

Morphological study of mosques in districts of the medina of Kairouan

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Abstract— The Great Mosque of Kairouan has experienced numerous studies while others masjeds of Medina did not know an interest. Thus, studies granted to these buildings have highlighted the historical origin of this architecture, its genesis and growth patterns. But the morphological peculiarities are ignored or suggested superficially. In this research, we focus on the study of mosques in parts of the intramural portion of the medina of Kairouan. Through the method of analytical morphology, we tried to characterize the intrinsic properties of these conformations and then compare them with extrinsic properties. After this work, the morphological analysis allowed us to identify patterns and changes in forms and define identity classes masjeds through different structural models. These structural variations may be the results of several extrinsic influences.

Keywords— *Masjed; Medina of Kairouan; morphological analysis; model.*

I. INTRODUCTION

Kairouan was nicknamed the city "to three hundred mosques." Despite numerous reallocations or disappearance of many of these places of worship (they are only 66 currently, 4 mosques and 62 masjeds). Medina of Kairouan is full of old small mosques in neighborhoods bearing the names of their original founders.

This type of buildings comes from a traditional architectural expertise. Hence the need to identify logical conformation and organization of these buildings and to identify traits that give them their identity and composition ratios that predispose this architecture. Moreover, modeling of the production system of traditional architectural forms can leverage the expertise and discover the architectural principles of the striking originality of these buildings. Thus the planned results can provide a working basis for policy makers, designers and researchers.

In addition, our study aims to highlight the morphological characteristics of these mosques, studying the traits related to the structure and internal divisions of these mosques and trying to understand the combinatorial

systems that govern these forms; in order to understand a historical model and highlight its main features. We propose in this article to explore, using the method of morphological analysis, architecture masjeds of the medina of Kairouan and answer the question: What are the morphological identities of these mosques?

II. COMPONENTS OF MASJED

Mosques without minbar or "Masjed" is usually a small mosque (sometimes a simple piece) neighborhood which is not appropriate for Friday prayers but for the five daily prayers.

The Prophet's house is a reference that helped define the first components of the mosque. Other elements are imposed by the use, even if they were not mandatory. So, plan a masjed is relatively simple and most often it contains the following components:

A. *The prayer room:*

This is a covered area where Muslim believers meet for the collective prayer led by an Imam. Believers must enter the prayer room barefoot. They pray kneeling toward Mecca, the direction of Qibla wall at the back of the room. The main elements of the prayer room of masjed are the qibla wall and the mihrab.

- wall of the qibla: The Qibla is the direction of Mecca, toward which Muslims turn to pray. In mosques, Qibla wall indicates that direction.
- The mihrab: The mihrab is a hollow carved into the wall of the qibla. It is the most sacred place of the mosque, which indicates the direction of Mecca and symbolizes the place where the Prophet Mohamed settled to pray. Mihrabs of masjeds are often quite simple and do not have decorations.

B. *Court :*

It is a small patio open often juxtaposed to the prayer room. It allows extending the area of prayer, and some over the masjeds contain mihrabs.

C. Gallery :

It's in some masjeds along the yard of one or both sides, punctuated by columns or pillars on which stood a few arches.

D. Minaret :

This is the top of the tower where a man, the muezzin, calls the faithful Muslims to prayer five times a day.

E. Ablution room :

Before prayer, Muslims must purify themselves by ablutions through wells (water tanks) located in this room or sometimes in the yard.

Whatever the components masjeds, they are "places of special meeting of the community." [1]. Thus, the necessary conditions for the creation of a masjid are taking the direction of the qibla and room to easily follow the direction of prayer by the Imam.

III. CHOICE OF CORPUS

The corpus consists of 58 masjeds belonging to the intramural portion of the Medina of Kairouan "fig. 1". The corpus "fig. 2" must be homogeneous, representative and controllable.

