with respect to scale*. What might appear to be ordered in terms of pure

geometry at one scale, might appear not true in another scale, where individual arrangements at the smaller scale prevails. Therefore, zooming in and zooming out is applicable in the fractal geometry to explore the different orders hidden at each level of the city hierarchy (Batty and Longley, 1994 p. 33). In the case of Tirana, after the organic growth phase, a geometric radio-centric scheme was laid over the city. Most of the developments at the urban scale (infrastructures, important buildings, urban "Walls", etc.) respected this scheme, in parallel with the previous organic one. This logic is particularly useful to discover and observe the "irregularities" at the finer scale.

3.1.b Typology and typological instruments; type as a pliable diagram to inform the urban plan
(Under the perspective of: de Quincy A-C. Q., Durand J-N-L, Rossi, Eisenman, Ungers, Alexander, Rowe and Koetter, Christopher CM Lee and Sam Jacoby)

After introducing some concepts about urban processes and city shaping, organic or planned; understanding some aspects influencing the form, being those material and/or non-material aspects; and interpreting the city as a malleable energy field; etc. it is worth now to go through some of the main theories that see the city from a more formal position, or as a structure of parts, and better understand how all that is molded in the urban morphology. Typology and type are two important concepts that will be presented from different points of view, including some contemporary and foregoing positions. As we will see in some details in the following paragraphs, typology and type, serve not only to have a deeper understanding of the urban morphology, but also to inform its transformations. In this section I will introduce also some concepts related to the fractal structure of the form; that see it as a system-structure organized in hierarchies and decomposed in elements; this will help further in the research to discover the order beneath of what looks to be chaotic in its superficial.

Resurgence of type
Recently the discourse on the typology and typological instruments has been revived. The AD (209, 2011) on *Typological Urbanism* edited by guest editors Christopher CM Lee and Sam Jacoby, bring under attention several important issues concerning this discourse that are relevant for my research. As Helen Castle states in the editorial of this AD issue (2011 p. 5), *the resurgence of type in architecture indicates a desire for syntax or underlying order*. Quoting Bos C. and van Berkel B., Castle (2011) remembers us that type provide a '*legacy of rationality'*. Type *endows architecture with coherency, logic, and structure* and especially in complex and unstructured urban situations offers order. Most importantly, what is with particular interest for my research, typological knowledge has to do with *architects' ability to assert themselves in the city*. As Castle continues, citing Serie Architects '*the notion of type as operative theory is generic enough to overcome differences and specific enough to engage and index the cultural, social and political nuances of its host*'. As such, it has the potential to be *both universal and local, providing architectural solutions to urban problems*. Type requires to look for *commonalities and similarities between built form*, or identify *the essence* in the built form. Even in all what we said so far there are a lot of concepts and language echoing from the precedent works related to the theory of type and its relationship with the city (Rossi, Ungers, etc.), most importantly what Lee and Jacoby demonstrate in this issue of AD is that type *lends order* … but *also provides the essential catalyst for innovative design thinking at the city scale* (AD, 209, 2011 p. 5).

In the introduction of the guest editors Christopher CM Lee and Sam Jacoby, *Typological Urbanism ad the Idea of the City*, they are inclined to the idea that *typological urbanism* can be seen also as an attempt to recover architecture relevance to the city and *re-empower the architect in the context of urban architectural production* ... In fact, the introduction itself and also recent projects they use as illustrations, bring evidence about the potential to use the *notion of type in informing the idea of the city* (AD 209, 2011 pp. 17, 19).

Speaking about *type and typology* they remind us the same definition of type in architectural theory from de Quincy A-C. Q. (1825) as *the idea of an element which ought itself to serve as a rule for the model*, therefor type is something *abstract and conceptual rather than concrete and literal*. Differently from the concept of type as an idea, Durand J-N-L (almost in parallel with de Quincy) developed the idea of *type as a model*. He worked a *systematic method of classifying buildings according to genre* and type for him could be graphically reducible *to diagram*. He also introduced fundamental precepts to work typologically*: precedents, classification, taxonomy, repetition, differentiation and reinvention* (AD 209, 2011 p. 19).

These authors bring several examples to illustrate their idea. Thus, UN Studio is engaged to argue how *typological instruments* can *connect architecture and urbanism*; how the *utilization of design models* can *synthesize types with the complexities of practice and reality*; and how these models should be capable of their *transformation and hybridization in order to fulfil the … requirements of an architectural project in an urban context* (AD 209, 2011 p. 19). In the same direction, Carl, P. in *Type, Field, Culture, Praxes* clarifies that '*types are isolated fragments of a deeper and richer structure of typicalities'*, *attempting to relate the architectural object to human situations* (p. 20).

This opens a discussion on the relationship between the typology and the urban plan. As Lee and Jacoby (2011 p. 20) write, the *instrumentality of type … lays in its ability to act as a pliable diagram, indexing the irreducible typal imprints that serves as the elemental parts to the plan.* These diagrams … *embody the basic organizational performance, history and meaning of precedent types that are then developed into new design solutions*. In fact, most of the cities can be explained and described through some dominant types (Manhattan skyscrapers, Tirana Recording Over, etc.). As Rossi argues buildings as '*permanencies*' act as *typological repository* of a city's history, construction and form (p. 21).

The discourse on typology and typological instruments, and their role as a pliable diagram informing the city plan, touches upon a delicate topic to be discussed in the context of so many failures and disasters caused by the regulatory planning instruments. My research lays in the area of criticism to deterministic city planning methodologies. Then, we naturally may question the need of the typical rigid and bureaucratic urban planning approach. But, are the refocusing on typological instruments; or the relationship between the typology and the urban plan; or the reinvigoration of the role of architect, etc. as presented in this section, some of the directions to look for? In a situation where the gap between the architecture and planning is deepening, do we need to better explore and be more open to strategies of city development in concomitance with the idea of city as an architecture project and large-scale design? And if yes in what way?

Foregoing theory and ideas about type and typology

Most of this language originate much time before the recent discourse on type and typology. It is worth here to highlight some important preceding concepts.

The Architecture of the City (Rossi, 1966)
Rossi's book was a response to a general concern manifested during 60s about difficulties to solve the crises of the city within the functionalist principles. One of the crucial arguments brought by Rossi in "*The Architecture of the City*" (1966) was the importance that he attributed to the architectural form. For him buildings are independent from their functions and functional reduction as a simplistic logic prevents from other knowledge such as, formal, historical and sociocultural (1984 pp. 46, 47). Type for Rossi is '*developed according to both, needs and aspiration to beauty; a particular type was associated with a form and a way of life, although its specific shape varied widely from society to society. The concept of type thus became the basis of architecture…*' (1984 p. 40).

For him the city was neither a subject to be approached with the economic logic, nor a mechanical object resulting from summing up its function. Contrarily, for him the city ought to be approached with the means of the city itself, which is *the architecture of the city*. For Rossi each architecture reincarnates in itself an event or an urban fact. Therefore, even the city as an artifact which is built over time contains traces, that sometimes may be also discontinuous. With the notion of traces is related the concept of *permanencies* as the past that is being experienced in the present and intimately tied to the city; and the concept of *persistence* as constancy of themes (physical structure, streets and urban monuments), which serves as generator of the plan (Rossi, 1984 p. 59).

Rossi speaks also about *locus*, as the *site of succession that like permanence is determined not just by space but also by time* (Eisenman introduction in Rossi, 1984 p. 7); Locus as *the relationship between a certain specific location and the buildings that are in it* (Rossi, 1984 p.103); that *begins in the event and in the sign that has marked the event* (1984 p. 106) (very near to quantum logic). In this concern, he argues that contextualism is an *empty* formalism, reductively seen as a relationship of figure and ground (Rossi, 1984 p. 123). For him there is a dialectic relationship between *permanence* (monuments) and *growth* and their characteristic to adapt. (Rossi, 1984 p. 60).

Rossi brought under attention also important dualities such monument-urban tissue, and most importantly morphology-typology. For him the city is connected through the typological structure as part of the urban structure. In fact, it was in the dialectical relationship between the urban morphology and typology that Rossi saw an important instrument that could be used to solve the crises in favor of creating better urban environment. This was quite revolutionary after the period of modernist planning and urban design totally excluded these concepts.

As Rossi repeats often in his book, he is *concerned with the architecture of the city*, with *its form*, *which seems to summarize the total character of urban artifacts, including their origins*… *This is in part what he means urban morphology*: *the description of the forms of an urban artifact*. As he states, this *draws us closer to a knowledge of structure but is not identical with it* (Rossi, 1984 p.32). According to him, *this permits a specific reading of the city as architecture of different parts* or components … *principally the dwelling and the primary elements* (1984 p. 61). Thus, the city as a structure of parts possesses *primary elements* around which buildings aggregate. The *dwelling area* (1984 pp. 69-72) as a piece of the city with a certain physical and social homogeneity is intimately related to its evolution.

Particular interest stays in the Eisenman's interpretation about typology as process, as the *effect of memory on type which allows for the new process of design* (Eisenman introduction in Rossi, 1984 p. 8). The type / object transformed by memory *embodies both an idea of itself and a memory of a former self* (Eisenman, 1984 p. 7). Thus typology is seen as *animating force of design … a catalyst for invention* (Eisenman, 1984 p.8). As we saw, a similar concept was presented also in the AD issue 209 (2011) in the context of reinvigorating the typological instruments.

The concepts related to the city as an historic process and structure of parts have been important to reconstruct the urban process of Tirana based on the relationship of the history and typology, as well as to understand the morphological structure, the role of permanencies and persistencies, and the degree of discontinuity or broken relationship in the process; to understand the various cases of the dual relationship between building typology and urban morphology: such as cases when the building structure is *detached from the form of the district* and does not follow the historic lines, and cases when the typological aspects of the houses which manifest a local culture, are *closely bound up with urban form*. In many cases the form of historic neighborhoods/ *mohallas* was mostly lost and morphological tensions were created because of this situation. These concepts are used in the 2nd chapter dedicated to historic analyzes and also in the 4th chapter dedicated to sample analyzes to designate and refine the selection of the samples.

*Ungers' and the rationalization of the existing (*Hertweck, F. and Marot, S. *2013)*
For Ungers architecture … *is the creative expression of the "vital clash between the active individual and his environment*": "*architecture is a vital penetration into a multilayered, mysterious, evolved and structured reality. Its creative function is to … integrate itself into that which already exits, to accentuate and amplify its surroundings. It always consists in the recognition of the genius loci out of which it grows*." (Ungers and Gieselmann 1960, in Hertweck and Marot, 2013 p. 26).

In terms of urban design (early sixties), Ungers' projects demonstrate *profound empathy for the situations that they reshape* … Typologies *are … rationally inflected* (modulated) *on the basis of logics and syntaxes abstracted from the existing situation*. This method that Ungers later described as the "*rationalization of the existing*" consists in the reinterpretation and rationalization of the morphologies that *provide the underlying themes* for the proposed configurations. For Ungers, *the site is the essence*, *the … material of the project*. He *entered in interaction with history* … not in the *way that could be said to 'take into account the old city'*, but also *drawing upon history for formative principles that could be transferred to the present* (Hertweck and Marot, 2013 pp. 26, 27). Ungers has much in common with Rowe, however he believes *in architecture ability to embody and intensify the site*, much more than Rowe's formal bricolage that reconciles the masterpieces of modern architecture with the ancient city (2013 p. 29). For Ungers, all interventions are *imaginary museums, forums of contradictions, Noah's Arks* sheltering the genetic heritage of architecture, in order to survive functionalism (2013 p. 27).

Ungers and Rossi bore the conviction that architecture is a *cultivated art*, rich with precedents such as *concepts, forms, and figures, capable of teasing out from reality … typologies to inflect … or latencies to reveal*. In his text '*Planning criteria*' written in 1976 he sustained that one of the most significant architectural principles was the *dialectical relationship with existing reality*, the *ambition to intensify the place*. However, what makes him different is the *ambition to overcome*

the dramatic tension between the rational order and the … contingency … nature of the real (Hertweck and Marot, 2013 p. 36). For this, Ungers uses his concept of *morphological urbanism*: he transposes *all the ingredients of the Genius Loci (blocks, streets, avenues, the park) …* precipitating them *into a kind of laboratory in which their process of evolutive metamorphoses is accelerated*. For him *the imagination is the principal faculty that makes it possible to extract from reality patterns or images that can be in turn manipulated and transformed.* (Hertweck and Marot, 2013 p. 37).

Ungers focuses also in the topic of the block and *urban villas* that … can *regenerate with materials drawn from its own genetic code an urban fabric threatened by decline*. Urban villa is an *architectural organism*, … alternative to the standard models, *that synthesizes the gen of urbanity*, *a micro city, a "city within the city"* (Hertweck and Marot, 2013 p. 39).

The above paragraphs are an inspiring guide to penetrate into the multilayered city phenomena and to explore the dialectical relationship between the built form and the reality in each city, including Tirana. In a similar way, among others, this research is an attempt to empathize with the situation that is trying to reshape, abstracting from the reality latencies of the genetic heritage, logics and syntaxes, or different motives with the ambition to intensify the site. Other important issues concern the exploration of Tirana's precedents that synthesize the gen of urbanity (mëhalla(s)); and the identification of ways that contribute to overcome the dramatic tension between the proposed city and the real Tirana. The solution potentially aims to be something which is more flexible than the formal bricolage, or than the "precipitation" of the ingredients in morphological urbanism, but an adaptable model to the changing needs of individuals and society. The research goes in this direction.

A Pattern Language (Alexander, Ch. et. al., 1977)
One of the concerns of this research is to understand the specific pattern languages in Tirana. A reference to enter into the logic of this language is the book of Alexander, Ch. et al. (1977) "A Pattern Language". They observe that most of the wonderful places of the world were made by people. Unless people *share a common pattern language* (1977 p. X), buildings and towns would not be able to come to life. Thus, the logic of the patterns is distilled from the practice that values the life experience and human freedom. Planning, design, or architecture can improve or limit this sense. These ideas are also in line with this research.

According to Alexander et. al (1977 pp. IX-XXXV), *patterns* as entities *are elements of the language* (p. X). In this line, they propose *a pattern language* composed by *253 patterns* (hypotheses), each of them a timeless entity. These patterns provide schemes for designs starting from the entire regions, cities, neighborhoods, clusters, gardens, buildings, rooms and furniture. They argue that *each pattern describes a problem which occurs over and over again*, but at the same time *describes also the core of the solution to that problem*, in that way that this solution can be used infinitely, without being repeated in the same way (p. X). While the problem *describes the empirical background of the pattern*, the solution describes the essential *field of physical and social relationships which are required to solve the stated problem* (p. XI) *… in a very general and abstract way* (p. XIII) in order to allow for adaptations to local conditions. Essential in this case is used in the sense of capturing in each solution *the invariant property common to all places* (p. XIV), or these things that *cannot be avoided* (p. XIII). In their view, *each pattern represents … the best guess* about the arrangements of the physical environment to

solve the problem (p. XV). In this concern, pattern language is important *to understand the nature of the building process* (p. IX).

Each pattern is connected to other patterns, so with the whole collection of 253 patterns can be created *an infinite variety of combinations* (Alexander et. al., 1977 p. XI). Therefore, patterns are not *isolated entities*. According to Alexander et. al., the nature of connecting between patterns is based on a *straight linear sequence* (p. XII)*:* each pattern is connected to *the larger patterns in which it is embedded*, coming above it in the language; *the patterns of the same size that surround it*, and to *the smaller patterns which are embedded in it* (p. XIII), coming below it in the language. This nature of connection, from the larger patterns to the smaller ones, gives to the language *the structure of a network* (p. XVIII). The *sequence of patterns is the "base map" from which you* [we] *can make a language* (p. XIX).

In my research patterns are considered as regular and intelligible sequences creating legible systems that are significant for the way Tirana's neighborhoods are created. In fact, the historic and morphological analyzes presented in the 2nd and the 4th chapters, consist in the investigation of the site specific Tirana's condition and its influence in the patterning models. Even in this case, patterns not only have a linguistic significance as in Alexander's view, but are entities owning site-specific essential qualities which can be further decomposed in elements that contain the ordering principles of the system-form. Under this perspective patterns are considered as a structured logic able to give life to a potential model to work with and to be further manipulated. In my research, patterns, more than solution under the condition of invariant properties, i.e. common to all places and to all ways of solving a problem, are (initially) culturally and anthropologically specific solutions, however transformable within the Society Space Time (SST) construct. In this respect, initially I'm dealing more with what is unique and shared experience within a site-specific society condition, and then work on the ability of potential transferability of similar logics within the SST frame. This is also an illustration of what Alexander et. al. (1977 p. XVI) state that each country, every society which is alive has *its own unique and distinct pattern language*. While in this book, they speak about *problem* and *solution* described by patterns, in my research I analyze and present the motive and the modality or social norms (as well as other triggering factors) that give birth to a pattern. In addition, the authors of this book do not see this as a closed language; contrarily they invite to enrich the language with other experiences and observations.

In my view, the patterns I present, such as "Historic Organic", "Recording Over", or "New Organic", are what Alexander et. al. considers as sequence of patterns, or as part of the whole language. As they say, the sequences of patterns are connected with "larger" patterns, such as those dealing with the "*mosaic of subcultures*", "*magic of the city*", "*subculture boundary*", "*identifiable neighborhood*", "*neighborhood boundary*", etc., and other "smaller" patterns which stay within them, such as "*sacred sites*", "*access to water*", "*man and woman*", "*activity nodes*" (Alexander et. al., 1977 pp. XX, XXI), to name a few. After understanding regularities that a pattern is made of, it can be translated in a set of instructions to be followed for the construction of a model. This logic of the patterns that are focused on life experience is extremely useful to be investigated in the specific case of Tirana.

Formal analyses, coexistence of different models, inclusive reasoning (Rowe and Koetter, 1978)
"*Collage City*" is a research work carried by Rowe, C. and Koetter, F. (1978), as an anti-utopian and revised version of Modern Movement urban design. Analyzing the failures of the city of modern architecture, they invite for solutions that support coexistence of different models and bring arguments in favor of a more open and inclusive approach as alternative to the abstract modern proposals. Eclectic, hybrid, juxtaposition, and sanitation of chaos through collage technique, to name a few, are presented as formal remedies that conduce to a more diversified urban environment. According to them the situation to be hopped might allow for the *joint existence of the overtly planned and the genuinely unplanned, of the set piece and the accident, of the public and the private, of the state and the individual* (Rowe and Koetter, 1978 p. 83).

From their rigorous formal analyses, contrasting figure-ground images of architectural and urban modernist proposals, with the rich and continuous textures of traditional historic urban contexts (ex. Unite d'abitation vs Ufizi Gallery), they bring into attention important design principles such as this of *urbanistically* active model, meaning to be *responsive to the close context* and *engaging empirical circumstances*, and at the same time defining an *ideal world*; *reconciling … self-conscious order and spontaneous randomness*; … *conferring value upon both new and old* (Rowe and Koetter, 1978 p. 68); or analyzing Asplund they speak about the use of *multiple design strategies*, that simultaneously combine the *empiricist reacting to site and the idealist* one; behave like *passive recipient and active reverberator* (Rowe and Koetter, 1978 pp. 72, 77).

The inclusive reasoning based on the acceptance of the reality, the coexistence of all potentialities that the city contains combined with the inspirations coming from history, hybrid and juxtaposition, are some key principles adopted by this research, especially during the historic analyses. However, beyond the inclusive logic which mostly remains in the formal aspects of the collage technique, the research tries to explore deeper in the meaning and motives of the different pieces of Tirana's collage, positioning it in a society-space-time frame; understand how and why these pieces inform, form and deform each other in order to use this information as a formative principle for a more conscious urban design.

As we mention above, Rowe stays in a more formal position focusing its analyses almost exclusively in the syntactic phenomenon and diminishing the importance of the relationships that architecture has with the society, construction and history. In fact, his examples are trans-historic. Instead, Ungers and Rossi tries to see internally and more in depth in the form of the city. Rossi does this through the idea of *typology* as process in architecture (let us remember again: the type transformed by memory; typology as animating force of design, etc.). Ungers does this through the idea of *rationalization of the existing* in order to provide the underlying themes abstracted from the existing situation, and using them to intensify the place through the new proposals (let us remember also the design of Noah's Arks to shelter the genetic heritage, and other concepts elaborated in the respective paragraphs).

Form under the Fractal city point of view – the order beneath (Batty, M. and Longley, P. 1994)
Another area where the research aims to go further is the specific understanding of the context, which requires new observation and analytical methodologies. Fractals, chaos and complexity as components of the quantum worldview can offer a theoretical ground for enlarging the base of the observation methodology. Potentially, this can also help to identify responsive solution methodologies in line with these observation techniques: non-deterministic and open-end

design solutions. These kind of methodologies go beyond inclusive reasoning I described in the previous paragraphs, and all-inclusiveness typical for the post-modern period. For this, in the following paragraphs, I start introducing some concepts related to understanding of form under the perspective of the fractal theory. I also present some definitions which play an important role in the further development of the research; for this reason, the paragraphs that follow are quite dense with citations from Batty and Longley.

Further to what we discussed so far, *fractal city* tries to understand the issues of form from a different point of view by going beyond the *physicalism* and concerns for architecture and esthetics, and by including those for economic, social and institutional structures (Batty and Longley, 1994 p. 1). The authors of the book "*Fractal Cities*" Michael Batty and Paul Longley (1994) explain how the *man-made systems develop and are organized*, by using methods from "*geometry of nature*" (1983), as called by Mandelbrot (Batty and Longley, 1994 p. 59). As these authors state, cities provide some of the best examples of fractals. This geometry is crucial to understand and visualize a world that looks *chaotic, discontinuous, irregular in its superficial physical form, but that beneath … lies an order which is regular*, and contain an *infinite complexity* (Batty and Longley, 1994 p. v). Most importantly, looking at the reality from this point of view we can provide a bigger and a holistic picture by tying together more things that before looked unrelated.

Often, architects and urban designers attempted to impose a simple smooth visual order on cities believing that such order would definitely improve the disorder and dysfunction. Imposing a simplistic Euclidian order on the (organic) city represent an example of the man's triumph over the nature. In the present day we are becoming aware that the naturally or organically growing city is optimal in many other ways, and for this the fractal perspective is becoming an important instrument. It can help to reframe the idea about the apparently chaotic urban situation. For example, the irregularity and messiness in Tirana is simply a superficial manifestation of a dipper order. This is also one of the things that this research aims to explore.

Morphology: growth and form; Form and function (Batty and Longley, 1994)
The analytic study of form is always more than it seems at first sights. Starting from Thompson (1917, 1961) who *implies form means shape*, Batty and Longley move more to meanings that involves in the approach to form the *geometry and space, as well as process and function*. White (1968) sums in the notion of form the meaning of *shape, configuration, structure, pattern, organization, and system of relations* (Batty and Longley, 1994 p. 42).

The analytic study of form implies that *form is the resultant of many forces or determinants interacting … through space and time, thus causing the system to evolve* ... (Batty and Longley, 1994 p. 42). As Thompson summarizes it "*… the form of an object is a 'diagram of forces'"* (1917, 1961 in Batty and Longley, 1994 p. 42). In this sense it means that the study of *form* is intimately related with the study of *process which give rise to* the form.

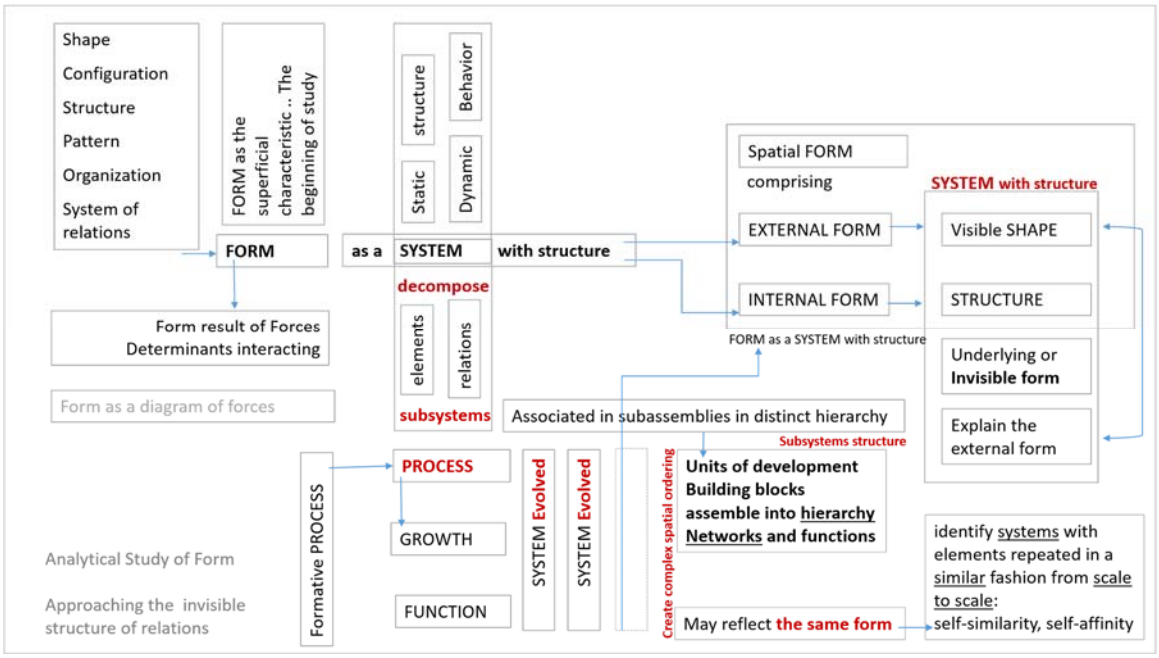
There are two dimensions that come out from the *association of process with form*: *Growth* used in biology and city planning according to which *forms evolve through growth*, and *objects are transformed through the … interaction of their forces*. This *led to the term 'organic form'* which was already analyzed in this chapter. *The second dimension relates to function. The various processes that contain the forces which determine form have specific functions* ... "*form follows function*" of the modern movement in architecture is an example that has been widely

explored especially in the first half of the 20th century. Related to that, Batty and Longley demonstrate the poverty of urban analyses and city planning that remained to such a *rigid interpretation of form* (we mentioned this also in Rossi section). *Morphology is thus the study of form and process, growth and form, form and function*. One of the ways to describe cities in terms of how they grow is by conjoining growth with *spatial forces which leave their marks on the evolution of form* (Batty and Longley, 1994 pp. 42, 43).

As we stated at the beginning form is more than shape and following Whyte (1968, in Batty and Longley, 1994 p. 43) he *speaks of spatial form, which he defines as comprising external form or visible shape, and internal form which is structure*. Therefore, form manifest properties of a *system with structure being the underlying or invisible form which explains the external urban form*. The last one is *subject of our immediate and casual observation*. As we know systems are studied in terms of their *statics* that imply *structure*, or their *dynamics* that imply *behavior*. Analyzing the structure's form, we can infer (deduct) the *behavior* and understand their *dynamics* (Batty and Longley, 1994 p. 43) (Figure 3.2).

System structures … are *composed of elements* as the basic *components* of the system, and *relations … defining the way the elements interact and function*. We can decompose *the system into sets of elements*, *define subsystems …*, which can be associated and arranged *into a distinct hierarchy.* … This aggregation in *subsystems (subassemblies) may reflect (replicate) the same form but at different system levels of the hierarchy (different scales).* This point *reflects one of the principles … that cities are fractal in form* (Batty and Longley, 1994 p. 43).

As these authors state, and as mentioned above, it is important to stress that *system structure can be described by relations organized as networks and/or hierarchies* (Batty and Longley, 1994 p. 44). Therefore, we can approach the urban form through *tracing the 'invisible structure' of relations which underlie the external form or outward appearance of cities* ... It is this invisible structure that can be described in terms of *hierarchies and networks … Hierarchies are basic organizing devices for describing and measuring the importance of urban functions across many spatial scales* (1994 p. 47). … *Spatial hierarchies relate elements of city systems and systems of cities at successive scales where elements of urban structure are repeated in diverse ways across the range* (Berry, 1964, in Batty and Longley, 1994 p. 47). These elements, or units of development, can be a housing block, that *assemble into hierarchy … together with the various communication networks which link …* with other *functions …, which have their own hierarchies and networks*. All this compose a complex ordering that cannot be exhausted within the Euclidean geometry (1994 p. 44). As Batty and Longley argue the main idea of fractal cities is to *identify systems in which elements are repeated in a similar fashion from scale to scale. If this similarity is strong in a geometric sense, then it is referred to as self-similarity or in its weaker form self-affinity* (Batty and Longley, 1994 p. 47).



3.2 Understanding form: the analytical study of form based on Batty and Longley (1994) concepts

A new geometry, scale, hierarchy and self-similarity

We can study the shape of the cities in terms of *simple geometry,* corresponding with what Batty and Longley (1994 p. 55) call the *doctrine of visual order*, and in terms of more *abstract geometrical relations, hierarchies and networks*, attempting a *deeper meaning to spatial order* ... While the *Euclidean geometry* cannot address issues related to the process of growth, the *geometry of relations* … can *unravel the complexity of urban form* by showing how the city is ordered. By tradition we push away any pattern which does not fit the Euclidean-Newtonian analytical sphere. For example, *objects which show the same kind of irregularity at many scales* that have been called *fractals* by Mandelbrot (1983, 1990), are irregular in Euclidean terms because they are not smooth. In fact, they display ordered patterns within this irregularity. Therefore, it would be better to enlarge our concept of irregularity and to accept that there are many types of regularities (Batty and Longley, 1994 p. 59).

Fractal geometry goes beyond a mere description of form by building on the idea of *linking form to function, of form to process, of statics to dynamics.* Fractal geometry *fulfills* Thompson's (1917, 1961, in Batty and Longley, 1994 p. 57) mission about *a geometry of growth and form*. A *geometry of fractions* that poses certain conundrum…; a geometry *of order on many scales*; *a geometry of organized complexity* (Batty and Longley, 1994 p. 57).

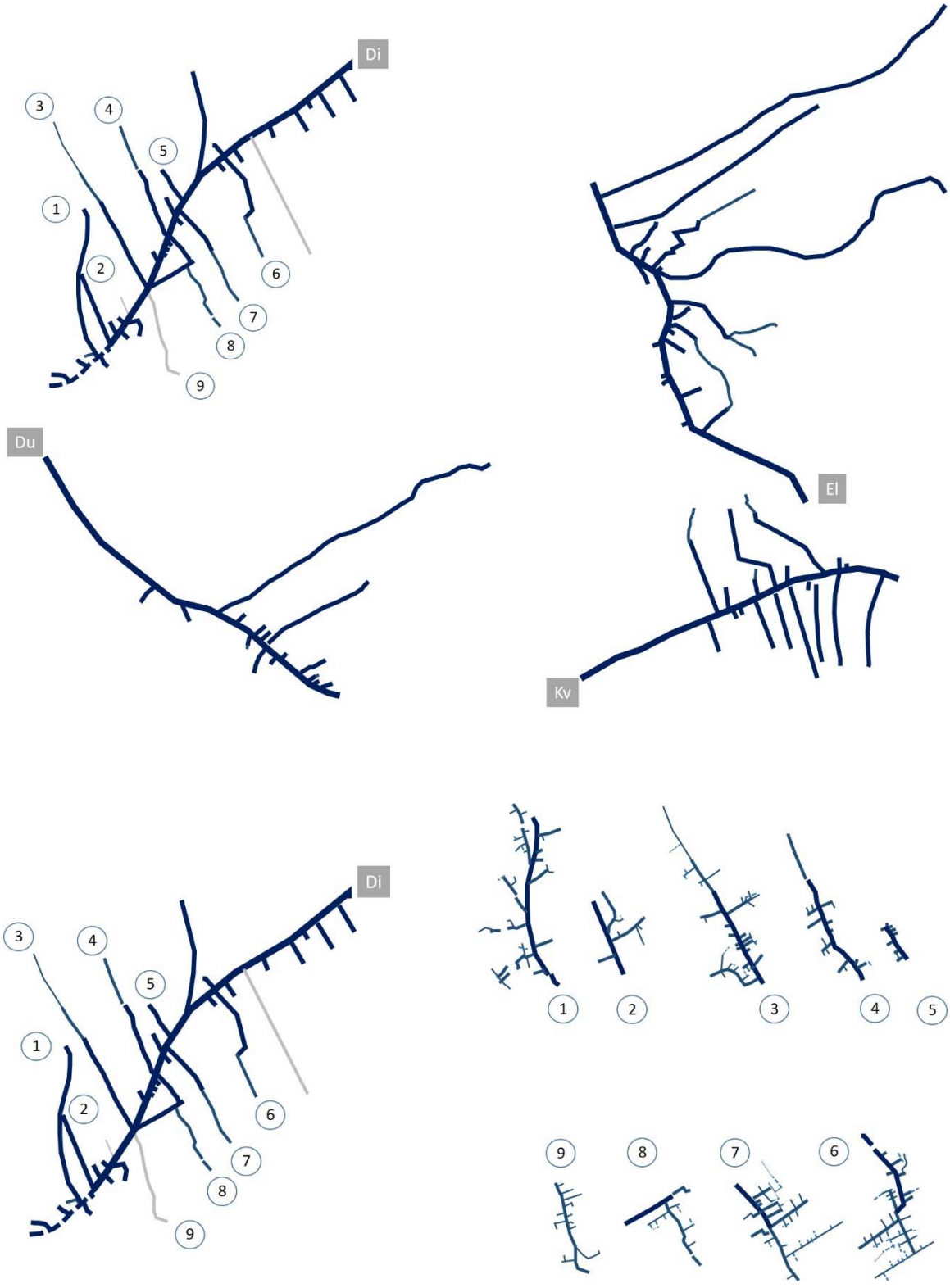
Cities can be better understood if observations include the above concepts. In fact, it is the property of self-similarity contained in the shape and form of cities which drives towards a *new geometry of cities*. This property is created because of the repetition of many common elements across spatial scales (or at different levels of the hierarchy) that create a similar structure (Batty and Longley, 1994 pp. 58, 59).

It is important now to understand how the order within fractals is to be found. Three are the main principles: first, fractals are always *self-similar*, which means they appear to have the *same degree of irregularity* and the *whole will always be manifest in the 'parts'*. Second, fractals can be described in terms of a *hierarchy of self-similar components*, *ordered hierarchically across many scales and the tree is the classic example*. Third, fractals *irregularity* in form, which means *continuous* forms *but nowhere smooth* (Batty and Longley, 1994 p. 60).

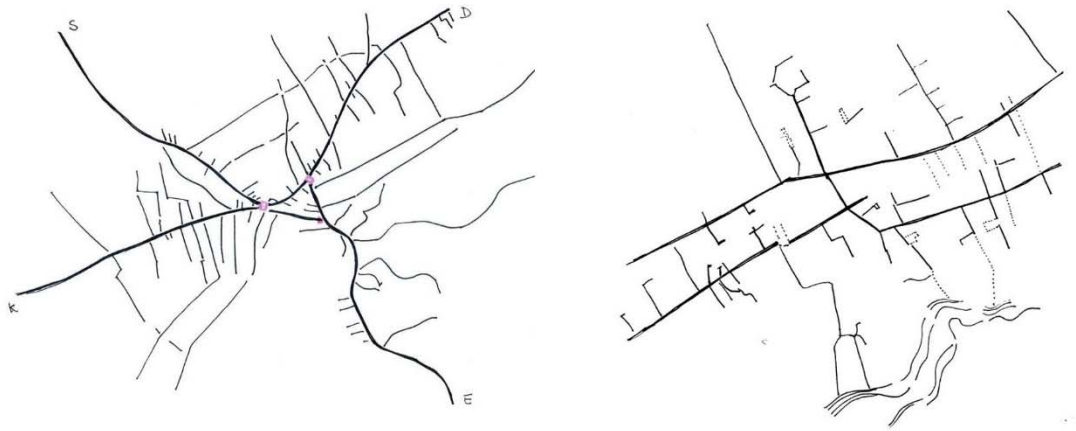
We can define fractals in terms of *Initiator* as a *geometric object*, *generator* as a motive applied to the initiator which *repeats itself at every scale*, and the *cascade* which forms the *process* of application. By *applying the generator to the initiator* the resulting geometric object is *composed of several initiators at the next level of hierarchy* (Mandelbrot, 1983, in Batty and Longley 1994 pp. 61, 62). This recursive process can continue indefinitely towards the limit creating the property of self-similarity. Most of the natural objects in fact manifest *self-affinity* (Batty and Longley, 1994 pp. 62, 63). This property is created by stretching or distorting the object in one direction over another during the application process of the generator to the initiator.

In addition to morphological approaches presented at the begging of this section, the *fractal city* approach is a crucial theoretical lent to investigate the city as an organized complexity. The analytic study of city form under this perspective that considers the city as a diagram of forces that evolves and contains its statics and dynamics, intimately related with the process, etc. expands our understanding, and adds more meaning to the city we know. Most importantly, the taboo of irregular city dilutes under such logic by introducing the properties of self-similarity and self-affinity as irregularity that repeats itself geometrically across many scales. In addition, considering form as a system with structure we can decompose the system-structure in sets of subassemblies, made by elements and relations. Analyzing that structure, we can get information about the behavior and thus the reasons behind the dynamics of the system. Finally, understanding form as a system-structure, and accepting self-similarity and /or self-affinity as organizing principles (Figure 3.3; 3.4; 3.5) that imply symmetry and recursion across scale (a pattern inside of pattern), is an important step forward towards looking at the whole. All these concepts are fully used during the analytical phase of the research.

3.3 Fractal qualities of Tirana (designed in the map of 1936)
Refraction as a recursive irregularity across six levels of hierarchy
Indicate static (structure) and dynamic (behavior)



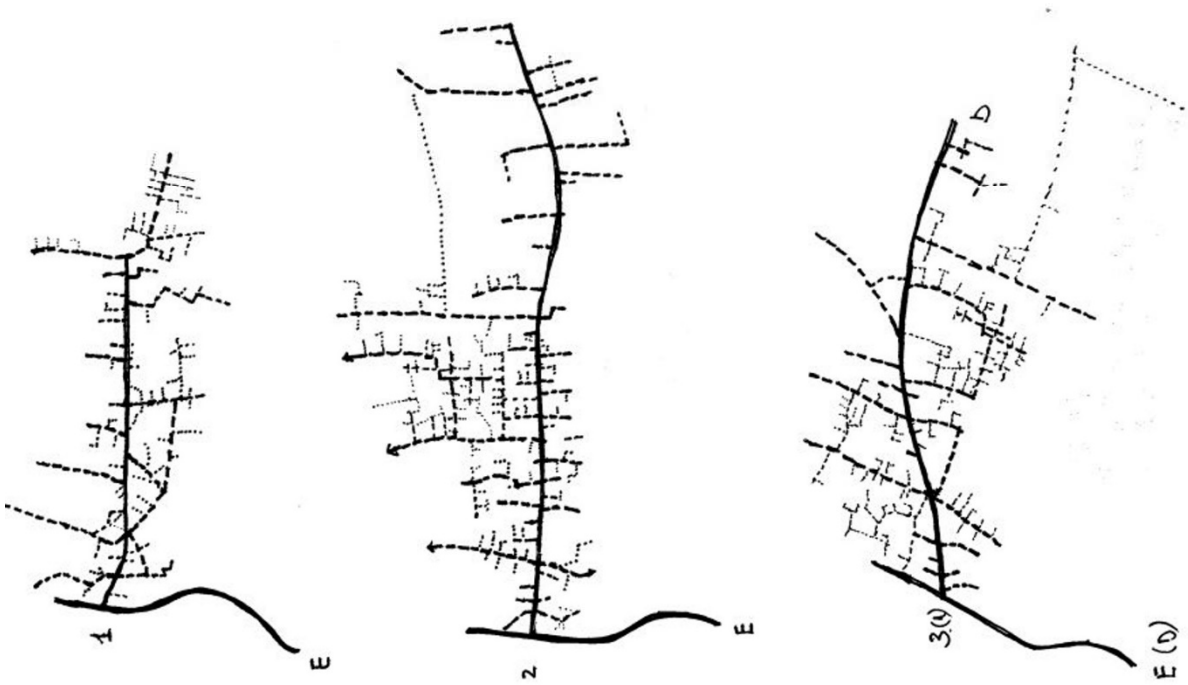
3.4 Fractal qualities of Tirana: refraction as a recursive irregularity across scales; details through the first three levels; Indicate static (structure) and dynamic (behavior)



Self-affinity as organizing principle: on the left is presented the entire structure of the city; on the right the structure of a random crossroad at a lower level of hierarchy

Self-affinity as irregularity that repeats itself geometrically across many scales
Self-affinity imply symmetry and recursion across scales (a pattern inside of pattern)

Below: separate branches of Tirana refracted in a self-similar way: recursive irregularity



3.5 Fractal qualities of Tirana, self-affinity as organizing principle: from the city as a cross-road to an ordinary cross-road within the city

3.1.c Complexity, self-organization and self-regulation
a more comprehensive, nuanced, complementary, and inter-relational indeterminate reality
(Under the perspective of: Arida, A. Batty, M. and Longley, P., Zohar, D. and Marshall, I. Mitchell, M. Gleick, J. Bandler, R. and Grinder, J.)

In the two first sections of this chapter I tried to remind some concepts and definitions about the urban form and the evolution of the organic processes; summarized some notions regarding the typology and typological instruments as a device that can inform the idea of the city; as well as tried to bring under attention how the form could be understood under the fractal perspective. Now is the time to see the city as a complex system, a place of many interactions tending to self-organize and self-regulate.

Speaking about complex systems, Mitchell (2009 pp. ix-xii) starts by remembering us that the *reductionist explanation* in terms of fundamental physics that started since 1600 with Descartes and Newton, was dismissed only by the twentieth-century science. The *antireductionist* idea started to be delineated in the phrase that *the whole is more than the sum of its parts* and took more significance while new sciences such as chaos, network theory, etc., overcame reductionism. They noticed that *complex behavior arises from large collections of simpler components* (2009 p. x). Mitchell argues that questions that belong to complex systems are an interdisciplinary field of research and try to explain *how large numbers of relatively simply entities organize themselves, without the benefit of any central controller into a collective whole that creates patterns, uses information, and in some cases evolves and learns*. (Mitchell, 2009 p. 4). The challenge still remains to understand how from *underlying simple rules* (p. xii)*,* complex systems produce interrelations, signaling and adaptive behavior over time.

The three patterns analyzed in this research are expressions of a complex and adaptive behavior. They meet the three criteria and properties set by Mitchell (2009 pp. 12-13) for complex systems: first, consist in *large networks of individual components*, each *following relatively simple rules with no central control …*, creating a *collective action* based on individual arrangements. Second, all this happens on the bases of *signaling and information processing* from their environments. Signals can be also interpreted according to the quantum paradigm as part of the non-material aspects, the wave effect, event horizon, etc. Third, the analyzed patterns are examples of *adaption*, or change of behavior to increase the *chances of survival or success - through learning* (there is more about this in the 5th chapter).

Open systems: self-organization, self-regulation and complexification
The concept of self-organization as the *capacity to borrow energy from their environment* to evolve into self-regulating and *use it to dilute entropy*, is also instrumental for Tirana. *Open systems* exchange energy or matter (or information) with their environment, *self-regulate and give rise to higher order complexity. … Only open systems are able of complexification and differentiation and hence of diversification*. *Self-organization* is at the base of complex forms of life (Arida, 2002 p. 174). Exploring the borderlines that allows Tirana to be an open system is very important. The information for city development is contained within the city itself and only open systems can guarantee the exchange and transmission of this information.

Deterministic Vs probabilistic indeterminism (Arida, 2002)
As I already mentioned, this research involves urban analysis, urban observation methodologies, and paradigms under which these observations are conducted. The way we see and

conceptualize the world, directly depends on our scientific knowledge and to what extent we are able to use it. Quantum City that challenges the traditional deterministic approach (Arida, 2002 pp. 53-57) to planning and design, inspires toward a conceptual shift from determinism to probabilistic indeterminism. Despite legal and regulative frameworks at place, *uncertainty* and *indeterminism* are a permanent parallel we face in the real life. This is true especially for cities which development occurs under unpredictable conditions, like was the case of Tirana after the collapse of the communist regime. In Tirana, since 25 years, a very rigid planning mentality was unrealistically trying to "correct" the reality (or the life) in accordance to a mental picture representing a very limited and narrow thinking, without considering in fact to revise the mental picture itself. Typical in this direction was the attitude towards the so-called informal city. In this concern, the non-deterministic approaches can be a remedy to relax the unrealistic rigidity and broaden up our mind in accordance to this conceptual shift. Operating within this kind of conceptual framework, predictions can be based on probability of something to happen (based on permissibility instead of prohibition). Contrarily, the seriality and deterministic approach of planning, in fact, contributed in the "destruction" of the city and creation of a culture of non-compliance with the rule of law. Below are listed some new approaches that derive from the non-deterministic logic.

Nuanced complementary

In the quantum paradigm *the constituents of a system stop being either particle or wave.* They can be both. Thus, from the exclusivist *either/or* approach (or *dualism*) we pass to the inclusive *dual both/and* logic (*particle-wave duality*). In open systems each duality *represents a smooth gradient*, a transitional (nuanced) *complementary*. Using complementary dualities, we may enlarge the observation and analytical base to our settlements, producing an infinity of possible *nuanced states*. If we go further with this logic and think of *particle as a fixed and localized quantity* limited in space and time, *and a wave as a dynamic quantity*, non-local covering unlimited areas of space and time, then we may consider other couples such as, space-society, individual-community, private-public, inner-outer, mass-void, urban-rural, place-memory, stones-culture, urbs-civitas, and so on, in analogy with *particle-wave duality*. (Arida, 2002 pp. 142-145). So instead of saying (either) public or private we can have a wider range of nuanced variations in-between. At the end of the chapter dedicated to historic analyses, I presented also a list with in-between two corresponding categories belonging to dual aspects of the urban fabric, such as private-public; invasion-mediation; interference-combination; imposition-superposition-stratification-du(tri)plication; interlocking-adhesion; etc. In fact, the reality of the cities contains an infinite of transitional nuanced categories which should not be excluded because they do not comply with the law.

Space as a field of information; material and non-material aspects

As I already presented in the previous paragraphs, *the urban realm is much more than the physical space*. In fact, it is the transformative role of the human mind, that produces that property and creates the specificities. We also mentioned in the previous paragraph how our brain models the world by overlapping *perceived space and cognitive space* (Arida, 2002 pp. 157-158). Thus, we see the world not only how it is physically but also from what we know about it. The research will explore the specifics of Tirana's pattern within this *mental construct*: not only from what I see, but also from what I know, and under which paradigm I observe the phenomena.

Relational principle
As Zohar and Marshall (1994 p. 54) say, it is in the *realm of relationship* that *quantum reality* is *truly revolutionary*. The *dynamic wave/particle dualism …* has enormous implication when quantum systems enter in relationships. In a reality where both/and is the rule, "*superposition"* or the *multiple reality* of the quantum realm is the norm. We get *one reality "on top of" another*. (1994 p.50)

As these authors state, in quantum reality relationship is *"creative"* (1994 p. 63), because of a new emergent quality is created when two quantum systems meet. *Their particle aspects tend to stay … separate, … while their wave aspects merge, giving rise to an entirely new system that enfolds the original. The two systems relate internally, they get inside each other and evolve together* in a new system which *… has its own particle and wave aspects and its own new corporate identity* (1994 p.54). This is a new "*emergent reality",* where the identity of individual systems was preserved *and at the same time taken up into a new whole that is … larger than the self on its own* (1994 p. 57). This kind of wholeness *poses qualities (and an identity) that arise only through the relationship* of its previous parts, being those undefined or indeterminate (1994 p. 63). It becomes clear now that this kind of a new whole, understood as such, is not reducible to the sum of its parts like in classical physic (a + b + interaction).

This correlation effect means that apparently separated "things" are *aspects of some larger whole that naturally keeps them in synchrony* ... like a *web of connections wrapping them both* as *no space between them* ... Quantum correlation exists also *across time*. *Two events that appear to have happened at different times in fact unfold as though they were happening at the same time* (Zohar and Marshall, 1994 pp. 59-60).

These concepts are extremely important while trying to understand the society-space-time wholeness as an unbroken web of relationships, between the physical structures (particle aspect) and non-material aspects (human factor, or various underlying factors, as a wave aspect) influencing the creation of successive emergent qualities. The table at the end of the 4th chapter presents in a correlational way the formative principles for each analyzed pattern in Tirana. Things are aspects of larger whole in Time-Space.

Reframing instrument *(Bandle, R. and Grinder*, J. 1982)
The expression used within the quantum paradigm that "*the physical and the mental are interchangeable*" reminds us that the improvements of the urban environment is not always about new construction. But how can we realize this interchangeability? The reframe as an instrument, as *Bandle, and Grinder* (1982) argue, can help to shift or broaden a mental construct so that we can understand in a different way an information that we knew even before, or we can see things that we couldn't see before. Coming back to Tirana, or any other city, we should start from the idea that we need to understand from a larger perspective, and under a different logic the information that "Tirana" as an "event" sends to us (in order to see the nuanced horizons we couldn't see before).

Sometimes, all a "bad" urban space needs to become a "better" one, is to clarify the information field it offers. Reframing the mental construct, we can understand differently that information. For example, an incoherent urban situation may be classified as a more complex or richer in information. As *Bandle and Grinder* (1982) argue, all behavior takes place in some context. The meaning that any event has depends upon the "frame" in which we perceive it. When we

change the frame we change the meaning. Framing is another word for contextualization, and reframing is re-contextualization. In a similar way, we can help others "see" a new / different point of view and take others factors into consideration. Reframing is also crucial in the creative process through the ability to put a commonplace event in a new frame that is enjoyable … this has to do with the ability to simultaneously associate an event in two separate and different contexts, as Koestler calls it, "bisociacion" (in Bandler and Grinder, 1882).

Thus, instead of looking at the existing urban situation as chaotic we can look at it as a complex and multilayered phenomena. Reading and discovering the hidden potentials (underlying factors and emergent qualities) is the first step towards discovering the richness and specificity of the urban patterns. Then, reframing should guarantee the interchangeability or the passage from "unreadable" to a legible "urban text" as a more conscious and community shared experience. Instead of "killing" the richness of the context we can reframe / recreate the existing in a new identity. To overcome these limitations architects, need to go beyond the conformist taboos and appeal to the power of the mind and the power of observation to reframe the stigmatized existing situations in a new identity.

3.2 Paradigm shifts

In the history of humanity there is a parallel between the advancement of scientific paradigms and the way people see, understand and react in their life. There are some fields of humanity that quickly embrace the novelties, and other fields where the inertia is much longer. At this stage of the research, it may be worth to briefly summarize how architecture and planning tune and adjust with scientific paradigms, particularly with those related to the concepts of space and time. First, I start summarizing the most important shifts in the scientific revolution, and then I try to understand if there is any influence in the way of rethinking architecture and urban design. It is also interesting to see and to reflect on the longer inertia of architecture to embrace the new conceptual shifts in relation to other fields of humanity, especially arts. Finally, this reasoning helps to reconfirm that the specific urban conditions, not only represent a specific culture, but are also influenced and interpreted by believes, worldviews and the scientific knowledge of the moment. *Quantum City* (Arida, 2002 pp. 26-81) is used as reference for the summary of the main points presented in the following section.

3.2. a Worldviews and important shifts

The "organic world view" (from antiquity to the sixteenth century)
The model of living during this period was based on small communities*,* therefore, people … *experienced nature in terms of organic relationships*, as a "*nurturing mother*" and not as an *object to control*. Consequently, man was *living in harmony with his environment* that was characterized by the *interdependence of spiritual and material phenomena*. As Arida (2002 p. 30) argues, Thomas Aquinas outlined the scientific framework of the middle ages worldview when *he merged Aristotle's philosophy of nature with Christian Theology and Ethics*. During this period science grew under the inquisitor control of the religion. This started to change when some pieces of knowledge surpassed the religious control, and the knowledge was becoming available to a larger number of people. Important factors such as Copernicus, Galileo, Descartes and Newton put under discussion the holiness of the religious believe, and the *sanctity of science* started to prevail over the sanctity of the nature as a *"nurturing mother"* (Arida, 2002

pp. 29-30). This happened during the Age of Scientific Revolution when a more *rational worldview* was about to start and authorities gradually started to become more secular.

Scientific revolution (seventeenth and eighteenth centuries) – preparation for industrial age: the world as a machine - science in the foundation of morals and politics.
Copernicus' *Heliocentric view* (1543) and Galileo's (1609) analyses on the *planetary motions* as well as the use of a mathematical language to formulate the laws of nature contributed to defeat the old cosmology. According to Galileo, mathematics could only describe *quantifiable properties*, while all *subjective mental projections* were excluded from the scientific inquiry (Arida, 2002 p. 31).

The major shift during the scientific revolution in the seventeenth century culminated in the Cartesian and Newtonian worldview. In fact, they prepared the world for the industrial age by the end of the eighteenth century. Cartesian *scientism* and the *firm believe in the certainty of scientific knowledge* influenced for a long time the entire planet about what we know and what we believe. This paradigm which gave an unprecedented impetus to the development in all fields created also some *negative side effects*. It fragmented our education in small separated boxes; and broke up problems into small separate pieces (Arida, 2002 pp. 32-33). As Senge, (1994, p. 3) says, "*when we then try to 'see the big picture'… the task is futile - similar to trying to reassemble the fragments of a broken mirror to see a true reflection. Thus, after a while we give up trying to see the whole altogether*". The price we pay is the difficulty we have to go back to the real world complexity. Descartes advocated also *the separation between objective and subjective matter*. Material universe was left empty from *life, meaning or spirituality* (Arida, 2002 p. 34).

Newton gave form to the *Cartesian vision by developing the mathematical formulation of the mechanistic view of nature*. Through his mathematical formulae, universally applicable, and the laws of physics, he could determine with absolute certainty *the state of a system at any time in the future*. As such, the universe was an *immense mechanical system … functioning as a machine* that was following mathematical laws in *absolute space* and *absolute time*. Newtonian paradigm emphasized the *time/space schism* that further contributed to the *determinism and absolutism of the modern vision*. During the Enlightenment this deterministic approach was extended also to the social sciences. The knowledge gathered during the scientific revolution made the world scientifically explainable (Arida, 2002 pp. 34-35).

Einstein revolution
The universality of Newtonian physics was put under discussion by discoveries in the world of electrodynamics and thermodynamics. Especially the second law of thermodynamics, related to entropy as a *measure of the system disorder* was particularly important. Many systems tend towards states of *less order* which is *irreversible.* With this, are related the concept of the *closed isolated systems* that drive to entropy and death of the system, and the concept of *open systems* that drive to *complexification* and self-regulations. On the other hand, these concepts highlighted the oversimplifications of the Newtonian physics and Cartesian worldview. (Arida, 2002 pp. 36-37).

In 1905 Einstein published his *special theory of relativity*. He proved that space and time were not absolute, but they were unified and dialectically linked in a *space-time continuum*. This continuum was not a simple Euclidian geometry, but a complex curved interactive and

topological geometry, *that could be prescribed by a special type of mathematics*. Even the gravity imagined by Newton as a *force between two objects*, according to the Eisnstein's worldview was seen as twisting, winding and meandering of space-time by the presence of a large object. The interacting of the masses also causes the effect of deforming the environment. Einstein *unified energy and matter, light and gravity* into the formula *(E=mc2)*. He showed that energy and matter were one, and *discovered the inherent power of the atom*. Other disciplines such as, arts (cubism, surrealism), history, anthropology, etc. started to follow the same logic. Relativity theory is one of the most quoted concepts in non-scientific literature (Arida, 2002 pp. 38-41).

Quantum Paradigm (particle wave duality; realty as infinite of possibilities; uncertainty principle; complementarity principle; tendencies to exists and tendencies to occur; statistically based reality)

Quantum Theory brought back the "*whole picture*" of the reality based on the Bohr's particle-wave *Principle of Complementarity*. According to him, the *particle-like and the wave-like* aspects of particles *complement each other*. The wave aspect which is *inseparable from the particle aspect of matter* has a real and physical influence on reality. Choosing one description over the other brings incomplete results (Arida, 2002 pp. 51, 52).

Most importantly, quantum theory challenges our idea of time and space: *the motion is not continuous* as in the classic mechanics, but *proceeds in minute jumps … transcending time and space*. The electron *jump(s) to all possible states simultaneously checking its possibilities … before "choosing" a particular state to rest in*. Between the different locations *there is an infinity of possibilities* for a particle to jump. This is represented by the wave function that is a *mathematical probability* of the presence of the particle at different points in space (*Copenhagen interpretation*). Under this logic, reality is an infinite of possibilities calculated by mathematical probabilities distribution wave. In addition, since quantum particles transcend time and space, they gain holistic and non-local properties (Arida, 2002 pp. 53, 54).

The probability of a particle to jump in one or in another location creates the *indeterminacy* in the quantum world. This prefigures a reality which clashes with Newtonian determinist physics. In '30s, the *Heisenberg's Uncertainty Principle* regulated through a mathematical formula Bohr's *Complementarity Principle*, by stating that it was *impossible to measure both complementary aspects precisely*, and that *the accuracy of measurement of either complementary aspect is inversely proportional to the other*. Therefore, *at the subatomic level, matter does not exist with certainty at definite places, but rather shows "tendencies to exist".* Similarly, *atomic events do not occur with certainty at definite times and in definite ways, but rather show "tendencies to occur". These tendencies are calculated using statistical mathematics, and are represented by the "wave function" …*; Therefore, we can say that this is a statistically based reality; interactive rather than absolute, and depending on how an observer chooses to observe it. Reality is a blur unless observed (Arida, 2002 pp. 55, 56). Although these statements come from physics and sciences, they drastically affected the way we see the world, and have a great importance for the conceptual framework of this research. The "new" attributes of the quantum reality, such as reality as an infinite of potentials, as a statistically based entity, as interactive and not absolute, to name a few, are important especially concerning the way that architectonic or urban phenomena could be observed and analyzed.

Fractals, chaos and complexity (as components of the new worldview named quantum (Arida, 2002, pp. 67, 68)**.**
Besides the fact that chaos and fractals helped in the solution of mathematical complex problems, they are finding applications in many other practical fields including architecture and city. Fractal geometry which signify also the *geometry of chaos*, was developed by Benoit Mandelbrot over a 30-year period. As we mentioned in the specific paragraphs dedicated to the fractal logic, *however chaotic, discontinuous or irregular* a natural object may seem to us, beneath hide a deep underlying order.

Batty and Longleys' research, materialized in their book "*Fractal Cities*" (1994), present examples of fractal urbanization as well as the application of the fractal geometry and analyses to architecture and cities. They argue that much of the pre-existing urban theory and models are based on the fractal logic. For them fractal geometry plays an important role *for the analyses and simulation of the growth of the city.* Most importantly, these authors extensively analyze the concept of the *organic city* under a fractal perspective. Reframing chaos as a more complex form of order without eradicating the layers of real life, was a conceptual step forward to understand reality and human freedom without prejudices and in a more inclusive logic.
Other important concepts of fractal geometry, such as *self-similarity*, *self-affinity*, *form as a system with structure*, the *infinite scalability*, the way how a fractal can be generated through the *initiator*, *generator* and the *cascade of the process* (already explained in the specific paragraphs), to name a few, are especially important for the way we see the urban form and urban processes, urban form and growth, and also as an additional layer to the morphological analyses.

I already introduced very briefly some concepts about complexity at the beginning of the section 3.1.c., where I cited Mitchell (2009) and Arida (2002). It is important to remember that the macroscopic self-organized behavior, called emergent, is produced by simple rules; that the independent members interact and produce complex behavior (among other structured neighborhoods and cities); that the intelligence or consciousness emerge out from these processes; that the process of measuring complexity is still a challenge, however there are some methods which are described in the 5th chapter; that the information obtained can inform the modeling and the design process; etc.

3.2.b Reflections on architecture and urban design

This brief excursus in the world of scientific revolution highlights some important conceptual shifts, which are important for this research. Relativity and quantum worlds shacked our ideas about the reality, which was not any more deterministic and linear in the certainty to predict the state of a system in the future; instead, it was a statistically and probabilistically based reality, filled with infinite potentialities and interactions, tendencies to exist or events to occur. It was a reality of both/and instead of either/or; and yet, a reality of nuanced complementarities filling the range in between the dual aspects. Thus, from closed and simplistic, reality became open and complex one, capable to self-organize and self-regulate using energy and information from its own environment. Although it may seem that these ideas have more to do with science and physics, they constitute the essence of our conceptual thinking with regard to the notions of space and time, that throughout history have also reflected substantial changes in architecture

and urban design. Most importantly, they bring us closer to understanding the reality without excluding elements and phenomena falling out of the Cartesian, Newtonian and Euclidean frame of thinking. Finally, they changed our perspective and bring additional lens to better see a bigger picture of the real world.

How much this worldview that is probabilistic and holistic influenced our mentality and our approach to the practice of architecture and urban design? Do we have the necessary theoretical and practical training to include this kind of understanding and interpreting architecture and the city? As some authors note (among others, Rowe and Koetter, Arida, etc.), there is a delay in the field of architecture and planning to include the scientific knowledge in the design practice. This long inertia is partly due to the traditionalist nature of educational institutions in general, especially education in architecture and urban design. Mechanistic concepts are still very strong in our education and in methodologies we use to interpret the practical life.

As Rowe & Koetter, (1978 p. 8) argue about the modern period, in *the twentieth century architect's working ideas … persist an eightieth century believe in the veracity of science (Bacon, Newton?)*, …. *the veracity of the collective will (Rousseau, Burke?)*; *and, if both of these can be … furnished with persuasive Hegelian, Darwinian, Marxian overtones, then there the situation rests, almost as it rested nearly one hundred years ago*. This interpretation illustrates the delay of architecture and urban design in respect to scientific and philosophic knowledge. According to these authors, it seems that the modern period was a kind of very delayed fulfilment, or last extension of the mechanical paradigm.

But, how much the transformation of the age of networked worlds, virtual communication and telepresence that is currently challenging the notions of space, time and materiality has influenced the everyday practice? Virilio, P. (1991) in the "lost Dimension" speaking about the metaphysical implications of space-time and speed says that if speed *expands time in the instant it contracts space, we arrive at the negation of the notion of physical dimension, and we must ask what is a dimension*? While this idea seems to belong to a real future, because of the current technological drive, our relationships within the space, including some basic notions related to it, such as the need for mechanic movements and physical presence in one place or in another, or the omnipresence tendency, etc. are under transformation. Under transformation is also the relationship that the space creates with architecture itself. As already mentioned, the idea of a reality filled with infinite potentialities and interactions brings a conceptual change in this relationship. According to Saggio (2010 p. 439), the space is not any more a simple container for the architecture-object; instead both, the space and the object itself are the result of deformations generated from an inter-relational field force, where the space and the object are conceived at the same time and intertwined with each other. For example, *Oosterhuis* and *Lénárd*in in the group ONL are researching for an architecture apt to behave like information technology and that enables dynamical relationships of information. This tendency is visible in the project realized in *Leidsche Rijn* near *Utrecht* where they aplied an original idea for an acustic barrier along the highway (Saggio, 2010 p. 437).

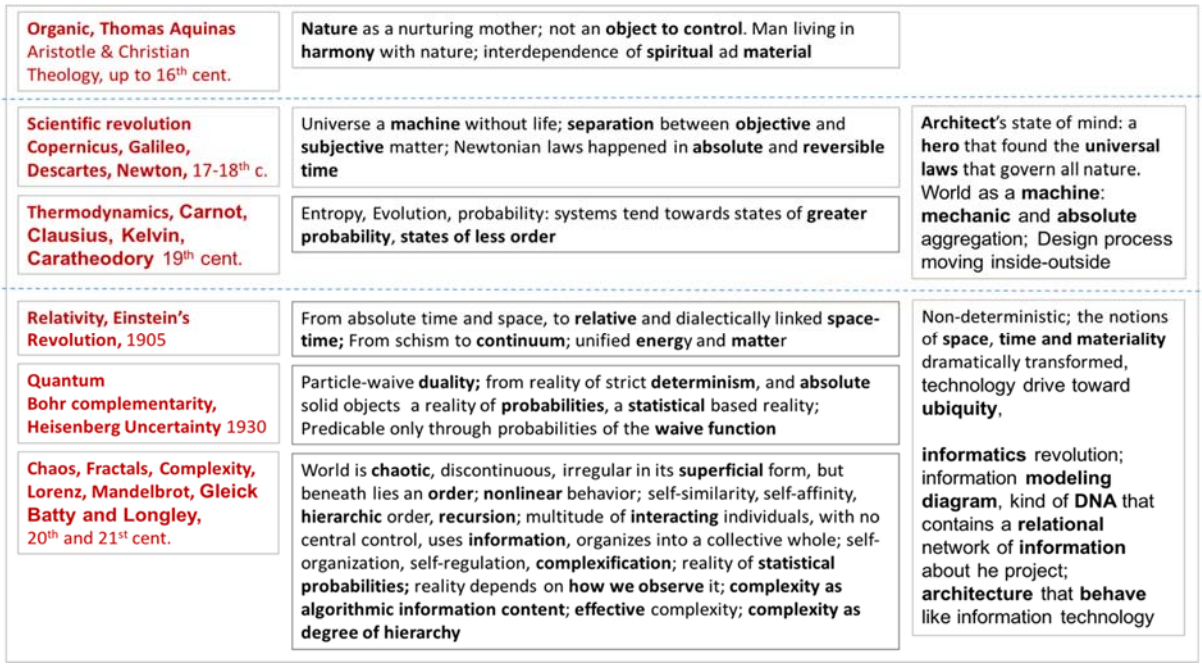
According to Senegala (p. 8), this shift which is related to the notions of space, time and materiality, among other requires architecture to redefine the boundaries of what we consider architecture, and to *embrace the virtual worlds*. For example, Greg Lynn argues about the potential role of digital technologies in enabling ways to deal with time-like events in

architecture. As he says in the "*Animate Form*", *deformation and transformation techniques* introducing time and motion into architecture are *not aesthetic choices but technical statements of the structure of the topological medium* (Lynn 1999 in Senegala, pp. 9, 10). There are other authors that tried to address the notion of time-like architecture such as, Peter Eisenman, Toyo Ito, Bernard Tschumi, Rem Koolhaas, Zaha Hadid, Richard Rogers, Neil Denari, Wes Jones et al. At this point, it is important to say that with the irruption of the digital world in the production and diffusion of architecture, many researchers supported the idea of a paradigmatic change, and that even architecture itself would have to follow the digital world. While some supported this idea, many others refused it; however, this produced a very fecund debate that created new modalities to see architecture, and most importantly opened new frontiers for the research.

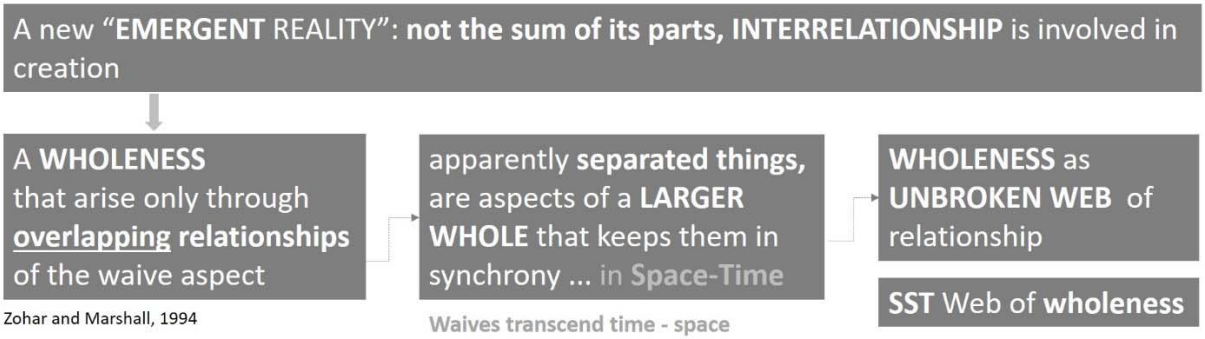
This is the reason why in this research, among other, I am based on paradigms which see the reality as an indeterminate and complex phenomenon; as well as in some of the authors that treat these issues under such perspective, such as Arida, Gleick, Longley and Batty, Mitchell, Zohar and Marshall and also other scholars cited in this research. Time has been matured to observe Tirana and other specific realities with an approach that is not exclusively the classic one.

No less important is the challenge that these conceptual shifts pose to architects and urban designers regarding their role in relation to the users or individual citizens. Among other this requires to explore methodologies that bring the design process nearer to the users' reality, but without falling in the simplicity/banality of the participatory processes (like in '70s and '80s), or without repeating the figure of architect as a hero that decided everything for the others (like in the modern period). This is a very delicate issue and both extreme positions should be avoided. There is nothing better than the words of Rowe and Koetter (1978 pp. 11, 13) to understand the attitude of the modern period architect that seemed to have found the universal laws that govern all nature. This *state of mind* was disclosed especially in the way how they envisioned the new world … there is *a quality of messianic passion, an anxiety both to end the world and begin it anew*, to create man's independence from historic context and nature (let us remember here the concept of absolute time and absolute space; and the "*Plan Voisen*" (1925) of Le Corbusier as one of the emblematic illustrations).

In this concern, it is not incidental that Batty and Longley the authors of "*Fractal City*", among other, try to reframe the concept of the informal city with this of the organic city as coordinated in the smaller scale; Arida the author of the "*Quantum City*" brings again into attention the issue of "*natural cities*" treated also by Alexander; or, Kostov the author of "*City Shaped*" speaks about organic cites and processes as self-generated, to name a few. In fact, all these cases bring under attention the important phenomenon of small scale individual arrangements, coordinated without the help of a central control, but through exchange of information. This is an important step forward towards looking at our cities as complex systems, and really treating them as complex phenomena. Under this condition, researching for design processes and methodologies which are informed by specific realities, remains a great challenge if architects and urban designers want to get nearer to the "*natural cities*", without misusing, ore being misused by the propaganda of false and populist participatory processes.



3.6 Paradigm shifts and the influence in architecture and urban design



3.7 Wholeness and relational; wholeness is not the sum of the parts

3.3 Re-positioning Tirana

3.3.a The bias in education

Albanian and wider context*:* motivating the shift

The urban condition in Tirana raises some concerns: how to make observable and part of the analyzes some subtle and / or indeterminate categories such as public or private, regular or irregular, unevenness and incongruous-ness of the context, superposition, etc. that usually are not accepted by authorities. In a simplistic logic all that is considered to be out of legal framework and hence not included and studied as part of the urban phenomena. In addition, that kind of reality was also falling out of the official academic knowledge for a long time. After the second world war, despite the fact that Albania was detached from the rest of the ex-communist bloc, the education system, including this at university level, was mostly based on

Soviet Union models characterized by a mechanistic logic and lack of realism. In fact, the reality was seen under the ideological frame of the socio-realist principles. As such, architects and urban designers were mostly trained how to build and how to create a uniform and simple geometric order, rather than how to deal in a creative way with the diversity of the urban phenomenon, or how to interpret complexity and accept variety. Therefore, the real city and the order understood in simplistic terms were two incompatible concepts.

