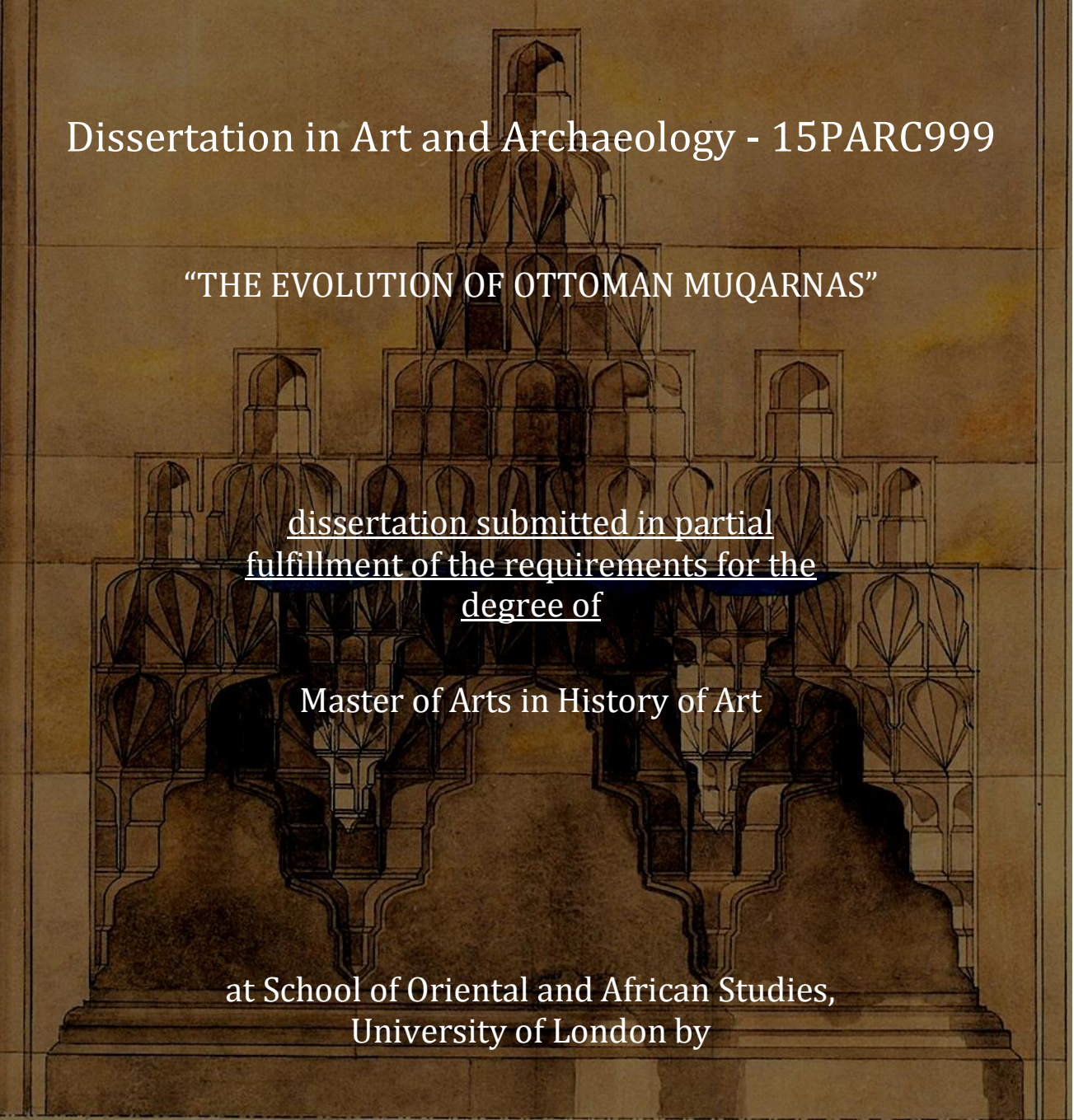




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“THE EVOLUTION OF OTTOMAN MUQARNAS”

dissertation submitted in partial
fulfillment of the requirements for the
degree of

Master of Arts in History of Art

at School of Oriental and African Studies,
University of London by

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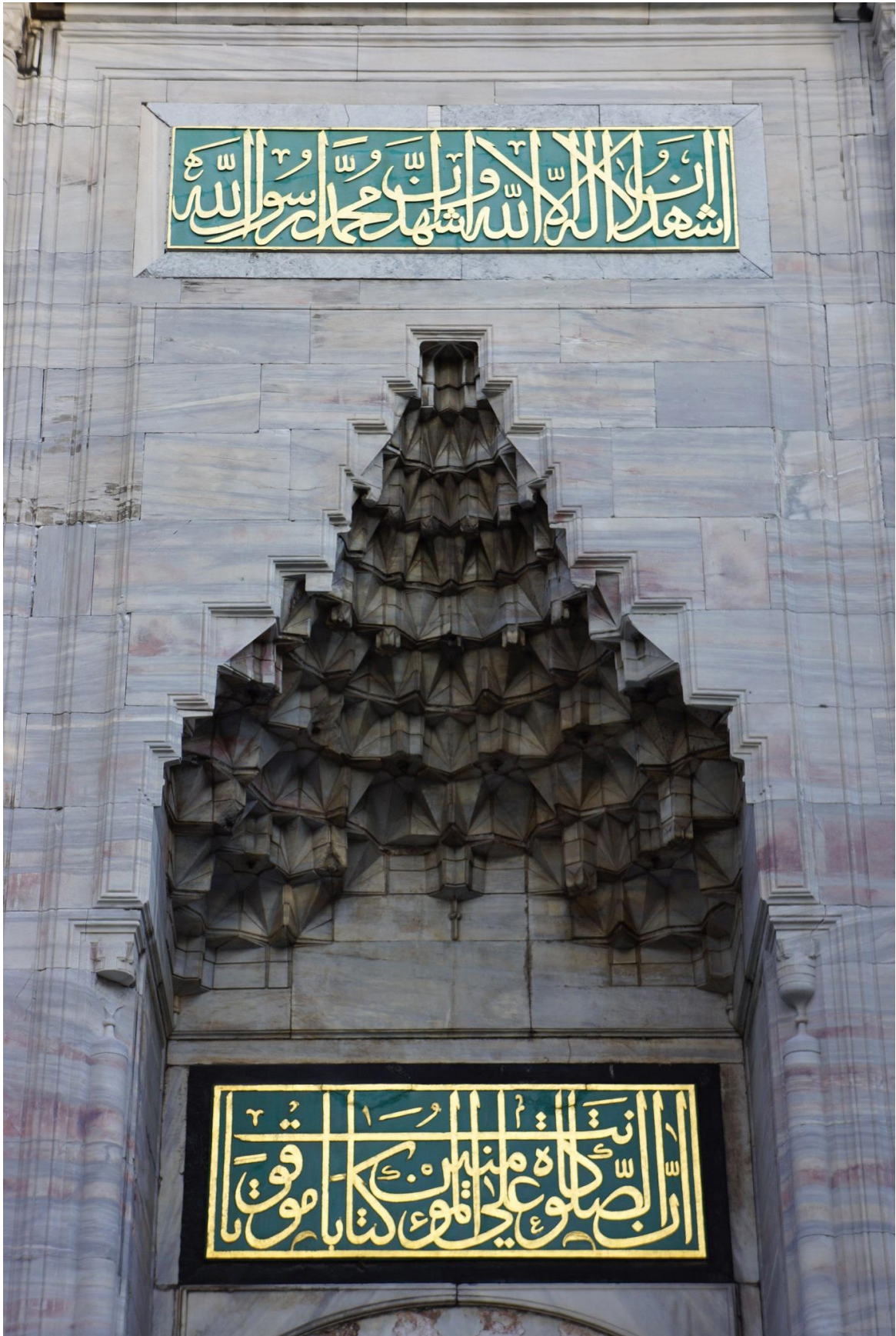
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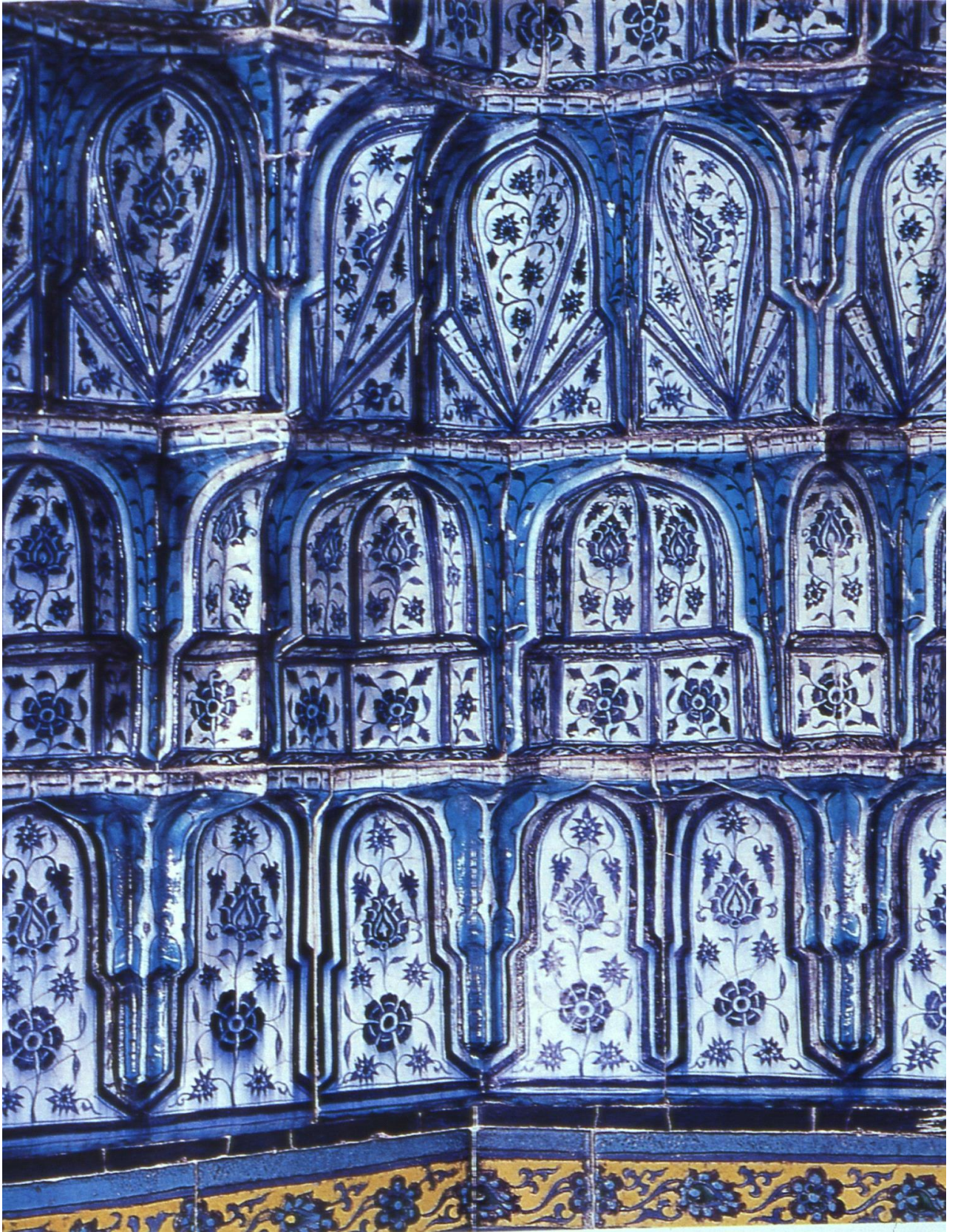
to my mother, who has supported me at every point of my time writing this thesis,

to my father who directed me to undertake this essay topic, which I have great passion towards,

And to my sister and brother of whom I invaded their rooms in the way that they call “the muqarnas invasion”.



Istanbul Sultanahmed Mosque, Courtyard entrance.



Edirne Muradiye Mosque, mihrab.



Riwaqs of al-Masjid al-Haram, Makkah.

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My special thanks are to my supervisor Doris Behrens-Abouseif who aided and supported writing this thesis and encouraged me when I wanted to study “muqarnas”.



Erzurum Yakutiye Madrasa (1310)

ABSTRACT

This dissertation examines the evolution of Ottoman muqarnas. The aim is to demonstrate what are the important subjects in the period of nearly five hundred year of development.

The second chapter is in order to define what muqarnas is and to reveal what are the main aspects of muqarnas.

The third chapter is about the principles of muqarnas. In this part arguments from various scholars are discussed and it concludes by an example demonstrating how a muqarnas plan should be read.

The last chapter is the main part of the dissertation. In this chapter it has shown that there is a continuum in the architecture of Anatolia, and Ottoman muqarnas is natural development of its predecessors. In the formation of Ottoman muqarnas, usage of marble has extreme importance. Ottomans brought new approaches and developed geometric schemes developed by Seljuks.

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Note on drawings, plans and sections,

Unless it is mentioned, grayscale muqarnas plans, geometric schemes and sections belongs to Odekan (1977) and (1981). As for the coloured muqarnas plans, they are taken from Shiro Takaeshi`s Muqarnas Database (2003).

“Regarding that which is called the science of geometry [handasa], in this age [1614], if the science of geometry is discussed among architects [mi'mar] and learned men [alim], each one will answer, "Yes, we have heard of it, but in essence we have not heard how the science of geometry works and what it deals with." ... As long as a person does not understand this rare and agreeable science, he is not capable of the finest working in mother-of-pearl, nor can he be expert and skilled in the art of architecture.”

*Ca'fer Efendi, Risale-i Mi'mariye
(in Crane, 1987)*

1. INTRODUCTION

This dissertation critically examines the dynamics of the evolution of Ottoman muqarnas in art and architecture. This requires bordering our investigation into Anatolia where examples of muqarnas had sprung. This work will cover between 12th and 18th centuries, marking its emergence and disappearance. Another topic must be examined is its geometry, due to the fact that muqarnas is different from other Islamic ornaments. It's geometrical scheme is drawn at second dimension, and later it is elevated to third dimension.

For us to understand Ottoman muqarnas, one needs to first look into the factors shaping muqarnas and how it evolved into what it was in Ottoman era. A brief background will be given about the characteristics of muqarnas decoration. The geographical diversity of muqarnas will be shortly demonstrated. Also the reasons of major architectural differences seen in the regions will be shortly examined.

In the next part, the principles of muqarnas will be discussed in relation to the Anatolian peninsula. How two-dimensional muqarnas drawings raised to the third dimension will be shown. The elevation of the muqarnas is peculiar to regions, as a consequence muqarnas

elements peculiar to Anatolia will be discussed. This will include an examination of existing muqarnas vault of Sultanhan caravanserai between Niğde-Aksaray road , which is done by Ödekan (1975). This examination will mark this style as the source of Ottoman muqarnas.

Later, in the next chapter where the evolution of Ottoman muqarnas examined, five geometrical typology produced by Ödekan (1977) in the pre-Ottoman area will be introduced and those will be explained by real examples. In this respect, the book of Ayla Ödekan (1977) “Muqarnas Portal Niche in Pre-Ottoman Turkish Architecture” is very interesting and it is obscure to the general reader in the west. In the study, muqarnas portals of mosques, caravanserais, hospitals and madrasas are classified in relation to their geometric scheme, their plans drawn and also photographs included.

After introducing pre-Ottoman muqarnas, Early Ottoman muqarnas portals will be examined. This part attempts to display the significance of Ottoman muqarnas. In this representation of diversity and significance, some examples have been selected to have a clear and vast representation of Ottoman muqarnas. During my research of diverse examples of muqarnas that appear in the Ottoman architecture, I found portal niches being the most diverse and commonly practiced muqarnas type amongst other usages. Other typologies, for example, transitional zones, capitals, window frames, minarets (balcony) also exist, however not as striking as the former. Here, Ödekan’s (1981) unpublished thesis “Muqarnas Niche Portals of Early Ottoman Period” is also very interesting, and this work is even obscure to Turkish Academia. This work also classifies portal niches into typologies, and in the dissertation we will use those. However due to some issues that is overlooked by

Ödekan such as material of muqarnas, and other uses of muqarnas, such as mihrabs, a critical approach is undertaken in this part.

The next part in the chapter is examining muqarnas of the classic period, when Sinan was the court architect, there are different approaches to muqarnas design. Later, post-Sinan period will be discussed from the beginning of 17th century to the middle of 18th century.

In order to reach wide range of muqarnas schemes Takahashi's muqarnas database is a very important source. Takahashi drew plans of any muqarnas decoration from all over the world, an attempt which is extremely valuable. For the plans of Sinan and post-Sinan period, and also for plan those Ödekan did not include, this source will have extreme importance.

In addition to both of Ödekan's work, Gülru Necipoğlu's (1995) Topkapi Scroll is also a valuable source regarding the study of muqarnas. However because of various issues which will be touched upon, the study leaves many points blank and therefore is not useful for both students of muqarnas and general reader. Therefore Necipoğlu's work will be criticized.

During the formation of Ottoman muqarnas, gypsum muqarnas usage was very common in the surrounding area. Therefore, the book of Seda Kula Say (2011) and Phd of İlter Büyükdığan (1986) is very useful source.

In my work I attempt to investigate how these developments took place and what is important for Ottoman muqarnas by referring to its geometrical composition and the final form took place in geometric design. The main hypothesis is Ottoman muqarnas is the

natural continuation of Anatolian Seljuk period muqarnas. Another sub-hypothesis here is material of muqarnas is very important and its nature creates different muqarnas elements in the third dimension.

2. DEFINING MUQARNAS

2.1. Definitions and characteristics

A basic definition is given by Al-Asad (1995:349) “the muqarnas is a vaulting system based on the replication of units arranged in tiers, each of which supports another one corbeled on top of it. In *Encyclopedia of Islam* Diez adds the transitional nature of the muqarnas system that “the transition is always in the state of equilibria that it shows a cubic form. In this sense that sort of form could only be possible in a cubic architectural style as happens in Islamic architecture.”

Muqarnas can nearly be part of any architectural element of a building. Muqarnas can appear on both outer and inner body of domes and can break squinches into consoles, arches and little domes. It fills half-domes of portals, mihrabs and iwans, Muqarnas can embellish either partially or totally the transition zone from walls or arches to dome. It also provides transition from a wall surface to a foreground or background wall surface for corbelling minaret balcony, mouldings and corbels in order to form three dimensional bands on wall surfaces. Muqarnas can be found at window niches, door cases and arc frames; at capitals, imposts of arches, building corners, fountain basins and gravestones. Therefore, although muqarnas is an architectural element and solely related to geometry, it is mostly used to emphasize other architectural elements. This characteristic should identify muqarnas as “an architectural decoration”.

There are not much early documents on muqarnas. The earliest one, is at Astvatsankal Monastery in Armania, dated to 1244 carved on stone revetment (Ghazarian and Ousterhout, 2001). Second one is inscribed on a plaster slab, forming a quarter of muqarnas vault, dateable to 1270's, was found at Ilkhanid Palace of Takht-I Sulayman. Other than that, dated to 1424, Kashi's treatise of Key to Arithmetic's includes a short chapter on muqarnas. The chapter contains relatively detailed geometric analysis about muqarnas. In the treatise one drawing gives two-dimensional account of muqarnas, defining each unit such as square, rhombus, biped and lozenge, and another drawing illustrates curvature of the ceiling of muqarnas that has extreme importance while the third dimension of muqarnas was secret and spreaded by word of mouth. (Al-Asad, 1995:353) The Topkapi and Tashkent Scrolls should also be mentioned. These drawings that belong to 16th century, demonstrates masters used to work on orthogonal grids and this system enables intricate applications in an easy manner. Those scrolls approve claims of Diez that the design of muqarnas is in fact cubic.

2.2. Regional Peculiarities

Takeashi (2003) made an important contrubition by creating a muqarnas database spanning all over the world which is also online. The database consists of muqarnas plans and their photographs. Those plans classified into three subheadings. The style of square, "is a nonperiodic tiling tessellation that have a fourfold rotational symmetry" used at domes, iwans and vaults. In his classification this type covers the whole geographic span of muqarnas. The style of pole table seperates the plan into segments with radial bundles of stars and polygons. This style is common in Anatolia, Iran and Central Asia.

There are some important factors that generate regional peculiarities. The first one is the nature of the formation of each muqarnas element. If one muqarnas plan applied to both Magreb and Central Asian muqarnas, it can yield two very different muqarnas example, without identifying they actually have the same scheme. Second one is the material. Nature of material dominates the characteristic of muqarnas. For instance, marble muqarnas examples are very prismatic, and gypsum ones are usually creates simple muqarnas and plain textures. This topic is interconnected with geography that one could use only material that is available or productable such as brick and gypsum.

3. THE PRINCIPLES OF MUQARNAS

Muqarnas has a peculiarity that should be designed firstly on second dimension, and then third dimension. This means in art historical terms there exist two types of media, second dimensional drawings and the final product of muqarnas. Before the final product, the plan of the muqarnas should be projected on second dimension, on a piece of gypsum slab, paper or any surface. After that the master elevates the plan and constructs the muqarnas in tiers. There are important points regarding elevation.

