# SULEYMANIYE MOSQUE: SPACE CONSTRUCTION AND TECHNICAL CHALLENGES

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**ABSTRACT:** This paper discussed the technical challenges faced architect Sinan when building Suleymaniye Mosque in the sixteenth century in the city of Istanbul, the capital of the Ottoman Empire.

This research began with the introduction that describes the reasons and justifications for conducting this academic work, explaining the objectives sought by the researcher to achieve. Chapter II discussed the monumental body of the Hagia Sophia and the factors that shaped its construction. Chapter III stands on the nature of the great amount of efforts architect Sinan exerted in building Suleymaniye Mosque, which linked to the name of a great Sultan, Suleiman the Magnificent, who wants construction no less important than any other building in the city of Istanbul. Finally concluded to research results showed the level of architectural qualities of Süleymaniye Mosque.

**KEYWORDS:** Ottoman Architecture**,** Architect Sinan**,** Suleymaniye Mosque**,** Hagia Sophia

## PART ONE: INTRODUCTION

The Ottoman Empire reached the summit of glory in the sixteenth century during the reign of Sultan Suleiman the Magnificent (r. 1520-1566), to shine Istanbul through the efforts of the architect Sinan who built Suleymaniye Mosque (1550-57) by the order of the Great Sultan. The Suleymaniye Mosque (1550-57) represents an important attempt by architect Sinan to compete with the Hagia Sophia scheme; he adopted its plan design, and then he re-drafted it in line with the nature of the internal use of the Ottoman mosques, taking advantage of sixteenth century technology.

Hagia Sophia (522-527) Byzantium churh, characterized by a unique geometric style and enormous interior space covered with pretty large baldachin dome. Historians have mentioned that the dome collapsed once at least.

Suleymaniye Mosque has known as one of the most prominent architectural landmarks in the history of Ottoman and Islamic architecture. Historians did not mention that this mosque suffered of any structural difficulties, but on the contrary was described as a mark; excellence and cohesion in the face of natural factors and earthquakes.

## PART TWO: HAGIA SOPHIA, THE MONUMENTAL MODEL

Hagia Sophia is a former Byzantine church and former Ottoman mosque, now a museum, built by Emperor Justinian, which was to surpass in magnificence all earlier churches. The two most famous architects Anthemius and Isidorus, were entrusted to construct the building.

## 2.1 HAGIA SOPHIA EXTERIOR, STEREOTYPICAL IMAGE

Between the four minarets the dome sits high above the square base. The outer frame of the dome is flat to some extent; it is surrounded from the east and west with a series of half-domes rising toward the central summit. Between every two north and south bold buttresses, extends large and deep arch to lift one side of the square base of the dome. Each arch is filled with a tympanum perforated with two layers of windows.

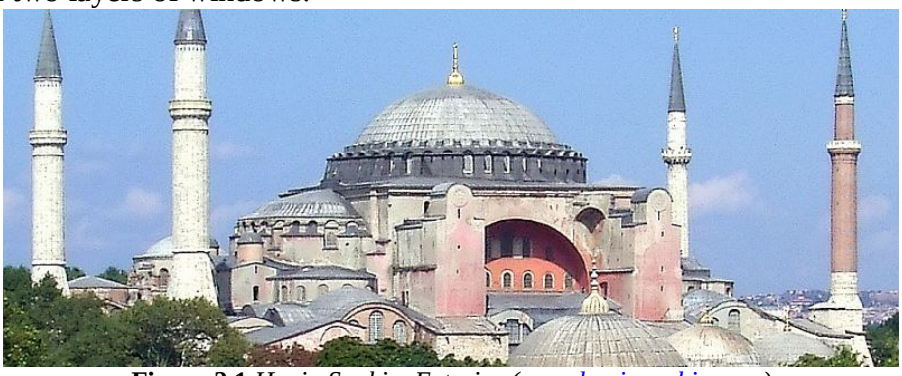

**Figure 2.1** *Hagia Sophia, Exterior (www.hagiasophia.com)*

External appearance of Hagia Sophia is expressive for the sheer size of the building and the lofty dome at the summit. It is clear that the architects of Hagia Sophia have poured their attention on the size of the building, so the dome rose to the highest possible extent, 56 m, and also its diameter extended to the maximum possible extent, 31 m. In other words; externally, the Size of Hagia Sophia is being impressive rather than aesthetics.

## 2.2 HAGIA SOPHIA INTERIOR, SPACE AND STRUCTURE

Haghia Sophia offers a duality in its plan. It is both a basilical building, meaning that it has an axial plan and it is also centralized, because of its large dome which conditions all the structure. The viewer drawn towards the apse and the central dome that rises above.

The main entrance, which can be accessed from the west garden, leads to the external Narthex, free of decoration and ornamentation. And then we pass to the internal Narthex, which is higher and wider and richer of decoration. There are three sets of doors, the middle group is higher and the middle door is the highest Imperial gate of Emperor Justinian.

