

The Analysis of Architectural Forms Using Numerical Model

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Abstract: We are discussing on, the complexity in architecture. Based on a morphometric study of the Medina of Gafsa, this article is suggesting deeper readings and a new knowledge of the produced forms. The frequential analysis of the Medina's Intra-mural urban forms, using Morphique 3 and other digital classification tools, lead to results that help understand how that urban form was structured and whether the islets were the result of aggregation operations or not. The Morphometric approach made us reach two different goals: First, that of identifying the morphic conformation structures of the significant tissue, historically speaking besides that of explaining the morphic conformation of the islet itself. Hence, this complex approach permits the binding of the morphometric analysis with historical and cultural data. That method provides us with new perspectives on the morphologic paradigms behind the complex urban tissue of the Medina. This paper aims at exploring the morphometric concepts enabling us to understand the inherent structures of the urban forms.

Key words: Morphometry, conformation, form, energetic descriptor.

1. Introduction

We learn through deep reading of the different morphologic architectural studies, that the Medinas are often looked upon through a variety of approaches: historic, ethnologic, geographic and morphologic. Each having its merit.

In this context, I refer to André Raymond (1985) defining the Medina by its different mutations throughout history. This very historic does focus on the Medina as a cultural product of several societies. Paul Sebag (1998) dealt with the history of big Arabic cities and put the stress on the birth and evolution of the Medina of Tunis. The approach he is suggesting allows us to understand the deep history of transitions, the changes in the status of the Medina and other interruptions during the production of the Medina. The ethnologic approach deals with the cultural diversities derived from the society's customs and conventions. Its object is the explicative and comparative studies of the social facts taking place throughout history.

Bourdieu's work, entitled as "A Theory of the Social Space", gave birth to a theory on societies and their different components. Some of its main findings: The hierarchies of the social groups, the cultural practices lying behind the conflicts of those social groups and the role the scholar system plays on legitimizing those social structures.

Forget Cécilia (2008), Ethnologue at the Institute of Cultural Heritage of Laval University in Quebec, seeks to tackle the different dynamic relations between the material components: (The space, its architecture, its landscape, its items, etc.) and non-material ones: (The spirit i.e. the thoughts, the narrations, the rituals, the memories, etc). This investigation was elaborated in her book that reads like "Thinking and Practicing the Spirit of the Space" [1].

As for the urban geographic approach of Amos Rapoport, it mainly deals with the special analysis of the Medinas, it associates with history to study the past and present of the Medinas. This latter approach is interested in the depiction of morphology (centralities,

varieties of the built structures densities, activities, suburb divisions, etc.). It also insists on the tight link between the site and the architectural production.

However, the morphologic analysis developed by Bernard Duprat [2] amids (LAF) “Laboratoire d’Analyse des Formes”, studies the morphologic characteristics of the architectural and urban entities. It presents us with the limits for the complex Medinal forms departing from their segmentation. However, this segmentation does rely on the subjectivity inherent in the human perception behind it [3-5].

In spite of their known merits and contributions, this analysis represents a descriptive overview thus a limit in front of characterization of forms:

“...With their very effort of conceptual generalizations, the descriptive terminologies do report the real structurations of the empirical materials, in a very imperfect way.” ...Par leur effort de généralisation conceptuelle même, les terminologies descriptives ne rendent que très imparfaitement compte des structurations réelles des matériaux empiriques [6, 7].

1. In addition to that, these methods did not consider the Forms of the Medinas. These latters are far from being simple geometric ones. They are indeed complex forms showing irregularities that do escape from the Euclidean geometrics like symmetric, homothety and translation. Hence the necessity of a complementary research as the topic of this paper offers. We suggest the morphometric approach [2] to study the urban forms to understand the underlying logics of the structure of the produced form.

2. By adopting this digital measurement tool, with improvement (within the work of a thesis), we suggest here to make use of a new knowledge on the Medina of Gafsa in order to understand its morphology.

2. Principles of Morphometry

Morphometry presents us with a quantitative and digital approach seeking to characterize the form. It identifies with logics of the spatial composition and

informs about a new meaning of urban forms. Morphometry is a measurement method for forms aiming at handling what escapes from the usual methods of representations:

First, the analytic representation, in its mathematical meaning is a representation through equations. Second, the grammatical representation is a descriptive narration of forms. Third, the combinatory representation between the syntactic conformation and spatio-temporal syntagmatic configuration.

In fact, Morphometry is an objective method that out passes the simple subjective perception and makes abstraction of the sensitive observation. It suggests and objective model for the analysis of the spatial forms. It out passes the morphologic analysis seen the facts that it does not consider the discontinuities representing a form (combinatory logics included).

The morphometric approach has two readings of forms. The first one, is the Medina specialized as a Form; this latter gives us “morphic stratum”. The morphic information is traced back on the interval of frequencies (topologic definition of the form), to high frequencies (figurational definition of the form), going through average frequencies (transitional interval between both). These three levels of definition characterizes the properties of the form [8-12].