First one is from the master's point of view, how to elevate the muqarnas drawing, how he is going to do? According to Necipoğlu (1995:52) "this task is depended on the unifying vision and relative expertise of architect-engineers who had mastered the methods of geometrically harmonizing two and three dimensional surface revetments with one another and with their architectural support." Özdural (1995) finds evidence from the untitled treatise of Omar Khayyam that *conversazioni* between mathematicians and artists had existed and they "collaborated to find solutions to the problems concerning the application of geometry to architecture and its related arts". In his next article Özdural (1996) finds an evidence this time about the ornamental geometry on the treatise "Interlocking figures". It has shown that the treatise "was indeed a compilation of notes taken by a scribe at a series of conversation between artisans and mathematicians".

The discovery of a drawing of a muqarnas vault dated to 1270's in Takth-i Suleyman has sparked academic discussions on how to interpret those drawings on third dimension. First to interpret the plan into third dimension was Harb (1978). Later, Yaghan (2000) made a new

interpretation by indicating Harb's mistakes. Lastly, Dold-Samplonius and Harmsen (2005) indicated that both were wrong. In all those studies, it is argued that each particular study fits well with the historical context. Among those, Dold-Samplonius and Harmsen's work is important because the study takes its stand from Timurid mathematician al-Kashi's treatise, Key to Aritmetics (ca 1430) which is important for our modern understanding of muqarnas. However, the interpretation of Dold-Samplonius and Harmsen is doubtful. Those scholars, writing on muqarnas plans actually putting forward puzzling interpretations, without having a full knowledge of how a geometric schema may established first, and what are the interrelations of geometric forms between two tiers, upper and lower. Although this study exploits al-Kashi, our understanding of muqarnas still remains obscure, and there should be ample analysis studying wide range of muqarnas plans. What is more, before looking anything else related to the drawing, this plaster slub is not verified to be right or wrong.

Al-Kashi has identified four muqarnas types. Simple muqarnas, clay-plastered muqarnas, curved muqarnas and Shirazi muqarnas. The first two are simple muqarnas' with little difference. As for the last two, Shirazi muqarnas is like curved muqarnas and it has greater variety (Dold-Samplonius and Harmsen, 2005). In Shirazi muqarnas al-Kashi explains all elements, such as square, rhombus, half rhombus, almond(deltoid), biped, jug, large biped and barley kernel (**Figure1**). Interpreting the muqarnas plate with the elements al-Kashi mentioned gives greater clarity and in this sense the historical context becomes much more sensible in connection to the plate. According to al-Kashi, elements of muqarnas includes "cells and of intermediate elements connecting the roofs of cells" (**Figure2**). This system is important for further analysis in the discussion.

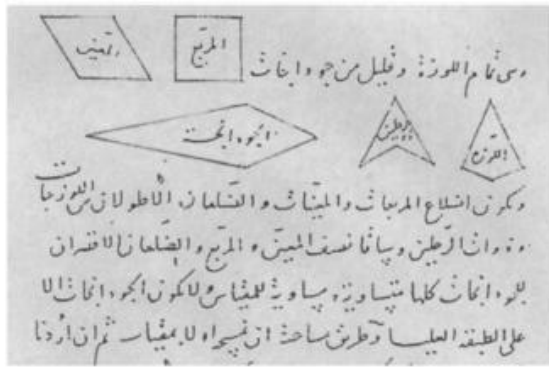


Figure 1 A-Kashi's projection of muqarnas elements.

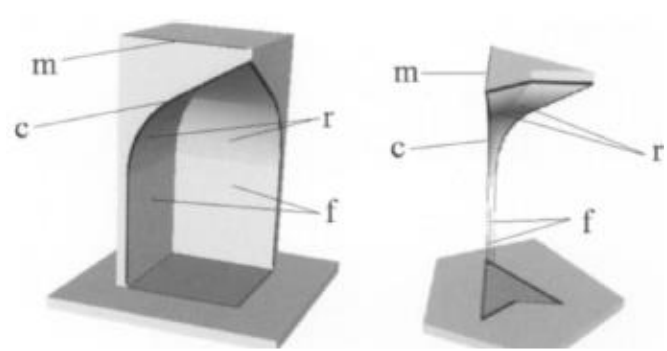


Figure 2 The cell (left) and the intermediate element.

While those scholars have tried to interpret second dimensional drawings, Ödekan (1977) has classified pre-Ottoman muqarnas portal niches, mostly belonging to Seljuks of Anatolia tradition, into typologies. In this study, real examples of muqarnas vaults, from caravanserais to mosques have been examined and plans and sections of those muqarnas had been drawn and put through to geometric analysis. Ödekan found five typologies had become widespread in pre-Ottoman Anatolia. Ödekan demonstrated a development at muqarnas portal niches, from simple to more sophisticated in both second dimension and third dimension. This study is very important and interesting because Ödekan classifies muqarnas portal niches which belongs to a certain time period and specific geography by analyzing their geometry from the first example, to the last one. This study is unique in its area.

Muqarnas portal niches are important sources for other muqarnas usage, due to its importance in the Seljuk architectural practice. If the dome was the most important element of Ottoman architectural practice, so was those portals of vast dimensions for Seljuks. This peculiarity made portal niches an important source for other muqarnas usage. It is clear that a portal plan is not always just for portal muqarnas. Under any circumstances, all muqarnas portals are in the form of a rectangular. If a portal plan folds in two, a muqarnas dome is

generated. Also some segments of portal niches can generate squinches or pendentives, if outer form of the segment suits to relative surface. A little piece of three tiers with a five pointed star in the middle, can embellish a minaret balcony easily. This importance of muqarnas portal niches shows that further investigation is necessary.

3.1. The Geometric Analysis of Muqarnas Portal of Nigde-Aksaray Sultanhan

Ödekan (1975) made an important contribution by explaining how a Seljuk portal plan drawn on second dimension. Ödekan underlines here the importance of how a muqarnas plan should be examined:

“When any portal is examined, it is seen that they are formed of some geometric forms such as octagons and multi-pointed stars. Also, these geometric forms establish geometric, circular, and rectilinear connections with one another while the rectangular area of the portal turns into zero point on the facade. The module of the system which consists of geometric modules within geometric relationships is concentric circles. Concentric circles sometimes create a radial array which is connected to a central point, whereas they sometimes create a system in which the relationships between the centers are developed by squares in the rectangular area. Analysis of the system in muqarnas portal half domes will help us understand the basic principles of the plastic formations in the third dimension and the characteristics of the geometric schemes because of the fact that the formation here is neither a coincidence nor a spontaneous creation.”

Ödekan (1975:38)

Ödekan (1975) establishes the systematic of portal in Niğde-Aksaray Sultanhan starting from the analysis of the geometric scheme. Accordingly, she firstly examines the module of geometric scheme and secondly the relationships between the modules within the geometric scheme.

Portal schemes always start with a half star. The apex point of the portal in the third dimension is the centre of the related star. Onto the axes that come out of this star, new centers on the axes that come out of the center in the second dimension are developed. New circles or sets of circles are encountered in every newly developing center. These sets of circles play an important role in determining the horizontal projection of elements and creating the geometric scheme. Ödekan calls these sets of circles as “GEOMETRIC MODULES.”

The portal of Niğde-Aksaray Sultanhan was divided into eight segments with axes and an eight-pointed star in the plan. **(Figure3)**

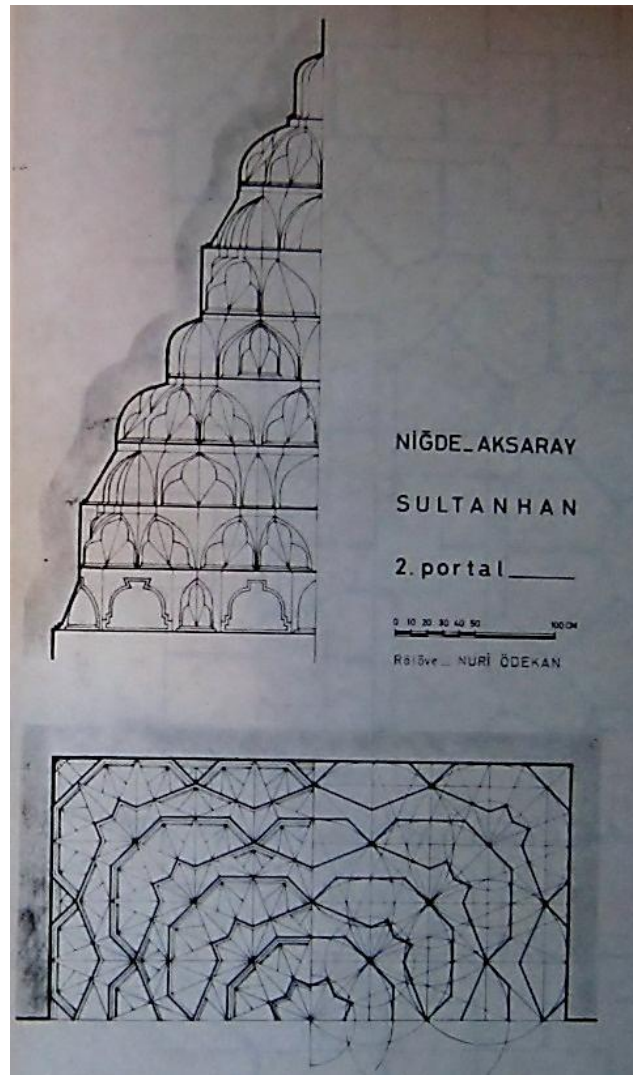


Figure 3 Plan and section of Niğde-Aksaray Sultanhan Portal

The third dimension consists of nine tiers including the star at the apex. The geometric modules are located on the diagonals of the portal plan and the y axis. Let us base on a diagonal; there are two geometric modules on this diagonal. Each geometric module is composed of two concentric circles. **(Figure4)**

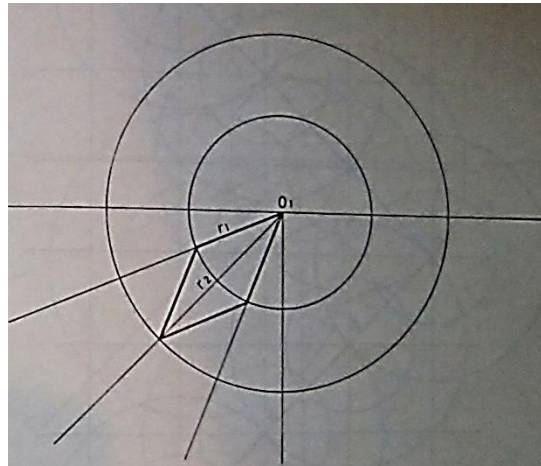


Figure 4 The Geometric Module

Let the radius of the small one of these circles be r_1 and the radius of the greater one r_2 . radius circles of the modules on this axis intersect each other at the centre. However, r_1 radius circles intersect by rendering the short diagonal of rhombus which establishes the relationship between the circles within the module as the common chord of these circles.

(Figure5) In this way, four centres that relate with each other as mentioned before occur on each diagonal.

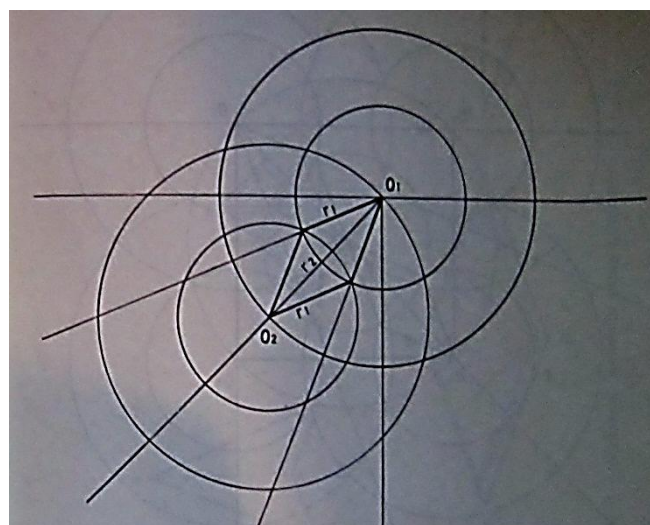


Figure 5 The relation between two modules

We can explain how these relationships create this scheme as follows. When we examine the sequence of the elements in the half of the portal plan in the geometric scheme, a clustering consisted of five modules that are dependent on the center of O^1 catches our attention. (Resim 4 ve 5) In this clustering, bilateral r_2 radius circles are tangent to each other at the center of O^3 and the inter-modular relationships mentioned above are repeated in four directions around a center. This way, the system in the portal of Niğde-Aksaray Sultanhan comes to an infinite loop.

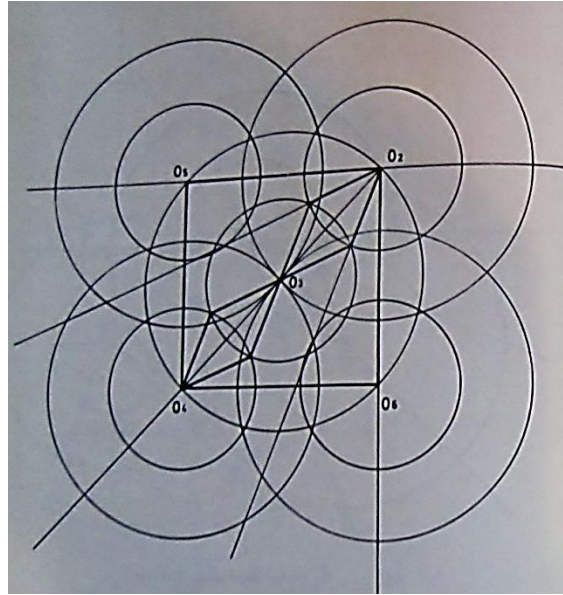


Figure 6 Figure Clustering of five geometric modules

This sort of analysis Odekan (1975) does never appears in Necipoğlu's (1995) Topkapi Scroll. Had that analysis been used perhaps we would have known more information regarding the practice of muqarnas drawings.

4. The Evolution of Ottoman Muqarnas

Before broaching the subject of the evolution of Ottoman Muqarnas, the portal niches of the Seljuk Period and the Principalities Period need to be analyzed on account of the fact that the Pre-Ottoman muqarnas constituted the Early Ottoman formation principles. This chapter which especially deals with the Pre-Ottoman muqarnas is both a summary and criticism of the classification which Ödekan (1977) put forward.

This research has two aspects. The first is to analyse the geometric scheme while the other is to present the formation of each muqarnas element. The examples from the Seljuks and the period after Seljuks make up the sufficient number of examples to be examined. Also, that the art of muqarnas reached to the last level of science of geometry during the Ottoman Empire with keeping the importance of the portal niches. As a consequence the development of brand new schemes will be displayed. Muqarnas ornaments lasted until the Baroque Period and the last portal with muqarnas ornaments is Hekimoğlu Ali Pasha Mosque. Portal niches in the Seljuk period mostly centered on mosques, madrasas, caravanserais, and hospitals. Muqarnas were also come across in several hammams from the Ottoman Period.

4.1. Pre-Ottoman Muqarnas

4.1.1. Geometric Schemes

Owing to the fact that muqarnas have their own peculiarities, not only the geometric schemes will be examined but also the elements that form these schemes in the third dimension will be presented.

The first portal niche in Anatolia is Alayhan Caravanserai that was built in 1192 on the road of Niğde-Aksaray. Important developments are as follow: type2 Kayseri Gevher Nesibe

Hospital built in 1205, type3 with Niğde-Aksaray Ağzıkara Han Caravanserai built in 1231, type4 with Kayseri Huand Hatun Mosque built in 1235, and lastly type5 with Konya Sahip Ata Mosque built in 1259.

4.1.1.1. Type1



Figure 7 The first muqarnas portal in Anatolia, Alayhan Caravanserai. Lines representing diagonals and dots are geometric modules

Alayhan is the first portal with muqarnas is in the category of Type1 which has the same principles with Niğde-Aksaray Sultanhan (**Figure7**). In Type 1, the apex niche is formed by an eight-pointed star of which one side is on the y axis. This is followed by an eight-pointed star or an octagon in the second row. The geometric module is constituted of two concentric

circles as mentioned in the chapter of Principles of Muqarnas. At least one more of the same element is aligned on the diagonal and the relationship between the geometric modules is established with a rhombus.

4.1.1.2. Type2

This type is consisted of two types as Type2A and Type2B. Type2B starts like Type2A on the apex point; however, its angular segmentations change later on.

4.1.1.3. Type2A

This type also starts with eight-pointed stars. The difference between this type and type1 is that the geometrical module of the former consists of three concentric circles. The inter-modular relation is provided with a rhombus and a square. The rhombus establishes the relationship between the circles with r_1 and r_2 radius as seen in the previous scheme while the square is tangent to the corner of the first circle, passes the second circle from its diagonal, and is tangent to the third biggest circle from the other corner of the diagonal. This way, the relationship between the three circles is maintained (**figure8**).

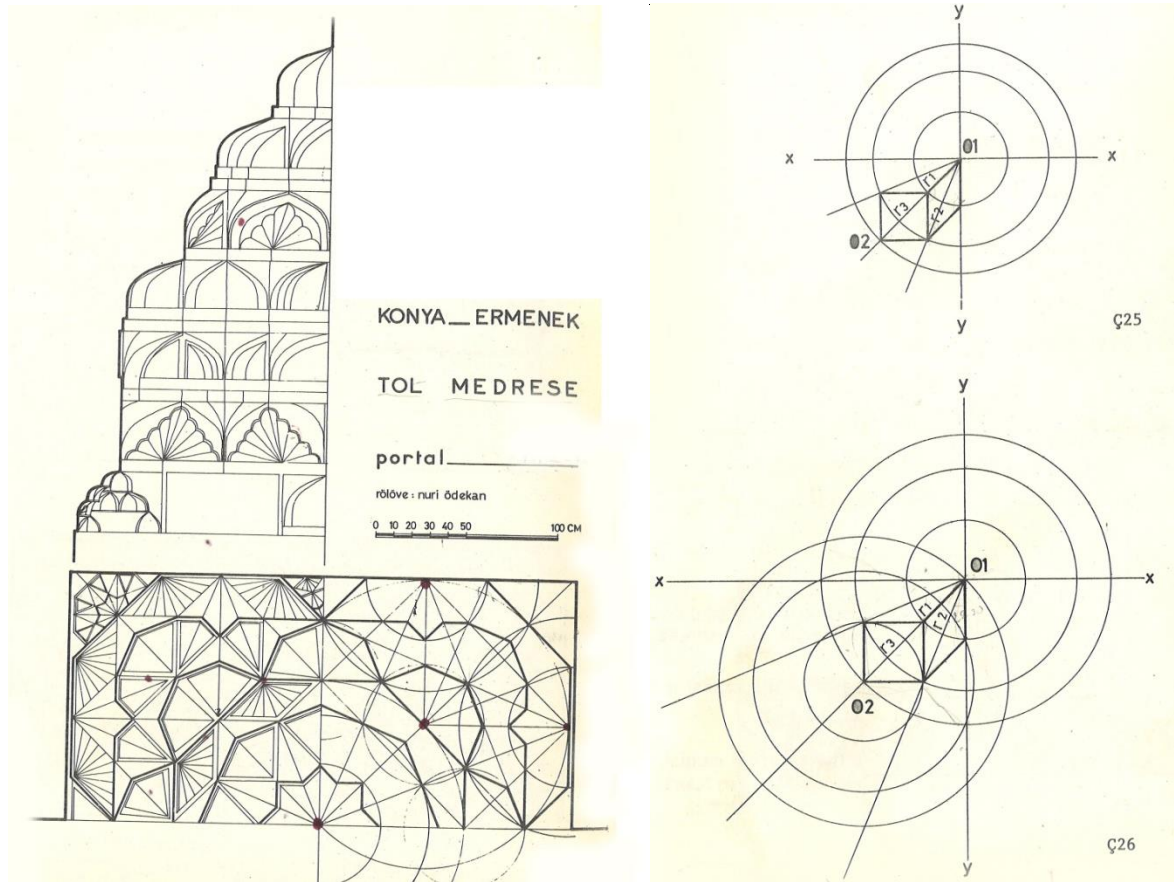


Figure 8 New geometric centers forms at the edges of Ermenek Tol madrasa portal (Left). Type2A Geometric module and relations (right).

Another characteristic of this type is that the geometric modules form new geometric centers at the bottom tier of the portal edge by making right angle crossing to the rectangular edges of the portal. This difference resulted in smaller muqarnas elements and a more dynamic facade compared to type1 in the formation.

4.1.1.4. Type2B

There are two different zones in the examples of Type2B. The first zone, with a depth that changes in each portal, is similar to the first subtype and is consisted of three concentric circles. The second zone is made of “angular segments” and corniches on the walls of the portal (**Figure9**). As it is seen, the schemes develop with the increase of the effect in the formation of the muqarnas in the third dimension.