Because of that bias in education we were more familiar with the language of deterministic rules. Authors such as Eduard De Bono raised potential risks created worldwide by an ill education system and the comfort of the *box culture*. Since 1967 he has been active in *enacting a revolution in the way we think*. As he says, at school we learned mathematics much more than arts, and how to divide the world in pieces in order to understand it better. This bias in our education is reflected in the way most of people think and take decisions; it influenced the linearity in our thinking and the conventional way we do things. Because of this, we prefer to go on the safe side rather than trying and experimenting new things. This created the false assumption that with rationality we can plan everything in advance (De Bono in Dudgeon, 2002 pp. 1, 17, 21).

Campbell and Cowan (2002 pp. 3, 7, 21, 22) in their Re:urbanism, *call for change in the way we think about cities, teach about them and shape their future.* They also are concerned that good urbanism is about *seeing the whole picture and rediscovering the art of building cities*, … *recognizing cites as complex* entities and … *managing their interaction*. Among other they argue that *cities are victims of specialisms*. With this, they intend that people that shape cities do not receive *training in how complex urban places work* and this is the reason why they produce *dead places*.

In a way or in another, despite specificities that exist in education systems from country to country, the need to educate architects and planners with the idea of a more complex and holistic view on the cities is a general requirement.

From this point of view, Tirana could be a good “laboratory”, where the complexity observed can be better analyzed and described under the logic of the *quantum city* approach. In relation to that, before being the realm of (physical) certainties, Tirana is a world of propensities and tendencies; a world where the nuanced complementarities in-between two corresponding categories (or *dualities of both/and values)* are widened up because of people’s “need” for more personal/private freedom; a world where a blurred (*uncertainty of choices*) situation is created “de facto” because of unclear uses and aims; a world of no “limits” and differences between planned and unplanned, designed or un-designed; a world where adaptations and compromises, declared or not declared, accepted or not accepted, create propensity to change and new *emergent qualities.* Educated not to accept such apparently irregular order, it comes easier to sterilize the real life and hinder the development. In fact, we may reconnect this “irregular” reality only through a new conceptual frame. This means to look at it not simply through categories of planned or unplanned, but to reframe the meaning of “irregular” reality as being a more complex form of order. In order that this happens, we need to be educated with the language and the logic that describe chaos and complexity of life and go beyond the physical aspects.

3.3.b Re-positioning Tirana from different theoretical lens:
Need to shift from mechanistic to the holistic view of reality

The paradigm shifts presented in the previous paragraphs help to understand how architecture and planning reacted to those shifts. In the brief excursus, we were mostly looking for the new logic and conceptual repercussions related to the shifts, rather than for their formal consequences. Going back to the reality of Tirana, as presented in the previous chapters, there is evidence that the efforts to understand, regulate and/or design should shift from only mechanistic and Cartesian-Newtonian (fixed and exclusively deterministic) to a combined and/or more Quantum worldview. The rules and the prescriptive regulations that govern our cities belong to the atomistic and partial-ized worldview with series of limitations, edges and borders. This deterministic, apparently "precise" and "one size fits all" rules, impede the natural development of life. Thus, if Tirana does not entirely fit within the rules of the Euclidian geometry and Newtonian mechanics, we do not need to change the city, but we modify our observation and analytical lens.

According to quantum paradigm, a "new" reality depends on how we observe it. As Capra (1982) says [The problem] *derives from the fact that we are trying to apply the concepts of an outdated worldview - the mechanistic worldview - to a reality that can no longer be understood in terms of these concepts. … What we need, then, is a new "paradigm" - a new vision of the reality; a fundamental change in our thoughts, perceptions and values. The beginnings of this change, of the shift from the mechanistic to the holistic view of reality, are already visible in all fields …* (Capra 1982, in preface).

Let's go back to the argument of observing a city. If we change the theoretical lens of observation, we can change also the meaning. Thus, the reality from an absolute and determinist entity, becomes a container of infinite potentialities and interactions, of tendencies to exist and tendencies to occur. Most importantly, the latent qualities which are hidden in the viscera of this container (environment) become meaningful only when/if we observe them, even though these qualities were there long ago before we observed them.

Starting from this standpoint, we can reformulate the main research question: can the reality of Tirana and its specific properties, observed and analyzed under this perspective, help to develop new urban design hypothesis that can be useful even for other cities in similar situation? Or the same question can be reformulated in a more generalized way: can the realities of our cities and their specific properties, observed and analyzed under the new theoretical perspective, help to develop new urban design hypothesis? Theoretical principles presented so far and the paradigms shifts, reinforce the awareness that the real city (including its specific emergent qualities) can be detected only if the theoretical observation lens and analytical methodologies enable this. For example, considering the concept of material and non-material aspects and all the related reasoning, such as the associated wave aspect, the event and the event horizon, human user as a vessel for non-locality, society-space-time as a construct permeated by the energy field, etc. extend our observation filed and help for a more holistic understanding of the urban phenomena. In the same direction contribute also other concepts such as this of the open systems and closed systems in relation to self-regulation and self-organization of cities (neighborhoods) as complex systems; or the concept of the form as a system with structure creating self-similarity or self-affinity at different scales of hierarchy. These concepts speak about a new understanding of parts and the wholeness; a wholeness that arise through

overlapping relationships (Figure 3.7). All this influences the analytical, the design and the decision making process.

The main research question is also related to another important issue: how can we give life to the existing cities using the emergent qualities as formative principles, or as proliferating elements. The theoretical discourse about typological instruments presented in this chapter (typology as a devise or animated force for design, typology as a pliable diagram, etc.), is still relevant here, but the 'hidden' formative principles (or what Ungers call as rationalization of the existing) emerge from an analytical process that goes through additional theoretical lens. This approach can also provide design methodologies which are totally emanated from the existing situation; that not only lays on the tradition of the theoretical discourse on typological instruments, but bring a deeper understanding of the reality through additional theoretical lens; a methodology that brings a wider range of potential applications through new instruments.

From this point of view, the research may be seen as a way towards a design approach where people are more involved or considered in the city design; not only through the direct physical participation, but through "catching" an intrinsic logic or an ordering principle in the patterning process; through "catching" the specific properties which give life to the existing city and enable their "interference wave" pattern, etc. This is better than fighting with the real city and sterilizing it in the name of rules with legal status.

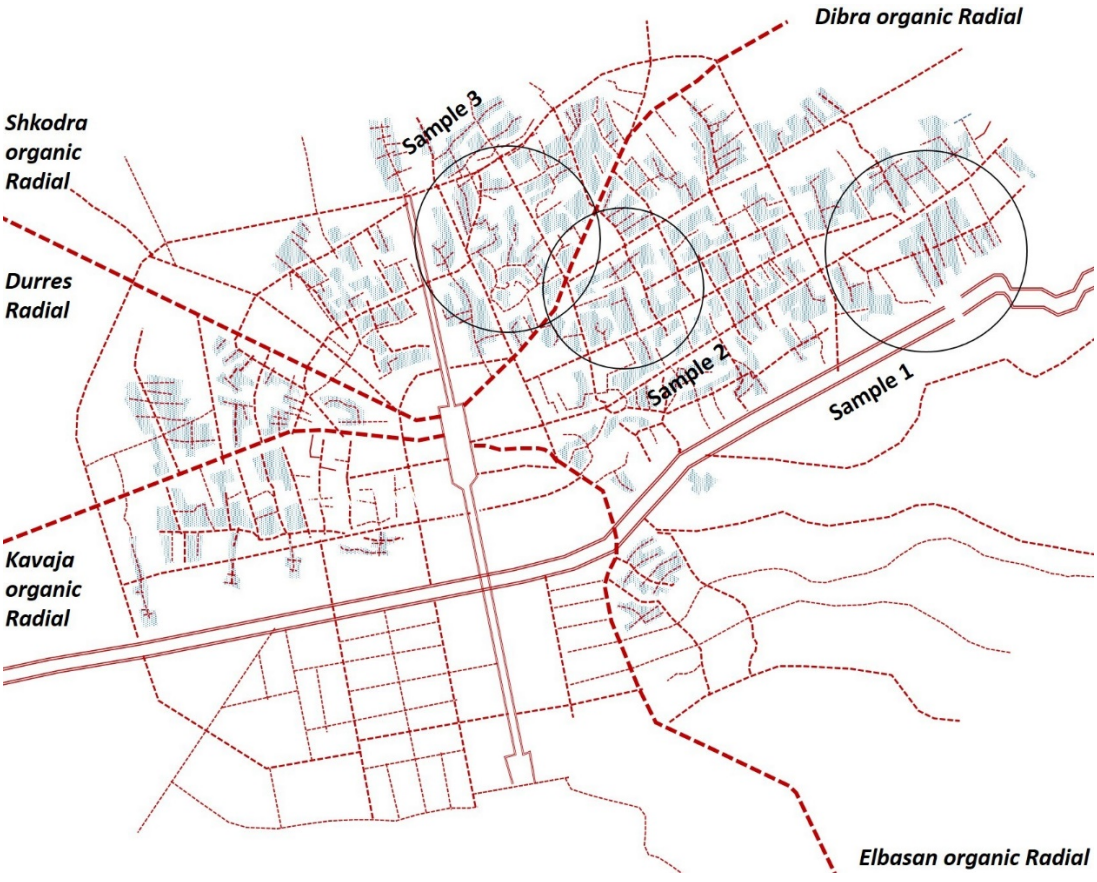
In the second chapter, dedicated to the historic analyses, I draw some conclusions related to the specifics of Tirana based on geographic context and historic processes. At the same time, I stressed the virtue of the social structures and local mentality to create unclearness and blurred conditions (states), which is one of the things that make the legibility of Tirana urban fabric a very challenging exercise. Thus, if in the former chapter we found out the existence of "in between categories", in this chapter we could interpret these categories as belonging to a nuanced complementary variety. Other concepts can be reframed in a similar way. For this reason, in this chapter I argued about the need to expand the observation and analytical focus using the already described theoretical concepts.

4. Exploring Patterns
Analyses and verification of the assumptions based on the research question

4.1 Pattern analyses and specific samples

At the conclusion of the 2nd chapter dedicated to historical analyzes, three main patterns to be further analyzed as well as specific samples for each of them were identified (as shown in Table 2.1). In this chapter, the field research and detailed analyses for each sample are presented in some details in order to bring more evidence about the assumption made for Tirana as a specific urban condition, where some "hidden" urban qualities may emerge. In this respect, Quantum City and Fractal City approaches in their aspects that influence human behavior and the related formal properties of the city, as presented in the 3rd chapter, are used in parallel and as part of morphological analyses. These theoretical lens help to add more meaning to the analyzed phenomenon, and to approach the "rationalization" process of the existing situation in an alternative way. Therefore, the results of this chapter will be the input for the last part of the research dedicated to the outline of a methodology for a modeling process based on the emergent qualities of Tirana.

4.1.a Pattern 1: historic organic – Eden(s) within Eden/(s)



4.1 Areas where the Historic Organic, or percistencies of that pattern still exist and "inform" construction activity; The three selected samples (2015)

Historic layers to be observed

This pattern **includes** those parts of the city which origin begins with the foundation of Tirana and arrived up to the present days, even though transformed in a way or in another. The selected samples are analyzed through four stages of their transformative process:

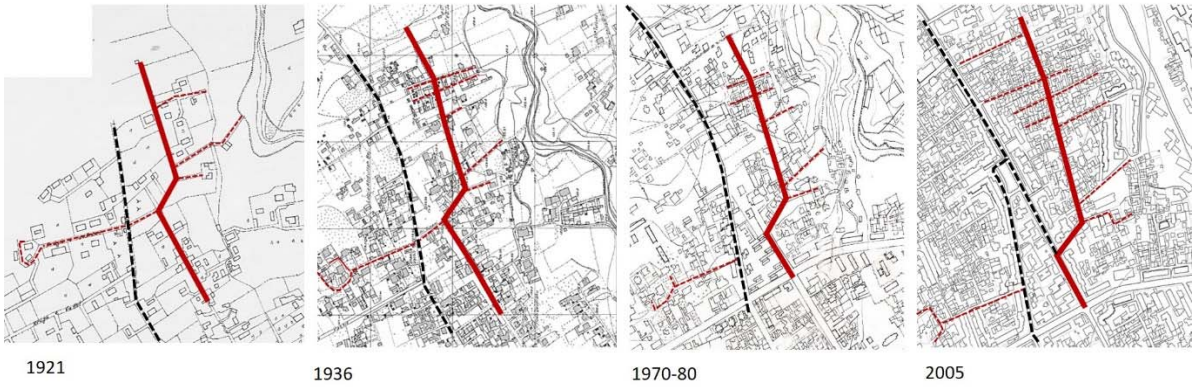
First, 1920-1925 when Tirana was still exclusively an organic city, which corresponds with the period immediately after Tirana became the capital of Albania (1920), but before the King Zog projects for transformation of Tirana (1925). The base for this survey served the map of 1921, which satisfy some minimum requirements for urban analyses. Through this map we can analyze the early stages of the selected samples and also that part of Tirana that we still consider the historic core of the city; how the separated nucleus/clusters (*imarets / kulliyes*) aggregated in a bigger pole through the *synoecism* process; and identify important pre-existing elements, whether natural (river beds, forest valley, etc.), or artificial (commercial paths intersecting in the central old Bazar), around which these nuclei/clusters aggregated. This is already described into more details in the 2nd chapter dedicated to historic analyses.

Second, 1925-1944, includes two main phases: The King Zog's ruling period which lasted until 1939, and the Italian Fascist occupation which started in 1939 and lasted until 1943. Therefore, this period was characterized first by Zog's vision to transform the image of Tirana based on a western model; and soon after, by the Italian cultural and technical influx in architecture and urban scenario. As analytical base for these surveys serve the map of 1937, formulated by the Italian Institute of Military Geography, based on *Santoni* aerial photographic system (Figure 4.3). This map brings evidence about a more consolidated phase of Tirana, and also about the most important King's Zog "*Grand Travaux*", considered as the first disturbance on the organic network. In addition, important projects formulated during this period, as well as the regulatory plan formulated from 1939 to 1943 by Bosio, G. Poggi, F. and Lambertini, I. (Figures 2.7; 4.3), served as a baseline to check about external influences on the selected samples.

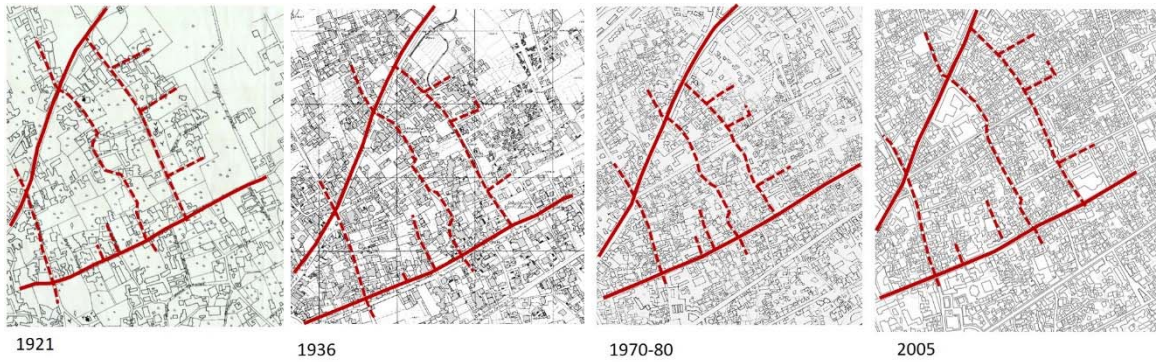
Third, 1944-1990, from the end of the Second World War to the collapse of the communist regime. This period is characterized by typical deterministic interventions reflected in central area redevelopments and new extensions in territories outside the city. As analytical base for these surveys serve the maps formulated by the Albanian Institute of Military Topography during the period between 1970 and 1980. In addition, the regulatory plans formulated during the period 1957-1958 and 1985-1989 (Figure 2.20) served as a baseline to check about external influences on the surveyed samples.

Fourth, from the collapse of the communist regime in **1990 to date**. This period is characterized by a high degree of uncertainty including the role of the state, which was mostly reflected in informal developments all over the city. As analytical base for this survey serve the map of 2005; however, this information is updated accordingly, based on the most recent areal or satellite images of Tirana. It is expected that the historic organic areas of Tirana, including the analyzed samples, to be highly impacted by the recently approved regulatory plan, because of the high intensities imposed by this plan on these areas.

Pattern 1 Historic Organic



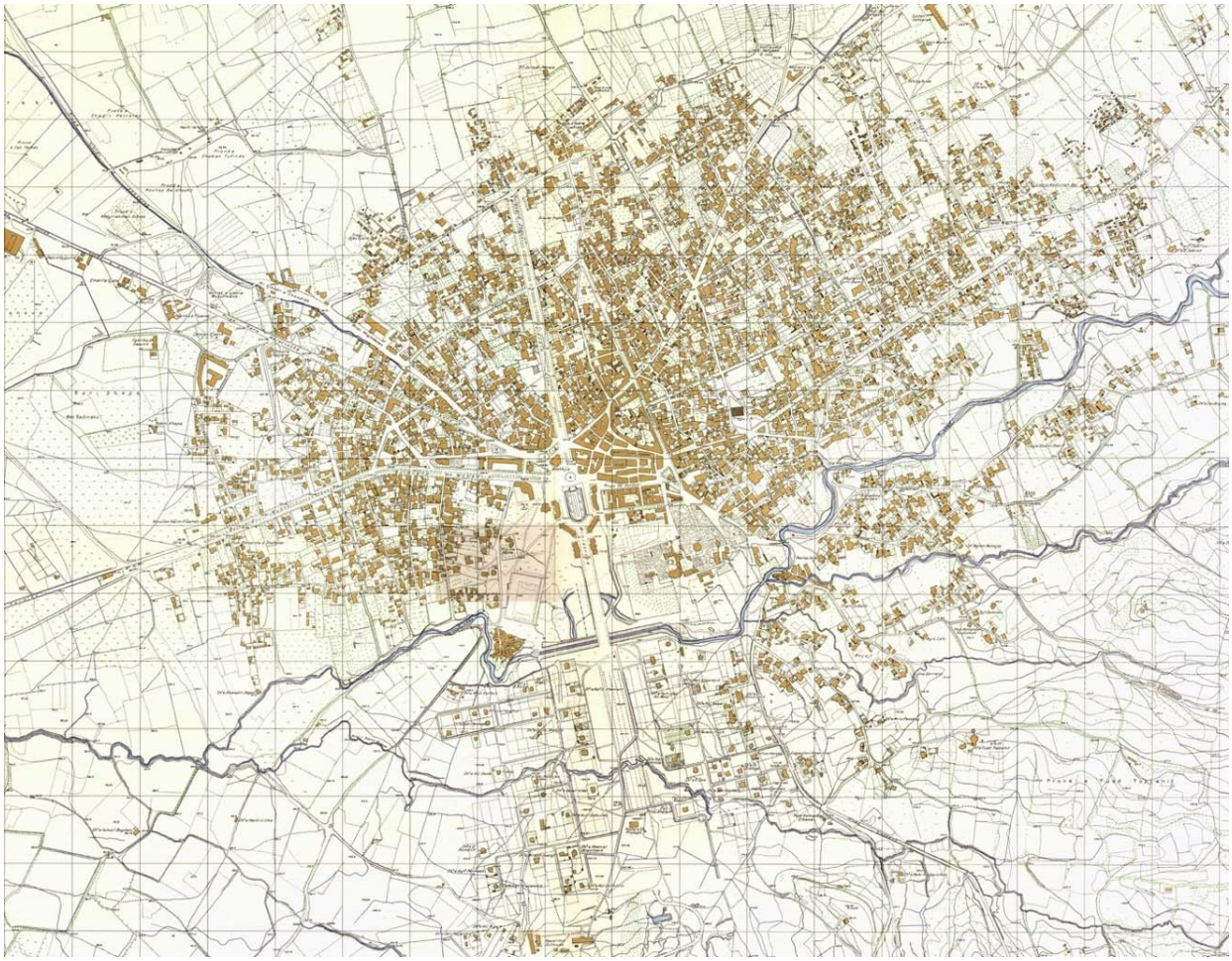
sample 1.1



sample 1.2

sample 1.3

4.2 Catalog of the analyzed samples



4.3 The map of 1937 formulated by the Italian Institute of Military Geography, based on *Santoni* aerial photographic system; Source National Technical Archive;

Below, the exiting situation of Tirana in 1937 overlapped to the proposal of the Regulatory Plan of 1939-1943 (marked with light grey); The plan influenced the orientation of the main road system, which was realized with modifications many years later;

Redesigned, based on the sources of the National Technical Archive, in "*Tirana Qyteti i Munguar*", Dhamo, Thomai, Aliaj

Pattern at the glance: the essence of the Historic Organic

This pattern constitutes the first layer of the organic Tirana. It is a direct descendent of the *imaret / kulliye* system of city foundation, combined with urban improvisations based on a specific anthropological culture and social structure. The Historic Organic pattern plays the role of a physical event that through interfering patterns continue to influence a certain specific approach in the settling and building process in Tirana (arousing / creating event horizons), and not only physically but also psychologically.

The patterning process is put into motion by a clear motive, such as the right on visual privacy that causes recursive introvert behavior across scales, legible in self-similar (self-affine) actions, such as deviating the straight-line to avoid the urban vistas, closing rather than opening, and isolating interstitial "not reachable" areas. This process results in an introvert character of the entire residential cluster.

There is a remarkable adaptability capacity within these areas. It starts initially from the inward aggregation and continue during the later stages with the outward wrapping process that complete the "full protection" and the visceral space: Eden(s) within Eden/(s), or self-affine Eden(s).

Historic Organic is an interlocked and cohesive neighborhood where the comportment of individuals is based on negotiation and implicit permission. On one side, this comportment is based on individual arrangements coordinated in small, but on the other side it is based on a long-term social formula, where the informal recognition of the "accepted social behavior" is important.

The Historic Organic pattern is characterized by similar principles and phenomena at different levels of city hierarchy. This characteristic creates the fractal properties of this pattern, which means that we can consider it as a system with structure (static), decomposable in subsystems that manifest similarities across scales; and we can study also the dynamics of Historic Organic as a system, which implies its behavior.

The formative / generating principles are intimately related to the social substance and group affinity.

The evolution of the organic patterns in Tirana

The evolution of the Historic Organic patterns in Tirana, up to the second decade of the last century, occurred under conditions of *limited public control* and *urban improvisations,* rooted in a specific *social structure.* These conditions together with the *physical determinants* as Kostov calls them, play an important role in the *irregular city-form* (2003, p. 62). Based on that, the settling process was guided by some anthropological principles that knitted in a natural way a self-regulated labyrinth structure. To give *meaning to the spatial dimension* of historic patterns in Tirana, *beyond its mere function*, as Arida says (2002 p. 165), it is worth to explore into some more details the *community ties* and anthropological principles, which were at the base of the private and public life or other interrelationships. These principles (the wave effect),

transformed in a shared experience and common identification (interference pattern exceeding time and space, a non-local property), were a kind of building blocks for the space they created (transformed in a specific observed reality, or units of elemental space).

We already explained how the first nucleus of *imarets/kulliyes,* based on the Ottoman culture of the city foundation, were established in Tirana during the 17th century. Given this historic context, the way the organic patterns developed, included some principles hired form the *model of the traditional Islamic city* (Kostov, 2003 p. 62). The culture of life in Tirana was based on a patriarchal enlarged family model, where many generations of descendants were living together in a big house, or in a nucleus created by several houses built within the same family plot. It was a nuclear family model which arrived up to the beginning of the last century. There are some Albanian authors such as Muka (2001), Shkodra (1984), etc. that describe this model of life and the respective housing and neighborhood space created by such model. Kostov in his book "*the city shaped*" (2003 pp. 62-64) explains some principles belonging to the same culture that can be adapted to Tirana's context. According to these principles, the essence of the city-form is subject to the respect of tradition, *ownership*, and the *Muslim right to visual privacy.* The design of *mëhalla*s (starting from the initial clusters to the neighborhoods) that aggregated based on group affiliation and relationship, as well as affinity and ethnicity, appeared to be sporadic and irregular, but embodied a long-term and stable social meaning creating cohesion according to the above principles. There was no prescriptive written regulation to handle the settling process into a geometrically predesigned scheme. People do, or do not do things based on the perceived consent.

In addition, the growth of Tirana, like in many other organic patterns around the world, when not prior abstractions existed (previous geometric traces or grids), was also influenced by *physical determinants* such as *topography, land division* and the process of *synoecism* (Kostov, 2003 pp. 53-62). We already explained the relevance of such concepts in a specific section of the 3rd chapter dedicated to the summary of theoretical concepts. In a bigger scale, the inception of the first nucleus and their further growth was influenced by the excellent qualities of the geographic container, as described by ottoman chroniclers and romantic travelers (including Edward Lear, etc. Figure 4.4). As explained in the 2nd chapter, it was a well-protected territory, formed by the combination of river necklaces and flat river terraces.

4.4
Tirana in the paintings of Edward Lear: 1848-1849

The Old Mosque (*Sulejman Pasha*) in the intersection of the regional trajectories (demolished in 1944)

Before describing the selected samples in Tirana, it is worth to understand some more details about how this *privatized urban order*, as Kostov (2003 p. 63) calls it, works:

Visual Privacy and **consecutive level of refractions** as a repetitive principle across scales:

- The analyzed samples in Tirana bring evidence that *the concern for privacy* was an important driving factor during the settling process, and for handling all life processes and interrelations within and outside the family.

- *The Concern for privacy* was reflected in the avoidance of *visual corridors*, starting from a cluster of houses to the urban vistas at the city scale (Figures 4.5; 4.6). Closing the space was more important than opening it; deviating the perspectives was more important than creating continuity. Consequently, the opening of doors and windows on building facades, and the high of the buildings, were determined by this concern for privacy and avoidance.

- This concern stimulated an introvert character of the house and of the entire residential cluster (repetition of the same principle across the scales). The appearance toward and from the street was not important (Kostov, 2003 p. 63). This character of the house and avoidance was guaranteed also by some other factors such as: the relatively high walls confining the plot; the long distance from the house to the access street; and the reduced building high (one or two floors) combined with the use of a dense greenery.

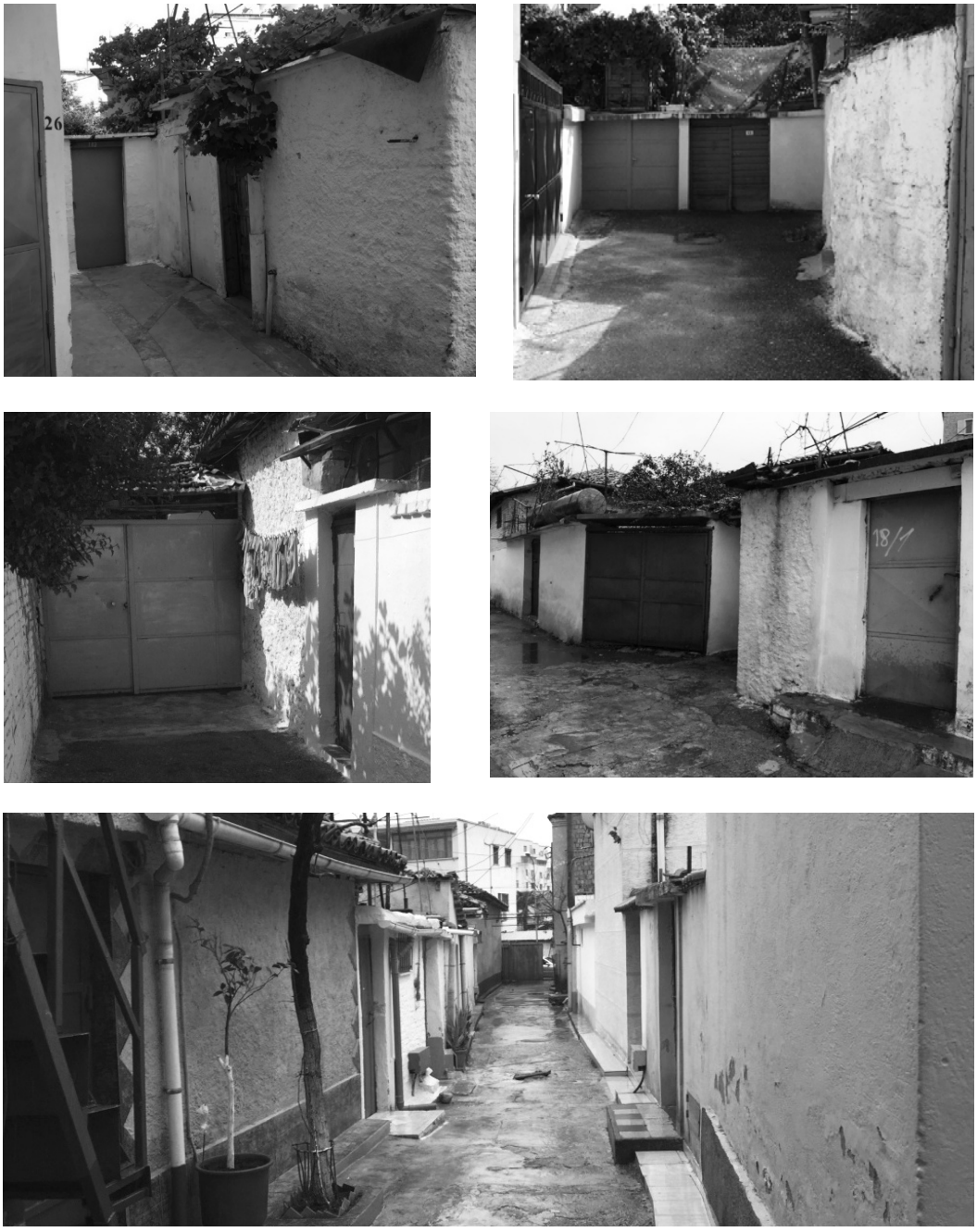
Tradition and Ownership: self-regulations and family ties

Tradition as invisible interference pattern

- People living in these kind of interlocked residential clusters grouped on the base of family ties. This situation was reflected in the way the entire society was functioning: the clannish and ancestral rules prevailed on the modern rule of law.

- In this kind of city, there is a balanced combination between citizen's personal property rights and the implicit consent to do things based on uncontested principles informally recognized. Thus, rather than instructed *what to do*, you do things based on *accepted social behavior* (Kostov, 2003 p. 63). Without the *force of tradition*, originated from the social structure, and social control this kind of *unsupervised city-making* would fall to anarchy (Kostov, 2003 p. 64). In fact, the open and unpredictable character of this system, makes it similar with the characteristics of an *open system*, which is based on the capacity of *self-organization* to *borrow energy* from its own environment in order to evolve, exchange information, *self-regulate*, *give rise to higher order complexity* and avoid *entropy* (Arida, 2002 p. 174).

- The same principle was applied on the space subdivision logic at the neighborhood and plot scale, and its use for public or private purposes. The space subdivision was starting from occupying the personal private space. The public space was less important in this kind of inward developments, and was a result of what was left (access roads) after the private plots and the houses were settled. In this sense the public space was continuously redefined based on negotiations while the buildings were risking to push it out. *A cul-de-sac was one common devise used* in these situations. In this self-regulated process, *the older uses and established structures had priority over new uses and structures* (Kostov, 2003 p. 63). The continuous negotiation was like a *malleable energy field* that created the *propensity* to change (Arida, 2002 p. 150) and continuously shift from one status to another, but within the general structure (and principles) established by previously consolidated functions and buildings (or persistencies).



4.5 Still existing *cul-de-sac* (dead-ends) from the three analyzed samples;
Configuration of an Introvert urban layout;
Public space in relation to the house and the access door






4.6 Space configuration that regulate the behavior through neighbor's watch pressure; Pictures from the three analyzed samples

Perceptual and physical borders (Figure 4.6)

- The public or private territory within this kind of residential cluster was mostly *marked by psychological and perceptual rather than physical* borders. This un-clarity or indeterminacy (double identity, or a potential degree of freedom in the use of space) between private and public creates ambiguous sensations *that charge space with various degrees of admissibility.* The indeterminacy of the context and the constitutive categories created can be explained with the inclusive both/and logic and the nuanced variety presented in the 3rd chapter. In fact, what Arida writes about the Middle-east Mediterranean towns is very similar to some parts of Tirana. He argues that these towns reflect a *conceptual continuity between private and public* (2002 pp. 187-189)**.** Similarly, in the historic parts of Tirana (but not only), the relationship between outer and inner qualities transmit the sensitivity to flow continuously from public to private without physical borders. You can see clothes drying in the public street, while shops, bars, or other public services are often located within the private housing spaces. The visitor takes the decision to penetrate further or not based on sensitivity and signals. You just follow the *territory shifts from public to private* receiving and interpreting different atmospheres (sounds, smells, views, etc.). Therefore, behavioral patterns (sensors) are stabilized in a try and error admissibility process. Also *inhabitants either adopt an indifferent, a welcoming or an alarmed curiosity* based on the same logic. The *intruder* is immediately identified by such an inexorably intelligent space where you are trapped. While on one side, *the open space flows organically* based *on pedestrian's sensitivity,* on the other side that creates the perception of psychological inaccessibility. An outsider penetrating in these areas of Tirana, feels like being between an intruder and a potential guest; or between the sense of "culpa" that impedes to continue further, and the mystery of the unknown that pushes to discover more. In addition, admissibility can change at different times of the day, and is influenced also by the configuration of the design layout such as housing composition and windows-door orientation in relation to the public space.

- This sensation is reinforced by the lack of public activities within the residential areas. However, some basic services were offered in proximity: the most frequent public building types were the local prayer services (the mosque, the *teke*, or in other cases the church), graveyards, markets, baths, etc. In the case of Tirana, most of the public gathering was happening in the organic center created by the Old Bazaar, where at least three central mosques were located and other public buildings were interlocked within the urban maze, creating as such interdependent systems within itself and with the rest of the city; however, the focus of this research is on the residential part of the city.

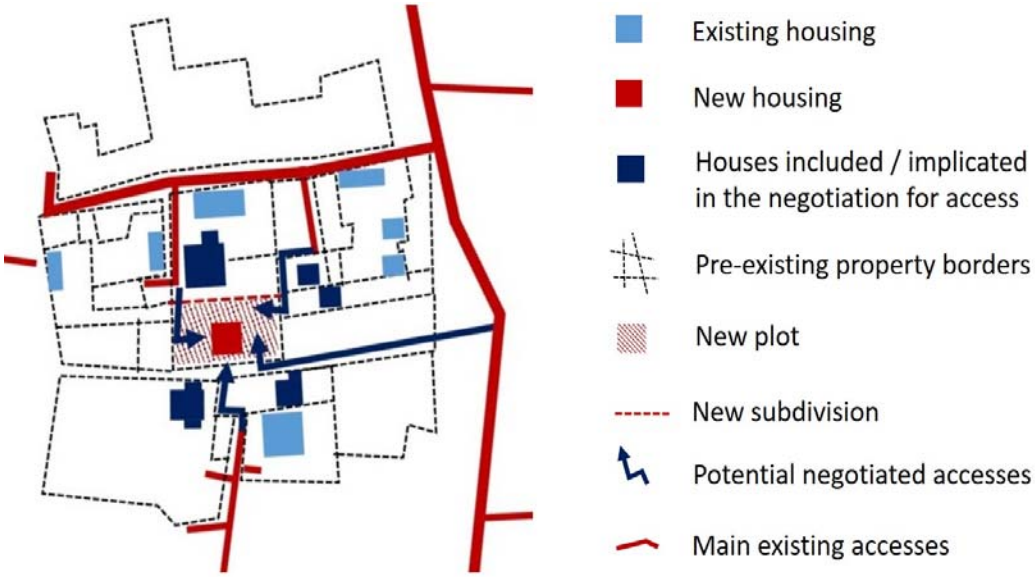
Interdependence and need for coordination

Within this interlocked system (city, neighborhoods, and clusters of houses) the interdependence between adjacent structures was unavoidable. Coordination was required for various repairs and issues related to the attached courtyards, such as partition walls, or for the maintenance of *cul-de-sac* that by tradition were considered to be the common property of the houses using it; Coordination was needed also for the informally established and uncontested vernacular rules, etc.

Flexibility, precariousness and adaptability – construction materials

- One of the main characteristics of such interlocked and self-regulated structures was the need for a high degree of flexibility, in order to resonate with continuous negotiations and redefinition of the relationships within the space. This was vital during the progressive densification of the neighborhoods or family plots (Figure 4.7). Therefore, flexibility needed to be compatible with a wide range of variable solutions, being those successful or unsuccessful. Conflicts especially those related to temporary extension of structures, or boundaries, etc. were adjudicated based on precedents.

- On the other hand, the space resulting from this kind of continuous negotiations and arrangements implies a degree of precariousness and the ability to be adapted (perceptually and materially) at any time the need was present. This was also reflected in the use of specific building materials that needed to adapt with the same flexibility to the required changes in the physical structures. The use of muddy / clay bricks, that could be easily produced from local clay, guaranteed the required level of flexibility. It is a well-known fact that this material was not so resistant, but at the same time it was an easily manipulable material, and most importantly could be produced by the family itself. Such degree of flexibility and adaptability in the use of space, as well as the identification of corresponding building materials, is something to consider in the contemporary urban design.

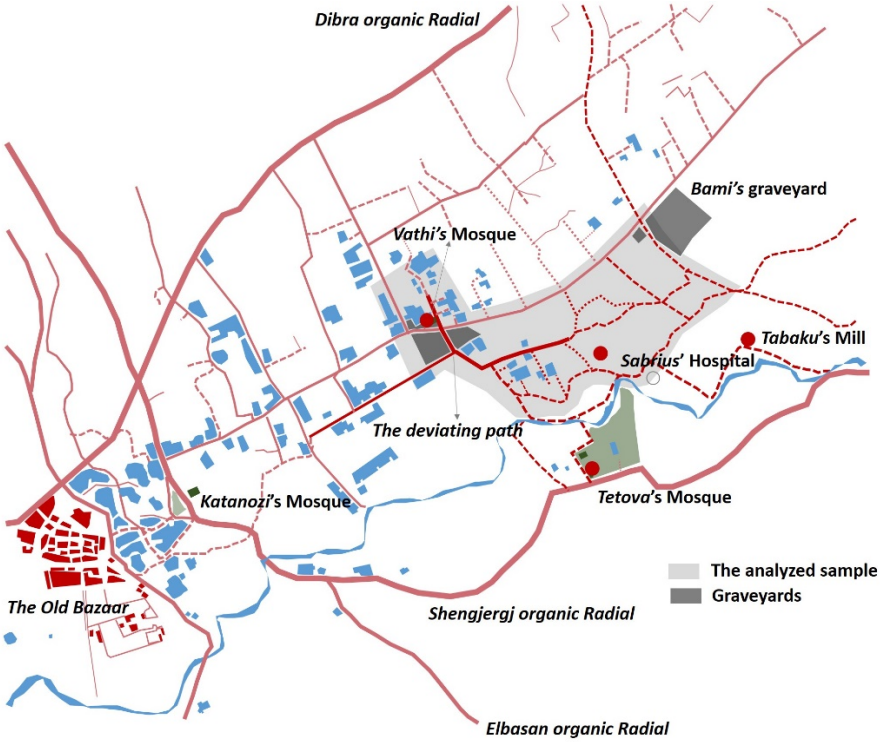


4.7 Plot / house flexibility and neighbor's reaction; in any of the negotiated cases a portion of garden is transformed in semi-private passage way; Same flexibility is adapted even in case of conflicts: access can be blocked on one side, but can be opened on the other sides; This produced an interlocked situation which could be balanced with a potential degree of flexibility.

These principles, as mentioned in the 2nd chapter, were exported in the Albanian territories during the period of the Ottoman occupation that lasted up to the beginning of the last century (1912). Despite the fact Tirana was a multi-religious town, the above-mentioned principles based in Qur'an, served as the building blocks for the main parts of the city. During the Ottoman occupation period that coincides with the city foundation, the predominating ideology derived from the Ottoman culture which had clear expansive objectives in the entire Balkan peninsula. In fact, many of these principles are still in the "air", substantially influencing many aspects of public and private life in Tirana, including city shaping and other developments in the city. Again, according to the quantum city approach, we might regard them as the wave effect, as an interfering pattern emitted (aroused) from within the unbroken SST network. Field surveys and the analyses carried out in the selected Historic Organic samples, bring evidences on the above-mentioned principles.

Sample 1.1

The "South-east *Dibra* neighborhood" (*mëhalla*), is grown out of a path that deviates 60 degrees to the south-east from the straight line perspective of the main road, creating as such the premises for the settling of a separate and undisturbed neighborhood (Figures 4.8; 4.10; 4.11, 4.14). The first nuclei were located neither far, nor near from the main road in the north, and from Lana stream in the south. There are some reasons to motivate the unexpected 60 degrees deviation of the path that are explained in the next paragraph.



4.8
Sample 1.1
Form and growth, 1921

The analyzed sample in relation to the main preexisting elements (organic radials, the center, the old bazaar, the mosques, graveyards, water mill, hospital, etc.)

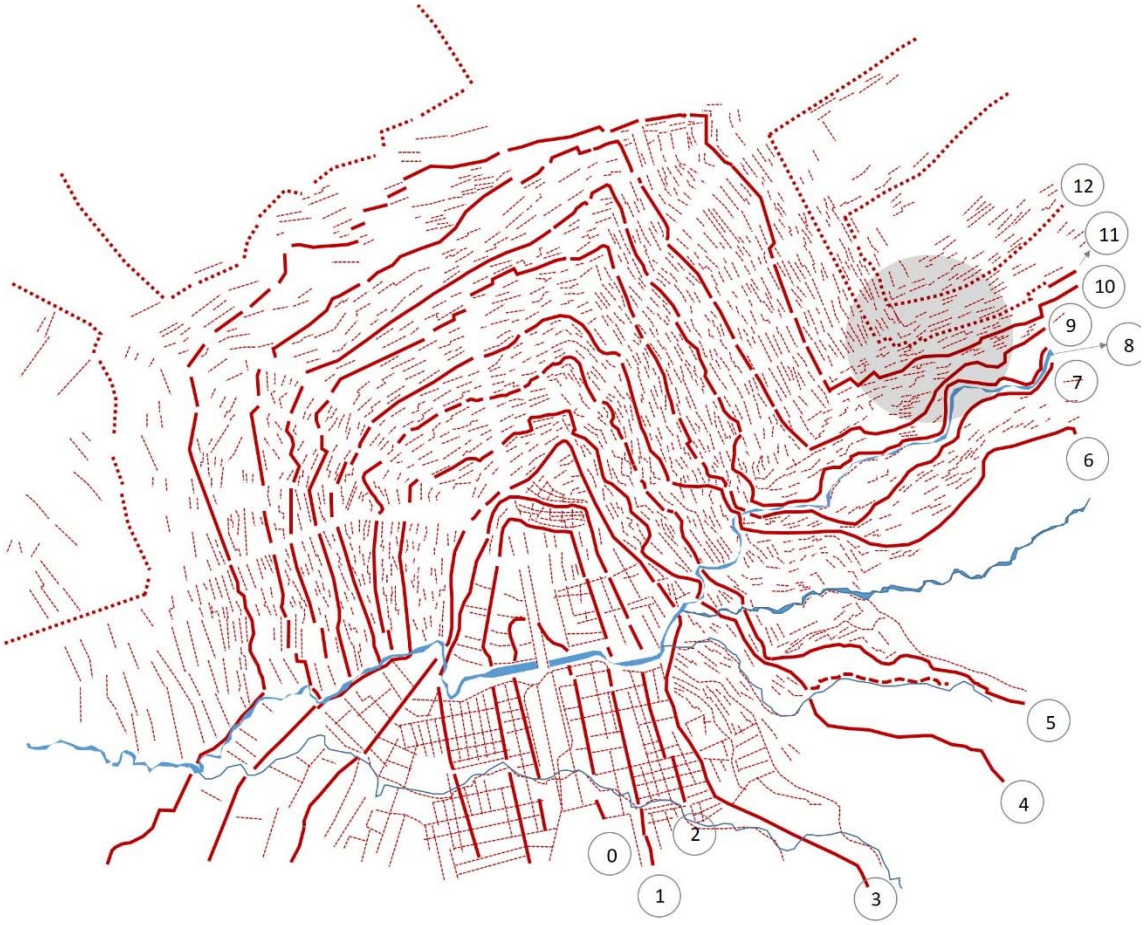
The main generating trajectories at the city level (organic radials of Dibra, Elbasani and Sh. Gjergji)

Form and growth: understanding structural properties of form

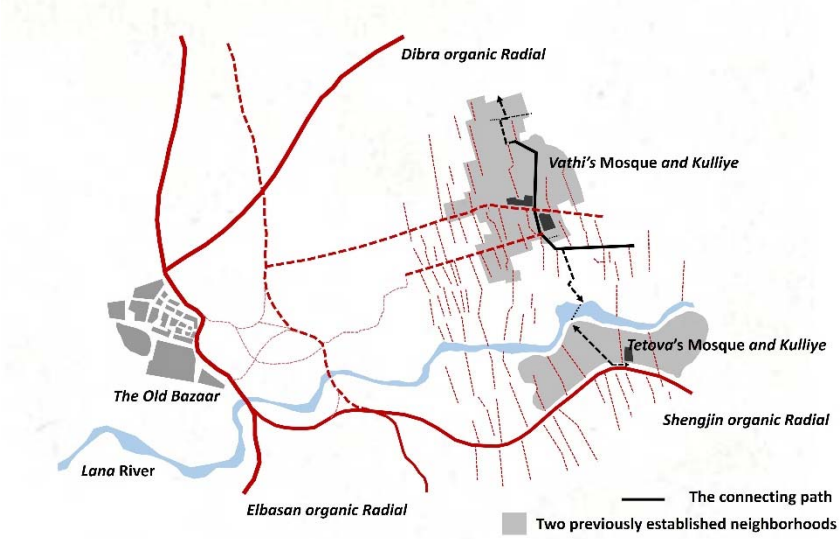
From morphological point of view, the analyzed unit is a combination of factors. They range from *physical determinants* to *social structure* and *urban improvisations*, as already explained in the previous paragraphs. Among the physical determinants, some of the most important include the Lana stream in proximity, the moderate slop downhill to the river (very appropriate for the discharge of the waste waters), and the subdivisions of land property oriented by the river and by topography (Figures 4.10; 4.12). In addition, the location seems to be influenced by some preexisting elements in the proximity of the area and the practical needs to avoid or to connect these elements. To name a few, the need to avoid the *Bami's* graveyard flanking one of the main rods adjacent to the area; the need to use the same path that connected with K*ryegjyshata* (the *Bektashi* sanctuary place), or with other important services such as the grinding mill, *Sabrius*' hospital, etc.; the need to use the path as a connection between two important mosques in the vicinity of the area, *Vathi*'s Mosque and *Tetova*'s Mosque, both local centers for the respective *kulliyes* (Figures 4.10; 4.13). In fact, this path after crossing the river in

a shallow area, was meeting the path connecting to the other mosque. In this logic, the analyzed sample is a neighborhood created almost half way from these two neighborhoods previously established according to *kulliyes* system, with the mosque as the central element. From this point of view, such deviation was also due to the instinct of settling in an appropriate distance, in isolation and in its own privacy a new neighborhood (because of the different culture of the settlers, or because of their belonging to different religious communities, or any other reasons).

At the city level, the area was located relatively in periphery and the modality of growth generated by the old bazaar in the center, through lines that rolls outwards the bazaar, is relatively weak. In fact, the area is located between the 8th and the 12th stripes (Figure 4.9) from the center. In such a distance the circular lines take the shape of linear stripes because the lack of gravity exerted from the center.



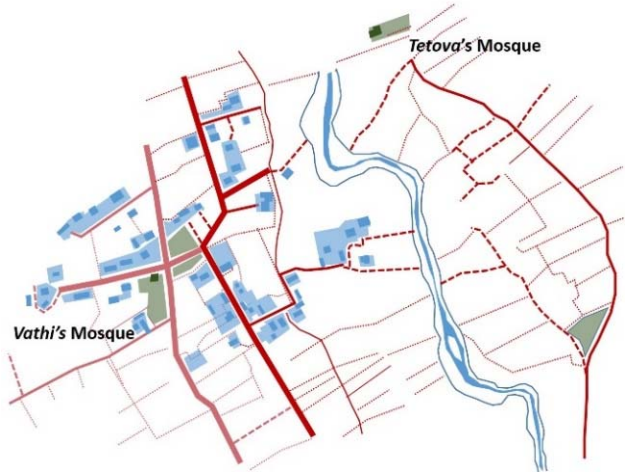
4.9 The modality of growth generated by the bazaar; the analyzed sample in relation to that modality; circular configuration lines rolling outwardly (1937)



4.10
Form and growth, 1921

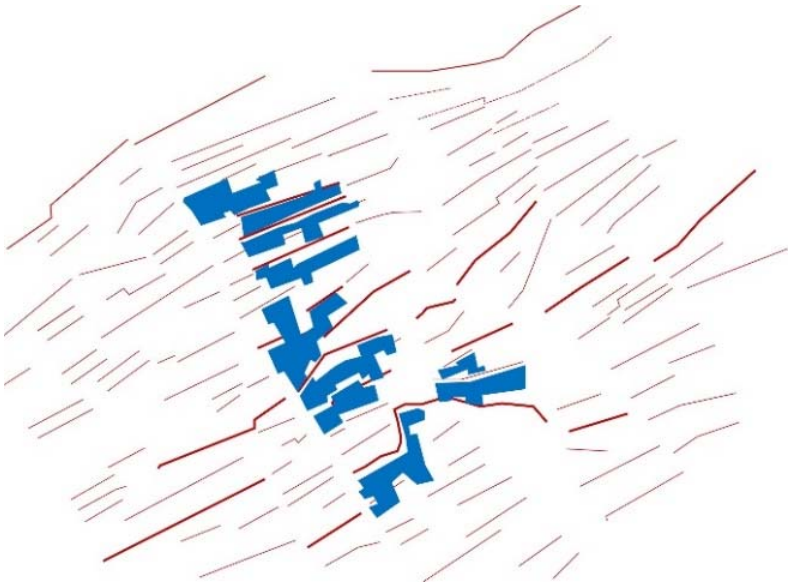
Physical determinants (topography, territorial lines and the direction of land subdivisions, river, mosques, etc.); The refracted path within the sample connecting the centers of the two preexisting *kulliyes*; The new neighborhood was located in between.

Once the privacy was guaranteed at the city level, it was important to guarantee a higher level of privacy within the neighborhood: in the groups (nuclei, clannish), and in the family plots (Figure 4.16). This inward settling process for the establishment of the neighborhood goes in parallel with the consecutive refractions and bifurcations[5] of the main feeding path: there are at least ten refractions and bifurcations points from the main path; each of them contains at least two to three consecutive deviations to reach the house or the cluster (groups) of houses. They remain dead-end or *cul de sac* that do not reach any of the main paths passing nearby (Figures 4.11; 4.13; 4.15; 4.18). This is another evidence that the role of the lower level paths was only to serve internally and not to create a connected and open network of communication. They were tracked in such a way to preserve the privacy and the independency from the main roads. The connection with the later was guaranteed only through the main feeding (generative) path of the neighborhood, which was also refracted several times.

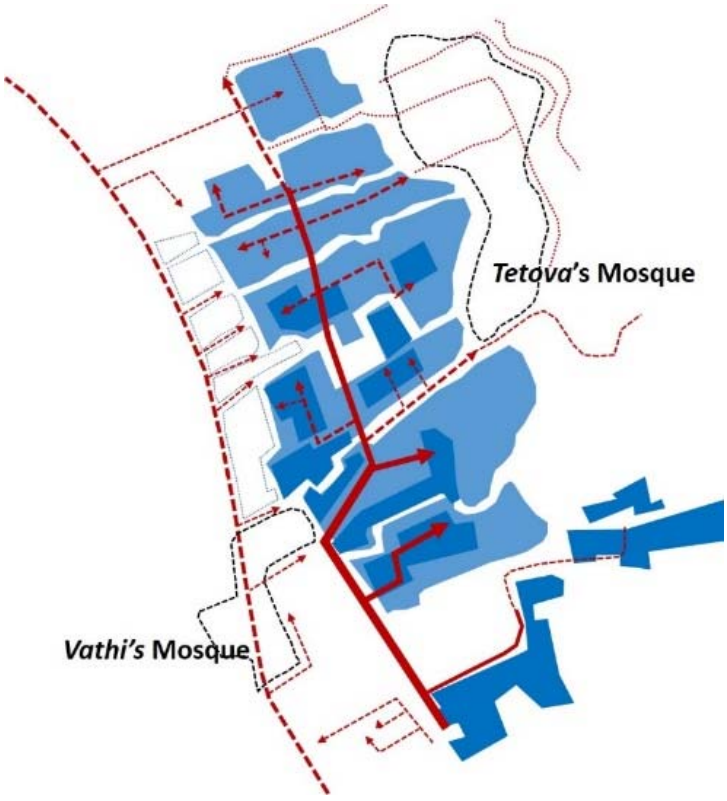


4.11
Nuclei in 1921

[5] In the framework of this research, with refraction we will understand the deviation or the change of directions occurring within the same line; while with bifurcation we will understand the break-out of a new line from the main line; More details about this are given in the 5th chapter.



4.12
Territorial lines (topography and land subdivisions) and their influence in orienting the extension of the initial nuclei (1937)



4.13
The location of the analyzed sample between two preexisting *kulliyes*;
neither near, nor far from the main road;

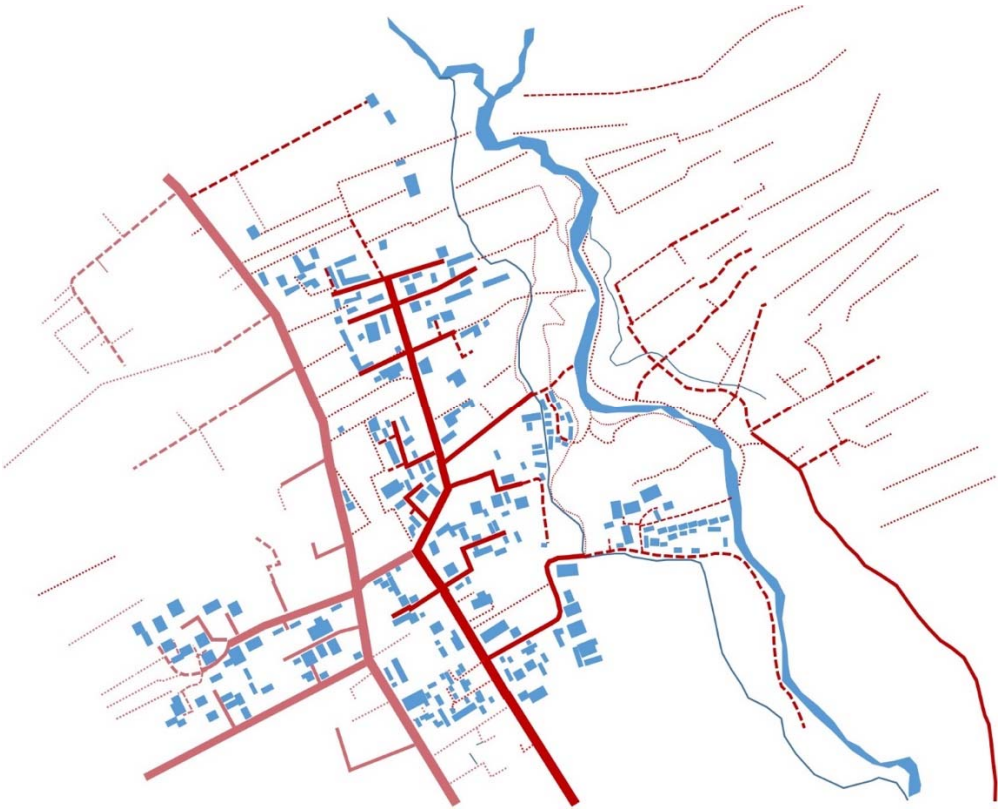
The expansion of the initial nuclei (1937)

The deviation of the lower level paths seems to be guided by a combination of factors. Among others, the previous land ownership patterns that are clearly visible from the map of 1937; the topographic features of the site; and the need to track the shortest run to Lana stream. While the bifurcated paths are opened on the direction to Lana stream, they are dead-ends from the opposite direction going up-hill. However, the prevailing motive of such deviations at this level

of city hierarchy was the instinct to guarantee the personal / family / cluster / neighborhood privacy.

The external empty buffer area, a kind of interstitial between the housing groups and the main roads, was filled much later (Figures 4.17; 4.19). During the 70's and '80s, as well as at the beginning of 2000 higher apartment blocks reinforced the enclosure and isolation of this neighborhood. They definitely wrapped / enclosed the area from outside. More details about that are in the following paragraphs.

4.14 Shapes of the sample in 1921, 1937, 2005 (the refracted path marked as reference)



4.15 Nuclei extension in 1937 and territorial knitting; levels of bifurcation and refraction.

4.16 The social structure; Clans or groups aggregated based on affiliation and relationship; From initial clusters to neighborhood

4.17 The external empty buffer area; interstitials between housing groups and the main road

4.18 Urban knitting and communication in 2005;
Persistencies and their influence; the hidden frame that influenced further developments

4.19 Mechanic collage and the ultimate closing through wrapping from outside; higher apartment blocks reinforced the enclosure and isolation (2005 updated with recent developments)

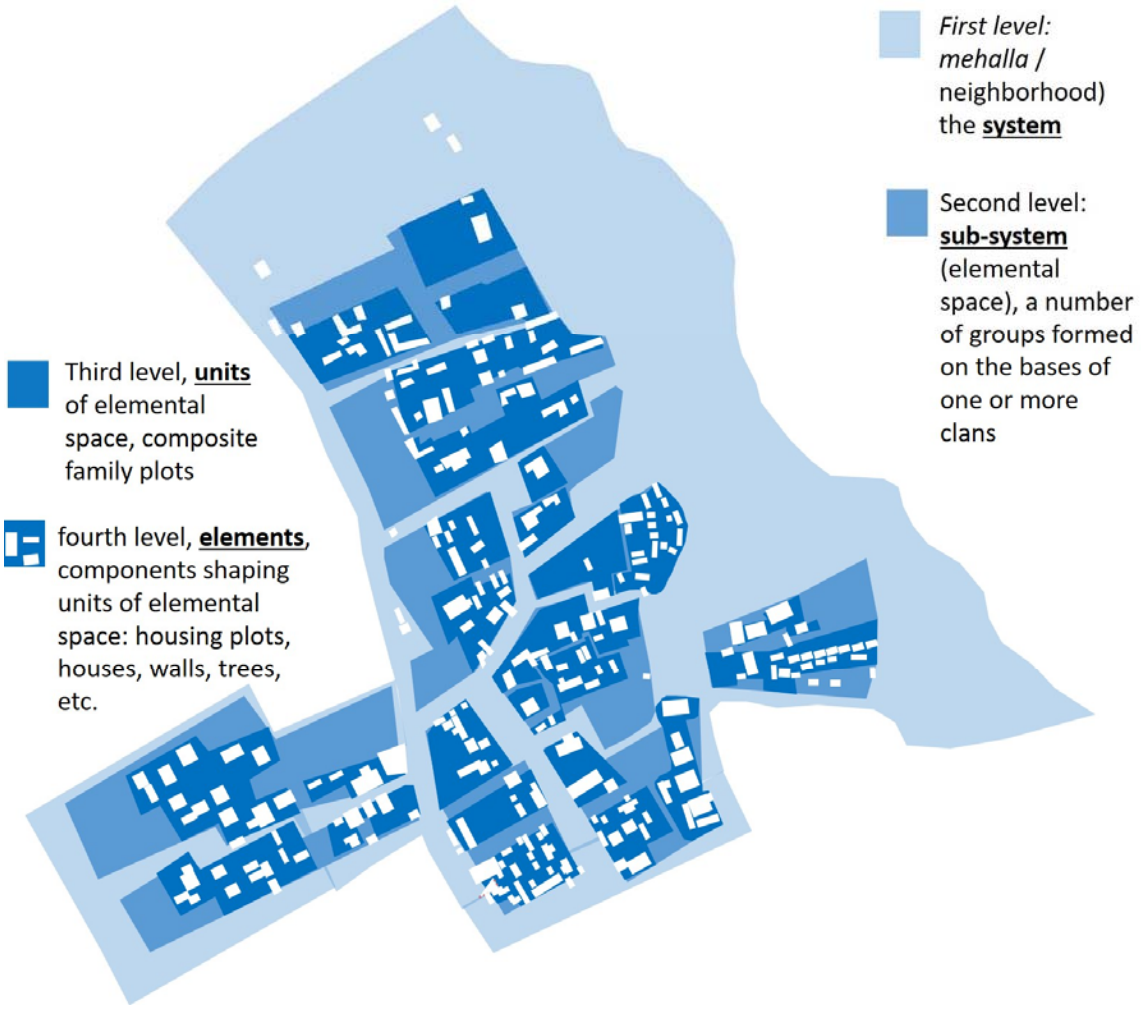
Levels of hierarchy within the system; Identification of systems, which elements repeat in a similar way from scale to scale (hierarchy)

The occupation modalities during the settling process: from a single house to neighborhoods

Starting from the system, which is considered as the first level of hierarchy, three other consecutive levels which correspond with the structure of the occupation process as well as the modality and frequency of the path deviations, exist. In the analyzed case, the entire sample (*mëhalla* / neighborhood) is considered as a system. The second level, sub-system (or the elemental space), is a number of groups or clusters formed on the bases of one or more clans, tribes, or big families. The process of groups' creation (based on clans, tribes, or big families), is

especially important at the initial stages because it determines the modalities of further settling process. The initially ample interstitial and isolating areas in between, leave space for further developments with the same settling logic. The third level, units of elemental space, consist in composite family plots containing further and smaller subdivisions. The fourth level, elements, include all components participating in the shaping of units of elemental space such as individual housing plots, houses, walls, trees, etc. (Figure 4.20).

To give meaning to the spatial dimension of these sub-assemblies, starting from singular elements, to units of elemental space and to the entire system, we already explored the anthropological principles (adapted by Kostov) that serve as the building blocks for shaping these spaces. The observations bring evidence that the use of similar principles at each of these levels, were transformed in shared experiences and self-similar / affine physical forms.



4.20 Levels of hierarchy within the system

Self-similar phenomena

The deviating principle, not only was manifested at the system level (*mëhalla* or neighborhood), but it was manifested even in the occupation pattern and positioning of the initial groups (clan or family clusters) within the space of the future neighborhood. These groups follow the same principle of avoiding and hiding from each other, similarly as the settling of *mëhalla* in relation to the city. The same principle scales down to the smallest subdivisions and to the process of opening and closing the main doors and windows in relation to the private, less private, semipublic and public spaces: a private and less private space never create straight-line perspectives.

The second self-similar phenomenon, intimately related to the previous one, is the creation of the interstitial spaces. In some cases, some of these interstitials, normally the more central ones were unreachable or inaccessible. Even in this case the logic of 'neither far nor near' that creates the privacy buffer areas, scales down from the system level to the units of elemental spaces and to the single houses and smaller elements that limit the spaces. As we saw from the figures (Figures 4.10; 4.11; 412; 4.13; 4.14; 4.15; 4.17), the first nuclei were neither far, nor near from the main road and other pre-existing neighborhoods; the housing groups or nuclei were initially detached from each other and not necessarily near to the main generating path; single houses within groups / nuclei or family plots were proportionally distanced according to the same logic; they were preferably located in a position to avoid the immediate contact with the public space of the street, or even semipublic or less private areas within groups or plots. This was already explained as part of the occupational pattern.

After avoiding, it was important closing the space. This was the third self-similar phenomenon. Closing was realized through the high walls, often reinforced by abundant greenery or orchards, isolating initially the neighborhoods from the other parts of the city, as well as the group families and the separate houses from each other. The importance of closing was reflected also in the existence of semi-public/private streets, and the neighborhood gates (which in some cases arrived up to date). During the continuous densification process, the same closing attitude was manifested within individual plots and dwellings lay out, reinforcing and consolidating even more the embryonic quality of the visceral space.

From chronological point of view, the abundant interstitial free spaces between nuclei and between the houses itself observed in the map of 1921, diminished and increasingly densified in comparison with the map of 1937 and in the following periods. As shown in the scheme (Figure 4.14), this occupation modality during the initial stages created the premises for two kinds of future developments:

Firstly, the interstitials between the historic developments and the main paths confining the area, created the condition to ultimately "enclose" the area from outside (Figures 4.14; 4;17). This kind of densification process started after the Second World War, when in the area were introduced 4 to 5 stories collective apartment blocks, and continued after the collapse of the communist regime when in the area were introduced even higher apartment block typologies. The former interstitial areas, once built could be directly accessed by the main paths, and / or sometimes by lower level paths coming from the internal part of the area as an extension of the historic network. Therefore, two independent servicing paths could be created within the same morphological unit: from outside and or from inside. We can observe from the map of '37 and '05 how the historic nuclei were outwardly /externally wrapped developing almost like linear

stripes along the main paths or even along lower level paths (Figure 4.19). In some cases, parts of the historic structure were substituted by new high rise typologies. These buildings drastically differ from the historic typologies, however their layout and the servicing systems are conditioned by the existing morphological system and previous arrangements. This sample represents a typical example of a totally interiorized historic neighborhood, initially created through an inward aggregation process aiming to hide in itself through avoiding the straight line perspective and exposure, locating in distance and creating interstitial buffer areas; and later by being wrapped from outside through building almost continuous and impenetrable edges.

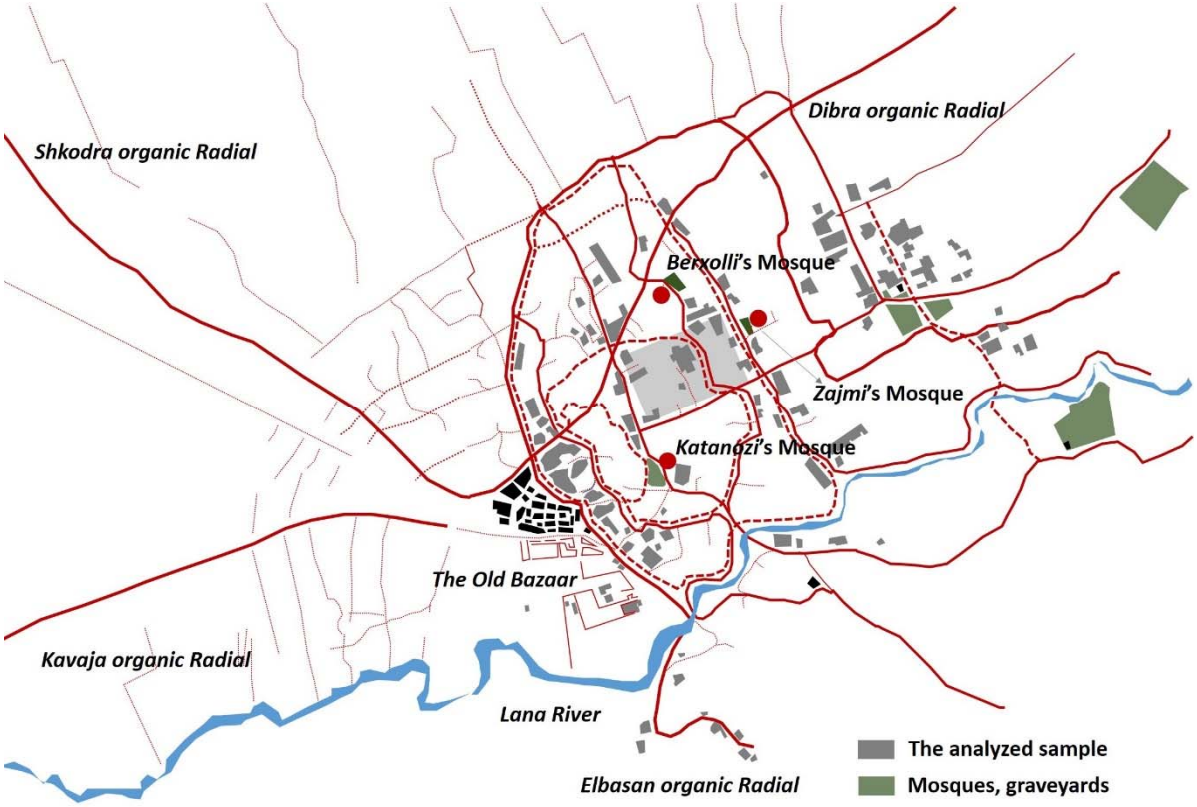
Secondly, the interstitials created conditions for developments through densification and implosion of internal spaces inside each group or family plots. Considering the fact that each family consisted of more than one familiar nuclei, the distribution logic within the family plot itself was subject to the same principles applied at the higher levels of hierarchy: respect to privacy of each individual nucleus within *mëhalla* and respect to privacy of each individual houses within the family plot. It would be worth here to remind again the specific meaning of privacy within the Muslim right to visual privacy. As mentioned, this was a kind of building block for shaping the elemental space.

Therefore, in the successive phases the plot itself was densified, transforming from single house plot into composed residential plot. This process required perpetual and infinite modifications such as plot subdivisions, openings and closing of the space in interior and in exterior. As explained, all this was based on the personal arrangements and affinities. Hence, lower level paths could be drawn and re-drawn continuously to provide access to the new houses and improve connectivity. As mentioned earlier, in some cases, it could be sufficient only the opening of new doors in the confining walls in order to use the courtyards as a private connection spaces. Even at this scale, the aggregation of plots and buildings aimed the creation of the "private Eden" based on internal negotiations and introvert behavior that characterizes the entire settling process (Figure 4.7).

<u>*Sample 1.2:*</u> "*Shkolla e Kuqe*" ("Read School").
Being located nearer to the center the influence of the "Old Bazaar" as the main gravity center is much stronger, which makes this case slightly different from the previous one. This *mëhalla* was grown out of two meandering paths deviating from one of the main city radials. In the following paragraphs I give some arguments to better understand these processes and the relation of the generative paths with factors in proximity and in a larger city scale.