A. Homogeneous

Specimens in our collection, by definition, they all have the same nominal identity. Indeed, the homogeneity of our corpus lies in cultural identity. In our case, it is a religious architecture where all specimens belong to a specific geographical area (Kairouan Medina), this implies a temporal homogeneity. "An isolate geographically and culturally exceptional" [2].

B. Representative

The choice of corpus ensures that the study sample must be large enough and most representative to the objects of the study. To ensure representativeness, we tried to take all masjeds intramural (which are 61 masjeds 3 are inaccessible).

C. Controllable

The collection consists of 58 masjeds. We propose in this study, to not diversify materials and limiting morphological analysis to plans.



Fig. 1: Location of masjeds in the medina of Kairouan
 Source: Map with a personal treatment

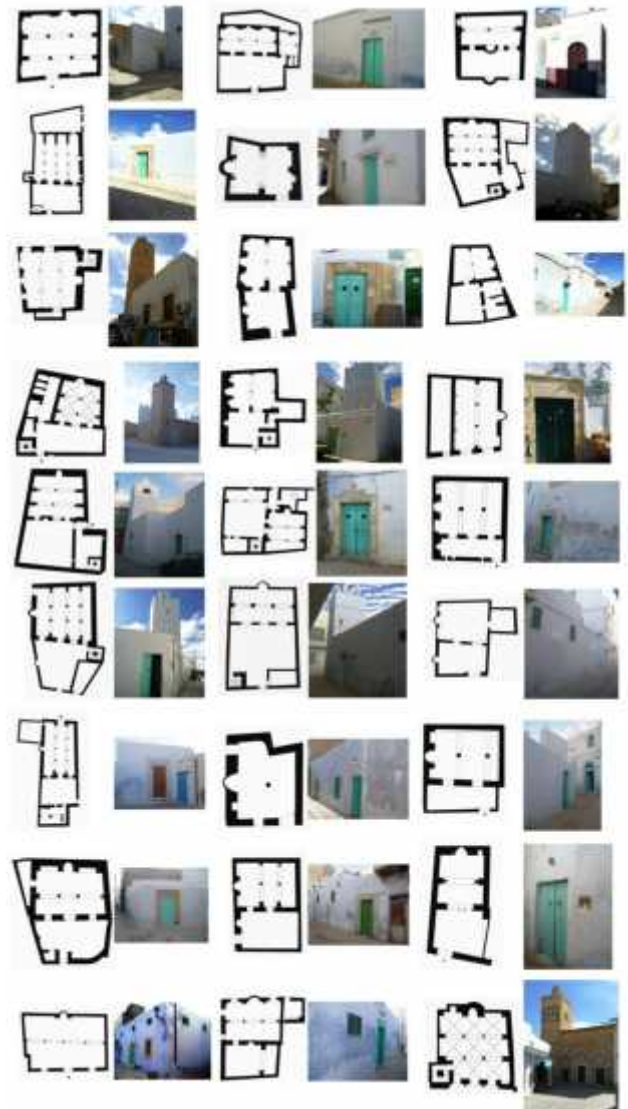


Fig. 2: Examples of masjeds of the medina of Kairouan
 Source: photos and personal statements

IV. MORPHOLOGICAL ANALYSIS

"Morphological analysis is to decompose the architectural object-side segments, following manifests and repairable parts discontinuities in order to facilitate the description. Decomposition can continue to result in non-decomposable elementary segments. Comparing counterparts separate specimens having the same nominal identity segments, will establish classes of specimens that satisfy the same basic structure." [3].



Stages of morphological analysis:

- Analytical decomposition.
- Objectification of analytical decomposition by comparing multiple specimens.
- Construction of a model of morphological structure.
- Develop a catalog of basic shapes.
- Processing of the results of the analysis.

A. Analytical decomposition

We begin by identifying the physical and visual limits of global forms are the lysis or apparent discontinuities. Segments are all definable because they are defined and perceived boundaries (discontinuities form the boundaries between adjacent segments). We admit that the assumptions of segmentation are all the possibilities or contingencies to decompose conformation of masjeds in pregnant segments.