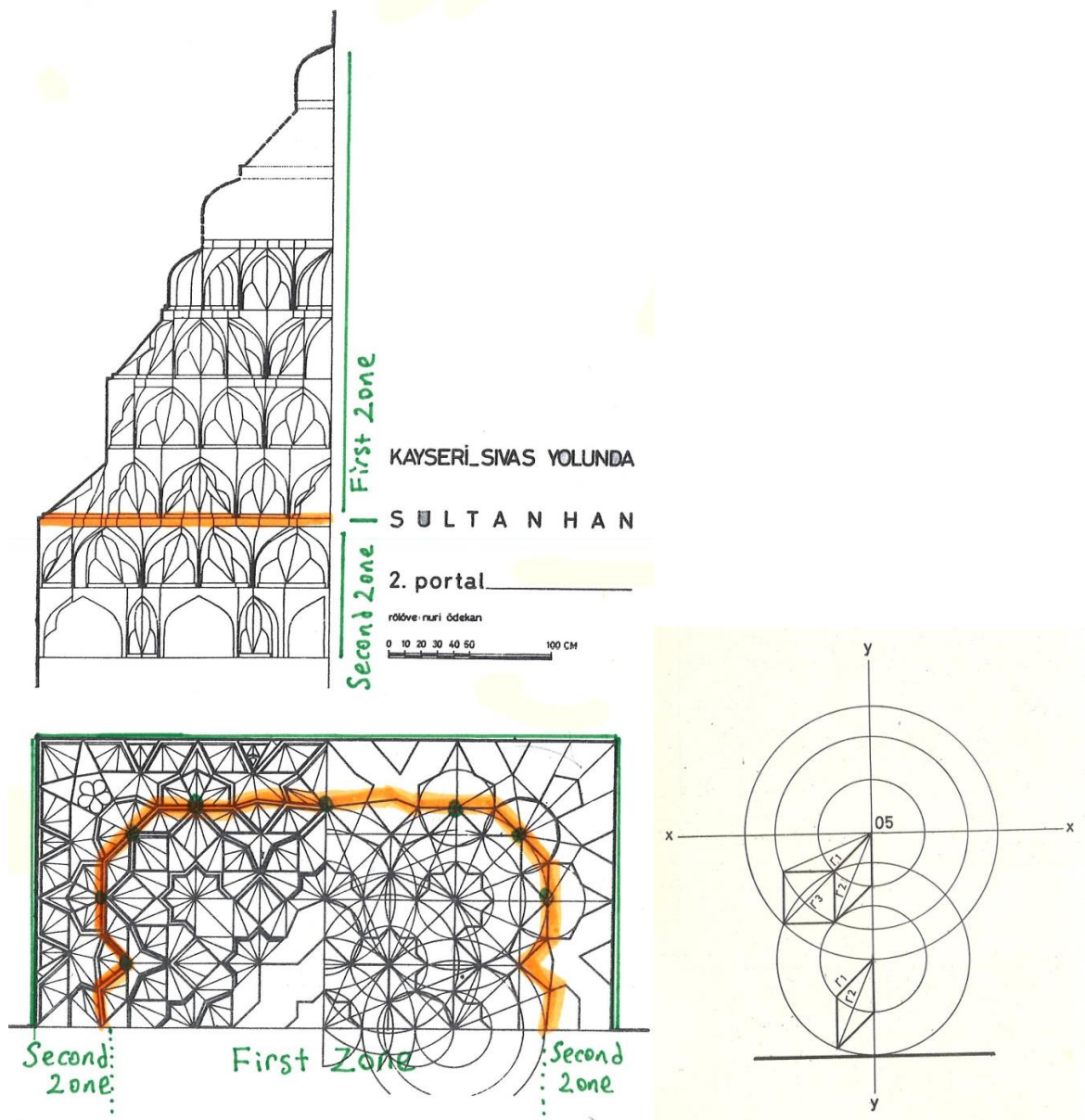


Figure 9 Kayseri-Sivas Sultanhan Caravanserai (left). Type2B Geometric module (right).

4.1.1.5. Type3

This type has two differences. This scheme starts with a ten-pointed star and the geometric modules are dispersed on 5 axes, whereas the other schemes divide the zone into four axes since they start with an eight-pointed star. That is to say, three axes instead of two occur on the half of the scheme. The second difference is that the number of the concentric circles in

the geometric module increased to four. The geometric module is established with two 72-degree-rhombuses and a 108-degree-rhombus.

The inter-modular geometric relations can be explained as constituting half of the portal area. There occur four modules when the geometric module on the apex point and the three modules located as one on each axis are included. The circles with r_4 radius of each 3 geometric modules intersect in one point, and this point is called O^2 . The fourth geometric module is drawn at this point. This way the scheme is completed. The most significant example of this scheme is Niğde Ağzıkarahan (**figures 10, 11**).

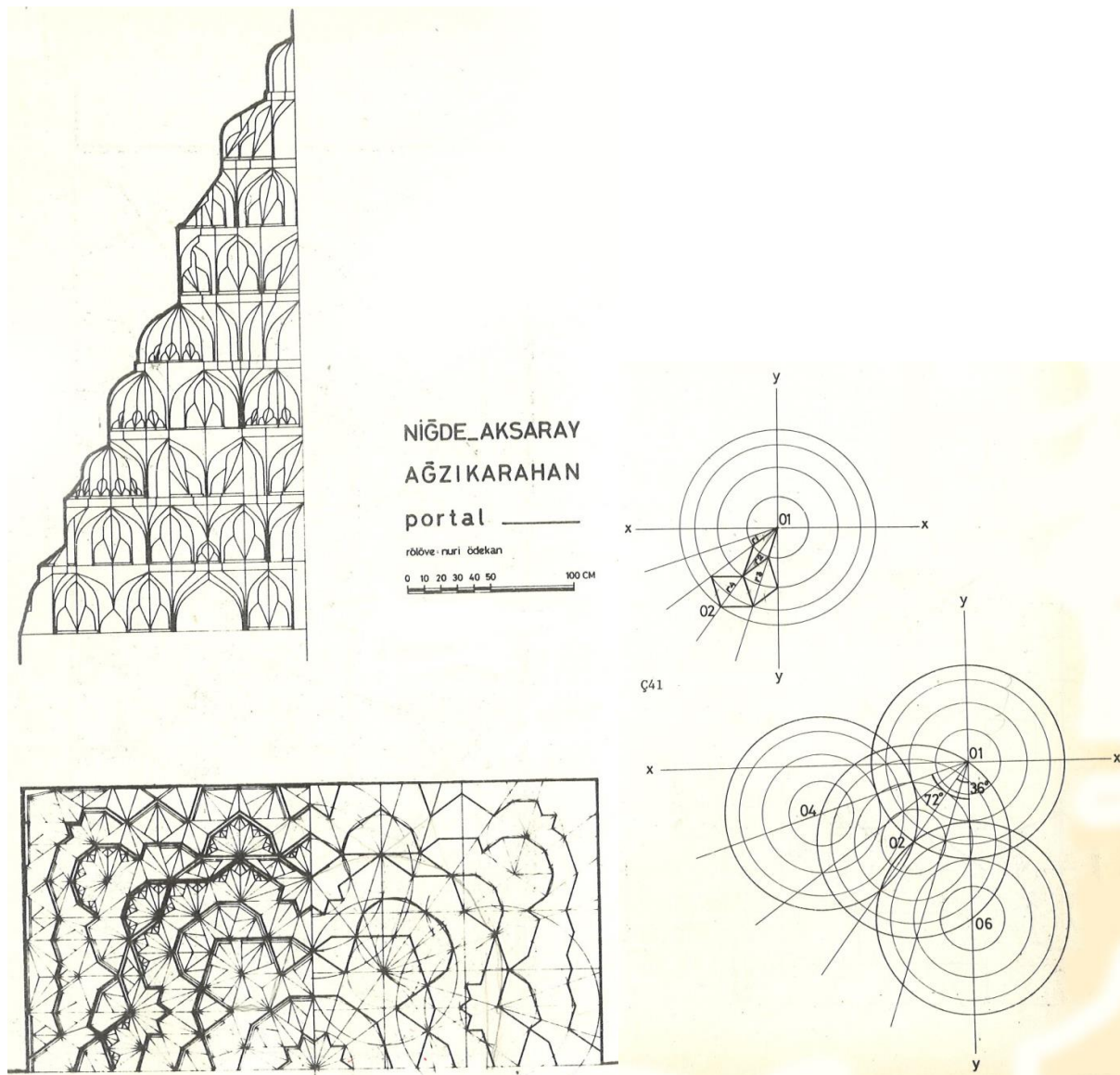


Figure 10 Nigde-Aksaray Agzikarahan portal (left). Type3 Geometric module and relations (right).



Figure 11 Nigde Agzikarahan portal.

4.1.1.6. Type4

The previous schemes offered the possibility of making a half-dome by starting from a single point. This type didn't form a geometric module; however, it brought a different approach to portal designing. Although Ödekan (1977) wrote that it was difficult to call this type as a proper scheme by creating three different geometric angular orders as dodecagon, pentagon and nonagon, especially the use of five-pointed stars requires this scheme to be defined as a geometric scheme. This type brought a very different approach in general and put forward a very advanced point of geometry. Therefore, Ödekan couldn't realize that this scheme had intended to be a central-plan scheme.

It was here when the twelve-pointed star was first tried instead of the eight-pointed star of Kayseri Huand Madrasa and Huand Mosque in which Type4 was developed. In this type, the craftsmen could be seen making efforts to find a new scheme.

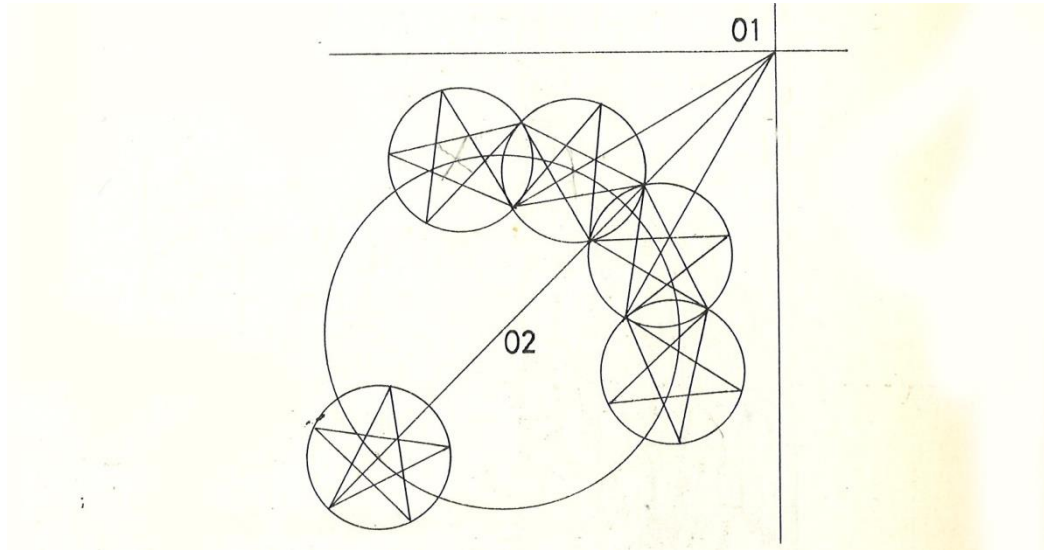


Figure 12 Type4 Geometric module.

According to this scheme, there are three zones on the diagonals of the portal area; the radial zone, the transitional zone, and the corniche zone. The point where eight-pointed star exists in the transitional zone is the center of the scheme. Therefore, the place where the central point exists is of great importance. The star at the center spreads out 18 “pencils of rays.” There is a big three concentric circle surrounded by five-pointed stars. The stars on the upper row change the direction to the center, whereas the star at the bottom of the center connects the scheme to the corner and to the end point of the portal (**Figure12**). The most important example of this scheme is the first portal in Kayseri Huand Mosque built in 1238 (**Figure13**). The number of stars was augmented in Kırşehir Cacabey Madrasa built in 1272, and the center of the scheme was composed of a little dome (**Figure14**).

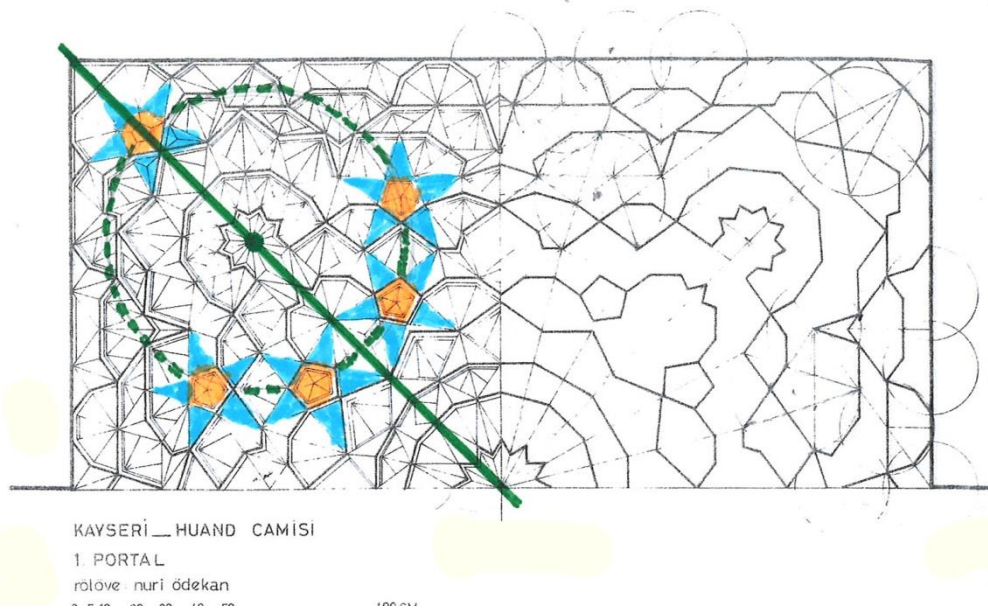


Figure 13 Kayseri Huand Mosque Portal Plan

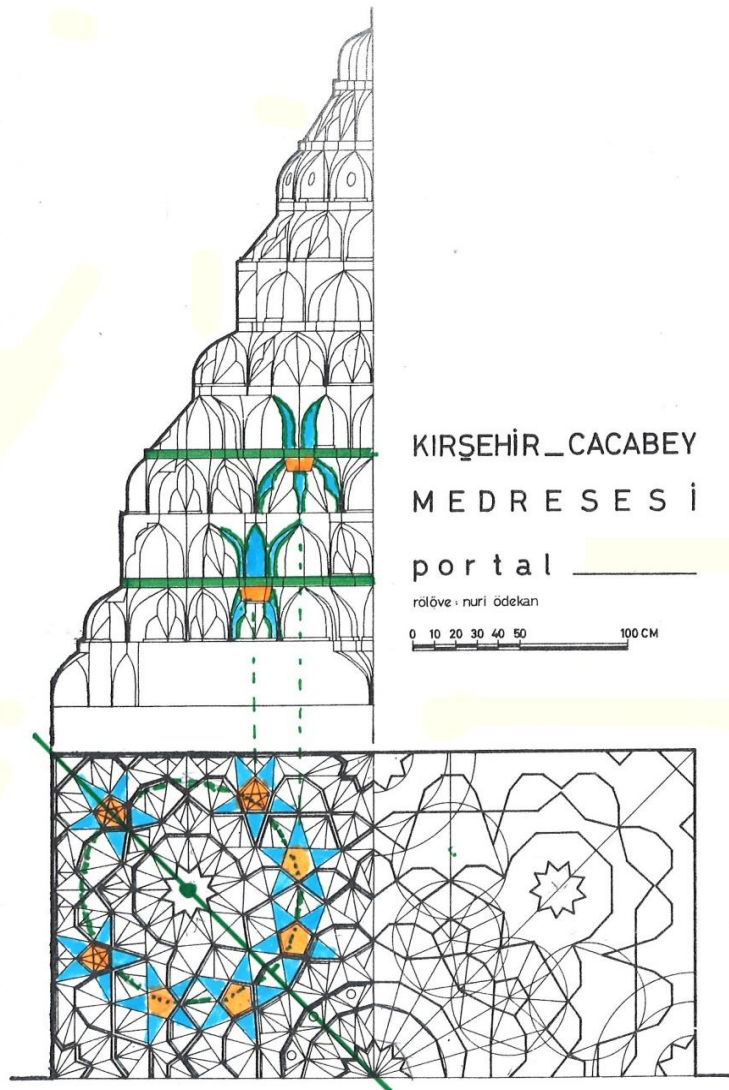




Figure 14 Kirsehir Cacabey Madrasa portal, blue stars connecting tiers notable. (coloured by author)

4.1.1.7. Type 5

Radial expansion becomes prominent in type5. Similar to type4, there are 3 zones in this type; however, not only the radial expansion is broader in this type but also “the auxiliary centers” that determine radial expansion are aligned as to draw two arches. Furthermore, the star forms are more diverse.

While the centrality of the scheme is more important in type4, radiosity and connection of tiers with diverse stars is more important in type5. Thus, the scheme is composed of 14 tiers conventionally. The best example of this type is Konya Ata Mosque Portal (**Figure15**).

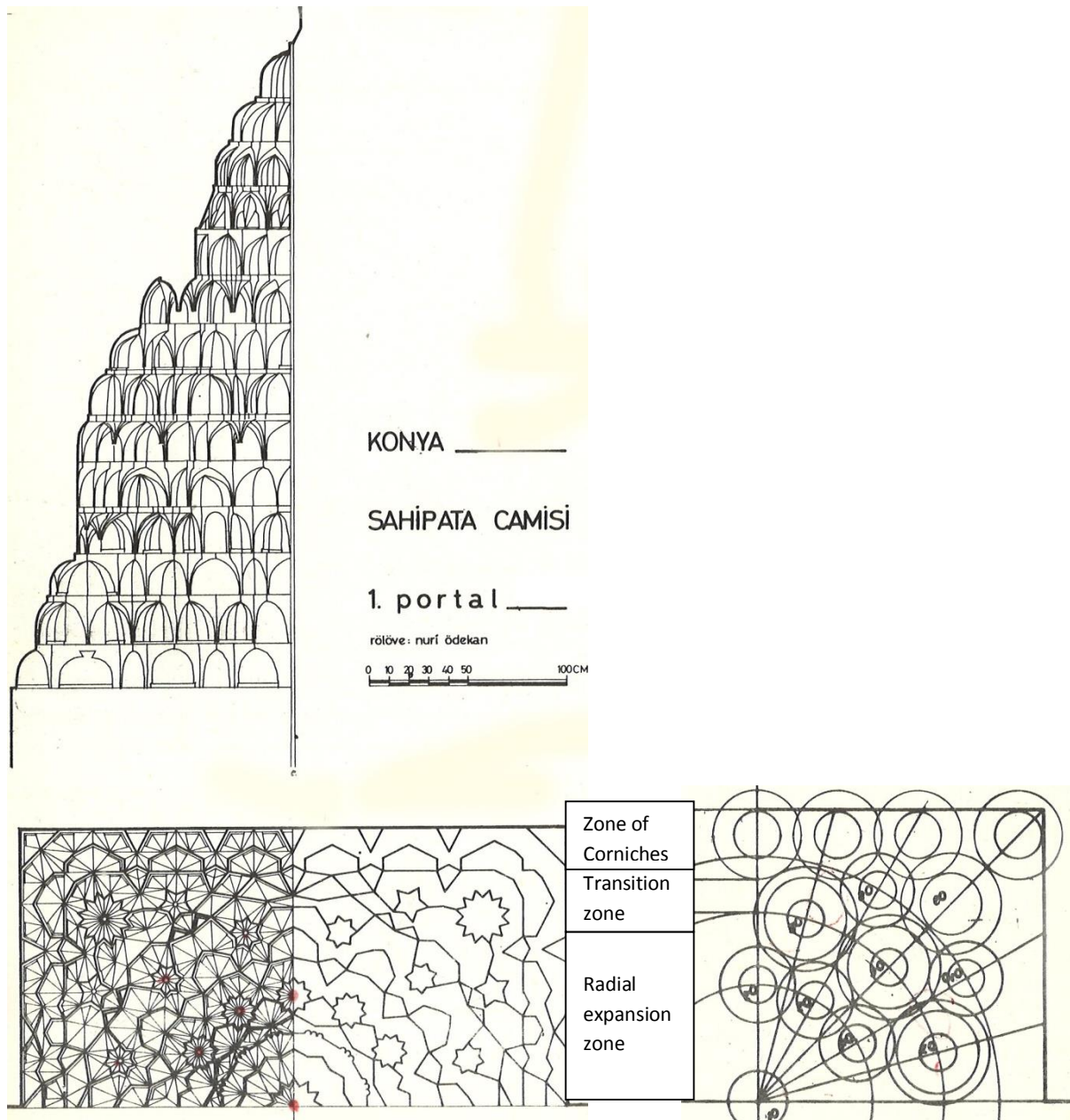


Figure 15 Konya Sahip Ata Mosque, plan and section (left). Type5 Geometric module and zones(right).