Upon entering, the central nave is open completely. In both sides the scene repeated symmetrically. Central space are extended by two half domes, a hierarchy of dome-headed elements built up to create a vast oblong interior, crowned by the main dome.

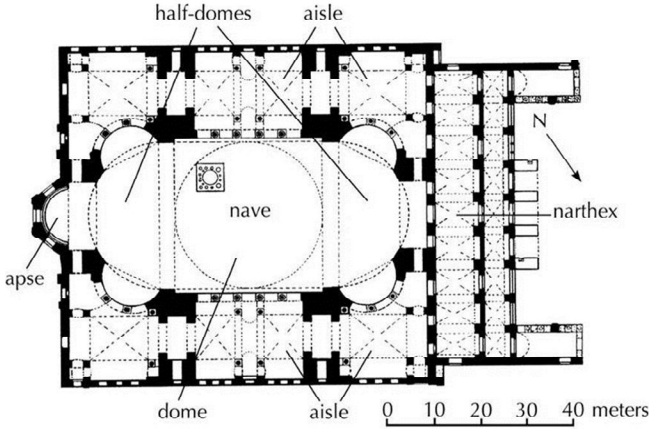


**Figure 2.2** *Hagia Sophia, Plan (www.hagiasophia.com)*

On the center, looking at the southern and northern directions, the main four piers with a set of columns and arches between them, its visible surfaces seem perfectly parallel to the east-west axis. Noticeable here that there is a difference between the system of columns on the two floors, in the ground level there are four columns, large in size and higher, compared to smaller six columns in the upper level, not matching in position to those below.

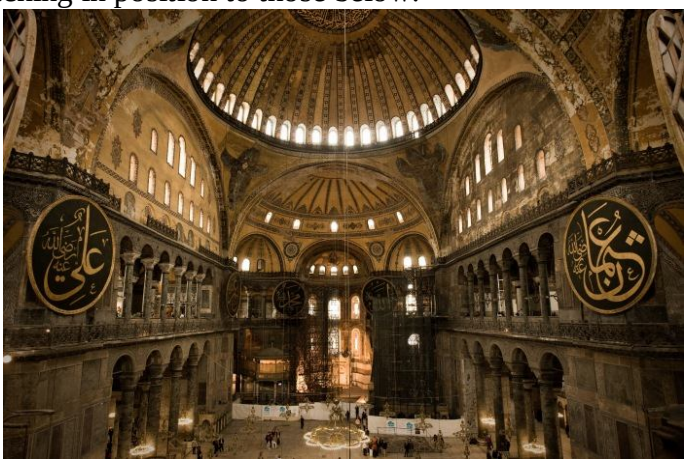

**Figure 2.3** *Hagia Sophia, Central Nave (www.hagiasophia.com)*

On the upper part of the nave, the arches spanning high through which tympanums are enclosed. Arches rise above the piers and separated on a 90 degree angle, and so on, the intervening space between the arches had filled with inverted triangles, pendentives. Above the pendentives the cornice spins, and the drum stands out with multiple windows to light the top section of interior space topped by the main dome.

The arches and pendentives and main dome are based on four main piers. Secondary piers and buttresses, all outside the boundaries of the central nave, as well as groups of arches to connect piers with each other, all are supporting and reinforcement the central structure. Arches and half-domes and pendentives that span between piers high above the nave are all built of limestone bricks.

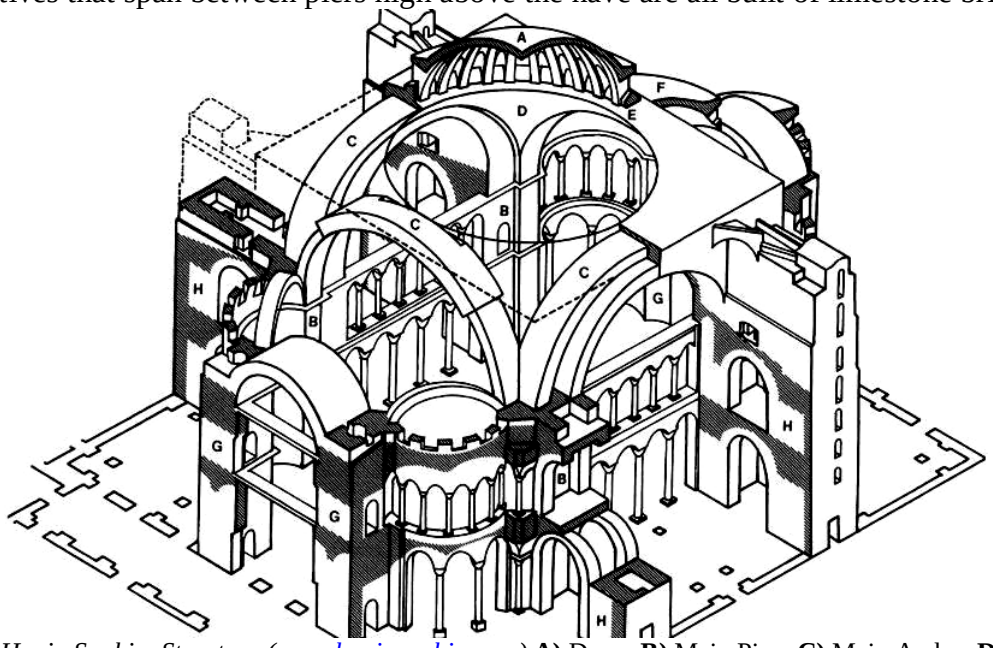


**Figure 2.11** *Hagia Sophia, Structure (www.hagiasophia.com)* **A)** Dome **B)** Main Piers **C)** Main Arches **D)** Pendetives E) Dome Base **F)** Half Domes **G)** Secondary Piers **H)** Side Buttresses