Form and growth: Understanding structural properties of form
As I explained in the previous sample, the morphological process in this unit is a combination of factors that range from physical determinants to social structure and urban improvisations. There are no topographic restrictions in this case to oblige the refraction and the line orientation of the path. Once that *kulliyes* were established, what counted more was the vicinity with the old bazaar and the modality of growth dictated by this strong central element generating circular lines rolling outwardly. Four of these rolling lines (paths) influenced the growth of this sample: the 6th, the 7th, the 8th, and the 9th (Figures 4.21; 4.22). The 7th and the 8th lines, meandering through the area have a greater influence in determining the character of the neighborhood, differently from the 6th and the 9th that just confine this *mëhalla* and follow a straight course, maintaining a longer continuity through the city (Figures 4.22; 4.23). It seems there are no specific reasons for the moderate meandering of the 7th and the 8th path lines, but

the previous land arrangements, and/or the need to connect preexisting elements, such as a sanctuary flanking Bami's road with Berxol's mosque located northern, and to continue even up to the intersection with *Dibra* radial.



4.21 Growth and form: The analyzed sample in relation to the "rotating" urban stripes; modality of growth generated by the old bazaar as a central element; pre-existing physical determinants and religious institutions

Since this neighborhood was located nearer to the center, the isolation and detachment of *mëhalla* from the other parts of the city was not achievable in the same way like in the first sample, hence the required privacy was guaranteed at the lower levels of hierarchy: these of groups (nuclei) and family plots. For this reason, there are at least six other bifurcation points from the 8th meandering line. In addition, from each of these bifurcations emanate at least two to three consecutive deviating levels that feed the access to the house or to the cluster. They are dead-ends and never reach any of the main trajectories confining the *mëhalla* (Figure 4.23). As we mentioned, there were no topographic restrictions in the area, therefore the refractions at this scale are simply guided by previous land ownership (clearly visible from the maps of the year '21 and '37), and most importantly by the inward instinct to guarantee the personal / family / cluster / neighborhood privacy (Figures 4.24; 4.25; 4.26; 4.27; 4.29).

4.22 The modality of growth generated by the bazaar; the analyzed sample in relation to this modality; circular configuration lines rolling outwardly (1937)

4.23 Urban knitting 1921, 1937 and 2005; circular rolling lines; and levels of bifurcation and refraction (at the neighborhood level);

4.24 The occupational structure and densification 1921, 1937; the insertion of new typologies (multistory collective apartments) after the Second World War up to date

Levels of hierarchy within the system: Identification of systems, which elements repeats in a similar way from scale to scale
The occupation modalities during the settling process: from a single house to neighborhoods

In a similar way with the levels of hierarchy presented in the previous sample, starting from the system, which is considered the first level of hierarchy, three consecutive levels as shown in the figure 4.34, exist: sub-systems (or the elemental space), the units of elemental space, and elements. These levels correspond with the occupation process and the modality and frequency of the path deviations, which is the behavior of the system.

The occupational pattern as mentioned, was mostly influenced by the four outward rolling lines as shown in figures 4.22; 4.23; 4.25 that in interaction with the pre-existing *kulliyes* seeded the initial developments of what would be transformed in the future *mëhalla*. This was also part of the synoecism processes at the city scale that as already explained resulted in a unified and bigger pole.

Observing the changes in the period between 1921 and 1937, we can recognize that the first nuclei located in a relative distance from each other and from the main paths (the four rolling lines and other roads confining the neighborhood), although they followed their directions and used them as the main accesses to the city. Because of that occupational behavior aiming the creation of privacy, a lot of free space was left especially along the main paths and in the core of the future neighborhood (Figure 4.31). This situation and the central location of the neighborhood, motivated the draw of additional lower level paths to feed developments in the perimetral and in the internal interstitial spaces (Figures 4.29; 4.30; 4.32; 4.33).

Within the nuclei, the occupational pattern and the privacy logic, followed the same principles mentioned in the previous sample: houses preferably located in a position to avoid the immediate contact with the public space of the street. They were reachable through deviating paths. Normally, no house was located at the end of a long prospected path, unless the direct view was blocked through high walls or dense vegetation.

4.25
Nuclei extension in 1921 and urban knitting

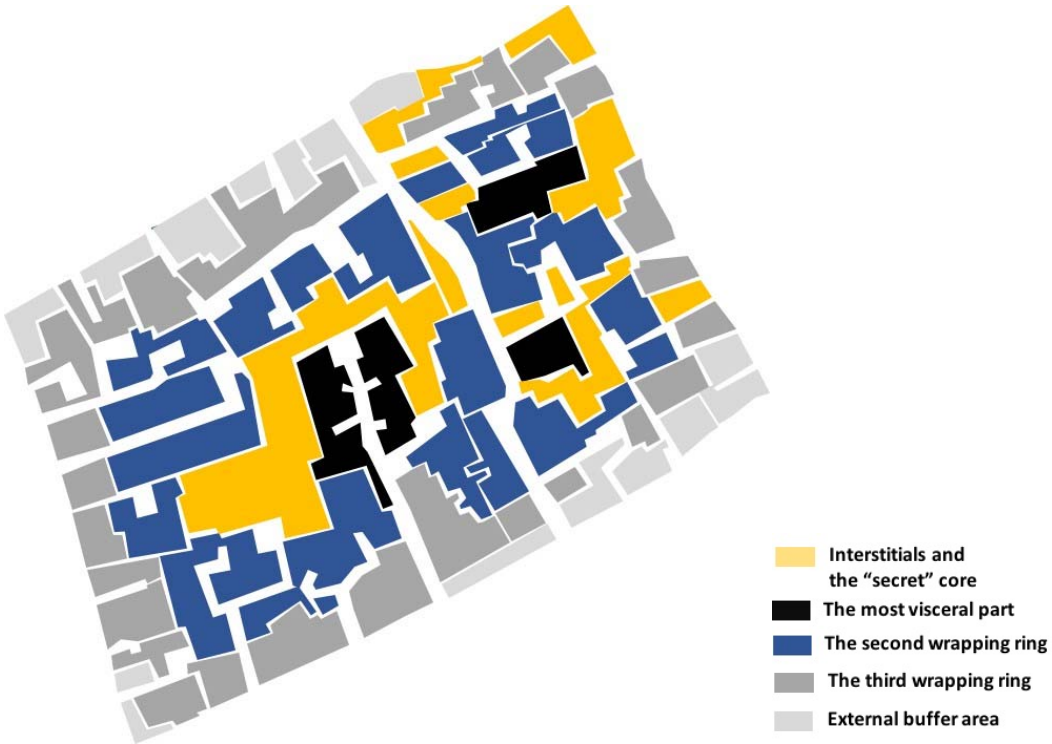
Important religious elements in proximity

4.26
Nuclei extension in 1937 and urban knitting

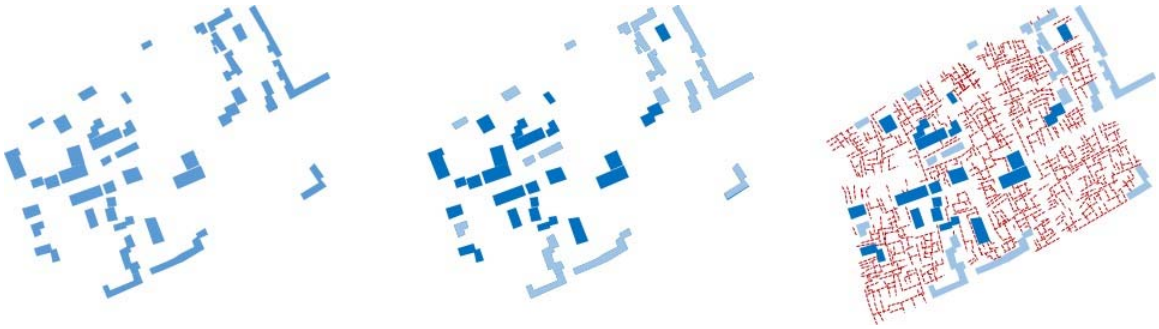
Important religious elements in proximity

4.27
Social structure; Clans or groups of houses aggregated based on affiliation and relationship (tribes, or big families)

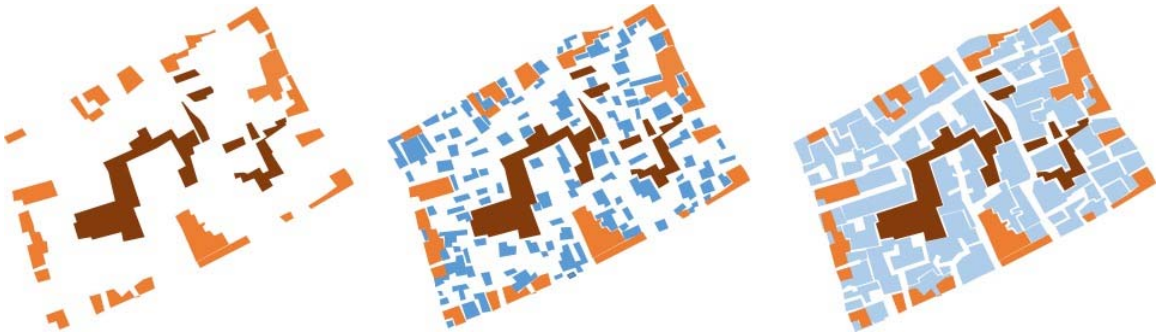
4.28
The wrapping process in relation to the “secret” core, or the most hidden and visceral part of the neighborhood; The visceral quality of space



4.29 Shapes of the sample in 1921, 1937 and 1980 up to date



4.30 The multistory collective apartment buildings influenced by the “hidden” frame of the organic developments; the figure in the middle shows the interventions from ’45-’89 (with lighter color), and from the begging of ’90s to date (with darker color); on the right is shown the relationship of these interventions within the organic maze.



4.31 The internal “secret” core and the external buffer areas in relation to the main road system; interstitials between the housing groups (1937)

4.32 Urban knitting and communication network in 2005 up to date; The persistence of the “hidden” frame influencing developments

4.33 Mechanic collage: permanencies from the original organic structures, and interventions after the Second World War up to date; Ulterior wrapping from outside; multistory apartment blocks reinforced the enclosure and isolation

First Level: the **system**; *mehalla* / neighborhood)

Second level: **sub-system** (elemental space), a number of groups formed on the bases of one or more clans

Third level, **units** of elemental space, composite family plots

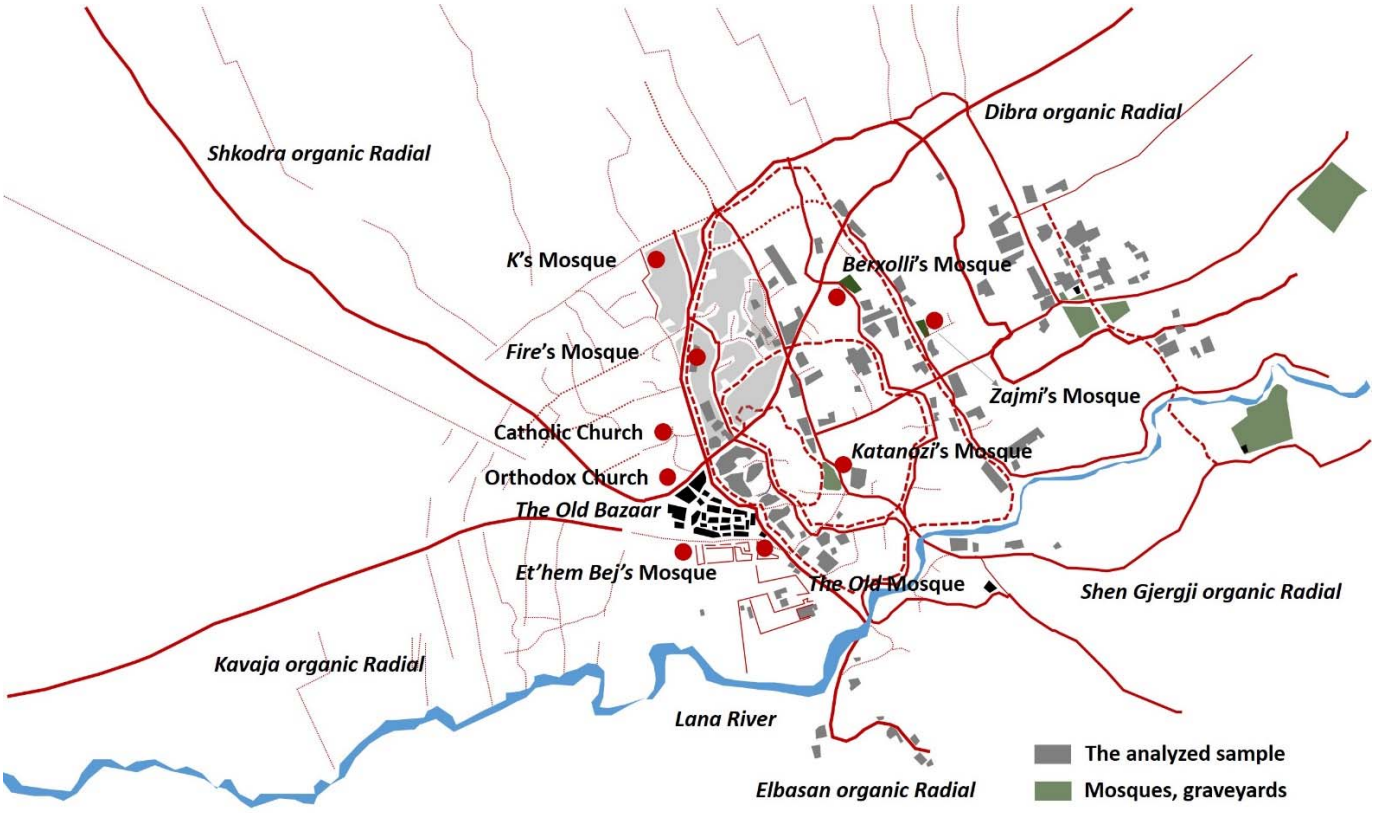
Fourth level, **elements**, components shaping units of elemental space: housing plots, houses, walls, trees, etc.

4.34 Levels of hierarchy within the system

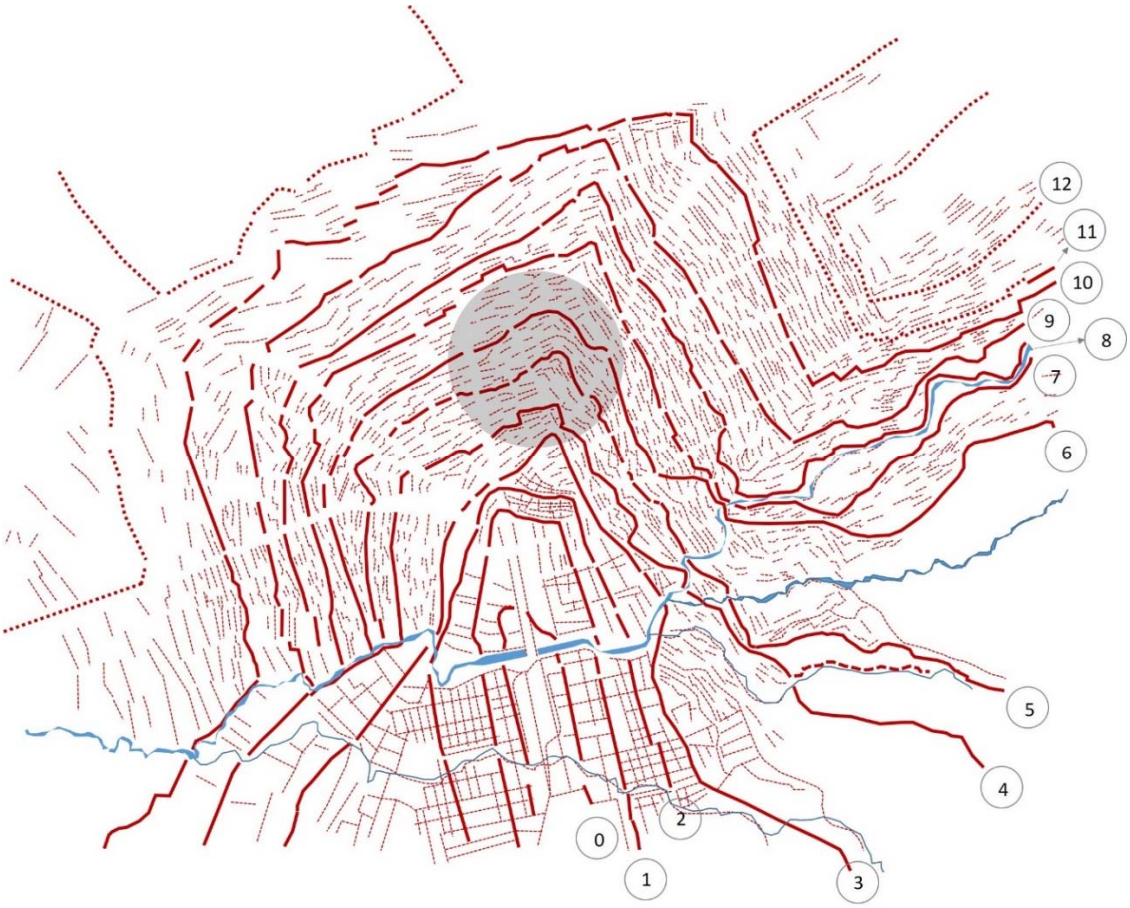
It becomes clear from observing the map of 1937 that the volumes of buildings that existed in the map of 1921, were wrapped from outside during this period (Figures 4.25; 4.26). New developments filled the interstitials between the preexisting buildings and the main paths confining the neighborhood (Figure 4.28). The development logic after the Second World War and after the collapse of the communist regime ('90s) is similar with what explained in the previous sample related to both, the wrapping process, and the internal densification within each family plot; not only filling the free spaces, but also substituting parts of the historic structures with new typologies (Figures 4.30; 4.32; 4.33). What differs in this case is the formal articulation (Figure 4.49) of the wrapping process in relation to the "secret" core, or the most hidden and visceral part of the neighborhood.

A path that normally contains the highest level of refractions and bifurcations feeds the infill developments of the core. Despite the complicated access, new typologies with a larger scale recently penetrated even within the hidden core. These typologies differ in mass and in volume from the historic ones, however, for the rest they follow the restrictions imposed from the intricate network and relationships contained within the morphology of the area (*persistencies*). The densification process that is further reinforcing the enclosure of the area, follows an engraved code transmitted not only through physical traces still existing in the area, but also through users' behavior interfering patterns transcending space-time. It would be worth to remind here the role of users that bring in the non-material aspects, or different cultural dimensions which are very important elements for the natural cities; or users as a vessel for non-locality etc., all those concepts are presented in the 3rd chapter as part of the quantum approach.

Sample 1.3: "North *Dibra* neighborhood", or known as "*Lagja Dibrane*"
Because of similarities with the two previous samples, regarding the structural properties of form, levels of hierarchy within the system, elements repeated in a similar way from scale to scale, and self-similar phenomena, this sample is presented only trough schemes and diagrams. Most importantly, in the 5th chapter this sample is subject to a detailed redrawing and an accurate measurement process, followed by data registrations and other statistical calculations that will be explained more in detail in the next chapter. Here I present only the main diagrams to understand the main characteristics of that sample.



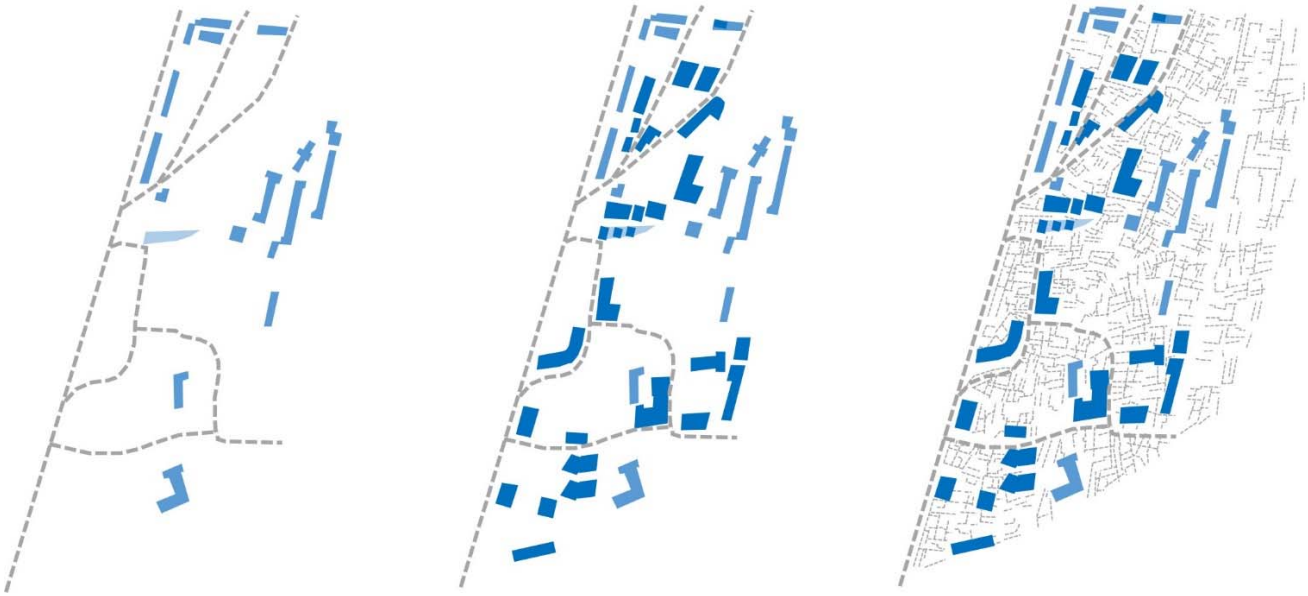
4.35 Growth and form: The analyzed sample in relation to the "rotating" urban stripes; modality of growth generated by the old bazaar as a central element; pre-existing physical determinants and religious institutions



4.36 The modality of growth generated by the bazaar; circular configuration lines rolling outwardly; the analyzed sample in relation to this modality; designed on the map of 1937

4.37 Urban knitting 1921, 1937 and 2005; levels of bifurcation and refraction; the rolling lines

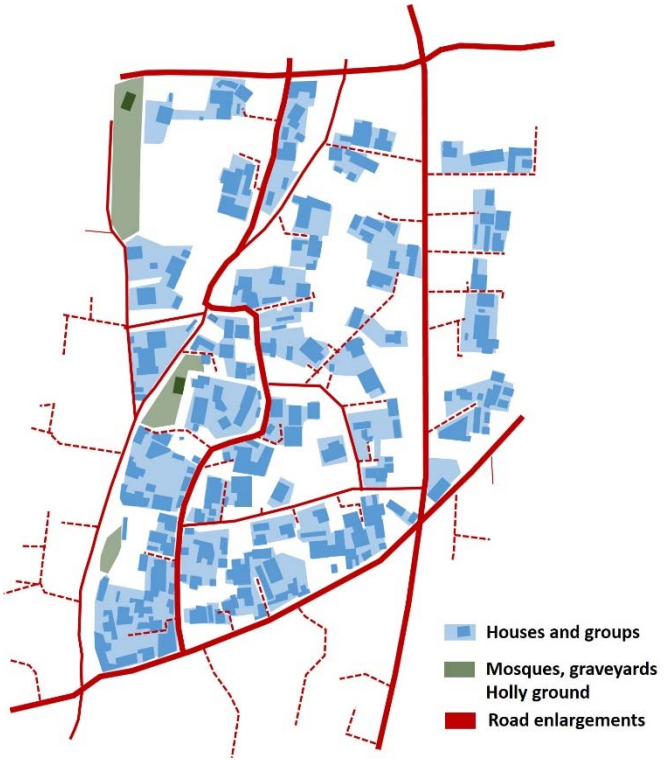
4.38 The occupational structure and densification 1921, 1937; the insertion of new typologies (multistory collective apartments) after the Second World War up to date



4.39 The multistory collective apartment buildings influenced by the “hidden” frame of the organic developments; the figure in the middle shows the interventions from ’45-’89 (with lighter color), and from the begging of ’90s to date (with darker color); on the right is shown the relationship of these interventions within the organic maze

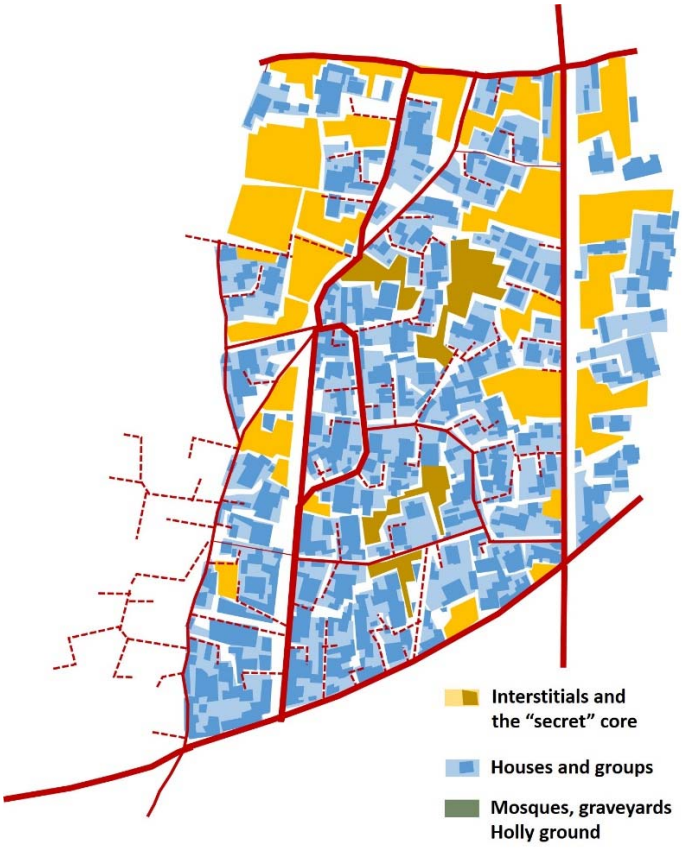
4.40 Shapes of the sample in 1921, 1937 and 1980 to date

4.41 The internal “secret” core and the external buffer areas in relation to the main road system; interstitials in between the housing groups (1937)



4.42
Nuclei extension in 1921 and urban knitting;

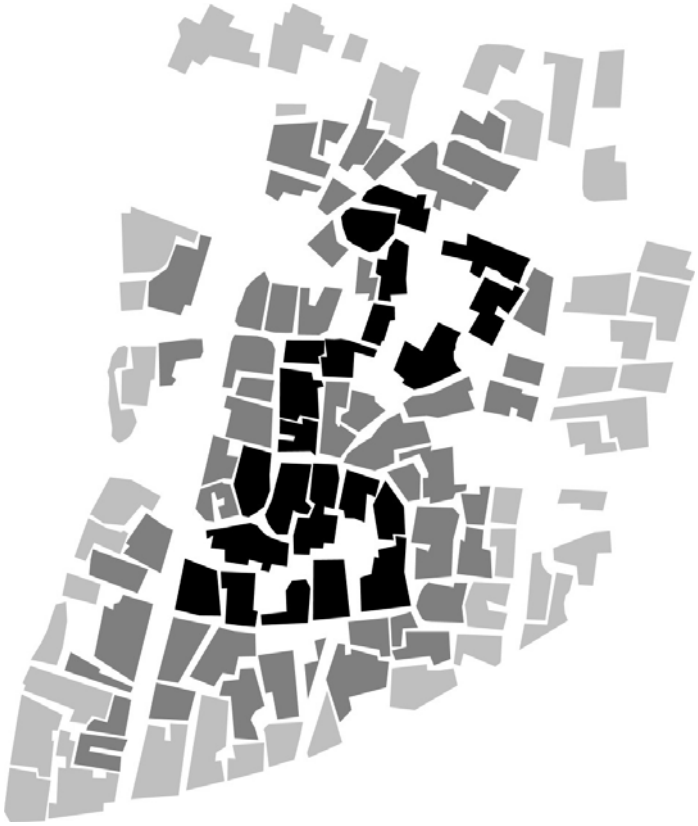
Important religious elements in proximity



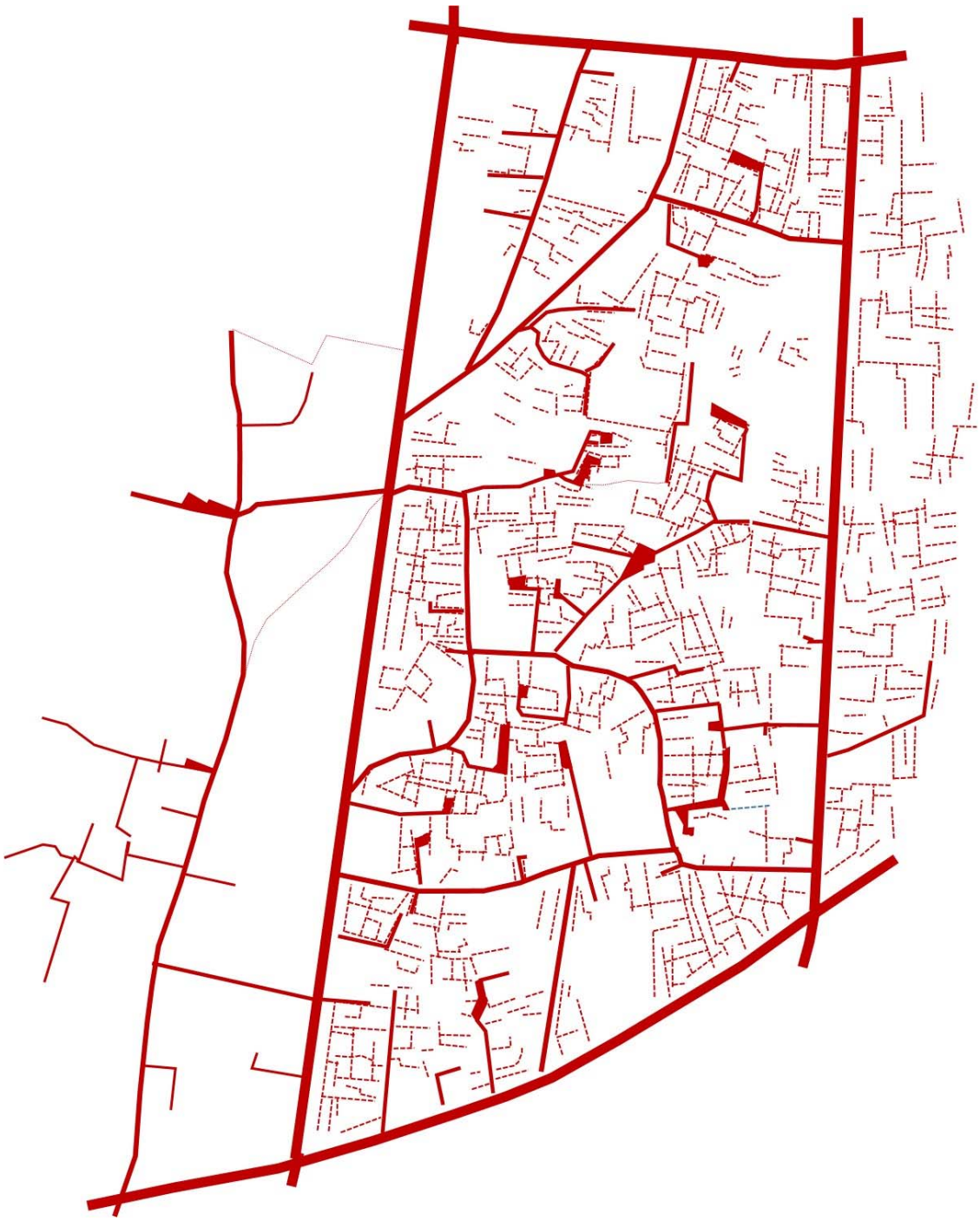
4.43
Nuclei extension in 1937 and urban knitting;

Interstitial free areas

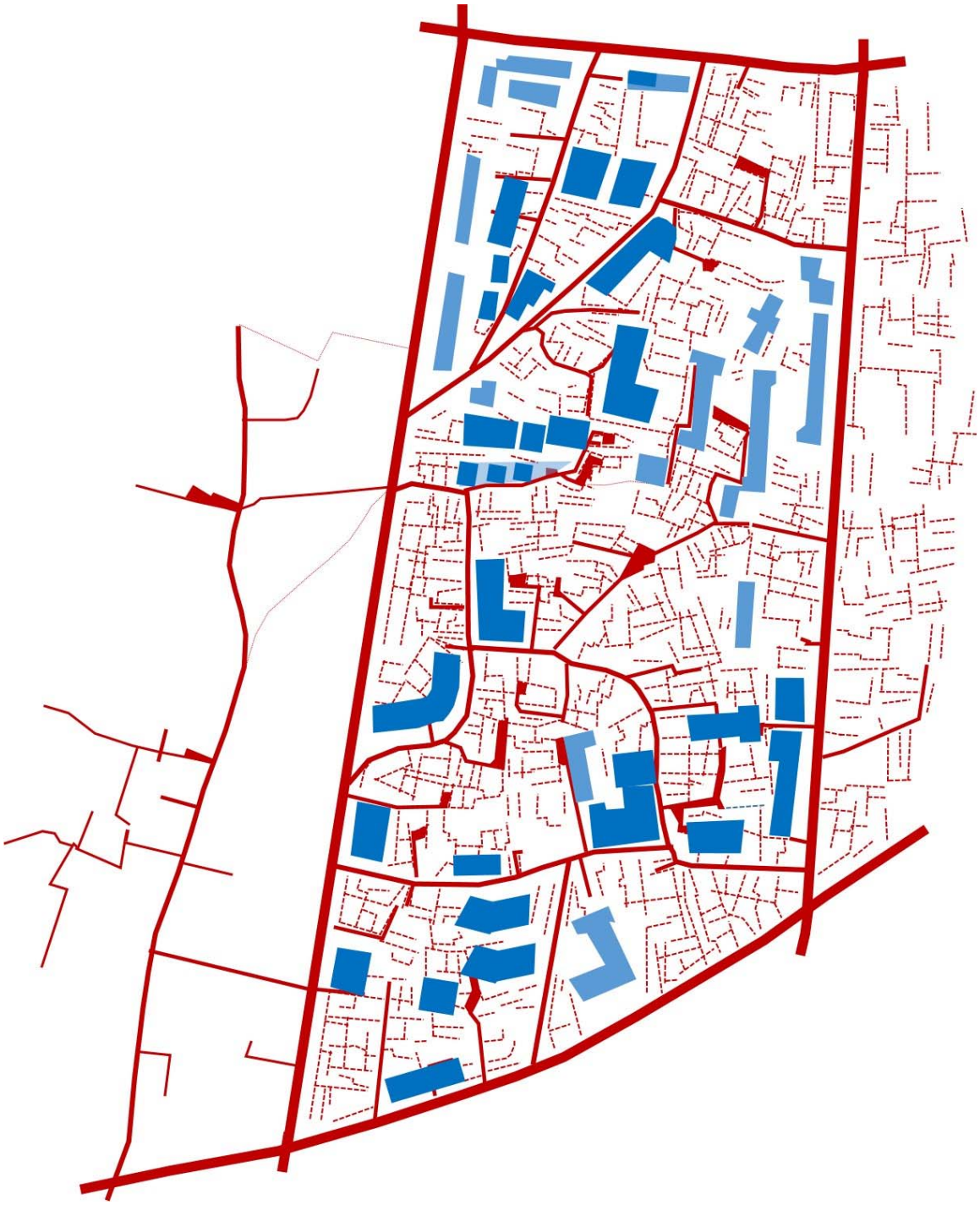
4.44
Social structure;
Clans or groups of houses aggregated based on affiliation and relationship (tribes, or big families)



4.45
The wrapping process in relation to the “secret” core, or the most hidden and visceral part of the neighborhood;
The visceral quality of space

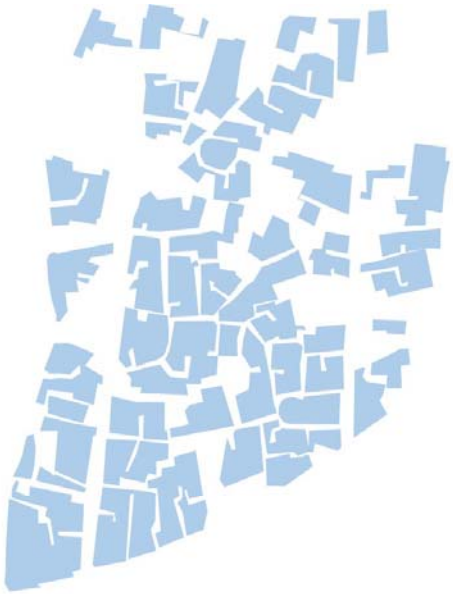


4.46 Urban knitting and communication in 2005 up to date; The persistence of the “hidden” frame influencing developments

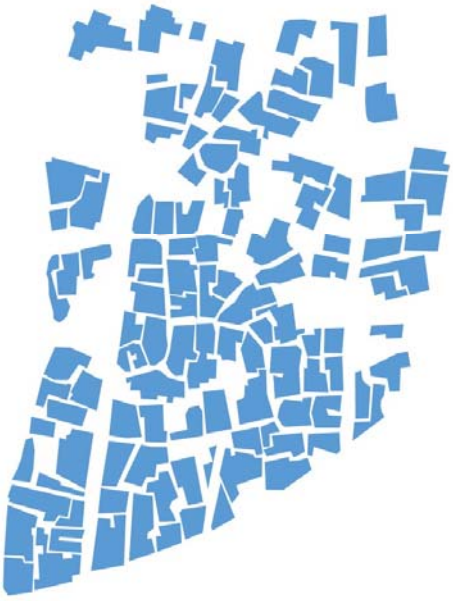


4.47 Mechanic collage: permanencies from the original organic structures; Interventions after the World War II up to the end of ‘80s (lighter color), and interventions after ‘90s (darker color); Ulterior wrapping from outside; multistory apartment blocks reinforced the enclosure and isolation

First Level: the **system**;
mehalla / neighborhood)



Second level: **sub-system** (elemental space), a number of groups formed on the bases of one or more clans



Third level, **units** of elemental space, composite family plots

Fourth level, **elements**, components shaping units of elemental space: housing plots, houses, fences, trees, etc.

4.48 Levels of hierarchy within the system

The adaption of the "social formula" during the last period – organic development outside the traditional social structure – the simulacrum

From morphological point of view, the analyzed samples currently represent a forced relationship of things staying together, or a mechanic *collage*, if we use a Rowe and Koetter (1978) expression. It contains three main components: permanencies from the original organic structures, interventions of the post-World War II period, and especially interventions of the period after the collapse of the communist dictatorship. Formally speaking these kind of interventions are mostly unrelated and un-proportioned to the historic organic city. However, despite this formal discrepancy, there are also some correspondences with the pre-existing layers, or latencies, including the behavioral pattern of the residents. Continuous redefinition of public/semipublic space through temporary arrangements and continuous negotiations, under the new social-economic conditions became extremely fragile and often degraded in violations and social conflicts. The "new negotiations" are not necessarily built on the old "social formula" based on family ties and relationships, but are mostly founded on short term interests.

The increase of the land value, especially in the central areas, put under pressure the traditional organic areas of Tirana, stimulating an infill plot-based redevelopment process. This process that is gradually substituting the organic fabric is following similar occupation modalities with the original organic, but in a different scale and in a different social context. Under this condition, the layout and the positioning of the multistory buildings on the plot, restrained within the frame of prior urban arrangements and property patterns. Thus, in most of the cases new developments remained exactly on the same layout of the previous historic building, but increased in height and volume. In addition, strangely enough, the principles of closing and deviating the space remained there even after the densification and intensification process. They were manifested in the highly complicated interlocked structures and dysfunctional intricate access to property. The principles survived not because they were consciously needed, but because they are embedded in the hidden frame of prior arrangements related to the land and housing property. During the last 25 years, the administrations were not able to create a new development or redevelopment culture based on the formulas of land consolidation and redistribution of rights and benefits; which implies also a preliminary approved design for the entire urban unit, a typical Western European culture that could lead to land consolidation and a more compact city.

Even there are legislative prescriptions about procedures and steps to follow in a process, they could not beat the hidden frame which *de facto* influences the development: arrangements, redefinitions and redevelopments of space based on individual (informal and often not successful) negotiations. Institutional structures react to these processes by "enforcing" a legislation that is never implemented (up to date there is not even one successful case). Thus, in reality, this kind of plot-based infill redevelopment is transforming the traditional neighborhood in something similar with the previous one (simulacrum), but only from the lay-out point of view. It is totally different for its volumes, and most importantly, for the principles of the organic city.

Most of the principles related to the social substance explained at the beginning of this chapter do not work in the same way or are not applicable in the bigger scale and in multistory buildings. Under the new conditions the right to visual privacy is no longer a principle to be followed, although, it remains engraved in the morphological permanencies; the creation of the small parterre "Private Eden" is already transferred on the top of the buildings, in the "flying villas",

which are normally occupied by the former landowners. The same logic of the “Private Eden” sometimes is manifested in the high walls that enclose or isolate kind of protected oases for children or other semi-public or private activities.

People living in the transformed urban clusters are not necessarily grouped or based on relationship and affinity, affiliation or ethnicity. Therefore, under the conditions of limited public control, and weak community structures, the interdependence and individual negotiation within these neighboring structures become very problematic. Individuals and group families are interlocked in a continuous effort for negotiations and adjustments on various issues related to the neighborhood life. All that happens within a space which is shaped, impregnated, saturated and inflamed with current and accumulated tensions. This is not helped by the fact that in many cases, in the collective apartment buildings, the family ties are still there; Contrarily, the property rights already transferred to more inheritors (married and mixed with different cultures) contributed to the dilution of many of the original principles. Most of the tensions are created because of un-clarities and doubts in the process of property division and building.

Thus, the “urban design” and the building itself are the result of the dealt pact between the hidden frames of the historic pattern (often not understood), new cultures penetrated in these areas, and the geometry of distances (the state normative) contained in the prescriptive regulative guidance, as the only controllable instrument. This is a typical example when people’s imprint on space (as a *vessel of non-locality*) is activated from a different and distant time-space, but within the SST web (the concepts of the wave effect, event and event horizon, interference pattern). They are *here-there* through *long distance communication*; they behave like living both, the current and a distant time-space (Arida, 2002 p. 153).

For this reason, we need a methodology of design that considers the *Society-Space-Time construct*. The process should be consciously oriented, differently from what is already happening in a non-structured way. In the quantum logic, the infinite potentialities become one reality once they are observed, in this case, when they will become conscious. It should be considered a new design methodology that on one side is based on modern / contemporary principles, but on the other side does not fall in the trap of the restrictive and hindering prescriptions of the rigid legislation.

Pattern 1:
Eden(s) within Eden/(s)

Visceral-ization of space:
The process of creating and experiencing the space from within, by refracting the perceptual (visual) lines and closing or isolating the space in an infinitesimal way, creates the visceral quality of the space. This kind of privatized space (from urban to individual space) creates the self-similarity / self-affinity of the organic Eden, as a logic that is applied through scales.

By analyzing this patterning process it becomes clear that:

- There are mutual or binary interrelationships in the interlocked systems: house-cluster-neighborhood-city-territory. They are the result of each other, as part of an organic process, at least in an initial stage. This means that the phenomenon should be treated in its wholeness, but in different details depending on the scale of observation.

- Self-similarity / self-affinity is created at least through four main levels of urban hierarchy, from the system (the sample level), to sub-systems (the elemental space), to units of elemental space, and to elements, corresponding respectively to the neighborhood (or *mëhalla*), groups or clusters based on streets, smaller clusters of houses based on family and fed by lower level paths, and elements such as houses, plots, fences, etc. (Figure 4.48). If we consider the city and the geographic container, there is also a fifth and a sixth level, corresponding to the urban and territorial levels. This self-similarity through scales is the result of the anthropological persistence, which emerge at various levels of the urban and territorial morphology.

- Each of the above mentioned levels is guaranteed through an avoiding and /or hiding process, which results in a self-similar (self-affine) visceral space. It starts from the level of the interior space in the house, the house layout, and arrives up to the higher level of the city hierarchy. This logic does not depend on how much space is available, or on physical determinants (topography, etc.), but is the direct result of urban improvisations based on a specific social structure and culture.

- The visceral configuration (created by avoiding, hiding, refracting, bifurcating, and wrapping, etc.) is a self-regulating ability of groups (social units, clans, or tribes). The motivation to guarantee independence from the external world (to reproduce Eden at different scales of territorial and urban hierarchies) encouraged the Introvert behavior and the inward configuration of the enclosure process (up to the tiniest unit of intimacy), within which the pressure of the neighbors' watch could not influence a certain behavior. In addition, this plays an important role to balance the perceptual limits. This is the motivation that stays at the base of the process for the creation of the visceral quality of space.

- The apparently chaotic and spontaneous urban order within a specific social and cultural construct has its own rationality. It comes out from a continuous negotiation embodied in the social structure and informal agreements. The resulting space is a temporary one and potentially correctible at any time based on the "social formula on the use space". The apparently disorder can be reframed thinking of it as a

temporary status (ephemeral); as an infinitesimal propensity of the system towards a never-reached order; as a potential condition of order, etc. This is an important principle in urban design that can be learned from these specific conditions.

- The infill development of the organic areas after the Second World War and especially after the collapse of the communist regime follows a similar logic with the historic one, but only from the formal point of view. These developments are not anymore the conscious requirement of a self-regulated society based on group affiliation. In fact, are the permanencies of the previous frame (physical and psychological) that guide that kinds of developments. Following the changes in the society structure and the dismiss of the traditional social order, the building block principles which gave meaning to the organic town, were merely reduced in a pragmatic infill. From this point of view, this phase represents the dissolution of the old principles nurtured by a typical traditional social structure, and their reincarnation in a simulacrum of the previous one: similar in shape but incoherent in its meaning. Thus, we need to think how to turn this situation in a more conscious urban condition; by taking in consideration the generating events and their horizons within the Society-Space-Time construct.

- The hidden frame of the organic pattern intimately embodied in the neighborhood structure is a strong permanence (let us remember Rossis' *permanence,* or *typology as an idea before the form,* and Ungers' *"the existent", etc.*). This frame was stronger than the urban design regulations trying to impose land consolidation. Most importantly, the hidden frame does not consist only on constancy of physical elements verifiable in the existing fabric, but it consists also on cultural / anthropological elements, including conscious or unconscious obedience to rules, community habits to solve problems by entering in informal arrangements, etc. The labyrinth structure before being a form in space is a mental construct. These are arguments in favor of considering the memory imprint about a specific territory as an interference pattern. This is how people adapt and re-adapt the environment they create.

- The charge of *space with various degrees of admissibility* (Arida, 2002 p. 188) based on sensations create the perception of territorial "shifts" from public to private. Therefore, instead of the typical antagonism / dichotomy public or private, the historic organic space can potentially be both public and private at the same time. The perceptual elements are changeable, and depend on the social formula on the use of space. From this point of view, again this model represents a high degree of flexibility and efficiency of the system in the use of space: propensity to change or create nuances in a model where potentially everything can be public or private, and at the same time can be both. This is a typical example of the quantum duality both/and instead of traditional dualism either/or.

- The *territory is like a malleable energy filed* (Arida, 2002 p. 150), which transmits codes and engraves the space through users' interference pattern transcending the classical notions of space and time. What is analyzed under this section as historic organic can be considered as an event horizon emerged by the interference pattern

aroused by an event existing in another time and in another reality, but within the SST web.

- Analyzes carried out under pattern 3: New Organic, help to understand differences and /or similarities in these kind of processes in general, and in the case of Tirana in particular.

Condensation of the observed phenomenon: Definitions (Figure 4.49)

The essence of pattern 1: The historic organic is an aggregation process during which clusters of houses based on group affiliation or family ties, driven by an introvert behavior motivated by the principle of the right on visual privacy, generate a recursive process legible in the modality of refracting the straight-line and creating interstitial isolation buffers. This process results in a visceral quality of space that is repeated in a self-similar / self-affine way across scales. The recent pragmatic in-fill is a simulacrum of the historic organic: it is similar in shape but incoherent in its meaning.

Eden(s) within Eden/(s) means interlocked from within and independent from the external world. This is initially acquired through an introvert attitude (avoiding, refracting and isolating), and inward configuration of the enclosure. At a later stage, the outward wrapping and / or an infill process reinforces the isolation. All that is based on the self-regulating ability of affiliated groups coordinated in small.

We can express and define (or even guide) a visceral-ization process of space through some variables such as: refraction and/or bifurcation (angles, length of the segments, number of refractions at each level of hierarchy, outward wrapping, etc.). There is more about this in the 5th chapter.

Historic Organic pattern owns fractal properties. We can speak about self-similarity/affinity of the visceral quality of space repeated (interlocked) through four levels of hierarchy: system, sub-system, units of elemental space, elements. Starting from the main paths and the interior space of the city, the repetition of the same principles across different scales is legible.

The challenge of a potential model that recreates the visceral quality of space, would be to activate a reiterative process (initiator, generator, cascade of the process), that generates throughout the four levels of hierarchy the introvert behavior, in order to fulfil the motive of the right on visual privacy, through the modality of refracting and isolating.

The aggregative process should have in its base the quality of the elemental space: the visceral nearness (based in the scaling up or down the infinitesimal tiniest unit of intimacy); It is interlocked and interdependent physically and socially.

4.49 Synthetic diagrams (carry the DNA for the further steps)

The essence of the visceral quality of space
The aggregation and occupation logics;

Closing and Deviating; linear or rotating stripes that guarantee and reinforce the isolation and privacy; inaccessible from the main road (at the city level); connected through independent trajectories;

Sample 1
Stripe development; Concealing between stripes and “buffer” isolation;

Sample 2 and Sample 3
Circular developments; Concealing through wrapping around the “secret” core

From the diagrams we note the repetitive nature of refractive points; the consecutive refractions; the bifurcation levels; the separated nuclei; the inward instinct, etc.

These characteristics will be analyzed into more details the 5th chapter.

4.1.b Pattern 2: Recording Over

Interiorized emptiness

As explained in the 2nd chapter dedicated to historic analyses, this pattern developed in those parts of the city mostly built after the Second World War with 4-5 stories collective apartment blocks. They were either built ex-novo in vacant territories, or built after the territories were transformed totally or partially in *tabula rasa* through demolition operations. As we already mentioned, this kind of interventions during the dictatorship period created the urban condition of emptiness that gradually started to fill-in after '90s through a non-planned or planned recording over process. However, as I will explain in the following paragraphs, this is mostly an informal process and often driven by illegal or corruptive practices (even when a legal design process is initiated, or "legal" steps are followed).

In this section, I will explore more on the modalities of this pattern, and whether there are some similarities in this process with the previous organic one (whether it is a similar interfering pattern or not); I will explore also what motivates the behavior underlying this pattern and what is the essential quality that characterizes the Recording Over pattern. I will also argue that this pattern manifests fractal property, which means that the form as a complex *system with structure* can be decomposed in subsystems and units that manifest similarities across scales and follow certain behavior (Batty and Longley, 1994 pp. 42-44).

This pattern can be interpreted also under the concept of the city as an *open system* that *exchange energy* with its environment, *self-organize* and *self-regulate* to reach a *higher order complexity* and *differentiation* (Arida, 2002 pp. 173-175). The transition from certain degree of order to *entropy* is typical for these kind of residential blocks built during the dictatorship that were supposed to be absolutely closed systems. Once the system was opened, it declined in disorder and increased entropy by "parasites" attached to the original system. In the following paragraphs I give observations and descriptions about steps in this process; how the system evolved and reached a certain degree of equilibrium; how potentially these blocks as open systems may self-organize and self-regulate.

Pattern at the glance: the essence of the Recording Over pattern

The Recording Over is an independent layer of planned and unplanned interventions which over time tends to osmose with the frames (collective apartment blocks) within which it occurs. The process cannot take place outside the presence of predesigned frames.

Frames are buildings which layout mostly follows an abstract logic related to the preexisting elements of the territory where they were built. Frames that in fact were supposed to create the public space within them, created the condition of emptiness, which was expressed in the form of a spaces never used, or a meaningless space (Figures 2.17; 2.18).

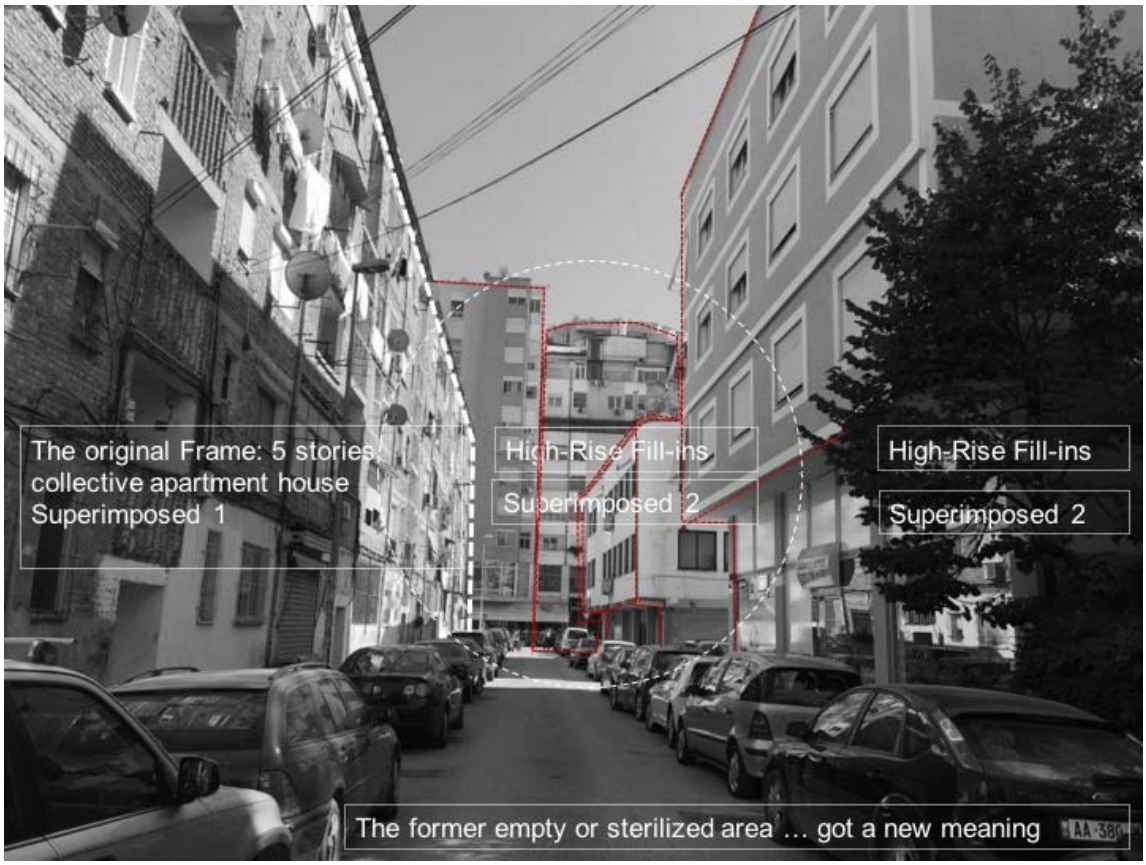
Recording Over is an inward filling-in and/or parasiting of the internal "public space", or of the emptiness. It consists in the interiorization of the emptiness transforming it in an involute space through carving and imploding the space within the frames preceding this process.

Interestingly, all this metamorphic process[6] reflects on one side the changes in the socio economic situation and the weak public control, and on the other side a social harm emerging from the past: the denied property rights during the communist regime. This kind of social complex evolved almost in a mass psychosis and motivated a revenge on everything that was considered to be public. In addition, we also mentioned in the previous chapter the inherited attitude towards the public space before the Second World War: the public space was the result of what was left after the private space was occupied.

In this sense, Recording Over may be considered as a re-appropriative *deregulation* process, as a re-composition or decomposition of space, where a lot of *coexistence and transcription* (Kostov, 2003 p. 46) happens through a complex and adaptive behavior;

[6] I use here the expression "metamorphic process" instead of "transformative process" because I want to stress the fact that the Recording Over was an evolution process from an immature form and stage of development (frames), to a more adult form and different stage. Framing the city was just an unfinished process.


The original Frame: 5 stories collective apartment house
Rooftop
Parasite structures (at the 5th and 6th levels)
Part of the not demolished original organic layer + resurrected layer represented by fill-ins built in the space of "reconciliation" between the original organic once erased and the space still possible to be used from ex-owners


The original Frame: 5 stories collective apartment house
Superimposed 1
High-Rise Fill-ins
Superimposed 2
High-Rise Fill-ins
Superimposed 2
The former empty or sterilized area … got a new meaning

4.50 Recording Over space-occupiers: fill-in; and parasite-ing structures in relation to the frames; (pictures from the analyzed samples)

4.51 Areas where the Recording Over, or tendencies of that pattern exist; The relationship with Organic Pattern

4.52 Recording Over space-occupiers: fill-in; and parasite-ing structures in relation to the frames

Rise, evolution and reasons behind

The recording over (or interior-ization) process started after the collapse of the communist regime, in ’90. There were several reasons that gave rise to this metamorphic process that involved the ubiquitous emptiness (in the sense of dehumanized and meaningless space). First, the change of socio economic situation and the law on housing privatization. This opened new possibilities for the families to invest individually their modest finances and incrementally enlarge their tiny apartments. Balconies, rooms, terraces, etc. extruded as much as the conditions could allow (Figures 4.50; 4.52; 4.56). There were no other realistic opportunities to reach the same objective at that time. From a unified state enterprise during the dictatorship, after several reforms the provision of housing atomized at the individual level. Second, the dream for more habitable private space was much easier to be realized under the situation of the weak public control. Quarrels and neighborhood conflicts reappeared: under these conditions, the old tradition about the use of space based on a social formula was more efficient than the regulations and the state control (which was heavily corrupted). People felt more confidence in the informal neighborhood arrangements rather than trusting the state to guarantee the use of space. Third, in many cases it was also an issue of property claim: during the communist regime many people were expropriated without any compensation and their houses were demolished to clear up the terrain for the construction of new apartment blocks (Figure 4.54). In these cases, people claimed to rebuild their houses (or sometimes even apartment blocks) in the same place/property lot, or in the portions of property lot that remained free after the apartment blocks (frames) were built during the communist regime. However, in many other cases, the land was claimed and “restituted” based on corruptive and false practices. Thus, the layer “killed” during the previous period started to resurrect, piece by piece, sometimes physically separated from the collective apartment blocks (mostly based in an abstract geometric design), and sometimes tacked to them. This juxtaposed layer gradually started to fill-in the public space (considered mostly as emptiness) with new housing or other services. At that time, this was considered as a legitimated revenge for the years of dictatorship. Interestingly, despite the supposition of the absolutist planning to break with the past and with the evils that could cause the private property, in a way or in another, there was a large social consent for all this informal and formal developments which could be also considered a social therapy for relieve. Fourth, in many cases, residents (especially those who lost their titles because of the land reform during the communist regime) considered the extensions and/or the filling-in of the public space as an opportunity to start up a family business activity: commercial services, restaurants, cafés, parking lots, store houses, etc. Fifth, this kind of attitude towards the public space was an old tradition in Tirana: as we mentioned in the previous section of this chapter while analyzing pattern 1, the public space was less important than the private one: the public space was the result of what was left after the houses were built. This tradition reappeared again, but in a much more complex situation, and under different social conditions (this can be considered as an interfering pattern).

Space-occupiers

The recording over pattern consists of two main space-occupiers:

- **Fill-in independent structures** (Figures 4.50; 4.52; 4.55; 4.56; 4.57), which are mostly new housing (villas or multistory apartment buildings), garages, commercial services or other activities such as restaurants, cafés, parking, store houses, open markets, etc. These added structures gradually eroded and recomposed the predesigned void spaces, or in many cases even decomposed it in tiny meanders and labyrinths. Thus, gradually the dead, empty, sterile space became full with new activities, with life, and most

importantly with a new meaning. This small-scale (sometimes even big) invasion process of the space was the opposite of the bigger scale erasure process that took place when the housing blocks, or the recording over frames, were constructed.

- **Parasite-ing structures** created by the extension of services or commercial activities mostly at the ground floor; and the extension of housing space in the full height of the apartment building, or in specific floors, especially on the rooftop (Figures 4.50; 4.52; 4.55; 4.56). These structures added more to the re-composition or decomposition of the predesigned space, and most importantly blurred the rigidity of the urban walls (frames) built in the previous period.

While in the previous pattern, it was the logic of the path refraction (rooted in a specific anthropological factor) that guided the dissemination of the building blocks of this pattern, it is the recording over frame that guide the same process in this case. Ultimately, the Recording Over is a deregulation process. For this reason, this pattern cannot be seen separated from the planned interventions that created the conditions for this pattern to germinate, i.e. the frames and the condition of emptiness deriving from these frames (Figure 4.51).

Recording over as a re-appropriative deregulation process: **from outer related to involute;**
Decomposing layers: blurring out the dichotomy between planned and organic
After creating a first idea about the reasons, functions and the way that the fill-in or parasite structures relate to the preexisting structures, it is worth now to explore somehow the steps leading to this kind of deregulated model, which happened without a premeditated design idea (this is the reason why I call it Recording Over, or it could also be called Organic Deregulation). There is an underlying logic (a hidden frame) that guide the location of the fill-in or parasite structures during the deregulation process. There are at least five potential layers (Figure 4.55) where the existing or the "new" space-occupiers can locate or germinate within the respective frames: first, the former original organic layer (part of the pattern 1). This is represented by sporadic and fragmented reminiscences from the not demolished historic fabric[7]; second, the superimposed abstract one, represented by the frames of apartment blocks built during the communist or in some cases during the fascist regime, detached from the morphological system and historic traces of the neighborhood or the city (Figure 4.54); third, the resurrected layer represented by fill-ins built in the space of "reconciliation" between the original organic once erased[8] and the space still possible to be used from ex-owners (for construction or other economic activities); fourth, the second superimposed layer represented by fill-ins (mostly high-rise apartment blocks, but not only) that mushroomed in intimate relation with superimposed 1, or with no relation to anything previous, that occupied a vacant piece of land; and fifth, the blurring one represented by parasite structures attached to the existing frames that "decomposed" their straight lines. In this case were the owners of the apartments[9] (that had

[7] In very few cases, the historic structure was not totally demolished because of financial restrictions. However, they were considered as temporary structures to be demolished at any time. Therefore, in some cases the frames were coexisting with the historic structures since the time they were built.
[8] In this case I refer to the that part of the historic structure that was physically demolished to leave the place for the apartment blocks or for the public space.
[9] The housing reform that started from 1993 privatized all the apartments built during the period of the communist regime. However, the ex-owners (of the areas where these blocks were built) were never compensated for the land and the buildings that the communist government seized from them.

nothing to do with the original ownership of the historic organic neighborhoods) that benefited from the situation. This was translated in social tensions between the former and the newer owners. The governments and the politics were not able to manage and to balance these new and not known social dynamics. Important to say that not necessary all these layers are found simultaneously in the same area.

After this process of deregulation happened, the newly built form and the way of living in these neighborhoods represented the total opposite of what the absolute planning supposed to create (Figures 4.58; 4.60). This process, which is also a kind of revenge to the absolute planning, is still going on by blurring out the dichotomy between planned and organic, or "regular" and "irregular", created by the abstract planning. However, there are some issues here to be further clarified: how the geometry of the different layers was worked and reworked without being entirely erased? How it survived in a more complex intricate mesh?

Steps in the process

Most of the areas included under this pattern represent typical examples of a determinist abstract planning inconvincibly and/or incompletely imposed where once a labyrinth network of cul-de-sac and narrow streets existed (both, physically and in people's mind). In similar cases Kostov speaks about *coexistence and transcription* (Kostov, 2003 p. 46) of cities belonging to different origins and cultures. From this point of view, we may adapt here some of his principles in order to better understand and explain this kind of deregulation process in Tirana. He describes the *freeing of movement from geometric order* (Kostov, 2003 p. 48) as the first step. According to him, we (as humans) *are not inclined to make right-angle turns* as we go about from place to place ... This organic movement *carved short cuts* through the rigid blocks and parts of the city, which crystallizes into new streets and later into built masses. This is how it started also in Tirana (Figure 4.58).

Lack of control due to the failure of institutions, combined with a mentality that did not value the public space/property, was translated in a more natural and unlimited movements in space, including this within the housing blocks. The freeing of movement (in this case not only from the geometry, but also from impediments on various uses and activities) carved a secondary network of shortcuts throughout the regular blocks. Therefore, a "parallel" city emerged, or reemerged from the "erased" layers, and as explained above, filled-in the space with activities that were missing before (Figure 4.57). In addition, the lack of identity and belonging concerning the public space (or as I termed before, the emptiness), facilitated the fragmentation into parts (catted by the freeing of movement), and the re-appropriation process through small-scale individual arrangements. Thus, the initially outdoor activities located along the streets, gradually transformed in modest sheltered activities, and finally in real built masses (The second last picture in figure 4.50). The continuous efforts for space readjustments resulted in a spontaneous intricate mesh recorded within the strictly predetermined abstractions of the "big urban walls", or frames. This went in tandem with the general sense of abandonment that reigned in Tirana and in Albania during this period. Depopulation as an expression of this phenomenon involved also these "socialist" neighborhoods because of people leaving the country for economic reasons after the collapse of the communist system. The new comers that filled-in these areas (mostly from the remote and depressed areas of the country) were apt to restart and re-form everything from the beginning (the last picture in figure 4.50), including the subdivision and the use of the public space. In fact, this process is never at rest in Tirana.

The second step according to Kostov (2003 pp. 48, 50) has to do with the *reorganization of the blocks* because of cultural shifts, and the way the space is managed by different cultures. During the communist period the abstract planning blocks created the urban dichotomy which was represented in the coexistence of two socially exclusive models: collective apartment blocks, made by "walls" or frames (representing the "good" model), and the remained substratum of the historic structures made by villas (representing the "evil" that needed to be curated by erasure; according to the regime, in these villas were still living people grouped according to kinship, tribe, ethnicity, or in other cases representatives from the so called bourgeoisie). After 90's the concept of ownership and the antagonism in managing the space drastically changed, driving so to reorganization of the internal space of the block and to the reconciliation of both models. This was like going back to a kind of organic invasion of the public space. Both, parasites and filled-ins were complicit in the occupation of space. Therefore, the *outer-related* modernist/communist grid, gradually transformed in *involute* organic block that mostly followed the curved lines explained in the previous step. While the public places and the space of the streets was *reduced through progressive infill*, alternative narrow streets and *an inward communication system was installed* in the newly created fabric. More than cul-de-sac system this was a disoriented communication system, and often even more complicated than the maze of the historic organic one.

The same phenomena happened even in the cases when the new apartment blocks were built in areas that did not overlap the organic city. For a combination of reasons explained at the beginning of this section, the Recording Over layers appeared even in these cases. This means that Recording Over pattern, is part of the cognitive space: what space itself creates in our brain about the idea of space; and arriving again to us through an interfering pattern from other Space-Time-Societies.

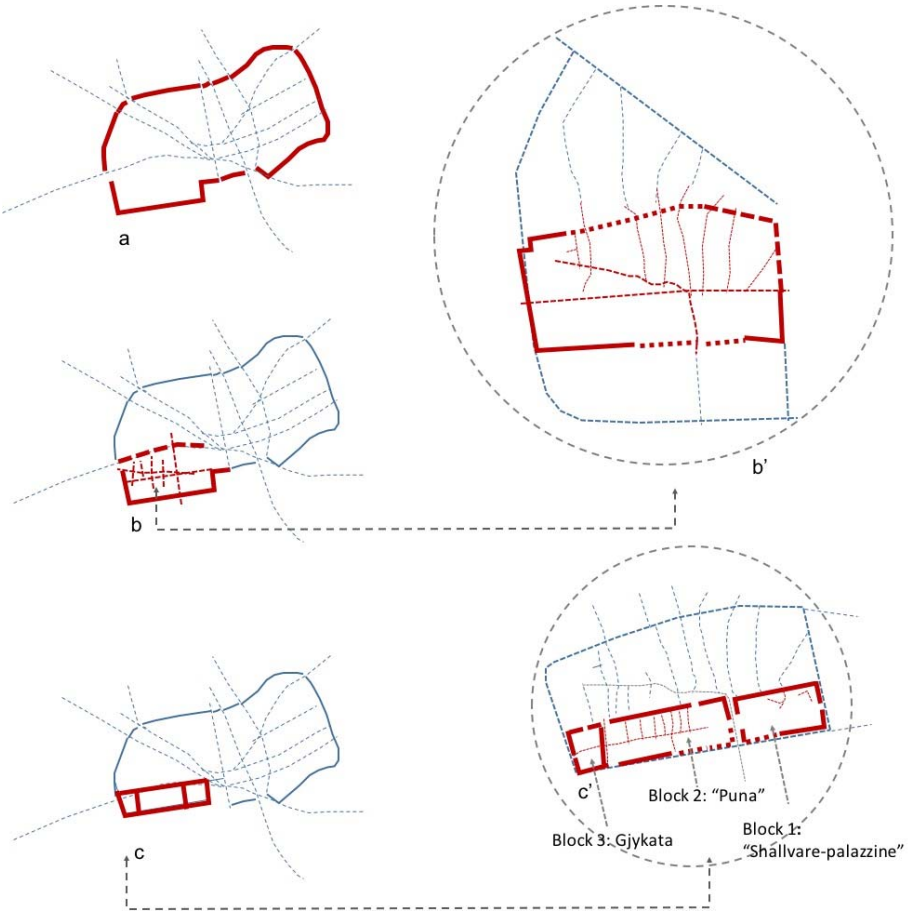
The third step has to do with the impact of *new public foci on the urban fabric* (Kostov, 2003 p. 51). To better understand this point, we need to remind the design concepts according to which these blocks were built. In addition to housing, they also contained a social center playing mostly a propagandistic function. Depending on the case, these centers contained several public functions such as the representative offices of the communist party at the neighborhood level, social services, or other administrative functions at the local level, including public libraries and cultural centers, etc. All that totally collapsed together with the regime. These kind of functions lost the original meaning as centers of propaganda and consequently stopped playing their role as public foci. Instead, new clusters of commercial services established new polarities that took over the reorganization of fluxes within the housing blocks. Markets, or service areas, appeared in the filled-in space and *tended to pull the circulation net* and the traffic flow toward them modeling thus a new course. Sometimes the self-designed re-appropriative lines (or the recorded over shortcuts) flourishing from the new uses, obstructed or even blocked the preexisting ones. According to Arida (2002) we may consider these poles acting as *events* that create new *event horizons* and *interfering patterns*.

***Samples**:*

2.1: Block 1 "Shallvare-Italian palazzine"; 2.2: Block 2 "Puna"; 2.3 Block 3 Gjykata (figures from 4.53 to 4.60)
The selected samples constitute a longitudinal urban strip, which is composed from three main parts. They represent the full variety of phenomena that characterize this pattern. As shown

below, this stripe with a considerable extension starts almost from the city center and continues up to the first ring (Figures 4.51; 4.53). For practical reasons, the three of them will be treated together.