4.1.2. 3D Muqarnas Elements

According to Ödekan, there are two basic elements in three dimensional geometric formations. These are corbelling elements and niche elements. She mentions that these elements enhance the plastic effect by corbelling. However, this distinction is difficult to

make since all elements “corbel” in this projection. In fact, Ödekan (1977:107) anticipated that these elements were more discernible in type1 and type2, and acknowledged that they were more difficult to be perceived in type3, type4, and type5. In her article in 1975, the distinction is more properly made as first degree corbelling elements and second degree corbelling elements. To make this distinction in Ottoman muqarnas is becoming gradually more difficult because the scheme gets more complicated and the formations become more prismatic. Therefore, this distinction will not be used here.

4.1.2.1. *Yaprak* (eng. Leaf) and mini muqarnas

According to Ödekan, the tendency in the Pre-Ottoman period was to benefit from the plastic appearances of the elements. *Yaprak* was the most preferred motif since it was the most proper motif that could enhance the plastic value of the curved surfaces of cells. **(Figure16)** Moreover, there existed elements carved as mini muqarnas; these consisted of several mini muqarnas.



Figure 16 Pre-Ottoman *yaprak*

4.1.2.2. *Püskül* (eng, tassels)

Püsküls are ornaments that are hanging from the small polygonal centre of the stars that were seen in Type4 and Type5. The examples in the first portal in Kayseri Huand Mosque ve Kırşehir Cacabey Madrasa are simple. The first example in which they hung from the star creating a plastic effect was seen in Konya Sahip Ata Mosque.



Figure 17 Pre-Ottoman *Püskül* at Sahip Ata Mosque.

4.1.3. *Kazayagi* (eng. Goose-foot)

Kazayagi is in the space of half-star in pre-ottoman period and usually fills between the yapraks and transfers triangle projections to the lower tier (figure18).



Figure 18 Pre-Ottoman *Kazayagi*.

4.1.4. Conclusion

The nub of the whole matter is the application of “star-polygon combination” that started in Alay Han to the half dome of the portal (**Figure19**). Different formations of this implementation are present in all examples of type1 and type2. By looking for other ways of different formations, “new arrays” were obtained from type3, type4, and type5. The experimentations in portal half domes helped in developing a rich muqarnas dictionary, and certainly reflected on other aspects of architecture.

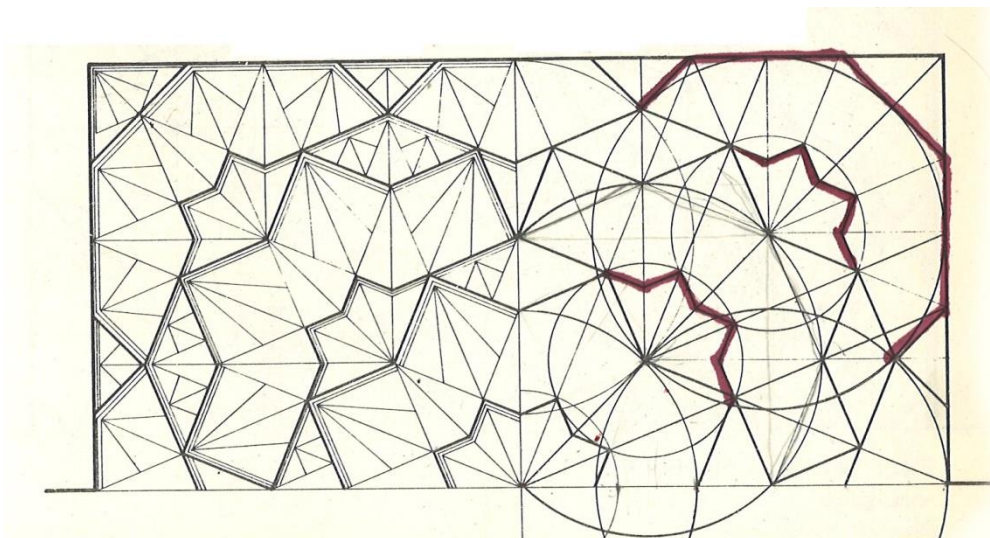


Figure 19 Star-polygon combination at Alayhan portal marked with red.

4.2. Ottoman Muqarnas

In this part typologies developed during the Ottoman era will be presented in relation to the last section which was significantly helpful for us to understand Ottoman muqarnas.

There are many examples of Ottoman muqarnas. For this reason, three dimensional elements will be discussed initially for us to understand three dimensional formation with schemes. This way will be easier to follow the geometric schemes. Another important matter is the significance of the material that is used. As mentioned earlier, the features of the material that is used is reflected in muqarnas and there occurs diverse examples from the same scheme. For this reason, the subject of material will be discussed after the muqarnas elements.

4.2.1. Ottoman Muqarnas Elements

According to Tayla (2005), there are four main Ottoman muqarnas elements. These are *yaprak*, *badem*, *kazayagi* and *fitil* respectively (**figure20**). We also have to count *püskül* as an muqarnas element.

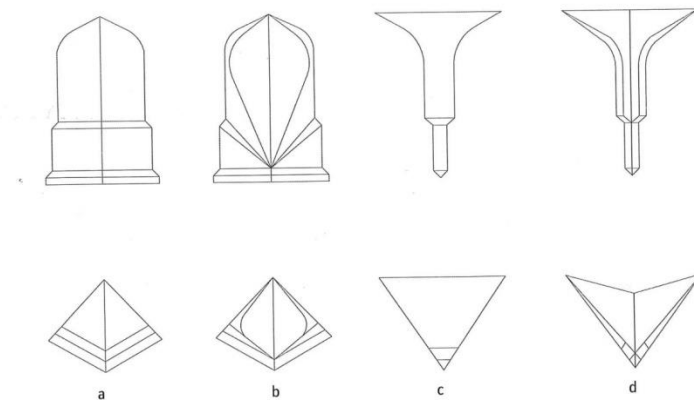


Figure 20 Tayla's classification of Ottoman muqarnas elements.

4.2.1.1. *Badem* (eng. Almond) and *Yaprak*(eng. Leaf)

It can be argued that *Badem* is the most important Ottoman muqarnas element. In pre-Ottoman era chapter, it was stated how the third dimensional formation came into being by *yapraks* which were differently ornamented. . But in Early Ottoman period, a new element; *badem* distinguishes from the *yaprak*. The formation of *badem* element is processed by decreasing 2 segments of *yaprak* in size which consists of 4 segments and increasing one segment in the shape of *badem* (**figure21**).

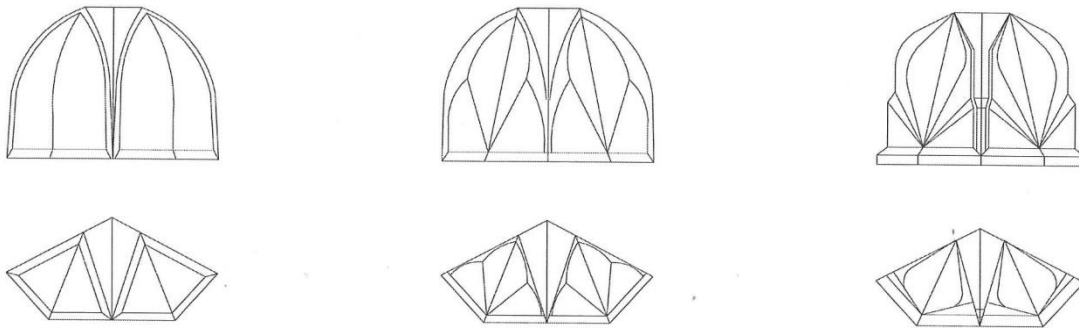


Figure 21 Transformation of Yaprak to Badem. pre-ottoman double yaprak(left), pre-ottoman four-segment yaprak (middle) and ottoman badem(right) in Tayla (2005).

One can see the first example of *badem* element in Bursa Orhan Mosque (1339) (**figure23**).

Badem element is widely used in the gypsum muqarnas. The uniqueness of the formwork used in gypsum might have caused this form. A more probable reason could be the transition to the marble, especially to Marmara marble which is known by its roughness. Edges of muqarnas became sharper and it would be easier for the marble artisan to carve, thus it may have become a standard figure (**Figure22**).

Yaprak has been used in tiers, sometimes flat and sometimes concave in Early Ottoman. (**figure25**)

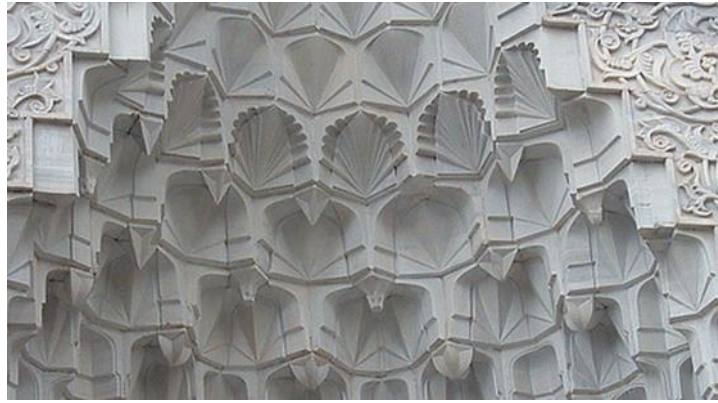


Figure 22 at Yesil mosque in Bursa, Seljuk twelve-segmented *yaprak* becomes shaper on the second tier and it is the last usage

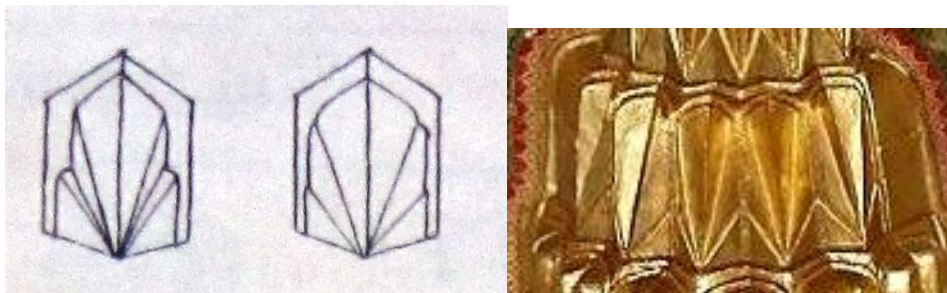


Figure 23 The *badem* figure (right), a tier of gypsum *badem* Bursa Orhan Mosque-mihrab.



Figure 24 Double *yapraks* at Suleymaniye Mosque portal (Left), *badem* at Atik Ali Pasha.

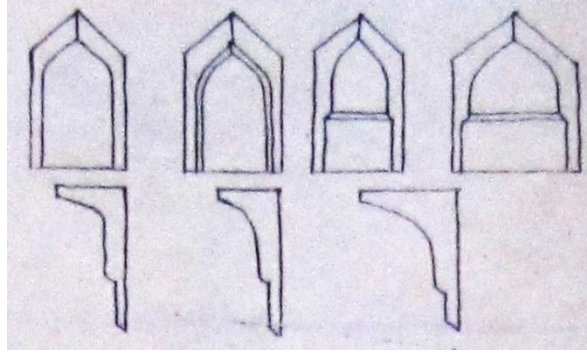


Figure 25 Ottoman *yaprak*.

These elements can be used in dual and trio manner. (Figure24). *Badem* has been used in a dual way in Istanbul Bayezid II Mosque and the architecture that comes after that as well. *Yaprak* especially has been used in a dual way at the star-shaped corners of *kazayağı*.

4.2.1.2. *Fitil* (eng. Bougie)

In pre-Ottoman era, this element used to be positioned between two *yapraks* and filled the triangular projection space. In some examples it was in the form of *kazayagi*. This practice has stopped in the Early Ottomans and it turned into *fitil* starting with İstanbul Bayezid II, Edirne Üç Şerefeli ve Atik Ali Paşa Mosques. However the top niche at the second tier lasted its shape till the very last example in the Ottomans. (Figure26)



Figure 26 *Fitil* element (left) Early Ottoman *Kazayagi* before separating into a *fitil* and two *yapraks* (right).

4.2.1.3. Kazayağı (eng. Goose-foot)

Kazayağı has been widely used in Early Ottoman period. The first examples in this period can be seen as a polygonal cornice in the last row. Also, it can be seen in upper rows of pre-Ottoman in its first examples, but has been replaced with *fitil* later. Many different examples of *kazayağı* has been formed throughout the Ottoman period. (Figures 27, 28)

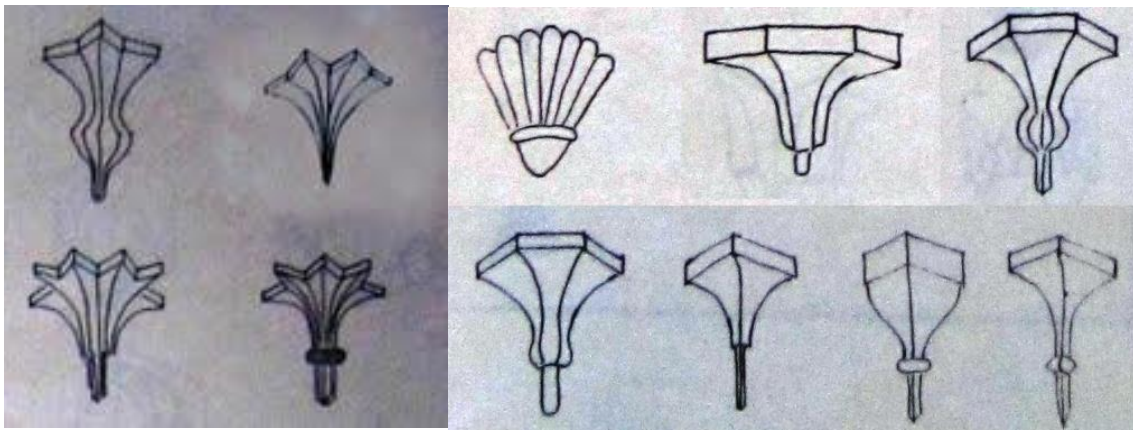


Figure 27 Some examples of Ottoman Kazayagi.



Figure 28 The last tier finishing with Kazayagis at Sultanahmed Mosque mihrab.

4.2.1.4. Püskül (eng. Tassel)

Püskül gave its first examples in the pre-ottoman era in the type 4 and type 5 with little polygonal planes extending to the ground. In the early Ottoman style, with the diversity in polygonal planes, there happened diversity in the *püsküls* as well. Ödekan (1981) argues that limiting the diversity of *badem* and *yaprak* which elevate geometric scheme to a third dimension is an important decision because it was consciously made. For this reason, it is an element that ornaments and enriches the appearance of muqarnas portals.

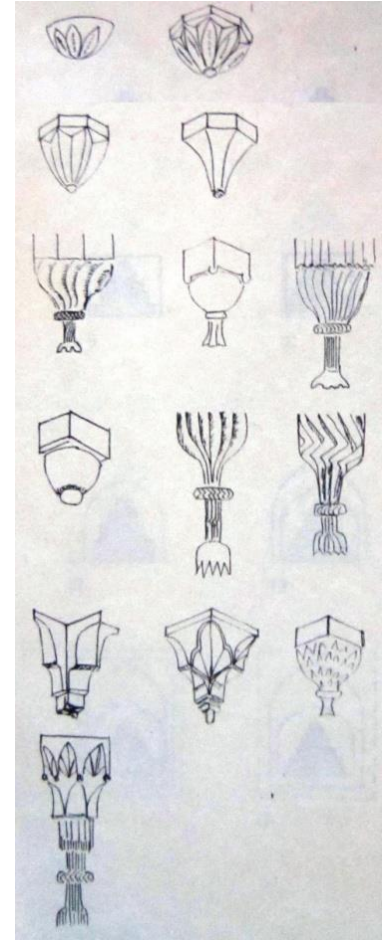


Figure 29 Some examples of Ottoman *püskül*.

It gave its first Ottoman examples in Bursa Yeşil Mosque and Edirne Muradiye Mosque as an extension of little polygons. It comes across in a floral form in Edirne Üç şerefeli mosque and turns into an advanced form in Istanbul Fatih mosque (**Figure30**). It is an indispensable practice in the Sinan era. Because it strengthens the plastic effect by hanging from the centre of the star, this way it also raises the significance of the radial scheme.

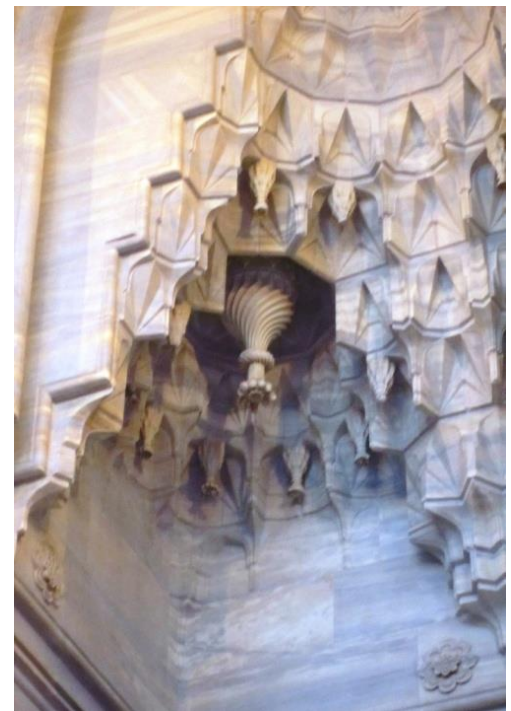


Figure 30 Puskuls at Istanbul Fatih Mosque.

4.3. Early Ottoman Muqarnas

In this part we will continue to study on portal niches. The reason of focusing on portal niches is the changes at this architectural element echoes later in others. Therefore, it is important to demonstrate new developments occurred in Early Ottoman period.

4.3.1. Portal Typologies and importance of building material

Odekan (1977) has studied Pre-Ottoman Muqarnas Portals and has also classified Early-Ottoman Portals with some examples. We come across a problem for Ottoman muqarnas here. Muqarnas is not used only in portals, but in hammam interiors and *mihirabs*. The reason of this is undoubtedly the material change; in Ottoman period muqarnas was carved out of gypsum, or poured into wood formwork, which was carved out of stone or rarely marble in Seljuk period. For example, when we examine two examples from the same period, we seen that the gypsum examples are in the quality of Seljuk period, but marble examples are more primitive, losing *yaprak* figure for instance. The reason of this is the challenge of carving muqarnas out of marble. Hence, we must always care for material properties as long as we derive benefit from Odekan's (1981) study.

4.3.2. The importance of Hammams

We also have to talk about the use of muqarnas as gypsum ornament when we look at the evolution of Ottoman Muqarnas. Looking into the use of muqarnas from this material is going to help us understand the evolution of muqarnas better. Gürle Köyü hamam dated

after the Osman Ghazi (died 1326) era is an example to this. (Say, 2010:92) By going beyond this transition, a plastic effect is created by the use of “large scale decorative *kazayaks*”. One can see this type of *kazayaks* in Edirne Üçşerefeli Mosque (**figure31**). Similarly, In Mudurnu Yıldırım Hammam the pendentives transform into muqarnas (**figure31**). With the 1388 dated Bolu Orta hammam one can observe all the elements in muqarnas portal niches in its hammam interiors(**figure31**). The most important of all that is located outside of Istanbul which generally date back to 15th and 16th centuries are Iznik Ismail Bey Hammam. and Saray Hammam, Gazi Mihal Hammam, Topkapi Hammam, Yeniceri Hammam, Beylerbeyi Hammam which are located in Edirne from the era of II Murad.



Figure 31 Bolu Yıldırım Pendentive (left) Gurlu Koyu Hammam (middle) Üçşerefeli Mosque (right)

4.3.3. Early Examples

The reason why we have some doubts about Ödekan’s (1981) valuable work is two examples of the period. Those examples are simpler ones as Orhan Bey Mosque built in 1339 and Timurtaş Pasha portal niche (**figures32,33**).



Figure 32 Orhan Mosque, Mihrab.