The greatest structural achievement of Hagia Sophia is the main baldachin dome, which amounted to a unique measure, cannot be compared with any other achievement of that time.

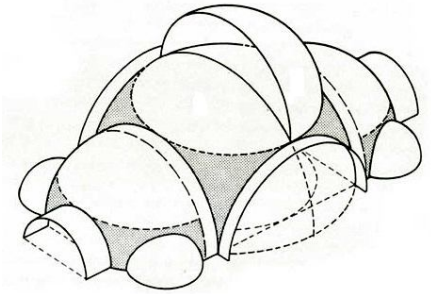

**Figure 2.12** *Superstructure of Hagia Sophia (www.hagiasophia.com)*

When studying the plan of Hagia Sophia seems that there is an explicit variation in the spatial configuration, the rectangular nave in the centre of the church has become complete. All the piers and columns enrolled outside the boundaries of the central nave at the horizontal level. On the vertical level notes that space has become wrapped by half-domes and barrel vaults that drafted this structure without any hindrance to reach the top of the delusive triangle at the peak of central spacious dome which culminated the interior space and gave it its majestic form. Quite the opposite, the side aisles have become more complex, with unclear distribution of space. This is due to the large piers and columns that occupied large parts of its spaces, especially at the interchange of the main piers with supporting piers, what makes this look like a hallway divided into three sections. Vertically, side aisles consist of two floors, the ground, in addition to the balconies floor, which also opens up to the central nave through the surrounding vaults system limits the central nave from almost all sides.

## PART THREE: SULEYMANIYE MOSQUE, THE IDEAL SPACE CONSTRACTION

Suleymaniye mosque (1550-57) is the most important Ottoman building in Istanbul, the largest of architect Sinan's works. Sultan Suleiman the Magnificent, wants to build a mosque than in size and elegance, all earlier grand mosques in Istanbul. At the age of sixty, architect Sinan reached the summit of his work in Suleymaniye mosque, and at the inauguration date, its dome was the widest 26.5 m. and the highest of 53m. of all the Ottoman mosques

### 3.1 SULEYMANIYE MOSQUE: OBJECTIVES AND POSSIBILITIES

Instructions of Sultan Suleiman refer to a comprehensive complex including great mosque in the center and modern university. According to Goodwin: "Beside the mosque, four major colleges were to be built together with all the usual charitable services including the public kitchen (imaret), a hospital (daruşşifa), a public baths (hammam), Caravanserai, tabhane. The mosque had to stand in the midst of its dependencies, the spiritual center of all the charitable and educational enterprises. Moreover, it was to be the most important mosque above the Golden Horn. It was the work of a man of matured experience, of a brilliant engineer who had a trained team at his command". (Goodwin 2003: 215)