The choice of the significant morphic strata depends on the quantity of the acquired information which leads us directly to the second reading: The Medina Specialized as a signature, thus giving us a spatial descriptor. This energetic descriptor characterizes the form and endows us with spatial representation. It has to do with measuring the form, according to its hierarchal decomposition and to determine the significant strata materializing the variation of the Form all through the interval of frequencies.

The descriptor’s phase informs about the emplacement of the form whereas we learn through the Amplitude about the underlying infos in those forms. The descriptors summit represents the full parts while the cavities do define the empty ones. The morphic

information together with the descriptors simplifies and makes both the identification of forms and its intrinsic characteristics, possible.

The following lay out sums up the general principle of the morphometric application for the study of the urban form of the Medina of Gafsa:

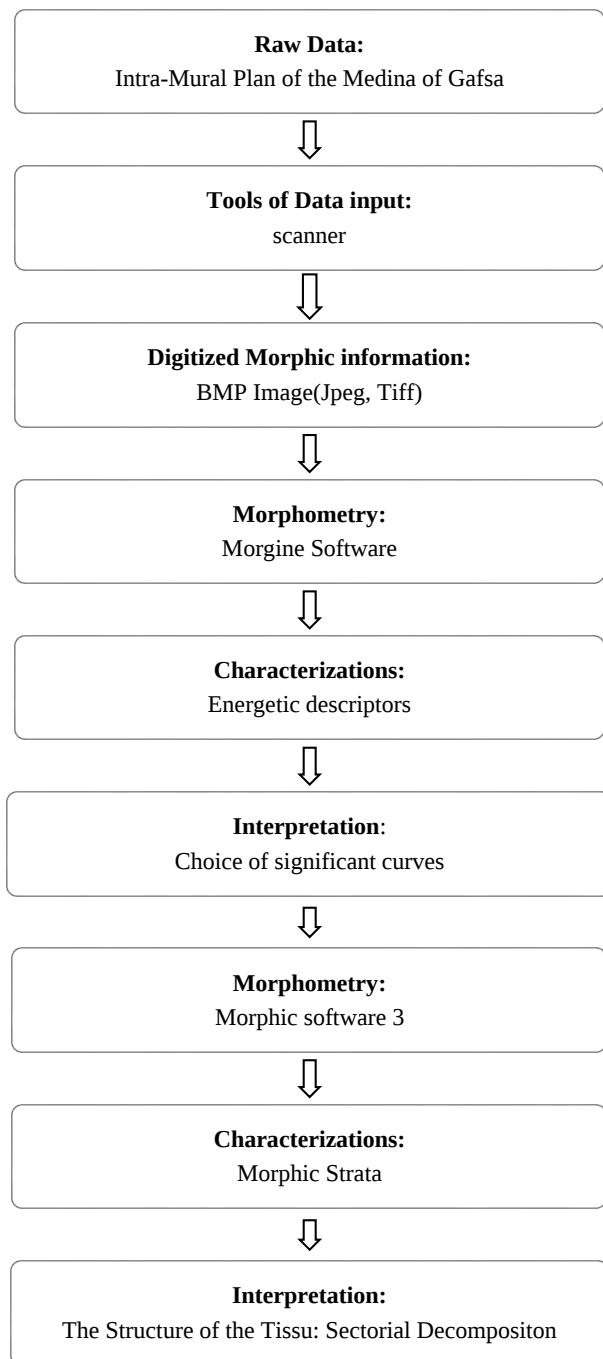


Fig. 1 Morphometric analysis approach.

3. Corpus Construction

Gafsa is the corpus of the prehistoric site called Capsa; the oldest city on Tunisian soil and the area of our study. In this paper we mainly refer to the backup plan of the Medina of Gafsa. This plan is carried out by multi disciplinary team in collaboration with Mustapha Tlili (writer), Cherif Lazhar (President of the Association of the Protection of the Medina, Gafsa) and the Municipal Patronage of Housing in the City of Palma, Italy.

We have chosen as a study material, the Intra Mural Plan of Gafsa: The only document expressing a precise two dimensional graphical representations of this tissue. Once the plan scanned, the plan served as a medium for building a digital database. We've recorded it in a vector format DWG. Finally we proceeded to its codification in grayscale. The white stands for the Built area and the black represent the void area.