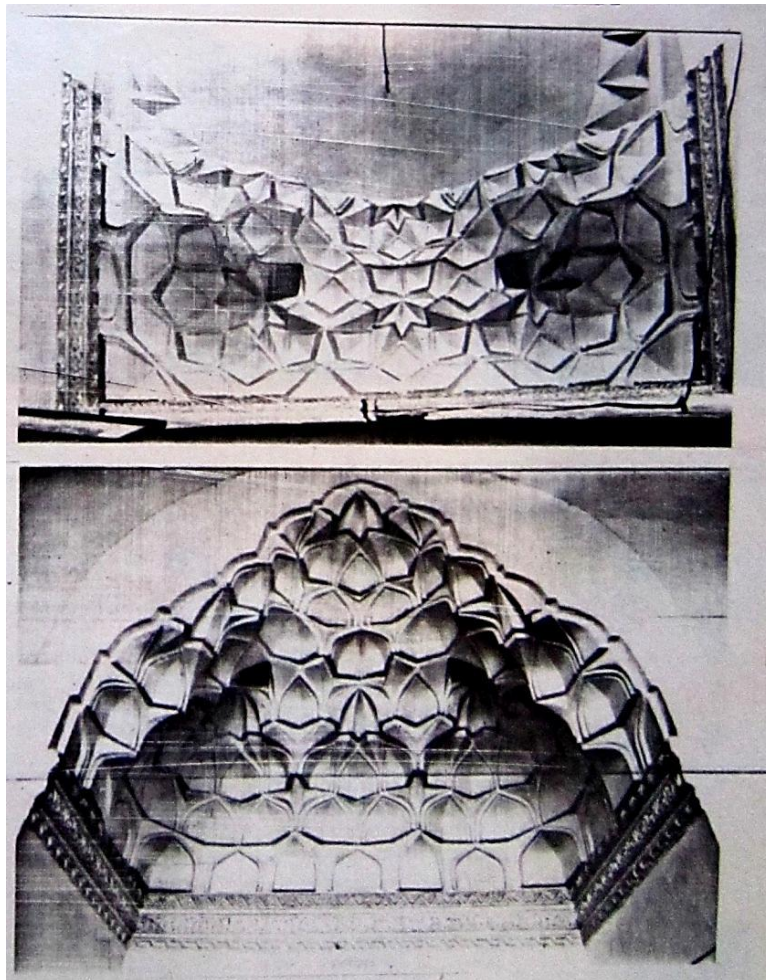


Figure 33 Timurtas Pasha Mosque, portal.

When these examples took into consideration, especially Timurtaş mosque in Bursa which is built in late 14th century, one could think by looking at the sophistication of Orhan Mosque mihrab that it should have been built after 1339. As we have learned from Aslanapa (1986), although Orhan Mosque was intended to be burnt to the ground by Karamanids in 15. century, the ornaments of rear walls and qibla wall is original. Ayverdi adds a different dimension to the matter. In the year when Ayverdi visited Ottoman buildings, he commented on the mihrab of the mosque. “Moreover, it is easy to find bits of gypsum in the ruins of İznik Orhan Mosque. After seeing the *mihrabs* of Samsa Çavu, Hüdevendigar, Şahadet and Çekirge Mosques, it is not logical to think that this *mihrab* does not belong to Orhan period.

(Ayverdi, 1986:80)

The evidence that support Ayverdi’s view is the mihrab of İznik Orhan Ghazi Mosque (**Figure35**), which is converted to mosque in 1331 by Orhan Ghazi. The brick corbelling work shows that it was ornamented with gypsum muqarnas, because it is also one of the contemporary construction techniques. The accuracy of this judgment comes out indeed when we compare those *mihrabs*.

As we can see from the muqarnas plan, there are six tiers and the *mihrab* niche starts with a six-pointed star at the apex. The scheme continues radial and forms a *püskül* at the 5th tier. As for the last tier, the muqarnas corbels connect to the wall with *kazayaks*. The mihrab of İznik Hagia Sophia has the same plan scheme with Bursa Orhan Mosque (**Figures34,35**). Therefore the mihrab that appears in the year of 1339 should be connected to the Ottoman gypsum muqarnas practice, although important early examples have been lost.

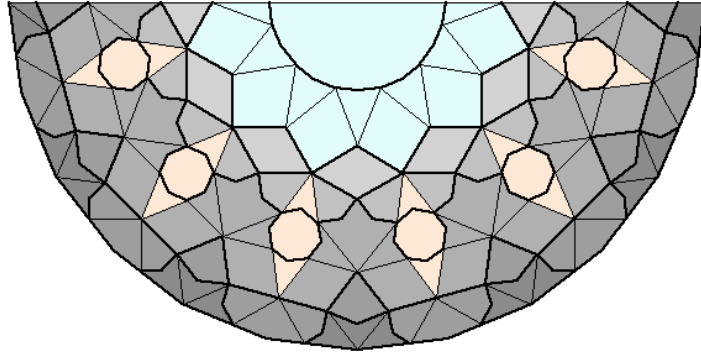


Figure 34 The Mihrab of Bursa Orhan Mosque.



Figure 35 The Mihrab of Iznik Orhan Mosque

The mihrab of İznik Yeşil Mosque (**Figure36**), which is built long after those two examples is considerably plain and masters had difficulty in order to reflect Seljuk style. Because especially when portal masters forming those well-known geometric schemes from marble, in relation to gypsum and other material, it takes longer period of time in order to understand the practice of marble carving. Another view is that the absence of masters could cause this problem. The underpinning idea here is the existence of traveler masters. Especially the network of caravanserais and their inscriptions show that masters could actually work at any point of the system.



Figure 36 Iznik Yesil Mosque, mihrab.

4.3.4. Geometric Schemes

After stating that Ottoman Muqarnas is not only about the geometric scheme and the three-dimensional formation but also about its material as well, we can now move onto discussing geometric forms.

4.3.4.1. Type A

As seen in Ödekan's works, Type A in early Ottoman muqarnas is a continuation of Type 1

and Type 2 of the pre-ottoman muqarnas **(Figure37)**. This type starts with an octagonal star and is designed with the combinations of eight-pointed star polygon. When we look at examples such as Niğde Sultan Han (1229) and Melik Mahmut Pasha (1362) in Mardin, we see that the elements used in radial expansion and advancement are exactly the same **(Figure39)**.

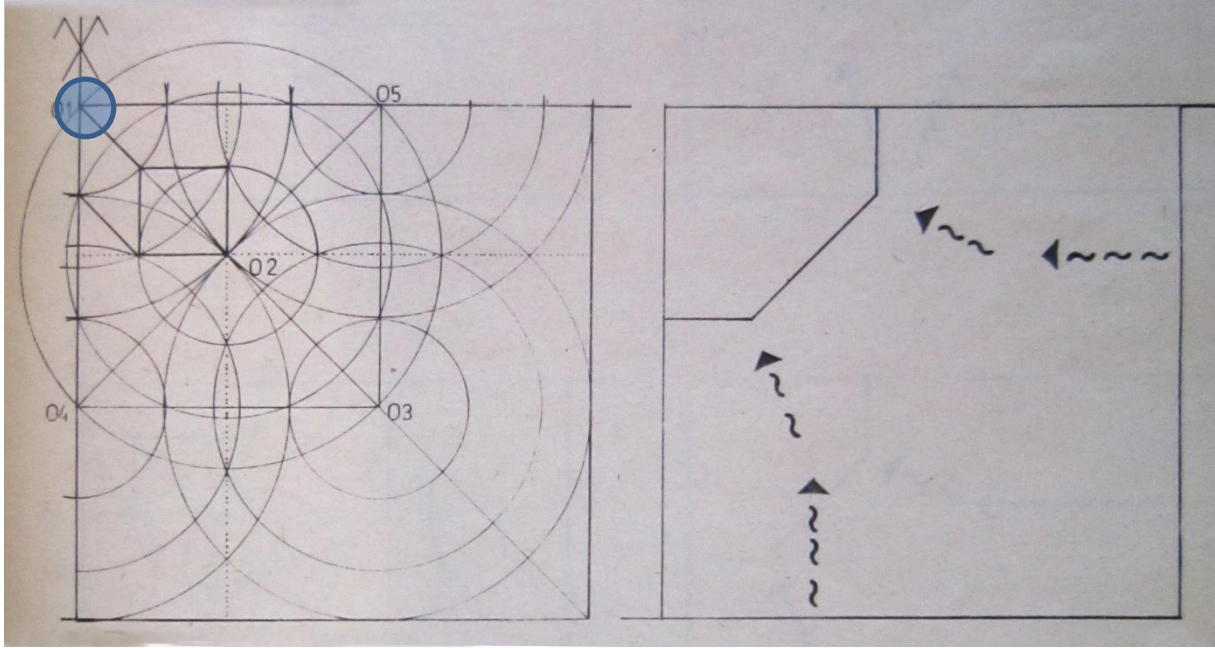


Figure 37 Ottoman TypeA.

The geometric module of this type is concentric three circles. In this type, concentric three circles and concentric two circles are experimented in different combinations to come up with an innovation. In this type, the Auxiliary centres accompany geometric modules just like in pre-ottoman type1. Bursa Timurtaş Mosque is an example for this type. **(figure38)** The scheme for this portal is developed by adding a fifth geometric module at the point in which four geometric modules cross with a third circle.

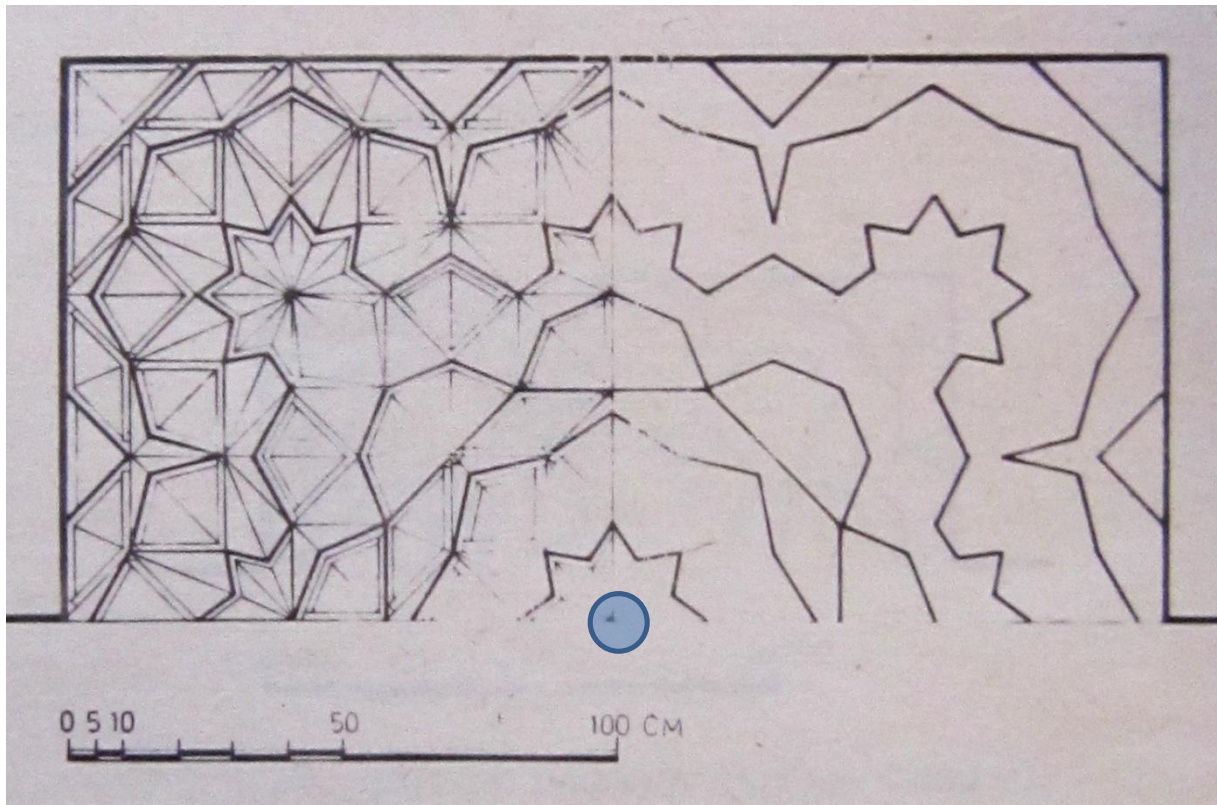


Figure 38 Timurtas Pasha Mosque Portal, plan.



Figure 39 Portals Niğde Sultan Han (left) and Melik Mahmut Pasha in Mardin. Similarity with Timurtas Pasha (figure32) is remarkable,

4.3.4.2. Type B

Ödekan (1981) explains this type in such words: “Early Ottomans continued the attempts of advancement by leading the edge of radial expansion to the border of rectangular area in TypeB” Ödekan words can be interpreted in the meaning that Ottoman TypeB is a continuation of pre-Ottoman type 5. For instance, the radial scheme is formed out of five, seven, ten and twelve- pointed stars in Konya Sahip Ata Mosque. However in Bursa Yeşil Mosque, it is formed with four, five, six and eight pointed-stars. The Early Ottomans had a difference with pre-ottomans in the manner that the radial expansion zone had a circle and the polygonal projections of tires is linked to a rectangular balanced with this circle. Thus, this circle indeed is a tangent to the border of the rectangular **(figures 40,41,42)**. Another difference is that it is not compulsory for the apexstar to be twelve-pointed. That’s why the portal plan can be divided into different number of segments.

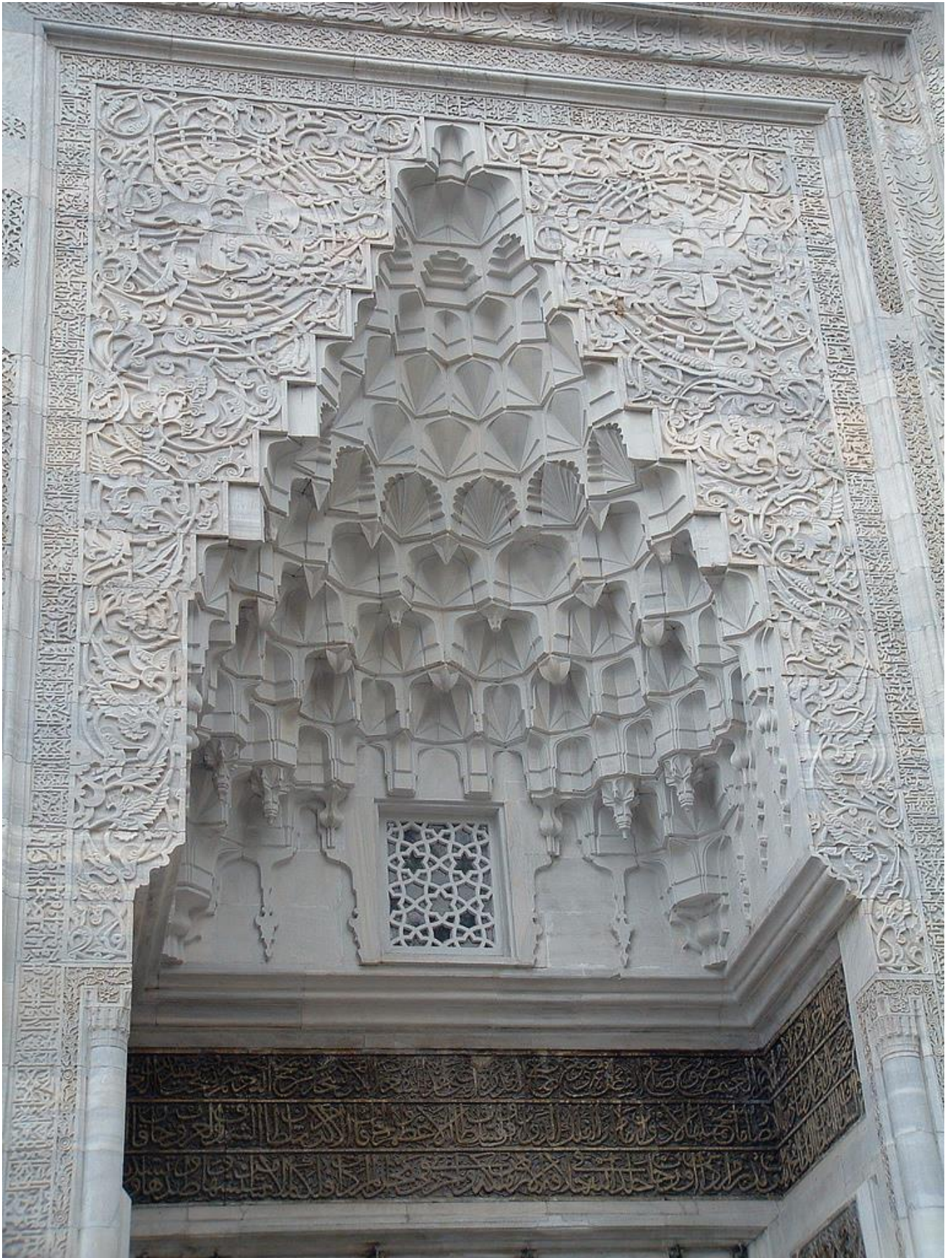


Figure 40 Bursa Yesil Mosque Portal.

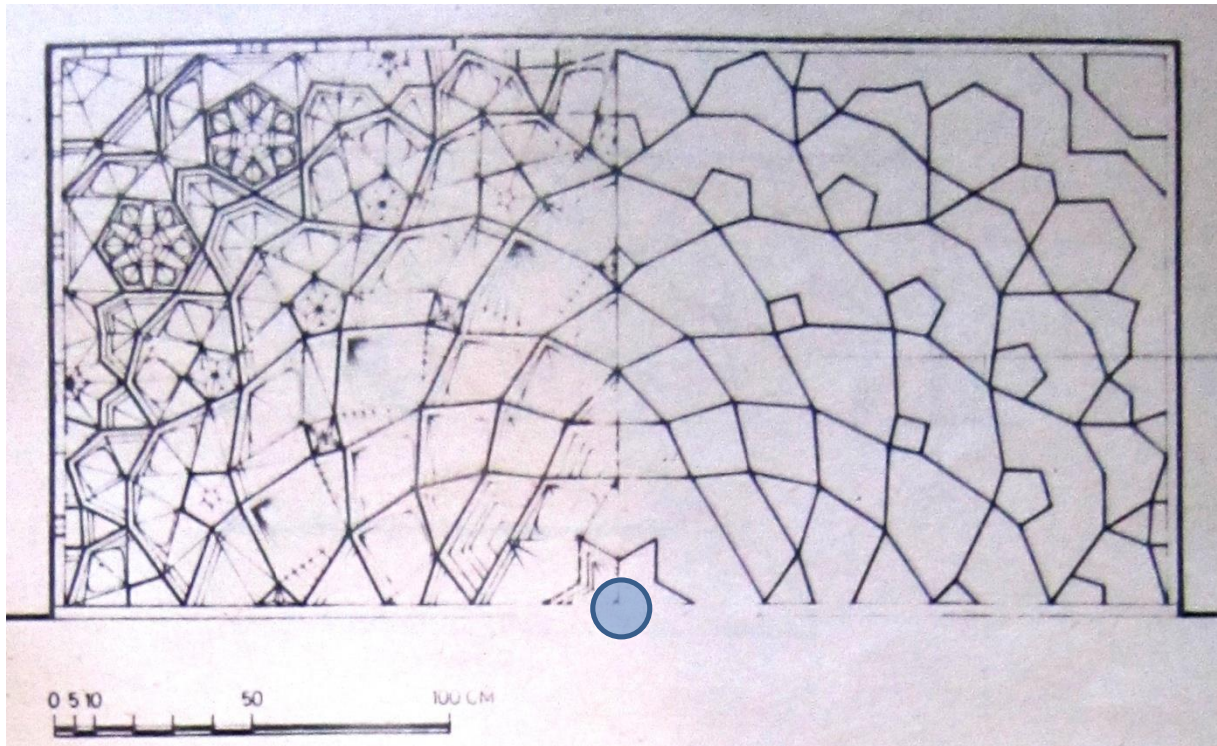


Figure 41 Bursa Yesil Mosque Portal plan.

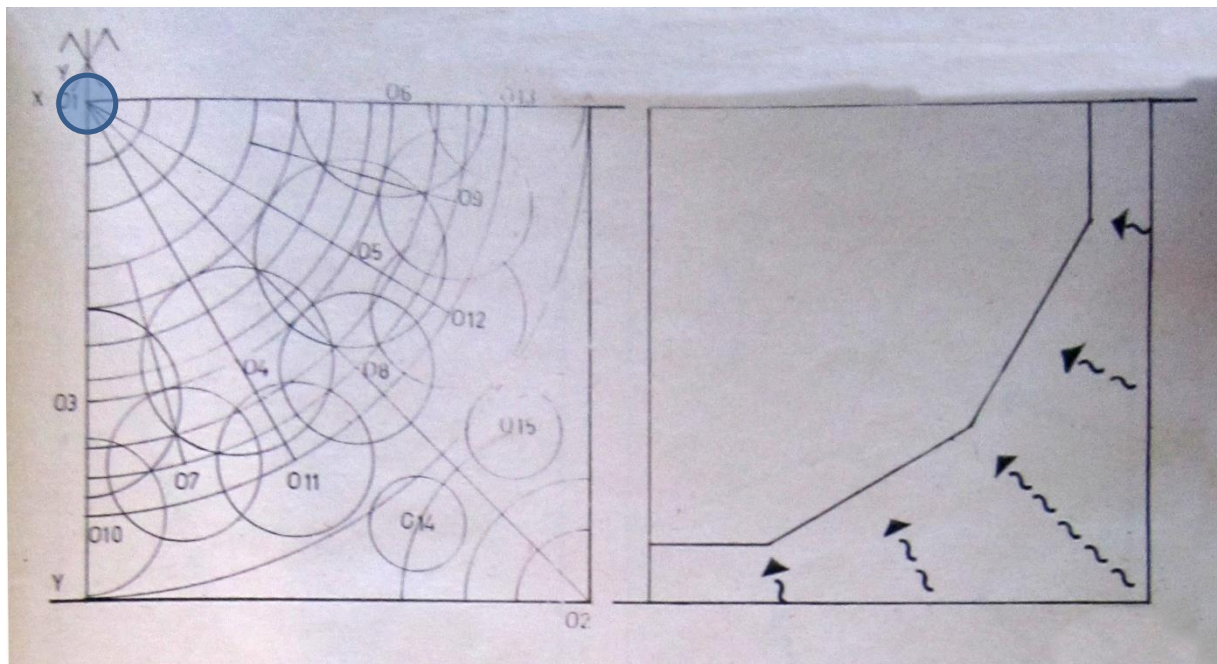


Figure 42 Bursa Yesil Mosque, geometric scheme.