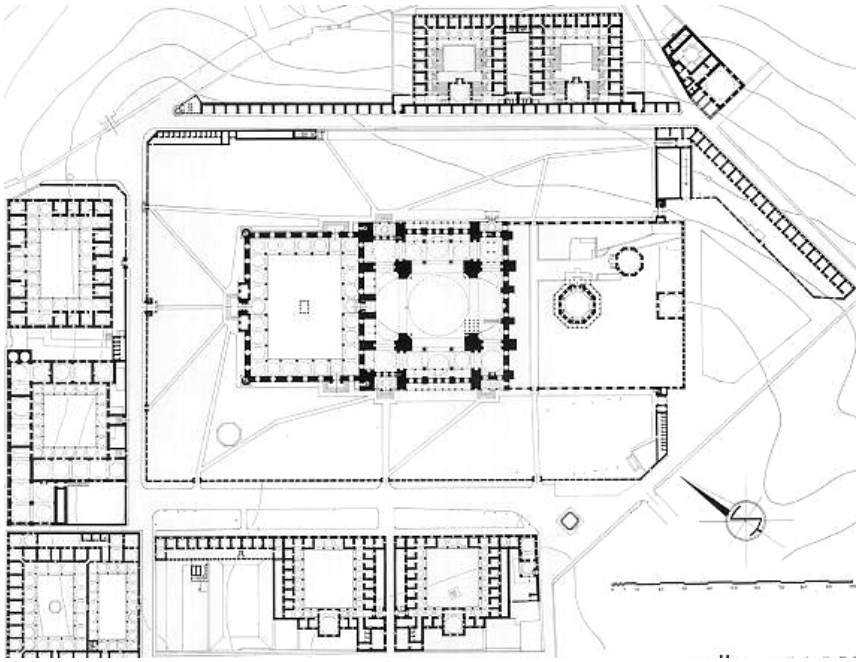

**Figure 3.3** *Suleymaniye complex, plan (www.suleymaniyemosque.com)*

Suleymaniye mosque represents another attempt by architect Sinan, after Shehzade mosque, to compete with the Hagia Sophia structure; he adopted its plan design, and then he re-drafted it in line with the nature of the internal uses of the Ottoman mosques. It is quite clear that the structure of Hagia Sophia is not easy to be defeated, both in terms of dome dimensions or in terms of the magnitude of the building itself. Therefor it constitutes a pretty structural challenge for Sinan.

Careful study of the size and design of Suleymaniye mosque stating that there is a set of prime goals determined in the architectural program. The most important of these goals is to create an expressive dome of high-quality design, very high and very spacious, and providing a much extended prayer hall to accommodate large numbers of worshipers. But with one condition, maintaining the unity and the openness horizontal extension of the interior space with as little as possible number of structural barriers on the ground level.

## 3.2 SULEYMANIYE MOSQUE: EXTERIOR SILHOUETTE

Suleymaniye mosque was built on the third hill of Istanbul that overlooks the Bay of Golden Horn, with one of its sides parallel to the coastline. This high Site, dominating the skyline of Istanbul, gives a clear indication about the dual desire of the Sultan Suleiman and architect Sinan in the creation of a very prominent edifice with unprecedented specification in Ottoman architecture. Thus, architect Sinan took advantage of the uneven site of the hill, where the land slopes sharply down eastward to the sea, to build the monumental mosque.

**Figure 3.8** *Suleymaniye Mosque, Exterior (www.suleymaniyemosque.com)*

In the front the four graceful minarets the imperial dome soars alone on the high peak of Suleymaniye mosque, on the both sides are the two large half-domes, supported by two corner half-domes for each, along with the north-south axis of the Mihrab, in a great similarity with the upper construction design of Hagia Sophia.

Below the dome, the eastern and western arches encircled the tympanums, in the form stresses on the desire of Sinan to show the vertical form of the upper structure. Rotation between half-domes and tympanums on the intersecting axes helped the emergence of a state of variation between the front and side facades, this discrepancy awarded the side facades more articulation. It has become deeper and more interaction with the viewer. In this context, Erzen highlights: The Suleimaniye was designed with equal care for its exterior look; here we can talk of a conscious effort to create a façade on both the east and west elevations. The whole cover system with the central dome and the two half domes, as well as the configuration of the plan is directly reflected on the elements of the elevations. (Erzen 2013)

Sinan moved the tympanums to the outside, thus gaining more space interiorly. This smart decision of Sinan, makes the two tympanums in a direct confrontation with the sun rays, enabling them to play a major role in lighting the interior space within three rows of windows. Side buttresses, built of stone, are directly related with the stabilizing turrets, ensuring there stability in the face of constant thrust of the central structure, and they gradually fall in line with the hierarchical configuration of the building.

Five domes heterogeneous in size placed alternately with side buttresses to cover the side aisles of prayer hall of Süleymaniye Mosque, three in the middle and two on the corners, in a manner seemed different from the previous Ottoman mosques as the Fatih and Bayezid II mosques, which relied on the domes of equal diameters repeated regularly.

Architect Sinan decided to build four minarets in Süleymaniye mosque placed on the four corners of the rectangular open courtyard. The two tall minarets put in the foreground corners, each with three balconies, showing the high technical levels reached by Ottoman architecture in the construction of minarets; their height stretched around seventy-six meters.

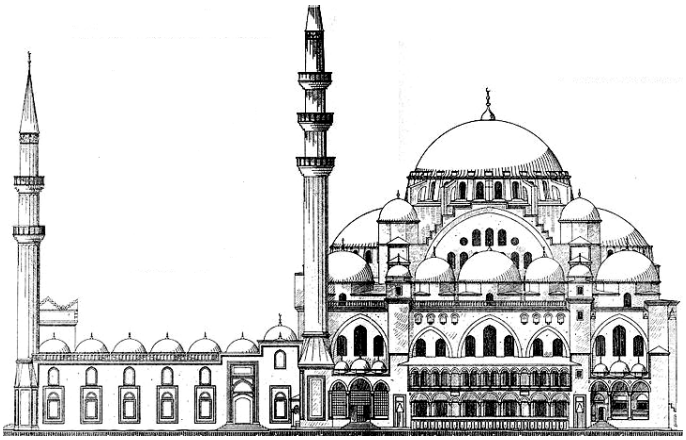

**Figure 3.10** *Suleymaniye Mosque, Side Elevation (www.suleymaniyemosque.com)*

Transversal exterior corridor (porch) covered with nine domes put into place naturally, open to the courtyard which in turn surrounded by columns and domed bays from all sides, in the middle put a sheltered ablution fountain.