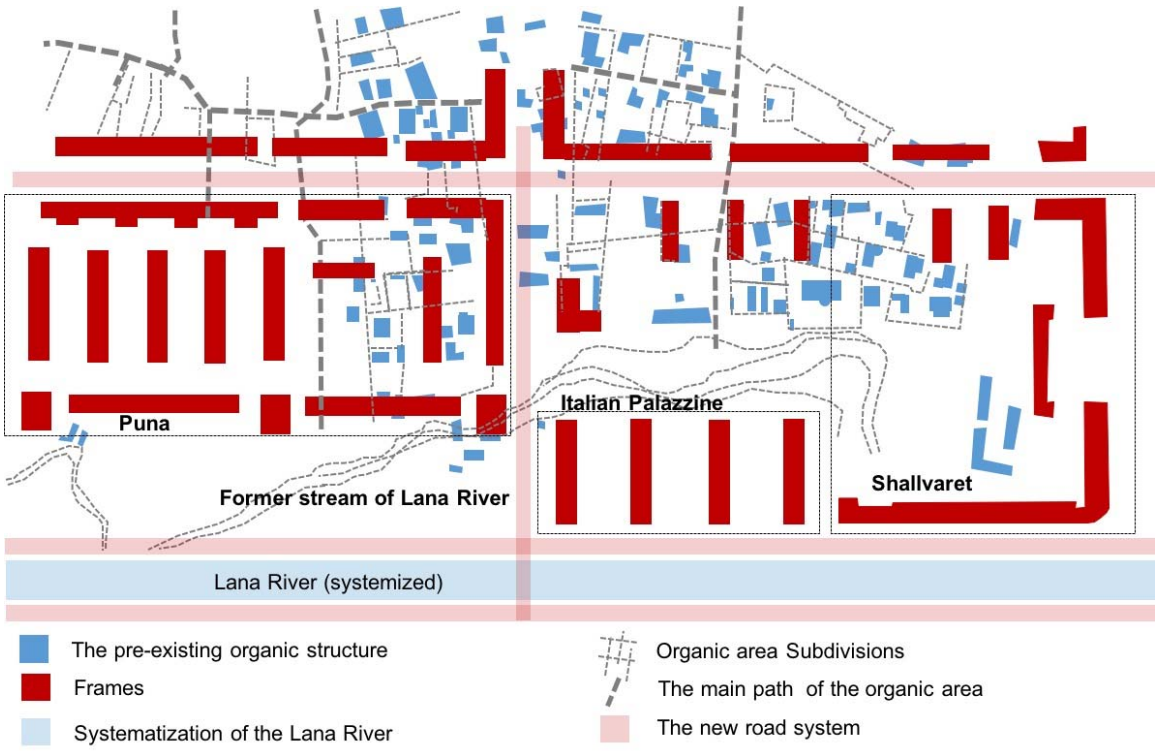
Form and growth: Understanding structural properties of the specific Recorded Over form
Before going further, I try to understand how the frames where the Recording Over pattern took place, were designed and built. From a compositional point of view, the analyzed samples include at least three typical frames or building blocks (Figure 4.53). First, the so-called "*Italian palazzine*", a residential block built during late '30s over the Italian fascist period in a free area at that time. This block embodies the (rationalist) principles of the Italian architecture and urban design of that period; second, "*Shallvaret*", a residential complex built at the end of '50s under the strong influence of the Russian socio-realist architecture and urban design. This complex, built in an almost free area is one of the largest collective apartment blocks in Tirana, and represents one of the first attempts to integrate social and commercial services within the complex; and third, "*Puna*" and "*Gjykata*", two residential complexes that started during the late '60s and continued to be constructed up to the beginning of '70s in a partially free area.



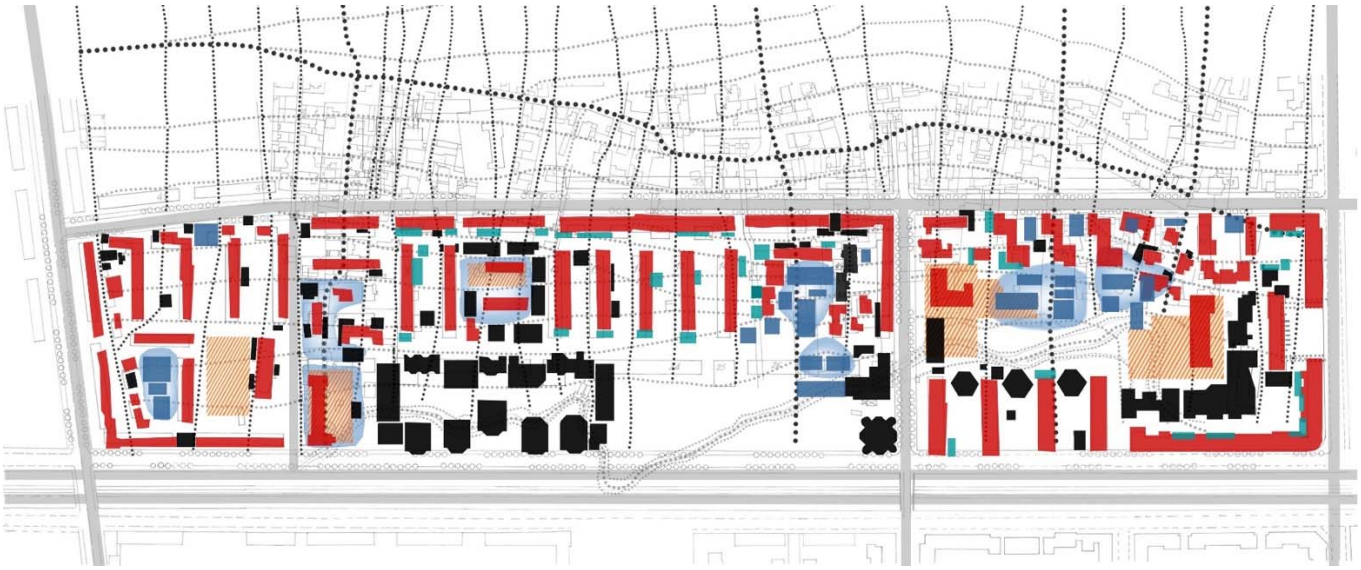
4. 53
The three analyzed samples in relation to the city

The idea of the frames is visible also in the city scale; As we see from the scheme, the urban design of this period (from '45 to '90) was attempting to treat the entire city, especially along the main roads, through walls and frames (blocks added in a simplistic logic like mechanical additional boxes);

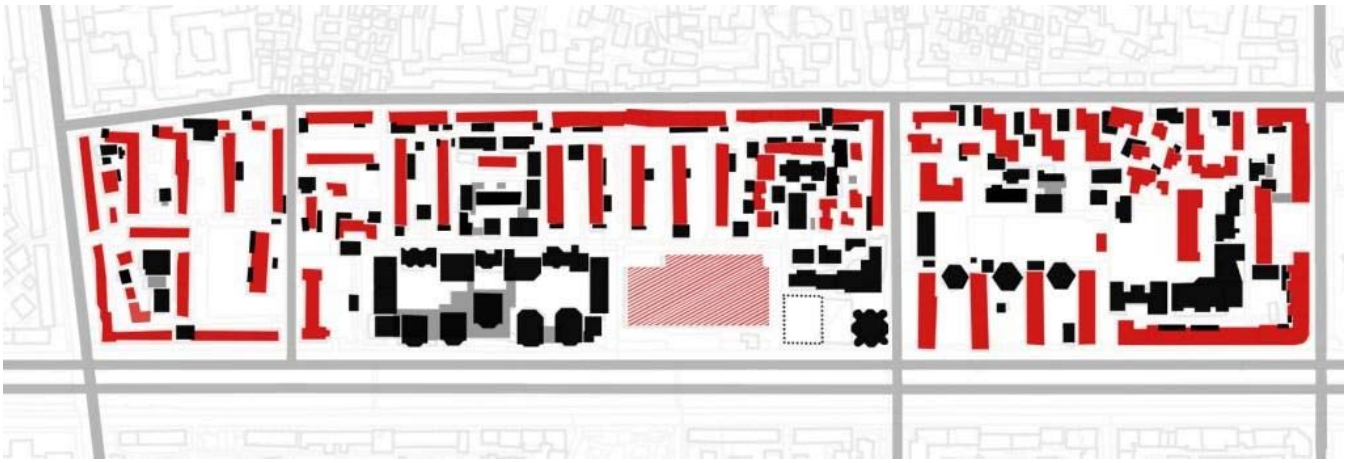
In many cases these walls played more the role of urban curtains to masque the historic city which was considered in a temporary status (ready to be demolished at any time), because it was representing the past.



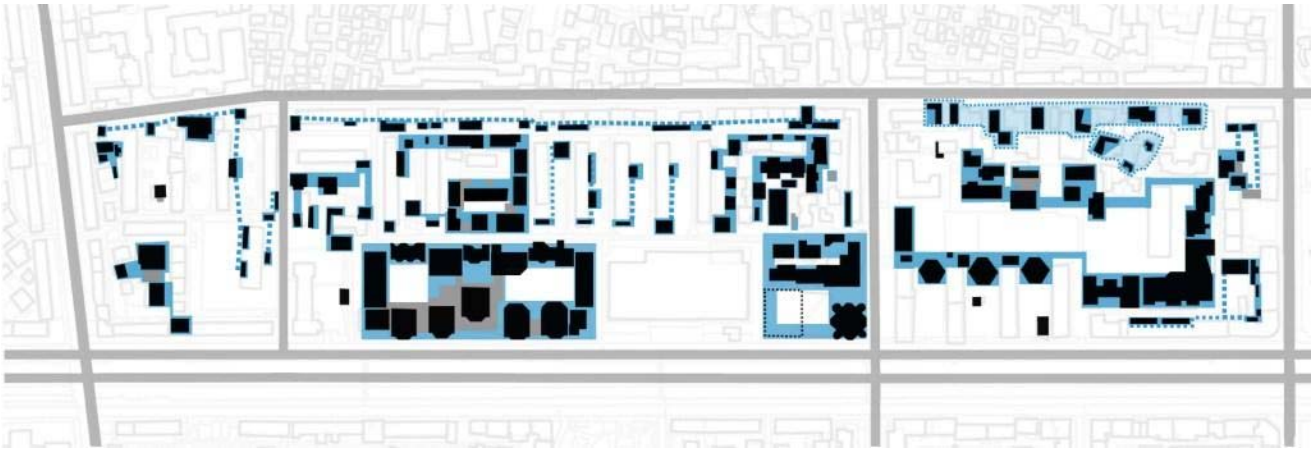
4.54 Fragment from sample 1 and 2 showing the superposition of frames over organic structure



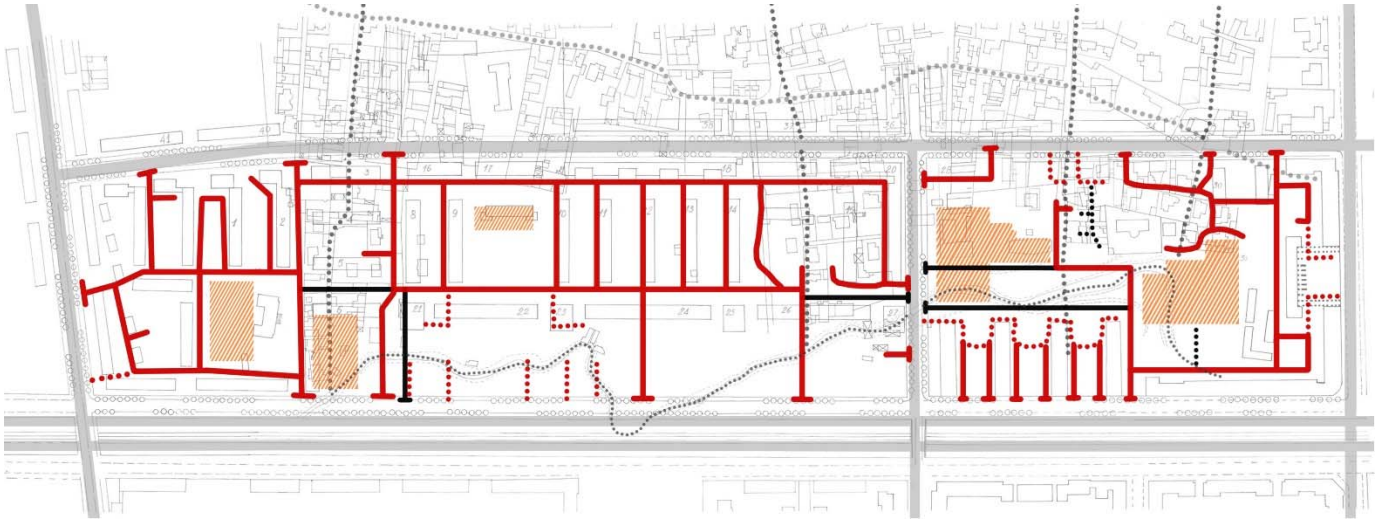
4.55 The hidden frame: five potential layers of Recording Over elements



4.56 The Recording Over of frames; Fill-ins and parasites marked with black (roof-top elements are not shown)



4.57 The Recording Over structure tend to entirely redefine the existing spatial system



4.58 The gradual influence of the Recording Over process on the communication network (deforming, blocking or atrophying parts of the structure within frames; marked in full black lines)

These blocks represent some of the most successful realizations built in Tirana according to the so-called Albanian socialist town planning principles. Each of these pieces represent specific characteristics not only from the architecture point of view, but most importantly, from the urban space they offer. These frames and the urban space they involved, created the special niche / habitat for their specific Recording Over.

From the morphological point of view, the analyzed samples, at least at the initial stage, are a combination of natural and artificial design elements and factors. Social structure and improvisations played an important role at a later stage, during the Recording Over phase. The three parts of the analyzed sample are located in the interstitial area between Lana River and the preexisting organic city (Figures 4.54; 4.55). Because of the risks of flooding and other geological problems, the organic city avoided to occupy this area. The "*Italian palazzine*" were the first "high rise" buildings that opened the way for other interventions during the communist regime starting from the late '50s, 'up to the '70s.

The design principles, especially those for the blocks built during the '50s and '70s, on one side had to take in account restrictions deriving from the natural environment, such as geological risks because of the vicinity to the river, risks of flooding, or restrictions deriving from the preexisting organic structures; on the other side, had to be driven by very clear design and normative objectives: to create in Tirana the first seeds of collective urban spaces based on a new social formula and inspired by the general ideas of social progress. The later was the most important! Based on these principles, the government seized the land. Therefore, individual land subdivisions and private property could not impose any limitations. Public space was sublime, therefore, in order to create the collective space, the new blocks were designed as if no previous layers existed. The figure ground urban layout (but not the architecture) especially in the case of "*Puna*" housing block, follows a similar logic with the layout of the initial stages of modernist urban design: 4 to 5 stories apartment blocks distant from each other, detached from the historic traces of the city, orientated according to the elio-thermic logic in order to permit light, fresh air, and the green vegetation to penetrate, and with the community services and education institutions in between. However, as I mentioned before, even in this case some small pieces of the previous organic structures still remained within "*Puna*" and "*Shallvare*" blocks.

Thus, the design principles used after the Second World War were completely different from the social formula on the use of space I already explained in the previous section (pattern 1, self-regulations). The so-called socialist town planning principles "apt" to create an egalitarian structure prevailed on any other formative principles. Instead, in the areas where the preexisting and the new structures were overlapping, the organic ones either were demolished, or indifferently were overlaid by the new ones.

The analyzed samples are bordered by a road system that was not part of the historic organic structure of Tirana, but was designed by the urban plans. These circumstances supported an urban design that could be easily detached from the previous organic structure of Tirana. Therefore, there is not a binary relationship between the adjacent organic city and the frames of the urban walls. While the historic organic growth of Tirana during the 19th- 20th century was generated by the development of the city as a market hub, the growth after the Second World War was generated by the development of Tirana as an industrial pole. This was the precondition for shifting the design mentality and using a new formula on the collective space.

So far I described how the frames were created and most importantly the mindset that motivated their establishment. Social improvisations after '90s started to record over and to add new layers to the frames and to the space they involved. In the following section I will give some more details on how this process can be seen under a more theoretical point of view.

The OCCUPATION modalities of the Recording Over process: from collective apartment blocks to [re]neighborhooding the emptiness; simplistic vs complex

Frames and Recording Over; central authority Vs self-organization
When we speak about occupation modalities we need to distinguish two main phases or physical entities: first, the creation of frames, according to an overall planning and design project coordinated by a central authority; and second (after '90s), the Recording Over of the frames by a relatively large number of people from or outside the area, that *organize themselves, without the benefit of any central controller, into a collective whole that creates patterns, uses information* and *evolves* learning (Mitchell, 2009 p. 4) (Figure 4.56). This is a main characteristic of the *complex systems* as we already argued in the previous chapters.

The reorganization of the occupational structure followed the socio-political and cultural shifts, which directly influenced the ownership patterns. Consequently, the forcedly collectivized and unified space suddenly was atomized based on the individual arrangements, concerns, affairs and all sorts of things. The unit of the occupational structure shifted from the big frames, to the smallest possible cell that could be adaptable to the frames in order to detract energy from anything built previously, being those buildings or spaces. Because of this, the outer-related socio-modernist block gradually transformed to involute organic block (Figure 4.60).

This inward process (behavior), was like going back to the old organic principles of occupying the space, as already explored in the previous pattern. Thus, if in the case of the Historic Organic pattern the introvert behavior created the visceral quality of space; in the case of Recording over pattern a similar inward behavior (motivated by a re-appropriative vindictive action versus the public space) transformed the outward quality of space to an involute one. This behavior can be also interpreted as a *wave effect*, or an *interfering pattern* (Arida, 2002) transmitted from another space-time (past "traditions", or cultural imprint) that is transformed in something similar but not the same (from visceral to involute quality of space). This behavior, which directly reflects on the occupation pattern and positioning of the elements, is at the base of the elemental space.

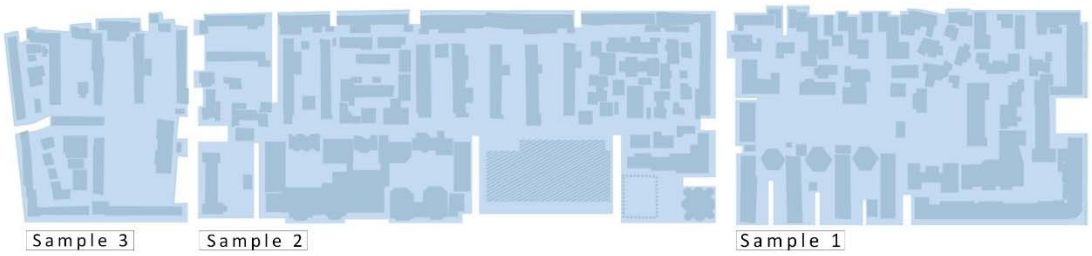
Mechanic additional boxes Vs fulfilling human-scale concerns
While the occupation modality of the first phase (frames creation) implies that the city aggregates according to a simplistic and mechanical logic of additional boxes in a scaling up or down order, the Recording Over phenomena implies unpredictability because it is closer to the myriad human-scale concerns (Figure 4.51; 4.53). The linear and mechanic aggregation logic does not apply any more under the condition of correlational and interdependent interests (no central control), which make the city or the neighborhood more than the sum of its parts. This condition, where the interdepended interests *come together to cooperate on solving problems* that affect the survival of the community as a whole, produces a *complex and adaptive behavior from underlying, simple rules* (Mitchell, 2009 p. xii).

Levels of hierarchy, form as a system with structure (Batty and Longley, 1994)
First, we need to clarify what is considered as level of hierarchy in this case. As described in the previous pattern, this has to do with the decomposition of the analyzed samples, considering each of them as a system with structure (Figure 3.2). Second, the level of hierarchy of the Recording Over pattern is intimately related to the level of hierarchy of the frames where it osmoses through parasite-ing or mushrooming. Therefore, when we speak about levels of hierarchy we will understand both, the hierarchy of frames and this of the Recording Over elements intimately related to those frames. This is represented through diagrams (Figure 4.59).

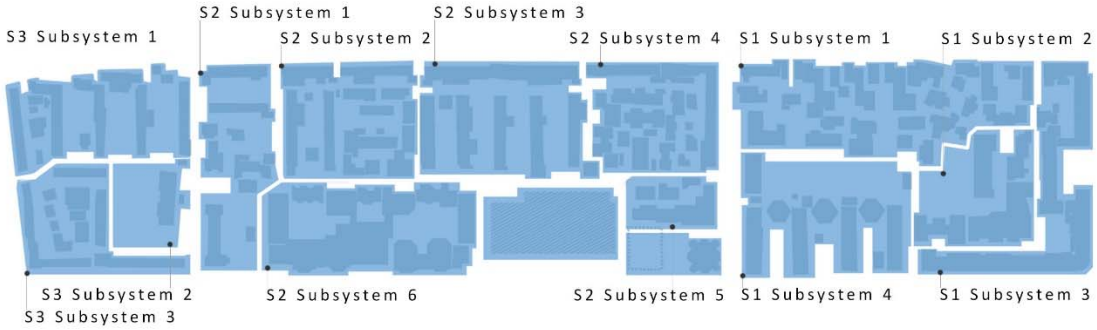
Thus, in order to better understand the combinations that drive to the involute block resulting from the Recording Over process, it is necessary to carefully decompose the form in the levels presented below. This would help to understand the behavior or the dynamics of the form as a system:

- **system**: each of the three building blocks within the selected urban stripe is considered as a system: "Shallvare-Palazzine"; *"Puna",* and *"Gjykata"*
- **subsystems**: the lower level hierarchy, as shown in figure 4.59, coincide with identifiable configuration of frames, where the recording over takes place;
- **units** (of elemental space): defined within subsystems. They are groups of elements with similar characteristics based on the typology of Recording Over elements (such as, Filling-in or Parasites), or on the origin of the Recording Over elements (such as, organic, resurrected, etc.), or on other specific factors.
- **elements**: the smallest particles of the system. In this case we need to understand how elements can be characterized in their variations. Then, we can carefully study the combinations and articulations of elements in Recording Over patterns that result from an inward process through the modality of wrapping from within and from without, and that produce the involute quality of space.

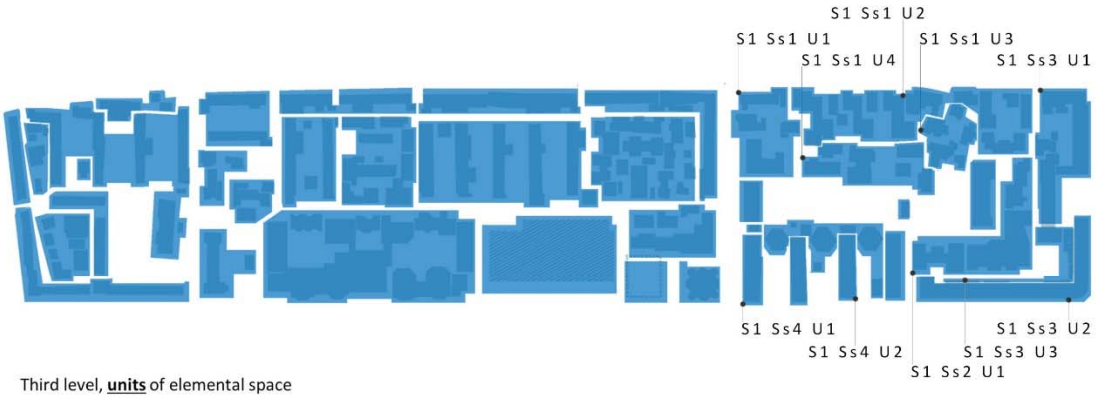
Tables to statistically "measure" this phenomenon can be created. In this sense, Recording Over can be considered as an algorithmic information contained in the set of regularities of this pattern. In general, if we have a statistical way to analyze a phenomenon we can create a model through which we can further study the behavior. I will come back to this issue in the 5th chapter. However, the process of measuring and modeling is tested only for one of the samples of pattern 1.



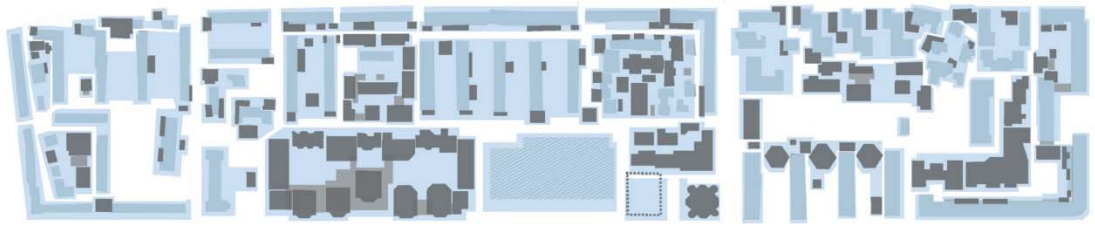
First Level: the **system**



Second level: **sub-system**
Identifiable configuration of frames, where the recording over takes place



Third level, **units** of elemental space
Groups of elements with similar characteristics based on the typology of Recording Over elements



Fourth level, **elements**
The smallest particles of the system; combinations and articulations of elements in Recording Over patterns

4.59 Levels of hierarchy within the system

The *CompleX_City workshop*[10] helped to further explore these issues and brought evidence about the motive of the Recording Over pattern, such as property claims, revenge on "unused" public space and diffidence in the government structures, as already explained throughout this chapter. The workshop reflected also on important issue related to the Recording Over pattern, such as: which are the event(s) emitting the interference pattern, the respective horizons, and how this malleable field energy may evolve; In this sense we may consider the Recording Over as the potential horizon of the previous land subdivisions, or the horizon of the historic organic pattern itself. This horizon aroused from the interfering patterns represent a new emergent reality which is similar but not the same with the origin. It is made of different elements related to their typology and formal or functional articulations. Some of these ideas are expressed in the presented diagrams.

Pattern 2: Recording Over
Interiorized emptiness

A new wave of spontaneity on the premeditated planned sectors of the city

Recording Over is a self-renewing power of a vast number of individuals, outside of the central control, attempting to improve their housing and other economic conditions, while adapting to a new economic and political system that was established after '90s. *It is the collective actions of vast numbers of components that give rise to the complex* and *hard to predict … behavior* (Mitchell, 2009 pp. 4, 6, 12). In this sense Recording Over pattern is an *open system* which maintain the equilibrium based on the information and the energy people generate from within the system. As we mentioned, ***s**pace is a field of information that our brain can transform into "adaptation exercise"* (Arida, 2002 p. 161).

By analyzing this patterning process it becomes clear that:

- The analyzed samples are portions of the city morphology enclosed within the urban frames. However, despite their seclusion from the rest of the city, these portions contain all the traces and processes occurred before and after the frames were built (from Historic Organic to Recording Over).

- The condition of emptiness created by the rigidity of the urban walls and the respective urban design, turned out to be a powerful catalyzer that proliferated the interior-ization of this condition through the Recording Over processes.

- The Recording Over is an inward continuous subdivision of space in many individual fragmented decisions coordinated in small, which drive towards an organic

[10] In this workshop that took place in POLIS University participated 15 students. The workshop was designed and directed by Dhamo, S. with the participation of Di Raimo, A. and Bregasi, L. and assisted by Hoxha, E. The methodology used during this workshop was field survey, desk top analyses, thematic discussion, etc.

deregulation of the predesigned urban units, including the public spaces. The condition of "hiding within the walls" and potentials to "use" the internal emptiness, revived (aroused) again the introvert behavior as a latent building block of the urban space that arrived as an interfering pattern reactivated from another society-time-space horizon. However, this "new introvert" behavior was "born" and "forged" within the framing walls and transformed in inward behavior. From this point of view, as mentioned, Recording Over itself may be considered as the horizon of the Historic Organic, considering the later as an event; and the reactivated respective introvert behavior transformed in inward behavior as an interfering pattern with a different identity. This horizon was potentially there, but became a tangible reality after 90's, when the social conditions changed.

- Even though the Recording Over pattern tends to reach a self-regulation status, the current situation of these areas in the city is mostly in a precarious equilibrium and space disorientation, or sometimes even similar with the characteristics of the "fit of survival". This is still an ongoing process and the way we can influence the situation is to understand how the entire system structure is composed and how the dynamics and the behavior of the system work or tend to work, in order to help reaching a higher degree of self-organization and self-regulation, without cutting the connections with the environment, or closing again the system. For this, the creation of a model through which to study the behavior would be a great potential.

- The inward behavior at the base of the Recording Over pattern is repeated in a similar (self-similar / self-affine) way from scale to scale creating a system structure that can be decomposed. This means that the Recording Over Pattern owns fractal properties.

- From this point of view, the Recorded Over pattern constitute urban entities where specific levels of hierarchy exist: first, in relation with the city, and second, within the same units, as already shown in this section. Understanding Recording Over from this perspective is a way how to get free from the taboo of looking at it only as irregular. This means to be able to understand the invisible form which explains the external (urban) form.

- We understand the internal part of the form, or the invisible part that explains the external form, through observing and understanding system dynamics which imply behavior.

  The behavior of elements and their articulation in patterns within subsystems and smaller hierarchic units, depends on some factors: first, the type of the space-occupiers, such as fill-in independent structures, or parasite-ing structures; second, the type of subsystem space (typology of space within frames); third, functional typology, such as housing, commercial services, restaurants, parking, etc.; fourth, formal typology, such as villas or multistory, etc., their formal layout, the height of the building (or element), position, and the modality of formal development; fifth, the origin or the type of the layer where an element is located (the original organic, the superimposed one, the resurrected one, the second superimposed, and the blurring parasites attached to one of superimposed); Figure 4.55

The equilibrium between Recording Over and the receiving structures (frames) is different: in some cases, the Recording Over takes over at that point that may irreversibly damage or transform the previous structures and replaces the old ones, in some other cases they coexist or create symbioses, but with a different identity as a result of a successful osmotic process.

- Identification of systems in which elements are repeated in a similar (affine) modality from scale to scale, are an important key in reading, understanding and replicating the model but in a rationalized way within a different society-space-time construct. (here we can refer again to the concept of typology as presented in the 3rd chapter)

- The organic deregulation of the Recording Over pattern transforms the public-private dualism (or dichotomy), to quantum public and private duality (both and); and not only that, instead of the strict division of functions, a nuanced variety of complementary uses flourishes. These factors contribute to create a more complex physical and social situation.

This complex condition requires a social formula in the use of space and in the perceived consent / allowance, even thou in many cases it ends up in social tensions. Because of this, it is needed to exchange information within the system; to borrow energy from the system; and to self-organize with the aim to reach self-regulation. The last one needs to be supported by external factors in order to be achieved.

Condensation of the observed phenomenon: Definitions

The essence of this pattern: The Recording Over is a re-engraving process taking place in the pre-designed urban units, that transforms not only the frames defining the space but also the space itself. This is a gradual process during which a considerable masse of individuals, driven by an inward behavior coordinated in small, and motivated by the (re-appropriative) revenge to the public space because of the denied property rights during the previous regime, generate a recursive process legible in the modality of wrapping the space and the buildings from within or from without. This process results in an involute quality of space that is repeated in a self-similar / self-affine way across scales.

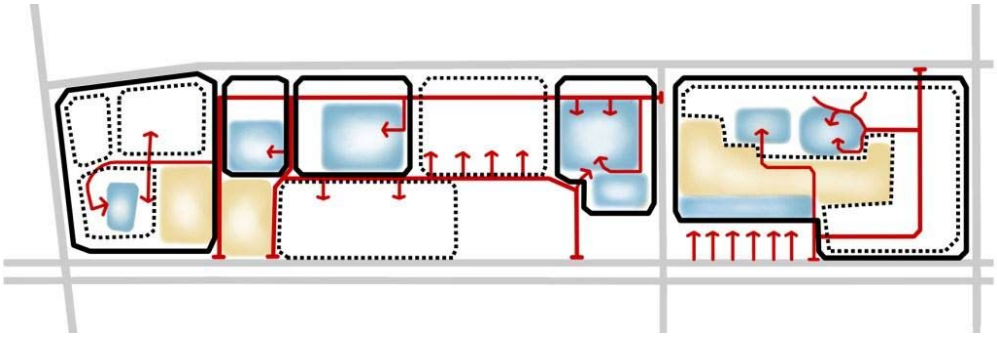
Recording Over is an organic deregulation of predesigned units. In this sense, it is the underlying form which give a specific meaning to the universal "walls" or frames from where the pattern takes life.

Recording Over is not simply an informal process, but a complex phenomenon; In order to give a positive impulse to the Recording Over areas, and push them from the precarious equilibrium to self-regulation, we need first to understand the system structure and its behavior. For this, the creation of a potential model can support further observations of the system's behavior in order to potentially influence the positive impulses toward self-

organization. Most importantly a potential model should have in its base the involute quality, which is the essential quality of space.

In support of the previous point, Recording Over as a system that owns fractal properties has a hierarchy structure interlocked at some levels; therefore, we can speak about the self-similarity/affinity of the involute quality of space created through wrapping modality; We can express (and even guide) the inward quality of space through some variables related to the type of space-occupiers, typology of subsystems space, functional and formal typology, etc., as already presented.

The challenge of a potential model that recreates the involute quality of space, would be to activate a recursive process (starting from the initiator, the generator, and the cascade of the process), that generates throughout the four levels of hierarchy the inward behavior, in order to fulfil the motive of re-appropriation of the public space through the modality of wrapping from within and from without.



4.60 Synthetic diagram:
Recording Over as a re-appropriative deregulation process: transforming from outer related to involute quality of space; *coexistence and transcription* (Kostov 2003)

The process tends to entirely, or quasi-entirely, interiorize the emptiness of subsystems: it is a gradual and continuous wrapping from within (or from without) through "building" almost consecutive perceptually impenetrable edges; Subsystems can be in a completed involute status (marked with light blue), or in progress.

4.1.c Pattern 3: - New Organic
Recent layers of an individually arranged city
Amassed and Floating City

Bathore-Paskuqan in the north-east part of Tirana (2000)

Tirana River area in the northern part of Tirana (2012)

4.61 Typical New Organic developments in Tirana

As explained in the 2nd chapter dedicated to historic analyses, this pattern developed after the decay of the communist regime in 1991, when the phenomenon of rapid and uncontrolled urbanization was triggered by drastic changes in the political and socio-economic conditions. I already introduced some indications abbot the dynamics, magnitude and reasons behind this process. In this chapter I argue that this phenomenon stigmatized and simplified under the category of informal, is in fact an organic process. This is the reason why I introduced from the beginning the label of the New Organic. While informal and unplanned are concepts mostly related to the legal status that automatically push away the idea of potential self-organization and self-regulation of these pattern, I try to see this phenomenon as a coordination at the smallest scale of individual arrangements, that as mentioned before, are characteristics of the open systems. I also investigate on some other factors such as the distribution of these patterns at the city scale, and if there are any relations between the latter and the New Organic pattern variations. Finally, I explore on the motive, behavior, modalities as well as other emergent qualities of the New Organic space, and whether some similarities with the two previous patterns exist.

Pattern at the glance: the essence of the *New Organic* space

This is an organic process, still under development and consolidation in many parts of Tirana. There are some similarities in the formal characteristics with the Historic Organic pattern, however this is only the appearance. In fact, there are differences in the reasons that motivated this pattern and in the anthropological factors that triggered the motive.

The New Organic pattern mostly developed in former agricultural areas, when for the first time in Albania the compact form of the city exploded. In this sense, this moment highlighted the passage from the traditional compact city, to the configuration of the future metropolitan region. This was a new phase.

There is still a lack of awareness about the underpinning motives that triggered this process. In most of the cases, especially at the initial stages, it was a self-providing housing system, under the total lack of public support for social housing. Among other, this process was also an organic aggregation of people, grouped to create a critical mass in order to find a common solution for their housing problem.

Pattern variation depends on the location of the area in relation to the poles of attraction (center-periphery), as well as on other historic and socio-economic conditions. With these factors is also related the density of the urban fabric, which largely varies from area to area. The latter is clearly visible in the figure-ground contrast and in the distribution of the main voids within these areas, etc. Physical fragmentation, as well as superfluous and often unclear status of space, are some other characteristics, especially of these areas located in the periphery belt.

Isolation (instead of privacy) was the main motive to select the specific locations, and this drove also the occupational pattern at the smaller scale. Instead of hiding through deviation to guaranty the privacy, like in the case of Historic Organic, in this case people isolate (both, in the smaller and in the larger scale) to guarantee a degree of freedom and autonomy from

the other parts of the city prejudicing and not accepting them. This motive is achieved in two main ways depending on the condition of nearness to the center or to the periphery: compression of space or inflation of space. Based on that, there is a "clashing" or "floating" of elements dispersed within this kind of space. It is important to say that the pressure to achieve this motive distorted and almost diluted the anthropological factor, especially in the areas nearer to the center.

The New organic pattern manifests fractal property, which means that the form as a system with structure is decomposable in subsystems that manifest similarities across scales. This logic helps to see the New Organic as a complex system, and to express this complexity in algorithmic terms, which in their turn can serve to potentially build a model that takes in consideration the reality of life.

Main characteristics

From a survey at the city and metropolitan scale, we may portray some distinctive characteristics of the New Organic form, which is neither compact, nor continuous (Figure 4.65). First, different densities of residential areas scattered alongside accidental voids mark the rural-urban fragments. Second, the nearer to the center the area is (or to a pole of attraction which not necessarily is always related to the main center) the denser and the more consolidated is, and the figure ground contrast is dominated by solids. Third, the more in periphery the area is, the larger are the voids, and the figure ground contrast is dominated by voids. Fourth, the more topographically fragmented the territory is (physical determinants such as steep hills emergencies, or any abrupt interruptions such as canals, previous land subdivisions, etc.) the less consolidated the area is, and the scattered the houses are. Fifth, the wealthier the area is the more consolidated the urban form is. There are other factors influencing the New Organic characteristics, such as the geographic provenience of the settlers, the psychological imprints they bring back, and other anthropological factors. The Kostov's (2003) *physical determinants* and *social structures* mentioned in the Organic and Recording Over patterns, apply in a similar way. However, as we will see, the essential quality of space has its own specificities even in this pattern.

Therefore, based on the above, the pattern variation depends on the condition of nearness with the poles of attraction; the socio-economic sources feeding them; the stage in the consolidation process, or time maturation; the combination with pre-existing physical determinants such as topographic elements and land subdivision; the social structure and improvisations, etc. However, the factor that most influences the morphology of this pattern is the condition of nearness to the main center (or poles of attraction); therefore, further descriptions and analyzes of this pattern are given based on their division in two main groups representing this condition (Figure 4.68).

1. Compressed New Organic
Amassed collision

Main characteristics

Occupation modality, motivation - tradition diluted
The areas belonging to this group are located in the transitory suburban belt, where the urban mass starts losing the quality of compactness, however is not fully vaporized (Figures 4.68; 4.69). The beginning of these phenomena was made visible by the construction of some basic shelters that mostly mushroomed in the immediate proximity of the dismissed industrial plants. The self-made shelters were made of recycled materials from the obsolete industrial sites. Gradually these settlements, which at the beginning were just some mere accumulations, densified because of some main reasons (Figure 4.62). First, the filling-in of all free spaces within the area that were offering the better access; and second, because of further subdivision of single plots for reasons similar with those described in the Historic Organic pattern (including new dwelling units for the extended families, selling portions of land, etc.). Because of that process and because the city itself was already growing, these areas started to become more attractive and more interesting for any kind of developments. For this reason, the land development ratio in these areas was much higher than the ratio in the areas included in the second group of this pattern, located much farther from the center.

The need to exploit in maximum the vacant / public space, under the condition of illegal occupation of land, was another motive for further densification. In fact, this kind of densification was aiming to increase the number of houses up to a critical mass, within which would be easier to hide the individual non-conformity with law; or, to reach a number (of houses and people) that statistically could change the perception about what is right and what is wrong. In this sense, this was a densification process to auto-protect and guarantee their existence under a non-legal status. At this point and under this pressure, we can speak about the distortion and almost dilution of the historic anthropological factor. The essence of the Historic Organic pattern based on the patriarchal enlarged family model, respect of tradition, ownership, and the right to visual privacy (already alienated), could not stand (or match) any more under the pressure of the new social conditions. The above mentioned traditions were heavily upset because of unclear ownership in the areas they settled, and also because of the large-scale emigration which shocked the “sanctity” of family ties (tradition). The younger generations, going out of the extended families to live in another city or in another country, despite the fact they were still settling according to the family ties or countries of origin, finally entered in a process of freeing-up by traditional obligations.

Under this “pressurized” condition, in order to guarantee the survival, the New Organic pattern went through a process of adaptation, which was based on the quality (risk) of collapsing in itself. This distinctive quality derives from the condition of compression: the need to densify in order to reach a critical mass. Collapsing in itself represents both, the continuous risks to lose the precarious equilibrium, and at the same time the potential to transit from the status of precariousness to a higher degree of self-organization by borrowing energy from the environment. The latter is guaranteed by the high degree of adaptability and exchange of information as the main characteristic of people living in these areas. In this sense, the aggregation based on group affiliation and relationship, appears to be again an important factor,

especially at the initial stages (Co-plan reports from ‘90s). This was still an interfering pattern generated (aroused) by the origin’s tradition, even though with a much smoother influence because it was weakened by the drastically changed society-space-time structure.

1994

2005

4.62 Bathore area from the early stages, to the later densification processeses (source, Co-PLAN archives)

Another factor driving the space to "collapse", is due to the fact that despite families were gradually becoming more open and more emancipated because of the free movement, the attitude towards the public space remained similar with what we already know from the two previous patterns: the private space was more important than the public space. Therefore, during this kind of organic settling process the public space still consisted in what was left after occupying the private space. Under these conditions, the free spaces, if they exist, manifest more the characteristics of a vacant superfluous and unclear space rather than a real public space. This un-clarity in confront of the vacant space often is manifested in the indistinct use of it for private purposes, which creates complications and conflicts for the access roads and the public realm in general. A direct result of that attitude (behavior) are the disconnected internal communication roads (dead-ends). They are mostly generated because of the inefficiency, but not because of the right to visual privacy like in the case of Historic Organic pattern. Therefore, this kind of dead ends were empty from their anthropological meaning. In fact, recent interventions in these areas, consisted mostly in opening and connecting the communication network. However, despite these similarities with the Historic Organic from the formal point of view, there are differences due not only to the different motives, but also to the different magnitude of the New Organic process, the different stage in the consolidation process, and most importantly the very different social context which is related to the opening of the socio-political system.

Development and evolution of the Compressed New Organic

There was not a predesigned scheme to steer people during the settling process. In a try and error process, people do or don't do things based on the perceived consent of authorities and / or other lieders or members of the community. Under this condition, two decades after the emergence of these settlements, people already weaved a relatively dense and fine knit urban fabric through a gradual organic process and almost undisturbed by authorities (with few exceptions). The relatively big original plots subdivided and further densified because of increase of population within the area.

This process can be also explained under the concept of the open systems: self-organization, self-regulation and complexification. I already explained (in chapter 3 under the section: 3.1.c complexity, self-organization and self-regulation) how the open systems exchange energy with the environment and go to complexification and differentiation (Arida, 2002 p. 174). From this point of view, it is important to understand this pattern as the capacity to self-organize through borrowing energy from the environment and evolving in self-regulation, giving rise to a higher order complexity and dilute entropy. As mention earlier, this is the way how these kind of urban systems *can find a dynamic equilibrium that allows them to regulate their energy into a creative order* ... They are also like *living system* in a *holistic inter-relationship*: any part of it is *incapable of existing in a state of self-contained exclusion* (Arida, 2002 p. 141) (compare with the official sterilizing zoning techniques that exclude and separate). The way these areas are developed and self-regulated is (de facto) an open system, which permanently is in a clear contradistinction with official regulations, or in attempt to bypass them.

Sporadic tentative of the government to regulate (or to close) the system by imposing a top-down and mechanical order without understanding how it works, creates nothing more than precarious equilibriums. Creating conditions for the open system to perform *is the only way of allowing it to self-regulate and avoid imploding by excessive entropy* (Arida, 2002 p. 141). In

order this happens we must guarantee a healthy relationship between the various systems existing within these areas; such as the system of production, the system of commerce or exchange of goods, the system of local public foci, etc. regardless being formal or informal. For example, there are plenty of informal production activities within the area, that are almost exclusively used within the same area, such as building materials, furniture, agricultural products, etc. Thus, instead of closing down the activities because they are informal, government should support further development and improvement of these activities in order to guarantee an auto-sufficient internal economic system.

Surveys carried out in these areas bring evidence about the potentials to self-organize and self-regulate in many New Organic areas in Tirana. Five stages may be identified in this process of transition: First, the existence of a certain degree of natural order containing also some traces of initial urbanization; Second, transition to a gradual decline in disorder because of more constructions appearing in the same territory (the level of entropy increases); Third, If the system remains open, further developments may help to reach certain dynamic equilibrium and the ability to evolve into social and physical self-organization-regulation through borrowing energy from their environment; Fourth, the system gradually may reach a higher level of order and consolidation; Fifth, potential to restart the cycle: equilibrium or precarious equilibrium until further developments such as, outside interventions, enclosures, etc. may create conditions for a gradual decline in disorder, and the process of self-organization and self-regulations may re-start but in a new spiral.

Housing and neighborhood typologies; their role in the process of de-traditionalizatoin
At the glance, New Organic areas present a high degree of monotony on housing typologies (Figures 4.61; 4.64 e). As already mentioned, they started from a simple self-made shelter, which incrementally improved and enlarged according to the family needs and finance availability (Figure 4.62). The land was “bought” through a legal or illegal transaction, or in many other cases it was a “concession” given by people who were not the real owners, but land speculators, false realtors, mafia, and the similar (Co-plan reports from 90s). This situation created a long term problem and a lot of insecurity for urbanization programs in the area. However, this insecurity did not impede people to invest individually in their houses.

The one to three story houses are the most frequently used in the New Organic areas. They range from typical rural “family houses” (*elbasançe:* the most diffused in the informal areas, Figure 4.63 a, b, d), to wealthy “farm houses”, groups of identical “twin” or more brothers, or even to a kind of “king’s houses” belonging to apparently wealthy families (but this may be only appearance), etc. (Figure 4.64 c, d). All that is done without architect (Figure 4.63 a, c), but through the help of the so-called master builders. They mechanically replicate the same “project”, adapting it only to the topographic situations and people requirements. The later often represents the housing owners’ “imprint” that carry memory and information from the countries of origin that resonate and recreate new social and physical interfering patterns. This is often expressed through an incoherent and idiosyncratic combination of unrelated architectonic elements: an alpine roof next to a Mediterranean flat roof; an open-air spiral staircase next to a hermetically closed one (Figure 4.64 a, b). This cacophony is even more visible at the neighborhood scale where the dominant cultures emerge in different ways. For example, from the way they shape the roofs, open the windows (Figure 4.64 a, b, f, g, h), create fences, or cultivate their gardens, etc. However, in a scenario like this, one has the sensation

that everything is unfinished and in a tentative state of becoming something different from what it is (Figure 4.64 c, d, e): the overlap of many different waves is still under process. Viewed all together they create an irrational and bizarre image.

However, in some other cases this interference pattern is often manifested as a more shared experience of "traces" from the countries of newcomers' origin, in order to create clearer *shared associations and more common identification* with each other and the rest of the city. This is typical for smaller groups. In this way *human user* becomes a *vessel for non-locality* (Arida, 2002 pp. 165, 153-155). The research is trying to bring under attention these human, non-material aspects, which exert a great influence on shaping the urban form, but so far passed without being seriously observed and understood.

The elaboration of the housing plans, both in interior and exterior, represents a simplistic repetitive logic, from floor to floor, regardless the wealth of the family (Figure 4.64 d, e). This kind of conceptual poverty and typological uniformity, as well as the other factors mentioned above, combined with the not unified anthropological principles, contributed even more to the dilution of the old traditions and disconnection with the past: people in these areas live in a transitory process. Here we can remind the role of the city as a *machine that connects and disconnects … detaches people from their traditions … through reduced social control …* creating thus *the freedom to be different* (De Cauter in De Geyter Architects, 2002 p. 11). This is the opposite of the Historic Organic role as a machine for traditional-ization.

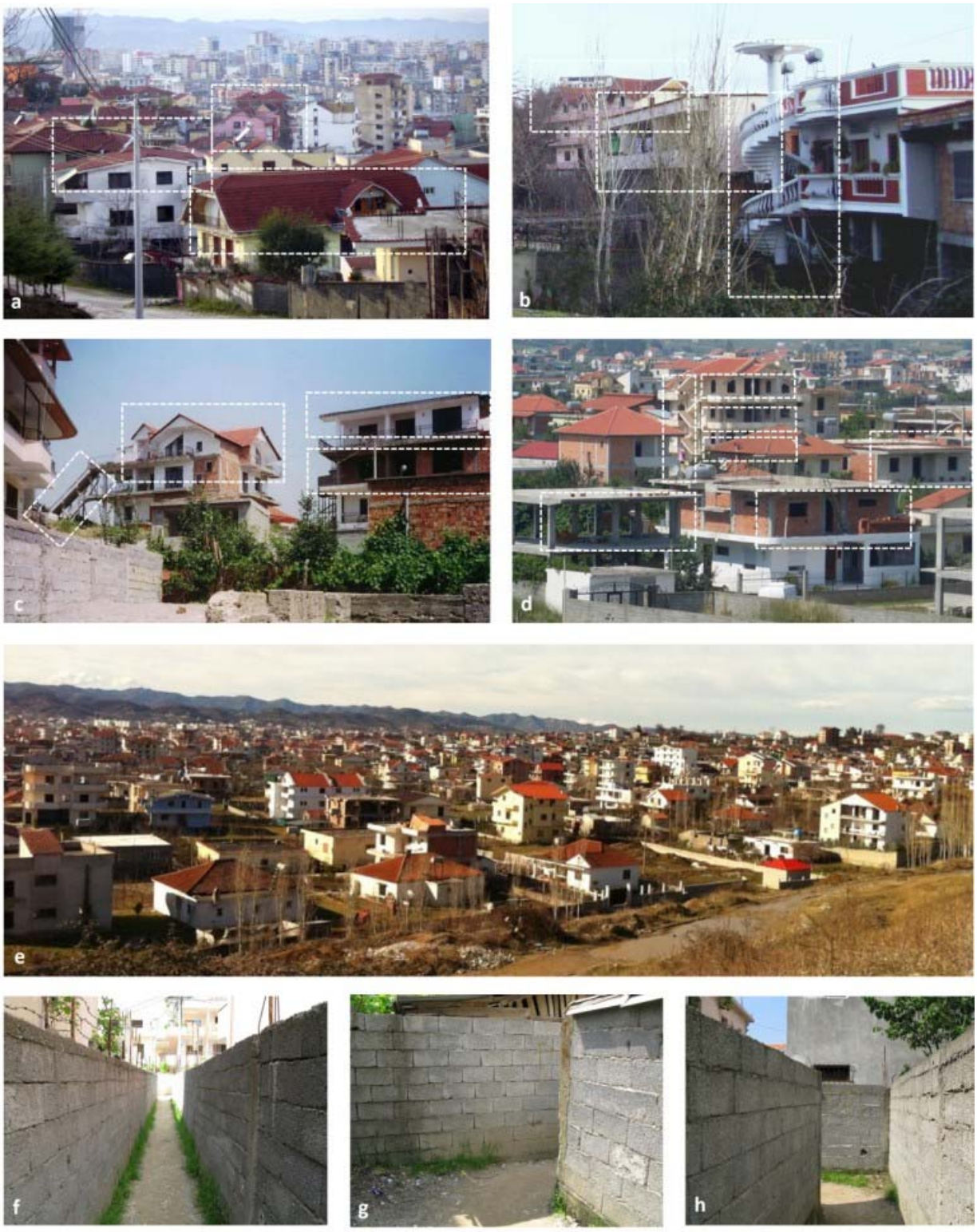
Flexibility, precariousness and adaptability

The public and the private space resulting from this kind of never-ending negotiable processes, and the continuous arrangements, implies a degree of precariousness and adaptability (psychologically and physically). Two are the main building materials used in these areas: recycled elements from the ex-factories next to which these settlements started; and self-made cement blocks produced within the area, often by families themselves (Figures 4.63 d; 4.64 f, g, h). This kind of cheap and flexible materials responded to the need for change and to the demand for flexibility of the physical structures. Similarly to the clay bricks used in the Historic Organic, the cement blocks manually produced could guarantee the required level of flexibility. Despite some defects presented by this material, such as poor isolation quality and resistance, etc., it is a material that can be easily produced and manipulated. Recently, new building materials, similar with those used in other parts of the city are used also in these areas.

Admissibility degrees

For a potential visitor, the sense of allowance while penetrating in these areas is similar with that of the Historic Organic: one is invited or prohibited to continue further mostly by signals received by the senses. However, the fact that these areas officially are still considered as informal and largely perceived as dangerous, creates an additional psychological impediment for outsiders, which decreases the sense of allowance. In this case, it is not the right to privacy but the quarrels and claims for the unclear property that makes aggressive and unwelcoming these areas. Despite the organic flow of the space, a visitor (potentially considered by residents as a harming agent) is under a psychological pressure of being trapped in an intricate continuity that suddenly may become discontinuity, which is perceived as a dangerous signal. This is contributing in the social segregation of these areas and in the creation of a ghetto culture.

4.63 Typical rural “family houses”*;* built through the help of the “master builders” with self-made cement blocks produced in the area, or by families themselves (source Co-PLAN archive)



4.64 Incoherent combination of unrelated architectonic elements; different imprints (a, b); typical rural houses (c, d); replication of the same “project” *in a* tentative state of becoming (e); The nearness condition is more a clash (mechanic aggregation, amass), or forced intimacy rather than a nearness relationship based on anthropological principles (f, g, h).

2. Inflated New Organic
Floating in superfluity

Main characteristics
The areas classified under this group are located in the farthest and the less dense peripheral belt. They embody characteristics of an open and inflated agricultural city diluted in the territorial texture (Figures 2.29; 4.68; 4.81). This sort of city, like the previous one, is not based on a predesigned scheme, but in human spontaneity and their instinct to adapt.

Occupation modality, morphology, typology and the specific character – emerging city
The inflated New Organic city is part of the dissolved city textures, scattered in the vastness of former agricultural land, knitted from big scale rural infrastructures, natural elements, and occasionally fragmented by former obsolete or functioning buildings or "mega-buildings". In fact, the former rural infrastructures such as, drainage and storm water canals, or service roads (Figure 4.81), together with some natural elements such as riverbeds and green areas alongside water canals, etc. played an important role in guiding the housing development in these areas. Other pre-existing structures, currently out of use, such as former dairy production farms, former military areas, mines and material extraction industries or industrial plants, etc., played also a role in seeding and attracting scattered houses, or aggregating developments, because of the infrastructures (water pipes, electricity, etc.) and the recycled building materials they could offer.

The morphology of these areas is a fusion of the above-mentioned territorial texture with low-density housing structures. A large knit rural fabric (if we can speak about fabric) weaved by natural or artificial territorial traces (water canals, agriculture service roads, riverbeds, etc.) is characteristic for these areas. Within this fabric (knitting), low-density groups of houses laid in single or double parallel lines are anchored. Therefore, the texture of these areas consists in mixing natural and artificial elements with different scales. The tiny grains of individual houses, formal or informal, which face the big scale fragmentation of the former agricultural land, or the natural fragments created by riverbeds, hills, etc., often gives the impression of an incomplete process that creates an out-of-scale or dimensional confusion. The one-to-three story houses, similar with those described under the first group of this pattern is the predominating typology. Collective apartment houses, or other buildings with a bigger scale, such as hotels, storehouses and economic productions, etc. may be occasionally found.

The common urban categories such as street, square, park, etc. traditionally used to analyze the city, are not fully applicable to classify the territory of the Inflated New Organic City. For example, the public space (=free natural space and / or left space), consists mostly in access paths embedded in drainage canals, riverbeds and their adjacent areas, as well as agricultural parcels that for different reasons are not yet occupied, etc. In fact, while these kind of inflated city encloses a lot of "free" space, which apparently is a "luxury" situation, the status of this space is unclear: it is difficult to make a distinction of what is public, or what can really be accessed by the "community" (if we can use this term). Again, like in the first sub-group of this pattern, this sort of "free" space manifests more the characteristics of a superfluous and unclear space rather than a real public space. While these empty superfluous spaces are a good potential for "public spaces" (potentially important even at the city level) they are not used as

such, also because they are empty from any public activities. This fact increases the perceived insecurity and decreases the sense of attraction toward these areas.

In addition, field survey in these areas bring evidence about former public assets that once left outside the attention of authorities, were illegally occupied and used for housing purposes, or other economic activities. This sort of perceived “autonomy” in land-use, combined with the atmosphere of the open (inflated) agricultural city, creates the specific character of this pattern

4.65 Tirana, south-east extensions (2008)

Specific characters
Despite the rural isolation, these areas embody a multitude of characters as typified through some key words in the following paragraphs:

“Bucolic” (Figure 4.66)
This character embodies the most pleasant aspects of the Inflated New Organic City. It stimulates the sense of abundance and welcoming comfort. As such, this character combines the intimacy of the private gardens with the free open spaces facing the houses (Figure 4.66 b, c, d). Distant hills and mountain ranges (Figure 4.66 b), and necklaces of trees alongside the riverbeds crown a flat or rolling landscape; High vegetation (Figure 4.66 a, e, f) and abundant fruit trees such as khakis, apples, pears, oranges, plums, etc. hide the houses bordered by vernacular fences; Unpaved former service agricultural roads sheltered under the big trees, or bordered by reeds, create perspective tunnels towards the open space, like a door in a room without walls (Figure 4.66 a, e, g).

4.66 Characters: “Bucolic”, the most pleasant aspects; sense of abundance

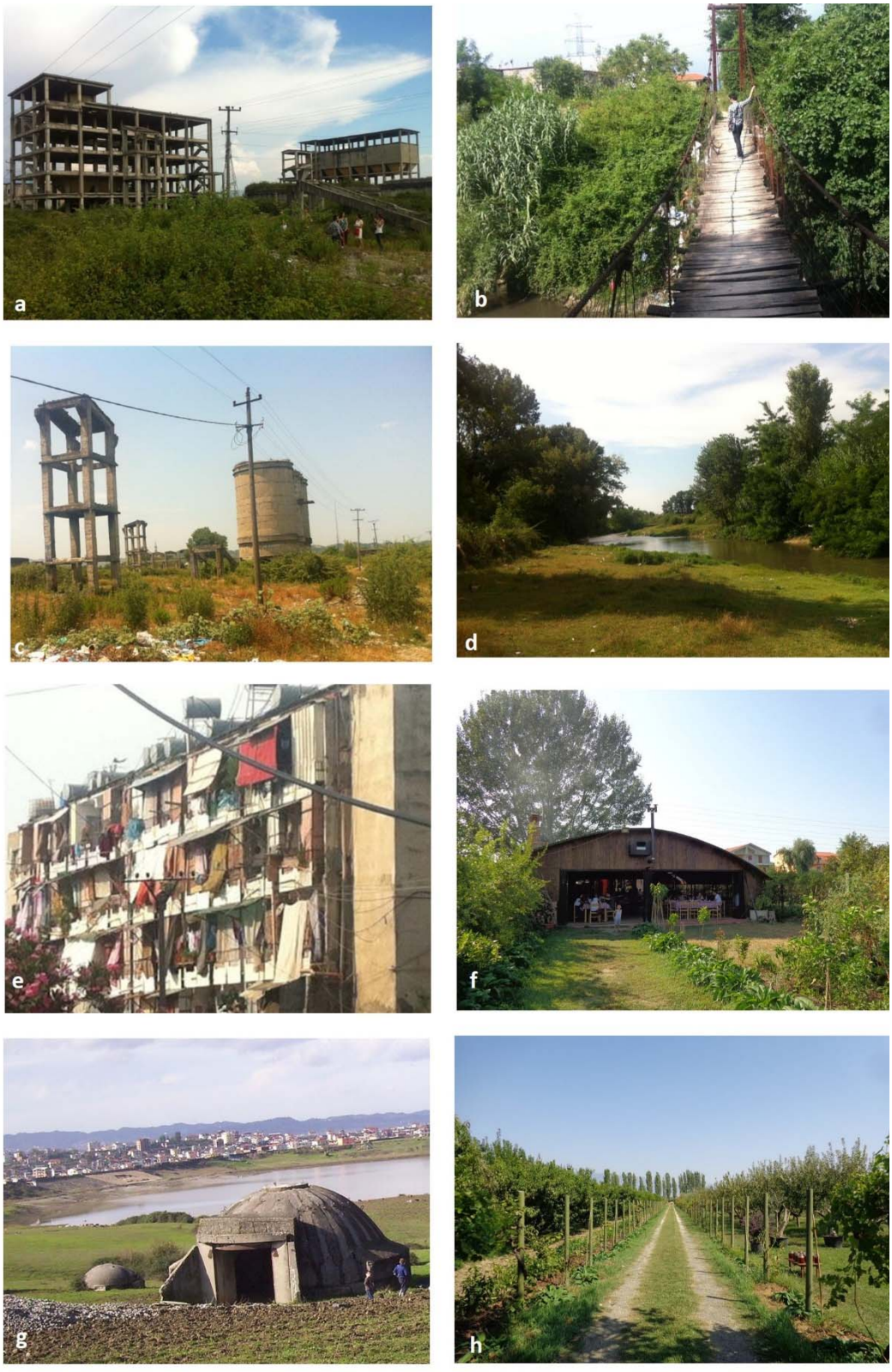
Small and mysterious groves (woods) (Figure 4.66 c) which imply (indicate) the presence of underground water are scattered in the vastness; People like “refugees” evading from their own past, or from others’ traditions (supposedly free from interference patterns) started everything from the beginning, including the creation of space in itself.

“The day after” (Figure 4.67 a, c, e, g)
This character embodies the most unpleasant and embarrassing aspects of the Inflated New Organic City, but at the same time quite suggestive also. It stimulates the sense of insecurity, unwelcoming fear, inaccessibility, and implies the vacuum of administrative authority. Sculptural necked cement or metallic remaining structures dominate this landscape (Figure 4.67 a, c) and often create a sort of spontaneous “land-art” measurable with the dimension of the open spaces. As such, this character is an absurd combination of former industrial and mining industry, or military structures (Figure 4.67 g) with current illegal occupation (Figure 4.67 e), in an absolute state of abandon and lasses-faire social situation. Isolated young or marginalized people uses these abandoned structures for unclear activities, ranging from leisure, to illegal activities. In a way, this scenario represents their social frustration and a conscious rebellion: a kind of protest against marginalization, lack of attention and social support. There is a huge potential to transform the “day after” areas from “black holes” to social attractors, or incubators at the city level.

“Alice in wonderland” (Figure 4.67 b, d, f, h),
This character embodies the most unexpected aspects of the *Inflated New Organic City*. It urges the sense of exploring “what is there” and how to “get in”. The sense of mysterious curiosity dominates in this case. As such, this character pushes to discover the “hidden objects” or “oases” that one may see from the distance, while they become loose as approaching. There is no precise path bringing you there. This fluctuating clarity, especially at the ground level, produces also a sense of anxiety. The hidden object may represent an infinite of things such as unexpected pedestrian bridge crossing over the river (Figure 4.67 b, d), small mysterious groves and dense green along the river, experimental agricultural parcels / laboratories (Figure 4.67 h), gated university campus, farmhouses (Figure 4.67 d), vineyards serving as restaurants and wine shops, etc. The unexpected surprise may be also unpleasant and inaccessible, such as former public assets, occupied by illegal activities or improvised housing, well protected by walls like an inaccessible “chateaux”.

This kind of reframing may be an important vehicle for transformation of these areas towards a more conscious urban condition. As such, the presented characters may be an inspiration font also for the normatively designed city. Although the Inflated New Organic gives the impression of a temporary city, in reality it is quite a stable one that impacts a large territory around Tirana.

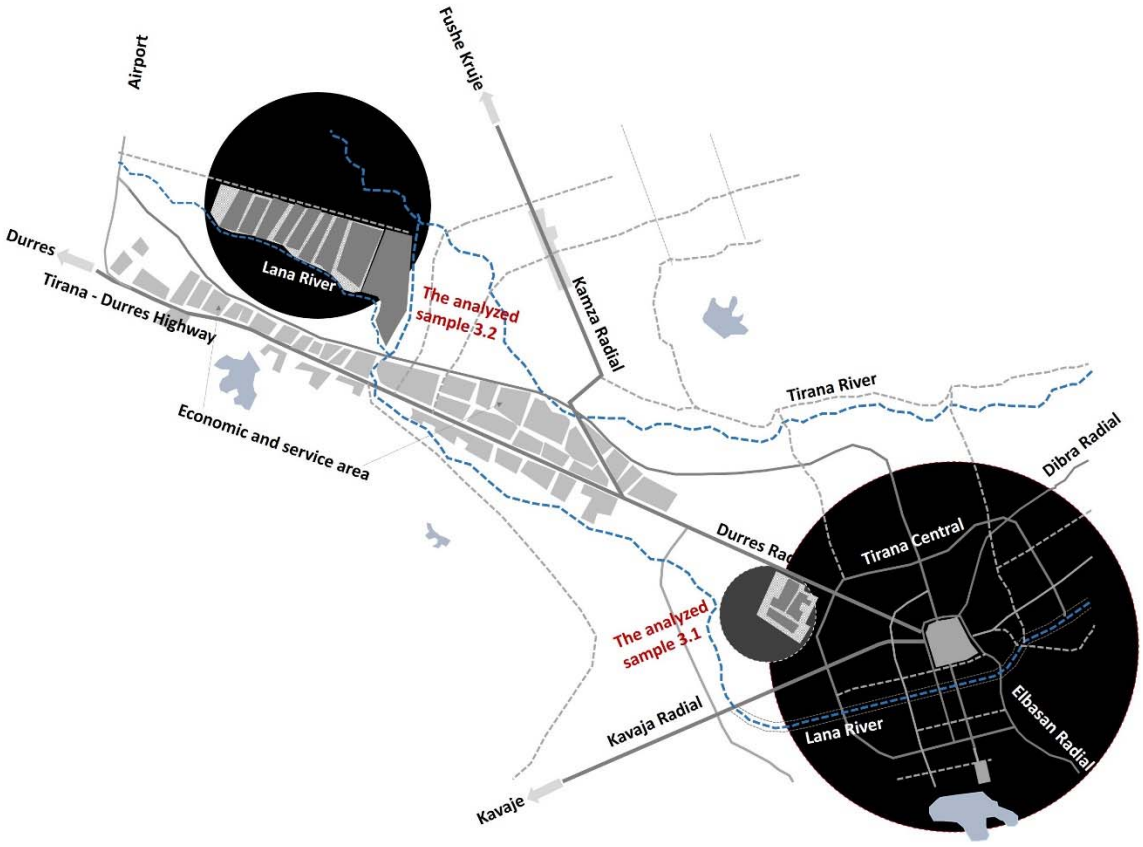
Admissibility degrees
For an outside visitor penetrating these areas, the atmospheres may range from the sense of attraction by mystery and a fervent curiosity to watch beyond the barriers, or within the vastness of the space (dense green, agricultural interstitials, natural interstitials, etc.); to the sense of “culpa” to enter in a “prohibited space” that reinforces the perception of inaccessibility. It is the extreme openness (dissolution) and the dilatation of space elements that creates the perception of an apparently inaccessible secrecy. Once walking across these areas one feels to be surveyed even from the sky, because of the lack of lateral references. This creates the challenge of insecurity and danger to go through;



4.67 Characters: “The day after” (a, c, e, g) the most unpleasant but at the same time suggestive; and “Alice in wonderland” (b, d, f, h) the most unexpected aspects

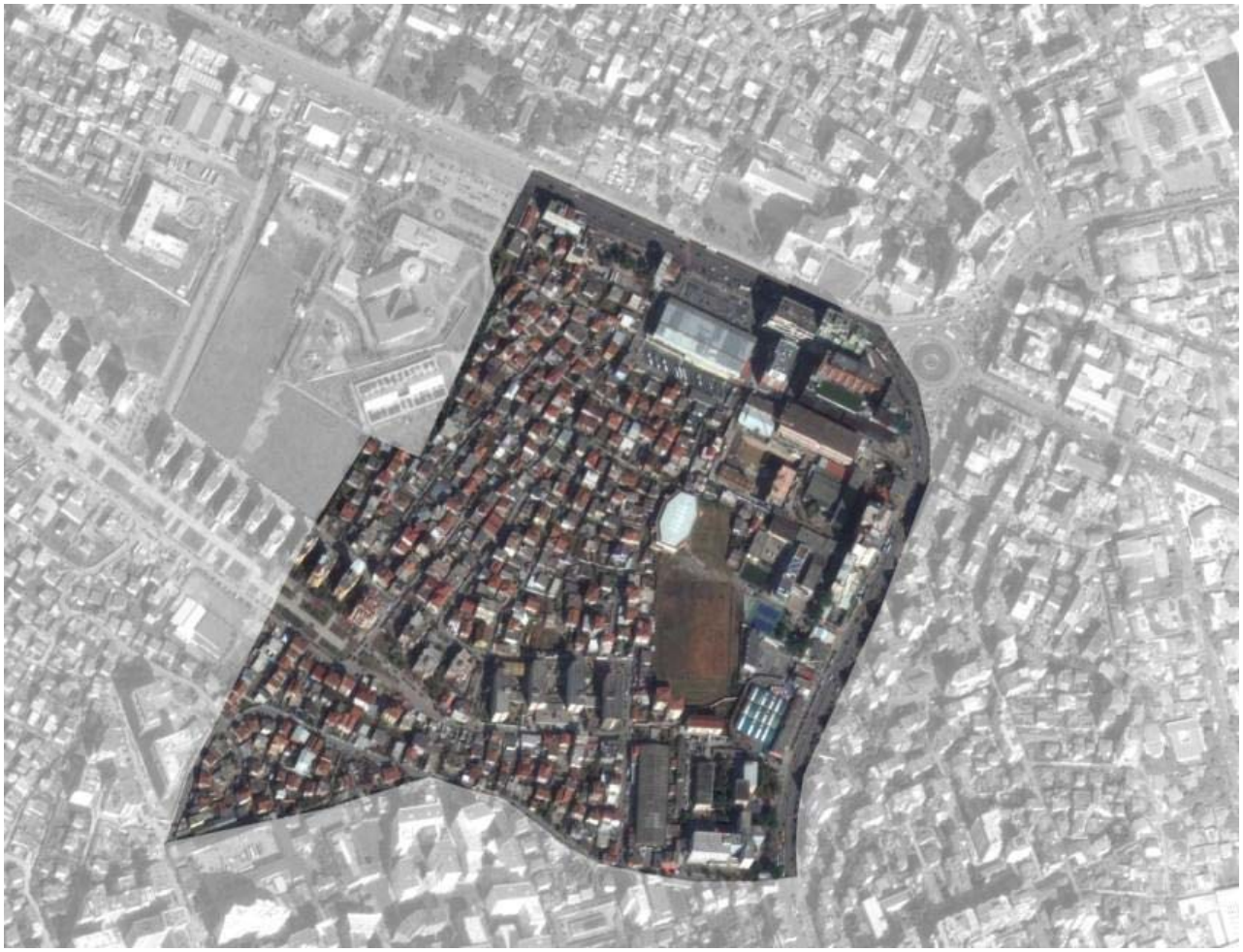
At the same time, this contradictory sensation urges even more the motive to explore the un-exhaustible “secret core”, such as areas alongside the natural elements (rivers, hilly areas), or agricultural left overs that looks more like abandoned gardens, etc. Between the pressure of curiosity and the mystery of the unknown, one goes away with the frustration of not being able to explore further the internal parts. In addition, the lack of exchanges between the residents of these areas (considered as second hand citizens) and those of the “central city”, reinforces even more the perception of inaccessibility, not only physically (lack of infrastructure), but most importantly, psychologically.