Another important example for this type is Istanbul Fatih Mosque courtyard portal and Istanbul Atik Ali Paşa Mosque Portal. As one can see in the examples, because the circle of the radial expansion zone is tangent to the area of rectangular plan, muqarnas elements

positioned at the plan edge hang down more than the ones in the middle. Because of this, there is a better plastic effect than Sahip Ata Mosque in which the muqarnas elements are parallel to the edge.

4.3.4.3. Type C

One difference this type has from other types is that instead of the radial expansion zone forming with muqarnas elements, it divides them into segments. The scheme can be divided into different segments. This type initially can be observed in Bursa Yesil Turbe. Here, the radial expansion zone is formed with segments and the transition to the rectangular portal edge is formed with *baklava* slices. Istanbul Fatih mosque's interior muqarnas niche and Istanbul Davutpasa Mosque (1485) portal are also amongst significant examples (**Figure43**).

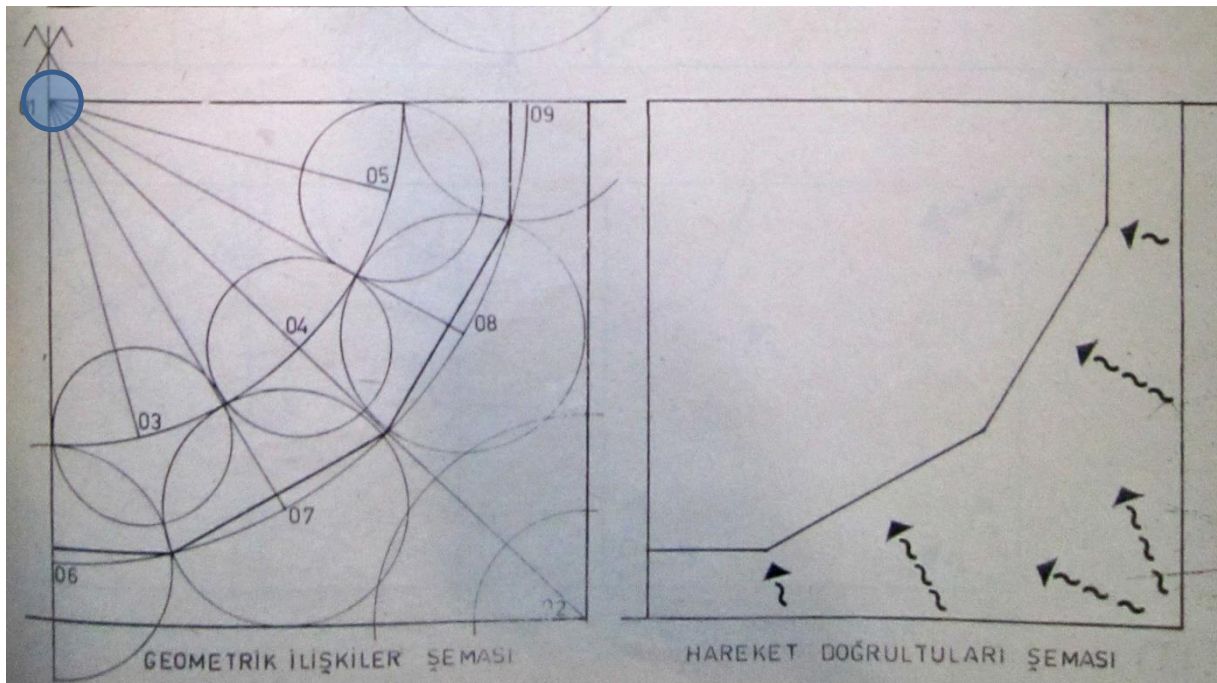


Figure 43 Istanbul Davutpasha Mosque, geometric scheme.

4.3.4.4. Type D

In the early Ottoman era, Edirne Old mosque (built 1414) portal niche and geometric scheme are amongst the early architectural experiment in this arena. It is almost impossible to come across another example of this experiment in both portal designs and *mihrab* designs of Anatolian Turkish architecture. This has brought new innovations in both scheme and three dimensional formation.

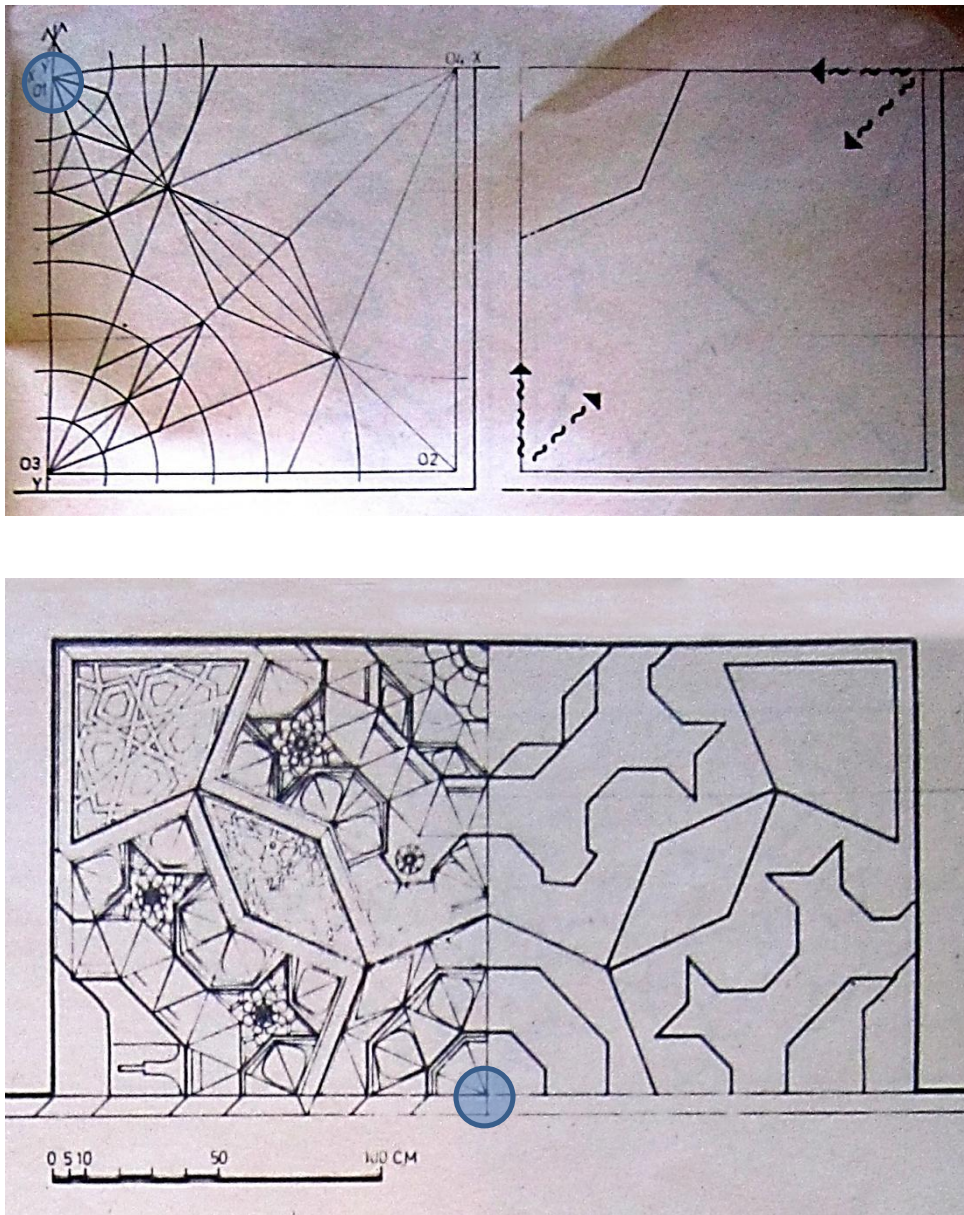


Figure 44 Edirne Old Mosque geometric scheme(above) and plan(below)

The geometric centres in this type are on the xx and yy axes which determine the rectangular edge of the portal. There are three circles in O1 point centre and most importantly there are five concentric circles on O3 circle being the first example of this kind in Anatolian portal history. The scheme starts with an octagon instead of a star at its apex, an innovation in the tradition and it finishes with an octagon at the bottom corner of the diagonal.

The reason for the formation of the octagons can be explained in the following manner. The polygon at the tangent position with the third circle of O1 point is crossed with the O3 circle which is at the corner of the diagonal. The chord that is formed out of this crossing application is drawn as the 45-degree rhombus and this scheme is formed as a result of that. Interestingly enough, through the process of formation of this scheme in this manner, horizontal planes came into being in the muqarnas portal. Especially, the rhombus plane on the diagonal can be differentiated easily. The reason why the scheme turned out like this is the fact that a non-radial scheme is formulated. However I argue that the real reason is to reach perfection in geometry (**Figure44**).

Although four pointed stars are positioned around the rhombus on the diagonal, they could not lead their extensions into the apex point through the diagonal. They also could not unite with the rectangular edge of the portal.

Another innovation is that the muqarnas is V-formed at the edges of the portal. This muqarnas tier ends with *kazayagi*. That is why Ottoman muqarnas became unique in itself. Especially during the era of Sinan and in the following eras, the last tier ends with a *kazayagi* with very limited numbers of exception.



Figure 45 Edirne Old Mosque Portal.

Ankara Karacabey Mosque

As for Old Mosque portal, proof for the argument about “reaching perfection in geometry” is surely Ankara Karacabey Mosque (built 1427-28). The scheme is formulated in a more perfect version by working on the scheme problems that arose during its earlier application in Old Mosque. The geometric modules increased to number four by an addition in every corner. These modules unite the portal corners with on the edge of the portal finishing with *kazayagi*. The position of the Rhombus in the centre changes from a linear angle with 90 degrees. (**Figure46**) This change not only fixes the problem of the rhombus hindering the radial expansion as a big block, but it also helps the rhombus be connected to the symmetry of the diagonal in a crosswise position. And the apex point is transformed into a dodecagon

polygon; three axes are formulated instead of only one. Although it can be said that they are all well connected, the rhombus plain does not cease to exist in this scheme.

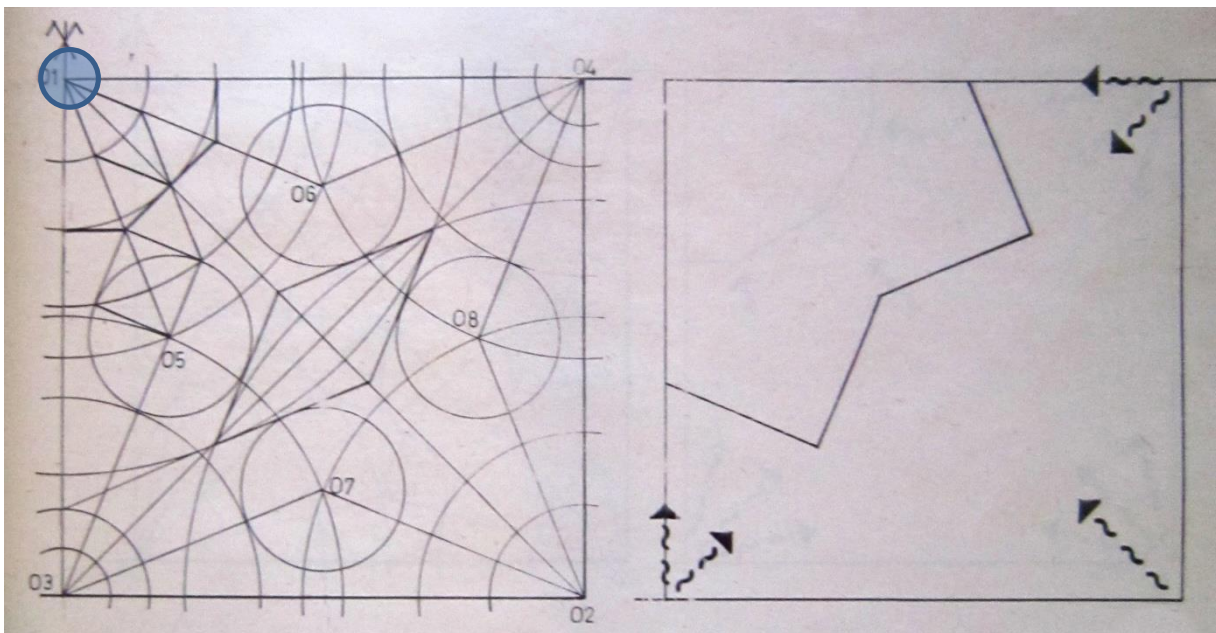
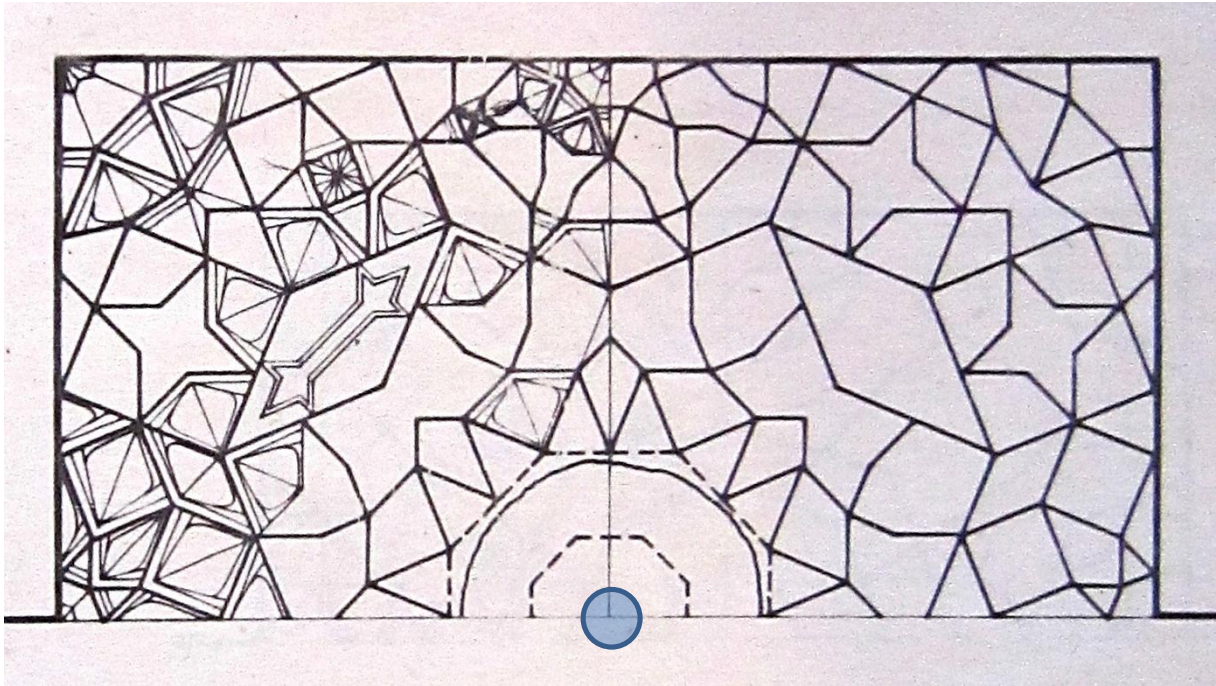


Figure 46 Ankara Karacabey Mosque.

Edirne Muradiye Mosque

Although Odekan (1981) did not put Edirne Muradiye Mosque into any categorization, the scheme that is explained above makes us understand that the ones who formulated this change, were seeking for a solution. Because there is disconnectedness between radial expansion and the zone radiating from bottom-edge corners, the bottom zone continues radial. The scheme is disrupted when it arrives to the point only four tiers remaining till the apex point. This issue displays the fact that the problem between the radial expansion zone and the zone radiating from the bottom edge is not solved yet (**Figure47**). What is going to solve this problem is indeed the type E.

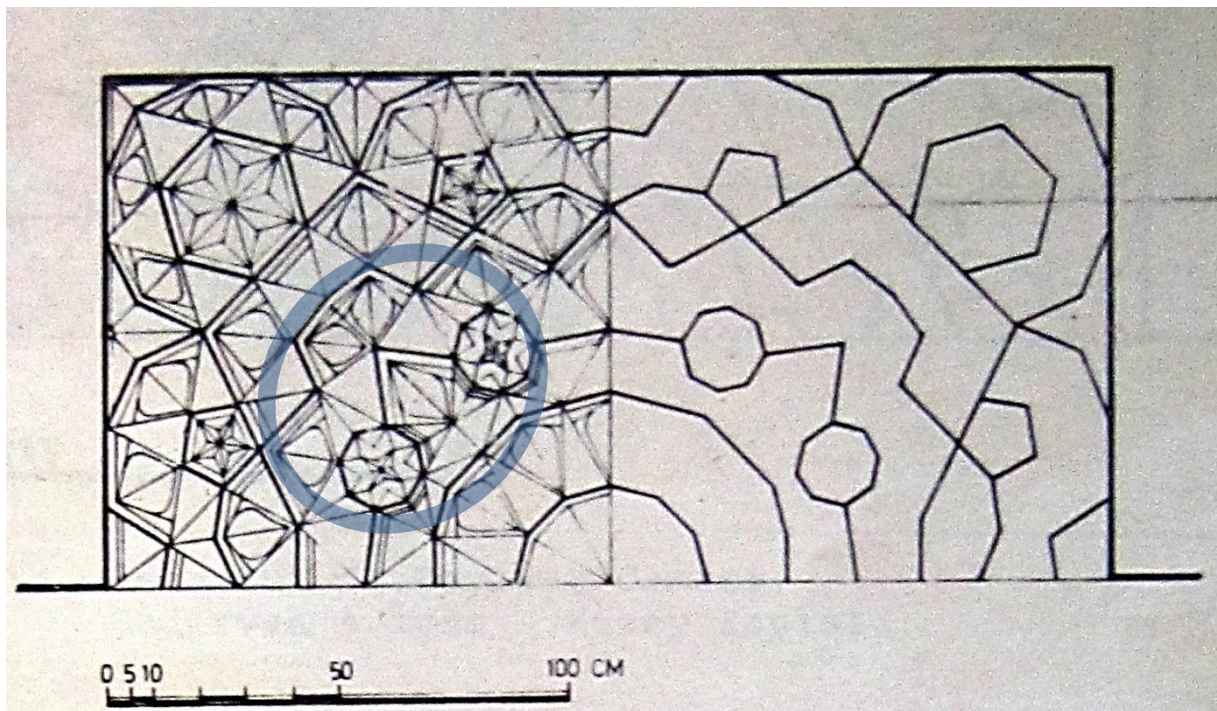


Figure 47 Edirne Muradiye Mosque and the problematic zone.

4.3.4.5. Type E

Edirne Üç Şerefeli Mosque:

Type E is an advanced version of type. When we look at the portal of Üç Şerefeli Mosque (1443-47), we see that the formation of a portal in such diversity can be only explained through the research of Anatolian portal heritage and the completeness of the transformation to marble. The architects of this portal must have observed Kırşehir Cacabey Madrasa portal, Mardin Zinciriye or Kayseri Hatun early portal examples since the influence of Ottoman Empire increased in Anatolia during the reign of II Murad (**figures14,48,49**). Because these examples can function as a source of solution for the problems we have mentioned in Ottoman portals. There is no other example of this any other Islamic civilization, being unique to itself. One can see that the matter here is solving the problems of Muradiye mosque and the new scheme in Edirne Old Mosque and enriching this technique.

