The Defensive Features in the Engineering & Architecture of Sinan's Magnificent Bridge of Büyükçekmece

Terry H. Little[1]
Independent Researcher
tlittlehord2@yahoo.com
ORCID No: 0009-0000-5299-9192

Abdulmennan M. Altıntaş[2*]
FORTH/Institute for Mediterranean Studies
mennanm@gmail.com
ORCID No: 0000-0002-0685-2293

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ABSTRACT

This article explores the engineering and military significance of the Büyükçekmece Bridge designed by Sinan bin Abdulmennan—hereafter referred to simply as "Sinan". Situated between the Sea of Marmara and Lake Büyükçekmece, this remarkable complex consists of four interconnected bridges linking three man-made islands. The bridge was a critical infrastructural element along the imperial route to Rumelia and Balkans.

While Sinan's mosques have long drawn scholarly and aesthetic attention, this study argues that the Büyükçekmece Bridge should also be recognized as a masterpiece that synthesizes functionality, spiritual symbolism, imperial grandeur, and military foresight. From a detailed analysis of drawings and field observations, the paper identifies a range of rarely acknowledged "hidden" features designed into the bridge. The goal of this paper is to investigate the military features incorporated into this complex of four different bridges (spans) and three different causeways on artificial islands. For simplicity, the four spans and three man-made causeways will be referenced as the bridge.

Methodologically, the study employs an interdisciplinary approach that combines archival sources, epigraphic evidence, architectural analysis based on Ottoman plans, and on-site observations conducted by the authors. By correlating spatial measurements with historical military practices, the article reassesses the bridge's strategic dimensions through both historical and technical lenses. The study concludes that specific structural characteristics, such as the ten distinct inclines, constricted passage points, asymmetrical span lengths, elevated sightlines, and the positioning of three artificial islands, were not solely functional or aesthetic but also enhanced the bridge's defensive capacity.

KEYWORDS

Architect Sinan, Büyükçekmece Bridge, Engineering of Sinan, Defensive Architecture, Strategic Infrastructure.

INTRODUCTION

Bridges have long symbolized more than mere physical crossings; they have signified the projection of might, pride of country and strategic control. Within the Ottoman tradition, Sinan (c. 1490–1588) stands as an engineering master who elevated bridge-building into a sophisticated art, integrating time-tested innovations for his bridges. The construction of the Büyükçekmece Bridge, also known as the Mimar Sinan Bridge or the Sultan Suleiman the Magnificent Bridge, officially began in 1563. The bridge was opened to use in 1567/68 during the reign of Sultan Selim II and measured 696.75 meters in length (see, Table I). Remarkably, this bridge is the only structure on which Sinan inscribed his name, even if in the form of an alias, "Yusuf bin Abdullah." This is an indirect evidence of the bridge's personal and professional significance to him (Bedlek, 2009; pp. 183-188).

[*] **Corresponding author.**

Figure 1. *A recent photograph of the Büyükçekmece Bridge. Photo taken by Terry H. Little.*

In the existing literature on Sinan's body of work, the emphasis has traditionally been placed on the aesthetic and symbolic dimensions in his mosques, rather than on the functional aspects of his works. However, recent studies have begun to reveal the coherence between Sinan's engineering acumen and his vision of urban planning. In particular, Emine Yeşim Bedlek's article "The Impact of Urbanization on Sinan's Masterpiece: Büyükçekmece Bridge" presents Sinan not merely as a mosque and complex architect, but as a spatial strategist operating at the scale of the imperial policy. According to Bedlek, Sinan played a central role in coordinating Ottoman urbanization on a macro level. His works functioned not only as individual monuments but also as key nodes in networks of transportation, communication, and sovereignty. The Büyükçekmece menzil (station) complex, is a critical component of this network, facilitating both military mobility and ideological integration. Within this framework, the bridge itself becomes more than a mere crossing as it stands as a special spatial expression of "urban continuity" and the glory of the Ottoman Empire (Bedlek, 2009; pp. 183-188). Niyazi Özgür Bezgin, on the other hand, has evaluated the design of the Büyükçekmece Bridge, which he categorizes as an "intermittent-bridge," from a military perspective (Bezgin, 2019). A further study, based on archival sources, reconstructs the maintenance history of the Büyükçekmece Bridge and demonstrates that it was not merely a one-time construction project, but the object of sustained administrative and technical attention over several centuries. The article also sheds light on Sinan's decision-making process during construction, his evaluation of topography, and logistical details such as material procurement (Bilgiç & Avşin, 2023; 577-607).

This study adopts a multi-layered methodological approach that integrates historical, architectural, and technical analysis. First, archival records were examined to trace the bridge's engineering history. Second, spatial data from the 1918 Ottoman technical drawings (PLK.p.5376) were used to calculate inclines, span lengths, island dimensions, and the geometric layout of the structure. These measurements were cross-referenced with on-site observations carried out by the authors. Finally, insights from military history and weapons studies were incorporated to interpret how specific architectural features may have functioned defensively. By combining documentary, technical, and field-based evidence, the study reevaluates Büyükçekmece Bridge as a work in which military foresight and engineering practice intersect.