Thus, for each masjed are required several alternative of fragmentation "fig. 3". The control operation is needed to validate the choice of the most appropriate segmentation hypothesis through the tool of comparison.



Fig. 3: Variants masjeds segmentation of the medina of Kairouan

B. Analytical modeling of the morphological structure

The control operation of the segmentation hypothesis by comparing and observation of recurrences allows establishing equivalence relations or homology position between segments of different specimens. "This homology should be defined as closely as possible as a relationship of bijective correspondence from one specimen to another, segment by segment, between each segment of different specimens." [4].

Thereafter, for each specimen of masjeds studied we will choose the morphological decomposition that contains homologies constitution compared to other specimens. Decomposition chosen is the assumption of the most relevant segmentation that contains pervasively present discontinuities. "Only are morphologically similar objects where the stability of relations between segments is evident from one specimen to another, even between the whole and its segments" [5].

Therefore, for comparison, the objects must have the same structure (same spatial arrangement manifest distinct parts, the stability of position); otherwise we reorganize our initial collection into several subsets of the same structure so as to have a structure per subset.

We present below "Table 1", a color coding for homologous segments specifying their positions and roles for a better reading of decompositions used for the different specimens.

TABLE 1

segment	color	position	role
A	Yellow	Above "B"	Main element covered
B	Blue	Below "A"	Main element discovered
C	Cyan	On the left of "A" and above "E"	Element on the left (first position)
D	Grey	On the right of "A" and above "F"	Element on the right (first position)

E		On the left of "B" and below "C"	Element on the left (second position)
F		On the right of "B" and below "D"	Element on the right (second position)
G		Below « B »	Element below
H		Above « A »	Element top

TABLE 1: Table color coding segments with presentation of the position and role

Control of assumptions segmentation is done by comparing and observation of recurrences. Equivalence relations are marked by the mechanisms of visual perception through "repeated observations, by which the initial perceptual assimilation gradually give way to logical operations" [6]. We consider that two or more segments are homologous if they obey between them to the rule of stability called positional relationships "fig. 4".