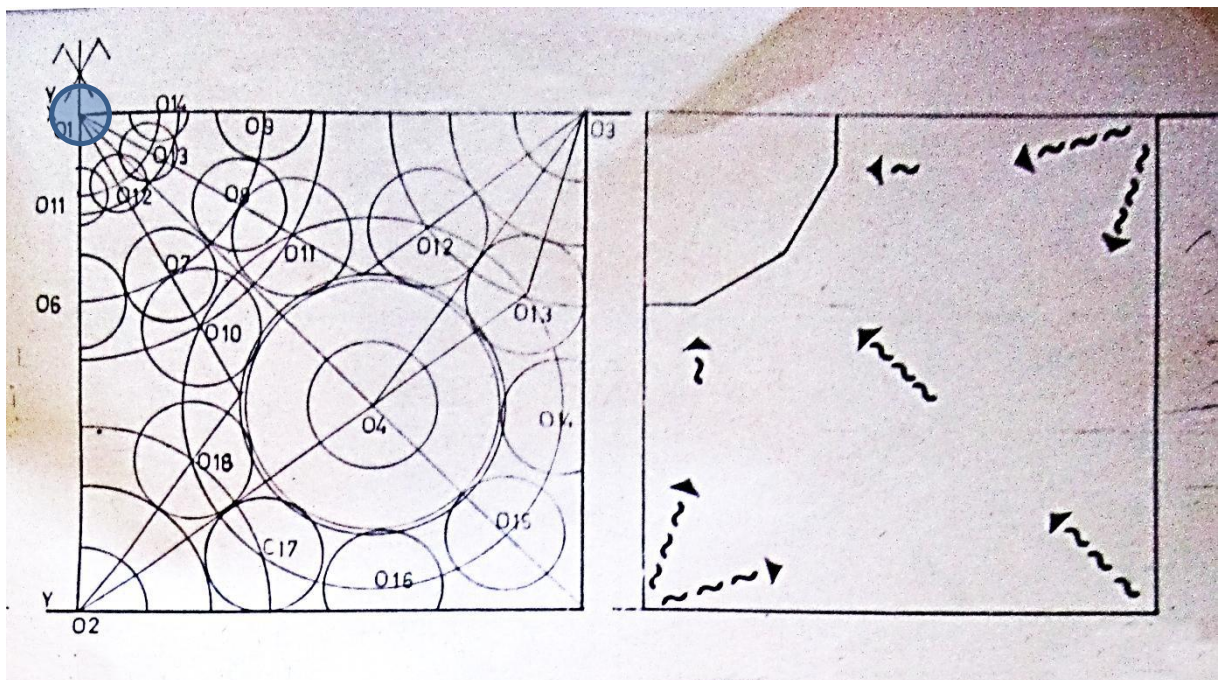
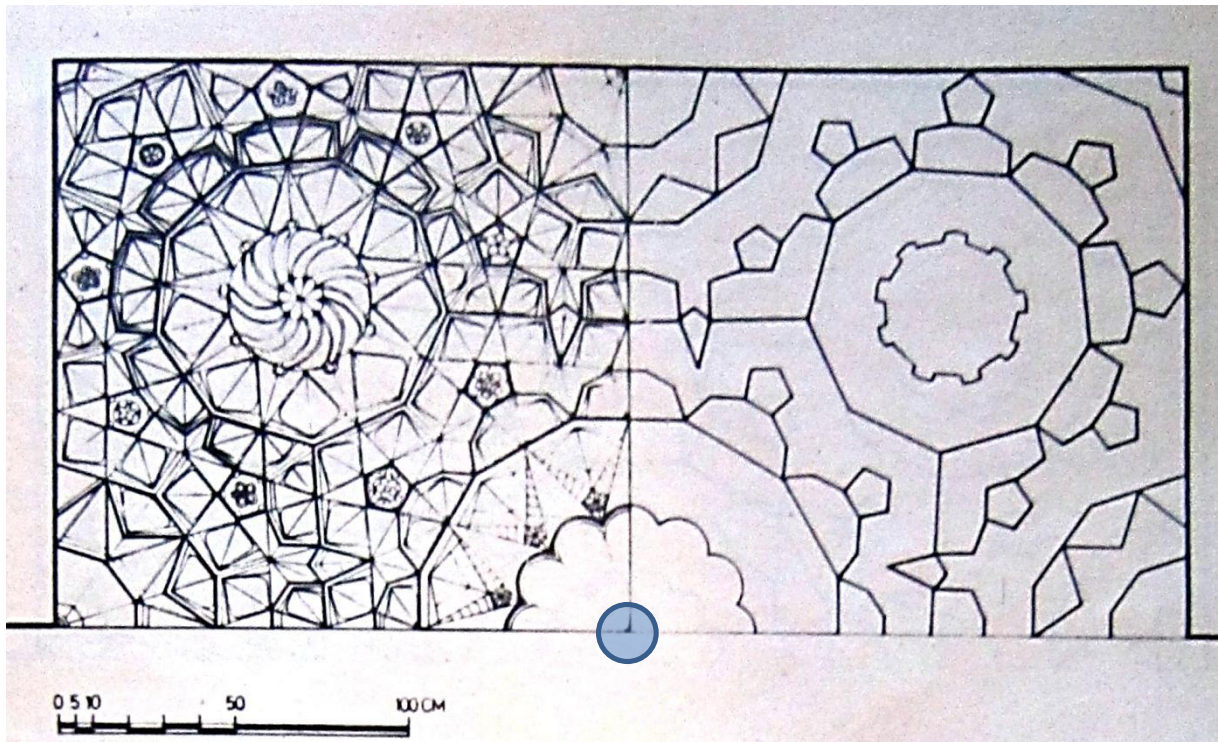


Figure 48 Edirne Uc Serefeli Mosque, Type5



Figure 49 Edirne Uc Seferli Mosque, portal

The most important aspect that differentiates type 5 from other examples is that a dome is created on diagonals. The architects might have realized the problem which is seen in Edirne Muradiye Mosque and Type D can be solved by creating a mini-dome. Radial Expansion zone in type 5 is supported by the corbelling elements. However the domes in Type 5 replace the planes that are positioned between the corbelling elements and the radial expansion zone of Type4.

In this type, there is a return to twelve-pointed stars and the scheme is divided into 12 segments. The formation of the scheme supports the argument that there is an inspiration and study of the Anatolia. For instance, the point of contact for the five-pointed stars and its relations with other elements is something that is solved out through the study of Kırşehir Cacabey Madrasa. Because the unification of the star and *kazayağı* and descending with a tier cannot be explained in any other explanation. For this reason, one can see the importance of the five-pointed stars in scheme increasing. These stars are positioned around a centre making a complete circle. (figure) The centre of the circle is also the centre of the dome and a large spiral *puskul* descends from its middle. Thus, the solution of the scheme is the five pointed stars transferring the direction to the centre from the radial zone.

(figures 14,48) Then from this centre by the means of five-pointed stars the direction finishes with a *kazayağı* at three corners. Attempting to come up with a new innovation, a tradition that started with Edirne Old Mosque has come to a new point with Edirne Üç Şerefeli Mosque. The goal of this attempt was as seen in the scheme to unite all the muqarnas elements in a centre point in the geometric scheme.

4.3.4.6. TypeF

The most beautiful examples of the early Ottoman portals can be seen in Istanbul Bayezid Mosque (built 1501-06). Ödekan (1981) argues that the western courtyard portal is categorized out of this section because it exemplifies the aspects of type E instead.

Considering the fact that Ödekan kept western courtyard portal out of this category, she should have kept the north courtyard portal out of this typology as well. Because this portal is a different variation of Type B . Istanbul Fatih courtyard portal and Atik Ali Pasha Entrance Gate have the same scheme. Thus, only the east courtyard and the entrance portals can be put into account together due to their coherence.

The examples in this type, contrary to the centrality of Type E, are a complete product of radial scheme. One can see that the radiosity of Type B and the centrality of Type E is put into together in this scheme. Possibly, the Type E and Type B came out in the other two portals for this reason. The module centres in Üç Şerefeli formed two symmetric domes on the portal and *puskuls* were hanging down from that. These centres are located on portal edge in Bayezid Mosque Type F.

This descending gives one perfect perspective in the sense that it not only helps hang down the *puskuls* but also gives a plastic effect through the end of the portal.(figures 50,51)

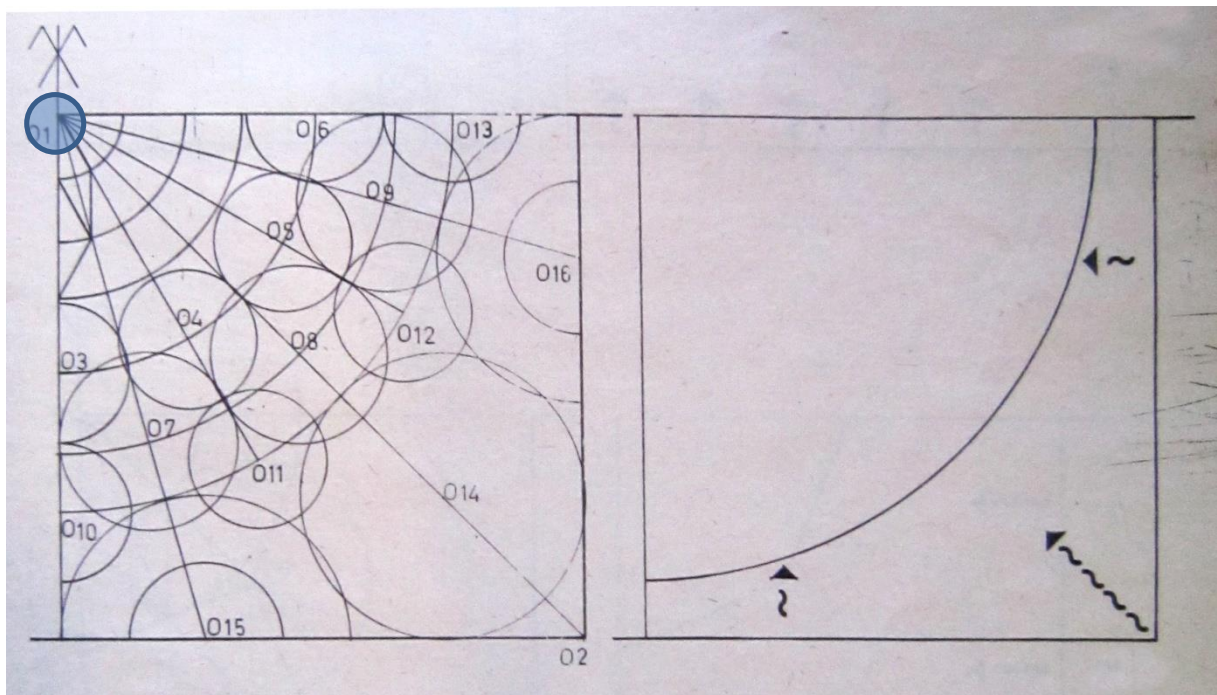
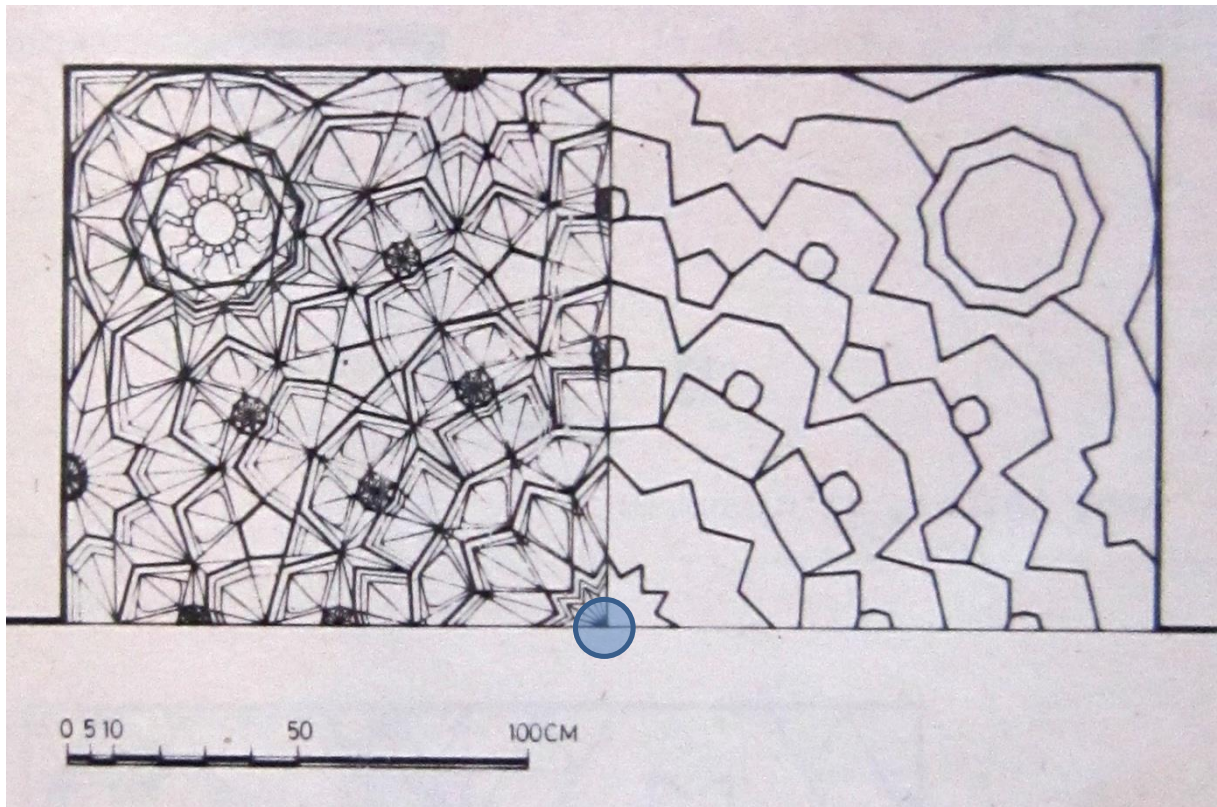


Figure 50 Istanbul Bayezid Mosque East Courtyard Portal



Figure 51 Bayezid Mosque, East Courtyard Portal.

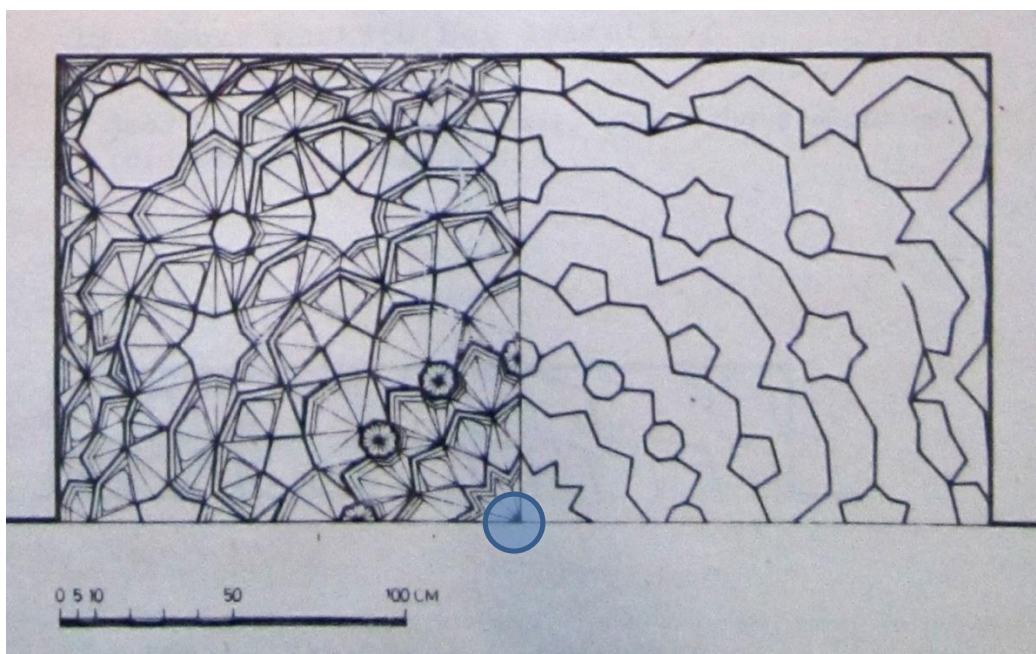


Figure 52 Bayezid Mosque, Enterence to mosque.

4.3.5. Architect Sinan's Muqarnas

Before we discuss the muqarnas portals of this era, one needs to acknowledge Sinan's role in the muqarnas roles. Because one needs to recognize his mastery in portal niches as well as geometry. It is known that there were students studying *ilm-i handasa*, science of geometry, under the mastery of the architect Mehmet Sedefkar Ağa during the era we are talking about. (Yuksel, 2005:18) That is why one cannot find a second person who has mastered both the construction and the science of geometry better than the architect of this era. Especially for the reasons given in earlier chapters, it is clear to see that Sinan worked on the portals personally himself as well. However in Sinan's architecture the portals are not as visible and comes out as distinguished.

There are two muqarnas plans Sinan advanced. One of them is the centric muqarnas plan of both İstanbul Fatih Mosque and Istanbul Bayezid II Mosque. The second one in the other portals of the same mosque is the advancement of the radial scheme in a manner that stars are added in the last tier. Sinan advanced both TypeE and TypeF simultaneously.

It is also important to talk about other examples of portals in this era which surrounded Sinan. The closest muqarnas portal example to Sinan era in Istanbul is Yavuz Selim Mosque built in 1521. (**figure53**) This scheme continues on from Type E with a new addition. Two mini-domes inside the portal are united in the centre with five-pointed stars. This example is important in terms of creating a centre in the rectangular projection of portal niches.

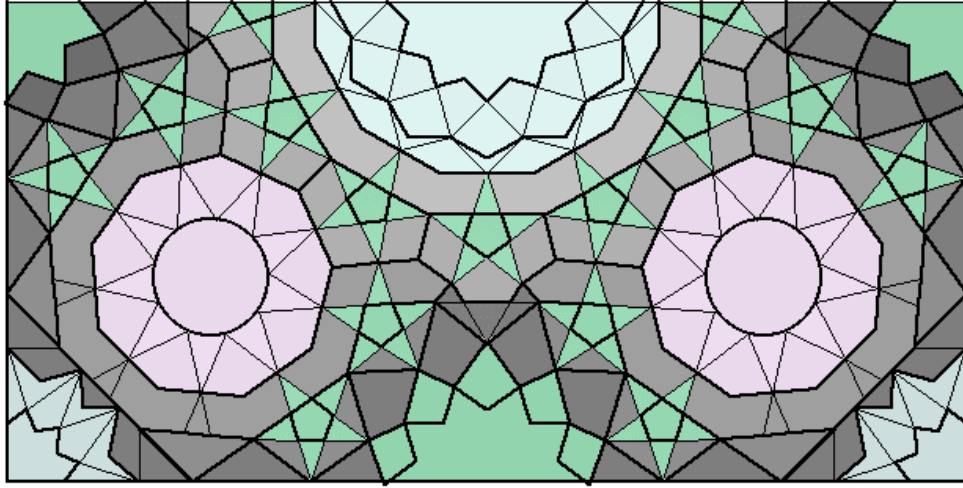


Figure 53 Yavuz Selim Mosque Portal.

Let us first discuss Haseki Sultan (built 1539-40) which is his first work of art in Istanbul **(Figure 54)**. In this example, Sinan exemplifies Type C by moving from the radial expansion zone to the plain segments. The rest of the scheme continues in a radial way with muqarnas. Type F continues in another early example of this era which is Üsküdar Mihrimah Sultan Mosque (built 1546-48). The scheme plan starting with a twelve-point-star is divided into six segments.

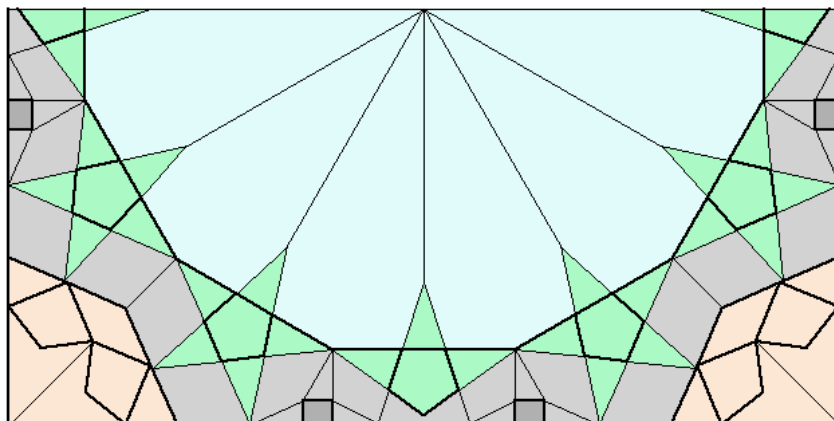


Figure 54 Haseki Hurrem Mosque Portal.

The scheme in the east portal of Bayezid Mosque continues at the entrance portal to Sehzade Mosque (1543-48). Although differently, the third tier with *badem* does not exist in Sehzade Mosque. In addition to that, it is ornamented with *yapraks* in the last tier.

And there is an innovation in the courtyard portal of Sehzade Mosque. It is an example differentiated from the other examples in a manner that continues to the very end of the scheme including the stars. We name this work of Sinan as Type G (**Figure55**).