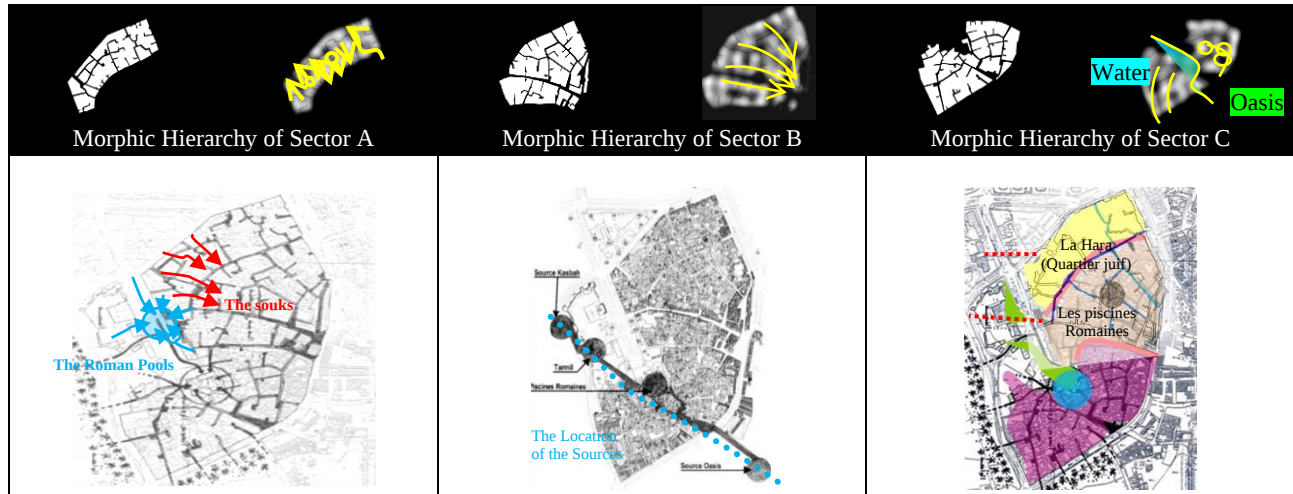
3.1 Analysis of the urban form

During the Morphometric application, we have first performed a study using "Morgine" launched from the environment "Matlab". This application has given us a serious of descriptors among which we had selected: Four energy descriptors (See Table 3), representing the significant strata.

As for the rest of the frequencies intervals, we observe no variation at the level of descriptors, which is why it was accurate to choose but the most important ones, in terms of morphic information. An objective selection of frequency bands has been established. Reading the morphic hierarchy became possible thanks to the efficiency of the frequency analysis. Morphic strata materializing the Form, gives it a sense of space that reflects the shape of the figure (structure, ruptures, defining the deadlocks). These latters asserts the tri sectorial decomposition of our urban core.

The Superposition of morphic strata [1-2] / urban form brings up two nuclei. One above corresponds to

Tableau 2 The Results of the Sectors' frequential analysis and the confrontation with the extrinsic aspects.



3.2 Sector Analysis

Using Frequency analysis, this paper shows a number of findings. They concern the structuring principles of sectors as well as a confrontation with the extrinsic aspects of the Medina.

The First sector A (See Table 4) show a regular form that highlights the stretching of perpendicular directions and therefore an open form to the outside. The Second sector B is located at the center of the whole tissue. Its structure justifies the southeast pathways converging towards the souks (i.e towards the commercial activities). The Third sector C (See Table 4) is divided into two parts. It shows introversion and an interrelationship between the water sources and oases. Indeed, the configurational scale observation highlights the Morphic hierarchy of the principal morphic axes involved in the definition of the urban forms.

The Cross between Morphic attributes and extrinsic aspects shows that the strategy of appropriation of the space is dependent on the intra mural geographical aspects. In fact, the axis penetrating Sector C highlights the Medina-Oasis-Water relationship and the alleys converging towards a same center (The water sources).

Sector B shows up curved paths; their curves are explained by the convergence of those directions towards the souks.

The Historians reports defend the anteriority of *Houmet El Oued* sector over the North Sector. The Morphometric analysis offers us more scrutinized study than the previous researches.

The actual findings argue for a tri-sectorial composition of the urban form. Morphometry confirms the importance of water as the source of genesis of the town of Gafsa.

This latter has evolved concentrically around its water source (The location of the Roman Pools). Water was the source of the wealth of the oasis and, therefore, causing the city's economic development and prosperity for several millennia. It is a purifying element religiously speaking: ablutions and other religious rituals, and also for bathing and cleaning practically speaking.

The Morphometric experimenting ground allowed us to extract the principle of structuring sectors from the intra mural tissue of Gafsa. In fact, the conformation of the tissue highlights the principal morphic axes of the Medina involved in the defining of its urban form.

The Cross between morphic attributes and extrinsic aspects shows that the strategy of appropriation of the intra mural space is in perfect integration with the geographic data. Besides the axis penetrating Sector C emphasizes the Medina-Oasis-Water relationship since all roads do converge towards a common center (the water source). The intermediate axis leaves a clear path

between the oasis and the source of El Kasba. With her oasis, the Medina of Gafsa used to form an indivisible whole.

4. Conclusion

The Morphometric approach is undoubtedly a means of knowledge, particularly relevant in the description and characterization of Forms. It facilitates the full explanation of the intrinsic phenomena manifested by a structural logic. However these intrinsic aspects confronted with other fields of knowledge does provide a part of the explanation that has been identified in our analysis.

Departing from all that, we were able to build interpretable classifications, which reflect the history, memory and mode of production of the Medina.

Morphometry, a measurement tool for urban forms, provided us with new techniques that have optimized our analysis. The study of the shape of the tissues shows us that it carries layers of historical development related to an urban development and to both of the social and topographic situations.

This work demonstrated that the forms studied are dependent on the people who inhabit them, those people's logics managing the space, their activities and their relationships. This very article highlights the contributions of the morphometric model and its efficiency analyzing complex shapes. The Medina of Gafsa is a complex system necessitates a deep analysis up to the scale of the building, seen its autonomous global system.

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