Samples analyzed under Pattern 3:
Sample 3.1 – *Pallati i Sportit Partizani*; Sample 3.2 *Rinas-Uka* farm



4.68 The condition of nearness to the main center (or poles of attraction); Sample 3.1 – *Pallati i Sportit Partizani*; Sample 3.2 *Rinas-Uka* farm

Sample 3.1 *Sub-group 1: Pallati i Sportit Partizani*



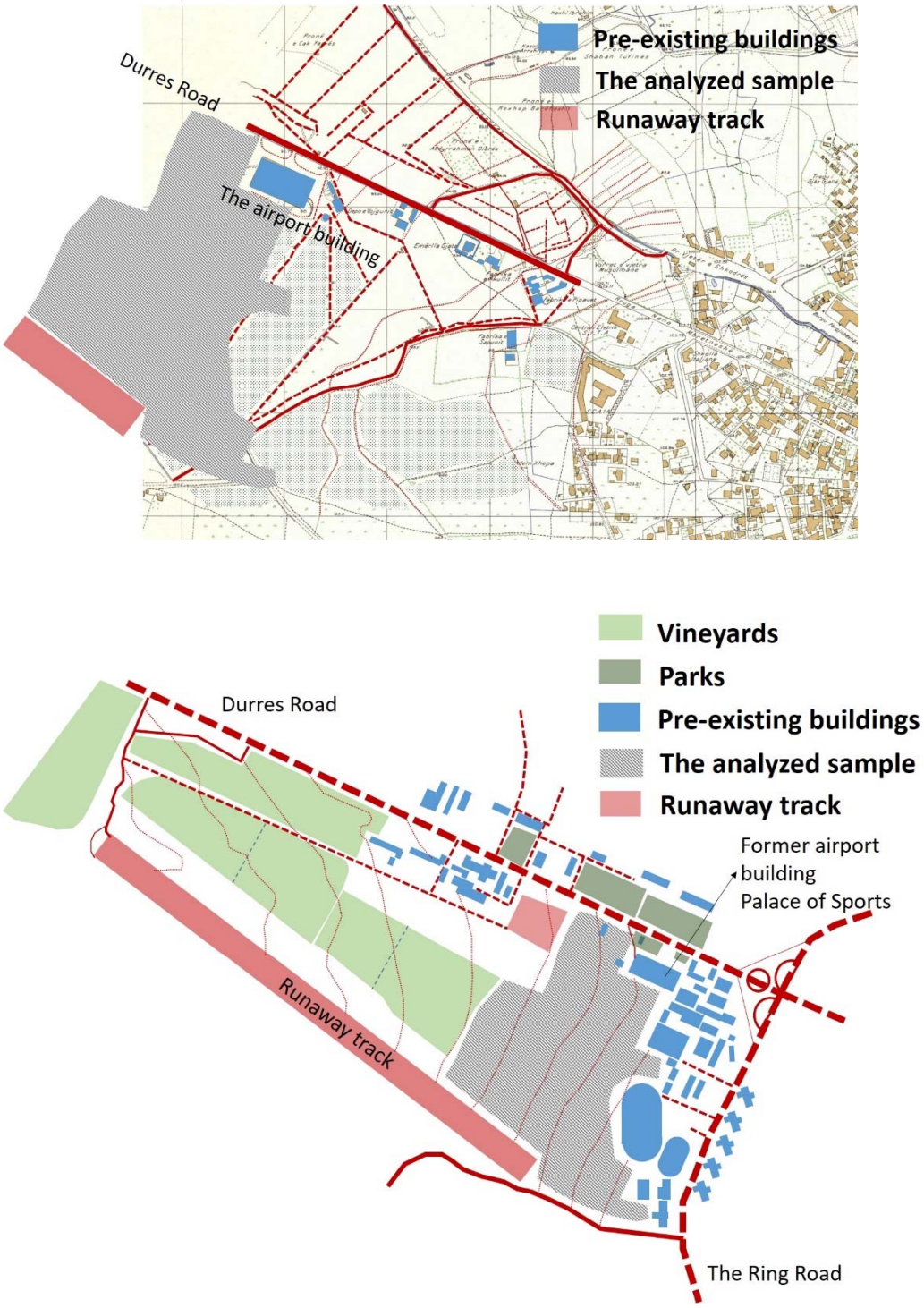
4.69 The current situation of sample 3.1 (source Google earth)

Form and growth: Understanding structural properties

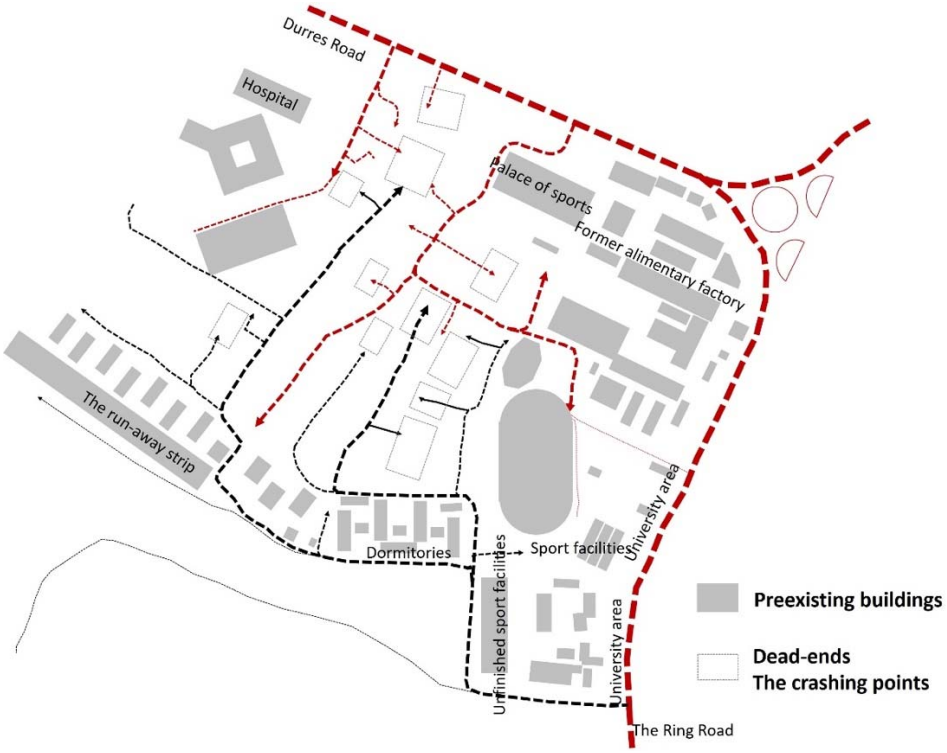
Location and the main generators of the selected sample
At the city level, this sample is located in the nearest peripheral belt of Tirana (Figures 4.68; 4.69), within a walkable distance from the center, but it was considered as a periphery when the first informal developments started there. However, this sector of the city arrived up to the beginning of '90s as a well-planned one, where the urban fringe and the agricultural one, as well as other public uses intersected and created mutual interpenetrations (Figure 4.70). Some of the public facilities included, the University of Sports, the Civil Engineering Faculty, students' dormitories, the palace of sports and some other unfinished sport facilities, a small hospital, some food industry, the old airport, etc. It was a typical figure-ground urban design with a lot of interstitials and unused free spaces in between. Important to say that after 90's some of these structures such as the alimentary factory, and part of the sport facilities, especially the unfinished ones, permanently stopped progressing and functioning. From this point of view, the area offered a rich dismissed or unused potential of construction materials to be recycled in informal developments. This factor advantaged the generation and the gradual development of the analyzed sample. It represents one of the first informal settlements nearer to the center, and is also one of the first settlements officially accepted by the government.

Morphology; natural and artificial restrictions
The morphology of the area, at least at the initial stage, resulted from the combination of two main factors: the pre-existing physical determinants, being those natural or artificial, and improvisations of the specific social structures (Figure 4.71). While the latter factors mostly influenced the occupation modalities, the former consisted in the pre-existing public structures mentioned in the previous paragraph mostly located along the main roads; as well as in some agricultural servicing roads for the vineyards and the airport's buffer zone. Apparently there were no natural restrictions in the area such as, topographic, geological, etc. and there were also no limitations from the previous land subdivision and private property, because the land was mostly state owned.

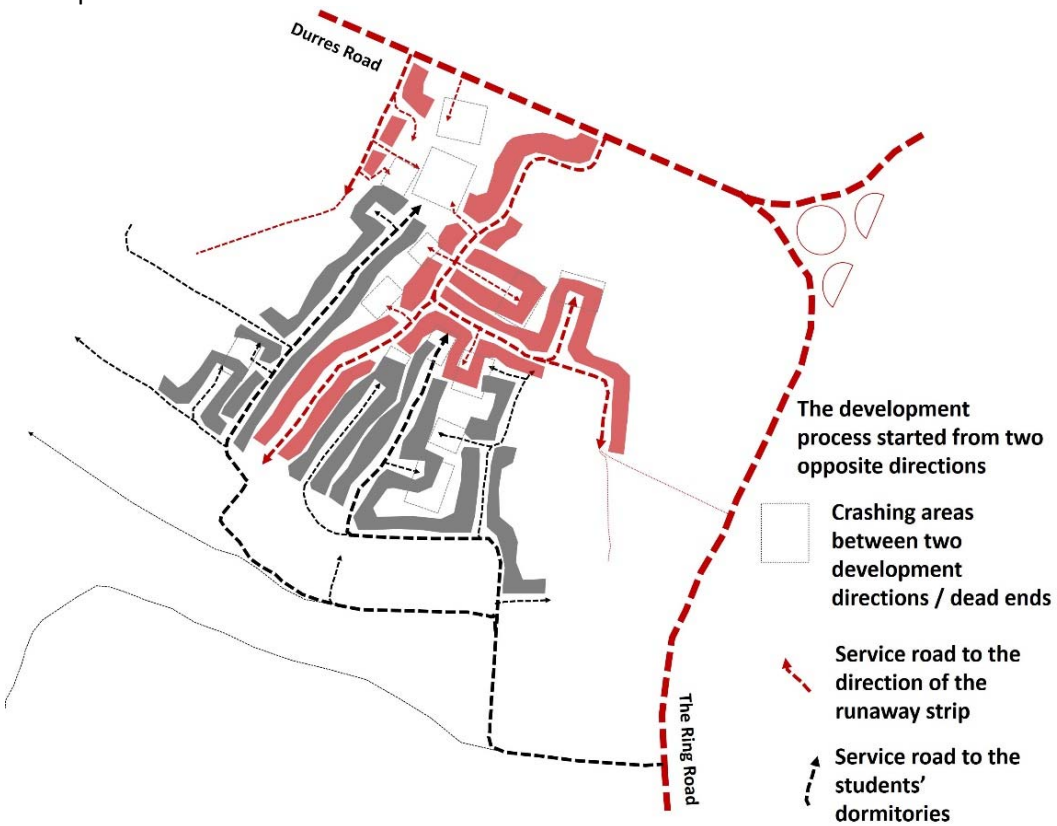
These factors influenced in shaping a settlement which gradually became a relatively dense one (Figure 4.75). The houses were aggregated along an independent internal organic system that initially was intricate and with a lot of dead-ends. This system was connected with the main roads only in two extreme points (Figure 4.73) through former servicing roads. In a later stage, urban upgrading projects connected some of the dead-ends in order to create a network (Figure 4.74).



4.70 The situation of the analyzed sample before 1937 (above); and before 1990 (below)

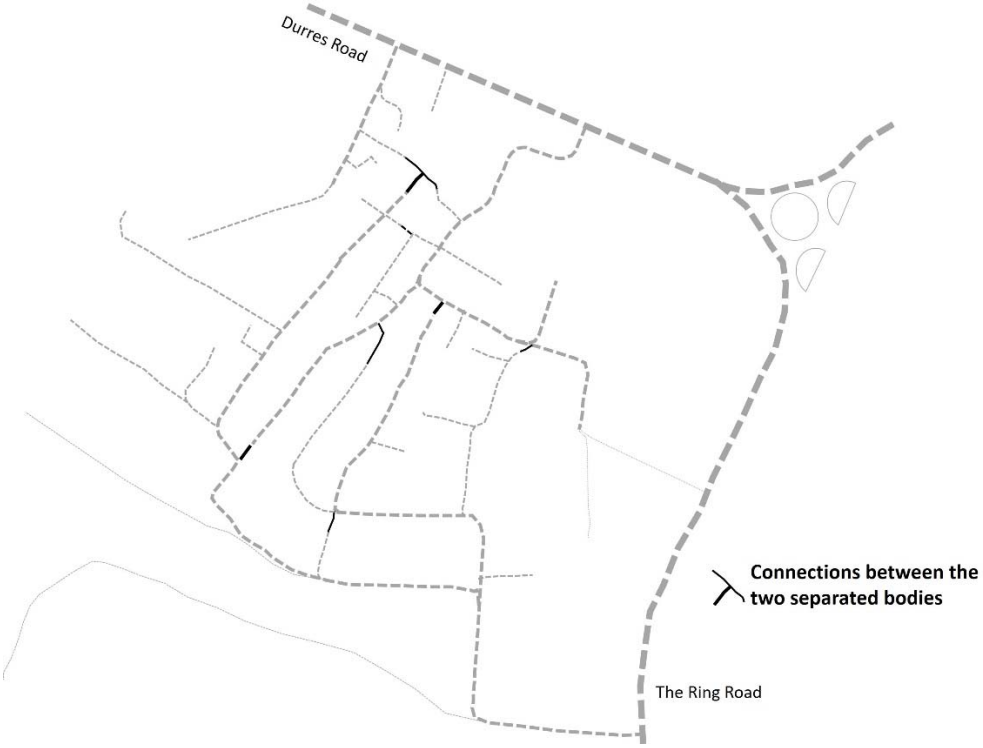


4.71 The main generators of the area: pre-existing elements attracting developments; Modality of occupation

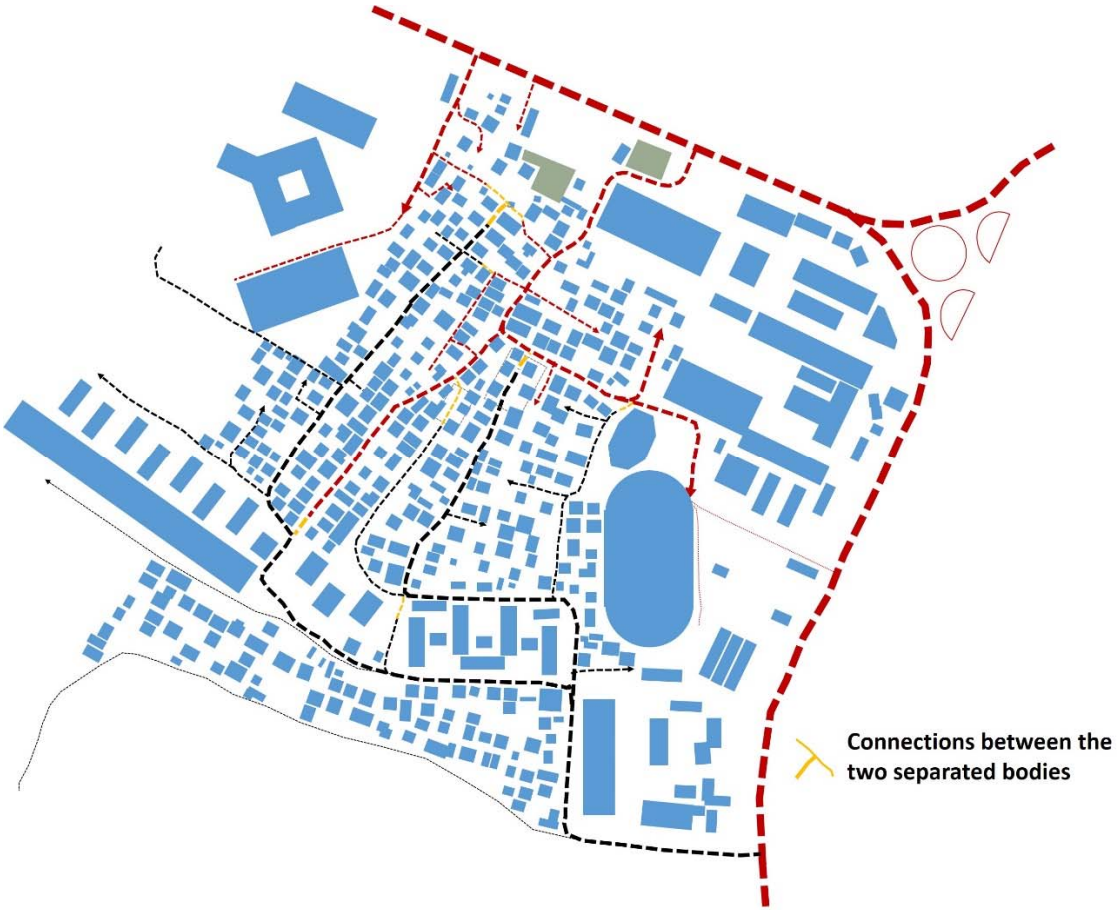


4.72 Two separated lines of development clashing

4.73 Former service roads transformed in development paths



4.74 Interventions to create a communication network



4.75 Figure ground plan of 2015

Reconstruction of the generative process

The occupation modalities during the settling process: from unused interstitials to a real neighborhood; self-organization and a*rrangements at the individual level (complex behavior) anthropological principles; decline in entropy and need for external leverage*
At the glance, from the formal point of view, the area represents the typical characteristics of what normally is labeled under the category of informal settlement. It shows the lack of predesigned guiding instruments and the vacuum of a central authority. On the contrary, the occupation modalities were prey of social improvisations and of the pre-existing physical features of the area. There is an absolute dominance of housing and lack of adequate public facilities and public space in the sample area.

The settlers of this sample came from different regions of the country (Co-plan reports from 90s), which means that social structure, the historic background, and the anthropological principles, were not quite homogeneous since the beginning of the settling process. For that reason, at the initial stages the new-comers settled in groups distancing themselves based on the provenience. This moment can be considered as a certain degree of equilibrium in the system (Figure 4.71), however, this kind of isolation could not last for a long time. I already

explained in the previous sections of this chapter some of the main reasons for densification (including the favorable and almost central location, improved access, the process of plots subdivision; instinctive need to reach a critical mass to hide the non-conformity with the law; and manipulation of the false realtors). All these processes that happened in a relatively short time created and disseminated among residents lack of trust and social tensions, and as explained, even in the case of this sample, it ultimately drove to the dissolution of the anthropological principles of the groups that initially attracted each other. This moment can be considered as a loss of the temporary equilibrium and decline in entropy (Figure 4.72). In fact, there were some external interventions, such as important government decisions for the housing legalization; or approval of projects to support the urban upgrading of the area through service and infrastructure provision that helped to establish a new equilibrium and potentially reach a higher self-organization stage (Figures 4.74; 4.75). Even these interventions were initiated and supervised by a central authority (being this an NGO or a government structure), they were implemented through the coordination with the local Community Based Organizations (CBO). Most importantly, for the first time the government structures stopped thinking about the erasure of this area. In this sense, this is a typical case when individual arrangements at the smaller scale, produce a collective whole (Mitchell, 2009), which with time evolves into a complex pattern.

Similar situations were manifested also in other New Organic areas throughout Tirana. Not without any reason the first official pilot examples of neighborhood upgrading (officially still labeled as informal areas), were catalyzed through NGOs and CBOs or other external factors. The negotiation under such a clashed reality, reinforced by the lack of trust on central authorities, becomes often a very difficult and never-ending process that cannot get out of the negative track without an external leverage.

Process / Steps in development

In the analyzed sample the development process started from two opposite directions along the pre-existing service roads connecting Durres Road with the Ring Road (Figure 4.72). Therefore, two main trajectories going in the opposite direction but without meeting each other fed two separated sub-units. As figures 4. 72; 4.73 show, each of the two main trajectories ramified or branched in some lower levels dead-end paths in order to feed the unoccupied areas at that time. These ramifications followed almost a parallel or perpendicular direction to the main trajectories and to each other; however, they never intersect. Thus, at an initial stage the lower level branches or capillaries originated from the main trajectories remained isolated, and because of that also the two main bodies initially remained separated. At the latter stages these bodies clashed and merged, also through the help of the upgrading projects (Figure 4.74).

The apparently lack of coordination at the neighborhood scale was pushing for more individual arrangements and information exchange at the smaller and individual scale. This was especially reinforced under the condition of people not belonging to the same tribe, or even not to the same areas of provenience, and not to the same culture (including religion). The different interfering patterns overlapping within a relatively small neighborhood (different event, and the overlapping of different event horizons), as explained earlier created tensions. These differences or the cultural clash were manifested also in the incoherency of architecture, in the different uses of the external parts of the houses, such as gardens, or in the different mentalities towards the use of the “public space”, etc. The lack of identity that shaped these areas is a big difference

with the process that shaped the Historic Organic one. However, it is a mistake to think that there is a total lack of coordination in the area, although is difficult to be predicted because it is closer to human-scale concerns.

Levels of hierarchy, form as a system with structure (Batty and Longley, 1994)
Fractal properties of collapsing in itself as the essential quality of the Compressed New Organic (Figure 4.76)

Although the legibility seems to be disoriented and rather undecipherable, there is an underlying structure and a distinctive character within fragments which seems to obey specific logics. The quality of collapsing in itself owns fractal properties. This means that after understanding the process and the behavior of the collapsing in itself system-structure-form, it can be decomposed in subassemblies, which elements repeat in a self-similar-affine way from scale to scale, as I already did for the other patterns.

The self-similarity / self-affinity of this sample drives from the layout of the preexisting physical determinants, mainly the former service roads, combined with the specific process of social improvisations.

- The entire sample is considered as the **system.** Starting from this level, three other consecutive levels exist:
- **sub-systems** (elemental space), consist in the legible freeform or straight stripes, physically shaped by the interaction of the houses and the paths as the main elements knitting the urban fabric, which tend to be labyrinthine or simple geometry.
- **units** of elemental space, consist in further subdivision or segmentation of the sub-systems' stripes. They are formed by legible aggregations of elements around tertiary or lower level internal paths. The quality of clashing and collapsing in itself becomes more legible at this level.
- **elements**, consist in the basic physical components which stay at the base of the pattern. They include houses, streets, dead-ends or tiny squares, plots, fences, etc. These are the elements that "clash" / collide (not necessary physically, but also socially through interfering patterns) and at the end create the main feature of the pattern: "collapsed in itself".

First Level: the **system** (neighborhood)

Second level: **sub-system** (elemental space), mainly from the interaction of the houses and the main paths

Third level, **units** of elemental space, aggregations of elements around tertiary or lower level internal paths

Fourth level, **elements**, components shaping units of elemental space: housing plots, houses, fences, etc.

4.76 Levels of hierarchy within the system

Conclusions

The collapsing in itself represents a compressed and densified mass of houses and human activities in a "meaningless" space, distorted and deflated because the lack of a clear anthropological principle. It starts with isolation in periphery and continues with the modality of amassing and compressing; creating a critical mass through increasing densification. Beyond a certain mass of accumulation, even though the density (arithmetically) may not be too high, the pressure on the elements of space distorts and dilutes its own anthropological principles (understood as information about the space). Because of that, the meaning (or the information) of the space tends to "collapse" in itself: the shaping process necked / dried from a clear anthological factor is driven by the need to create a critical mass where to hide for overcoming the legal problem.

The nearness condition created after this pressure is more a clash (mechanic aggregation, amass), or forced intimacy rather than a nearness relationship based on anthropological principles. Under this clashing physical condition space becomes often conflictual.

The isolation[11] of the new comers in periphery was their stratagem to be not immediately evicted. This kind of location enabled them to metamorphose from a shelter to a real house. It is a well-known fact in the city generation processes that people concentrate and settle together for common purposes or to solve common problems. In this case, a critical mass of people in need, not assisted by government gathered together to solve the housing problem in the same informal way. According to this logic, once the "violation of the law" is committed by a multitude of people, it becomes a common practice. At this point, it is potentially easer to vindicate this problem as a violated right and to treat it in the framework of the social problems. The issue then may be seen also under an ethical perspective. At the beginning of 2000, the mass of the informal settlements in Albania, Tirana in particular, increased at such levels that seriously questioned whether people were violating the law, or it was the law or something else that was violating people. This shacked a basic ethical issue: what is right and what is wrong? From this point of view, the amassing strategy worked!

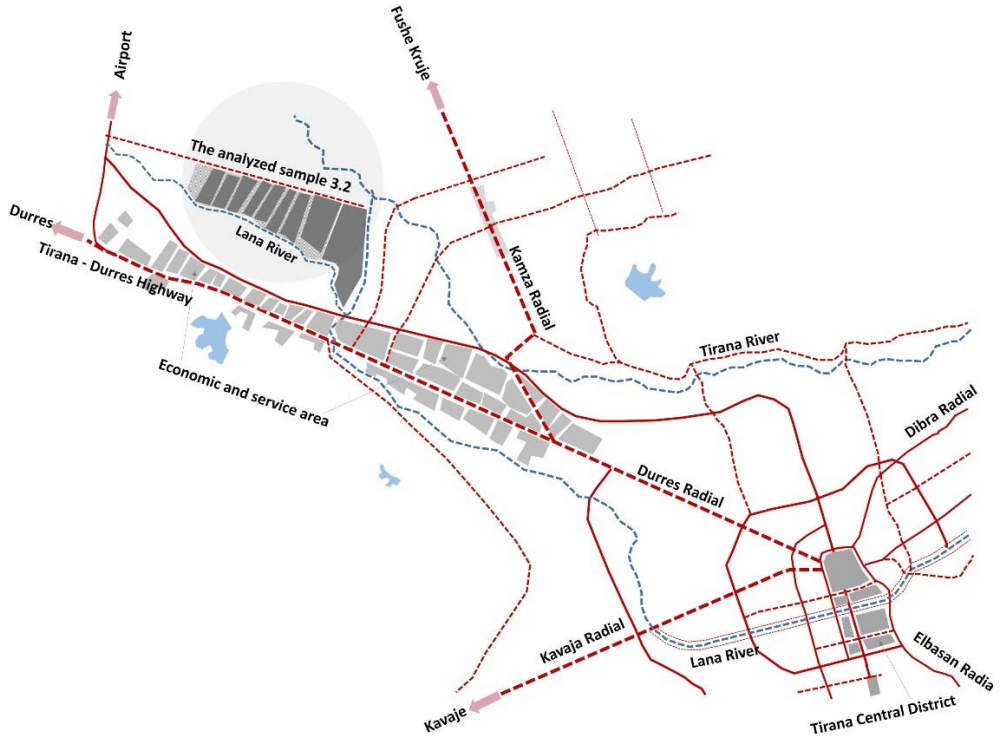
Two were the prevailing factors that fed this amassing: on the one hand people that attracted each other based on family connections or origin (even the influence of this factor was diminishing), and on the other hand the land speculators who encouraged the phenomenon of land occupation and illegal transactions in their favor. They were a kind of catalyst for this process and the only ones to understand how this process would end-up. They also needed to hide beyond the critical mass. In any case, consciously or unconsciously people were part of a large land speculation scheme.

Most importantly, as explained in the 2nd chapter dedicated to the historic analyses, behind that situation stays the poor economic condition and the impossibility of this people to find their niche in the legal housing market. From another point of view, this can be seen as people ability to adapt: the system they activated has the characteristics of an open system that borrows the energy from its own environment, although combined with some equilibrating leverages from outside. For the same reasons, this situation could not be saved from being

[11] Details about the social processes that happened after 90s are given in the specific chapter related to historic analyses

manipulated by criminal interests of land speculators. Finally, behind all this situation stays the government incapability in its role as provider and especially in its role as enabler.

Simple 3.2, *soub-groupe 2: "Uka Farm"*



4.77 Location of the sample in relation to the center and other economic development areas

Form and growth: Understanding structural properties
anthropological principles; Morphology

The analyzed sample is located in a former agricultural land once cultivated with various vegetables, or fodder (Figure 4.77). In the proximity of the area were located also two big livestock complexes. All this was part of the state owned agricultural farms, or the so called "cooperatives", which were important entities for the administration of the agricultural economy. After the collapse of the communist system the agriculture land was privatized and according the law, the land was distributed to the farmers working in cooperatives in the moment of privatization. This context created the first condition for land fragmentation: the application of the law was followed by further subdivisions of the big plots distributed to each family, which triggered an uncontrollable land transaction process. At the same time, this process opened the way for the construction of new housing units without any control, in areas very far from the center, where never happened before. As explained, the beginning of '90s when this process started was a very chaotic period in Albania. The migratory movements already started and while the land was under the process of privatization and subdivision, some of the new comers (or just land occupiers, or speculators, etc.) succeeded to register through

corruptive practices as members of the state farms (cooperatives) which land was under privatization. All these phenomena happened in the framework of an administration which was totally incapable to understand these social processes and was even unwilling to help the situation.

An important factor that attracted people to settle in this area was the fertile land, which provided the opportunity to cultivate various crops for livestock. Interviews and report studies written from Co-PLAN during this period, bring evidence that for people used to live with agriculture and livestock, with inadequate education to adapt to the city labor market, this kind of economy was vital especially at the initial stages. This is one of the reasons why still there is a considerable amount of land which is used for agricultural purposes, orcharding, or green houses (even in some cases primitive and self-made).

The agricultural use of the area was compromised after 1993 when the mushrooming of isolated or groups of houses became evident. It was not a predesigned scheme to guide people, however there were some physical determinants such as the proximity with Lana River, as well as the existence of former irrigation or drainage and storm water canals in a flat land, that guided the improvisations and social dynamics during the settling process (Figure 4.79). Most of the newcomers in this area were originally from the northern part of Albania, or similar regions. Their cultural, social and historic background, as well as the anthropological principles based on those values were quite homogeneous. Differently from the areas nearer to the center, in this case the pressure for urbanization was not the same; there were less interventions from external factors, and even less interference patterns generated from different cultures of people settling there. It was a much clearer predominating culture in this case.

Before going further, it is worth to bring here some information about the settling model of this predominating culture (Figure 4.78). The vernacular typology (Thomo et. al., 2004) of the regions from where people were coming from, is the so-called “stony tower house”. By tradition this typology was an individual residence sheltering an extended nuclear family; the houses were located in considerable distance from other as part of a low-density (extensive) mountain village, or community. This typology represents a typical solitaire house conceived in all its being not to be aggregated with other similar. Therefore, the original anthropological principle imported to the periphery of Tirana, drove to a settling model supposed to create isolation through loneliness in space. This is different from the privacy through hiding and deviating the straight line perspectives based on a different culture (pattern 1). Isolation for privacy and isolation as loneliness are two different settling models. Most importantly, according to this settling model, the houses like focal points in the landscape, located in distance from each other, were part of an integral territorial system (Figures 4.79; 4.80).

4.78 The settling model of origin; solitaire house not aggregated with other similar; loneliness

Thus, besides a usual garden surrounding them, the house was the focal element around which were grouped several natural or artificial elements such as meadow and pastures, groves, sometimes creeks and water mills, cultivated land, orchards, etc. According to such settling model, the house potentially aggregates with the natural open spaces, but not with other houses. This settling model, emerged in the periphery of Tirana as the arousal effect of the interfering patterns (the wave factor) from another reality: people as a vessel for non-locality (the event was located in the countries of origin and the event horizon was created / aroused as a new emergent reality in the periphery of Tirana; SST web of wholeness).

This model led to the excessive use or even misuse of space, especially at the initial stages. However, differently from what happened in the Compressed New Organic areas, in this case the idea of the superfluous and inflated space as the essential quality of the pattern, remained the main characteristic even after the densification processes (Figures 4.79; 4.82; 4.83). This quality is preserved for various reasons, among others, because the isolation characteristic is preserved and embodied as part of the essential logic of the pattern through different scales; because the original plots were big enough to house sufficient space even after further subdivisions; because the scale of pre-existing geometric layout (physical determinants) guiding this pattern does not allow to overcome certain vicinity (water canals); because the agriculture culture of life and the combination of uses related to it (within and outside the private plot) still play an important role for people living there; because the process of development combines characteristics between plot densification and intensification (explained further); etc.

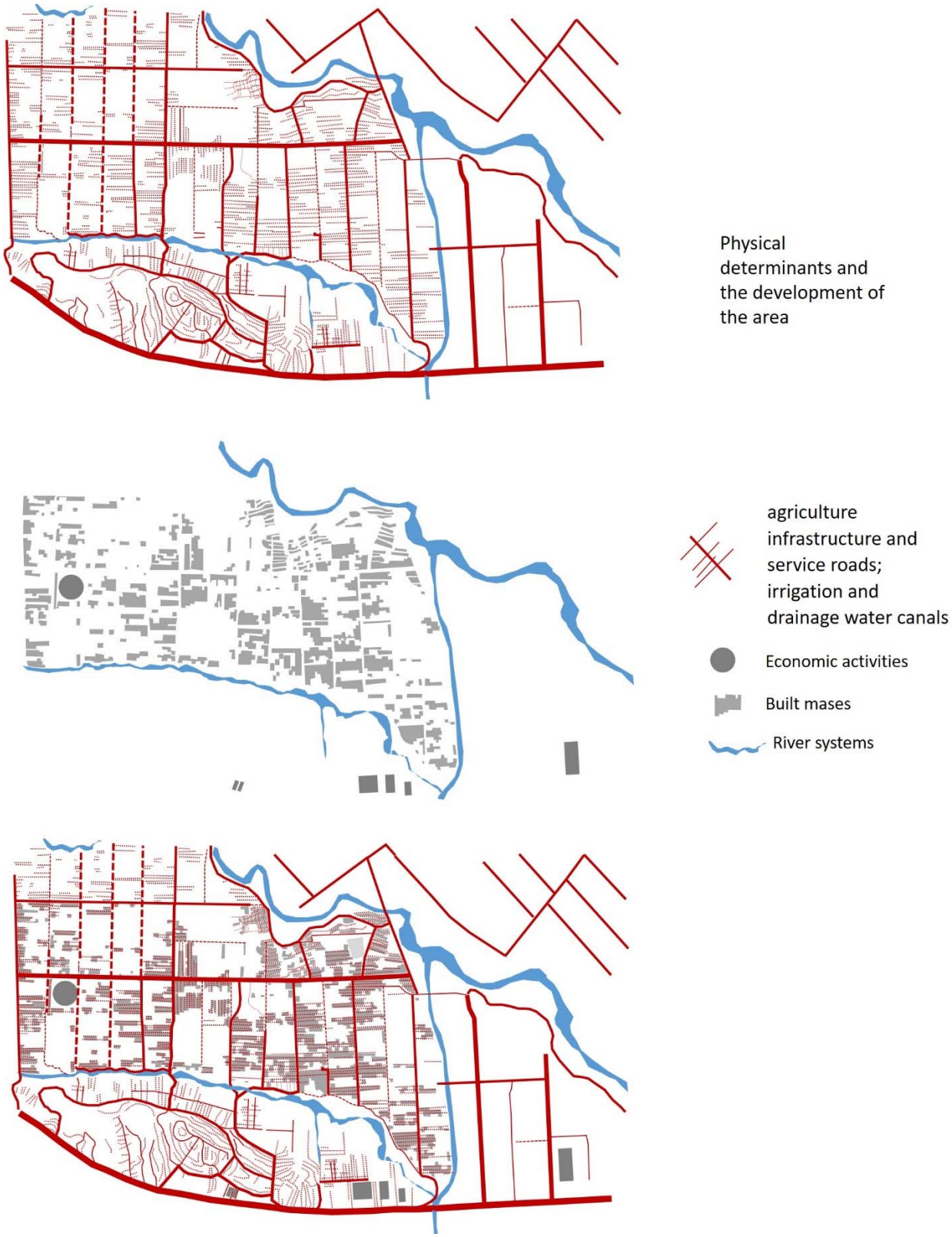
The morphology is a combination of low-density housing coagulations, concentrated along the former rural infrastructure skeleton, with accidental but regular free spaces (Figures 4.79; 4.82; 4.83). The latter, is not a real public space, but the result of what is left, or what is still used for agricultural purposes. Thus, the concept of public space in the area is still vague and unclear. The superfluous space within the analyzed area resembles an inflated “balloon” that has reached to its maximum size limited between the two branches of the river. Dispersed coagulations of housing masses fluctuate within this inflated “balloon”. This character is typical for the areas under this sub-group.

The housing groups are fed by a ramified path network. There are at least three to four levels of ramification from the main path to the lower level paths. The paths and their consecutive branching levels follow the former agriculture infrastructure (irrigation or drainage canals and service roads). The deviation angle to the lower level paths in this case is 90 degrees because of the flat topography and the rationality of the predesigned agriculture infrastructure. This fact creates the impression that the area is structured according to an orthogonal grid. In fact, the area does not function according to a real connected grid network.

4.79 Settling models in the sample area; physical determinants: the proximity with Lana River, irrigation or drainage and storm water canals that guided the improvisations and social dynamics during the settling process (source Google earth)

4.80. Examples of settling models in the periphery of Tirana

4.81 Satellite view in two different moments (2002; 2017): a slow densification process can be noticed (source Google earth)



4.82 Understanding structural properties of form; The occupation modalities during the settling process

4.83 The occupation modalities during the settling process at the level of three longitudinal stripes; Figure ground plan

Reconstruction of the generative process

The occupation modalities during the settling process: from a single house to neighborhoods; between plot densification and intensification; coexistence within the neighborhood-plot

Analyzes and interviews from the area indicate that the mushrooming of houses initially started in proximity of Lana River, and along those agricultural service routes flanked by water canals on both sides; while those routs which were not flanked by water canals were less preferred. It is clear that this preference was due to the need for discharging the wastewaters. The developments were taking place along the third level path refracted in 90 degrees from the main and from the secondary service roads. The 90 degree (deviating) principle was reflected even in the occupation pattern and positioning of houses within the space of what would become the future neighborhood. Because of the preexisting gridded configuration, and because of the anthropological principle of isolation and / or "hiding" from authorities through dispersion and fusion within the space, the rational (quality) of the space inflation was created. This quality was intimately related with the existence of interstitial free spaces in between the houses and between the dispersed groups of houses. This was different from the visceral quality of space: while Historic Organic created privacy through hiding in vicinity (refraction and wrapping from within), in the Inflated New Organic hiding is realized through the inflation of space.

The first nuclei of houses located in the area gradually enlarged and became denser (Figures 4.79; 4.85) through two main process: multiplication, which means construction of new separate houses within the original plot; and enlargement of the existing houses through adding more floors to the existing ones; or sometimes even building a new bigger house in order to dedicate a separate floor for each of the new families. Therefore, after one or two decades, a process of densification and implosion of the internal plot space happened to adapt for larger families. The land was subdivided, or the number of floors was increased according to the number of male children in the families initially allocated there. Despite this internal process of densification, since the original plots were relatively large, the new houses could still settle in distance from the preexisting ones; their gardens could contain the same elements like the original plot, but in a smaller scale, reflecting as such the model of the neighborhood within a single plot (self-similar-affine fractal property of inflation). Therefore, most of the single-house plots, where the houses were mostly located at the rear of the plot and as far as possible from the street, were transformed into composed residential plots.

There are two kind of fences within each plot: external fences to designate the ownership and make the distinction from the open space, and internal fences to precise the portion of land designated to each of the nuclear families in order to avoid potential quarrels. The external fences are made of cement blocks, organic materials, or sometimes trees; instead the internals are made of sticks or organic materials such as willows, etc. Within the big family plot sometimes, a green house or other buildings to support the family business exist. Even the toilet services sometimes are located in the exterior as a separate entity next to the water canals; this was the case especially at the initial phases. In some cases, an internal road nourishes the communication of the separate nucleus / entities within the original plot. During important family celebrations, such as weddings or other similar occasions, the entire plot space is used. This kind of coexistence creates a complex universe of relationships within a composite plot, or neighborhood-plot, supposed to be managed by the parents or the older brother.

Typology of houses
From the typological point of view, the self-made houses represent a very basic scheme. Especially at the initial stages, the one-story houses reflect a relative similarity with the cow-houses: rooms incrementally added in a parallel layout next to the original vain and to the agricultural layout of the area. The two or three-floors houses with rooms distributed around a corridor appeared in later stages. However, the interior was a typical self-made one, with a lot of inefficiencies and superfluity (spaces without a clear use, in contrast with the historic organic where the efficiency and the multiuse of spaces was a priority). From this point of view, even the houses in the Inflated New Organic City, represent the essence of this pattern (inflation). While the settling model at territorial scale reflected the imprint of the new comers' origin in a more substantial way, the shelters and also their improved versions reflected somehow the "stony towers" of origin. The new houses they built in these areas, with parallel stripes and geometric layout was mostly rooted in the design of agricultural infrastructures, rather than in the typological models of origin. Especially at the initial stages, the house was almost a pragmatic direct visualization of the context and of the cow-houses or greenhouses they had within their plots. Also, the quality of dispersion in the inflated rural-urban space surrounding their houses, was embodied in the superfluity of the internal space and its use.

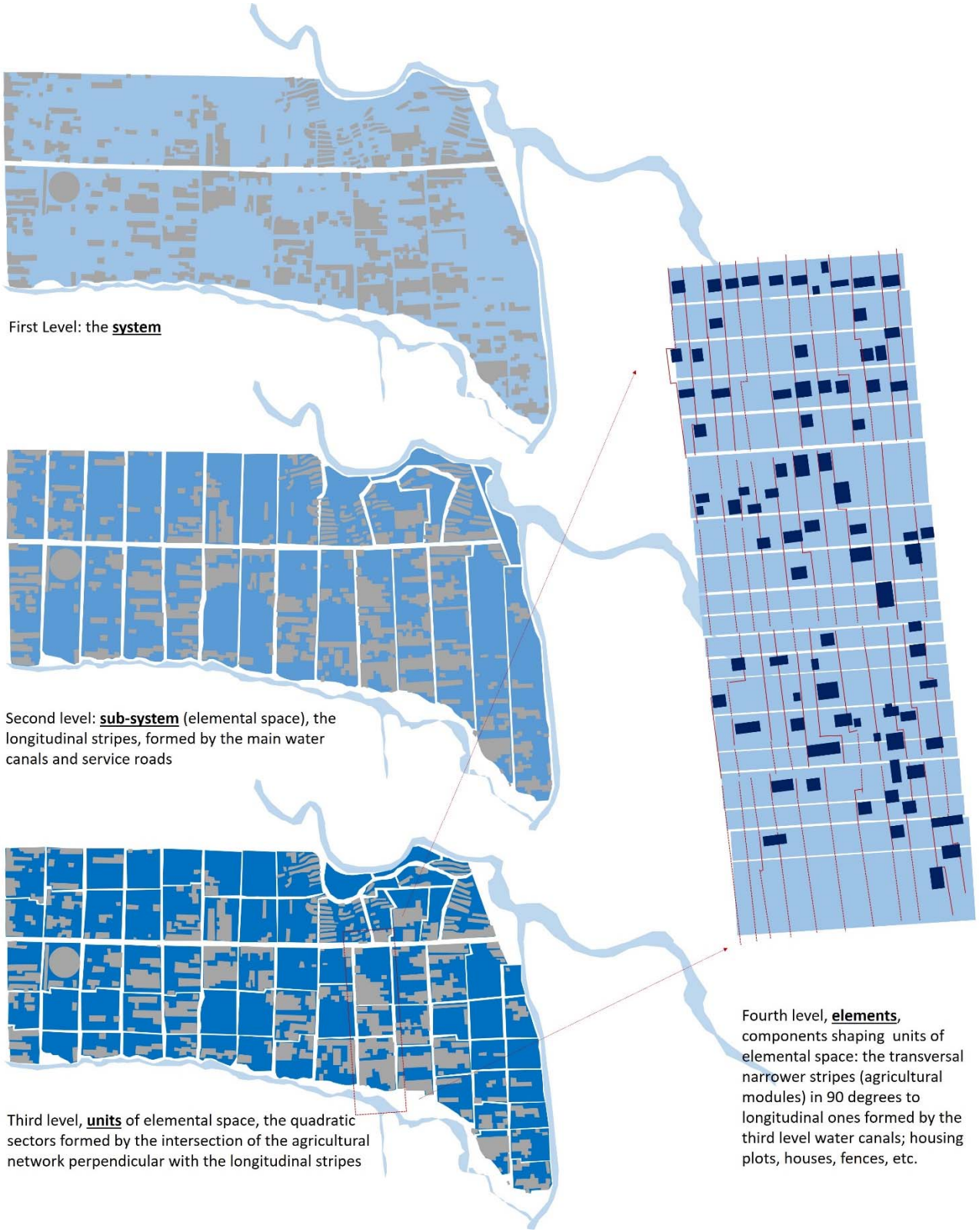
In later stages of development, the houses bear not only characteristics from the specific site and the places of origin, but also many alien characteristics imported from other cultures where people emigrated. This is a sign that the anthropological principles under the influence of interfering patterns in the area are under a dissolution and fusion process simultaneously. This is especially visible in the totally lost architectonic coherency, already observed in the previous sub-group. However, in this case we can speak not only about "dissolution" but also about "fusion" (the hybridization role of the city). This is because in this case things are happening with a lower magnitude in comparison with the Compressed New Organic.

Levels of hierarchy, form as a system with structure (Batty and Longley, 1994);
Fractal properties of inflated New Organic City.

The quality of inflating as the essential quality of this pattern owns fractal properties. This means that after understanding the process and the behavior of the inflating system-structure-form, it can be decomposed in subassemblies which elements repeat in a self-similar-affine way from scale to scale (Batty and Longley, 1994), as we already did for other patterns.

The self-similarity-affinity of this pattern derives from the layout of the preexisting rural infrastructures that generate an almost perfect orthogonal modular order in combination with the dynamics of the social improvisations. This context creates up to four levels of hierarchy across the system (Figures 4.83; 4.84).

- The entire sample located in the outskirts of the city (between a former service agricultural road and Lana river) is considered as the **system.** Starting from this level three other consecutive levels exist:



4.84 Levels of hierarchy within the system

- The second level, **sub-systems** (elemental space), consist in the longitudinal stripes, formed by the main water canals and service roads within the area, laid in an almost rectangular way related to the main roads and canals.
- The third level, **units** of elemental space, consist in the quadratic sectors formed by the intersection of the agricultural network perpendicular with the longitudinal stripes.
- The fourth level, **elements**, include the transversal narrower stripes (agricultural modules) in 90 degrees to the previous ones formed by the third level water canals; in these stripes the individual housing plots are settled according to specific housing modules that segmented the linear transversal stripes; The family may occupy one or more modules (segments) along the stripe. Other elements to be considered within the stripes are: the fences, water canals, service agriculture roads, groups of trees, groves, other functional activities such as cow-houses, green houses, etc. Thus, smaller subdivisions may exist within each individual module applying again the 90-degree logic

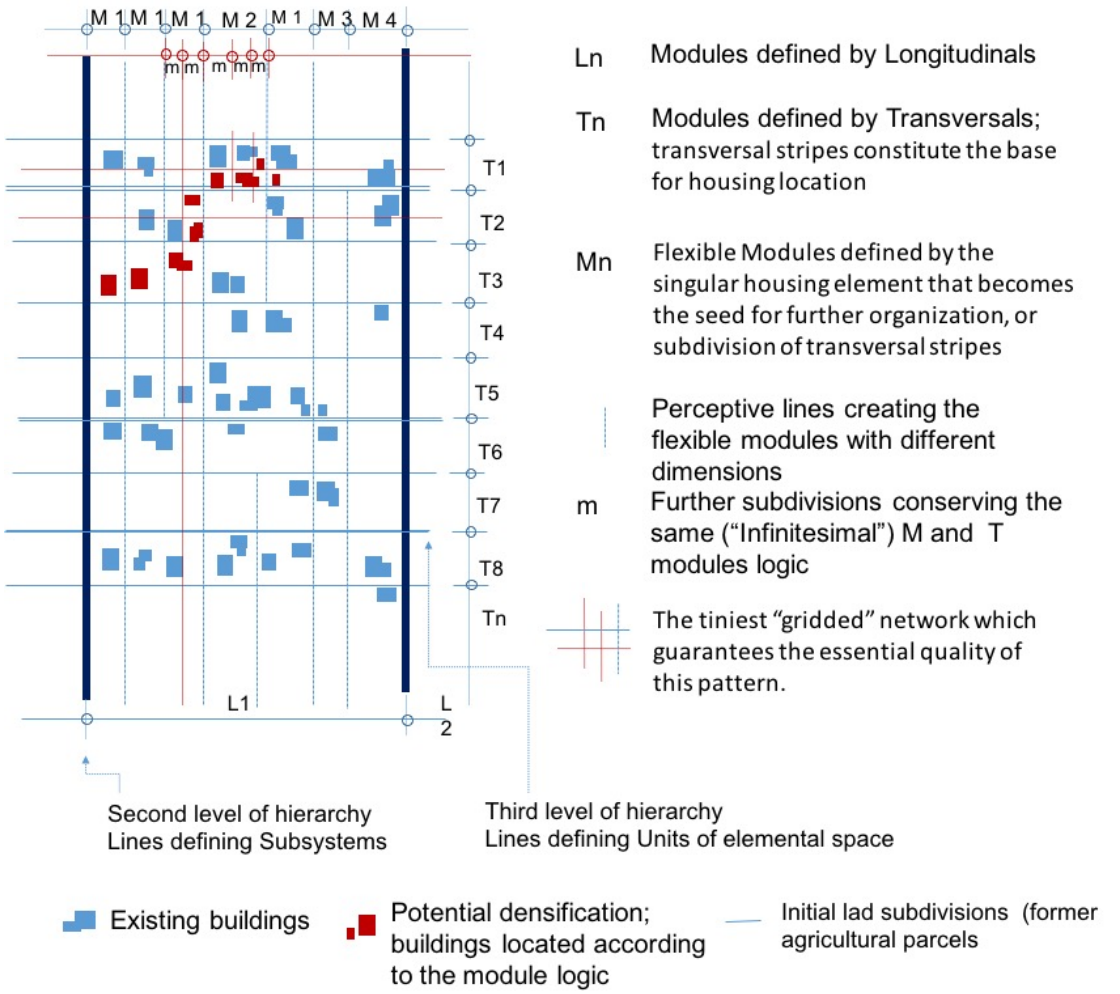
Network of relationship and unit of self-similarity: intersection of agricultural stripes and housing modules (Figure 4.85)
Once we know the structure of the system it is worth to give some more details on the tiniest structure at the base of the self-similarity and hierarchy of this pattern.

While the transversal stripes constitute the base for housing location, it is the singular housing element that creates the module and becomes the seed for further organization, subdivision of transversal stripes, and the creation of the entire knitted structure. The intersection of the imaginary lines of the housing modules, with the transversal narrower stripes, perpendicular to each other (Figure 4.85), create the tiniest "gridded" network which guarantees the essential quality of this pattern. Thus, a normal house module serves as a base to subdivide the transversal stripes in buildable plots or agricultural plots, creating as such the hidden orthogonal legibility. Each "quadratic" unit within this network can be potentially kept free or used for any purpose including housing.

As said, according to the number of male sons a family may use, one, two or more modules (easily sub divisible) to build separate houses along the stripe, or add more floors to the house within the plot in relation to the agricultural land. This process is well "planned" ahead, however it depends on the quantity of land each family benefited from the land reform, or the quantity of land the family bought from another family as a result of the subdivision process.

The fact that the individual plots are formed and based at the transversal narrower stripes, gave more flexibility to families to use the space according to their needs, and also to carry land transactions in the cases the space is limited. Thus, as already mentioned, this pattern does not create the relationships of excessive vicinity, even after densification process happens.

Maintaining this kind of relationship has also another rational: the same logic of subdivision that exists at the upper levels of hierarchy, system and sub-system, applies also at the tiniest levels. For that reason, the consecutive subdivisions go towards the infinitesimal portions of space which contain the same model of space; thus, the subdivided space is based on the same self-similar / self-affine logic. Because of that kind of relationship, it remains "infinitesimal distant"; the pattern creates the idea of a potentially inexhaustible space.
Still, a considerable portion of the transversal narrower stripes is reserved for agricultural activities which give the specific character to this pattern.



4.85 The tiniest structure at the base of the self-similarity and hierarchy of this pattern; easily used for agricultural, housing or other purposes; There is a condition of distancing, or better a particular kind of nearness

Conclusions

The essence of this sample represents the basic characteristics of this subgroup: a dispersed mass of houses and human activities in a superfluous inflated space. The main motive driving to dispersion originates from the anthropological factor, isolation and loneliness in space, combined with the need to avoid the authorities and bypass the law through fusion within the inflated space (disappearing). Therefore, the inflation results from combining the conditions of superfluity and dispersion: dispersion as an escape from themselves, or from repressive traditions; from the others or from the rest of the city. Superfluous space (through scales and for all densities), can be inflated by qualifying it through dispersion (based on the same anthropological model: house as the focus of a larger territory). In most of the cases, this pattern was developed in a more relaxed urbanization condition.

The regular pre-existing grid inherited from the agricultural infrastructures, combined with the anthropological settling model imported from the countries of origin, created a rationally inflated space model based on the 90-degree principle (or on the rationality of the agricultural systems). The house condenses in itself the quality of the settling model by grouping around a larger landscape and becoming the center of the territory and the entire "universe". Therefore, in this model the house is part of an integral self-similar territorial system which is replicated from the largest to the tiniest detail of this pattern. Thus, the self-similarity / self-affinity of the "inflating" logic starts from focusing the space and the landscape ("divided" by the agricultural grid) through single housing elements.

The composite plot (similar with a small neighborhood) that embodies the idea of a potentially superfluous space is a complex and fragile universe of relationships which results from a combination of internal densification and intensification processes. There is a condition of distancing, or better a particular kind of nearness, infinitely reducible without losing the qualities of the anthropological model, that is created based on the self-similar unit-network (the intersection of transversals and longitudinal agricultural networks). This dictates the occupational structure and the common behavior of this pattern.

As explained in the previous sub-group, behind that situation stays the poor economic condition and the impossibility of people to find legal solutions. Most importantly it shows also the government incapability to play its role. However, we can learn a lot from people adaptability and the way the open system reacts and readapts to new circumstances.

Pattern 3: New Organic - Compressed and Inflated
Amassed collision and Floating in superfluity

New Organic is an informal subdivision of space in many individual fragmented decisions and nuanced variety of complementary uses coordinated in small. This drives towards an organic growth in a continuous transformation and shifts / leap from one category to another.

- The New Organic is a dynamic open system created by a vast number of individuals in quest for living resources: it borrows energy from its environment in terms of internal human and physical resources (labor force, existing infrastructures, building materials, land resources, etc.) in order to reach a status of equilibrium. External

"push" related to the property issues, or decisions related to infrastructure development and facilitation to set the rules of the game, etc. was needed especially in the cases when the anthropological factor within the area was not clear and strong (social formula does not work), in order to rich a new status of equilibrium and tend to self-organization.

- New Organic manifest properties of a system with structure with levels distributed across a "network" of preexisting rural infrastructures (physical determinants).

- Further to understanding the structure, I analyzed also the dynamics of the form that implies the behavior of elements in relation with the supporting structures: the preexisting rural infrastructures with a freeform or linear straight line. The potential of this structures to influence the behavior can better explain the external form. There is more predictability when supporting structures develop according to a geometric layout, because of some simple basic "rules" and some limitations (self-conditioning) set by these structures in the use of territory at the larger and smaller scale. This kind of structures create better and clearer possibilities for the organization at the individual scale: the relationship of nearness. This is a typical example when the structure influences the occupational behavior and the form of the neighborhood.

Compressed New Organic VS Historic Organic
Despite the fact that the Compressed New Organic is an internally closed space, and some formal characteristics are relatively similar with the Historic Organic, the space resulting from the New Organic process does not manifest the visceral quality because it is not based on the same anthropological principle of the Historic Organic Pattern. Compressing and clashing processes dilute the anthropological principle. Therefore, the space resulting from this processes created a forced intimacy of private elements at the "smallest scale", becoming gradually conflictual. This is the opposite of the space (process, form) which is generated by the "building blocks" that contain the genes of the visceral space (explained in pattern 1). The visceral space besides being internally closed and protected through hiding in itself, or deviating the straight lines and the open perspectives, is not a conflictual space. The New Organic pattern does not follow the principle of avoidance and refracting to create the right to privacy, but is mostly a random and forced aggregation to amass; most importantly, it is a very rapid process that makes difficult the cooperation and the use of a social formula.

Inflated New Organic VS Historic Organic
The Inflated New Organic pattern incorporates within it an "immense superfluous space". In this case, it is exactly this factor that guarantee the privacy and isolation: they do not need to hide or deviate, they create the loneliness in space. These characteristics are transmitted by the anthropological factor, which in this case is not totally diluted because of the relative social homogeneity and the lack of (or reduced) interactions with other cultures.

Motives: Historic Organic Vs New Organic
Historic Organic and New Organic are triggered by very different motives: In the Historic Organic the visceral relationship between elements of space does not depend on how much space is available, or on physical determinants (topography, etc.), but is the direct result of urban improvisations based on a specific anthropological principle, social structure and

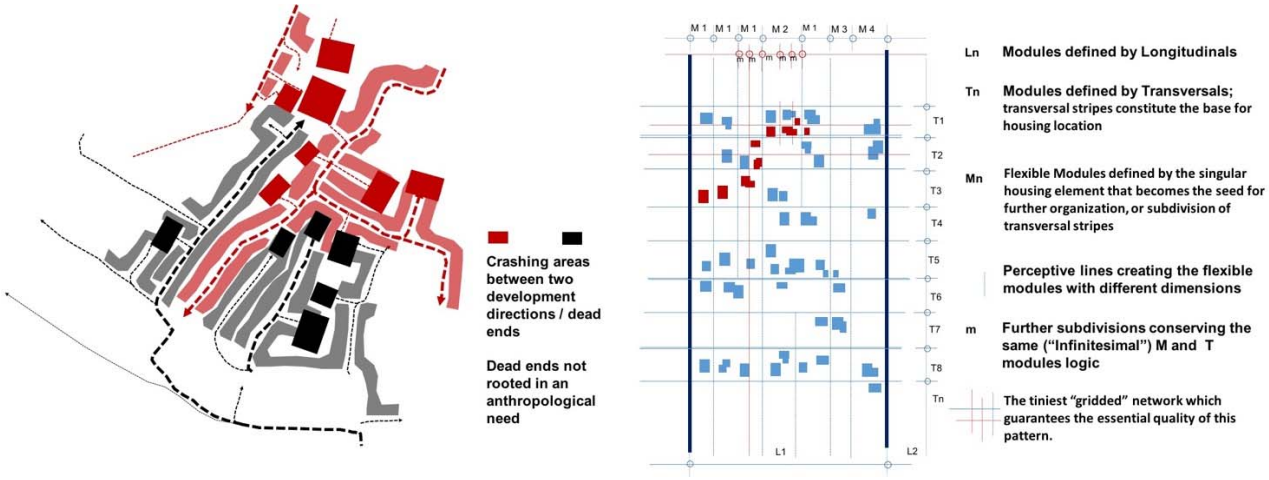
culture as already explained. In the Compressed New Organic, the motive is based on the need to increase the number of houses in a specific area in order to reach a critical mass within which “to hide”; In the Inflated New Organic, the motive is based on the dispersion of houses to the point of blurring, and getting “lost” from the sight.

Condensation of the observed phenomenon: Definitions

The essence of this pattern: The New Organic is an aggregation process during which individual houses grouped in the urban/rural space acquires a certain masse through densification or dispersion. This condition of isolating in periphery (to hide from authorities) create the quality of a space collapsed in itself (no anthropological principles) through the modality of compression; or the quality of an inflated space through the modality of floating nucleus or sparse houses in the rural space.

The challenge of a potential model that recreates the quality of collapsed or inflated, would be to activate a recursive process, that generates throughout the four levels of hierarchy the behavior of densification or dispersion, in order to fulfil the motive of amassing or isolation, through the modality of compressing (how to reach certain mas of density) or floating (how to reach certain mass of dispersion);

The aggregative or dispersive process should have in its base the quality of the elemental space: forced intimacy or infinitesimal distant superfluity.



4.86 Synthetic diagrams; The essence of the space **collapsed in itself**: crashed and a dead-end-ed space because of “blindness”, but not because of anthropological requirements. The essence of the **inflated space**: “infinitesimally” subdivided based on a logic reflecting the territorial model in a self-similar way.

4.2 Patterns multiverse: synthesis of the pattern analyses; Emergent qualities as potential generators for city design

The following table contains the compressed information from the previous section. Comparing the three patterns help to understand how different, but at the same time how similar they are. The summary presented in the following table highlights how the essential quality of the pattern is related to a motive that urges a specific behavior, which in its own put in motion a process that operates in the framework a specific modality. This essential quality is distributed through a hierarchic structure, which helps to understand the cascade of the process. The information from the table serves as a potential base for a modeling process.

Table 4.1 The emergent qualities as potential generators for city design

Patterns	**Historic Organic**	**Recording Over**	**New Organic**	
			Compressed	**Inflated**
"Nickname"	**Eden(s) within Eden/(s)**	**Interiorized emptiness**	**Amassed collision**	**Floating in superfluity**
Motive	**Right to visual <u>privacy</u>**	**<u>Re-appropriative</u> <u>Revenge</u> to public space**	**<u>Isolation</u>** and **amassing**	**<u>Isolation</u>** and **lowliness** (initially)
Preconditions deriving from the social and historic contexts (past-present) under which the space is created; the wave factor emitted from the event; Triggered by anthropologic principles; Final aim why a specific space is created	Concern for privacy based on tradition and ownership of groups affiliated by family relationships, clans, or ethnicity; settled in appropriate distance, in isolation and in privacy; Public space less important than private; aims enclosed and intimate private spaces by filtering contacts with the outside world.	Denied property rights; Self-renewing power of people to re-appropriate the "emptiness": urban environment sterilized from the social meaning and dried-up from identity; Weak public control; perceived consent of authorities; deregulated process and poor economic situation.	Denied freedom of movement; Massive segregation as a strategy to auto-protect; to create a social causa; to hide non-conformity with the law; Weak public control; perceived consent of authorities; Lack of legal and affordable alternatives.	Denied freedom of movement; Dispersion as auto-protection to avoid public attention; to hide non conformity with the law; Tradition of loneliness and isolation in space. Land reform; Unclear privatization of agricultural land; Weak public control and perceived consent;
Behavior	**<u>Introvert</u>**	**<u>Inward / stuck to frames</u>**	**<u>Densification</u>**	**<u>Dispersion</u>**
Behavior as an intrinsic property inspired by anthropologic principles, social and historic contexts (past-present); Behavior as the dynamics of the system-form,	An introvert behavior imported (interfered) by the ottoman culture: closing the space was more important than opening; Tendency to hide for privacy; Behavior sourced in a patriarchal enlarged family model;	An introvert behavior "forged" within the framing walls = inward; Corroded gradually the space from inside (later also from outside); "unnoticed"; "stealthily" behavior sourced in the uncertain and unclear environment, as well as in the disregard for	An invading or occupational behavior of massive groups, under the pressure of rapid urbanization, land speculation and the need to create a critical mass for auto-protection. Behavior sourced in the perceived social unjust and uncertain situation,	An occupational pattern stimulated by un-clarity of land reform; the anthropological principle of isolation and loneliness, and the need to perceive the house as an integral part of the territory; A behavior sourced in a rural model of life; perceived freedom and

(the invisible part); Important while replicating in a model; Interfering pattern imported in local-temporal reality; Horizon of anthropological principles translated in individual arrangements	It is a recursive concealing (avoiding the visual corridors) at all scales; Reinforces the neighborhood cohesion and long-term social intention coordinated in small based on informally recognized principles.	"public"; cultural shifts in the use of space; Freeing of movement from geometric order of "frames"; subdivision of space in many fragmented decisions coordinated in small; It is a filling-in and/or parasite-ing behavior; depends on relation with frames; functional and formal typology', the origin, etc.	not in anthropological principles; It is a mass compactness behavior driving to almost clashing conditions; Relationships coordinated in small; social formula on the use of space needs external help; Locational behavior guided by the course (pace) of preexisting territorial structures.	abundance about land and other life resources; It is a spreading and scattering behavior in relation to other houses and pre-existing rural layouts or service routes; The shared behavior concerning locational preferences and the land subdivision process, is influenced by the geometry of pre-existing territorial structures.
Process as mechanics	**Inward Organic aggregation**	**Osmosis through re-engraving**	**Pressurized Organic aggregation**	**Organic modular organization (house and territory as a unit)**
The way how elements come together, create gravitations and differentiate; grow and are put in motion by a specific behavior; Mechanics in relation to anthropologic principles;	Inward aggregation of affiliated groups settled in separated nuclei; and outward wrapping; Distancing at all scales "neither far, nor near" based on privacy requirements and recursive path refraction; No written rules exist, but there are principles regarding the use of space negotiated in small; Redefinitions are based on perceived consent and accepted social behavior.	Osmosis of recording elements with the space and the frames within which it occurs through Re-engraving; Relatively tensioned coexistence and transcription of predesigned elements; No rules or principles exist: it is driven by the needs of a family for living spaces or economic activities.	Organic aggregation of individual houses; social pressure to solve the housing problem; No distancing or settling rules or principles exist; however, rules are negotiated / coordinated in small based on precedents; group affinity or affiliations;	Isolation of house as focal point in the landscape, or particular kind of nearness; Distancing based on "infinitely" reducible self-similar unit-network. Units or modules reflect the same anthropological model: the relation of the house with the territory; Rules set by territorial specificity, not by coordination or negotiation. Further developments combine densification (multiplication) and intensification (adding more floors).
Modality	**Refraction**	**Wrapping**	**Compressing**	**Floating**
The way how the main motive is achieved; How the behavioral pattern is concretized in	Recursive deviation; Refraction of the straight line in order to isolate and avoid the "external" environment; fulfil the	Wrapping the space and / or the buildings from within or from without; Wrapping buildings through stuck-ing and / or carving with parasite-	Compressing / clashing houses and other activities through rapid densification; Densification as a behavior at the	Diffusion of houses and other activities in territory; The individual behavior of dispersion to fulfil the aim of isolation/

social normative based on information exchange, to achieve the motive; It is a recursive action; a kind of generator that applies on initiator (straight line, free space) to replace and scale it	aim to preserve the privacy and the independency from what is perceived the "outside world'; The individual introvert behavior is translated in the group behavior of refraction: reflected in dead-ends; (enclosure through scales starting from the personal space).	ing elements (tending to osmose); or wrapping the space within frames through inward implosion with fill-ins; The inward wrapping to re-appropriate at the individual level, becomes a group behavior of wrapping; fulfil the aim to re-appropriate the public space and the rigid frames.	individual level, as well as land speculation, translates in the group behavior of compressing in order to ally and create the critical mass to solve the housing problem.	loneliness, translates in the group behavior of floating and fusion-ing within the territorial superfluity. Fusion-ing means that the house and the surrounding territorial elements create a unit-system with similar characteristics through scales, from the garden to the open territory.
Essential quality	**Visceral**	**Involute**	**Collapsed in itself**	**Inflated**
Emergent quality of the local-temporal space aroused from a motive (event), behavior (interfering pattern), modality (information exchange): quantum whole The finer scale where the idea about the space translates in space, due to the combination of specific factors; Emergent quality embodies a set of regularities;	**Visceral** means an interiorized historic neighborhood (cluster or house) through an inward aggregation process aiming to hide in itself through the modality of refraction that isolate and wrap inwardly and outwardly; Results in intimate visceral nearness where privacy is created by closing and concealing; lower level paths serve only internally; private and public distinguished by perceptual borders; Interlocked and interdependent residential clusters; interlocked houses; Sourced by a homogeneous anthropological principle.	**Involute** means an intricate, often labyrinthine structure that osmose inwardly and organically with the preexisting buildings or pre-designed outer-related public space; A re-composed or decomposed public space; following curved or former organic lines; Interiorized public space occupied by parasites or fill-ins driven by personal interests; creation of a new meaning within the frames of "emptiness". More than a labyrinthine or cul-de-sac system, it is a disoriented or complicated communication system; It is a space saturated with inward tensions.	**Collapsed** means a critical mass, in clashing physical conditions, potentially producing social conflicts; stimulated to reach a critical mass, it starts by creating the condition of the neutral nearness that soon evolves to a forced intimacy (nearness), and to clash at the later stages; Space created under high pressure and unfriendly environment; Space becomes meaningless, distorted and deflated: dried from a clear anthropological factor and agreements; Characterized by random, rapid and forced aggregation to reach a certain mass.	**Inflated** means a group of scattered houses (low, or high density) floating, or even submerging in superfluity; Superfluity means that the house as the smallest element is part of an integral territorial system, made of self-similar units that follow the same anthropologic principle from the largest to the smallest scale (even the garden is a micro universe of "territorial" integrity groped around the house); At the smaller scale, it is a rationally inflated space through individual acts of keeping an "infinitesimal" distance that reflects the same geometry of the larger scale; Characterized by a relaxed unobserved environment and lack of interaction between groups.