SINAN: LIFE, ARCHITECTURAL CULTURE, AND HISTORIOGRAPHY

Sinan (c. 1490–1588) was the most renowned architect of the Ottoman Empire, whose innovative designs laid the foundation for later Turkish religious and civic architecture. Originally born to Christian parents in central Anatolia, he entered the Janissary corps, the elite infantry unit of the Ottoman Empire, in 1512, at which time he converted to Islam and devoted his life to serving the Ottoman dynasty, particularly Sultan Suleiman I. He received his early education at a school overlooking the Atmeydanı, near the sultan's palace and the Hagia Sophia Mosque, where he first developed a keen interest in carpentry. He later took part in Sultan Selim I's Egyptian campaign of 1516–1517, during which he encountered a wide range of architectural traditions. Sinan was deeply influenced not only by Seljuk and Safavid monuments but also by ancient structures and the pyramids of Egypt. In this way, he developed an architectural style grounded in the interplay between architecture and urban design (Mülâyim, 2009).

Sinan demonstrated his engineering skills in the 1530s by building military bridges and fortifications. By 1539, he completed his first nonmilitary project called Haseki Hürrem Sultan Complex (Kartal, 2012). During his tenure as chief architect, he constructed numerous mosques, palaces, baths, bridges, schools, and caravanserais across various regions of the empire. His most famous works include the Şehzade Mosque and the Süleymaniye Mosque in Istanbul, along with the Selim Mosque in Edirne (Crane & Akin, 2006).

What stands out in Sinan's work is not the "traditionalist" style often associated with his era, but rather an "innovative" approach. During the reign of Sultan Suleiman the Magnificent (r. 1520–1566)—a period marked by a flourishing of architectural creativity—Sinan honed his skills as both an engineer and an architect. It is therefore anachronistic to characterize his body of work as representative of an outdated style, or to treat concepts such as "architectural creativity, innovation, and individuality" as being uniquely European (Necipoğlu, 2016; pp. 25). An important point often overlooked in discussions of Sinan is that he served as the head of the imperial corps of architects (*hâssa mi'mârları*), and that the state-sponsored buildings of his time were the result of this group's collective labor. This, of course, does not diminish Sinan's stature as a creative genius. The structures erected under his supervision reflect his design principles and artistic sensibilities to varying degrees. However, it is well established that—except for monuments commissioned by sultans, their consorts, and other dynastic figures in Istanbul and Edirne—many projects, although designed by Sinan, were not constructed under his direct supervision (Necipoğlu, 2016; pp. 34-35).

Drawing on Uğur Tanyeli's analysis, it becomes clear that describing Sinan's architectural production in terms of creative individuality, exceptional genius, or timeless rational innovation reflects a modern, ahistorical projection onto the sixteenth century rather than an accurate account of its epistemic and institutional realities. Such interpretations, as Tanyeli argues, construct a mythical Sinan by imagining the chief architect and the imperial corps of architects as if they operated like a contemporary architectural office—complete with autonomous design decisions, centralized authorship, and a modern professional identity (Tanyeli, 2021; pp. 40-42). In contrast, Sinan's work must be understood within the knowledge regime, administrative structures, and socio-political conditions of his own time; only then does it become possible to distinguish historical agency from retroactive idealization. From this perspective, what renders Sinan "innovative" is not modern notions of individual creativity, but rather his capacity, as head of a collective architectural corps, to solve spatial and technical problems within the framework of sixteenth-century Ottoman institutional practice. This approach moves beyond subject-centered narratives and situates Sinan's body of work within the broader structures that enabled and shaped architectural production in his era.

Sinan's portfolio of bridge construction is broader than often assumed. Although he mentions only eight bridges in his autobiographical writings, modern scholarship identifies at least twelve structures attributed to him. These bridges vary considerably, from modest causeways to large multi-span river crossings, demonstrating the wide spectrum of engineering solutions Sinan employed over his career.

Establishing this broader context is essential, for it enables us to appreciate how the Büyükçekmece Bridge diverges from typical patterns in Sinan's body of work in terms of scale, structural ambition, and technical complexity. A concise comparative overview of these bridges is provided in Appendix I.

HISTORICAL BACKGROUND OF THE BRIDGE

In antiquity, a bridge known as Athyras, flanked by guard towers at either end, stood on the site of the present structure. Situated along the Via Egnatia, it connected Istanbul with Europe and remained in service throughout the Middle Ages. By the late Byzantine period, however, the bridge had fallen into ruin through neglect. In the aftermath of the conquest of Istanbul, Sultan Mehmed II (r. 1444-1481) ordered its repair, and it appears to have remained in use for some time thereafter (Eyice, 1992; pp. 520). Ogier Ghiselin de Busbecq, an ambassador to Suleiman the Magnificent (r. 1520-1566), crossed this bridge in 1556, he observed:

> *Close to Constantinople we crossed over bridges, which spanned two lovely bays [Buyuk Tchekmedjé and Kutchuk Tchekmedjé]. If these places were cultivated, and nature were to receive the slightest assistance from art, I doubt whether in the whole world anything could be found to surpass them in loveliness. But the very ground seems to mourn its fate, and complain of the neglect of its barbarian master. Here we feasted on most delicious fish, caught before our eyes (Foster & Daniel, 1881; pp. 109).*

While inspecting the environs of the Ottoman capital, Sultan Suleiman personally witnessed the hardships endured by the local population due to the ruined bridge at Büyükçekmece. When the Sultan ordered the construction of a new bridge, Chief Architect Sinan conducted a preliminary study. According to his findings, the earlier bridge had been built inland within the marsh to reduce costs, as constructing near the sea was more expensive (Necipoğlu, 2005; pp. 140). However, since a solid foundation could not be established in the swamp the bridge gradually collapsed. Sinan argued that the new bridge should instead be built closer to the sea, where the ground was more stable. Although this would make the bridge longer and more costly, Sultan Suleiman, desiring a durable structure, approved Sinan's proposal and issued the construction order (Eyice, 1992; pp. 520-521).