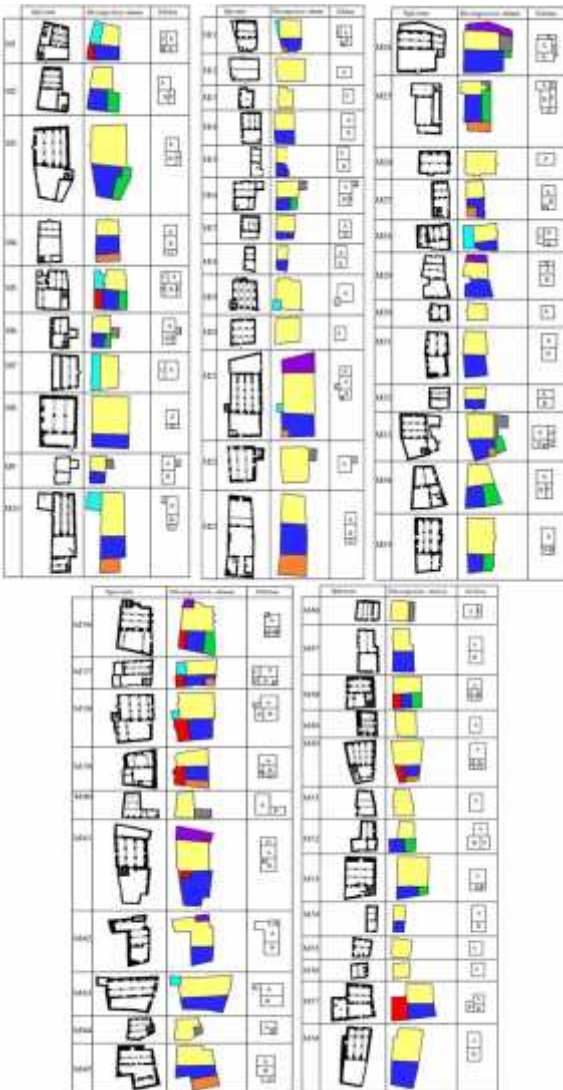


Fig. 4: The decomposition of selected specimens

According to the records of Figure 4 we can identify the structural model "fig. 5" of mosques neighborhoods plans located in the intramural portion of the medina of Kairouan.

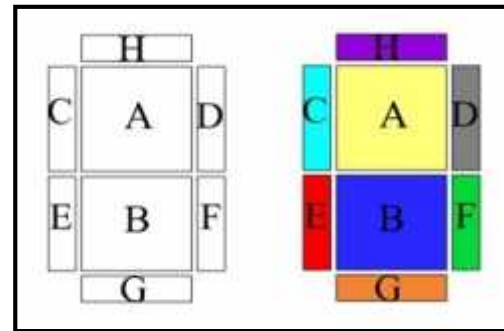


Fig. 5: Structural model of the plane of masjed

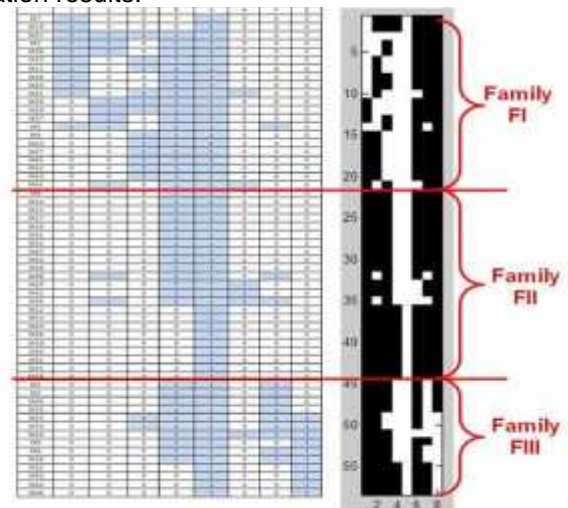
C. Treatment of morphological data

In order to reach the model we proceed to the objectification of research using a statistical software (module that is associated with the interactive Matlab calculation software. It allows to perform numerical simulations based on algorithms of numerical analysis). We focus in this section at treatment of morphological data segmentation previously developed.

We prepare an array attribute / object where each line corresponds to a specimen and each column corresponds to a segment. We note "1" if the segment is present, if not we note "0". This table will serve as a background on what the software method for processing inputs. The reclassification of this table is using the software for data processing which is capable of permutations of columns and rows according to frequency. Thereafter, the software processing seriation gives us another aspect of the objective results. In fact, this software shall classify digits 0 and 1 by seriation of rows and columns.

The result is a graph class the corresponding entries into families and a second table with the new order of specimens and attributes "Fig. 6".

Seriation results:



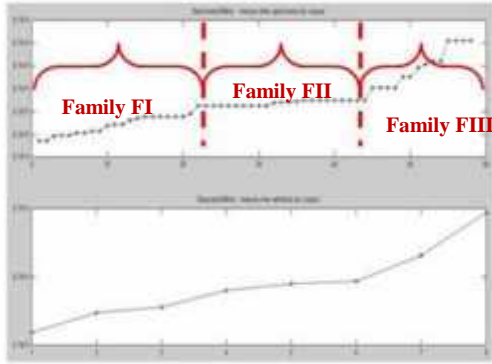


Fig. 6: treatment result of seriation

The graph and the measurement curves present three major families of specimens. Each of these families is likely to a second level of division in more homogeneous families.