## 3.3 SULEYMANIYE MOSQUE: SPATIAL CONSTRUCTION

Successful experience in Süleymaniye mosque shows that architect Sinan has acquired a deep knowledge in the techniques and methods of raising the domes to the tops of mosques, as part of the structural system of piers and arches without affecting the luster of the interior space on the ground level while maintaining its openness and homogeneity. In this regard Prof. Muzaffer Ozgules states: if all contributions of Sinan to Ottoman architecture evaluated, one should be specially highlighted: Making a synthesis of the dome construction of previous ages and finalizing the dome structure as a prototype for the use of his successors. It will not be wrong to call him the "master of domes", since he had covered hundreds of buildings of every scale with domes and perfected this technology by trying several different schemes. (Ozgules, 2008: 9)

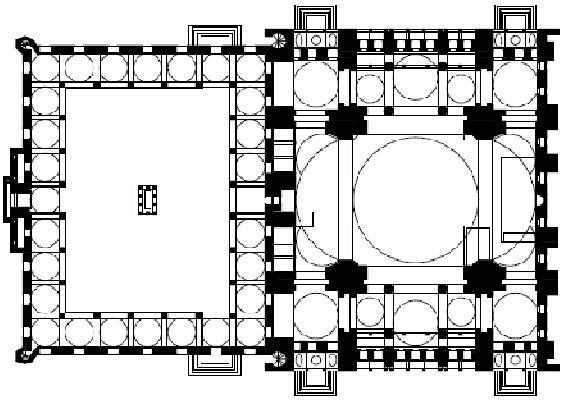

**Figure 3.12** *Suleymaniye Mosque, plan (www.suleymaniyemosque.com)*

The fundamental objective of the prayer hall is to accommodate parallel rows of worshipers within a single space, prepared for protecting them from the sun, rain, and different weather conditions. Geometrically, the appropriate plan is the square or rectangle.

The interior space of Suleymaniye mosque begins to evolve from the center within three axes, longitudinal, transversal and vertical. From the center, the circle of the dome rotates to form the limits of the central square; its side length is equal to the dome diameter. At its corners the huge piers established in a symmetrical manner. The shape of the piers in plan is quasi-square, arches are

branching from its peak to all directions, two huge arches spring from each pier and separates on a 90 degree angle, the void in between two arches had filled with pendentives that rise up concavely and rotates with the curve of the upper cornice. Above the upper cornice the drum begins to grow upward through a consistent set of 32 ribs stand interchangeably with 32 windows. Ribs continue rising centrally to complete the shell of the dome to reach the top vertex of the dome at the highest point in the interior space.

**Figure 3.13** *Suleymaniye Mosque, Central space (www.suleymaniyemosque.com)*

In the direction of the Mihrab axis, the central space is expanding by two half-domes, matching with two of the main arches to constitute a suitable element for supporting the central dome, in a similar quite picture to the roof design of the central nave in Hagia Sophia. Further widening, supporting and lighting granted by the hanging corner half-domes that spanning in diagonal line between the main piers and the side buttresses integrated within the north and south walls.

Qibal south wall in Suleymaniye mosque, houses the Mihrab in the center, became closer to the central piers, linked with them by corner half-domes and pointed arches, which transmit thrust coming down from upper structure through a group of buttresses towards the foundations. The back wall bounced slightly to the back allowing the buttresses to emerge internally bold. Certainly architect Sinan was forced to have such unfavorable solution, because he does not want to deform the external transversal Porch, which includes the ceremonial gate to the center on the north south axis of the Mihrab.


**Figure 3.14** *Suleymaniye Mosque, Interior (www.suleymaniyemosque.com)*

From the center of the dome at ground level extends transverse axis, east - west, outside the boundaries of the central square, standing at the far edges of the piers to line up a series of three

arches rise above two porphyry monolithic columns, the middle arch is the triumphal arch of Sultan Suleiman the Magnificent, it is the widest and the highest. This arch came to demonstrate the excellent skills of Sinan showing the sublime structural status of the Suleymaniye mosque. These developed construction solutions facilitate the extension and the openness of the interior space horizontally. It was also due to the absence of the balconies, which was available in Hagia Sophia.

To the top of the triumphal arches, the cornice continues rotating to stand from above the perforated tympanums with three layers of windows to fill the side arches of the dome, east and west. Obvious difference between these tympanums and those in Hagia Sophia that here they became bounce more to the outside widening the interior central space.

Beyond the columns and main piers located the side aisles, east and west. These aisles found here to emphasize the rectangular and transversal body of the prayer hall, in a clear difference with the longitudinal extension of the side aisles of Hagia Sophia. They are built of singular uninterrupted spatial unit covered by five small domes vary in diameter.

**Figure 3.15** *Suleymaniye Mosque, Interior (www.suleymaniyemosque.com)*

The east and west side walls of the prayer hall have become more vital and relevant planning and construction. On the one hand there are two entrances on each side to facilitate the movement of worshipers during the entry and exit from the mosque five times a day. On the other hand the side buttresses that support the central structural system have been incorporated into the side walls, with half projecting inside and half projecting outside, interiorly they concealed by the addition of the small balconies, exteriorly they integrated with the exterior two-story side galleries.