The construction of the bridge involved the use of the cofferdam (batardo) technique, a method of building in water since the Roman period. The cofferdam method refers to the creation of a temporary watertight enclosure from which water is pumped out to provide a dry and stable working area for laying foundations below the waterline, an approach widely used in hydraulic construction to enable permanent works to be executed in otherwise submerged conditions (White & Prentis, 1940, pp. 102–103). From a technical perspective, it is also worth noting that the bridge piles of the Büyükçekmece Bridge differ from those of many other Ottoman structures. In most cases, the foundations of the piles rise directly from the riverbed. In this case, however, the piles were built to form large artificial islands that Sinan likened to galleons. As was done in Roman times, wooden piles approximately five meters in length were driven into the areas created by the cofferdams at intervals of 70 to 80 centimeters in a grid pattern, and the heads of the piles were fastened together. A layer of khorasan mortar, more than one meter thick, was poured over the pile heads. Upon this layer, an interlocked stone platform was built. The reason for such a meticulous and detailed construction process was, as Sinan himself noted, necessary because of the extremely weak soil conditions (Tanyeli, 2021; 266). Thanks to Sinan's detailed planning and careful execution, the bridge—despite being built on poor ground—has withstood the passage of centuries and operates to this day. Sultan Suleiman passed away in 1566 during the Siege of Szigetvár before the completion of the Büyükçekmece Bridge. Shortly after the sultan's death, the bridge was finalized in 1567.

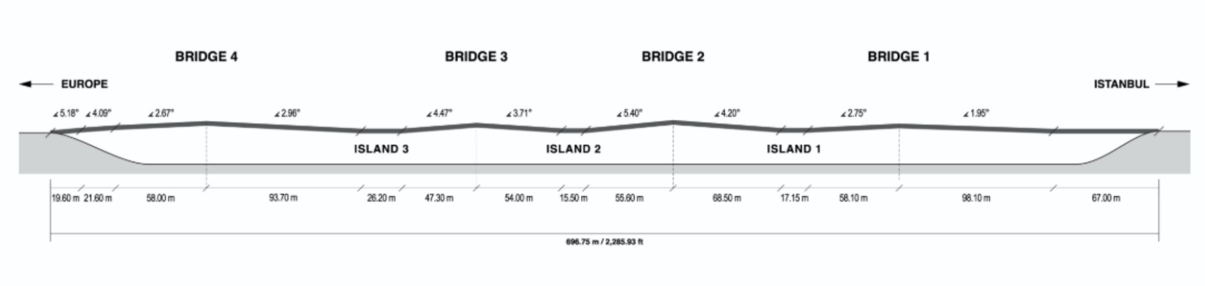

Figure 2. *Elevation of the bridge showing span lengths and inclines in degrees of the angle. The drawing was prepared on the basis of the slope and length data found in the plans contained in the Ottoman Archives, file dated 1918 and coded (PLK.p.5376).*

THE BRIDGE AS A LOGISTIC AND COMMERCIAL INFRASTRUCTURE

Situated on the main route connecting Istanbul to the interior regions of Europe, the Büyükçekmece Bridge served as a crucial transit point for the provisioning of the Ottoman capital with agricultural and commercial goods. As a key artery within the empire's broader transportation and trade network, its uninterrupted operation ensured the secure, rapid, and weather-resistant movement of supplies. For the surrounding regions, which lacked sufficient resources to meet the capital's provisioning needs, goods transported from distant provinces held vital importance. Caravans carrying such foodstuffs could safely reach both designated delivery points and urban markets and storage facilities via robust and dependable passages such as the Büyükçekmece Bridge. In the early modern period, the Büyükçekmece Bridge functioned as a multifaceted logistical cornerstone, securing internal access to Istanbul and supporting the city's vital supply needs. Owing to the determination of Sinan and the technological capabilities of his era, the uninterrupted transport of agricultural and pastoral products was maintained not only in times of peace but also during crises. For this reason, the bridge must be regarded not only as an engineering masterpiece but also as a fundamental component of Istanbul's everyday economic life (Göktepe, 2017; pp. 857-916; Yazıcı, 2024; 183-189).

MILITARY SIGNIFICANCE OF THE BRIDGE

The principal weapons the Ottoman Army had in its arsenal for defending the bridge consisted of archery pieces (Turkish bow), muskets, swords (yatagan, shamshir, pala), maces, and field artillery. The subject of this weaponry in detail is beyond the scope of this paper. Nevertheless, one can surmise the locations of the three islands by Sinan would be to have the maximum effect and drenching of the killing zones for defending the bridge. The available sources are insufficient to determine with accuracy the effective ranges of each weapon in relation to the islands, and therefore to explain with certainty why Sinan designed their shapes, sizes, and locations as he did. Nevertheless, the positioning of the islands and elevated spans would have allowed Ottoman troops to direct enfilading fire along the length of the bridge, exposing an approaching enemy to sustained fire from multiple angles.