Levels of hierarchy	System, S-System, Units of elemental space, Elements	System, S-System, Units of elemental space, Elements	System, S-System, Units of elemental space, Elements	System, S-System, Units of elemental space, Elements
Systems in which elements are repeated in a self-similar (affine) way from scale to scale; the system has its own structure and behavior which is important to understand in case of replicating in a model	City System: = the sample Sub-system: based on the way how houses and other elements are located in linear freeform stripes, along feeding paths within the neighborhood; Units of elemental space: legible configurations of composite family plots containing further and smaller subdivisions; Distinguishable physical layout, density or social structure; fed by the lower level paths within the area; Elements: include all components participating in the shaping of elemental space such as individual housing plots, houses, walls, trees, etc.	City System: = the sample Sub-system: based on the way how RO elements are grouped within legible configurations and how are stacked and attached to specific frames; Units of elemental space: units of elements with similar characteristics within subsystems. Grouped according to the typology of elements (parasites, fill-ins); or according to the origin of the RO element (resurrected, etc.); Elements: Parasite or Fill-ins, as well as all other surrounding elements contributing to confining and closing the space such as external walls, green walls, veins of internal communication, etc.	City System: = the sample Sub-system: based on the way houses and other elements are located along the pre-existing secondary paths and grouped in legible configurations: linear stripes, freeform meanders, or labyrinthine etc.; (linear meandering) Units of elemental space: aggregations of houses and other elements within sub-systems. Grouped in legible configurations based on distinguishable physical layout, density, social structure, or the stage of maturity, etc.; generated by tertiary communication system. (Segments) Elements: houses, streets, dead-ends, small squares, plots, fences, etc.	City System: = the sample Sub-system: based on the way houses and other elements are located along the pre-existing secondary paths (or rural infrastructure) and grouped in legible configurations: linear geometric stripes, freeform meanders, etc.; (Longitudinal Strips) Units of elemental space: units of houses and other elements within sub-systems. Grouped in legible configurations based on distinguishable physical layout, density or social structure, the stage of maturity, etc.; generated by the tertiary communication system. (Quads) Elements: houses, canals, streets, transversal plots, narrower stripes, rural elements, other agricultural activities, etc.
Recursive process	**Issues for further research**			
Recursion of the same behavior / modality at different scales; To build a fractal model which owns the essential qualities of a	Refraction and isolation that creates visceral space; Observe the detailed qualities of refraction and isolation. In the 5th chapter this idea is developed further in some more	The pace of stack and fill-ins along the inward and outward wrapping lines that creates the involute space; In the case of this pattern and the two following ones, the research is limited only	The pace and the nature of clashing physical conditions that drives to collapsing; which are different critical masses to reach the condition of collapsing in itself;	The regularities of the floating houses in self-similar inflated units; how self-similar superfluity is created; how the infinitesimal distance is applied through scales; etc.

pattern, we need to understand the recursive process	details; however it serves just as an initial example regarding the use of a model.	in the observation and analytical phase. It needs to be further developed by other researches.		

4.3 Conclusion based on the field research, analytical work and theoretical principles

This section synthesizes the specific qualities of the analyzed patterns and reflects on why and how the emergent qualities may be used as information to generate models that aim to explore an urban design more in tune with reality and the natural way people create their living environment. There is a vast literature and practice on how to give a voice to the people and about methods of citizen participation in urban planning and urban design. However, this is an alternative to the classic citizen participation, which often is prey to subjectivity, corrupted interests, and political manipulations. People can be important not only through their direct and physical participation, but also through understanding and enabling their interference patterns in a SST framework.

For this reason, it is important to re-focus again on the spatial structure at which base stays the individual behavior (rooted in anthropological principles) that creates the essential quality of the patterns. In this way we can match the specific quality of a spatial structure with the specific behavior, the motive underlying this behavior, and the modality how the specific space is created.

As explained in the previous chapters, I used the concept of the *fractal city* (Batty and Longley, 1994 pp. 42-44) to go deeper in our understanding of the form as *system structure*, organized in *subassemblies* with *hierarchy* and with *dynamic* behavior. Thus, understanding the internal *invisible* part of the form was vital to understand factors which influence the *external form*; This reasoning about the form as a system structure and the specific analyses carried for each pattern, contributed to find a better match between the *structure* of the form and the *behavior* underlying this form (patterns).

Based on these principles, I tried to demonstrate that the analyzed patterns manifest fractal properties. The *self-similarity* / *self-affinity* across structure is understood as organizing principle that implies a relative *symmetry*, *similarity* or *affinity* across scales and *recursion* (patterns inside of patterns). This organization which can be seen also as part of system's *complexity*, is the way how I investigated on the "*irregularity*" of the real city that repeats itself geometrically across many scales (Batty and Longley, 1994 pp. 43-44, 47, 58-60, 63). The system can be decomposed in *subassemblies* and expressed in algorithmic terms (or as a recipe), which in their turn can serve to create a model that is based in the real life with characteristics mentioned above. The way subassemblies aggregate (in subsystems, units, elements) and replicate the same form but at different *levels of hierarchy* (or at different scales), is also very important for the model. These levels of hierarchy that explain the idea of form as a system with structure correspond with a specific occupational structure and modality that explain specific behavioral habits, which in its own are triggered by a motive, as the ultimate aim at the base of a pattern.

On the other hand, the quantum city concept helped to reconnect material and non-material aspects. Pattern analyzes carried out under this research support the fact that shaping the space is not only a physical issue. We add *memory and meaning* to it, and in parallel we create the *cognitive space inside our mind*. Therefore, this process *involves the psychological and the physical shaping of our behavior* (Arida, 2002 pp. 158, 160-161). In the same way, the emergent qualities: visceral, involute, compressed or inflated, which resulted by analyzing not only the historic fabric, but also the existing ones, reflect also the cognitive space. These qualities condense the memory and meaning with which users saturate (impregnate) the space. In this concern, spatial identification helps to develop the idea of space as a shared experience among users. This shared experience transforms in a potential cognitive information load.

The city understood as a field of information helped to understand how the cognitive space becomes material space. Thus, the emergent qualities understood as cognitive space, translates in human motive that in its own underlies a specific behavior and the modality of "creation". Therefore, it is a two-way interaction: The *environment shapes us as much as it is shaped by us* (Arida, 2002 p. 160).

In addition, as we already mentioned, human user is a – *vessel for non-locality*; they carry the *memory* in the form of *information*, or as an idea, or culture. This means that the effect of an event may fall *beyond its spatial and temporal locale* (Arida, 2002 pp. 153-154). This is the way how the events (for example, the elemental space of a pattern transformed in cognitive space) emit waves and create new or different (similar, self-similar and self-affine) event horizons within the SST frame. Therefore, we may say that the identified emergent qualities and their related spatial structures, are resulting from interference patterns of the events and their event horizons in the current SST, with the wave factor emitted from the cognitive space acting as event from the past (within SST construct: beyond its spatial and temporal locale). The house space and the related activities, respectively understood as a dwelling event and event horizons, are a typical example in this concern. The dwelling behavior and the way we exist (historically: present / past / future) are powerful events that create the housing horizons in the way it is materialized (temporary physical borders).

That's why there are similarities and differences between the analyzed patterns. As we know, when two or more waves overlap, the interference wave is different from the parent wave. This conception, looking at the material and non-material aspects simultaneously helps to understand why the three analyzed patterns have some similar elements, but nevertheless transformed, while shifting / leaping from one reality to another.

Based on these principles, I tried to observe, analyze and understand the emergent quality of each pattern in a holistic approach: as interrelationships created within the SST web of wholeness (material and non-material aspects, physical or mental entity, transcending time space); and within a system structure with its levels of a hierarchy and complexity. These interrelationships will be explored more in the following chapter. Observing and analyzing the way people dwell, I tried to identify the limits (infinitesimal) where the physical and mental meet: considering the physical limit of a dwelling as the event horizon of a dwelling behavior (the event creating it); and considering the dwelling as the main event creating the specific patterning process.

Considering that *space is a field of information* we can ask some important questions. How "does it work" the space under such conception: why things are the way they are and what do they mean for those who created them? Can we become "smarter" if we first understand what does this mean for Tirana (or cities in general)? Meaning stored as a valuable and usable experience can help us to construct our cognitive space and shift from unconscious to conscious. This is the way how our brain transforms all this information in a continuous "exercise", builds up connections, stores it in memory (human or artificial), uses and re-uses it in similar cases; This is the way *how space makes us smarter* (Arida, 2002 p. 161).

In this principle is rooted the hypothesis of my research: I see the world not only as it physically appears, but also from the level of what I know about it. Throughout the thesis, I try to reframe the reality through "pushing" (storing) information from the field of unconscious to this of conscious; including things that do not look at first sight, or maybe appear completely different to us. Additional theoretical lens helped about this. The use of this information to attempt the creation of a model, morphologically generated by the emergent qualities, is an illustration of that: meaning stored in a model as a valuable, usable and shared experience. These qualities of the urban environment that are preserved up to date can help to correct the rigidity of the top-down principles and to create or design without compromising users' freedom. Let's remember here that despite many rules and regulations, people bypassed and followed their own rules based on a specific anthropological culture. From this point of view, the essential qualities of space can be considered as an indexing instrument or devise to "design" a city that specifically adapts to people's needs. This method helps to reinforce specific patterns and characters discovered through an analytical process, and most importantly pushes the city shaping process from the field of unconscious practice to the conscious knowledge.

This reasoning path urges for courageous experimentations and for testing an open framework of opportunities, where a strategy of myriad organic coordination and deregulations, even though rationalized, is not completely excluded like in the conventional planning and design. This is an alternative to the mono-block imposed building schemes which is typical for Tirana and many cities around the world. At this point some more challenges appear. Can we load information extracted from the reality to a potential model? This is the subject of the next chapter.

5. Specific realities and potential models for a better observation of the reality, or for urban design application

In the previous chapters I argued how to read, decompose and express the analyzed patterns through organizing them in a set of regularities, or informative principles. I also argued that the spatial structure of these patterns manifest fractal properties reflected in the repetition of irregularities (recursive self-similar-affine structure) across levels of hierarchies (Figures 4.20; 4.34; 4.48; 4.59; 4.76; 4.84). These repetitions represent a range of formal variations, but at the same time they manifest consistency in their formative and/or generative logic.

After "extracting", or "distilling" the essential qualities of the analyzed patterns, such as visceral, involute, collapsed, inflated (summarized in Table 4.1), we may potentially use these qualities and the regularities observed in each of them as informative agents for a model that embodies the principles and the morphological characters from that specific reality. With a model, which is a cognitive fact, we can make projections to understand how the type of bottom-up activities, often considered as irregular, might interfere with the city's ordinary and regulative design processes. However, some more analytical and survey work should be done to deeply understand additional details from that specific reality. This is done by further decomposing the set of regularities contained in the essential qualities of space. The following paragraphs contain more details about this process.

5.1 Modeling that reflects the specific urban phenomena; Main principles

Before going further, it is important to address here an important issue regarding the responsibility for defining an urban model; and the respective roles of the local society and the professional design team. As already mentioned, this kind of modeling process is deeply rooted in understanding of the reality and the specific urban phenomena. Principles of fractal city and quantum city are used as additional theoretical lens during the analytical phase to read the complexity of the real life and to create a model that reflects the morphological genesis and other specific qualities. In fact, a model that considers the anthropological factors and human behavior as the base of space hierarchy, may have repercussions in the conventional and bureaucratic planning by urging them to consider the human creativity.

In the reality "model", people unconsciously are part of a statistical model that we can express through a set of combinations of elements, which represent the most characteristic essence of a specific pattern (such as, Historic Organic, Recording Over and New Organic). However, "unconsciousness" in this case does not mean that people are not aware about how they create their site specific conditions. Their awareness is embodied in the "modality" according to which the social groups act. Modality in the sense of this research (presented also in Table 4.1) is understood as the way that the individual behavior, is transformed in a more complex societal group behavior, by exchanging information generated by a common motive. Therefore, the more complex behavior is a shared behavior, which often translates in a traditional awareness, or social normative. From this point of view, the decomposition of the recursive regularities in elements, as well as their description and measurement (presented in tables attached at the end of the 5th chapter) can lead to further understanding of the motive, behavior, mechanics of the process, and modality, as the underlying triggering factors that generate the essential

quality of space, which is at the base of the specific patterns; we can understand also how this information can be further used as inputs for the potential model.

In this concern, the summary presented in Table 4.1 at the end of the 4th chapter (for example, privacy through introvert refraction produces visceral nearness throughout the system; etc.), may help in the modeling process. As Batty and Longley (1994 p. 140) argue, *incorporating the application of the underlying process through recursion …, consistent with fractal structure* may lead to models applicable to different levels of spatial hierarchy. This logic that echoes the idea of type will be explained in the next section.

Analyzing and "decomposing" the essential quality of space in this logic, not only helps to better understand the human behavior, but also to create a good base for generating a massive variety of urban forms based on a similar logic. Thus, some main issues to be further investigated through the modeling process would be: which are a range of forms (beyond the observed ones) relative to the specific essential qualities of space (visceral, involute, collapsed, and inflated); which are the main features that characterize them; which are a number of informative parameters and their specific effect in relation to the essential qualities of space; etc. This can help to find the best fit with the behavioral model of a society, for example within the "visceral model" or "recorded over model", etc. At the same time, this helps to focus not only on how the city will look like, but most importantly, how would work and function under different urban conditions. In relation to that, a model can help to understand how it can be adapted to different needs, or how it can perform under continuously changing society-space-time construct considered as a continuum whole; by changing some of the factors, but without abandoning the qualities established by the principles or the DNA of the origin. Therefore, through experimentation we may explore the evolution of form starting from some *baseline* (Batty and Longley, 1994 p. 131) and observing the performance by modifying one or some of the formative factors.

Once we accepted that the pattern logic manifests fractal properties, we can define these properties in terms of a recipe indicating the steps and the process, containing the *initiators, generators and the cascade which forms the process of application* (Batty and Longley, 1994 p. 62). Based on this logic and the measurements presented in Table 5.6 (at the end of this chapter), we can identify a set of regularities that generate the essential qualities of space (visceral, involute, collapsed, and inflated) across scales, starting from the way the initiators (as a starting base) will be replaced and scaled applying the generators. For example: we may apply on the straight line considered in this case as an initiator, the refraction (a modality motivated by the right on visual privacy), or wrapping (a modality motivated by the re-appropriation of the public space), considered in this case as a generator that repeats itself at every scale. The generator can be expressed in ranges of parameters derived from the measurements (statistical calculations) presented in Table 5.6. We can also identify the process of application, or the recursion by defining the cascade of the generative process in accordance to the levels of hierarchy (four in the case of the analyzed patterns). As Batty and Longley argue*, the tree which defines* the *cascade is indicative of the generative process, which at each level replaces each part* of the initiator, *by further elaboration of* it … *at yet a finer scale* (1994 p. 62). In our specific case the recursion process will be stopped at that level that the motive generating this specific fractal model fulfills/satisfies the anthropological principle that motivated such kind of behavior: for example, the exterior space is "infinitely" filled-in and visceral-ized, and the interior space is fully privacy-sized (based on the right to visual privacy).

However, these principles are not merely used from the mathematical point of view, but to investigate the complexity of the organic city; to analyze, understand and conceptualize regularities (algorithms) through measurements; to look at the inter-relational structure of the pattern as a whole (Gleick, J. 1998), understand its internal properties, the hierarchic structure, and the recursions within this structure. Transferring this approach to the field of urban observations and analyzes, led to important and additional interpretations related to the quality of space. In this perspective, fractal geometry becomes an instrument (fractal model) for creating relationships between behavioral actions or arrangements at the finer scale, and their physical context: the spaces shaped according to the anthropological principles. These relationships are important inputs during the design process.

5.2 The recursion process and echoing with the idea of type

This logic echoes with the idea of type and the related theory about its relationship with the city and architecture as a formative principle. There is a renewed discourse on typologies focused on typological instruments, and the relationship between the typology and the urban plan as an alternative to the typical urban planning approach. As mentioned in chapter 3, these ideas that go in the direction of the city as an architecture project (Dogma and Series in AD, 2011) consider the role of typologies as a *pliable diagram* that inform the idea of the city and *serve as the elemental parts to the plan* (Lee and Jacoby in AD, 2011 p. 20). From this point of view, it is worth to remember here again some of the most important concepts related to typology. While for De Quincy A-C. Q. (1825) type was *something abstract and conceptual rather than concrete and literal*, almost in parallel with him, for Durand J-N-L type was *a model* reducible to *diagram* (AD, 2011 p. 19). For Rossi a particular type was associated with a form and a way of life. An interesting view on Rossi's typology was given by Eisenman (1984 p. 8). In the introduction of Rossi's book, he explains that typology is understood as a process, as the *effect of memory on type, which allows for new process of design*; As such, typology is seen as *animating force of design … a catalyst for invention*. The type / object transformed by memory *embodies both an idea of itself and a memory of a former self*. Instead, for Ungers' and his *rationalization of the existing* (Hertweck and Marot, 2013 pp. 26-27), architecture was a *penetration into a multilayered … reality*. The interventions are *typologies rationally inflected on the basis of logics and syntaxes abstracted from the existing situation* that provide the *underlying themes* for the proposals. He speaks about *formative principles that could be transferred to the present;* and about the *imagination … that makes it possible to extract from reality patterns … that can be in turn manipulated and transformed* (Hertweck and Marot, 2013 p. 37). Also for Castle in the editorial of AD (2011 p. 5), type *indicates a desire for syntax or underlying order*; it has the potential to be *both universal and local, providing architectural solutions to urban problems*; Lee and Jacoby (AD, 2011 pp. 17, 19) illustrate the possibility of utilizing the *notion of type in informing the idea of the city …* as an *essential catalyst for innovative design* (2011 p. 5). UN Studio (AD, 2011 p. 19) argues *how the utilization of design models can synthesize types with the complexities of … reality …* transform and hybridize to *fulfil the … requirements of an architectural project in an urban context*.

From this point of view, the work carried out under this research can also be considered as an attempt to inform the idea of the city with underlying themes rationalized (essential-ized) from the reality; a reality, which was observed, analyzed and understood from different theoretical

lens. The set of regularities identified from analyses and measurements, which in their turn are translated into generators, or formative principles, is similar with the idea of the type as a process. As Lee and Jacoby (AD, 2011 p. 19) argues, the concept of type since the beginnings varies from being an *abstract and conceptual* idea, to being a model *reducible to diagram*. Most importantly, the concept of type as a formative process is open as an innovative force of design.

5.3 Potential methodology to observe and measure patterns as complex behavior Towards a modeling process

5.3.a Measuring complexity

In the 3rd chapter I argued that the analyzed patterns represent a complex behavior because they meet the three criteria and properties set by Mitchell (2009 pp. 12-13); As mentioned in this chapter, they are *networks of individual components*; all happens on *signaling* and *information* exchange; and their behavior aims to increase the *chances of survival … through learning*. In addition, from the analyses presented so far we understood also that the environment of the analyzed patterns is highly characterized by the properties of the complex behavior. While trying to adapt to the changing situations, people produced a collective whole starting from basic simple rules, even though the "wholeness" is in continuous and precarious equilibriums. In order to see this more clearly, and better understand the statistical model in which people take part, in this chapter I present an effort to outline a procedure for measuring the pattern as a complex system. Here I tried to face the difficult issue of *measuring the complexity*. As Mitchell says (2009 pp. 13, 94-95, 111), measuring complexity still remains a challenge *because of many different interacting dimensions*. However, here I try to summarize from this author some of the main methods for measuring the complexity which are helpful for this research, such as *complexity as algorithmic information content, statistical complexity, and complexity as degree of hierarchy* (Mitchell, 2009 pp. 98-100, 102, 109-111). As already mentioned, the aim to undertake this step is that potential conclusions may be used to inform the design of a model.

As mentioned, it is difficult to include complex systems in a *single measurement scale* because of the many interacting dimensions (Mitchell, 2009 p. 111). For this reason, there are several methods for measuring complexity. Here are some of them:
Complexity as algorithmic information content, proposes that the *complexity of an object is the size of the shortest computer program that could generate a complete description of the object* (Kolmogorov, Chaitin, Solomonoff in Mitchell, 2009 p. 98). In this case, a string of information can be very simple with *low algorithmic information content* (ABABABAB), or totally *random* with *no discernible overall pattern to it* (ATCGGTACT). Other cases may present something in between, with correlations among different parts, or combinations with some randomness. Therefore, we can speak about *effective complexity* defined as the amount of information content of the string's set of regularities. For this reason, we first start by figuring out the description of the regularities and the way they combine with randomness. Gell-Mann (in Mitchell, 2009 p. 98) proposes that effective complexity assumes that *any given entity is composed of a combination of regularity and randomness*. Referring to the above example, the first string *has a very simple regularity* (ABABABAB), *predictable structure*, and a *low effective complexity*, instead the second string *has no regularities* (ATCGGTACT), therefore, *no information is needed to describe its regularities*. In this case, *while the algorithmic information*

content of the string itself is maximal …, the *effective complexity is zero*. Thus, v*ery ordered and very random entities have low effective complexity* (Mitchell, 2009 p. 99). These important concepts are used during the measuring and data elaborating process of the analyzed sample (tables 5.3; 5.4; 5.5; 5.6).

Statistical complexity (Crutchfield and Young in Mitchell, 2009 p. 102) *measures the minimum … information about the past behavior of a system that is needed to optimally predict the statistical behavior of the system in the future* through … *constructing a model of the system based on the observation of the messages the system produces*. The model is *statistically indistinguishable from the behavior of the system itself*. According to this method the system is thought as a "*message source*" *and its behavior is somehow quantified as discrete "messages"* (Shannon in Mitchell, 2009 p. 102). This model permits to *include random choices*, therefore, a model could be built also with the types of the second string (ATCGGTACT) (Mitchell, 2009 p. 102).

Complexity as degree of hierarchy implies that a complex system is "*composed of subsystems that, in turn, have their own subsystems, and so on*" (Simon in Mitchell, 2009 p. 109). Fractal self-similar patterns at all scales are an example. According to this method, *the most common attributes of complex systems are hierarchy and near-decomposibility*. The later implies that *there are many more … interactions within a subsystem than between systems* (Mitchell, 2009 pp. 109-110). Pattern analyses provide examples of the *near-decomposibility*. For example, there are more interactions between elements composing the units of elemental space than between the units itself. The frames of the recording over pattern are another typical example. Once built they cut-out portions of the city that could not organically (normally) interact with each other; at the same time, they were "sterilized" from within. After the system was opened they were recorded over: a thriving metabolism happened within.

5.3.b Steps: from essential quality of space to the set of regularities end other elements

In the following sections I try to illustrate the steps toward a modeling process: sample 1.3 from the Historic Organic Pattern is used as example. Most importantly, my intent is not the model per se (which can be subject for other researches), but the methodology towards a modeling process, starting from the observation techniques and the analytical process for identifying the emergent qualities, to the way these qualities can be translated in a set of regularities and informative principles. While observation lens and pattern analyses are presented in the three previous chapters, in the following sections and in the table below, is presented the process of decomposing the emergent qualities in a set of regularities as an important step to extract information. This information can be used in a design process which is deeply rooted in the specific reality of the city.

Table 5.1 Steps: from essential quality of space to the set of regularities end other elements

1. Define the **recursive** physical and behavioral **regularities** that characterize a range of forms relative to the visceral quality of space (deviation and / or isolation during the occupation process);
2. **Decompose** these regularities in specific **elements** that define those regularities (such as, lines, straight line refraction, straight line bifurcation, angles, rotation, etc.);
3. **Measure and register** those elements against **factors**, such as segmental length, the size of angles, direction of rotation, consistency of rotation, sequences and alternations, etc.;
4. Analyze the data and calculate **relative frequencies** of the directly measured factors; or the relative frequency of the indexes numbers;
5. Define **parameters** relative to the recursive deviation and / or isolation, indicated by ranges (expressing the quantified features of elements' regularities) as shown in the excel tables attached at the end of this chapter. These parameters are indicative for the recursive behavior of deviation and isolation, revealed as the main regularities/ characteristics producing visceral quality of space;
6. Write **strings of information** and define the set of regularities of the recursive behavioral processes, expressed in sequences and alternation of sequences of the observed phenomenon (table 5.3; 5.4; 5.5).

Both, point 5 and 6 are two different ways to inform the design process. Some of the factors can be better presented as stings of information, instead some others as parametric ranges.

Measurements are summarized and statistically elaborated in tables representing the quantification of regularities and / or specifics of the analyzed behaviors. Tables are attached at the end of this chapter.

Observations and measurements are organized according to levels of hierarchy in the system, or according to subassemblies within the analyzed patterns, in which elements are repeated in a similar (affine) way from scale to scale; therefore, the regularities are registered and reported according to those levels: system, sub-system, units and elements (defined since the analytical phase in the 4th chapter); (Figures 4.20; 4.34; 4.48; 4.59; 4.76; 4.84). From this process is identified the algorithmic information (shown further in this chapter) embodied in the visceral quality of space, as a number of steps and sequence of actions that involve repetition of some operations to be performed, and that serve as input for the model. Therefore, the parameters and/or the strings of information extracted from the observations, measurements, and statistical calculations of the analyzed patterns, define a system which behavior creates the "visceral quality of space". This is what the model can test and what will be illustrated in a very basic way in the last part of this research.

The system has its own behavior or dynamics, which understanding is important to generate and replicate the model (creating self-similarity / self-affinity across scales). In this sense, the "visceral" behavior is the dynamic of the system (or, of form as a system-structure), the invisible part that better explains the external form. As already mentioned, behavior as an intrinsic property is motivated by anthropologic principles which create the specific quality of space (visceral, recorded-over, compressed or inflated). In fact, the set of individual behaviors, that translate in modality, i.e. in social norms (because there is information exchange), help to achieve the main motive. As mentioned before, behavior, transformed in

modality creates the awareness at the societal group level. As such, it is a kind of generator that applies on initial elements.

Incorporating in a recursive logic the *application* of the above dynamics, as *underlying process* throughout the levels of hierarchy, consistent with fractal structure of the system-pattern may lead to a potential model (Batty, M. Longley, P. 1994 p. 140).

5.3.c Parameters and specific elements to be observed and measured (example sample 1.3)
Reminder. The urban condition relative to the visceral quality of space:
A continuous process of the straight line **deviation** motivated by the introvert behavior, that creates a specific elemental space as the logical output of a subdivision process aiming **isolation**, concealing and hiding from the outer space (Figure 5.1). This is visible in the recursive logic of refraction, bifurcation and isolation during the occupation process, which results in self-similar or self-affine visceral spaces across levels, starting from city to neighborhood and finer scales. Once the recursive regularities are identified (deviation and/or isolation), the next step is to decompose them in specific elements and factors to be measured.

Recursive regularity 1
Deviating in a recursive logic and specific elements that indicate this behavior (Figure 5.2):
There are some specific elements that indicate that kind of behavior to be observed and measured against factors as presented in the table below. This table is the base to formulate the excel tables where all the data is registered and calculated. More details about these elements and factors, including some clarifications for the refraction and or bifurcation from the straight line; the angles and the nature of rotation according to which the straight line deviates; the frequency and the alternation of such events; etc. are given in the following paragraphs of this section.

Table 5.2 Recursive regularity 1: elements and factors to be measured

Elements	**Factors**	**Measurements**
Nodes		
	Number of nodes along the line (**Nn**)	**Nn**: an absolute number of refractions (R) and bifurcations (B) nodes
		Nl: Index number of nodes per length
		Nlf: Relative frequency of Nl
Lines / segments		
	Straight line segmental length (**Ls**)	**Ls:** Directly measured distance
		Lsf: Relative frequency of Ls
		Lsi: Segmental Length index number
		Lsfi: Relative frequency of Lsi
Angles		
	Angle of refraction (**Ar**)	**Ar**: Directly measured angle
		Arf: Relative frequency of Ar
		Rrr: Resultant of Ar
	Rotation of refraction (**Rr**)	**Rr**: Clockwise (**+**) or counterclockwise (**-**)

		Crr: Consistency of refraction rotation (Rr) ratio (a number between 0 and 1)
	Angle of bifurcation (**Ab**)	**Ab**: Directly measured angle
		Abf: Relative frequency of Ab
	Rotation of bifurcation (**Rb**)	**Rb**: Clockwise (**+**); counterclockwise (**-**)
		Srb: Sequences of refractions (R) and bifurcations (B)
		Arbr: Alternation of refraction (Rr) and bifurcations (Rb) rotations; Node's charge
Width		
	Width of the street (**W**)	
		Wf – relative frequency of width
		Wfi – Width variation

Recursive regularity 2

Occupational logic of isolation and specific elements that indicate this behavior:

There are some specific elements and factors (Figures 5.6-5.9) that indicate this kind of behavior such as, the locational logic of the initial settling points (located along the oldest and lower level access streets); the distancing of these initial points from each other and from the main access roads; the way the nuclei expand and keep relative distances; the creation of interstitials and or unreachable cores; etc. Below is presented an indicative list of elements and factors for this kind of behavior to be observed and measured. However, while for the first case related to the deviation logic, the observation and calculation process is brought up to the end, in this case the process is limited to the description of some definitions and measurement principles. However, the excel tables used for the recursive regularity 1, can be used as a reference also in this case. As mentioned, the objective of this research is more about the methodology rather than the model per se.

Recursive regularity 2:

Elements:

1. Initial settling points / units;
2. interstitials and or unreachable cores

Factors to be measured:

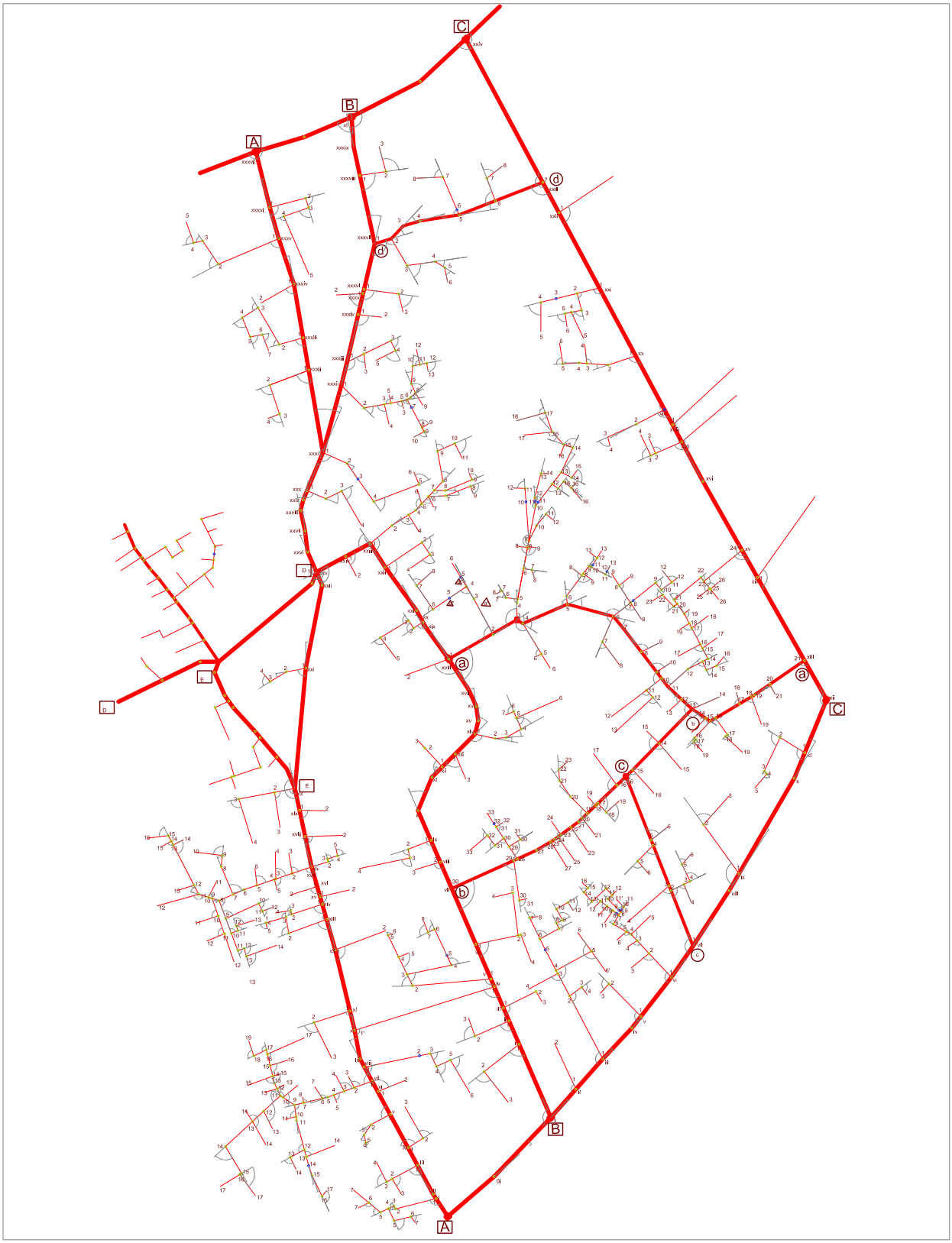
1. Chronology (**Ch**)
2. Nuclei Distance (**Dn**)
3. Nuclei Area (**An**)
4. Distance of the nuclei from the street (**Ds**)
5. Distance between the perimeters of the nuclei (**Dp**)
6. Built area ratio (**Br**)

More details related to these indicators are explained in the following pages.

These measurements satisfy only the three first levels of hierarchy. If we want to understand the way this patterning model is embodied in the finest level of hierarchy (the fourth: elements

within the units of elemental space), we need to undertake measurements at this scale, such as the single house, borders, main doors, windows, elements of greenery, etc. and then observe their correlational geometries within the units of elemental space. This means to observe positioning and distancing of the external walls and the main entrance from the street, from the main door in the house or from the windows, and from the house itself; how the main door and windows are opened in relation to the main access from the public street (the deviating factor in a smaller scale); positioning of the windows in relation to the main semi private area of the house; any other filters that conceal and create privacy from external to internal; and how people close the space in the finer scale up to the total enclosure, etc.; However, this research is limited to observations and measurements at the urban scale, which covers only the three first levels of hierarchy.

5.1 Recursive deviation, limited accessibility and isolation, 1921, 1937, 2005



5.2 Sample 1.3: the base for observation and measurement of elements and factors that indicate / define the recursive regularity 1

Recursive regularity 1*:* Deviating in a recursive logic

General information

In the following paragraphs I give some general information about measurements and the way they are presented in this section and in the attached excel tables.

Absolute and relative values
The measurements of segments, angles, number of nodes, or other elements, are presented in two ways, both in their absolute and relative values. In order to have a better idea about the variation of some range values, between the minimal and maximal absolute values of a factor (for example, segmental lengths, or angles, etc.), the relative frequencies based on same ranges as shown below are calculated.

Ranges
The ranges used for distribution of values in the case of segmental length (Ls), measured in meters, are the following: 1-20; 20-40; 40-60; 60-80; 80-100; 100-150; 150-200; etc. The ranges used for distribution of values in the case of refraction and bifurcation angles (Ar, and Ab), are the following: 1-10; 10-30; 30-60; 60-90; 90-120; 120-150; 150-180; Other ranges used for calculations are presented in the excel table.

Relative frequencies
After calculating the relative frequencies of segmental length, or of any other element, according to these ranges, we can analyze their distribution according to the hierarchy level of lines and make some conclusions regarding their use. As we mentioned, people unconsciously are part of a statistical model. Let us remember here s*tatistical complexity* (Mitchell, 2009 p. 102) and how a model can be produced *based on the observation of the messages* of the system.

Strings of information
Some other data, which are mostly regarding the sequence of events are registered as strings of information. For example, the Rotation of refraction (Rr) and Rotation of bifurcation (Rb) marked by the clockwise or counterclockwise directions + or -; the Sequence of refraction and bifurcation (Srb) which give an idea about the complexity of the node; the Alternation of refraction and bifurcation rotations, or the node charge (Arbr). Once we have these strings, the set of regularities can be depicted ad analyzed in relation to other elements and their relative frequencies. The strings of information are similar with what is explained in *complexity as algorithmic information content* (Mitchell, 2009 p. 98-99).

Index numbers
Some other data are given by an index number resulting from the ratio between different measurements. For example, the Nl: Nodes per length index, results from the ratio between the total length of the line and the total number of nodes along the same line: It shows the average distance between nodes according to each level of hierarchy; the Crr: Consistency of refraction rotation ratio, results from the ratio between the number of clockwise and counterclockwise directions: It shows the behavior of the line in relation with the quality of concealing; or Lsfi:

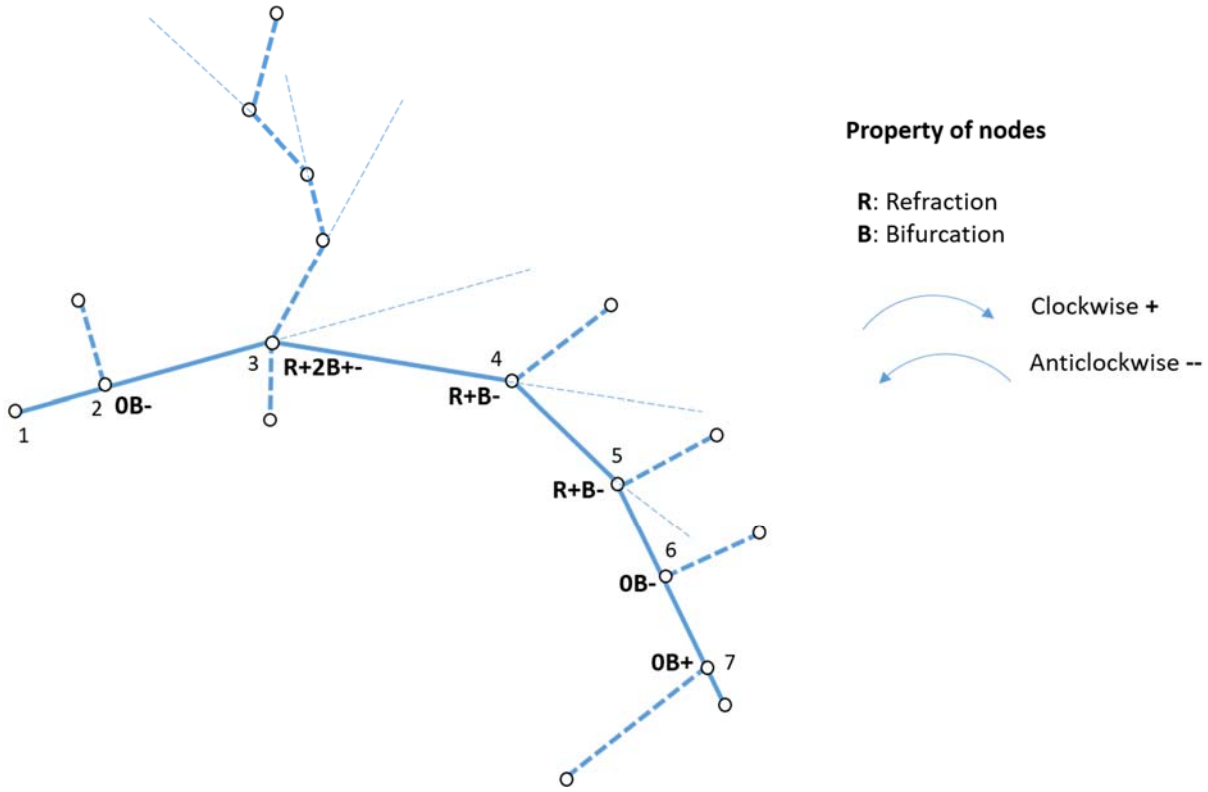
Index number of segmental length, results from the ratio between the length of two consecutive segments: It is a kind of generator applied on initiator.

Levels of hierarchy define the cascade of the process.

Nodes (Figure 5.3)
in the context of this research, Nodes are created by a refraction: a deviation from the straight line perspective; and/or a bifurcation: a point where a new line starts. The new line extends refracting or bifurcating independently from the line where it started.

Property of Nodes
Nodes can be simple or complex. Nodes are simple when they contain only one event such as refraction or bifurcation (nominated by R or B); Nodes are complex in cases they contain a combination of more than one event such as refraction and one or more bifurcations (nominated by R nB where n is the number of bifurcations).
Nodes along the line are nominated with the identification numbers: 1, 2, 3, 4, n. For each of the bifurcated branches numbering starts from the number of the bifurcation node.

Identification of Nodes
A node contains the identification number (1, 2, 3, n); the event that create the node marked by R and/or nB; rotation direction marked by "+" or "-" for simple nodes, or with more than one sign for complex nodes. Pluses or minuses depend on the clockwise or counterclockwise rotation of the events containing the node.



5.3 Nodes: identification and properties

*1.1 **Ls**: Straight line segmental length; **Lsf**: Relative frequency of segmental lengths; and **Lsfi**: Relative frequency of segmental length index numbers*

Segmental length (**Ls**) is measured by the distance between two consecutive nods of refraction along the same line (road). Measurements are done separately for each line according to the level of hierarchy, from the primary roads that limit the sample, to the lower levels, as presented in the Table 5.6 and Figure 5.2. The conclusion from the measurements are the following:

The higher the level of hierarchy of lines, the lower the relative frequency of the ranges with shortest segmental length (Ls range between 1 to 20m), in comparison with other lines belonging to lower levels of hierarchy in the same sample. For example, Ls range between 1-20m constitute 35 % of segmental lengths in the higher level lines (excel tables marked with grey color); instead the frequency of the same range increases to 71%, and 91 % at the lower levels of hierarchy (excel tables marked with green and blue colors); However, the same trend is not reflected only in the second higher level lines in hierarchy (marked with yellow), where the frequency of the range with the shortest Ls remains approximately the same with this at the highest level lines, 32%; For all measurements and figures refer to Table 5.6

The range of Ls from minimal to maximal absolute values, within the same level of hierarchy varies as follows, for primaries: 223 ≥ Ls ≥ 6.5; for secondaries: 98 ≥ Ls ≥ 11.5; for tertiaries: 82 ≥ Ls ≥ 1.5; for the fourth: 45 ≥ Ls ≥ 1.6. As we can notice, the maximal value of segmental lengths is reduced starting from the highest level of hierarchy to the lowest ones (Ls starts from 223m in the highest level of hierarchy and decreases to 98m, 82m, and 45m in the lower ones; Here is excluded the length of 334m in one of the primaries and also the lower of 24m as outliers).

Instead, if we compare the distribution of ranges within the same hierarchy level, we notice that in each of the levels, the range of Ls between 1-20m occupies the main weight in relation to all other ranges. It varies from 32% and 35% in the two higher levels, to 91% in the lower level (marked with blue in the excel tables); if we increase the values of Ls range from 1-40m, in this case the range becomes an absolute majority: starting from 64% in the grey lines, remaining in the same value of 64% in the next level, and significantly increasing to 96% and 99% in the two lower levels. The range of Ls from 40-60m is almost stable in the two first levels of hierarchy: It various from 21% to 26% in the two first levels, and significantly decreases in the two next levels in 3% and 1%. The weight of the Ls segments in the range starting from 60m to 100m is almost insignificant. The above numbers and results are fully understandable because we are analyzing here things at a neighborhood scale, and in general in a small scale of development. It makes a lot of sense that the main weight of dimensions here referee to the range of distances between 1 to 20m. In fact, this is the length that can better guarantee the required concealing for privacy needs.

In the excel tables is calculated also the relative frequency of the index numbers (Lsfi) resulting from the ratio between the length of two consecutive segments (Lsi); for this, first is calculated the Lsi as the ratio of segments 1-2/2-3; 2-3/3-4; etc. Then similarly with the previous cases, is calculated the relative frequency (Lsfi) of these indexes based on ranges. The application of typical (most frequent) indexes as a generator on the initiator (the most frequent ranges of Ls used as initiators), can guide the extension of the segments along the same line.

For more details, refer to the excel Table 5.6 and the summary sheets.

1.2 ***Nn****: Number of nodes along the lines;* ***Nl****: Index number of nodes per length*

The number of nodes (Nn) is measured by the number of refractions, and or bifurcations located along the same line. This is represented by an absolute number such as 5, 7, etc.

The Index number of nodes per length (Nl) is measured by the ratio between the length of the line (L, the total length: from the initial point to the intersection with another line, or to the end of the line), and the number of nodes (Nn, refractions and or bifurcation located along the same line). Nl= L/Nn; Example: L = 30m; Nn = 10; Nl = 30m/10 = 3m/node; If the number of nodes would be 5, Nl = 6m/node

Nn and Nl are measured for all the levels of hierarchy

From the measurements we notice that the higher the level of hierarchy of lines, the higher the number of nodes (Nn) per line. For example, in the highest level of hierarchy the number of nodes ranges from 12-39; in the second level from 6-20 and in the next two levels from 2-15 and from 2-8 nodes; we can notice then that the lower number of nodes starting from the highest level of hierarchy to the lowest ones is 12, 6, 2 and 2.

In relation to that, from the excel tables we can notice also that lines with 2 to 3 nodes constitute 65% of the lowest level lines (in the excel tables marked with blue) and 46% of the third level lines. This is understandable, because these lines distribute to a more private, or almost private atmosphere (serve to a reduced number of houses). Instead lines with such number of nodes do not exist in the two upper levels of hierarchy; they start from 6 nodes, and 12 nodes. This is also understandable, because they are public or semi-public lines and their main role is to create the passage to higher levels of privacy.

From the tables can be noticed also that the Nl average is higher in the highest levels of hierarchy. Starting from 29.2m at the first level, it reduces to 18m, 15m and 10m at the lower levels. These figures are quite understandable. Nl at the highest level should guarantee the location of groups of houses (subsystems) and / or units along them, which means that a distance from 30 to 20 m between nodes is need for the location of a group with at least two to three houses with garden in the first contact with this line; Instead, for the lower levels, the Nl coincides with the measures of a single house with garden, or even a usable vain and the space for a connecting path. In this case the potential to hide and to create visceral space is higher. However, the visceral space depends also on other factors that will be presented further, such as the rotation angle and the direction of rotation.
As we can see, the analyses of the measurements so far are quite coherent with the analyses and observations presented in the previous chapter.

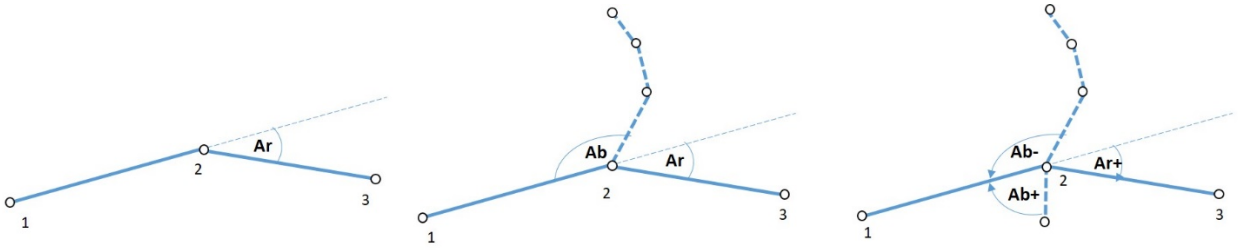
1.3 Ar: Angle of refraction: Ab: Angle of bifurcation

The Angle of refraction (Ar) is measured by the angle of deviation from the straight line of the segment, at the nodal point where this deviation starts (Figure 5.4).

The Angle of bifurcation (Ab) is measured by the angle created at the nodal point between the bifurcated segment and the line from where the bifurcation starts.

As already explained, nodes can be simple (case 1, Figure 5.4 below), or complex, (case 2, Figure 5.4), and still even more complex when bifurcation can happen in more than one direction (case

3, Figure 5.4). In each of these cases, as shown in the scheme we can measure the refraction and / or the bifurcation angles. As explained, the angles of refraction and / or bifurcations are distinguished by the rotation direction: positive "+" if it is clockwise; and negative "-" if it is counterclockwise. The schemes below illustrate these cases.



Node 2, case 1
only refraction
Ar measured by the angle of deviation from the straight line extension of the segment at the point where deviation starts

Node 2, case 2
refraction and bifurcation
Ab is measured by the angle created between the first bifurcated segment and the line from where the bifurcation starts.

Node 2, case 3
refraction and bifurcation in two directions
the angle of bifurcation will be distinguished by the rotation direction: positive "+" if it is clockwise and negative "-", if it is anticlockwise.

5.4 Nodes; Ar: Angle of refraction: Ab: Angle of bifurcation

From the measurements we can study the variation of Ar from minimal to maximal absolute values, within the same level of hierarchy. For primaries, 94 ≥ Ar ≥ 1; secondary 66 ≥ Ar ≥ 2; tertiaries 109 ≥ Ar ≥ 3; and the lower level 116 ≥ Ar ≥ 6; As we can notice, the maximal values of Ar are higher for the lower levels, and the same is true also for the minimal values.

However, these values represent the extreme margins. In order to have a more detailed information about how some ranges (presented at the beginning of this section and in the excel tables) are distributed between the extreme values presented above, we may calculate the relative frequency of Ar for these ranges (Arf). This is a similar process with what I described in the case of Ls. Related to that, from the measurements of Ar presented in the excel table and their grouping in ranges, we notice that the highest the levels of hierarchy the higher the relative frequency of the smaller angles of refraction. For example, in the first level of hierarchy the range between 1-10 degrees occupies 68%, which is the main weight in relation to all other ranges; it decreases to 53% in the second level, and significantly decreases for the next to lower levels, in 6% and 7 % (in the excel tables marked with blue and green colors). The opposite is true for the two lower levels of hierarchy, where the range of Ar between 60-90 degrees constitutes respectively 50% and 45% of the total weight of ranges. These results make a lot of sense, because the higher levels of hierarchies, as we know are the more public streets, which means they can be "nearer" to the straight line perspective. The opposite is true for the lower levels of hierarchy where higher values of Ar guarantee more privacy (almost full deviation, nearer to 90 degrees).

In a similar way, we can study the variation of angles of bifurcation (Ab), from minimal to maximal absolute values within the same level of hierarchy. They vary as follows: for primaries, 173 ≥ Ab ≥ 44; secondary, 155 ≥ Ab ≥ 74; tertiaries, 165 ≥ Ab ≥ 54; and the lower level, 104 ≥ Ab

≥ 11; As we can notice, the maximal values of Ab are higher for the higher levels of hierarchy; Instead, there is no distinguishable variation pattern for the minimal values.

From the measurements of the bifurcation angles (Ab), we notice that the highest relative frequency of angles of bifurcation, for all hierarchy levels is within the range of 60 to 90 degrees and 90 to 120 degrees. Starting from the highest to the lowest level of hierarchy, the weights of frequencies for the respective ranges (60-90 and 90-120) are as follow: 41% and 48%; 57% and 34%; 48% and 44%; 44% and 50%. From this figures we understand that the role of bifurcation is to maximize the concealing. The fact that the highest relative frequency of angles of bifurcation falls within the range between 60-120 degrees means that the deviation from the straight line is almost maximal.

*1.4 Rotation direction: **Rr** – Rotation of refraction; **Rb** – Rotation of bifurcation; **Crr** - Consistency of refraction rotation (ratio); **Rrr** – Resultant of the refraction rotation; **Srb** Sequence of refraction and bifurcation; **Arbr** alternation of refraction and bifurcation rotation;*

Rr, rotation of refraction and **Rb**, rotation of bifurcation is observed at the nodal points located along the communication lines; It defines the direction of rotation in relation to that line by taking the values "+" or "-" depending on the clockwise or counterclockwise rotation (Figure 5.5). Rotation is an additional information to the measurement of angles presented in the previous paragraphs. In the excel table, Rr and Rb are presented as strings of information which serve to be inserted in the Arbr string of information. The later can be interpreted as alternation of the sets of regularities.

Crr, Consistency of refraction rotation index – is measured by the ratio between the number of clockwise and counterclockwise rotations along the same line of movement (the same level of hierarchy). The division starts from the smaller number. Bifurcations are not counted as change of direction, because bifurcation starts a new line of movement at a lower hierarchy level.

Crr can be a number equal to 0; equal to 1; or between 0 and 1; but never bigger than 1.

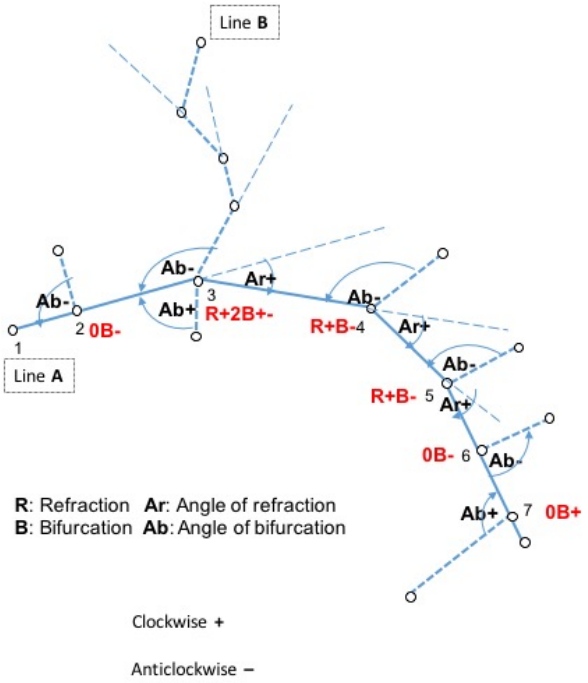
Examples:
1. In the case of figure 5.5, for the main line: Crr = 0 (0/3 = 0). If Crr = 0 or near to 0, means that all, or most of the rotations have the same direction tending to a closing circle; potentials of a line like this to create concealing conditions are higher.

2. If Crr = 1 or near to 1, the directions of rotations are balanced and the line tends to be a symmetric sinuous; potentials for privacy are also balanced. Concealing conditions along the same line are higher in case of combination of simple nodes with a higher number of complex nodes. In these cases, the refraction effect of deviation is maximized by bifurcation effect of "full" concealing.

The nearer to 0 the Crr is, the more asymmetric sinuous the line tend to be; potentials to conceal and to create visceral space tend to be more similar to the first case. The nearer to 1 the Crr is, the more symmetric sinuous the line tend to be; potentials to conceal and to create

visceral space tend to be more similar to the second case. However, potentials to create visceral space depend also on the combination with other parameters presented in this section.

In conclusion, consistency of refraction rotation index Crr, shows that the movement of a communication line can be typified in three main categories: 1. tending to a **closing circle**; 2. tending to a symmetric **sinuous**; 3. tending to be an **asymmetric sinuous** which can be closer to a circle or to a regular sinuous, depending on the value of Crr.



Rr – Rotation of refraction and **Rb – Rotation of bifurcation** are measured along the lines; marked by "+" or "–" depending on the clockwise or anticlockwise rotation.

Crr – Consistency of refraction rotation

Line **A**
Crr = 0/3 = 0
All senses of rotations have the same direction tending to a closing circle

Line **B**
Crr = 2/2 = 1
Directions of rotations are balanced and the line tends to be a symmetric sinuous

Rrr – Resultant of refraction rotation – is measured by the sum of angles of refraction along the same line. Shows the consistency of rotation.

Srb – Sequence of refraction and bifurcation: expressed by typicality of alternation along the line;
Information string: 0B, R2B, RB, RB, 0B, 0B

Arbr – Alternation of refraction and bifurcation rotation directions : expressed by typicality of alternations (regularities) along the line;
Information string: -; ++-; +-; +-; -;+

5.5 Rotation and the related parameters

Another way to observe the consistency of rotation is the resultant of refraction rotation (**Rrr)**, which is measured by the sum of the angles of refraction at the nodes along the same line. In a similar way with Crr, Rrr shows also the consistency of rotation. The higher the value of the sum the higher the potential to create concealing conditions (similar with the case when Crr=0).

Arbr alternation of refraction and bifurcation rotation directions. This is an information written about the rotation directions of the nodes along the same line. After registering all the information about rotation directions in strings for each line (example: +, +-+, +-, +-), we can depict typicality of alternations (regularities) along the line that can be written in the form of string sequences for each line and /or for a group of lines with the same number of nodes. Let us remember here *complexity as algorithmic information content* (Mitchell, 2009 pp. 98-99) and that any string representing a line can be composed from a combination of regularities and randomness.

In the case of the analyzed sample, this phenomenon has been observed by writing strings containing the information on the direction of rotations, and then reading and depicting the repetitions as potential regularities with certain frequency. As shown in the excel table (sheet:

Rotations), the way how we can see the regularities of Arbr is subject to the number of nodes. Up to a certain number of nodes it is still possible to depict regularities for the entire string, and designate types of the line, beyond this number we can depict only sequences of regularities and also the way they combine within the string. From the observations, it was noticed that up to the four-nod lines it is still possible to see regularities and the rotation behavior for the full line length, and the relative frequencies can also be calculated for this kind of regularities. For example, for the two node-lines (the shortest lines) in the analyzed sample, 58% of nodes are antilock wise rotation; 32% clockwise; and 11% contain both directions at the same node. For the three-nod lines 35% of them contain the same combination of "- +"; 27% the combination of "+ - "; 19% "- - "; and another 19% "+ +" (Table 5.3).

2 Nodes														
	Lines													
Type of line 1												**58%**	11 -	Type 1
	-	-	-	-	-	-	-	0 -	0 -	0 -	0 -	**32%**	6 +	Type 2
Type of line 2												**11%**	2 +-	Type 3
	+	+	+	+	+	+								
Type of line 3														
	+-	0 +-										**100%**	19 Tot	
3 Nodes														
	Lines													
Type of line 1	+	+	+	+	+	+	+							
	-	-	-	-	-	-	-							
Type of line 2	-	- 0	-	-	-									
	- 0	-	-	-	-									
												35%	9 - +	Type 3
Type of line 3	0 -	0 -	-	-	-	-	-	-	-			**27%**	7 + -	Type 1
	+	+	+	+	+	+	+	+	+			**19%**	5 - -	Type 2
												19%	5 + +	Type 4
Type of line 4	0 +	+	+	+	+									
	+	+	+	+	+									
												100%	26 Tot	

Table 5.3 Example of strings with 2 and 3 nodes (types of lines are settled horizontally; instead strings of specific lines vertically)

Starting from the five-nod lines, the regularities can be seen in the relative frequencies of the most repeated sequences in the strings with the same number of nodes, or within the defined ranges of nodes. Even in this case, depending on the repetition and their combination we can speak about different typologies of lines. Lines containing combinations of longer sequences[12] and lines containing combinations of shorter sequences. This is typical for long string lines. In these cases, after depicting the regular sequences, it is important to observe the irregularities and to see how the regularities are settled and combined with irregularities in the string, and if some rhythms are created between regularities and irregularities.

For example, in the 12-node lines observed in the analyzed sample we can speak only about the relative frequency of the sequences and their combination (Table 5.4). For example, 36% of the strings are made by the identical repetition of the (long) sequence "- + - + +-" in each string (option 1); another 18% is made from the repetition of at least one sequence of "- +". The

[12] Longer sequences are considered these kind of sequences containing more than two signs; shorter sequences are considered the sequences composed by two signs;

remaining 45% is “irregular”. In the table below is given also a second option how regularities can be depicted also on the base of the repetition of the “-+” sequence.

12 Nodes											
sequence: - + - + +-		option 1		**sequence: -+**		optoin 2					
-	-			-	-						first option
+	+			+	+				**36%**	8	Each string contain an equal sequence "- + - + +- "
-	-			-	-						
+-	+			+-	+						
+-	+-			+-	+-						Each string contain a triple plus sequence "+ + +"
-	+			-	+						
+-	-			+-	-						
+	-			+	-						
+	-			+	-				**18%**	4	In the remaining, each string contain at least
-	+			-	+			sequence	**55%**		one "- +" sequences
+	-			+	-						
	-				-			iregular	45%	22	

Table 5.4 Example of strings with 12 nodes; sequence of regularities and their combination with irregularities in two options (strings of information for specific lines are settled vertically; sequences of regularities are highlighted in grey)

In the 14-15-node lines (Table 5.5) of the analyzed sample, 56% of the total strings is made by the "- +" sequences (option 3) and the remaining 44 % is “irregular”. In the table below are given also two other options of regularities, based on the repetition of the “++-+” and ++- sequences (option 1); and “+-+” sequence (option 2).

14-15 Nodes															
Sequences: "+ + - +"; "+ + -"			option 1	**sequences "+ - +"**			option 2	**sequence "- +"**			optoin 3				
+	+	-	+	+	+	-	+	+	+	-	+				
+	+	-	-	+	+	-	-	+	+	-	-				
-	-	+-	+	-	-	+-	+	-	-	+-	+				
+	+	-	-	+	+	-	-	+	+	-	-				
-	+	+	+	-	+	+	+	-	+	+	+	option 3	in three variants		
+	+	-	--	+	+	-	--	+	+	-	--	**56%**	30 sequences "- +"		
+-	+-	+0	+- 0	+-	+-	+0	+- 0	+-	+-	+0	+- 0	44%	24 the rest		
-	+	-	+	-	+	-	+	-	+	-	+	**33%**	18 sequences "+ +"		
+	+-	-	--	+	+-	-	--	+	+-	-	--		36 the rest		
+-	-	-	-	+-	-	-	-	+-	-	-	-	**15%**	8 complex nodes "+-"		
-	+-	+	+	-	+-	+	+	-	+-	+	+				
+	-	+	+-	+	-	+	+-	+	-	+	+-		46 diferent		
-	-	-	-	-	-	-	-	-	-	-	-				
+	-			+	-			+	-						
													54 nodes		

Table 5.5 Example of strings with 14-15 nodes; sequence of regularities and their combination with irregularities in three options (strings of information for specific lines are settled vertically; sequences of regularities are highlighted in grey, or marked with different borders)

Srb Sequence of refraction and bifurcation: this is an information written about the alternation of sequences of refractions and/or bifurcations nodes along the same line. Similarly with Arbr, once we have the strings of information for each line according to the number of nodes, we can analyze them to depict the typicality of alternations (regularities) along the lines, that can be expressed by string sequences for each line and /or for a group of lines with the same number of

nodes. For example, the information string of Srb for Line A in Figure 5.5 is: 0B, R2B, RB, RB, 0B, 0B. The excel tables contain also all information strings for the analyzed sample. Similar observations and conclusions, like in the case of Arbr, can be elaborated here also.

1.5 **W** - Width of the street; **Wf** – relative frequency of width; **Wfi** – Width variation

As we noticed from the field survey, the width of the street in an organic neighborhood varies differently from the way it varies in other parts of the city. In the organic neighborhoods the width changes in small segments and is subject to different criteria such as, topographic variations, time of construction, people living adjacent to that street, etc. For that reason, the width of the street should be measured for each segment between two consecutive nodes. For example, W1-2, W2-3, W3-4, etc. Based on these measurements we can identify the relative frequency of width (Wf) expressed in % for each level of hierarchy. However, these measurements are not included in the excel tables, due to the secondary role this factor plays in the formation of the neighborhood.

The information presented in this section serves to program and better refine the behavior of the lines in a model. As we saw, the identification of parameters, or ranges of parameters, starts from assigning to each node the properties that can be directly measured (such as, angle of refraction and angle of bifurcation, rotation of refraction and rotation of bifurcation, etc.), (Figure 5.2), then registering those data in the Table 5.6 and calculating frequencies, index numbers, or other statistical functions according to definitions and indications given in the previous paragraphs.

Recursive regularity 2*:* Occupational logic of isolation, the creation of interstitials; and specific elements that indicate this behavior

While in the previous section, I tried to describe the set of recursive behaviors related to deviating the straight line perspectives, and presented a methodology for their measurements; in this section I describe the set of behaviors related to occupational logic during the settling process, and propose a potential methodology for their measurements. In this respect, two are the main elements to be further observed and decomposed in factors: first, positioning of the Initial settling points / units within the space of the future neighborhood, based on the 'neither far nor near' logic of avoidance; and second, the creation of interstitials and or unreachable cores (Figure 5.6). This reasoning derives from the detailed pattern analyses carried out in the 4th chapter. At the same time, as mentioned at the beginning of this section, these two elements should be measured against some factors as described in the following paragraphs.

Definition of Nuclei

As already explained, nuclei are groups, or clusters of houses formed on the bases of one or more clans, tribes, or big families settled within the space of the future neighborhood. The process of groups' creation, determines the modalities of further settling process. According to hierarchy levels I described in the 4th chapter, while the entire neighborhood (the sample) corresponds to the first level, nuclei correspond to the second level of hierarchy or sub-system level (Figures 4.44; 4.48). Within nuclei are contained the units of elemental space belonging to the third level of hierarchy, which consist in composite family plots containing smaller and

minute subdivisions; and the elements which belong to the fourth level of hierarchy and include all components participating in the shaping of individual housing plots, houses itself, and other elements such as, walls, trees, etc. In the following diagrams, nuclei are nominated with a capital letter (upper cases): for example, nuclei A, B, C, etc. (Figure 5.7).

2.1 Ch: Chronology:
Chronology indicates the phase when a nucleus started. Chronology is marked with an absolute number starting from 1. Each consecutive phase of development is signed with ascending numbers. Nuclei that are developed simultaneously or nearly simultaneously, are marked with the same number. This is shown in the respective schemes (Figure 5.7).

Examples:
A 1, means that nucleus A is developed during the first phase;
C 3, means that nucleus C is developed during the third phase;

2.2 Dn: Nuclei Distance; and Dnf: the relative frequency of the distance
Dn, is measured by the distance between the centers of the neighboring nucleus (the center of a nucleus is considered the gravity center of the geometrical figure enclosed within the perimeter of the nucleus). The number of the measured distances for each nuclei depends on the number of the neighboring units at the time the measurement is performed. This can be done for the years ’21 and ’37.

Example (Figure 5.7):
For nucleus A: A-B; A-L; A-K
For nucleus B: B-K; BC
For nucleus C: C-K; C-D

In a similar way with what explained in the previous section, measurements can be summarized in tables and used for calculations of the relative frequencies of Dn.

2.3 An: Nuclei Area and Anf: the relative frequency of An
An is measured by the area in square meter of each nucleus. The following diagrams show the occupational logic in two moments: 1921 and 1937. The nuclei area is more distinguishable in the map of 1921 (Figure 5.6).

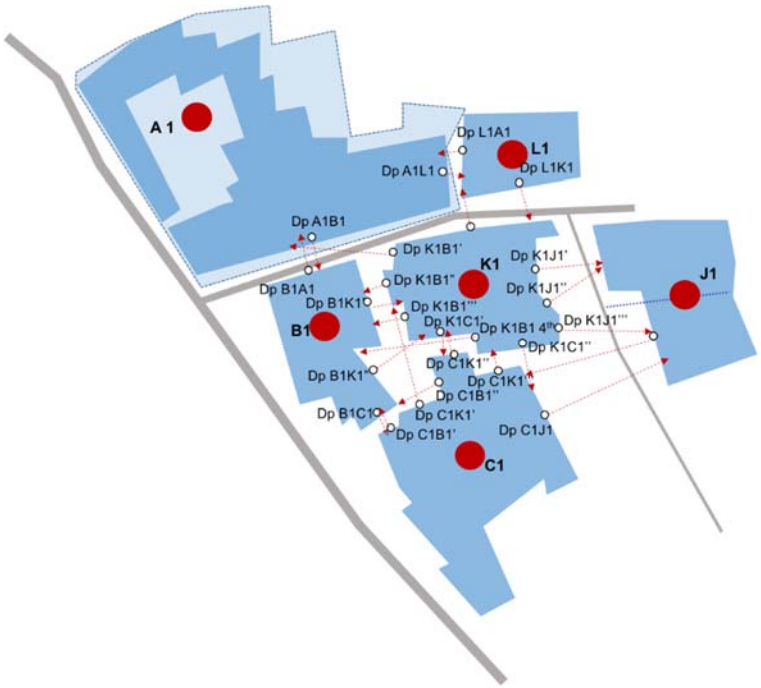
2.4 Ds: distance of the nuclei from the street, Dsf: the relative frequency of Ds
Ds, is measured by the distance from the center of gravity of each nucleus to the main street. The distance is measured along the line of access street where the center of gravity is located (Figure 5.8). After measuring these distances, we can calculate the relative frequency of the distances from the street, the **Dsf**.

2.5 Dp: distance between the perimeters of the nuclei, Dpf: the relative frequency of Dp
Dp, is the distance between the neighboring perimeters. This distance is measured by the length of the perpendicular from the mid-point of each segment creating the perimeter, to the intersection with the facing side of the neighboring perimeter (Figure 5.9). Based on that we can calculate the relative frequency of the distances between perimeters, the Dpf.

5.6 Occupational Logic 1921, 1937

5.7 Chronology; measurement of the nuclei area and their distance from the gravity center of the neighboring nucleus, 1921

5.8
Measurement of nuclei distance from the street, 1921



5.9.
Distance between the perimeters of the neighboring nuclei

2.6 Br: Built area ratio

Br results from the ratio between the sum of all nuclei's area at the time the measurement is performed, and the total area of the sample. This can be calculated for the years '21, '37, '89, '05, etc. The difference of the ratios in different years can create an idea about the increase rate of nuclei and of the sample in general.

In the last part of this chapter I presented a list of potential parameters to be observed and a basic methodology haw they can be measured and interpreted. Those parameters can be more than the list presented in this section; however, in the following steps not necessarily all these parameters are used. As I mentioned even earlier, the main focus of the research is on how to extract information from a site specific reality and show that this information representing its emergent qualities can be used computationally to create a model, in order to better observe that reality, or to be used for design purposes. This is the subject of the next chapter.

5.4 Patterns emerging from a set of rules: towards a computational model of the urban tissue

5.4.a Intro

Given the data coming from the previous investigations, I would try now to organize that data within a basic model. Here, the model is aimed at emphasizing the highlighted emergent characteristics I have already described in the previous chapters. The attempt in creating a model is supported by two important ideas, which are also a mean to prepare a future development of my research.

The first idea has to do with the model itself, as a scientific[13] device capable to highlight the main features of the patterns coming from the previous investigation. Once built, the model could eventually highlight dimensions that would be otherwise unobserved and not properly considered.

The second idea regards the type of scientific model, which is formalized as within a computational framework and in particular based on parametric variables. This decision was made in order to create a highly formalized model, which can work efficiently regarding the geometry and also some morphological dimension.

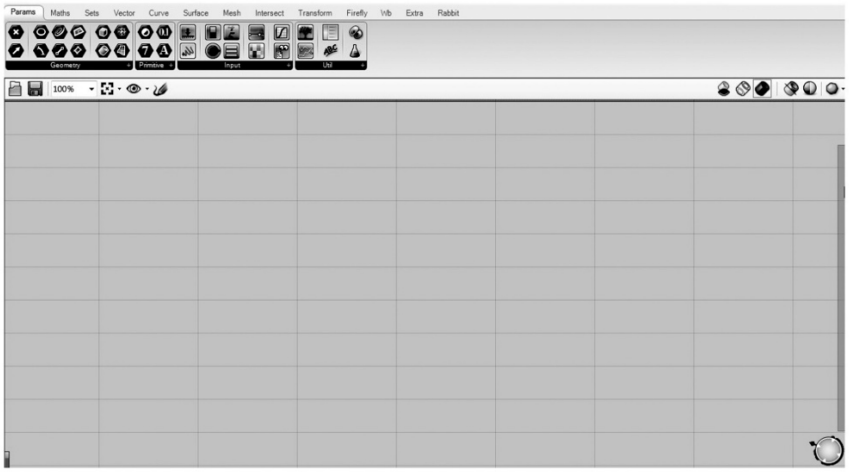
The model has been created by using a very well-known software environment, namely the plugin for Rhinoceros © Grasshopper, which allows to easily create procedural sequences of algorithms, and their prompt consequences in terms of geometry visualization. Given its flexibility the software allows to create algorithmic procedures[14] by working through out a graphic interface[15], which is nevertheless quite intuitive. Another advantage is related to the

[13] *Scientific modeling, the generation of a physical, conceptual, or mathematical representation of a real phenomenon that is difficult to observe directly. Scientific models are used to explain and predict the behavior of real objects or systems and are used in a variety of scientific disciplines, ranging from physics and chemistry to ecology and the Earth sciences. Although modeling is a central component of modern science, scientific models at best are approximations of the objects and systems that they represent—they are not exact replicas. Thus, scientists constantly are working to improve and refine models.* From Encyclopedia Britannica (https://www.britannica.com/science/scientific-modeling)

[14] The algorithmic procedure is intended as a sequence of actions and instructions that a computer needs to follow in order to perform a task.