D. Objectification of the segmentation and identification of structural models

The collection of our study is not homogeneous in terms of morphological structure but has homologies position reflecting a convergence. Thus, the specimens are divided into subfamilies that form a homogeneous despite internal distinctive heterogeneous “fig. 7”.

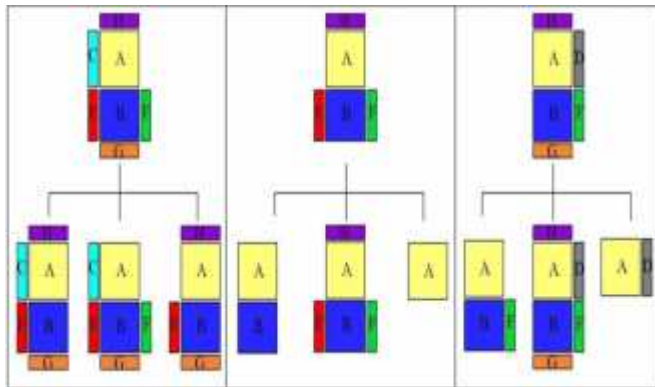


Fig. 7: Overview of the different structural models

These structural models are the background and basis for the development of changes in forms of different specimens.

V. EXTRINSIC EXPLANATION

The classification provides a set of variants based relationships between segments. To understand these morphological variants we propose to bring extrinsic fact, through which we could obtain explanations by relating morphological knowledge with knowledge of another order.

Families’ masjeds positions relative to their neighborhoods:

We propose to study the report of specimens of each family with their neighborhoods. Thus, we represent each specimen in his islet “fig. 8”. The demarcation of islets is made on the basis of material and spatial continuity. Indeed, the islets are the pieces of the solid urban (buildings) separated by empty urban (squares, squares, streets, alleys and dead ends).



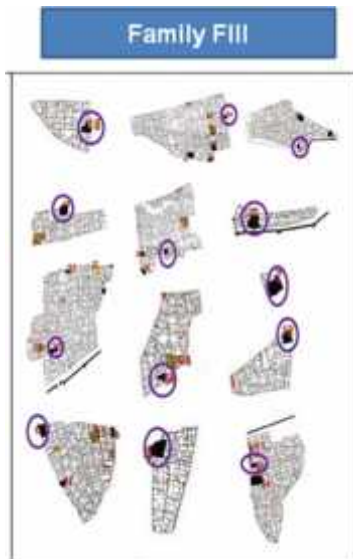


Fig. 8: Positions of specimens of each family in their islets

The masjeds generally occupy peripheral positions in their islets in order to protect the privacy of other buildings and to ensure better visibility. They usually overlook streets or alleys to ensure better accessibility to people of neighborhoods.

VI. CONCLUSION

In this paper we proposed a method of morphological analysis applied to the architecture of masjeds of the medina of Kairouan to release the identity morphological characteristics resulting from the correlation established between these forms obtained from a traditional architectural knowledge and historic environment, and social urban in order to provide for researchers, teachers and students needed to study this kind of buildings, assumptions about the organization of architectural space in these masjeds logic.

Thus, morphological analysis has allowed us to systematically explore all possible through several segmentation hypothesis combinations. These assumptions prove by identifying discontinuities evident. To confirm the selection of the most appropriate variant, control operation is necessary through the tool of the comparison. This is a delicate operation and requires a structured reflection. Therefore, we used combinatorial states to achieve the optimal or appropriate solution. The segmentation hypothesis chosen for each specimen will give us a catalog of basic shapes of each segment. Thereafter, we proceeded to the objectification of the search through the tool information processing BSK to generate structural models and classes of objective forms.

The classification system has allowed us to identify three main families of masjeds which have a certain convergence despite their structural differences. Comparing them with extrinsic data, we found that these masjeds generally occupy peripheral positions in relation to their islets to protect the privacy of other buildings and to ensure better visibility. In addition, they usually overlook streets or alleys to ensure better accessibility to people of neighborhoods.

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