In the fourteenth and fifteenth centuries, the Ottomans, like their European counterparts, employed massive and cumbersome siege cannons. These guns, weighing between 6,000 and 16,000 kilograms, had muzzle diameters ranging from 50 to 80 centimeters and fired stone projectiles weighing between 150 and 700 kilograms. For instance, the siege cannon used by the Sultan's army during the 1453 siege of Istanbul was 9.2 meters long and fired a 601 kg projectile, with a maximum range of 1,709 meters (Ágoston, 2005; pp. 64-65). The analysis of sixteenth-century Ottoman weaponry is central to understanding which defensive functions the bridge could realistically fulfil. As Ágoston has shown, the massive siege bombards of the fifteenth century—some exceeding 6,000 kilograms—were no longer the primary field weapons during Sinan's lifetime. Their limited mobility made them unsuitable for rapid deployment on narrow or elevated platforms such as the artificial islands of the Büyükçekmece Bridge. Instead, mortars and smaller-caliber firearms constituted the practical tools of battlefield defense in this period.

This technical context is essential, because it clarifies the kinds of weapons the Ottomans could have deployed on the bridge. The narrow causeways and island platforms are consistent with positions intended for archers and musketeers rather than for heavy artillery. Their ranges correspond closely to the distances between the islands, the roadbed, and the European approach to the bridge. Thus, the spatial organization of the bridge aligns with the effective "killing zones" of available weapons, suggesting that Sinan designed the islands and varying elevations with the tactical realities of contemporary firearms and archery in mind.

Similar to their European rivals, the Ottomans continued to manufacture increasingly large siege and fortress guns; however, by the sixteenth and seventeenth centuries, the artillery commonly used in the field was significantly smaller than the colossal bombards of the fifteenth century. Sources from the mid-sixteenth century indicate that the Ottomans, much like their European contemporaries, drew a clear distinction between large siege guns and smaller field artillery. During this period—when the Büyükçekmece Bridge was under construction—mortars weighing around 600 kilograms had become increasingly common. These mortars discharged explosive shells weighing between 30 and 98 kilograms (Ágoston, 2005; pp. 70-73).

Although considerably smaller and lighter than traditional siege cannons, mortars were not well-suited for deployment on the islands supporting the Büyükçekmece Bridge. From a defensive standpoint, weapons with greater logistical flexibility and rapid deployment, such as firearms (muskets, rifles, pistols) and bows, emerged as more suitable alternatives. Soldiers from the Janissary corps who took part in Sultan Suleiman's Iraq campaign of 1553 carried matchlock muskets measuring between 88 and 110 centimeters in length and firing projectiles weighing approximately 15 grams. It should be noted, however, that the muskets of this period were unrifled. Their accuracy was low, effective range limited, and the reloading process time-consuming. In contrast, Turkish bows, with a maximum range of approximately 500 meters, offered high accuracy, significant impact, and rapid use, making them a more preferred choice among soldiers (Ágoston, 2014; pp. 105). For this reason, the widespread adoption of firearms among the Janissaries, the elite corps of the Ottoman army, was delayed until the late sixteenth century (Ágoston, 2014; pp. 98). Given the state of military technology at the time of the Büyükçekmece Bridge's construction, it is plausible that the islands surrounding the bridge were designed as platforms for positioning archers and musketeers.

The construction of the bridge by Sinan coincided with a period during which the Ottoman Empire was at the height of its political and military power. Nevertheless, it is our contention that Sinan, with notable foresight, incorporated certain defensive features into the design of the bridge in anticipation of possible attacks from Europe and with the aim of safeguarding the imperial capital. This interpretation gains support from later developments in both the nineteenth century and the early twentieth century.

For example, during the Russo-Ottoman War of 1877–78, a major defensive line was established at Büyükçekmece. Strategically located on the narrow isthmus between the Sea of Marmara and the Black Sea, that line took advantage of the natural geography—lakes, swamps, and ridges—to form a formidable barrier against invasion. Although an assault by Russian forces under General Skobeleff was narrowly averted by the signing of an armistice, the fortifications later became the principal line of defense for Constantinople. Once fully completed and adequately manned, they were regarded as virtually impregnable over land (Greene, 1879; pp. 427-428). Moreover, during the Balkan War (1912–13), the Bulgarian army advanced as far as Büyükçekmece and took up positions in the village of Kalikratya, located just to the west of the Büyükçekmece Bridge (see Figure 3). As a result, the Sinan's bridge became the frontline position between the Ottoman and Bulgarian forces.