[15] The traditional way of formalizing an algorithm in a computational environment would be to write the sequence of actions in a formal programming language following grammatical rules. This procedure would require previous knowledge of the programming language from the operator. On the other side the

easiness about setting up the procedure and its emerging characteristics at the level of behavior and morphology generation. Grasshopper could be seen as a visual interface in order to build/compose sequences of algorithms, aimed at creating a certain procedure. Being a plugin for Rhinoceros, the main aim is the generation of geometry or what is known as 3d models. In my case rather than the 3d model, the interest is on the algorithmic sequence, as my intention is to show that a certain pattern could be reproduced computationally, and even used as the base for a new urban project.

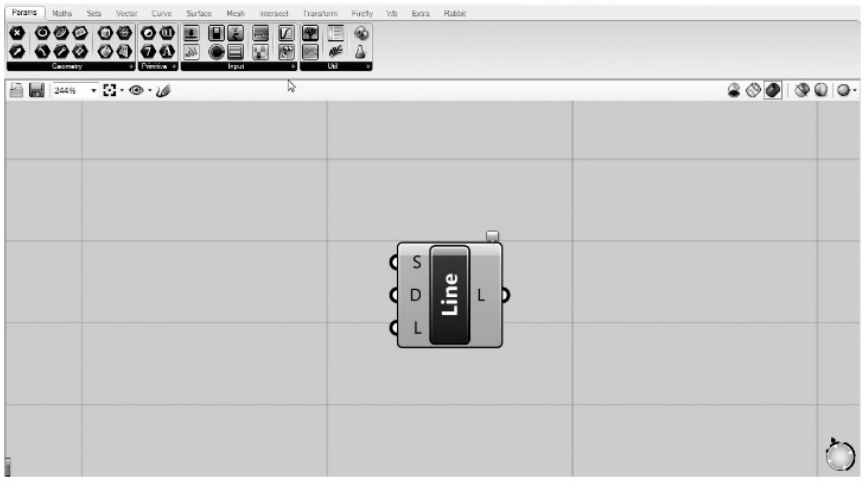


5.10
The Grasshopper Environment

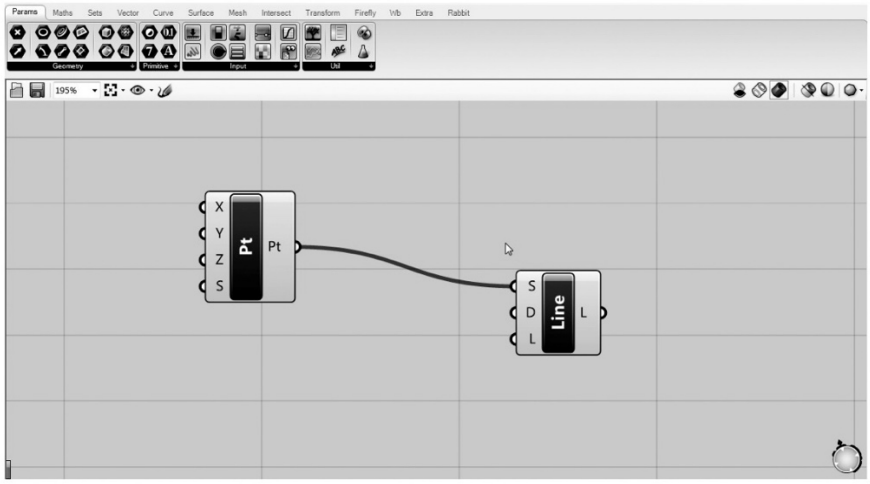
A very important thing to be highlighted is the way Grasshopper works. In this software each algorithm is represented by a small visual box, called *component.* Each component, can represent one or a set of pure mathematical operations, as well as one or a set of geometrical operations. In addition, there are even components which exclusively deal with the data flow, and the way information are sequentially processed.

By looking carefully at the component, it can be noticed that the component often has a set of inputs (on the left border of the component) and a set of outputs (on the right border). Building an algorithmic sequence means connecting visually one or more than one output with one or more than one input and vice versa. In this way a process is established and a result is achieved. Normally, these results being strings, numbers or Boolean values, what is really important is the geometrical result.

graphic interface of Grasshopper is based on the combination of readymade blocks of code, avoiding this way the need from the operator to formally write the instructions.



5.11
The Line component with the inputs set and output, on the left and right borders respectively



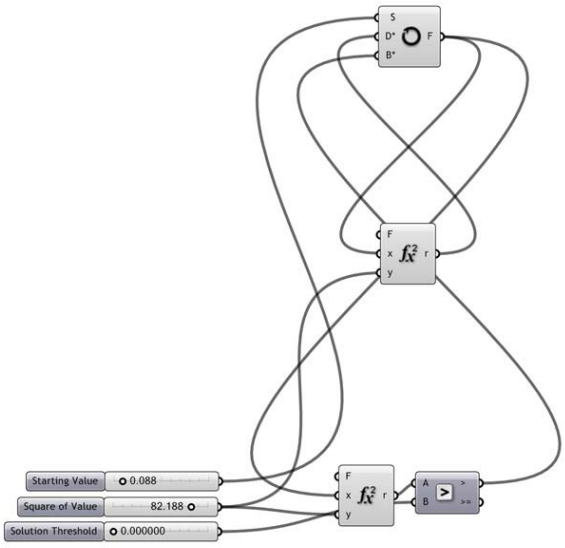
5.12
The Point component connected with the Line components. You can notice that the Point is connected with the inputs S of Line, which means establishing the origin of the line

Despite this short and elementary introduction, the potential of the plugin becomes clear, especially when the geometry and the procedure are more complex. However, in my case, as I aim to create a model, I assume that some characteristics will be discharged in favor of those who I considered the most relevant. By holding the fact that every model is always a reduced and abstract representation of the reality, I assume as fundamental the hypothesis that all the behaviors behind the urban transformations are *recursive* and they tend to repeat themselves in a fractal way, as I tried to make clear in the previous chapters.

The fundamental idea of the recursive behavior requires the introduction of a secondary plug-in, called Hoopsnake[16], which can easily run as a loop, although within a sequential procedure[17].

[16] http://www.food4rhino.com/app/hoopsnake

[17] A conventional algorithm is based on a sequence of consecutive instructions. The challenge at this point would be to repeat some of the instructions for a certain number of times. The part of the algorithm repeated in a recursive way is called a loop. Hoopsnake allows this way Grasshopper to perform recursive tasks and in this context it can be used to design a model that shows fractal behaviors.



5.13 Hoopsnake component and procedure[18]

As it can be easily understood from the way the procedure is organized, the hoopsnake component creates a series of one or more loops, through which the algorithm can basically *repeat itself,* as it should happen within a recursive procedure.

5.4.b The main features of the model given some basic assumptions

I would start considering what I call the historic organic pattern, and the main characters I would like to emphasize in the model. One of them is exactly the character of self-repetition, which produces the pattern described earlier in the text. It is important to state that the computational model is built through two phases. The aim of the first one is to set up a logical procedure for the recreation of some basic features observable in the historic organic pattern. Since in this phase the most important task is the setting up of the algorithm, the values of the parameters are not taken from the measurements of the existing situation but are chosen by fine-tuning the behavior of the algorithm. Only during the second phase, once the model will be set up, the values of the Table 5.6 will be used as parameters of a more complex algorithm. Being the algorithm a procedure, namely a step by step process, I would like to describe the way these steps have been built within Grasshopper. With this regard, the first result was establishing a procedure aiming to reproduce one of the observed behaviors in the evolution of the historic organic pattern: the random walk. The main generative paths of the pattern can be fairly approximated by a sort of *random*[19] *walk*[20], capable to recreate the first path, or trunk-

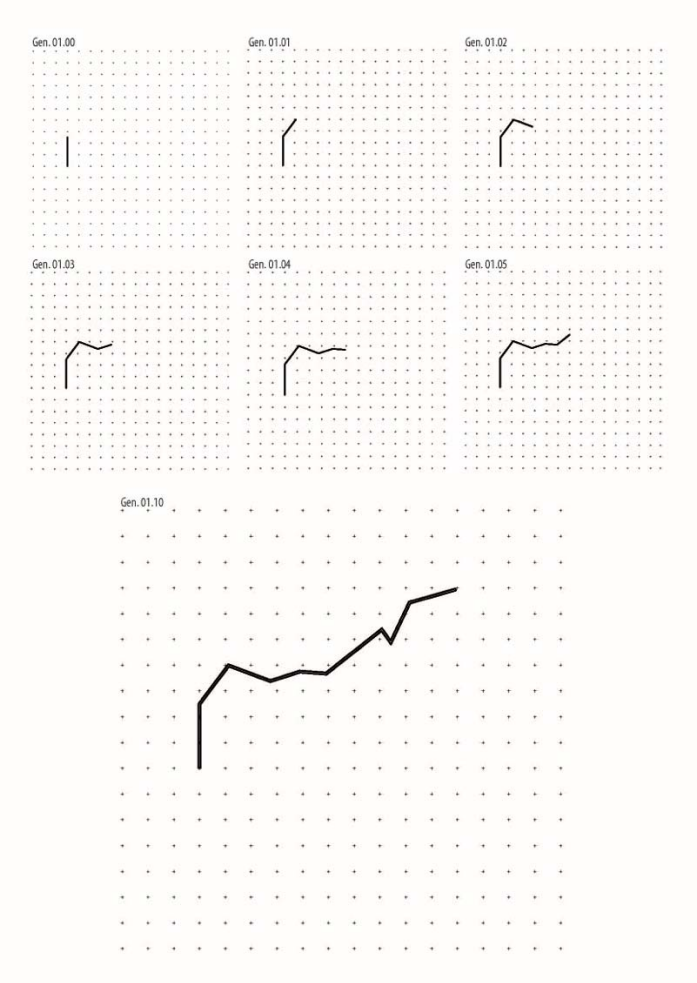
[18] *credits: Yannis Chatzikonstantinou, creative commons*

[19] In the reality this is a pseudo-random procedure, since it is still practically not possible to create a real random set of numbers in a computational environment.

[20] The random walk in computer science can be defined as the set of rules and procedures that create a succession of segments where each consecutive one starts where the precedent ends and randomly develops in a new direction

road (what could be alternatively read as a matrix–path or generative settlement–path). The random walk is controlled by two parameters, the length of each successive segment and the angle of deviation from the previous segments. The values of these two parameters are randomly chosen by the algorithm from a set of numbers. The work done in this part of the algorithm was focused on defining the appropriate limits of the set of numbers to be chosen from, in order to approximate the real features of the settlement observed. So the length and direction of each segment is chosen from a range of numbers coherent to the observable behavior in the territory. The algorithm then choses from this range the exact consecution of values that define the random walk.

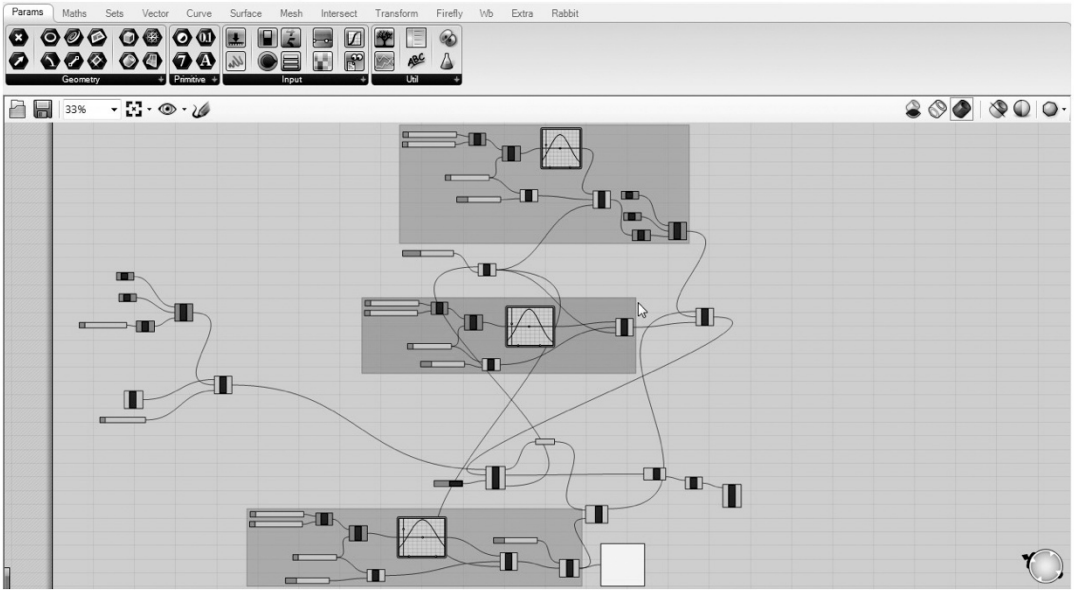
As shown in the next image, after a number of recursions executed by the algorithm in Hoopsnake, some consistent geometrical features start to be observable. For practical reasons, 10 recursions are valuated as enough for the behavior to become visible and approximate with the observed reality. The algorithm, choosing from the defined range of parameters controlling the length and direction of each segment, is already able to simulate spatial configurations. In this case, the similarity with the same types of paths, common in Tirana, gradually emerges.



5.14 Pseudo-random walk

I decided to put the path overlapping a grid of points to also show the path's deviation compared to the grid. This - not at all a granted result - could be a good base in order to test the next steps of the recursion and the model's capability to respond to a set of parameters coming from the previous analysis and observations (Table 5.6).

The initial algorithm of the random walk that was already able to recreate some features of the urban settlement, in the next stage is further developed by incorporating the empirical data taken by the observations. The intent is to have a more sophisticated model, able to recreate and manipulate a larger range of behaviors and spatial configurations. The more complex procedure (algorithm), which in Grasshopper is called *definition,* can be seen in the following image. Some important features can be observed and explained.

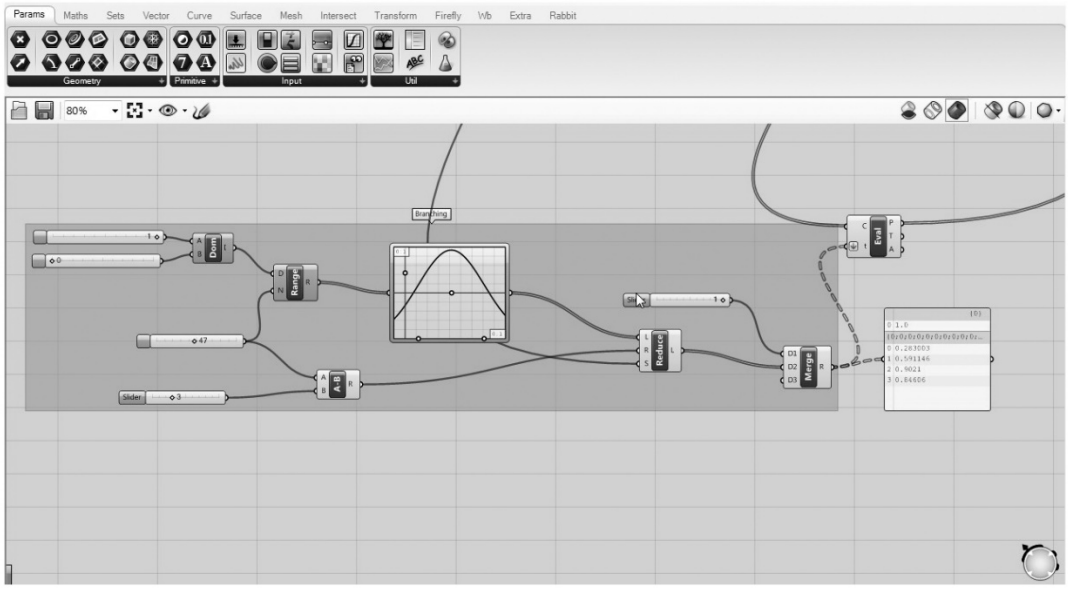


5.15 The entire Grasshopper definition (algorithm)

There are three main zones, emphasized in the above picture by three grey rectangles. Each zone is a part of the algorithm focusing on some geometrical features: the angle of rotation among the segments, (the upper one); the variation in the length of the segments (the zone in the middle); and the bifurcation points of the segments (the lower part). These three important blocks of the algorithm represent and control three development features of the urban settlement: the length of the segments; the angle of deviation of each successive segment; and the bifurcation of each segment of paths as observed and measured in the selected sample. These features were formalized in parameters of this algorithm. In each of the three blocks of the definition, a Gaussian graph is visible. These graphs plot a second order function that is the one that best approximates the measurements (the calculated relative frequencies) taken from the observation.

This part of the definition allows me to have at each iteration, a random number for each of the three parameters explained above. In this phase the random number is chosen from the range

of the observed and calculated parameters. On the other hand, the Gaussian distribution allows to have more probable and less probable parameters, as the distribution observed in the reality. The lower part of the definition, represents another crucial step in the procedure. This part defines the points where the bifurcations start in every recursion. By zooming-in on this part we can make further observations.



5.16 The branching (bifurcation) part of the Grasshopper definition

Starting from the left, it could be observed that in the first step a domain[21] of numbers is created. This domain which represent all possible points of bifurcation is then redistributed according to a Gaussian[22] distribution. Out of all possible points of bifurcation the algorithm selects in each iteration only 3 values that identify 3 points on the segment from which the branches are originated.

In the next steps, instead of a pseudo-random generation, I am going to use the parameters gained from the observation.

[21] All the domains in this definition represent the minimum and the maximum value of an observed phenomenon. In this case the represented phenomenon is the point of a segment where a branching occurs. This is expressed as a ratio of the first segment created after the branching, to the total length of the segment. The value 0 would mean that a branch is created at the beginning of the segment; the value 0,5 would mean that a branch is created in the middle of the segment; the value 1 would mean that a branch is created at the end of a branch and so on.

[22] The Gaussian distribution aims that branching can occur anywhere along the length of the segment, but it is most probable to occur at the maximum point of the Gaussian graph, in accordance with the values from the table 5.6 summarizing data from the observed sample.

5.4.c First results of the generative model

At this point if we try to execute some recursions of the model we can observe the following: Firstly, the necessary number of recursions to reach a certain degree of complexity is lower than the simple random walk path that we generated at the beginning with 10 recursions. I noticed that after 5 recursions, the branching becomes complex enough to recall some characteristics of the analyzed patterns.

Secondly, already at the third generation the pattern becomes consistent enough with the reality. Therefore, one of the first conclusions that can be assumed, is the computational nature of some urban phenomena. In general, the formalization of the generative procedure through an algorithm is crucial to observe the emergence of morphologies visible in the reality. The range and the distribution of the possible values for each parameter governing the algorithm, allows the closer approximation to the real conditions; or even further variations of the morphology. The ability of the algorithm to allow variations is the key to future use of the model not only as an instrument for understanding reality through its recreation in a simulation, but most importantly as a design tool allowing modifications, variations and the emergence of novelty.

5.4.d Variations

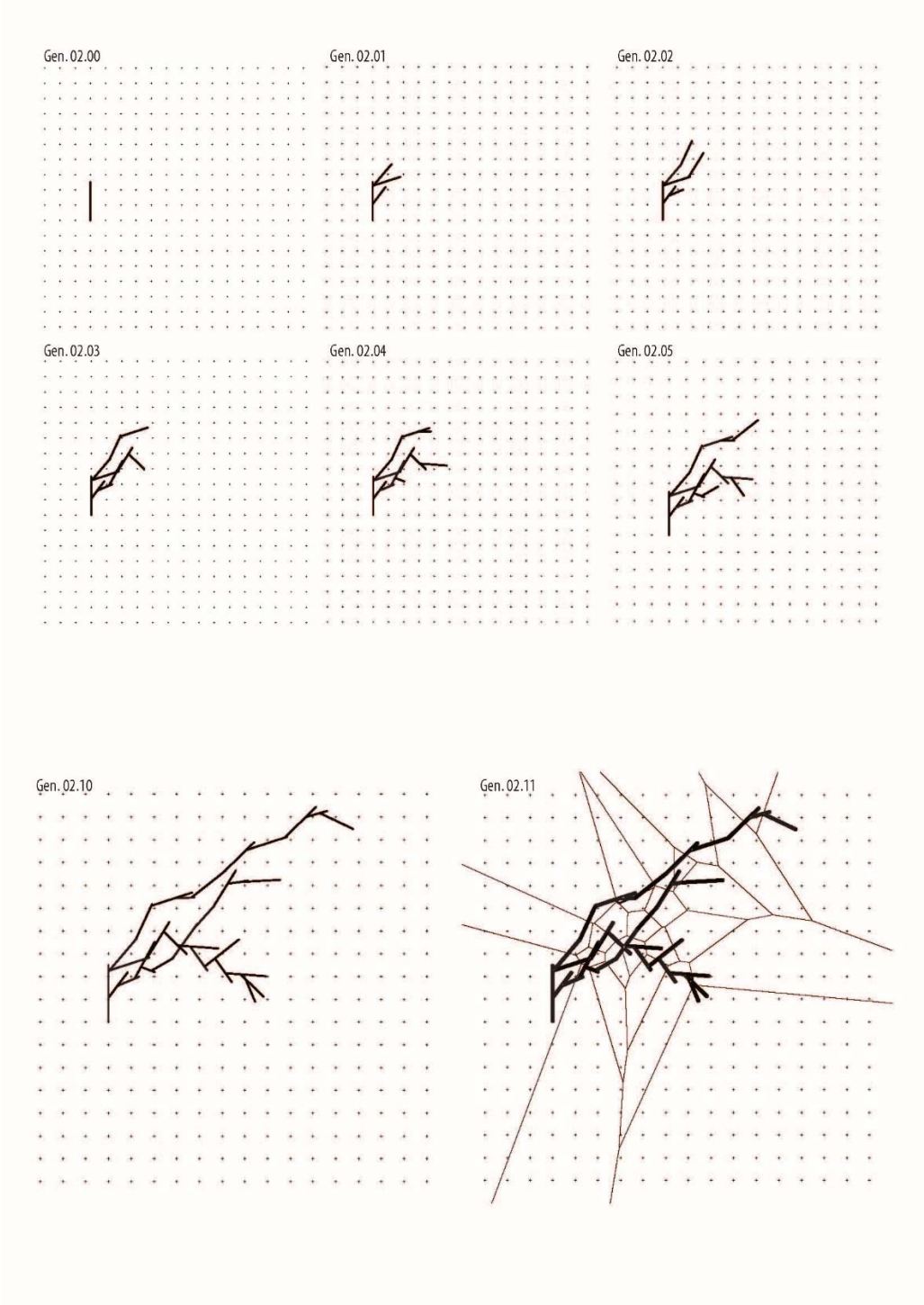
In the last two pictures, I tried also to use a Voronoi[23] algorithm component, in order to emphasize the potential of the algorithm to create spatial structure. As it can be observed in the following quadrants representing each a variation of the model, modifications of the parameters, can articulate a catalogue of branched pattern. Each of them can be even seen as a potential matrix for an urban settlement model, reflecting the observed quality of the pattern.

Overlapping the last step of Voronoi algorithm with the historic Organic sample shows a satisfactory similarity with the real situation; however, the model reproduces with a certain approximation the recursion and therefore the fractal characteristics of the tissue empirically analyzed. Having a model that reproduces the historic and anthropological feature of the city will be extremely useful at a later stage in Tirana. Further steps in this research could try to put together the fractal and anthropological character of the city, along with the rational one with European and Italian matrix, that coexists and intersects with the Ottoman one, as presented in the historic analyzes.

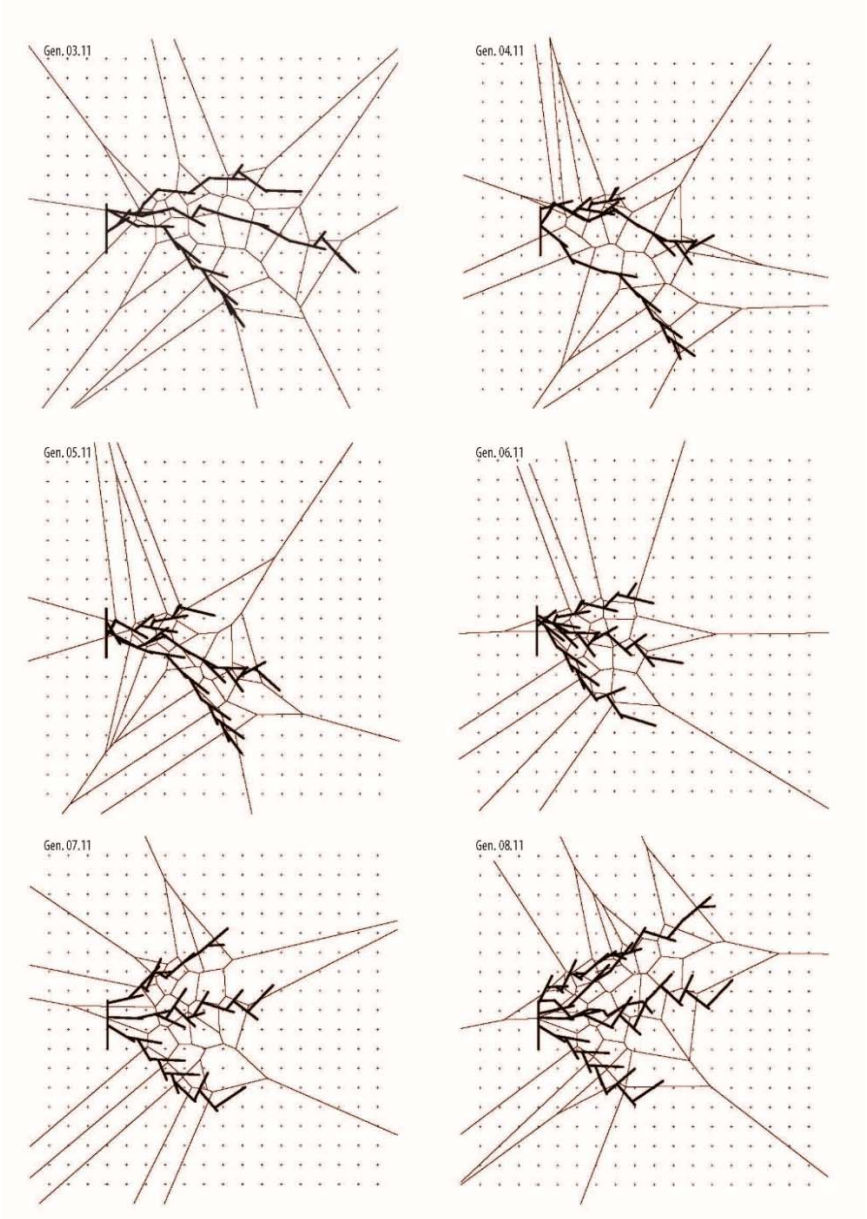
This investigation, using the possible manipulations and variations of the algorithm, could be further developed by modeling other behaviors of the urban settlement like the way in which each plot is subsequently subdivided or the way in which the houses are positioned inside each plot. For practical reasons I decided to pause this part of the investigation at the actual stage of development, but the potentials for future use of the model are already visible. In fact, this was

[23] *The partitioning of a plane with n points into convex polygons such that each polygon contains exactly one generating point and every point in a given polygon is closer to its generating point than to any other.*(http://mathworld.wolfram.com/VoronoiDiagram.html). The Voronoi diagram offers a fair approximation of the process of creating equidistant borders between potential settlers represented in the model by the end points of the branching path.

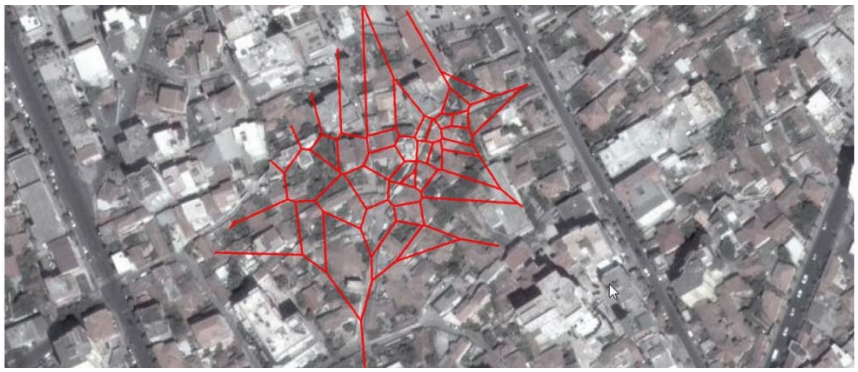
the main aim at this stage of the research. The model shows good capabilities of supporting further ramifications of the research and possible use for future design proposals that are able to embody the spontaneously developed urban qualities of Tirana, or other specific characteristics observed in different urban environments.



5.17 The results after 5 recursion of the whole generation using parameters coming from the observation (Table 5.6)



5.18
Variations gained by modifying the parameters



5.19
Attempt to overlap the last step of Voronoi algorithm, with the Historic Organic sample

6. Conclusions; The inquiry process: from induction to deduction

Research question: can the transformation of Tirana's urban morphology be understood from a theoretical perspective in order to outline new hypothesis for city design?

At the end, it is worth going back to the initial question from where this research started, and see whether the presented arguments helped to understand in a more holistic perspective the reality of our cities. For this, in the following paragraphs I will recap some of the main issues the research went through. As I mentioned right at the beginning, the inquiry process involved a theoretical perspective on urban analysis, urban observation methodologies, paradigms under which the observations are conducted, as well as the contemporary debate on urbanism and architecture roles in shaping the city. These are the main issues that structured the logical path of the research process.

The presented research is embedded in this group of ideas and previous researches that reflect an attempt to understand, interpret and envision in a new and different way the reality we live in our cities. This attempt for a new vision is directly related to the progress of the scientific world that continuously is pushing the barriers of the reality we know. From the mechanic view of the world as a perfect machine, but empty from human spirituality, to the holistic quantum view of the reality, where *the dynamics of both our bodies and our minds emerge from the same laws and forces that move the sun and the moon or that bind atoms together,* as Zohar and Marshall say (1994 p. 13)*,* there is a great conceptual leap. This shift has been extensively explained throughout the chapters, and most importantly it has been seen in relation to the concept of time and space which are directly related to the way we observe, analyze and conceptualize our cities. Related to that, among other, I tried to present a rich depository of language and concepts that help for a deeper understanding of the human nature, its consciousness and the environments they create. These and many other arguments are used to present the need for analyzing and observing our cities from a broader theoretical positioning, which is one of the main issues raised from the research question.

In relation to that, my initial concern to start the research was how to make observable and part of the analyzes some subtle and non-material aspects normally excluded; or how to include other categories such as chaos (or the so-called irregular developments) that in a simplistic logic are seen under the category of informal and as phenomena not even related to architecture and planning. In this concern, it is becoming clearer that categories based only in a mechanic worldview where *people as faceless units* are treated *with impersonal rules (*Zohar and Marshall, 1994 p. 27) are not enough to fully understand the reality. Throughout the research I tried to argue that we miss a lot of nuances and subtle human sensations, which constitute an essential base for the everyday life of the city and individual arrangements. My clear positioning is that to get out from this impasse we need to observe and analyze our cities through additional and unconventional theoretical lens.

In relation to that, throughout the research I argue that if we change the theoretical lens of observation, we can change also the meaning. Let us remember here some of the main reframed concepts / categories used in this research; the concept (lens) of event and event horizon emitting waves and interfering patterns that transcend time and space, helped to see the city as a malleable energy field (Arida, 2002) and not just as a static entity; this is related also with a new conception of territoriality as a continuation beyond local-temporal (space-time)

condition; the concept of fractals (Batty and Longley, 1994) and their self-similar or self-affine property as recursive regularities that repeat across scales, transformed our idea about what apparently looks like chaos; this is related with a new conception of form as a system-structure with its static (structure) and dynamic (behavior); understanding dynamics help to better understand the external form (the latter had a large impact in the conceptualization of the pattern analyzes and the translation of their emergent qualities in a potential model); the concept of organic understood as individual arrangements at the finest scale (Batty and Longley, 1994) and as part of an open system that tend to self-regulate, pushed away the prejudices labeled under the category of informal; the concept of the complex behavior (Mitchell, 2009) and classifying patterns under this category, helped to see them as information that can be depicted in various ways; finally, and most importantly, all these theoretical lens converge in what holistic (Zohar and Marshall, 1994; Gleick, 1998) means in the quantum reality. This helped to introduce concepts such as SST construct (Arida, 2002) and to see things that "exist" beyond the local time-space; or to see in a different way some mechanic concepts, such as zoning or other techniques, which occurrences in fact go beyond territoriality understood in mechanical terms (simply the sum of its parts). There are more concepts used in the research, but here I named only a few of them.

This reasoning significantly influenced the way I saw the city, understood the phenomena internally and externally, decomposed in subassemblies or elements, diagrammatized, measured, translated in information, etc. I tried to use Tirana as a case study, however, a similar approach can be followed also for other cities, or other specific conditions. What this case demonstrates is the potential offered by a methodology that aims to broaden the angle of observable reality through additional theoretical lens; the possibility to apply in a concrete case theoretical concepts, even though most of them are hired from the field of physics or other sciences; and most importantly, the potential to bring back the "discovered" (latent / hidden / underlying / subtle) emergent qualities in the design process. This analytical and observation process helped to answer more thoroughly and maybe in a different way the research question; This can be considered as one of the modest contributions of this research.

The research touches also on the issue regarding the role of people in shaping the urban space. Throughout the research this appeared under the label of urban improvisations and social structures; people as a vessel for no-locality; users are as much designers as the design team; and finally under the SST web of wholeness, which is nearer to the position of this research related to people involvement or their influence that include material and non-material aspects. In fact, people leave their traces (event horizons) in the city. Therefore, they can be part of the design not only through their direct participation, but also through understanding or "catching" their intrinsic logic (the ordering principles) in the patterning process, and embodying this in a potential project; or enable their "interference wave" pattern.

While the "extraction of information" from the city, using additional theoretical lens, was the first challenge set by the research question; the second one was related to using this material for outlining new methodologies and hypothesis for city and urban design. There is a rich tradition related to this issue that I tried to explain under the theoretical discourse about typological instruments. In this regard, I clarified also how this issue is intimately related to the way we can give life to our cities using the emergent qualities latent in the urban environment and using them as formative principles. Related to that the research proposes a methodology to decompose the essential quality of space in recursive regularities and after observing them

through a “measurement” procedure proposes to create a scientific model that reflects that site specific reality. It was clearly noticed that the computational nature of some urban phenomena can be used to elaborate models that help to better understand the reality and to highlight dimensions that would be otherwise unobserved or not properly considered. In addition to that, the ability of the algorithms to vary allows modifications and the use of the model not only as a scientific one, but also as a design tool. This is key to future uses of the model not only in Tirana but also in other specific realities.

The paradigms under which the city is observed and our ability to include without prejudices the entire urban phenomena, as already mentioned, becomes quite important here. Therefore, what counts more is the methodology how I arrived to the model and to all the data used to create the model. These issues are also related to the contemporary debate on urbanism and architecture roles in shaping the city. The research tries not to give a definitive answer to this question, but first of all to offer a methodology for observation and “measuring” specific patterns, rather than aiming the model in itself. This and other issues related to the use of a model establish some directions for future research.

I argued about Tirana but the logic is valid for the city in general; As I mentioned at the beginning of this research, the inquiry process goes from induction to deduction. First, I analyzed if the observed phenomena in Tirana met any theoretical preconception, then assessed and tuned the theoretical lens accordingly in order to evaluate the full range of qualities embodied in the urban environment, and finally tried to express those qualities in a model based in the understanding of the specific urban phenomena. The lesson learned is that if our cities do not entirely fit within the rules based on mechanic concepts, we do not need to change the city, but we assess and modify our observation and analytical lens accordingly. This logic is an important message of this research that can be applied in any kind of specific environment.

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Annex

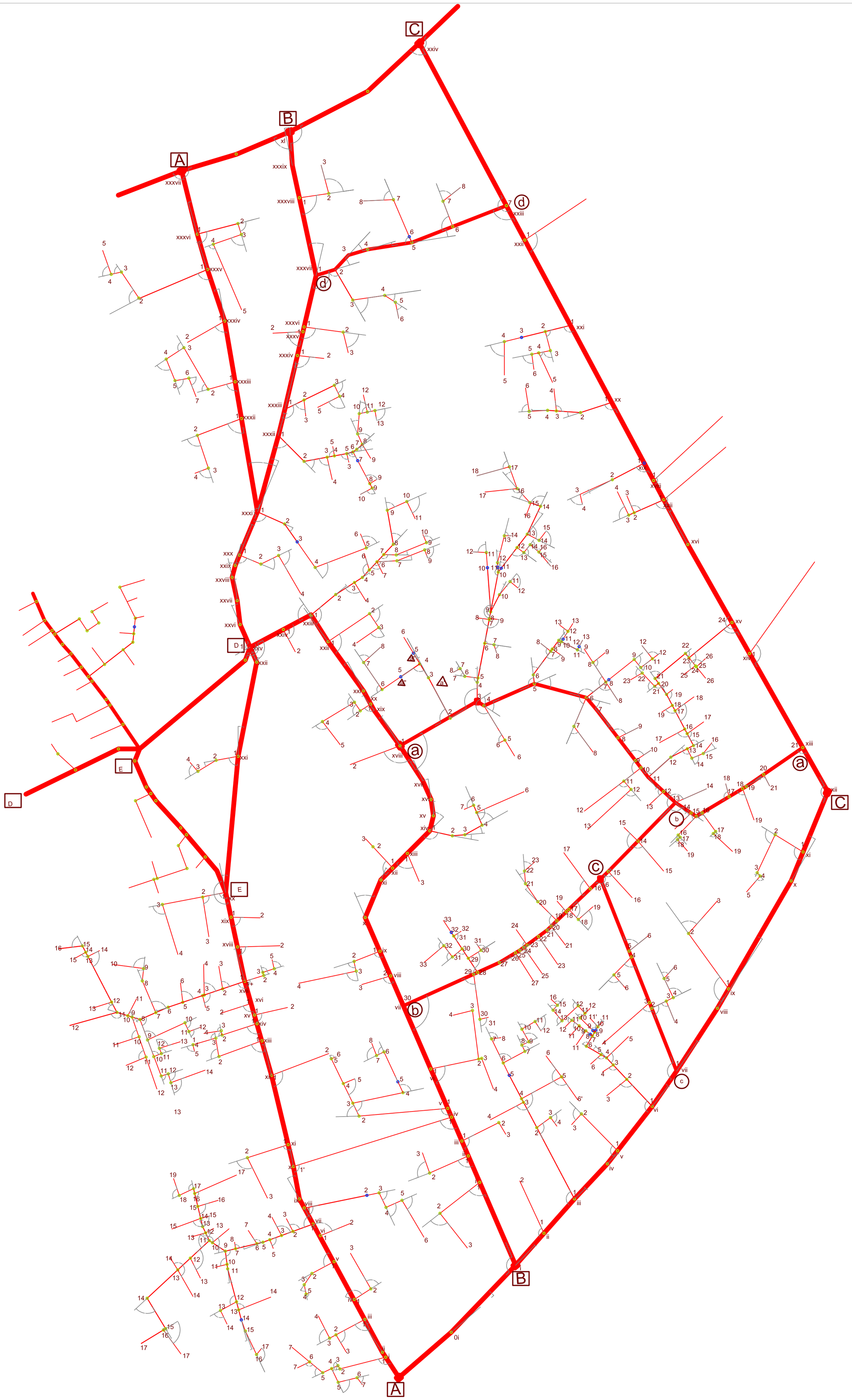
Table 5.6

Observation, registration, calculation and summary of the measurement for sample 1.3; Parameters and ranges of parameters (attached as Excel table)

Lines' hierarchy

First Level	In Figure 5.2 Lines: A-C; C-C; B-B etc.	
Second Level	In Figure 5.2 Lines: a-a; b-b; d-d	Line c-c is not considered as outlier (artificial line: not organic / opened through projects)
Third Level	In Figure 5.2 Lines: a2' a3; or: AC-iii; AC-vi; etc.	Named by the higher level line (a; b, d; AC; CC; etc.) and the number of node where the line starts (3; 5; iii; etc.)
Fourth Level	In Figure 5.2 Lines: a-2-4; a-3-5 or AC-iii-6; etc.	Using as the first coordinate the main line (a, or AC, etc.); then the node of bifurcation on the main line (2. 5, iii. vi; etc.); and the node of bifurcation on the lower level line (2, 3, 6, etc.)
Fifth Level (not considered)		There is a reduced number of lines at such a level; almost inconsiderable in relation to the number and measurements of other lines

Measurements: Lines are measured starting from the highest hierarchy to the lower ones. In the registration sheets each main line and the relative branches are divided by a line (light orange)


A
B
C
D
E
a
b
c
d

ranges
1-20
20-40
40-60
60-80
80-100
100-150
150-200
200-350

ranges
01-0.5
0.5-1.0
1.0-1.5
1.5-2.0
2.0-2.5
2.5-3.0
3.0-3.5
3.5-4.0

ranges
1-10
10-30
30-60
60-90
90-120
120-150
150-180

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
	Nodes along the line	Measured segments	*Segmental length (m)*	*Soort Ls*	*Number of events*	*Relative frequency of segmental length*			*Segmental Length index number*	*Sort Index number LS*	*Number of events*	*Relative frequency of index numbers*	*Number of nodes along the line*	*Nodes per length*	Nodes along the line	*Angle of refraction*	*Rotation of refraction*	*Sort Ar*	*number of events*	*Relative frequency of Ar*	*Angle of bifurcation*	*Rotation of bifurcation*			*Sort Ab*	*number of events*	*Relative frequency of Ab*	*Consistency of rotation ratio (refracti*	*Resultant of refraction rotation*	*Sequence refraction & bifurcation*	*Alternation of refractoin and bifurcation*
A-C	A	A-0i	40.6	25											A																
	0i	0i-i	54.6	28	2	**22%**	20-40		0.7	0.5	1	**13%**	0.1-0.5		0i	5	-	2										-5	0R	-
	i	i-iii	52	40.6					1.1	0.6					i	2	-	2			113	-			98			-2	BR	--
	ii			42.8						0.7					ii			3			107	-			99				B0	-
	iii	iii-iv	28	44					1.9	0.7	3	**38%**	0.5-1.0		iii	3	-	3			111	-			99			-3	BR	--
	iv	iv-vi	42.8	52					0.7	1.1					iv	5	-	3							107			-5	0R	-
	v			54.6						1.5	2	**25%**	1-1.5		v			5			98	-			111				B0	-
	vi	vi-vii	25	56.6	6	**67%**	40-60		1.7	1.7					vi	3	-	5		1-10	99	-			111			-3	BR	--
	vii	vii-viii	44	86	1	**11%**	80-100		0.6	1.9	2	**25%**	1.5-2		vii	2	-	8	8	**100%**	124	-			113	7	**78%** 90-120	-2	BR	--
	viii	viii-x	86						0.5						viii	3	-								124			-3	0R	-
	ix														ix						111	-			128	2	**22%** 120-150		B0	-
	x	x-xii	56.6						1.5						x	8	-											-8	0R	-
	xi														xi						99	-							B0	-
	xii														xii						128	-							B0	-
TOTAL			**429.6**		**9**	**100%**					**8**	**100%**	**13**				**0+:8-**		**8**	**100%**						**9**	**100%**				
									33.05																			**0**	**-31**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-iii	1	1-5	82					82							1															
	2			5.6	1	**33%**	1-20	24	3.4	3.4	1	**50%**	3.0-3.5		2						98	+			90	1	**25%** 60-90		B0	+
	3			24	1	**33%**	20-40	5.6	4.3	4.3	1	**50%**	4.0-4.5		3						90	-			91				B0	-
	4			82	1	**33%**	80-100								4						91	+			92				B0	+
	5	5-7	24												5	00									98	3	**75%** 90-120		00	00
	6														6					90-120	92	+							B0	+
	7	7-8	5.6												7	109	+	109	1	**100%**								109	0R	+
	8														8															
TOTAL			**111.6**		**3**	**100%**					**2**	**100%**	**7**				**0-:1+**		**1**	**100%**						**4**	**100%**				
									15.94																			**0**	**109**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-iii-2	2	2-3	10	6.2				10							2					60-90										
	3	3-4	6.2	10	2	**100%**	1-20	6.2	1.6	1.6	1	**100%**	1.5-2.0		3	90	+	90	1	**100%**								90	0R	+
	4														4																
TOTAL			**16.2**		**2**	**100%**					**1**	**100%**	**2**				**0-:1+**		**1**	**100%**											
									8.1																			**0**	**90**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-iii-4	4	4-5	27	15				27							4															
bif fundor	5	5-6	15	16	2	**67%**	1-20	15	1.8	0.9	1	**50%**	0.5-1.0		5						82	-	97	+	82	1	50%			2B0	+-
	6	5-6'	16	27	1	**33%**	20-40	16	0.9	1.8	1	**50%**	1.5-2.0		6										97	1	50%				
TOTAL			**58**		**3**	**100%**					**2**	**100%**	**2**													**2**	**100%**				
									29																			**NA**	**NA**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-iii-6	6	6-7	14	4				14							6															
	7	7-8	4	4.5				4	3.5	0.5					7	87	-	87											-87	0R	-
	8	8-9	4.5	8.5				4.5	0.9	0.5	2	**40%**	0.1-0.5		8	90	+	89											90	0R	+
	9	9-10	8.5	9				8.5	0.5	0.9					9	94	-	90		60-90								-94	0R	-
	10	10-11	9	14				9	0.9	0.9	2	**40%**	0.5-1.0		10	89	+	90	4	**80%**									89	0R	+
	11	11-12	16.5	16.5	6	100%	1-20	16.5	0.5	3.5	1	**20%**	3.0-3.5		11	90	+	94	1	**20%**									90	0R	+
	12														12					90-120										
TOTAL			**56.5**		**6**	**100%**					**5**	**100%**		**6**			**2-:3+**		**5**	**100%**										
														9.42														**0.67**	**88**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-v	1	1-2	30	8.5	1	**50%**	1-20	30							1					90-120										
	2	2-3	8.5	30	1	**50%**	20-40	8.5	3.5	3.5	1	**100%**	3.0-3.5		2	93	-	93	1	**100%**								-93	0R	-
	3														3															
TOTAL			**38.5**		**2**	**100%**					**1**	**100%**		**2**			**0+:1-**		**1**	**100%**										
														19.25														**0**	**-93**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-vi	1	1-4	39	3.9				39							1															
	2			4				14	2.8	0.5	1	**11%**	0.1-0.5		2						98	-			91					B0	-
	3			5				9.5	1.5	0.7					3					10-30%	100	-			97					B0	-
	4	4-6	14	6				12	0.8	0.8					4	17	-	17	1	**11%**	91	+			98				-17	BR	+-
	5			8				3.9	3.1	0.8	3	**33%**	0.5-1.0		5			76			108	-			100					B0	-
	6	6-8	9.5	9.5				6	0.7	1.5	1	**11%**	1.0-1.5		6	91	+	82							108	5	**100%**	90-120		91	0R	+
	7			12				13	0.5	1.6					7			88		60-90	97	-								B0	-
	8	8-9	1.5	13				8	1.6	2.0	2	**22%**	1.5-2.0		8	76	-	89	4	**44%**									76	B0	+
	9	9-10	11	14	9	**90%**	1-20	4	2.0	2.8	1	**11%**	2.5-3.0		9	00		91										00		0R	00
	10	10-11	3.9	39	1	**10%**	20-40	5	0.8	3.1	1	**11%**	3.0-3.5		10	91	+	91											-91	0R	-
	11	11-12	6												11	88	-	91											-88	0R	-
	12	12-13	13												12	91	-	93	4	**44%**									-91	0R	-
	13	13-14	8												13	93	+	00		90-120									93	0R	+
	14	14-15	4												14	82	+												82	0R	+
	15	15-16	5												15	89	-												-89	0R	-
	16														16																
TOTAL			**114.9**		**10**	**100%**					**9**	**100%**		**15**			**3+:5-**		**9**	**100%**						**5**	**100%**				
														7.66														**0.6**	**-34**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-vi-7	7	7-8	1.6	1.6				1.6							7					60-90										
	8	8-11	13.5	5.4				13.5	0.1	0.1	1	**50%**	0.1-0.5		8	00		82	1	**100%**									00	00
	9			13.5	3	**100%**	1-20	5.4	2.5	2.5	1	**50%**	2.0-2.5		9						93	-			85	1	**50%**	60-90		B0	-
	10														10						85	-			93	1	**50%**	90-120		B0	-
	11	11-12	5.4												11	82	-												-82	0R	-
	12														12																
TOTAL			**20.5**		**3**	**100%**					**2**	**100%**		**5**			**0+:1-**		**1**	**100%**						**2**	**100%**				
														4.1														**0**	**-82**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-vi-8	8	8-9	1.5	1.5				1.5							8															
	9	9-10	2.3	2.3				2.3	0.7	0.6					9	00				10-20									00	00
	10	10-11	4	4				4	0.6	0.6					10	13	+	13	1	**100%**	99	-			99	1	**100%**	90-120	13	BR	+-
	11	10-11'	7	7	4	**100%**	1-20	7	0.6	0.7	3	**100%**	0.5-1.0		11																
	11'														11'																
TOTAL			**14.8**		**4**	**100%**					**3**	**100%**		**2**			**0-:1+**		**1**	**100%**						**1**	**100%**				
														7.40														**0**	**13**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-ix	1	1-2	40	26				40							1					60-90											
	2	2-3	26	40	2	**100%**	20-40	26	1.5	1.5	1	**100%**	1.0-1.5		2	77	+	77	1	100%									77	0R	+
	3														3																
TOTAL			**66**		**2**	**100%**					**1**	**100%**	**2**				**0-:1+**		**1**	**100%**											
														33														**0**	**77**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AC-xi	1	1-2	19	2.6				19							1																
	2	2-3	25	12				25	0.8	0.2	1	**33%**	0.1-0.5		2	96	-	68											-96	0R	-
	3	3-4	2.6	19	3	**75%**	1-20	2.6	9.6	0.8	1	**33%**	0.5-1.0		3	68	-	83	2	**67%**									-68	0R	-
	4	4-5	12	25	1	**25%**	20-40	12	0.2	9.6	1	**33%**	9.5-10		4	83	+	96	1	**33%**									83	0R	+
	5														5																
TOTAL			**58.6**		**4**	**100%**					**3**	**100%**	**4**				**1+:2-**		**3**	**100%**											
														14.65														**0.5**	**-81**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
C-C	A	A-xvi	167												A										74					
	xiii			167	1	**50%**	150-200	167							xiii						85	-			80					B0	-
	xiv			334	1	**50%**	300-350	334	0.5	0.5	1	**100%**	1.0-0.5		xiv						115	+			85	3	**23%**	60-90		B0	+
	xv														xv					1-10	80	-			91					B0	-
	xvi	xvi-xxiv	334												xvi	1	+	1	1	**100%**					94				1	0R	+
	xvii														xvii						94	-	102	+	96					2B0	+-
	xviii														xviii						105	+			97					B0	+
	xix														xix						91	-			100					B0	-
	xx														xx						100	-			102					B0	-
	xxi														xxi						104	-			104					B0	-
	xxii														xxii						96	+			105					B0	+
	xxiii														xxiii						97	-			105					B0	-
	xxiv														xxiv						74	-	105	+	115	10	**77%**	90-120		2B0	-
TOTAL			**501**		**2**	**100%**					**1**	**100%**	**12**						**1**	**100%**	**13**						**100%**				
														41.75			**0-:1+**											**0**	**1**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
CC-xvii	1	1-3	22.5												1																
	2			15	1	**50%**	1-20	22.5							2					60-90	89	+			89	1	**100%**	60-90		B0	+
	3	3-4	15	22.5	1	**50%**	20-40	15	1.5	1.5	1	**100%**	1.0-1.5		3	88	+	88	1	**100%**									88	0R	+
	4														4																
TOTAL			**37.5**		**2**	**100%**					**1**	**100%**	**3**				**0-:1+**		**1**	**100%**											
														12.5														**0**	**88**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
CC-xi	1	1-2	21	6	1	**33%**	1-20	21							1					1-10											
	2	2-3	21	21				21	1	1	1	**50%**	0.5-1.0		2	3	+	3	1	**50%**									3	0R	+
	3	3-4	6	21	2	**67%**	20-40	6	3.5	3.5	1	**50%**	3.0-3.5		3	79	-	79	1	**50%**									79	0R	-
	4														4					60-90											
TOTAL			**48**		**3**	**100%**					**2**	**100%**	**3**				**1+:1-**		**2**	**100%**											
														16														**1**	**82**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
CC-xx	1	1-2	19.3					19.3							1					1-10; 10-30											
	2	2-4	19.3	11				19.3	1.0	0.8					2	22	+	3	1	**33%**									22	0R	+
	3			14				11	1.8	1.0	2	**67%**	0.5-1.0		3			22	1	**33%**	100	+			100	1	**100%**	90-120		B0	+
	4	4-5	11	19.3				14	0.8	1.8	1	**33%**	1.5-2.0		4	3	-	84	1	**33%**									-3	0R	-
	5	5-6	14	19.3	4	**100%**	1-20								5	84	+			60-90									84	0R	+
	6														6																
Total			**63.6**		**4**	**100%**					**3**	**100%**	**5**				**1-:2+**		**3**	**100%**											
														12.72														**0.5**	**103**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
CC-xxi	1	1-3	29.6	10				29.6							1																
	2			19.6	2	**67%**	1-20	10	3.0	0.5	1	**50%**	0.1-0.5		2						89	-			89	1	**100%**	60-90		B0	-
	3	3-4	10	29.6	1	**33%**	20-40	19.6	0.5	3.0	1	**50%**	2.5-3.0		3	00				60-90										00	00
	4	4-5	19.6												4		76	-	76	1	**100%**								-76	0R	-
	5														5																
TOTAL			**59.2**		**3**	**100%**					**2**	**100%**	**4**				**0+:1-**			**1**	**100%**					**1**	**100%**				
														14.8														**0**	**-76**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
CC-xxi-2	2	2-3	11.6	4				11.6							2					60-90											
	3	3-4	7	7				7	1.7	0.4	1	**33%**	0.1-0.5		3	94	-	87	1	**50%**									-94	0R	-
	4	4-5	4	9				4	1.8	1.7					4			94	1	**50%**	76	-			76	1	**100%**	60-90		B0	-
	5	5-6	9	11.6	4	**100%**	1-20	9	0.4	1.8	2	**67%**	1.5-2.0		5	87	-			90-120									-87	0R	-
	6														6																
TOTAL			**31.6**		**4**	**100%**					**3**	**100%**	**4**				**0+:2-**			**2**	**100%**					**1**	**100%**				
														7.9														**0**	**-181**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
B-B	i	i-x	223.3	6.5				223.3							i			1			75	-			60					B0	-
	ii			7				24	9.3	0.2					ii			1			90	-			68					B0	-
	iii			9				40	0.6	0.2					iii			1			93	+			71					B0	+
	iv			9.7				9	4.4	0.4					iv			3			96	-			74					B0	-
	v			12				9.7	0.9	0.5					v			4			108	-			75					B0	-
	vi			13				12	0.8	0.5	5	**23%**	0.1-0.5		vi			5			78	+			78					B0	+
	vii			14				22	0.5	0.6					vii			7			91	+			86					B0	+
	viii			14				28	0.8	0.6					viii			7			97	-			86					B0	-
	ix			15				13	2.2	0.8					ix			7			92	-			88					B0	-
	x	x-xi	24	16				35.6	0.4	0.8					x	46	+	8							89				46	0R	+
	xi	xi-xiv	40	18.7				18.7	1.9	0.9					xi	22	+	8							90				22	0R	+
	xii			20	12	**52%**	1-20	40	0.5	1.0	6	**27%**	0.5-1.0		xii			8		1-10	94	-			90	12	**38%**	60-90		B0	-
	xiii			22				15	2.7	1.1					xiii			9	13	**59%**	68	+			91					B0	+
	xiv	xiv-xv	9	24				14	1.1	1.1					xiv	31	-	16			122	+			92				-31	BR	+-
	xv	xv-xvi	9.7	27.5				14	1.0	1.2	3	**14%**	1.0-1.5		xv	8	-	17							92				-8	0R	-
	xvi	xvi-xvii	12	28				7	2.0	1.9					xvi	16	-	22							93				-16	0R	-
	xvii	xvii-xviii	22	35.6				6.5	1.1	2.0	2	**9%**	1.5-2.0		xvii	9	-	25		10-30					94				-9	0R	-
	xviii	xviii-xix	28	40				27.5	0.2	2.2	1	**5%**	2.0-2.5		xviii	4	-	27	5	**23%**	102	-		96	+	94				-4	2BR	+--
	xix	xix-xxi	13	40	7	**30%**	20-40	46	0.6	2.7					xix	7	+	31		30-60; 80-90					96				7	0R	+
	xx			46	1	**4%**	40-60	16	2.9	2.9	2	**9%**	2.5-3.0		xx			46	2	**9%**	86	-			96					B0	-
	xxi	xxi-xxii	35.6	66				80	0.2	3.3	1	**5%**	3.0-3.5		xxi	7	-	84	1	**5%**					96				-7	0R	-
	xxii	xxii-xxiii	18.7	80	2	**9%**	60-80	66	1.2	4.4	1	**5%**	4.0-4.5		xxii	3	+	94	1	**5%**	88	+			97				3	BR	++
	xxiii	xxiii-xxv	40	223.3	1	**4%**	200-250	20	3.3	9.3	1	**5%**	9.0-9.5		xxiii	84	-			90-120	97	+			97				-84	2B0	+-
	xxiv														xxiv						90	-			97					B0	-
	xxv	xxv-xxvi	15												xxv	94	+				94	-	138	-	102				94	2BR	+--
	xxvi	xvi-xvii	14												xxvi	17	+								108				17	0R	+
	xxvii	xxvii-xviii	14												xxvii	5	-								113				-5	0R	-
	xxviii	xviii-xix	7												xxviii	27	+								120	16	**50%**	90-120	27	0R	+
	xxix	xix-xxx	6.5												xxix	8	+								122				8	0R	+
	xxx	xxx-xxxi	27.5												xxx	1	+				92	+			130				1	BR	++
	xxxi	xxxi-xxxii	46												xxxi	7	-				148	-	89	+	138				-7	2BR	+--
	xxxii	xxxii-xxxiii	16												xxxii	1	-				60	+			148	4	**13%**	120-150	-1	BR	+-
	xxxiii	xxxiii-xxxvi	80												xxxiii	1	-				130	+							-1	BR	+-
	xxxiv														xxxiv						97	+								B0	+
	xxxv														xxxv						74	-								B0	-
	xxxvi														xxxvi						96	+								B0	+
	xxxvii	xxxvii-xxxix	66												xxxvii	25	-				120	+							-25	BR	+-
	xxxviii														xxxviii						86	+								B0	+
	xxxix	xxxix-xl	20												xxxix	8	+												8	0R	+
	xl														xl						71	-	113	+						2B0	+-
TOTAL			**787.3**		**23**	**100%**					**22**	**100%**	**39**						**22**	**100%**		**14+:14-**				**32**	**100%**					
														20.19														**1**	**35**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB--i	1	1-2	30	26				30							1					60-90											
	2	2-3	26	30	2	**100%**	20-40	26	1.2	1.2	1	**100%**	1.0-1.5		2	90	-	90	1	**100%**									-90	0R	-
	3														3																
TOTAL			**56**		**2**	**100%**					**1**	**100%**	**2**				**0+:1-**		**1**	**100%**											
														28														**0**	**-90**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-ii	1	1-2	25	13	1	**50%**	1-20	25							1					90-120											
	2	2-3	13	25	1	**50%**	20-40	13	1.9	1.9	1	**100%**	1.5-2.0		2	91	+	91	1	**100%**									91	0R	+
	3														3																
TOTAL			**38**		**2**	**100%**					**1**	**100%**	**2**				**0-:1+**		**1**	**100%**											
														19														**0**	**91**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-v	1	1-2	52					52							1					60-90											
	2	2-5	37	3	1	**33%**	1-20	37	1.4	1.4	1	**50%**	1.0-1.5		2	68	+	68	1	**50%**									68	0R	+
	3			37	1	**33%**	20-40	3	12.3	12.3	1	**50%**	12.0-12.5		3			95	1	**50%**	76	+			76					B0	+
	4			52	1	**33%**	40-60								4					90-120	87	+			87	2	**100%**	60-90		B0	+
	5	5-6	3												5	95	+												95	0R	+
	6														6																
TOTAL			**92**		**3**	**100%**					**2**	**100%**	**5**				**0-:2+**		**2**	**100%**							**2**	**100%**			
														18.4														**0**	**163**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-v-3	3	3-4	30	5				30							3																
	4	4-5	7	7				7	4.3	0.4	1	**25%**	0.1-0.5		4	103	-	91											-103	0R	-
	5	5-6	19	7.5				19	0.4	0.7	1	**25%**	0.5-1.0		5	00		98		90-120								00		00	00
	6	6-7	5	19	4	**80%**	1-20	5	3.8	3.8	1	**25%**	3.5-4.0		6	91	-	103	3	**100%**									-91	0R	-
	7	7-8	7.5	30	1	**20%**	20-40	7.5	0.7	4.3	1	**25%**	4.0-4.5		7	98	+												98	0R	+
	8														8																
TOTAL			**68.5**		**5**	**100%**					**4**	**100%**	**5**				**1+:2-**		**3**	**100%**											
														13.7														**0.5**	**-96**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-ix	1	1-2	16	6				16							1																
	2	2-3	6	16	2	**67%**	1-20	6	2.7	0.2	1	**50%**	0.1-0.5		2	85	-	85		60-90									-85	0R	-
	3	3-4	34	34	1	**33%**	20-40	34	0.2	2.7	1	**50%**	2.5-3.0		3	90	+	90	2	**100%**									90	0R	+
	4														4																
TOTAL			**56**		**3**	**100%**					**2**	**100%**	**3**				**1+:1-**		**2**	**100%**											
														18.67														**1**	**5**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xiv	1	1-2	13.5	6				13.5							1																
	2	2-3	7.4	7.4				7.4	1.8	0.6					2	15	-	15		10-30									-15	0R	-
	3	3-4	11.6	11.6				11.6	0.6	0.9	2	**50%**	0.5-1.0		3	24	-	24	2	**50%**									-24	0R	-
	4	4-6	13	13				13	0.9	1.8	1	**25%**	1.5-2.0		4	84	-	84	1	**25%**	60-90								-84	0R	-
	5			13.5	4	**100%**	1-20	6	2.2	2.2	1	**25%**	2.0-2.5		5			91	1	**25%**	91	+			91	1	**100%**	90-120		B0	+
	6	6-7	6												6	91	-			90-120									-91	0R	-
	7														7																
TOTAL			**51.5**		**4**	**100%**					**4**	**100%**	**6**				**0+:4-**		**4**	**100%**							**1**	**100%**			
														8.583														**0**	**-214**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xx	1	1-2	7.2	6				7.2							1																
	2	2-3	6	7.2				6	1.2	0.3	1	**33%**	0.1-0.5		2	91	+	87											91	0R	+
	3	3-4	22	17	3	**75%**	1-20	22	0.3	1.2					3	87	-	91	2	**67%**	60-90								-87	0R	-
	4	4-5	17	22	1	**25%**	20-40	17	1.3	1.3	2	**67%**	1.0-1.5		4	96	-	96	1	**33%**	90-120								-96	0R	-
	5														5																
TOTAL			**52.2**		**4**	**100%**					**3**	**100%**		**4**			**1+:2-**		**3**	**100%**											
														13.05														**0.5**	**-92**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxii	1	1-2	29.5	10				29.5							1																
	2	2-3	10	16	2	**67%**	1-20	10	3.0	0.6	1	50%			2	91	+	89	1	**50%**	60-90								91	0R	+
	3	3-4	16	29.5	1	**33%**	20-40	16	0.6	3.0	1	50%			3	89	+	91	1	**50%**	90-120								89	0R	+
	4														4																
TOTAL			**55.5**		**3**	**100%**					**2**	**100%**		**3**			**0-:2+**		**2**	**100%**											
														18.5														**0**	**180**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxiii	1	1-2	19	11				19							1					1-10;10-30; 30-60;60-90											
	2	2-4	18.5	12.5				18.5	1.0	0.7					2	7	+	7	1	**20%**									7	0R	+
	3			18.5				27	0.7	1.0	2	**40%**	0.5-1.0		3			14	1	**20%**	89	+			70					B0	+
	4	4-8	27	19				20	1.4	1.1					4	14	-	53	1	**20%**					89	2	**40%**	60-90	-14	0R	-
	5			20	5	**83%**	1-20	12.5	1.6	1.4	2	**40%**	1.0-1.5		5			76			120	-			120					B0	-
	6			27	1	**17%**	20-40	11	1.1	1.6	1	**20%**	1.5-2.0		6			88	2	**40%**	136	+	70	+	131					2B0	++
	7														7						131	+			136	3	**60%**	120-150		B0	+
	8	8-9	20												8	53	-												-53	0R	-
	9	9-10	12.5												9	76	+												76	0R	+
	10	10-11	11												10	88	+												88	0R	+
	11														11																
TOTAL			**108**		**6**	**100%**					**5**	**100%**		**10**			**2-:3+**		**5**	**100%**						**5**	**100%**				
														10.8														**0.67**	**104.00**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxiii-6	6	6-7	12	5				12							6																
	7	7-8	17	12				17	0.7	0.7	1	**50%**	0.5-1.0		7	18	-	18	1	**50%**	10-30								-18	0R	-
	8	8-9	5	17	3	**100%**	1-20	5	3.4	3.4	1	**50%**	3.0-3.5		8	91	+	91	1	**50%**	90-120								91	0R	+
	9														9																
TOTAL			**34**		**3**	**100%**					**2**	**100%**		**3**			**1+:1-**		**2**	**100%**											
														11.33														**1**	**73**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxiii-7	7	7-8	7.3	5				7.3							7																
	8	8-9	19	7.3				19	0.4	0.4	1	**50%**	0.1-0.5		8	22	-	22	1	**50%**	10-30								-22	0R	-
	9	9-10	5	19	3	**100%**	1-20	5	3.8	3.8	1	**50%**	3.5-4.0		9	91	-	91	1	**50%**	90-120								-91	0R	-
	10														10																
TOTAL			**31.3**		**3**	**100%**					**2**	**100%**		**3**			**0+:2-**		**2**	**100%**											
														10.43														**0**	**-113**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxx	1	1-2	13.6	11.5				13.6							1																
	2	2-3	11.5	13.6	2	**67%**	1-20	11.5	1.2	0.4	1	**50%**	0.1-0.5		2	49	-	49	1	**50%**	30-60								-49	0R	-
	3	3-4	26	26	1	**33%**	20-40	26	0.4	1.2	1	**50%**	1.0-1.5		3	86	+	86	1	**50%**	60-90								86	0R	+
	4														4																
TOTAL			**51.1**		**3**	**100%**					**2**	**100%**		**3**			**1+:1-**		**2**	**100%**											
														17.03														**1**	**37**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxxi	1	1-2	17.5	9				17.5							1																
	2	2-3	12.8	12.8				12.8	1.4	0.6					2	31	+	31	1	**33%**	30-60								31	0R	+
	3	3-4	18	17.5				18	0.7	0.7	2	**50%**	0.5-1.0		3	00		76										00	00	00
	4	4-5	32	18	4	**80%**	1-20	32	0.6	1.4	1	**25%**	1.0-1.5		4	76	-	87	2	**67%**	60-90								-76	0R	-
	5	5-6	9	32	1	**20%**	20-40	9	3.6	3.6	1	**25%**	3.5-4.0		5	87	-												-87	0R	-
	6														6																
TOTAL			**89.3**		**5**	**100%**					**4**	**100%**		**5**			**1+:2-**		**3**	**100%**											
														17.86														**0.5**	**-132**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxxii	1	1-2	21	3				21							1																
	2	2-5	25	4				25	0.8	0.6					2	55	-	5		1-10; 10-30; 30-60; 60-90; 90-120								-55	0R	-
	3			4				4	6.3	0.6					3			7	2	**25%**	93	+			78					B0	+
	4			4.5				3	1.3	0.8					4			27			90	-			88					B0	-
	5	5-6	4	7				4	0.8	0.8	4	**50%**	0.5-1.0		5	5	-	29	2	**25%**	93	+			90	3	**50%**	60-90	-5	BR	+-
	6	6-7	3	9				7	0.6	1.3					6	27	-	55	1	**13%**	102	+			93				-27	BR	+-
	7	7-8	4	12	7	**78%**	1-20	12	0.6	1.3	2	**25%**	1.0-1.5		7	7	-	72							93				-7	0R	-
	8	8-9	7	21				9	1.3	2.0	1	**13%**	11.5-2.0		8	72	-	74	2	**25%**	78	+			102	3	**50%**	90-120	-72	BR	+-
	9	9-10	12	25	2	**22%**	20-40	4.5	2.0	6.3	1	**13%**	6.0-6.5		9	29	+	91	1	**13%**									29	0R	+
	10	10-12	9												10	74	+												74	0R	+
	11														11						88	-								B0	-
	12	12-13	4.5												12	91	+												91	0R	+
	13														13																
TOTAL			**89.5**		**9**	**100%**					**8**	**100%**		**12**			**3+:5-**		**8**	**100%**						**6**	**100%**				
														7.458														**0.6**	**28**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxxii-6	6	6-7	6	6				6							6																
	7	7-9	18	8				18	0.3	0.3	1	**50%**	0.1-0.5		7	00														00	00
	8			18	3	**100%**	1-20	8	2.3	2.3	1	**50%**	2.0-2.5		8					60-90	87	-			87	1	**100%**	60-90		B0	-
	9	9-10	8												9	90	+	90	1	**100%**									90	0R	+
	10														10																
TOTAL			**32**		**3**	**100%**					**2**	**100%**		**4**			**0-:1+**		**1**	**100%**						**1**	**100%**				
														8														**0**	**90**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxxiii	1	1-3	32	7.2				32							1																
	2			15	2	**67%**	1-20	7.2	4.4	0.5	1	**50%**	0.1-0.5		2						70	+			70	1	**100%**	60-90		B0	+
	3	3-4	7.2	32	1	**33%**	20-40	15	0.5	4.4	1	**50%**	4.0-4.5		3	90	+	89		60-90									90	0R	+
	4	4-5	15												4	89	+	90	2	**100%**									89	0R	+
	5														5																
TOTAL			**54.2**		**3**	**100%**					**2**	**100%**		**4**			**0-:2+**		**2**	**100%**						**1**	**100%**				
														13.55														**0**	**179**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxxvi	1	1-2	23	13	1	**50%**	1-20	23							1																
	2	2-3	13	23	1	**50%**	20-40	13	1.8	1.8	1	**100%**	1.5-2.0		2	69	+	69	1	**100%**	60-90								69	0R	+
	3														3																
TOTAL			**36**		**2**	**100%**					**1**	**100%**		**2**			**0-:1+**		**1**	**100%**											
														18														**0**	**69**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
BB-xxxviii	1	1-2	17.5	17.5				17.5							1																
	2	2-3	17.5	17.5	2	**100%**	1-20	17.5	1	1	1	**100%**	0.5-1.0		2	97	-	97	1	**100%**	90-120								-97	0R	-
	3														3																
			35		**2**	**100%**					**1**	**100%**		**2**			**0+:1-**		**1**	**100%**											
														17.5														**0**	**-97**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
A-A	i	A-ii	17	6.5				17							i						109	-									-
	ii	ii-ix	102	7				102	0.2	0.2					ii	5	+	1							44	1	**3%** 30-60		5	B0	+
	iii			10				20	5.1	0.2					iii			2			90	-			70					0R	-
	iv			14				55	0.4	0.2					iv			2			95	+			71					B0	+
	v			14				57.5	1.0	0.4	4	**22%**	0.1-0.5		v			2			90	-			74					B0	-
	vi			15				53.4	1.1	0.6					vi			3			84	+			77					B0	+
	vii			17				80	0.7	0.7					vii			4			98	-			79					B0	-
	viii			20	8	**42%**	1-20	56.5	1.4	0.7					viii			5			71	+			80					B0	+
	ix	ix-x	20	22				10	5.7	1.0					ix	20	+	5							83				20	0R	+
	x	x-xii	55	27.5				15	0.7	1.0	5	**28%**	0.5-1.0		x	3	-	8		1-10	97	+			84				-3	BR	+-
	xi			32				14	1.1	1.1					xi			9	10	**59%**	86	-			84					B0	-
	xii	xii-xvii	57.5	38.3	4	**21%**	20-40	14	1.0	1.1					xii	2	-	11			97	+			85				-2	BR	+-
	xiii			53.4				7	2.0	1.1					xiii			17			87	-			86					B0	-
	xiv			55				6.5	1.1	1.4					xiv			17			88	-			87					B0	-
	xv			56.5				27.5	0.2	1.5	5	**28%**	1.0-1.5		xv			20		10-30	87	+			87					B0	+
	xvi			57.5	4	**21%**	40-60	114	0.2	2.0	1	**6%**	1.5-2.0		xvi			27	5	**29%**	88	-			87					B0	-
	xvii	xvii-xx	53.4	80	1	**5%**	60-90	32	3.6	3.6	1	**6%**	3.5-4.0		xvii	4	+	32			87	-	91	+	88				4	2BR	++-
	xviii			102				22	1.5	5.1	1	**6%**	5.0-5.5		xviii			35	2	**12%**	80	+			88					B0	+
	xix			114	2	**11%**	90-120	38.3	0.6	5.7	1	**6%**	5.5-6.0		xix					30-60	77	+			88					B0	+
	xx	xx-xxi	80												xx	17	+				170	-	88	-	89				17	2BR	+--
	xxi	xxi-xxii	56.5												xxi	11	+				74	-			89				11	BR	+-
	xxii	xxii-xxv	10												xxii	35	-								90				-35	0R	-
																									90	21	**64%** 60-90				
																									91						
	xxv	xxv-xxvi	15												xxv						94	+	44	-	92					2B0	+-
	xxvi	xvi-xvii	14												xxvi	17	+								93				17	0R	+
	xxvii	xxvii-xviii	14												xxvii	5	-								94				-5	0R	-
	xxviii	xviii-xix	7												xxviii	27	+								95				27	0R	+
	xxix	xix-xxx	6.5												xxix	8	+								97				8	0R	+
	xxx	xxx-xxxi	27.5												xxx	1	+				92	+			97				1	BR	++
	xxxi	xxxi-xxxiv	114												xxxi	32	-				173	-	89	+	98				-32	2BR	+--
	xxxii														xxxii						79	-			109	9	**27%** 90-120			B0	-
	xxxiii														xxxiii						84	-			170					B0	-
	xxxiv	xxxiv-xxxv	32												xxxiv	9	-				70	-			173	2	**6%** 150-180		-9	BR	--
	xxxv	xxxv-xxxvi	22												xxxv	2	+				85	-							2	BR	+-
	xxxvi	xxxvi-xxxvi	38.3												xxxvi	2	+				89	+							2	BR	++
	xxxvii														xxxvii						83	-	93	+						2B0	+-
TOTAL			**741.7**		**19**	**100%**					**18**	**100%**		**34**			**6-:11+**		**17**	**100%**						**33**	**100%**				
									21.81																			**0.55**	**28**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-i	1	1-2	27	2				27							1																
	2	2-3	2	10	2	**50%**	1-20	2	13.5	0.2					2	72	+	65											72	0R	+
	3	3-5	10	23				10	0.2	0.4	2	**67%**	0.1-0.5		3	83	-	72		60-90									-83	0R	-
	4			27	2	**50%**	20-40	23	0.4	13.5	1	**33%**	13.0-13.5		4			83	3	**100%**	89	-			89	1	**50%** 60-90			B0	-
	5	5-7	23												5	65	+								114	1	**50%** 90-120		65	0R	+
	6														6						114	-								B0	-
	7														7																
TOTAL			**62**		**4**	**100%**					**3**	**100%**		**6**			**1-:2+**		**3**	**100%**						**2**	**100%**				
														10.33														**0.5**	**54**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-i-4	4	4-5	9	5				9							4																
	5	5-6	11	9				11	0.8	0.8	1	**50%**	0.5-1.0		5	78	-	67		60-90									-78	0R	-
	6	6-7	5	11	3	**100%**	1-20	5	2.2	2.2	1	**50%**	2.0-2.5		6	67	+	78	2	**100%**									67	0R	+
	7														7																
TOTAL			**25**		**3**	**100%**					**2**	**100%**		**3**			**1+:1-**		**2**	**100%**											
														8.333														**1**	**-11**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-iii	1	1-3	23					23							2					90-120	87	-								B0	-
	2			14.5	1	**50%**	1-20	14.5	1.6	1.6	1	**100%**	1.5-2.0		3	91	+	91	1	**100%**					87	1	**100%**	60-90	91	0R	+
	3	3-4	14.5	23	1	**50%**	20-40								4															
	4																													
TOTAL			**37.5**		**2**	**100%**					**1**	**100%**	**3**				**0-:1+**		**1**	**100%**						**1**	**100%**				
														12.5														**0**	**91**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-v	1	1-2	15	1.5				15							1																
	2	2-3	8	6				8	1.9	1.3	1	**33%**	1.0-1.5		2	28	-	28	1	**33%**	10-30								-28	0R	-
	3	3-4	6	8				6	1.3	1.9	1	**33%**	1.5-2.0		3	46	-	46	1	**33%**	30-60								-46	0R	-
	4	4-5	1.5	15	4	**100%**	1-20	1.5	4.0	4.0	1	**33%**	3.5-4.0		4	97	-	97	1	**33%**	90-120								-97	0R	-
	5														5																
TOTAL			**30.5**		**4**	**100%**					**3**	**100%**	**4**				**0+:3-**		**3**	**100%**											
														7.625														**0**	**-171**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-vi	1	1-2	11.5	11.5	1	**50%**	1-20	11.5							1																
	2	2-3	24	24	1	**50%**	20-40	24	0.5	0.5	1	**100%**	0.1-0.5		2	87	-	87	1	**100%**	60-90								-87	0R	-
	3														3																
			35.5		**2**	**100%**					**1**	**100%**	**2**				**0+:1-**		**1**	**100%**											
														17.75														**0**	**-87**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-vii	1	1-5	32	11.3				32							1										73						
	2			17				23	1.4	0.2	1	**20%**	0.1-0.5		2						98	+			79					B0	+
	3			20	3	**50%**	1-20	11.3	2.0	1.2					3						98	+			85					B0	+
	4			23				50	0.2	1.4	2	**40%**	1.0-1.5		4					1-10	88	-			85					B0	-
	5	5-9	23	32	2	**33%**	20-40	20	2.5	2.0					5	9	+	9	1	**20%**					88	5	**42%**	60-90	9	0R	+
	6			50	1	**17%**	40-60	17	1.2	2.5	2	**40%**	2.0-2.5		6			47	1	**20%**	110	+			98					B0	+
	7														7			76		30-60	85	+			98					B0	+
	8													nuk ka	8			78							98						
	9	9-11	11.3												9	47	+	90	3	**60%**	98	-			102				47	BR	+-
	10														10					60-90	73	+			103					B0	+
	11	11-14	50												11	76	-				149	+			110	6	**50%**	90-120	-76	BR	+-
	12														12						102	-			149	1	**8%**	120-150		B0	-
	13														13						103	-	79	+						2B0	+-
	14	14-15	20												14	78	-												-78	0R	-
	15	15-17	17												15	90	-												-90	0R	-
	16														16						85	-								B0	-
	17														17																
TOTAL			**153.3**		**6**	**100%**					**5**	**100%**	**15**				**2+:3-**		**5**	**100%**						**12**	**100%**				
														10.22														**0.67**	**-188**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi	index Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-vii-9	9	9-11	10	4.6				10							9																
	10			7				31	0.3	0.3					10						11	+			11	1	**33%**	10-30		B0	+
	11	11-14	31	10				7	4.4	0.5	2	**50%**	0.1-0.5		11	7	+	6							83	1	**33%**	60-90	7	0R	+
	12			15	4	80%	1-20	15	0.5	3.3	1	**25%**	3.0-3.5		12			7		1-10	104	+			104	1	**33%**	90-120		B0	+
	13			31	1	20%	20-40	4.6	3.3	4.4	1	**25%**	4.0-4.5		13			7	3	**75%**	83	-								B0	-
	14	14-15	7												14	7	-	116	1	**25%**									-7	0R	-
	15	15-16	15												15	6	-			90-120									-6	0R	-
	16	16-17	4.6												16	116	-												-116	0R	-
	17														17																
TOTAL			**67.6**		**5**	**100%**					**4**	**100%**	**8**				**1+:3-**		**4**	**100%**						**3**	**100%**				
														8.45														**0.33**	**-122**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-vii-12	12	12-13	10	9				10							12					60-90											
	13	13-14	9	10	2	**100%**	1-20	9	1.1	1.1	1	**100%**	1.0-1.5		13	87	-	87	1	**100%**									-87	0R	-
	14														14																
TOTAL			**19**		**2**	**100%**					**1**	**100%**	**2**				**0+:1-**		**1**	**100%**											
														9.5														**0**	**-87**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-vii-11	11	11-13	9	9				9							11																
	12			9				23	0.4	0.4	1	**33%**	0.1-0.5		12					10-30	100	-	94	+	83	1	**17%**	60-90		2B0	+-
	13	13-17	23	10	3	**75%**	1-20	9	2.6	0.9	1	**33%**	0.5-1.0		13	12	+	12	1	**33%**					92				12	0R	+
	14			23	1	**25%**	20-40	10	0.9	2.6	1	**33%**	2.5-3.0		14			97			83	-	92	+	93					2B0	+-
	15														15			102	2	**67%**	93	+			94					B0	+
	16														16					90-120	99	+			99					B0	+
	17	17-18	9												17	102	-							100	5	83%	90-120	-102	0R	-
	18	18-19	10												18	97	+											97	0R	+
	19														19																
TOTAL			**51**		**4**	**100%**					**3**	**100%**	**8**				**1-:2+**		**3**	**100%**						**6**	**100%**				
														6.375														**0.5**	**7**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-viii	1	1-2	37	7				37							1																
	2	2-3	7	9				7	5.3	0.4	1	**25%**	0.1-0.5		2	00													00		00	00
	3	3-4	9	10	3	**60%**	1-20	9	0.8	0.8					3	76	+	76												76	0R	+
	4	4-5	10	25				10	0.9	0.9	2	**50%**	0.5-1.0		4	88	-	83												-88	0R	-
	5	5-6	25	37	2	**40%**	20-40	25	0.4	5.3	1	**25%**	5.0-5.5		5	83	+	88	3	**100%**	60-90									83	0R	+
	6														6																
TOTAL			**88**		**5**	**100%**					**4**	**100%**	**5**				**1-:2+**		**3**	**100%**											
														17.6														**0.5**	**71**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xi	1	1-2	25	25				25							1																
	2	2-3	26.4	26.4	2	**100%**	20-40	26.4	0.9	0.9	1	**100%**	0.5-1.0		2	99	-	99	1	**100%**	60-90								-99	0R	-
	3														3																
TOTAL			**51.4**		**2**	**100%**					**1**	**100%**	**2**				**0+:1-**		**1**	**100%**											
														25.7														**0**	**-99**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xiii	1	1-2	27	4				27							1																
	2	2-3	11	11				11	2.5	0.8	1	**33%**	0.5-1.0		2	100	+	90												100	0R	+
	3	3-4	14	14	3	**75%**	1-20	14	0.8	2.5	1	**33%**	2.0-2.5		3	97	-	97												-97	0R	-
	4	4-5	4	27	1	**25%**	20-40	4	3.5	3.5	1	**33%**	3.0-3.5		4	90	-	100	3	**100%**	90-120									-90	0R	-
	5														5																
			56		**4**	**100%**					**3**	**100%**	**4**				**1+:2-**		**3**	**100%**											
														14														**0.5**	**-87**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xiv	1	1-2	21.5	3				21.5							1																
	2	2-3	3	10	2	**67%**	1-20	3	7.2	0.3	1	**50%**	0.1-0.5		2	97	+	38	1	**50%**	30-60								97	0R	+
	3	3-4	10	21.5	1	**33%**	20-40	10	0.3	7.2	1	**50%**	7.0-7.5		3	38	-	97	1	**50%**	90-120								-38	0R	-
	4														4																
			34.5		**3**	**100%**					**2**	**100%**	**3**				**1+:1-**		**2**	**100%**											
														11.5														**1**	**59**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xvii+	1	1-2	11.5	2				11.5							1																
	2	2-3	2	5.5				2	5.8	0.3	1	**33%**	0.1-0.5		2	32	-	32	1	**33%**	30-60							-32	0R	-
	3	3-4	7	7				7	0.3	1.3	1	**33%**	1.0-1.5		3	88	+	88										88	0R	+
	4	4-5	5.5	11.5	4	**100%**	1-20	5.5	1.3	5.8	1	**33%**	5.5-6.0		4	85	-	85	2	**67%**	60-90							-85	0R	-
	5														5															
TOTAL			**26**		**4**	**100%**					**3**	**100%**		**4**			**1+:2-**		**3**	**100%**										
														6.5														**0.5**	**-29**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xvii-	1	1-6	47.5	13				47.5							1															
	2			14				18	2.6	0.3	1	**25%**	0.1-0.5		2						81	+			54	1	**8%** 30-60		B0	+
	3			18	3	**60%**	1-20	14	1.3	1.3	1	**25%**	1.0-1.5		3						72	+			72				B0	+
	4			44				44	0.3	2.6	1	**25%**	2.5-3.0		4						95	-			78				B0	-
	5			47.5	2	**40%**	20-40	13	3.4	3.4	1	**25%**	3.0-3.5		5						78	+			80				B0	+
	6	6-8	18												6	5	-	5	1	**25%**					81			-5	0R	-
	7														7			35		1-10	89	+			87				B0	+
	8	8-11	14												8	35	+	45	2	**50%**	87	-			88			35	BR	+-
	9														9			70	1	**25%**	54	-			89				B0	-
	10														10			30-60; 60-90			80	+			89	8	**67%** 60-90		B0	+
	11	11-15	44												11	45	+				147	-			95			45	BR	+-
	12														12						100	-			100	2	**17%** 90-120		B0	-
	13														13						89	+			147	1	**8%** 120-150		B0	+
	14														14						88	-							B0	-
	15	15-16	13												15	70	+											70	0R	+
	16														16															
TOTAL			**136.5**		**5**	**100%**					**4**	**100%**		**15**		**1-:3+**			**4**	**100%**						**12**	**100%**			
														9.1														**0.33**	**145**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xvii--7	7	7-8	20	7.3				20							7															
	8	8-9	7.3	18				7.3	2.7	0.4	1	**50%**	0.1-0.5		8	29	+	29	1	**50%**	10-30							29	0R	+
	9	9-10	18	20	3	**100%**	1-20	18	0.4	2.7	1	**50%**	2.5-3.0		9	89	-	89	1	**50%**	60-90							-89	0R	-
	10														10															
TOTAL			**45.3**		**3**	**100%**					**2**	**100%**		**3**			**1+:1-**		**2**	**100%**										
														15.1														**1**	**-60**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xvii--8	8	8-11	35	4				35							8															
	9			5.4	2	**50%**	1-20	4	8.8	0.3	1	**33%**	0.1-0.5		9						85	-			85				B0	-
	10			21.4				5.4	0.7	0.7	1	**33%**	0.5-1.0		10					60-90	89	-			89	2	**100%** 80-120		B0	-
	11	11-12	4	35	2	**50%**	20-40	21.4	0.3	8.8	1	**33%**	8.5-9.0		11	85	-	85	1	**33%**								-85	0R	-
	12	12-13	5.4												12	91	+	91										91	0R	+
	13	13-14	21.4												13	94	-	94	2	**67%**								-94	0R	-
	14														14					90-120											
TOTAL			**65.8**		**4**	**100%**					**3**	**100%**		**6**			**1+:2-**		**3**	**100%**						**2**	**100%**			
														10.97														**0.5**	**-88**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xvii--8-9	9	9-10	24	5.7				24							9					60-90										
	10	10-11	5.7	7.2	2	**67%**	1-20	5.7	4.2	0.8	1	**50%**	0.5-1.0		10	93	+	86	1	**50%**								93	0R	+
	11	11-12	7.2	24	1	**33%**	20-40	7.2	0.8	4.2	1	**50%**	4.0-4.5		11	86	-	93	1	**50%**								-86	0R	-
	12														12					90-120										
TOTAL			**36.9**		**3**	**100%**					**2**	**100%**		**3**			**1+:1-**		**2**	**100%**										
														12.3														**1**	**7**		