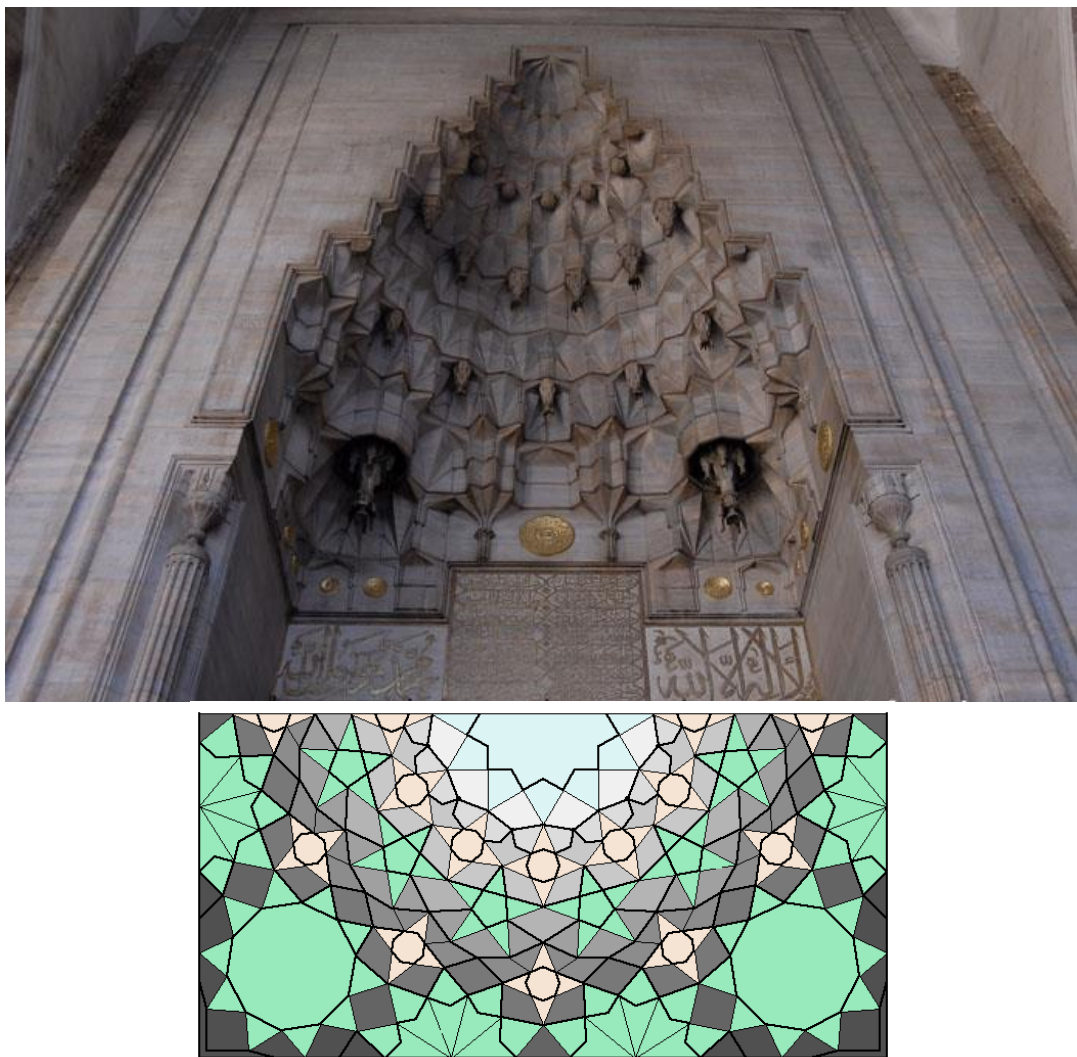


Figure 55 Sehzade Mosque Courtyard entrance

When we look at the examples covered till now, we can see that Sinan tried the former portal niches. He formulated his first original portal in Suleymaniye Mosque (1550-58). This example shows that Sinan has the mastery of all Type5 examples. This scheme is the latest perfected version of Anatolian portal architecture since Alayhan Caravanserai. Because the complete symmetry that is formulated has an eight-fold speciality (**Figures,56,57**). The scheme that starts with an eight-point star as in the examples of Type5 descends from the radial expansion zone and is transferred to the centre. And then it makes three directions and is completed with a three dimensional formation along with *kazayaks*.

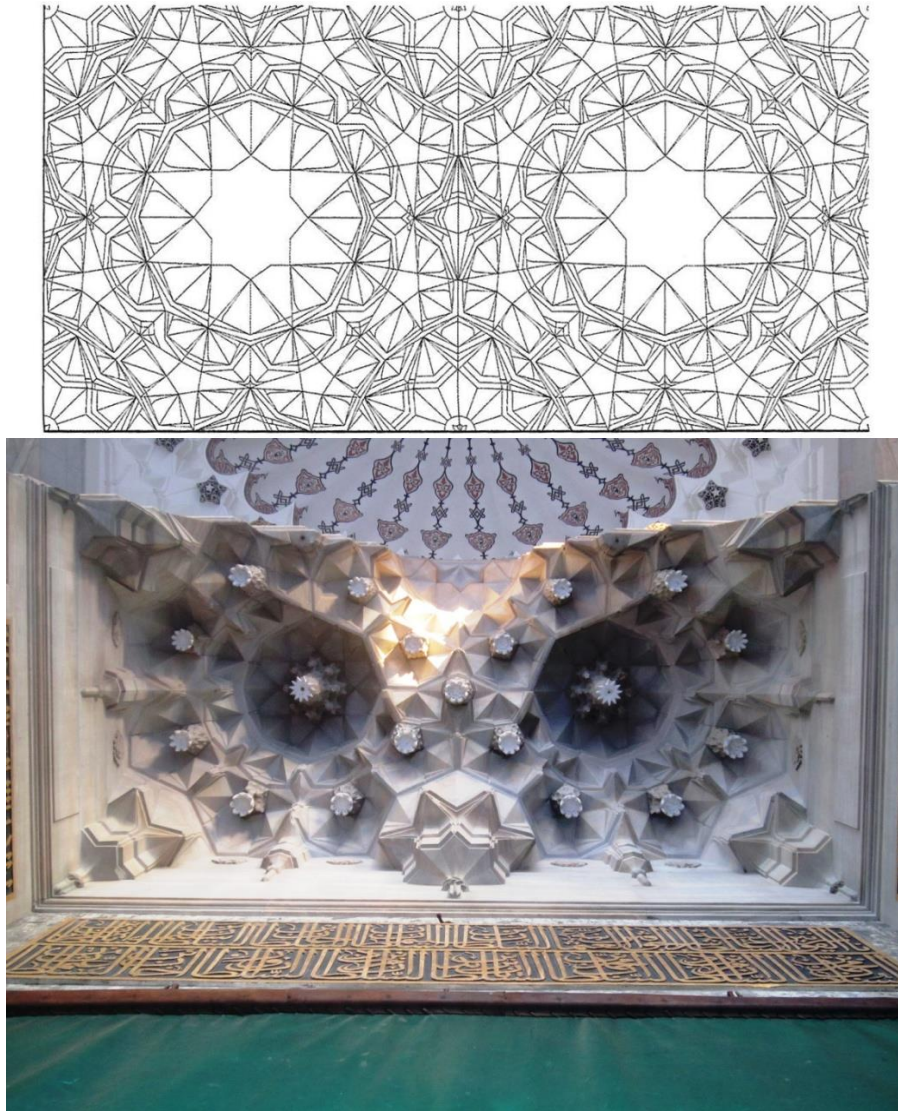


Figure 56 Full symmetry at Suleymaniye Mosque. In Tayla, (2005)

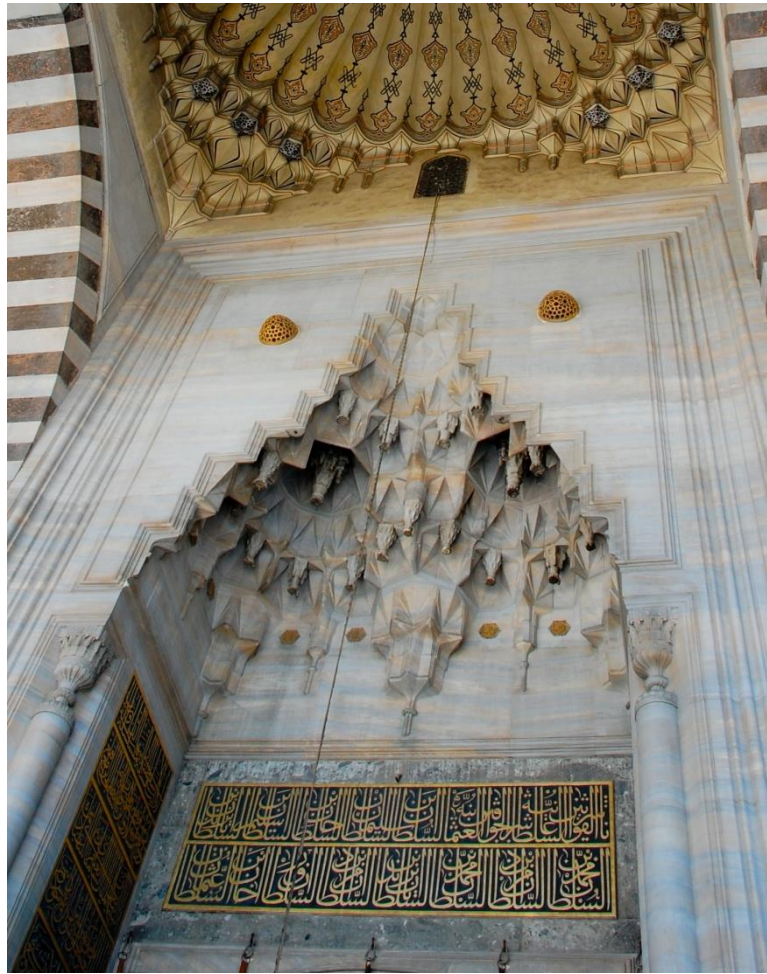


Figure 57 Süleymaniye Mosque portal.

Another example we will look at after this is Selimiye Mosque portal. As mentioned above, the first sophisticated examples are formulated during the transformation from eight-segmented scheme to twelve-segmented scheme as in pre-Ottoman Type 4 and Type 5. It is important to recognize that Sinan was in realization of this transformation. Because in Süleymaniye Mosque which he refers to as his “semi-skilled-*kalfalik*-work” Sinan used eight pointed stars. However in Selimiye, he used twelve pointed star. The axes that stem from this star in Selimiye Mosque portal are transferred to the centre through five-pointed stars and after that transferred to *kazayaks* through five-pointed stars like in the example of TypeE. (Figure58)

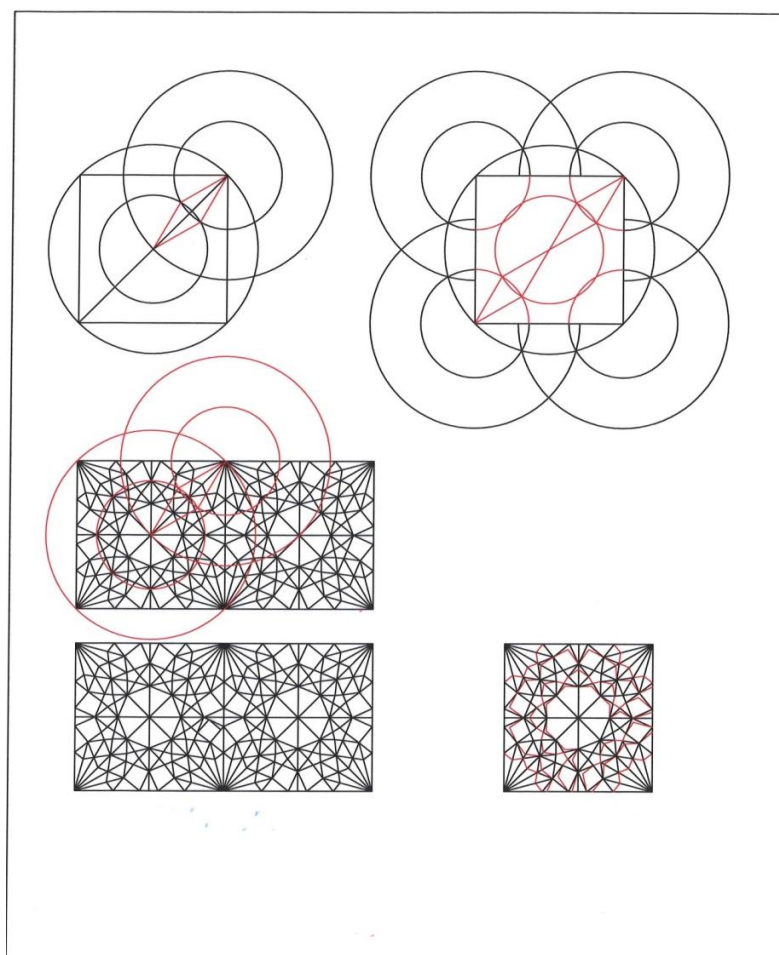


Figure 58 Selimiye Mosque portal (above) plan and geometric scheme (below), courtesy of Hassa Architecture Co.

Sinan also advanced new schemes along with these perfect models. The plan scheme formulated in Zal Mahmut Pasha Mosque is compiled out of half of general schemes.

(Figure59) In its design, the goal is to highlight the muqarnas elements with the *puskuls* because the muqarnas-revetment contrast is highlighted as well.

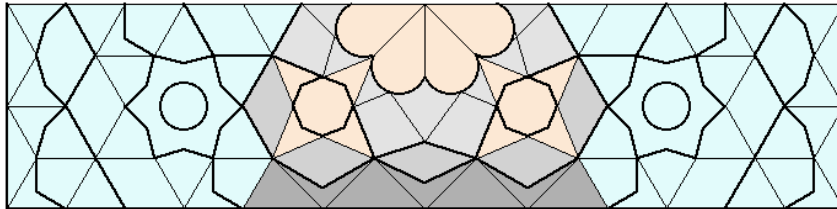


Figure 59 Zal Mahmut Pasha Mosque Portal

4.3.6. Muqarnas portals after Sinan

After Mimar Sinan, the schemes of Type E and Type F which he followed continued. Cerrahpaşa Mosque (built 1593-94) is Type F. Yeni Mosque Portal is the same with courtyard entrance to Sehzade Mosque which is considered to be a Type G. Sultanahmed Mosque (built 1616) courtyard entrance is also considered to be a Type G. It looks different to the portals in the past with its big sizes and the way the portals are positioned on the portal revetment. **(figure60)**

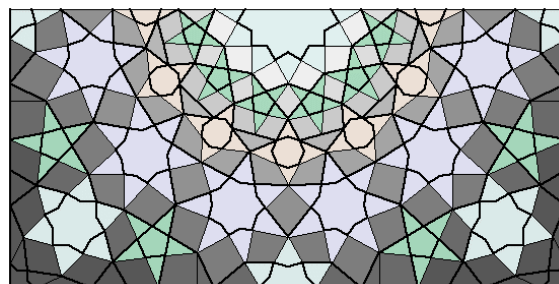


Figure 60 Sultanahmet Mosque Portal.

The last example is the last Ottoman portal niche which is Hekimoğlu Ali Pasha Mosque portal (built 1735). This portal is significant in the sense that it finishes the radial scheme which is seen in Istanbul Bayezid Mosque with *puskuls*, it succeeds at completing the radial expansion with the same kind of stars and it is a continuation of Type F. Hekimoğlu Ali Pasha Mosque is indeed a perfect ending to the Ottoman portal tradition. **(Figure61)**

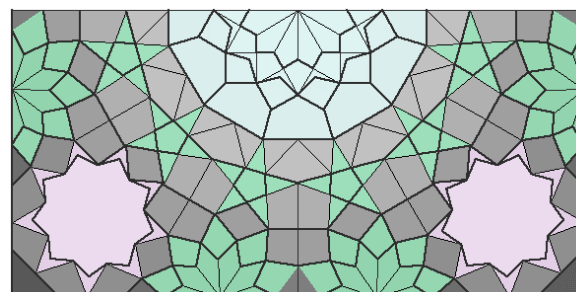


Figure 61 Istanbul Hekimoglu Ali Pasha Portal

5. CONCLUSION

This dissertation has attempted to explain the evolution of Ottoman muqarnas. The study demonstrated that Ottoman muqarnas is indeed a continuum of the Seljuk period with both its geometric schemes and muqarnas elements. Ottomans knew well the Anatolian examples and they exploited the important aspects of pre-Ottoman Type4 and 5.

The muqarnas scheme has produced two main typologies in Ottoman era, one is central schemes with domes in the middle, and the other is the radial scheme which ends with an *püskül* at the corner.

It has also showed that by the beginning of 16th century muqarnas elements becomes standardized and limits to only four type of 3d elements. *Badem* becomes the most important one.

The study also demonstrated that works of most of the scholars on muqarnas are not very useful. For instance, Necipoğlu's book, despite its volume, it is not very helpful and mostly a source of generalisations. Necipoğlu also fails to how to read second dimensional plans and what is important in reading those plans.

When we take material into consideration, from Seljuks to Ottoman we see this sequence: from Stone to gypsum and marble. Gypsum transforms those elements into more plain ones. As for marble, the material becomes much harder and therefore the contours become

sharper. The softness and coziness of Seljuk muqarnas leaves to the light-shadow plays of Ottoman muqarnas. This play gives muqarnas a sculptural value. A study on

Sinan makes important contrubutions to the use of muqarnas. An ornament-structure relationship is establish that maybe has not done in the whole architectural history.

This study only touches upon what Sinan did generally. Therefore, the muqarnas that Sinan has developed is a further study area with wide range of examples. Also a geographical survey of Ottoman muqarnas can be done, for instance Balkan, Syrian or Egyptian.

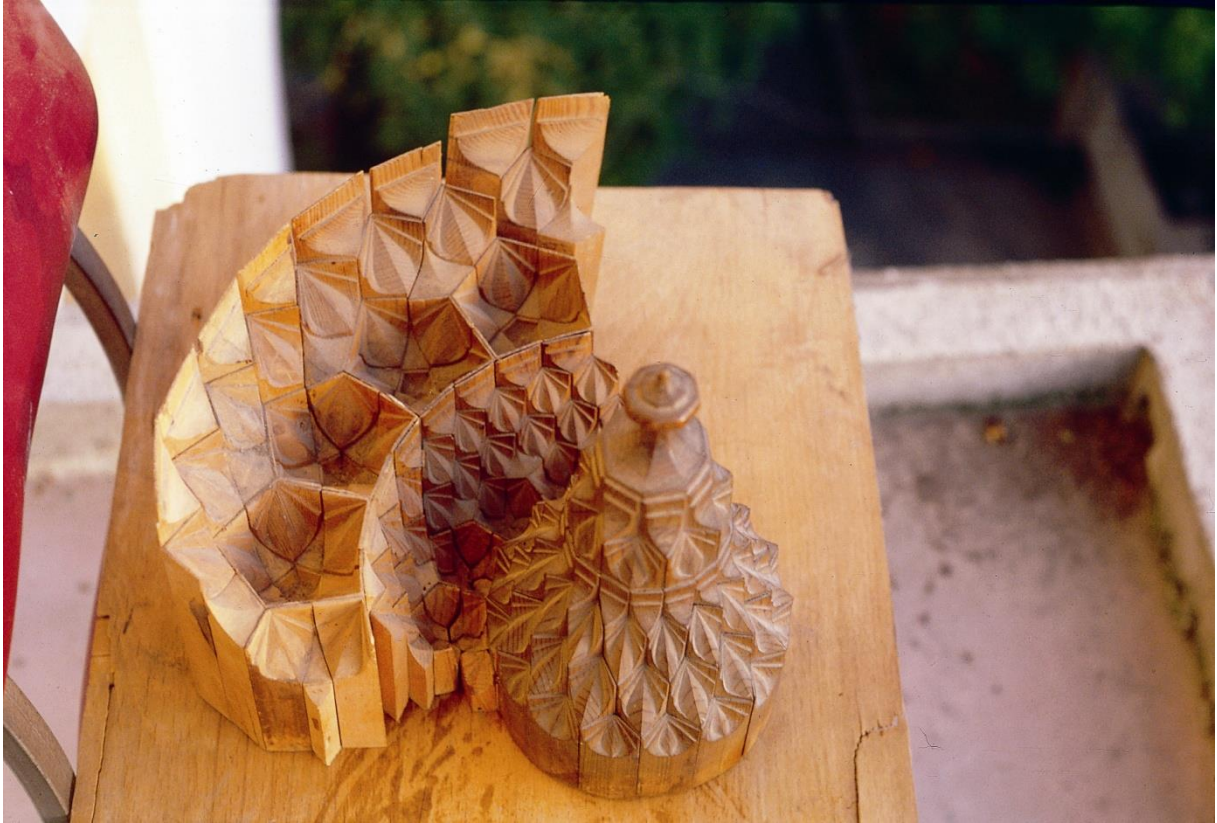


Figure 62 A replica of Ottoman ceiling muqarnas from a house, geometric projection of a tier of star in the below is remarkable.

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