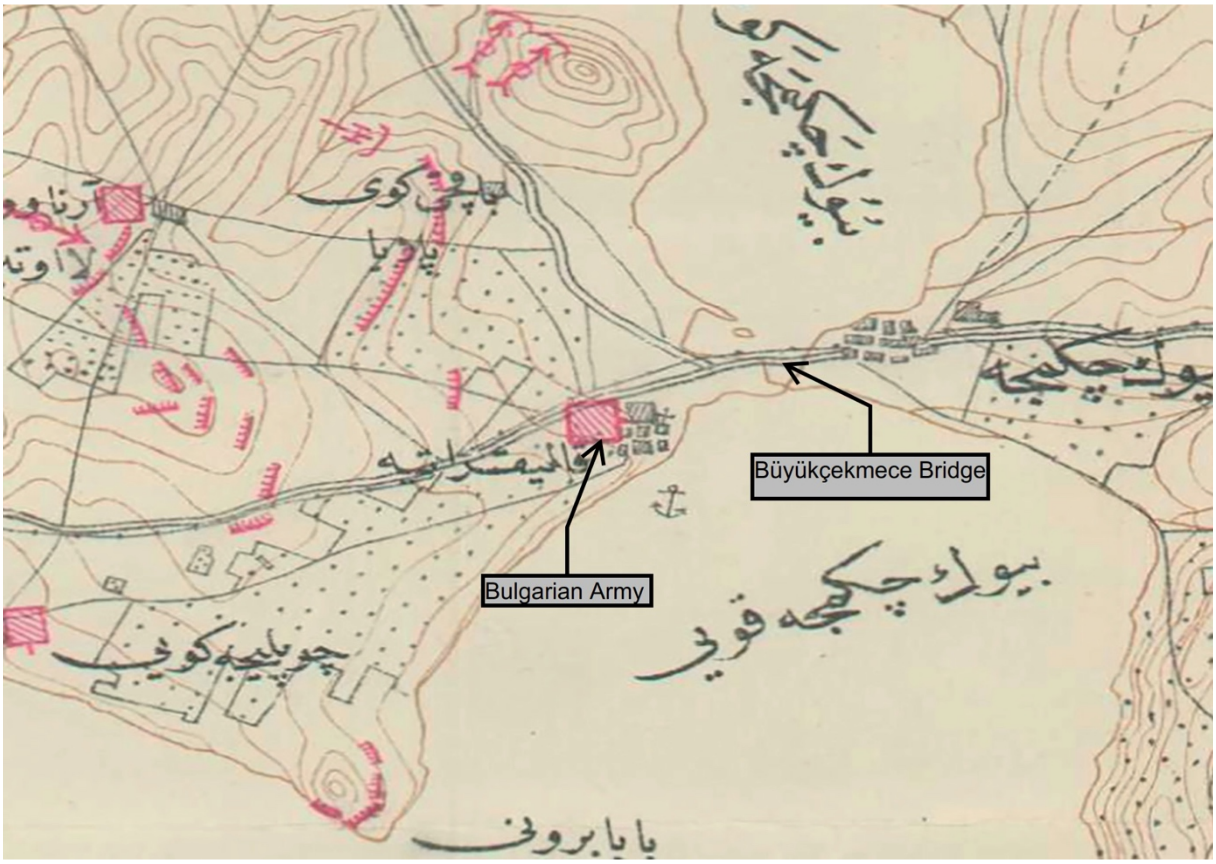

Figure 3. *Position of the Bulgarian army entrenched at Kalikratya during the Balkan War (Negiş, 2024; pp. 92).*

Indeed, the defensive features found in the design of some of Sinan's bridges can also be observed in his constructions in the Balkans. For example, the road that crosses the Mehmed Pasha Sokolović Bridge, built by Sinan in Višegrad in 1578, makes a 90-degree turn immediately at the end of the bridge, thereby conferring a strong defensive quality to the structure (Pašić, 1994; pp. 82-83). Another example is the Mostar Bridge, constructed in 1567 by Sinan's apprentice Mimar Hayreddin under the chief architect's supervision. At both ends of this bridge stood fortified towers named Halebija and Tara. According to Evliya Çelebi, who visited Mostar in 1664, the towers were commissioned by Sultan Suleiman the Magnificent, each guarded by eighty soldiers and placed under the authority of a *dizdâr* (commander). The Tara Tower remained in use as a gunpowder magazine until 1878 (Aruçi, 2020; pp. 296-298).

CONTROL OF MOVEMENT AND SPATIAL CONSTRICTION

As Turkish architectural historian Doğan Kuban notes: 'Such an accurate geometry is not coincidence, it is a method, an application of geometry with secrets' (Kuban, 2016; pp. 24). Kuban made this assessment to analyze the religious symbols and connotations in Sinan's works. This study proposes that structural elements such as the bridge's varying slopes, roadbed configuration, and overall width played a significant role in shaping its defensive and military functionality.

The 4th bridge on the European side has many components design into this bridge to make it difficult for attacking forces under drenching fire from the defending Ottoman Army. Within the first 41.90 meters upon stepping onto this first span there are two different inclines, a diagonal bend to the right of ~37 degrees and a pinching effect by the two retaining walls. The first incline is 5.18 degrees for 19.60 meters upon entering this span. The left retaining wall beginning at the entrance is 19.52 meters long with the right retaining wall beginning at the entrance is longer at 27.25 meters. This difference in lengths of the retaining wall creates a subtle pinching point forcing the troop on the left retaining wall to the right into their fellow soldiers. The incline at this diagonal bend drops to an incline of 4.09 degrees for a distance of 21.60 meters. At this point the incline changes again to 2.67 degrees to the apex of this bridge. The exposed downside, facing Istanbul, is 93.70 meters long at an incline of 2.96 degrees to the causeway. This is a lot of changes for any attacking forces to deal with.

The sum effects on the up span (facing Europe) is to create jamming of the attacking forces together, their feet contending with the different inclines, changing directions to the right in the diagonal bend, rough cobble stone roadbed, discussed later in the paper, all the while trying to fight their way forwards with drenching fire raining down upon them. At 41.90 meters the Ottoman's could barricade the roadway at the tablets on each side of this bridge as well as adding barricades at will anywhere they like.