## 3.4 SULEYMANIYE MOSQUE: TICHNICAL INNOVATIONS

When talking about architecture of Süleymaniye mosque stands out the traditional comparison with architecture of Hagia Sophia, especially in the technical and structural aspects. Although the technological idiom in the Byzantine and Ottoman eras is considered traditional, but the thousand years that separates between the Ottoman Suleymaniye and the Byzantine Hagia Sophia, must carry a lot of improvements and developments.

### 3.4.1 UNIFIED AND HOMOGENEOUS SPACE CONSTRUCTION

Sinan successfully enlarged the prayer hall, to become the largest of Ottoman mosques. The rectangular shape of the prayer hall parallel to the Qibla wall ensures the main function, namely prayer within the ranks of the equal and parallel. Architect Sinan also succeeded in maintaining the internal space open and unified with very few number of structural barriers.

Sophisticated structural systems where Sinan put his trust were able to raise the interior space delightfully. Daylight distributed evenly in all areas until the prayer hall become fully lit. Central dome was expressive enough and corresponding with the size of the building.

### 3.4.2 STRUCTURAL INNOVATIONS

Historians have never mentioned that Suleymaniye mosque suffered of any structural difficulties, but on the contrary was described as a mark; excellence and cohesion in the face of natural factors and earthquakes over almost 460 years. According to Ozgules, "The most important innovation Sinan brought to Ottoman architecture was the double boundary system". The first boundary is the central structural box, and the second boundary is formed by the arches and buttresses that are used to support the central dome. (Ozgules, 2008: 8+9)

Architect Sinan has mastered the construction of the robust dome completely, putting it on the top of the pretty upraised central structural system. It is spherical in shape, its height equals to half its diameter.

In fact the double boundary system is inevitable structural solution, because the dome with its central physical nature does not recognize the wishes of the architects, so the most appropriate structural plan for lifting and supporting the baldachin dome is the box scheme, especially with the availability of the pendintives. Architect Sinan actually excelled in the Süleymaniye mosque by freeing the structural system, dividing it for three sections, the central box, the exterior box, and the bridging system.

The component of the central box, the main four piers, the main four arches, and the four pendintives are playing a key role in lifting the central dome. This goal has been confirmed by reducing the number of columns of the central square to only four, and also through the clarity of the four arches and the four pendintive in the internal and external perspective.

Structural system of the exterior box, although architect Sinan tried to hide its features through integrating it with the walls of the prayer hall, but it still independent structurally, and its function has been determined in strengthening and supporting the central structural system. The walls here do not carry or support the upper construction.

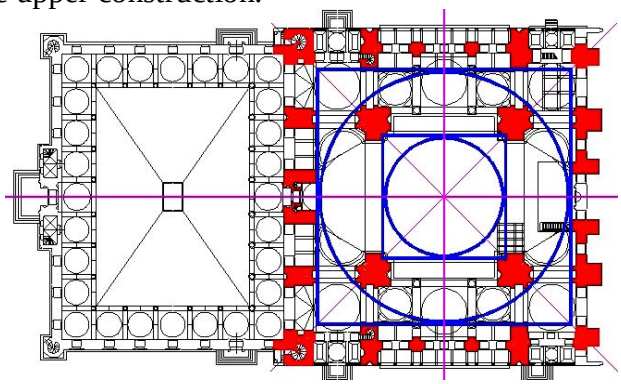

**Figure 3.17** *Suleymaniye Mosque, Double Boundary System (Author)*

The exterior side galleries added by architect Sinan on the east and west facades of the Süleymaniye mosque have played an important role in the process of softening the form of protruding blocks of the side buttresses, getting them more in tune with the vertical rhythm of the side facades.

For linking between these two structural systems, the central box and outer box, architect Sinan used the bridging system, which is a different set of structural elements with a variety of geometric shapes working on passing the pressure coming down from the central dome toward the buttresses

in the exterior box, and then to the floor foundations. This system consists of the large half-domes, corner half-domes, and pointed arches.

### 3.4.3 OPTIMIZATION OF DAY-LIGHTING

The large interior space of Süleymaniye mosque requires sufficient day-lighting, and only was to achieve that is by increasing openings and windows in the surrounding body of the prayer hall. Reliance on a perfect structural system to elevate and support the superstructure of Suleymaniye mosque, makes the ground walls free to operates within a specific function, enclosing the rectangular interior space and determining its limits. Freeing the walls from carrying weights of the upper domical roof, allowes for adding a great number of openings within three layers, included about five entrances, one hundred and fifteen windows different in shape and measurements to provide the prayer hall with the enormous amounts of daylight.