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xvii--8-1	10	10-11	4.7	3				4.7							10															
	11	11-12	3	4.7				3	1.6	0.2	1		**50%** 0.1-0.5		11	93	-	93											-93	0R	-
	12	12-13	13	13	3	**100%**	1-20	13	0.2	1.6	1		**50%** 1.5-2.0		12	93	+	93	2	**100%**	90-120								93	0R	+
	13														13															
TOTAL			**20.7**		**3**	**100%**					**2**	**100%**		**3**			**1+:1-**		**2**	**100%**										
														6.9														**1**	**0**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xvii--9	9	9-12	45												9					60-90										
	10			45	1	**100%**	40-60	NA				NA			10	88	+	88	1	**50%**									88	B0	+
	11														11	94	+	94	1	**50%**									94	B0	+
	12														12					90-120										
TOTAL			**45**		**1**	**100%**								**3**			**0-:2+**		**2**	**100%**										
														15														**0**	**182**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xx	1	1-3	38					38							1															
	2			30	1	**50%**	10-30	30	1.3	1.3	1	**100%**	1.0-1.5		2					60-90	95	-			95	1	**100%**	90-120		B0	-
	3	3-4	30	38	1	**50%**	30-60								3	90	-	90	1	**100%**									-90	0R	-
	4														4															
TOTAL			**68**		**2**	**100%**					**1**	**100%**		**3**			**0+:1-**		**1**	**100%**							**1**	**100%**			
														22.67														**0**	**-90**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xxi	1	1-2	13	7				13							1															
	2	2-3	12.5	12.5				12.5	1.0	1.0	1		**50%** 0.5-1.0		2	21	-	21	1	**50%**									21	0R	-
	3	3-4	7	13	3	**100%**	1-20	7	1.8	1.8	1		**50%** 1.5-2.0		3	81	+	81	1	**50%**									81	0R	+
	4														4															
			32.5		**3**	**100%**					**2**	**100%**		**3**					**2**	**100%**										
														10.83																

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xxxii	1	1-2	28	8				28							1															
	2	2-3	20	20	2	**67%**	1-20	20	1.4	1.4	1		**50%** 1.0-1.4		2	88	-	88		60-90									-88	0R	-
	3	3-4	8	28	1	**33%**	20-40	8	2.5	2.5	1		**50%** 2.0-2.5		3	88	+	88	2	**100%**									88	0R	+
	4														4															
			56		**3**	**100%**					**2**	**100%**		**3**			**1+:1-**		**2**	**100%**										
														18.67														**1**	**0**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xxxiii	1	1-2	16.5	8				16.5							1															
	2	2-3	28	11.5				28	0.6	0.6					2	76	+	76											76	0R	+
	3	3-4	12.4	12.4				12.4	2.3	0.7					3	93	-	78											-93	0R	-
	4	4-5	13.6	13.6				13.6	0.9	0.9	3		**60%** 0.5-1.0		4	78	-	79		60-90									-78	0R	-
	5	5-6	8	16.5	5	**83%**	1-20	8	1.7	1.7	1		**20%** 1.5-2.0		5	81	-	81	4	**80%**									-81	0R	-
	6	6-7	11.5	28	1	**17%**	20-40	11.5	0.7	2.3	1		**20%** 2.0-2.5		6	79	+	93	1	**20%**									79	0R	+
	7														7					90-120										
TOTAL			**90**		**6**	**100%**					**5**	**100%**		**6**			**2+:3-**		**5**	**100%**										
														15														**0.67**	**-97**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xxxv	1	1-2	43.6	6				43.6							1															
	2	2-3	18.7	15				18.7	2.3	0.4	1		**33%** 0.1-0.5		2	84	+	69											84	0R	+
	3	3-4	6	18.7	3	**75%**	1-20	6	3.1	2.3	1		**33%** 2.0-2.5		3	69	-	83		60-90									-69	0R	-
	4	4-5	15	43.6	1	**25%**	40-60	15	0.4	3.1	1		**33%** 3.0-3.5		4	83	+	84	3	**100%**									83	0R	+
	5														5															
TOTAL			**83.3**		**4**	**100%**					**3**	**100%**		**4**			**1-:2+**		**3**	**100%**										
														20.83														**0.5**	**98**	

Lines	Nodes	segments	Ls (m)	Sort	N. event.	Lsf (%)	Ranges	Ls (m)	Lsi index	Sort	N. event	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort	N.event.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort	N. event	Abf (%)	Crr	Rrr	Srb	Arr
AA-xxxvi	1	1-2	24.7	6.7				24.7							1															
	2	2-3	6.7	17	2	**50%**	1-20	6.7	3.7	0.4					2	88	+	88		60-90									88	0R	+
	3	3-4	17	24.7	1	**25%**	20-40	17	0.4	0.4	2	**67%**			3	88	-	88	2	**67%**									-88	0R	-
	4	4-5	42	42	1	**25%**	40-60	42	0.4	3.7	1	**33%**			4	94	-	94	1	**33%**									-94	0R	-
	5														5					90-120										
TOTAL			**90.4**		**4**	**100%**					**3**	**100%**	**4**				**1+:2-**		**3**	**100%**										
														22.6														**0.5**	**-94**	

ranges
1-20
20-40
40-60
60-80
80-100
100-150
150-200
200-350

ranges
01-0.5
0.5-1.0
1.0-1.5
1.5-2.0
2.0-2.5
2.5-3.0
3.0-3.5
3.5-4.0

ranges
1-10
10-30
30-60
60-90
90-120
120-150
150-180

0

Lines	Nodes Nodes along the line a-a	segments Measured segments	Ls (m) *Segmental length (m)*	sort Ls *Segmental length relative frequency*	Fe *number of frequences*	Lsf (%) *Relative frequency of segmental length*	Ranges	Ls index nı *Segmental Length index number (ratio)*	sort *number of frequences*	Lsfi *Relative frequency of index numbers*	Nn *Number of nodes along the line*	Nl *Nodes per length*	Nodes	Ar *Angle of refraction*	Rr *Rotation of refraction*	Sort Ar *number of events*		Arf (%)	Ab *Angle of bifurcation*	Rb *Rotation of bifurcation*	Ab2	Rb2	Sort Ab *number of events*		Abf (%)	Crr *Consistency of rotation ratio*	Rrr *Resultant of refraction rotation*	Srb *Sequence refraction & bifurcation*	Arr *Alternation of refractoin and bifurcations rotatoins; Node's*	W *Width*	W *Width relative frequency*	Wv *Width variatoin*
a-a																															
	1	1-3	52.2	14.6									1																7		1.0
	2				1	**10%**	deri 20	0.92	0.4				2						94	-			78					B0	-			
	3	3-4	47.8	22				0.68	0.5				3	66	+	2			122	-			79					66	BR	+-	7		1.2
	4	4-5	32.3	31.6				0.98	0.7				4	57	-	3			155	+			80					-57	BR	+-	6		1.0
	5	5-6	31.6	32.3				3.10	0.7				5	39	+	9		deri 10	107	-			83					39	BR	+-	6		1.0
	6	6-7	98	34.2					0.9				6	35	+	10	4	**44%**	127	-	82	+	86					35	2BR	++-	6		
	7								1.0				7	2	+	35							86					2	0R	+			
	8								1.2				8			39		30-60	101	-			90	7	**41%**	60-90		B0	-			
	9								2.3				9			57	3	**33%**	94	-			94					B0	-			
	10								3.1				10			64		60-90	90	+			94					B0	+			
	11	7-11	49.5	40	5	**50%**	20-40	0.51					11	10	-	66	2	**22%**	86	-			95					-10	BR	--			
	12												12						86	+			101					B0	+			
	13	11-13	22	47.8				0.44					13	9	-				113	-	89	+	106					-9	B0	+--			
	14												14						78	+			107						BR	+			
	15	13-15	14.6	49.5				0.66					15	64	-				80	+			113	7	**41%**	90-120		-64	B0	+-			
	16												16						95	+			122						BR	+			
	17												17						106	-			127	2	**12%**	120-150			B0	-			
	18												18						79	+			155	1	**6%**	150-180			B0	+			
	19	15-19	34.2	52.2	3	**30%**	40-60	2.34					19	3	-													-3	B0	-			
	20												20						83	+									BR	+			
	21	19-21	40	98	1	**10%**	80-100	1.17					21																			
TOTALS			**422.2**		**10**	**100%**					**20**				**4+:5-**		**9**	**1**		**10+:9-**		**2**		**17**	**100%**						
												21.11														**0.8**	**-1**				

Secondary:	Nodes	segments	Ls (m)	sort Ls	Fe	Lsf (%)		Ls index nı	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr	W	W	Wv
b-b																														
	30	30-27	62	14									30													B0				
	29			20	2	**40%**	deri 20	0.23	0.2				29					74	+			74				B0	+			
	28			50					1.1				28					81	-			81				B0	-			
	27	27-25	14	56.5	2	**40%**	40-60		1.4				27	7	-	2						83				-7	0R	-			
	26			62	1	**20%**	60-80		2.5				26			5		91	+			85				B0	+			
	25	25-21	20					1.43					25	5	-	7		deri 10				86				-5	0R	-			
	24												24			7	4	**100%**	89	+			87				B0	+			
	23												23						86	-			88				B0	-			
	22												22						88	+			89				B0	+			
	21	21-15	50					2.50					21	7	-								89				-7	0R	-			
	20												20						83	+			89		60-90			B0	+			
	19												19						87	-			90	11	**69%**			B0	-			
	18												18						93	-			91					B0	-			
	17												17						91	+			91					B0	+			
	16												16						97	-			93					B0	-			
	15	15-13	56.5					1.13					15	2	-				89	+			97		90-120			-2	BR	+-			
	14												14						90	-	85	+	101	5	**31%**				2B0	-			
	13	Oika e fundit eshte llogaritur si bifurkim											13						89	-	101	+							0R	-			
TOTALS			**202.5**		**5**	**100%**					**17**				**0+:4-**		**4**	**100%**						**16**	**100%**						
												11.91																				

Secondary:	Nodes	segments	Ls (m)	sort Ls	Fe	Lsf (%)		Ls index nı	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr	W	W	Wv
c-c	1	1-6	121.5	121.5	1	**100%**	120-140	NA	NA	NA	NA												66							
	2																		95	+			68				B0	+			
	3																		70	-			70		60-90		B0	-			
	4																		66	-			73	4	**67%**		B0	-			
	5																		73	+			95		990-120		B0	+			
	6																		68	-	112	+	112	2	**33%**		2B0	-			
TOTALS			**121.5**		**1**	**100%**					**5**													**6**	**100%**						
												24.3														NA	NA				

Secondary:	Nodes	segments	Ls (m)	sort Ls	Fe	Lsf (%)		Ls index n	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr	W	W	Wv
d-d	1	1-2	11.6	11.5									1				deri 10													
	2	2-3	11.5	11.6				0.99	1.0				2	30	-	7	1 **25%**	103	+			75				-30	BR	+-			
	3	3-4	11.7	11.7	3	**60%**	deri-20	1.02	1.0				3	31	+	12	10-30					83	60-90			31	R0	+			
	4	4-5	26.3	26.3	1	**20%**	20-40	2.25	2.2				4	7	+	30	2 **50%**					90	3 **60%**			7	R0	+			
	5	5-7	59.6	59.6	1	**20%**	40-60	2.27	2.3				5	12	-	31	1 **25%**	75	-			97	90-120			-12	BR	--			
	6												6				30-60	90	-			103	2 **40%**				B0	-			
	7												7					83	-	97	+						2B0	-			
TOTALS			**120.7**		**5**	**100%**						**6**			**2+:2-**		**4 100%**						**5 100%**							
												20.11667													**1**	**-4**				

Length	00-0.5	deri 10
deri 20	0.5-1.00	10-30
20-40	1.0-1.5	30-60
40-60	1.5-2.0	60-90
60-80	2.0-2.5	90-120
80-100	2.5-3.0	120-150
100	3.0-3.5	150-180
100-120	3.5-4.0	
120-140		

ranges
1-20
20-40
40-60
60-80
80-100
100-150
150-200
200-350

ranges
01-0.5
0.5-1.0
1.0-1.5
1.5-2.0
2.0-2.5
2.5-3.0
3.0-3.5
3.5-4.0

ranges
1-10
10-30
30-60
60-90
90-120
120-150
150-180
150-180

Lines	Nodes	segments	Ls (m)	sort Ls		Lsf (%)	Ranges	Ls index n	Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
	Nodes along the line	Measured segments	*Segmental length (m)*	*Segmental length relative frequency*	*number of frequences*	*Relative frequency of segmental length*		*Segmental Length index number (ratio)*			*Relative frequency of index numbers*	*Number of nodes along the line*	*Nodes per length*		*Angle of refraction*	*Rotation of refraction*		*number of events*		*Angle of bifurcation*	*Rotation of bifurcation*				*number of events*		*Consistency of rotation ratio*	*Resultant of refraction rotation*	*Sequence refraction & bifurcation*	*Alternation of refractoin and bifurcatio*
a-2	2	2-3	27	13.8										2					1-10											
	3	3-5	17	17	2	**67%**	1-20	0.63						3	3	-	3	1	**100%**									-3	R0	-
	4			27	1	**33%**	20-40	0.81						4						87	-			87	1	**100%**	60-90			-
	5	5-6	13.8											5	00															00
	6													6																
TOTAL			**57.8**		**3**	**100%**							**4**	**14.45**		**0+:1-**		**1**	**100%**						**1**	**100%**			
																											0	-3		

Lines	Nodes	segments	Ls (m)	sort Ls		Lsf (%)	Ranges	Ls index n	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-2-4																											
	4	4-5	13.5	13									4														
	5	5-6	13	13.5									5	00												00	00
	6	6-7	19	13.5									6		90	+	82	60-90								90	0R	+
	7	7-8	13.5	19	4	**100%**	1-20						7		82	+	90	2	**100%**							82	0R	+
	8												8														
TOTAL			**59**		**4**							**4**			**0-:2+**		**2**	**100%**									
												14.75													**0**	**172**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3	3	3-4	11	6.7				11					3														
	4	4-10	66	11				66					4	11	+	11										11	0R	+
	5			11				28					5			12		86	-			86				B0	-
	6			13.6				18.2					6			21		88	+			87				B0	+
	7			18.2				6.7					7			27	10-20	87	-			88	3	**30%**	60-90	B0	-
	8			19.8	6	75%	1-20	11					8			29	5 71%	93	+			92				B0	+
	9			28	1	13%	20-40	13.6					9			86	1 14%	165	-	196	-	93				2B0	--
	10	10-13	28	66	1	13%	60-80	19.8					10	27	+	97	1 14%	165	-			93	3	**30%**	90-120	27	BR	+-
	11												11				90-120	00				126	1	**10%**	120-150		00	
	12												12					93	+			165					B0	+
	13	13-14	18.2										13	12	-			92	-			165	2	**20%**	150-180	-12	BR	--
	14	14-15	6.7										14	97	-							196	1	**10%**	180-210	-97	0R	-
	15	15-16	11										15	29	+											29	0R	+
	16	16-17	13.6										16	21	+			126	-							21	BR	+-
	17	17-18	19.8										17	86	-											-86	0R	-
	18												18														
TOTAL			**174.3**		**8**	**100%**						**15**			**3-:4+**		**7**	**100%**						**10**	**100%**			
												11.62													**0.75**	**-107**		

Lines	Nodes	segments	Ls (m)	sort Ls	Num Fre	Lsf (%)	Ranges	Ls index n	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3-5	**5**	5-6	7.7	4.6									**5**				30-60										
	6	6-7	5.3	5.3									**6**	51	+	51	1 **50%**									51	0R	+
	7	7-8	4.6	7.7	3	**100%**	1-20						**7**	86	-	86	1 **50%**									-86	0R	-
	8												**8**				60-90										
TOTAL			**17.6**		3	100%						**3**			**1+:1-**		2 100%										
												5.87													**1**	**-35**		

Lines	Nodes	segments	Ls (m)	sort Ls	Num Fre	Lsf (%)	Ranges	Ls index n sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3-6	6	6-7	5.5	5								6				60-90										
	7	7-8	5	5.5	2	**100%**	1-20					7	64	+	64	1 **100%**								64	0R	+
	8											8														
TOTAL			**10.5**		**2**	100%					**2**			**0-:1+**		1 100%										
											5.25												**0**	64		

Lines	Nodes	segments	Ls (m)	sort Ls	Num Fre	Lsf (%)	Ranges	Ls index n sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3-9	9	9-10	26	8								9														
	10	10-11	9	9	2	**67%**	1-20					10				60-90									00	00
	11	11-12	8	26	1	**33%**	20-40					11	83	-	83	1 **100%**								-83	0R	-
	12											12														
TOTAL			**43**		3	100%					3			**0+:1-**		1 100%										
											14.33												**0**	**-83**		

Lines	Nodes	segments	Ls (m)	sort Ls	Num Fre	Lsf (%)	Ranges	Ls index n sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3-9'	9	9-10	11.3	6								9				10-20										
	10	10-11	9.9	9.9								10	12	+	12	1 50%								12	0R	+
	11	11-12	6	11.3	3	**100%**	1-20					11	90	+	90	1 50%								90	0R	+
	12											12				60-90										
TOTAL			**27.2**		3	100%					3			0-:2+		2 100%										
											9.07												**0**	102		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Frequ	Lsf (%)	Ranges	Ls index n sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3-10 (14)	10	10-11	2.8	2.8								10														
	11	11-12	2.8	2.8								11	00			10-30									00	00
	12	12-13	16.3	4.3								12	19	+	19	1 **50%**								19	0R	+
	13	13-14	4.3	16.3	4	**100%**	1-20					13	76	+	76	1 **50%**								76	0R	+
	14											14				60-90										
TOTAL			**26.2**		**4**	**100%**					**4**			**0-:2+**		**2 100%**										
											6.55												**0**	**95**		

Lines	Nodes	segments	Ls (m)	sort Ls	Num Fre	Lsf (%)	Ranges	Ls index n sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3-9-12	12	12-13	5	5								12				1-10										
	13	13-14	6	6								13	87	-	10	1 **33%**								-87	0R	-
	14	14-15	6.7	6.7								14	94	-	87	1 **33%**	60-90							-94	0R	-
	15	15-16	11	11	4	**100%**	1-20					15	10	+	94	1 **33%**	91	-			91	**1**	**100%**	90-120	10	BR	+-
	16											16				90-120										
TOTAL			**28.7**		**4**	**100%**					**4**			**1+:2-**		**3 100%**						**1**	**100%**			
											7.175											1	2	**0.5**	**-171**		

Lines	Nodes	segments	Ls (m)	sort Ls	Num Fre	Lsf (%)	Ranges	Ls index n sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-3-9-13	13	13-14	7.8	6								13				60-90										
	14	14-15	6	7.8	**2**	**100%**	1-20					14	79	-	79	1 100%								-79	0R	-
	15											15														
TOTAL			**13.8**		**2**	**100%**					**2**			**0+:1-**		**1 100%**										
											6.9												**0**	-79		

Lines	Nodes	segments	Ls (m)	sort Ls		Lsf (%)	Ranges	Ls index n sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	Abf (%)	Crr	Rrr	Srb	Arr
a-5	5	5-6	5.3	5.3								5				30-60										
	6	6-9	25	6.4								6	44	+	44	1 33%								44	0R	+
	7			12	3	**75%**	1-20					7			80		92	-			92				B0	-
	8			25	1	**25%**	20-40					8			89	2 67%	92	+			92				B0	+
	9	9-11	12									9	80	+		60-90%					95	3	**100%**	90-120	80	0R	+
	10											10					95	-							B0	-
	11	11-13	6.4									11	89	-											-89	0R	-
	12											12													00	00
	13											13														
TOTAL			**48.7**		**4**	**100%**					**8**			**1-:2+**		**3 100%**						**3**	**100%**			
											6.09												**0.5**	**35**		

Lines	Nodes	segments	Ls (m)	sort Ls		Lsf (%)	Ranges	Ls index n	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar		Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N.frequ	Abf (%)	Crr	Rrr	Srb	Arr
a-5-10	10	10-13	12.5	12.5	1	**100%**	1-20						10																
	11												11	00														B0	00
	12												12						95	-			95	1	**100%**	90-120			-
	13												13																
TOTAL			**12.5**		**1**	**100%**					**3**													**1**	**100%**				
												4.17														NA	NA		

Lines	Nodes	segments	Ls (m)	sort Ls		Lsf (%)	Ranges	Ls index n	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N.Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-6	6	6-8	17	6									6																
	7			14									7						95	-	85	+	85	1	**50%**	60-90		2B0	+-
	8	8-9	19	17									8	00									95	1	**50%**	90-120		00	00
	9	9-10	6	19	4	**100%**	1-20						9		89	+	88		60-90								89	0R	+
	10	10-12	14										10		88	-	89	2	**67%**								-88	0R	-
	11												11		92	-	92	1	**33%**								-92	0R	-
	12												12						90-120										
TOTAL			**56**		**4**	**100%**					**6**				**1+:2-**			**3**	**100%**					**2**	**100%**				
												9.33															**0.5**	**-91**	

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n	sort	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar		Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab		Abf (%)	Crr	Rrr	Srb	Arr
a-6-7	7	7-9	23.2										7																
	8			23.2	1	**100%**	20-40						8						96	+			96	1	**100%**	90-120		B0	+
	9												9																
TOTAL			**23.2**		**1**	**100%**					**2**				**NA**									**1**	**100%**				
												11.6															**NA**	**NA**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n	Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-6'	6	6-7	18	18										6					30-60										
	7	7-8	19	19	2	**100%**	1-20							7	60	-	60	1	**100%**								-60	0R	-
	8													8																
TOTAL			**37**		**2**	**100%**						**2**				**0+:1-**			**1**	**100%**										
													18.5															**0**	**-60**	

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n	Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-4	4	4-6	34.5											4															
	5			43.5	1	**100%**	20-40							5						84	-			84	1	**100%**	60-90		B0	-
	6													6																
TOTAL			**34.5**		**1**	**100%**						**2**													**1**	**100%**				
													17.25															**NA**	**NA**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n	Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-10	10	10-11	12.7	6.4										10					60-90										
	11	11-12	6.4	12.7	2	**67%**	1-20							11	94	-	88	1	50%								-94	0R	-
	12	12-13	34.6	34.6	1	**33%**	20-40							12	88	+	94	1	50%								88	0R	+
	13													13					90-120										
TOTAL			**53.7**		**3**	**100%**						**3**				**1+:1-**			**2**	**100%**										
													17.9															**1**	**-6**	

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-11	11	11-12	17.8	3									11					1-10											
	12	12-14	15	11.5									12	14	+	8	1	**17%**									14	0R	+
	13			15									13			14	1	**17%**	89	+			80					B0	+
	14	14-19	34	17.8	4	**57%**	1-20						14	91	-	86		10-30					85				-91	0R	-
	15			23									15			90		60-90	98	+			88					B0	+
	16			32.7									16			90	3	**50%**	89	-			89		60-90			B0	-
	17			34	3	**43%**	20-40						17			91	1	**17%**	98	+			89	5	**56%**			B0	+
	18												18					90-120	85	-			98					B0	-
	19	19-21	11.5										19	8	-				100	+			98				-8	BR	+-
	20												20						88	-			100		90-120			B0	-
	21	21-22	23										21	86	+								100	4	**44%**		86	0R	+
	22	22-23	3										22	90	+												90	0R	+
	23	23-24	32.7										23	90	-												-90	0R	-
	24												24						100	-	80	+						2B0	+-
TOTAL			**137**		**7**	**100%**					**13**				**3+:3-**		**6**	**100%**						**9**	**100%**				
												10.5														**1**	**1**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-11-13	13	13-14	6.2	6.2									13					20-30											
	14	14-15	7.2	7.2									14	86	-	29	1	**50%**									-86	0R	-
	15	15-16	8	8	3	**100%**	1-20						15	29	-	86	1	**50%**									-29	0R	-
	16												16					60-90											
TOTAL			**21.4**		**3**	**100%**					**3**				**0+:2-**		**2**	**100%**											
												7.13														**0**	**-115**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-11-20	20	20-21	2.9	2.9									20																
	21	21-22	11	8									21	85	+	77		60-90									85	0R	+
	22	22-23	8	11	3	**100%**	1-20						22	77	-	85	2	**100%**									-77	0R	-
	23												23																
TOTAL			**21.9**		**3**	**100%**					**3**				**1+:1-**		**2**	**100%**											
												7.3														**1**	**8**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-11-23	23	23-26	15.5	15.5	1	**100%**	1-20						23																
	24												24						88	+			87					B0	+
	25												25						87	-			88	2	**100%**	60-90		B0	-
	26												26																
TOTAL			**15.5**		**1**	**100%**					**3**													**2**	**100%**				
												5.17														NA	NA		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
a-15	15	15-16	15.2	1.7									15					60-90											
	16	16-17	1.7	2.1									16	86	-	86	1	**33%**									-86	0R	-
	17	17-18	2.1	8.8									17	91	+	91											91	0R	+
	18	18-19	8.8	15.2	4	**100%**	1-20						18	91	-	91	2	**67%**									-91	0R	-
	19												19					90-120											
TOTAL			**27.8**		**4**	**100%**					**4**				**1+:2-**		**3**	**100%**											
												6.95														**0.5**	**-86**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
	16	16-17	13.5	2														60-90										0R	
a-16	17	17-18	2	13.5										84	+	84	1	**50%**									84		+
	18	18-19	15	15	3	**100%**	1-20							96	-	96	1	**50%**									-96	0R	-
	19																	90-120											
TOTAL			**30.5**		**3**	**100%**					**3**				**1+:1-**		**2**	**100%**											
												10.17														1	-12		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
b-29	29	29-30	26.7	5.5	1	**50%**	1-20						29																
	30	30-31	5.5	26.7	1	**50%**	20-40						30	95	-	95	1	100%									-95	0R	-
	31												31																
TTAL			**32.2**		**2**	**100%**						**2**			**0+:1-**		**1**	**100%**										
												16.1														**0**	-95		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
b-28	28	28-32	28										28																
	29												29						89	+			84					B0	+
	30			8.4	1	**50%**	1-20						30						84	-			89					B0	-
	31			28	1	**50%**	20-40						31						90	+			90	3	**100%**	60-90		B0	+
	32	32-33	8.4										32	00														00	00
	33												33																
TOTAL			**36.4**		**2**	**100%**						**5**												**3**	**100%**				
												7.28														**NA**	**NA**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
b-28-29	29	29-30	8.8	4.5									29					90-120											
	30	30-31	4.5	8.8	2	**100%**	1-20						30	93	-	93	1	**100%**									-93	0R	-
	31												31																
TOTAL			**13.3**		**2**	**100%**						**2**			**0+:1-**		**1**	**100%**										
												6.65														**0**	**-93**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
b-28-30	30	30-31	7.4	7.4									30																
	31	31-32	8.3	8.3									31	92	+	92		90-120									92	0R	+
	32	32-33	15	15	3	**100%**	1-20						32	93	-	93	2	**100%**									-93	0R	-
	33												33																
			30.7		**3**	**100%**						**3**			**1+:1-**		**2**	**100%**										
												10.23														**1**	**-1**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
b-19	19	19-20	15.9	7.5									19																
	20	20-21	12.8	7.5									20	11	+	11		10-30									11	0R	+
	21	21-22	7.5	12.8									21	30	+	30	2	67%									30	0R	+
	22	22-23	7.5	15.9	4	**100%**	1-20						22	53	+	53	1	33%									53	0R	+
	23												23					30-60											
TOTAL			**43.7**		**4**	**100%**						**4**			**0-:3+**		**3**	**100%**										
												10.93														**0**	**94**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
b-17	17	17-18	8.2	8.2									17					60-90											
	18	18-19	11.3	11.3	2	**100%**	1-20						18	88	-	88	1	**100%**									-88	0R	-
	19												19																
TOTAL			**19.5**		**2**	**100%**						**2**			**0+:1-**		**1**	**100%**										
												9.75														**0**	**-88**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
c-4	4	4-5	14.7	10.7									4					60-90											
	5	5-6	10.7	14.7	2	**100%**	1-20						5	86	-	86	1	100%									-86	0R	-
	6												6																
TOTAL			**25.4**		**2**	**100%**						**2**			**0+:1-**		**1**	**100%**										
												12.7														**0**	**-86**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
c-2	2	2-4	14	8.4									2			67		60-90											
	3			12.5									3			89	2	**100%**	86	+			86	1	**100%**	60-90		B0	+
	4	4-5	12.5	14	3	**100%**	1-20						4	89	-												-89	0R	-
	5	5-6	8.4										5	67	-												-67	0R	-
	6												6																
TOTAL			**34.9**		**3**	**100%**					**4**				**0+:2-**		**2**	**100%**						**1**	**100%**				
												8.73															**0**	**-156**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
d-2	2	2-3	20.1	7.4									2																
	3	3-4	19	10									3	68	-	41		30-60									-68	0R	-
	4	4-5	7.4	19									4	41	+	46	2	67%									41	0R	+
	5	5-6	10	20.1	4	**100%**	1-20						5	46	+	68	1	33%									46	0R	+
	6												6					60-90											
TOTAL			**56.5**		**4**	**100%**					**4**				**1-:2+**		**3**	**100%**											
												14.13															**0.5**	**19**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
d-5	5	5-6	3.7	3.7									5																
	6	6-7	23.7	17.3	2	**67%**	1-20						6	00				60-90										00	00
	7	7-8	17.3	23.7	1	**33%**	20-40						7	69	-	69	1	**100%**									-69	0R	-
	8												8																
TOTAL			**44.7**		**3**	**100%**					**3**				**0+:1-**		**1**	**100%**											
												14.9															**0**	**-69**		

Lines	Nodes	segments	Ls (m)	sort Ls	N. Freq.	Lsf (%)	Ranges	Ls index n Sort	N. Freq.	Lsfi	Nn	Nl	Nodes	Ar	Rr	Sort Ar	N. Freq.	Arf (%)	Ab	Rb	Ab2	Rb2	Sort Ab	N. Freq	Abf (%)	Crr	Rrr	Srb	Arr
d-6	6	6-7	16	13									6					60-90											
	7	7-8	13	16	2	100%							7	73	+	73	1	**100%**									73	0R	+
	8												8																
TOTAL			**29**		**2**	**100%**					**2**				**0-:1+**		**1**	**100%**											
												14.5															**0**	**73**		

Summary of Measurements

Ls: Segmental length — **Lsf: relativ frequancy of Ls**
Nn: number of nodes — **Nnf: relativ frequancy of Nn**
Nl: Nodes / length — **Nlf: relativ frequancy of Nl**
Nl average
Ar: Angle of refraction — **Arf: relativ frequancy of Ar**
Ab: Angle of bifurcatoin — **Abf: relativ frequancy of Ab**

Lines	Ls (m)	Sort Ls	N. Event.	Lsf (%)	Ranges	Nn	Nn sort	N. Event.	Nnf (%)	Ranges	Nl	Nl Sort	N. Event.	Nlf (%)	Ranges	Ar	Sort Ar	N. Event.	Arf (%)	Ranges	Ab	Sort Ab	N. Event.	Abf (%)	Ranges
A-C	25	6.5				**13**					**33.05**					5	1				113	44			
	28	6.5					**12**					**20.19**				2	1				107	60	2	**2%**	30-60
	40.6	7					**13**	2	**50%**	10-15		**21.81**	2	**50%**	20-25	3	1				111	68			
	42.8	7					**34**					**33.05**	1	**25%**	30-35	5	1				98	70			
	44	9					**39**	2	**50%**	30-40		**41.75**	1	**25%**	40-45	3	1				99	71			
	52	9.7						4	**100%**			**116.8**	4	**100%**		2	2				124	71			
	54.6	10									**Nl Average**	**29.2**				3	2				111	74			
	56.6	12															2				99	74			
	86	13														8	2				128	74			
C-C	167	14				**12**					**41.75**					1	2				85	75			
		14															3				115	77			
		14															3				80	78			
		14															3					79			
		15															3				94	80			
		15															3				105	80			
		16															4				91	83			
		17															4				100	84			
		18.7	18	**35%**	1-20												5				104	84			
		20															5				96	85			
		20															5				97	85			
		22															5				74	86			
		22															5				102	86			
		24															7				105	86			
B-B	6.5	25				**39**					**20.19**					46	7				75	87			
	7	27.5														22	7				90	87			
	9	27.5														31	8				93	87			
	9.7	28														8	8				96	88			
	12	28														16	8				108	88			
	13	32														9	8				78	88			
	14	35.6														4	8				91	88			
	14	38.3														7	9				97	89			
	15	40														7	9	32	**68%**	1-10	92	89			
	16	40	15	**29%**	20-40											3	11				94	89			
	18.7	40.6														84	16				68	90			
	20	42.8														94	17				122	90			
	22	44														17	17				102	90			
	24	46														5	17				86	90	35	**41%**	60-90
	27.5	52														27	20				88	91			
	28	53.4														8	22				97	91			
	35.6	54.6														1	25				90	91			
	40	55														7	27				94	92			
	40	56.5														1	27	10	**21%**	10-30	92	92			
	46	56.6														1	31				148	92			
	66	57.5	11	**21%**	40-60											25	32				60	93			
	80	66														8	35				130	93			
	223.3	80															46	3	**6%**	30-60	97	94			
		80	3	**6%**	60-80												84	1	**2%**	60-90	74	94			
		86	1	**2%**	80-100												94	1	**2%**	90-120	96	94			
		102																47	**100%**		120	94			
		114	2	**4%**	100-120																86	95			
		167	1	**2%**	150-200																71	96			
		223.3	1	**2%**	200-250																96	96			
			52	**100%**																	138	96			
																					89	96			
A-A	6.5					**34**					**21.81**					5					109	97			
	7															20					90	97			
	10															3					95	97			
	14															2					90	97			
	14															4					84	97			
	15															17					98	97			
	17															11					71	98			
	20															35					97	98			
	22															17					86	99			
	27.5															5					97	99			
	32															27					87	100			
	38.3															8					88	102			
	53.4															1					87	102			
	55															32					88	104			
	56.5																				87	105			
	57.5																				80	105			
	80															9					77	107			
	102															2					170	108			
	114															2					74	109			
																					94	111			
																					92	111			
																					173	113			
																					79	115			
																					84	120	41	**48%**	90-120
																					70	122			
																					85	124			
																					89	128			
																					83	130			
																					91	138			
																					88	148	6	**7%**	120-150
																					44	170			
																					89	173	2	**2%**	150-180
																					93				
																							86	**100%**	

Ls: Segmental length — **Lsf: relativ frequancy of Ls**
Nn: number of nodes — **Nnf: relativ frequancy of Nn**
Nl: Nodes / length — **Nlf: relativ frequancy of Nl**
Nl average
Ar: Angle of refraction — **Arf: relativ frequancy of Ar**
Ab: Angle of bifurcatoin — **Abf: relativ frequancy of Ab**

Lines	Ls (m)	Sort Ls	N. Event.	Lsf (%)	Ranges	Nn	Nn sort	N. Event.	Nnf (%)	Ranges	Nl	Nl Sort	N. Event.	Nlf (%)	Ranges	Ar	Sort Ar	N. Event.	Arf (%)	Ranges	Ab	Sort Ab	N. Event.	Abf (%)	Ranges
a-a	14.6	11.5				**20**					**21.11**														
		11.6					**6**	1	**33%**	6		**12**	1	**33%**	10-15										
	22	11.7					**17**					**20**	1	**33%**	15-20						94	74			
	31.6	14					**20**	2	**67%**	15-20		**21**	1	**33%**	20-25	66	2				122	75			
	32.3	14.6						3	**100%**			**53**	3	**100%**		57	2				155	78			
	34.2	20	6	**32%**	1-20						**Nl average**	**18**				39	3				107	79			
		22								10-15					0-5	35	5				127	80			
		26.3								15-20					5-10	2	7					81			
		31.6								20-25					10-15		7				101	83			
		32.3								25-30					15-20		7				94	83			
	40	34.2								30-40					20-25		9				90	83			
		40	6	**32%**	20-40											10	10	9	**53%**	1-10	86	86			
	47.8	47.8															12				86	86			
		49.5														9	30	2	**12%**	10-30	113	86			
	49.5	52.2															31				78	87			
		56.5														64	35				80	88			
		59.6	5	**26%**	40-60												39				95	89			
		62	1	**5%**	60-80												57	4	**24%**	30-60	106	89			
	52.2	98	1	**5%**	80-100												64				79	89			
			19	**100%**												3	66	2	**12%**	60-90		90			
	98																	17	**100%**		83	90			
b-b	14					**17**					**11.91**											90	20	**57%**	60-90
	20																					91			
	56.5																				74	91			
	62																				81	93			
																						94			
																7					91	94			
																						95			
																5					89	97			
																					86	101			
																					88	103			
																						106			
																7					83	107			
																					87	113	12	**34%**	90-120
																					93	122			
																					91	127	2	**6%**	120-150
																					97	155	1	**3%**	150-180
																					89		35	**100%**	
																2					90				
d-d	11.5					**6**					**20.11667**										89				
	11.6															30									
	11.7															31					103				
	26.3															7									
	59.6															12									
																					90				
																					83				
																					75				

Ls: Segmental length — **Lsf: relativ frequancy of Ls**
Nn: number of nodes — **Nnf: relativ frequancy of Nn**
Nl: Nodes / length — **Nlf: relativ frequancy of Nl**
Nl average
Ar: Angle of refraction — **Arf: relativ frequancy of Ar**
Ab: Angle of bifurcatoin — **Abf: relativ frequancy of Ab**

Lines	Ls (m)	Sort Ls	N. Event.	Lsf (%)	Ranges	Nn	Nn sort	N. Event.	Nnf (%)	Ranges	Nl	Nl Sort	N. Event.	Nlf (%)	Ranges	Ar	Sort Ar	N. Event.	Arf (%)	Ranges	Ab	Sort Ab	N. Event.	Abf (%)	Ranges
a2	13.8	1.5				4	2				14.5	6				3					87				
	17	1.7					2					7				11					86	54			
	27	2					2					7				27					88	70			
a3	6.7	2				15	2				11.6	7					3				87	72			
	11	2					2					7					3				93	73			
	11	2.1					2					8				12	3				165	76			
	13.6	2.6					2					8				97	5				165	78			
	18.2	3					2					9				29	5				0	78			
	19.8	3					2					9				21	7				93	80			
	28	3					2					9				86	7				92	81			
	66	3					2					9					8				126	84			
a5	5.3	3.7				8	2				6.09	10				44	9	9	**6%**	1-10	92	84			
	6.4	3.9					2					10				80	11				92	85			
	12	4					2	14	**24%**	2		10					11					85			
	25	4					3					10	15	**25%**	5-10	89	12				95	85			
a6	6	4				6	3				9.33	11				89	14				95	86			
	14	4					3					11				88	14					86			
	17	4.5					3					11				92	15					87			
	19	5					3					11					17					87			
a6'	18	5.3				2	3				18.5	12				60	21					87			
	19	5.5					3					12					21					87			
a4	43.5	5.5				2	3				17.3	13					22				84	87			
a10	6.4	5.6				3	3				17.9	13				94	24					88			
	12.7	6					3					13				88	27					88			
	34.6	6					3					13					27				89	88			
a11	3	6				13	3				10.54	13				14	28				98	88			
	11.5	6					3	13	**22%**	3		14					29				89	88			
	15	6					4					14				91	29				98	89			
	17.8	6					4					14				8	30	17	**12%**	10-30	85	89			
	23	6					4					15				86	31				100	89			
	32.7	6.4					4					15				90	32				88	89			
	34	6.4					4					15				90	35				100	89			
a15	1.7	6.7				4	4				6.95	15				86	38					89			
	2.1	6.7					4					15				91	41					89			
	8.8	7					4					15	20	**34%**	10-15	91	44					89			
	15.2	7					4					16					45					89			
a16	2	7				3	4				10.17	16				84	46					90			
	13.5	7					4					16				96	46					90			
	15	7.2					4					17					47					90	38	**48%**	60-90
		7.2					4					17					49					91			
b29	5.5	7.4				2	4	14	**24%**	4	16.1	18				95	53					91			
	26.7	7.4					5					18					53					91			
b28	8.4	7.5				5	5				7.28	18				0	55				89	92			
	28	7.5					5					18					60	15	**10%**	30-60	84	92			
b19	7.5	8				4	5				10.93	18				11	65				90	92			
	7.5	8					5	5	**8%**	5		18				30	67					92			
	12.8	8					6					18				53	68					93			
	15.9	8					6					19					68					93			
b17	8.2	8.2				2	6				9.75	19				88	68					93			
	11.3	8.4					6	4	**7%**	6		19					69					93			
		8.4					7	1	**2%**	7		19					69					95			
c4	10.7	8.5				2	8	1	**2%**	8	12.7	19				86	69					95			
	14.7	8.8					10					19	18	**31%**	15-20		70					95			
c2	8.4	9				4	12				8.73	21				89	72				86	95			
	12.5	9					13					23				67	72					97			
	14	9					15					23	3	**5%**	20-25		73					98			
		9.5					15					26					74					98			
d2	7.4	10				4	15				14.13	28	2	**3%**	25-20	68	76					98			
	10	10					15	7	**12%**	10-15		33	1	**2%**	30-35	41	76					98			
	19	10						**59**	**100%**			**858**	**59**	**100%**		46	76					98			
	20.1	10										Nl average	**15**				76					98			
d5	3.7	10				3					14.9					69	76					98			
	17.3	10															76					100			
	23.7	10.7															76					100			
d6	13	11				2					14.5					73	77					100			
	16	11															78					100			
		11															78				98	100			
AC-iii	5.6	11				7					15.94					109	79				90	102			
	24	11															79				91	102			
	82	11.3															80				92	103			
AC-v	8.5	11.3				2					19.25					93	81					108			
	30	11.5															81					110			
Acvi	3.9	11.5				15					7.66					17	82				98	114			
	4	11.5														91	83				100	120	35	**44%**	90-120
	5	11.5														76	83				91	126			
	6	11.5														0	83				108	131			
	8	11.6														91	83					136			
	9.5	12														88	84				97	147			
	12	12														91	84					149	5	**6%**	120-150
	13	12														93	84					165			
	14	12														82	84					165	2	**3%**	150-180
	39	12.4														89	85						**80**	**100%**	

AC-ix	26	12.5	2	33	77	85					
	40	12.5				86					
AC-xi	2.6	12.5	4	14.65	96	86					
	12	12.7			68	86					
	19	12.8			83	86					
	25	12.8				86					
		13				87					
CC-xvii	15	13	3	12.5	88	87	89				
	22.5	13				87					
CC-ixx	6	13	3	16	3	88					
	21	13			79	88					
	21	13				88					
CC-xx	11	13	5	12.72	22	88	100				
	14	13.5				88					
	19.3	13.5			3	88					
	19.3	13.6			84	88					
CC-xxi	10	13.6	4	14.8	76	88	89				
	19.6	13.6				88					
	29.6	13.8				88					
		14				88					
BB-i	26	14	2	28	90	88					
	30	14				89					
BB-ii	13	14	2	19	91	89					
	25	14				89					
BB-v	3	14	5	18.4	68	89	76				
	37	14.5			95	89	87				
	52	14.7				89					
BB-ix	6	15	3	18.67	85	90					
	7.4	15			90	90					
	11.6	15				90					
	13	15				90					
	13.5	15				90					
BB-xiv	6	15	6	8.583	15	90	91				
	7.2	15.2			24	90					
	17	15.9			84	90	73	**50%** 60-90			
	22	16			91	91					
BB-xx	10	16	4	13.05	91	91					
	16	16.5			87	91					
	29.5	17			96	91					
BB-xxi	11	17	3	18.5	91	91					
	12.5	17			89	91					
	18.5	17				91					
	19	17				91					
	20	17.3			7	91					
	27	17.5			14	91					
BB-xxiii	11.5	17.5	10	10.8	53	91	89				
	13.6	17.5			76	91	120				
	26	17.8			88	92	136				
BB-xxx	9	18	3	17.03	49	93	131				
	12.8	18			86	93					
	17.5	18				93					
	18	18.2			31	94					
	32	18.5			0	94					
BB-xxxi	3	18.7	5	17.86	76	95					
	4	19			87	95					
	4	19			55	96					
	4.5	19			5	96					
	7	19			27	96					
	9	19			7	97					
	12	19.3			72	97					
	21	19.3			29	97					
	25	19.6			74	97					
BB-xxxii	7.2	19.8	12	7.458	91	97	93				
BB-xxxiii	15	20	4	13.55	90	99	90				
	32	20			89	100	93				
BB-xxxvi	13	20	148	**71%** 1-20	2	18	69	109	31	**21%** 90-120	102
	23	20.1							**145**	**100%**	78

BB-xxxviii	17.5	21	2		17.5	97	88	
	17.5	21					70	
		21						
AA-i	2	21.5	6		10.33	72	89	
	10	22				83		
	23	22.5					114	
	27	23				65		
AA-iii	14.5	23	3		12.5	91	87	
	23	23						
AA-v	1.5	23	4		7.625	28		
	6	23				46		
	8	23.7				97		
	15	24						
AA-vi	11.5	24	2		17.75	87		
	24	24.7						
AA-vii	11.3	25	15		10.22	9	98	
	17	25				47	98	
	20	25					88	
	23	25				76	110	
	32	25				78	85	
	50	25				90	98	
AA-viii	7	26	5		17.6	76	73	
	9	26				88	149	
	10	26				83	102	
	25	26.4					103	
	37	26.7					85	
AA-xi	25	27	2		25.7	99		
	26.4	27						
AA-xiii	4	27	4		14	100		
	11	27				97		
	14	28				90		
	27	28						
AA-xiv	3	28	3		11.5	97		
	10	28				38		
	21.5	29.5						
AA-xvii+	2	29.6	4		6.5	32		
	5.5	30				88		
	7	30				85		
	11.5	30						
AA-xvii-	13	32	15		9.1	5	81	
	14	32				35	72	
	18	32				45	95	
	44	32.7				70	78	
	47.5	34					89	
AA-xx	30	34.6	3		22.67	90	87	
	38	37					54	
AA-xxi	7	37	3		10.83	21	80	
	12.5	38				81	147	
	13	39					100	
AA-xxii	8	40	51	**25%** 20-40	3	18.67	88	89
	20	42					88	88
	28	43.5						95
AA-xxiii	8	43.6	6		15	76		
	11.5	44				93		
	12.4	47.5				78		
	13.6	50				81		
	16.5	52	7	**3%** 40-60		79		
	28	66	1	**0%** 40-60				
AA-xxv	6	82	1	**0%** 60-80	4	20.83	84	
	15						69	
	18.7						83	
	43.6							
AA-xxvi	6.7				4	22.6	88	
	17						88	
	24.7						94	
	42							
			208	100% Ranges		**858.246**		

Ls: Segmental length
Nn: number of nodes
Nl: Nodes / length
Nl average
Ar: Angle of refraction
Ab: Angle of bifurcatoin

Lsf: relativ frequancy of Ls
Nnf: relativ frequancy of Nn
Nlf: relativ frequancy of Nl

Arf: relativ frequancy of Ar
Abf: relativ frequancy of Ab

Lines	Ls (m)	Sort Ls	N. Event.	Lsf (%)	Ranges	Nn	Nn sort	N. Event.	Nnf (%)	Ranges	Nl	Nl Sort	N. Event.	Nlf (%)	Ranges	Ar	Sort Ar	N. Event.	Arf (%)	Ranges	Ab	Sort Ab	N. Event.	Abf (%)	Ranges
a-2-4																90	6								
	13.5	1.6				**4**	**2**				**14.8**	**4.1**				82	7					11	1	**6%** 10-30	
	13.5	2.3					**2**					**4.17**	2	**6%** 1-5			7					76			
	19	2.8					**2**					**5.17**					10	4	**7%** 1-10			82			
a-3-5	4.6	2.8				**3**	**2**				**5.87**	**5.25**				51	12					83			
	5.3	2.9					**2**					**5.87**				86	12					83			
	7.7	4					**2**					**6.375**					13					85			
a-3-6	5	4				**2**	**2**	7	**23%**	2	**5.25**	**6.55**				64	18					87			
	5.5	4					**3**					**6.65**					19					87			
a-3-9	8	4				3	3				**14.33**	**6.9**				83	22					88	8	**44%** 60-90	
	9	4.3					3					**7.13**					29					93			
	26	4.5					**3**					**7.18**					29	8	**15%** 10-30			93			
a-3-9'	6	4.5				3	**3**				**9.07**	**7.3**				12	51	1	**2%** 30-60			95			
	9.9	4.6					**3**					**7.40**				90	64					96			
	11.3	4.6					**3**					**7.9**					67					97			
a-3-10	2.8	5				**4**	**3**				**6.55**	**8**				19	76					99			
	2.8	5					**3**					**8.1**				76	77					99			
	4.3	5					**3**					**8.333**					78					100			
	16.3	5					**3**					**8.45**					79					104	9	**50%** 90-120	
a-3-12	5	5				**4**	**3**				**7.18**	**9.07**				87	82						18	**100%**	
	6	5					**3**	13	**42%**	3		**9.42**	18	**58%** 5-10		94	82								
	6.7	5.3					**4**					**10.23**				10	83								
	11	5.4					**4**					**10.43**					85								
a-3-13	6	5.4				**2**	**4**				**6.9**	**10.97**				79	85								
	7.8	5.5					**4**					**11.33**					86								
a-5-10	12.5	6				**3**	**4**	5	**16%**	4	**4.17**	**11.6**				0	86							95	
a-6-7	23.2	6				**2**	**5**				**11.6**	**13.7**				0	87							96	
a-11-13	6.2	6				**3**	**5**	2	**6%**	5	**7.13**	**14.33**				86	87								
	7.2	6					**6**					**14.8**				29	87								
	8	6.2					**6**	2	**6%**	6		**15**	9	**29%** 10-15			88								
a-11-20	2.9	6.2				**3**	**8**				**7.3**	**15.1**	1	**3%** 15-20		85	89								
	8	6.7					**8**	2	**6%**	8		**29**	1	**3%** 25-30		77	89								
	11	7						31	**100%**			**295.808**	31	**100%**			90								
a-11-23	15.5	7				**3**					**5.17**					0	90							88	
b-28-29	4.5	7				**2**					**6.65**	**Nl AVERAGE**	**10**			93	90							87	
	8.8	7															90								
b-28-30	7.4	7.2				**3**					**10.23**					92	90								
	8.3	7.3														93	90	25	**45%** 60-90						
	15	7.3															91								
AC-iii-2	10	7.4				**2**					**8.1**					90	91								
	6.2	7.5															91								
AC-iii-4	15	7.7				**2**					**29**					0	91							82	
	16	7.8															92							97	
	27	8															93								
AC-iii-6	4	8				**6**					**9.42**					87	93								
	4.5	8														90	94								
	8.5	8														94	94								
	9	8.3														89	94								
	14	8.5														90	94								
	16.5	8.8															94								
AC-vi-7	1.6	9				**5**					**4.1**					82	97							93	
	5.4	9															98							85	
	13.5	9															102								
AC-vi-8	1.5	9				**2**					**7.40**					13	103							99	
	2.3	9															116	17	**31%** 90-120						
	4	9																55	**100%**						
	7	9.9																							
CC-xxi-2	4	10				**4**					**7.9**					94								76	
	7	10																							
	9	10														87									
	11.6	11																							
BB-v-3	5	11				**5**										103									
	7	11									**13.7**					0									
	7.5	11.3														91									
	19	11.6														98									
	30	12																							
BB-xxiii-6	5	12.5					**3**				**11.33**					18								87	
	12	13														91									
	17	13.5																							
BB-xxiii-7	5	13.5					**3**				**10.43**					22									
	7.3	13.5														91									
	19	14																							
BB-xxxii-6	6	15					**4**				**8**					90									
	8	15																							
	18	15																							
AA-i-4	5	15.5					**3**				**8.333**					78									
	9	16														67									
	11	16.3																							
AA-vii-9	4.6	16.5					**8**				**8.45**					7								11	
	7	17																							
	10	18														7								104	
	15	18														6								83	
	31	19														116									
AA-vii-11	9	19					**8**				**6.375**					12								100	
	9	19														102									
	10	20	86	**91%** 1-20												97								83	
	23	21.4																						93	
AA-xvii--7	7.3	23					**3**				**15.1**					29								99	
	18	23.2														89									
	20	26																							
AA-xvii--8	4	27					**6**				**10.97**					85									
	5.4	30														91									
	21.4	31														94									
	35	35	8	**8%** 20-40																					
AA-xvii--9	45	45	1	**1%** 40-60			**3**				**15**					88									
			95	**100%**												94									