At 41.90 meters on this span the two panels holding the tablets, one on each side of the fourth bridge, are easily barricaded with heavy timbers which would block the advance of the attacking troops. Of course, all along the whole length of the bridge including the causeways on the three islands could be barricaded. Col (ret.) Keith M. Nightengale writes:

> *The bridge design is based upon the need to break up any direct assault across it the traditional approach to storming a position. Every turn and space are designed to give the defender maximum advantage and the attacker disadvantage (K. M. Nightengale, personal communication, March 10, 2024).*

TACTICAL IMPLICATIONS OF THE BRIDGE'S GEOMETRY

The rationale behind this design feature requires careful interpretation, as the presence of ten distinct inclines (see Figures 4.1 and 4.2) cannot be explained by structural necessity alone. Sinan's knowledge would have come from his years of military experience with marching troops and from his design work of stairs. Sinan knew that 'feet have memory'. In crossing this bridge, he was denying advancing troops the important human feature by changing the inclines ten times. With the changing slopes, the purpose was to cause accidents and disorder within the attacking army.

We are aware that some of the changes in the slopes may be attributable not only to natural causes such as earthquakes and settlement of the foundations (Bulut et al., 2019; pp. 77-87), but also to anthropogenic interventions. These may include cumulative effects of successive repair campaigns, alterations in the roadbed during Ottoman and Republican maintenance works, sediment deposition and dredging activities around the piers, and long-term changes in water levels and hydrodynamic forces affecting the artificial islands. The justification for considering these additional factors lies in the well-documented history of periodic repairs and environmental modifications around the Büyükçekmece Bridge, which demonstrates that both natural processes and human interventions have played a role in reshaping its structural profile over time.

The evidence that Sinan engineered these changing inclines is fact which is obvious with the four bridges not being equal in length on each side. The side facing Istanbul is longer with bridges 1, 2, and 3 (see Table 1). The three causeways are more or less level with major evidence of movement. Bridge 4 on the East European side is 99.2 meters and the Istanbul side is 93.7 meters which is interesting to speculate why Sinan did this additional 5.5. meters of climbing to tire the attacking forces? The military reasons for these differences lengths are further are addressed.

Attacking troops on the exposed Istanbul side of the four bridges give the Ottoman troops more time to have the attacking troops in their "killing zones" from all their positions on the bridge including the causeways, the islands and the Istanbul land side. Table 1 provides the length of each span.

Table 1. *The Length Bridge Side Differences.*

Bridge	European Side	Istanbul Side
1	58.1	98.10 (Longer by 40 Mts.)
2	55.60	68.50 (Longer by 12.9 Mts.)
3	43.30	54.00 (Longer by 10.70Mts.)
4	99.20 (Longer by 5.50 Mts.)	93.70

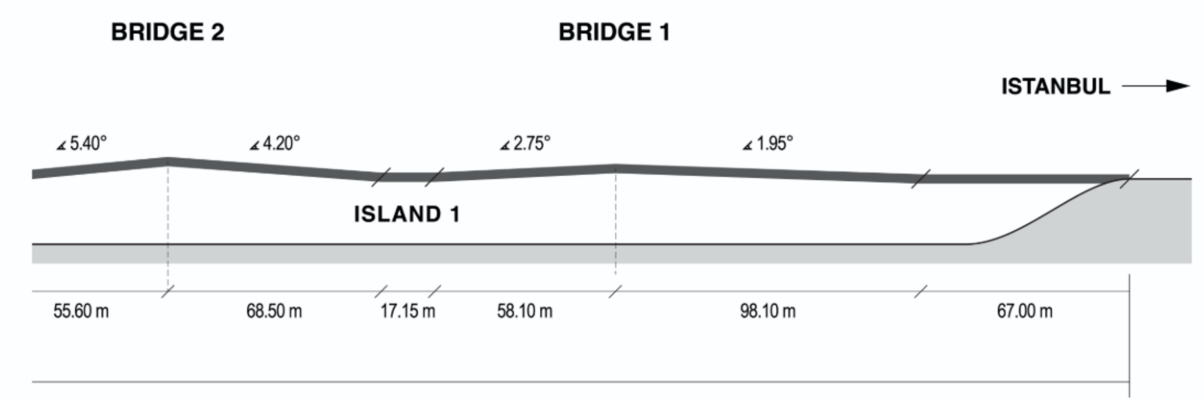

Figure 4.1. *Elevation of the bridge showing span lengths and inclines in degrees of the angle (PLK.p.5376).*

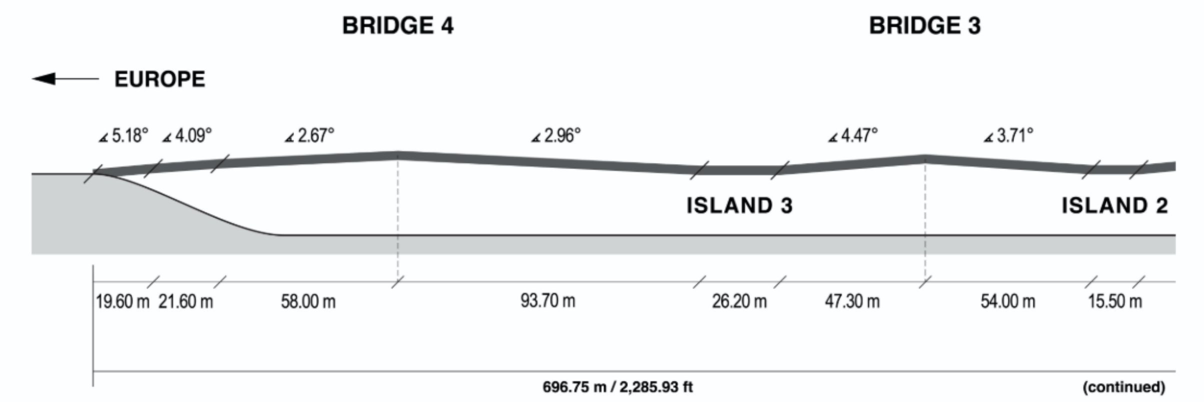

Figure 4.2. *Elevation of the bridge showing span lengths and inclines in degrees of the angle (PLK.p.5376).*