For illuminating the central nave, Sinan deliberately uses the tympanums instead of half-domes on the east-west transverse axis, and thus tympanums, with forty-six windows, became very close to the center of the prayer hall and in direct confrontation with the sun rays. Large two half-domes played an important role, too, each of them has marked with twenty-six windows distributed within two rows, thirteen window opened in the large half-dome, and thirteenth windows opened in the corner half-domes and the central arch. Drum of the central dome received thirty-two window distributed in a central manner, for more light and glow.

### 3.4.4 HEATING AND VENTILATION SYSTEMS

Through equal distribution of day-lighting, architect Sinan was able to make the interior space of the Süleymaniye mosque homogeneous and pleasant, and that by perforating the architectural centric body of the prayer hall with an unprecedented number of vary shape windows, putting them in the face of the sun throughout the year.

Daylight has other benefits as well; the sun rays warm up the interior space, especially in the cold winter of Istanbul, but in the warm summer solar heat may be redundant for the interior place, so it was necessary to control the amount of solar heating. Sinan invented a solar screen system that covers all the upper windows of Sulymaniye mosque except Qibla wall, which marked by stained glass windows. The solar screens are cut of a stone or marble, perforated with geometric pattern of regular size circles. Solar screens are controlling the amount of light that penetrate the windows during the movement of the sun, either over a day or over the annual four seasons. When the sunlight slanting morning or evening, or in the winter, the circular shapes become perpendicular to the lines of the sun rays and do not impede their passage into the prayer hall. But the higher the sun with midday, the circles turn into a case is not perpendicular to the lines of the sun rays and do not allow their direct passage into the prayer hall, because they operate on shattering the severity of the sun rays, only then moves from the sun to inside its light and not its heat.

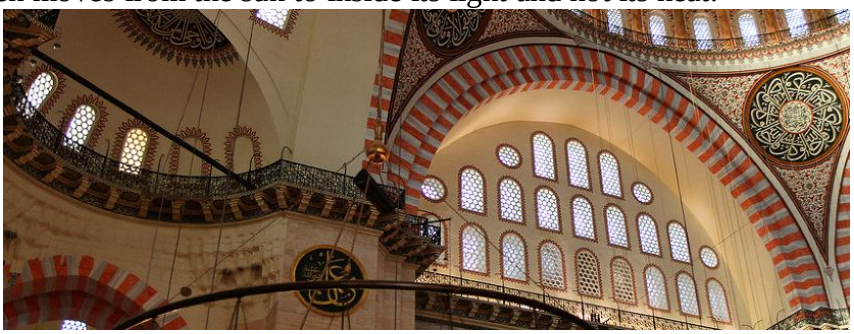

**Figure 3.18** *Suleymaniye Mosque, Interior (www.suleymaniyemosque.com)*

Casement windows on the eye level is the only windows that can be opened and closed in Suleymaniye mosque, they are made of double shutters, external glass shutters and the internal wood shutters. It can be opened during the day to ventilate and cool the interior space and to let the smell of flowers in the front garden to perfume the atmosphere of the mosque. It can be closed at night and in winter time in order to maintain the warmth of the interior space.

It seems that previous solutions may not sufficient enough to control the temperature of the prayer hall, especially in winter when the temperature drops down in Istanbul and the sun rays disappear behind the clouds. So that, Sinan adopted innovative technique to heat the prayer hall, he used the under floor heating system by digging water channels under the mosque to allow the flowing of the warm water coming from the public bath (Hammam) annexed to the complex, the warm water works on heating the air stream running through the water channels. Then the warm air stream comes out through specific outlets in the floor of the mosque providing the prayer hall with required warmth. It is also possible for these ground channels to drag the cold water during the hot summer days, cooling the air stream running with the water for cooling and refreshing the interior space. (Suntur 2005: 3).

### 3.4.5 ACCOUSTICAL PROPORETIES

some researchers dealt with the issue of acoustic distribution of the mosques built by architect Sinan, but unfortunately sources that talk about the subject are very limited and do not suffice. Here the researcher will try to shed some light on the efforts made by the architect Sinan in this regard, particularly in the Süleymaniye Mosque.

In a large size hall, such a hall of Suleymaniye mosque, it was the responsibility of architect Sinan to develop the acoustic properties and enable the sound accessing to all corners. The Ottomans have a long old knowledge of the acoustic properties of the dome, architect Sinan introduced a range of innovative solutions for this purpose, first through diversification in size and measure of the domes to fit into the size of the waves and sound frequencies. And in order to improve the strength of the reflection of the sound, architect Sinan used the acoustic resonators, which is a special cut stone planted in the main dome and large half-domes have the ability to, purify the sound and getting rid of the echo. Dr Kayili points out: "Cavity resonators, placed in a dome, prevent the reflection of sound energy and reradiate it throughout the room. By reradiating the incident energy in all directions, the room becomes a diffused sound field and the danger of echoes due to delayed reflections from dome is eliminated." (Kayili 2005: 9)