Figure 5. *Photograph from standing on the apexes of bridge 4 with the apes showing for Bridge 1,2, and 3 looking towards Asia. Photo taken by Terry H. Little.*

The cobble stone surface of the road was purposely used to slow everything down that crossed the bridge. Traveling over this road on the four bridges and the three causeways is almost impossible at any speed other than slowly. The four-hoofed animals pulling wagons and caissons would struggle with their footing. Mounted troops would struggle too along with all foot soldiers with the roughness of the cobble stone surface. Even when walking, one is forced to be conscious of this surface to keep their balance from tripping and stumbling. Advancing troops would quickly realize this roadbed was difficult and frustrating.

THE STRATEGIC ROLE OF ARTIFICIAL ISLANDS

The Sultan in his order to Sinan to build this bridge did include that one reason for the bridge was for his troops to have safe passage over this swamp for his campaigns. The 3rd island is well within range for the Ottomans to reach the attacking forces on the land with their variety of weapons. The weapons of the Ottoman from this position such as archers, canons, rifles, bows and arrows would have previously been zeroed in on specific areas of the 4th bridge and land to have maximum drenching fire effectiveness. Islands 1 and 2 likewise served as additional firing platforms. In addition, each island could be used to stage reserve troops, store supplies, and establish first-aid stations.

The shape and size of the islands on the seaside of the causeway are smaller than the inland side is a mystery to us as there is no historical evidence on the reasons for this that we have found. We do know that the size and shape were significant to Sinan because he always had reasons for everything he did. The three islands, one can assume, are strategically located to give the Ottomans a defensive advantage.

Table 2. *Islands Surface Area Excluding Causeway (PLK.p.5376).*

Islands	Left Side	Right Side	Total
1	~ 699 m^2	~ 1356 m^2	2055 m^2
2	~ 773 m^2	~ 1324 m^2	2097 m^2
3	~ 1190 m^2	~ 1344 m^2	2534 m^2
		Total Surface Area	6636 m^2
Causeway surface area for island 1 is 586 m2, island 2 is 547 m2 and island 3 is 539 m2.			

WIDTH OF BRIDGE

The width of seven meters wide is explained by Niyazi Özgür Bezgin in his article. The bridge's seven meters width would have comfortably accommodated six janissaries marching abreast, or three mounted cavalrymen (*sipahi*s) (see Figure 6), with enough room for horse-drawn carriages and even artillery units. Estimated at a pace of one meter per second, a full battalion could cross the lagoon in about twenty minutes, underlining the bridge's role as an efficient conduit for imperial mobilization (Bezgin, 2019; pp. 5-7).

While Bezgin's analysis clarifies the functional rationale for a seven-meter-wide platform in facilitating military and logistical movement, this study extends the discussion by examining how such width contributed to the bridge's defensive potential. A roadway broad enough to accommodate six janissaries marching abreast or multiple mounted units simultaneously also created a spatial environment in which defenders could rapidly reposition, deploy reserves, or form layered firing lines across the span. When considered alongside the bridge's staggered inclines, constriction points, and exposed approaches, the width emerges not merely as a feature of traffic design but as an element that enhanced the tactical flexibility of Ottoman forces. In this sense, the present article situates the bridge's width within a broader system of spatial control, contributing an interpretive layer that complements but goes beyond the logistical explanation provided by Bezgin.

Figure 6. *The painting represent the the Ottoman Army crossing the Büyükçekmece the bridge heading to European from the Asian side (Artist: M. Şişman).*

PSYCHOLOGICAL AND PERCEPTUAL DIMENSIONS OF DEFENSE

The length of the bridge with the undulating rise and fall of the four individual bridges, the tunneling effect of the retaining walls, the subtle bend, the exposed position on each Istanbul span and on the causeways all contribute to a psychological demoralizing effect—we reference you to Figure 3 to view what the attacking force would see. Further, Sinan also was considering the positive psychological impact on the Ottoman troops knowing that they were "holding the high ground" and the Ottoman troops would fully comprehend their advantages in defending their city of Istanbul.

Viewed in this light, the psychological dimension of the bridge's design forms an integral part of its defensive logic. The alternation of rising and falling slopes, the sense of exposure generated on the Istanbul-facing spans, and the narrowing created by retaining walls collectively shaped the attackers' perception of vulnerability while reinforcing the defenders' sense of positional advantage. These effects complement the physical defensive features discussed earlier, suggesting that Sinan's design sought to influence both the bodily and mental conditions under which a military confrontation would unfold.