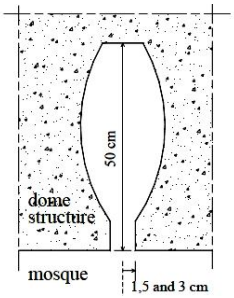


**Figure 3.20** *Cavity Resonators, Section (From Kayili)*

### 3.4.6 SOOT CHAMBER

The researcher has discussed the daylight of Süleymaniye Mosque, but what about night lighting. Muslims pray Fajr before sunrise approximately one hour, and pray Asha after sunset approximately one hour. For lighting the interior space architect Sinan used four thousands of candles and oil lamps, hanging by a very large system of rings hanging by metal wires. The great number of traditional lighting units, certainly has emissions of undesirable soot, if it headed towards

the ceiling of the mosque it would deform the fine decorations covering it in black. To solve this problem, architect Sinan invented an ideal way to get rid of this soot, based on an air circulation system. The airflow passes over the candle units, sweeping the soot and heading toward the chimney chamber in the center of the back wall of the prayer hall, exactly over the central main door. Four holes perforated in the bottom of the chimney to collect the soot into the chamber. Once the soot accumulated in the chimney, will be collected and recycled to make ink for Calligraphers. (Cambaz 2005) Airflow have another advantage here, it also works on providing the candles with oxygen and thus light up in a good way.

## DISCUSSION

It seems clear that the issue of size and dimensions were not the main issue for architect Sinan, but the main goal he sought to achieve is improving the interior space of Suleymaniye mosque. Sinan put the bulk of his knowledge in order to provide all the amenities in the prayer hall, it is pretty spacious and well-lit day and night, cooled in summer and winter, well ventilated and perfumed, decorated with the latest styles of glazed ceramics and calligraphy.

It is reasonable here to assume that architect Sinan was able to overcome the size and measure of the dome of Hagia Sophia in Suleymaniye mosque, but the interior determinants prevented him from achieving this goal. Researcher is absolutely convinced that the reason lies in that architect Sinan avoided placing columns in the front and back of the prayer hall to support the corner half-domes and increasing its size, then enlarging the main half-domes and the main central dome. The reason for this is due to that these columns could destroy the harmony in the lines of worshipers, especially the lines in the forefront close to Qibla wall. Breaking the lines in prayer hall is not in accordance with design methodology in Ottoman mosques since its inception, which based on a free single spatial unite allows as much as possible lines of worshipers to continue without any interruption.

## CONCLUSION

1- The fundamental difference between the Süleymaniye Mosque and the Hagia Sophia is located in the nature of the internal utilization. Space distribution in Hagia Sophia was according to the nature of Christian worship that requires divisions consistent with the religious and social status of the attendants. In the Süleymaniye Mosque space distribution was according to the nature of prayer for Muslims that requires a unified and homogeneous space, free of structural barriers as much as possible.

2- Architect Sinan was able to construct an integrated and balanced architectural model in the Süleymaniye Mosque, form and function. The functional design requirements of the internal space did not lead to the neglect of the external shape, and the objective of a very expressive exterior body did not disfigure the interior environment. Space and structure complement each other in perfect harmony here.

3- Architect Sinan did not only best use of the technology of sixteenth century when he built Süleymaniye Mosque, but he was a genius artist who designed a proactive spatial and structural innovative solutions compiled architecture and engineering sciences. These solutions may be useful and inspiring to many architects and engineers in all subsequent ages.

## BIBLIOGRAPHY

**Cambaz, Mustafa (2005).** Photographer, Turkey, www.mustafacambaz.com
**Erzen, Jale (1999). Proceedings of the Symposium on Mosque Architecture,** Volume 4: The Architectural Design of Mosques.
**Goodwin, Godfrey, (2003). A History of Ottoman Architecture.** Thames and Hudson Ltd, London.
**J. Mainstone, Rowland (2006). Hagia Sophia, Architecture, Structure, and Liturgy of Justinian's Great Church.** Thames & Hudson Ltd, London.
**Kayili, Mutbul (2005). Acoustic Solutions In Classic Ottoman Architecture.** FSTC Limited, United Kingdom (UK).
**Kuran, Aptullah (1987). Sinan, the Grand Old Master of Ottoman Architecture,** Washington DC and Istanbul, Ada Press.
**Necipoglu, Gulru (2005). The Age of Sinan, Architectural Culture in the Ottoman Empire.** Reaktion Books Ltd, London.
**Ozgules, Nuzaffer, (2008). "Fundamental Developments of 16th Century Ottoman Architecture: Innovations in the Art of Architect Sinan,"** MITU, Ankara, Turkey, http://www.stps.metu.edu.tr.
**Stratton, Arthur (1972). Sinan.** New York: Charles Scribner's Sons.
**Selen, Onur (2008) Architect Sinan: An Intellectual Design in 16th century Ottoman Capital**. İstanbul Kültür University.
**Suntur, Ahmet Rasim (2005). Muhteşem Süleymaniye (Camii Şerifi ve Külliyesi) İstanbul. http://www.hvac-turkey.com/detail-41-the-magnificent-suleymaniye-mosque**
**Yerasimos, Stéphane (2007). Constantinople: Istanbul's Historical Heritage,** H.F.