CONCLUSION

The Büyükçekmece Bridge complex, as demonstrated through the technical and historical analyses in this study, represents a sophisticated synthesis of hydraulic engineering and defensive design. Rather than functioning solely as a means of passage, the bridge emerges as a multi-layered security threshold positioned on a critical western approach to the Ottoman capital. This study has identified several features that substantiate the bridge's military and strategic character. First, the division of the crossing into four separate spans connected by three man-made islands effectively created a controlled bottleneck, enabling the regulation and segmentation of movement across the water. Second, the carefully calibrated inclines and visibility breaks observed in the architectural layout suggest an intentional design logic that facilitated surveillance and defensive response, consistent with the requirements of sixteenth-century warfare. Third, the foundation techniques—closely aligned with Sinan's experience in military engineering—indicate a structure capable of enduring not only environmental pressures but also the logistical demands of large-scale imperial mobilization.

The integration of these defensive considerations within an architecturally refined framework highlights the extent to which infrastructural projects could serve as instruments of imperial power. Read in this light, the Büyükçekmece Bridge can be understood as the culmination of Sinan's accumulated expertise across both civil and military domains. By shifting scholarly attention from the monumental spaces of imperial mosques to the functional and strategic dimensions of bridge construction, this study demonstrates the value of an interdisciplinary approach to Ottoman architectural history. The bridge thus stands as evidence of a moment in which engineering resilience, logistical foresight, and aesthetic ambition converged in the service of imperial authority.

APPENDIX I: A REVIEW OF SINAN'S BRIDGES

Table 3. *Bridges built by Sinan, according to Sinan's biographies (Öziş, 1997; pp. 1148).*

Bridge	Location	Date of Construction	Total Length
Cisr-i Mustafa Paşa (Svilengrad)	Svilengrad	1528/9	300 meters
Halkalı (Odabaşı)	İstanbul / Halkalı	1528/9	40 meters
Gebze	Gebze	1550	65 meters
Kapıağası	Istanbul / Haramidere	1563	75 meters
Marmaracık	Çorlu	1564/65	-
Büyükçekmece	Istanbul / Büyükçekmece	1567/68	577 meters
Silivri	Istanbul / Silivri	1568	333 meters
Apullu (Sinanlı)	Babaeski	1572	124 meters
Vişegrad	Višegrad	1577/8	179 meters

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CONFLICT OF INTEREST

The Authors declare that there is not any conflict of interest about this paper.

REFERENCES

Ágoston, G. (2005). *Guns for the sultan: Military power and the weapons industry in the Ottoman Empire*, Cambridge University Press.

Ágoston, G. (2014). Firearms and military adaptation: The Ottomans and the European military revolution, 1450-1800. *Journal of World History, 25*(1), 85-124.

Aruçi, M. (2020). *Mostar Köprüsü*. TDV İslam Ansiklopedisi, (30), 296-298.

Bedlek, E. Y. (2009). The impact of urbanization on Sinan's masterpiece: Büyükçekçece Bridge. In V. Özek & E. Benian (eds.), *Design language in historical areas* (pp. 183-188). Trakya Üniversitesi.

Bedlek, E. Y. (2012). *Büyükçekmece menzil complex and great Sinan*. Büyükçekmece Belediyesi Kültür Yayınları.

Bezgin, N. Ö. (2019). Rediscovery of the great architect's bridge: Mimar Sinan Bridge, Istanbul, Turkey. *Transportation Research Record, 2673*(8), 99-111.

Bilgiç, U., & Avşin, A. (2023). Mimar Sinan'ın biyografileri ve Osmanlı arşiv belgeleri ışığında Büyükçekmece (Kanuni Sultan Süleyman) Köprüsü onarımları. *Sanat Tarihi Dergisi, 32*(2), 577-607.

Bulut F., Aktuğ B., Yaltırak C., Doğru A., & Özener H. (2019). Magnitudes of future large earthquakes near Istanbul quantified from 1500 years of historical earthquakes, present-day microseismicity and GPS slip rates. *Tectonophysics,* (764), 77-87.

Crane, H., & Akin, E. (2006). *Sinan's Autobiographies*. Brill.

Eyice S. (1992), *"Büyükçekmece Köprüsü"*, TDV İslam Ansiklopedisi, (6), 520-521.

Forster, C. T. and Blackburne Daniell, F. H. (1881). *The Life and Letters of Ogier Ghiselin de Busbecq: Seigneur of Bousbecque, knight, imperial ambassador, vol. I, C*. Kegan Paul & Co.

Göktepe, K. (2017). İstanbul'un iaşesinin temini meselesi ve İstanbul'un iaşesine katkı sağlayan bir merkez: Tekirdağ Kazası (XVIII.-XIX. yüzyıllar). *Belleten,* (81), 857-916.

Greene, F. V. (1879). *The Russian army and its campaigns in Turkey in 1877-1878*, D. Appleton and Company.

Kartal, Ş. (2012) *Haseki Hürrem Sultan yapıları* [Unpublished MA Thesis], İstanbul Teknik Üniversitesi.

Kuban, D. (2016). *Sinan'ın sanatı ve Selimiye*. in K. Fırat (ed.) Heaven, Dome / Void: Architect Sinan, Kiptaş.

Necipoğlu, G. (2005). *The age of Sinan: Architectural culture in the Ottoman Empire,* Reaction Books.

Necipoğlu, G. (2016). *Sinan çağında mimarlık kültürü ve âdâp: Günümüze yönelik yorumlar.* In H. Aynur & A. H. Uğurlu (eds.) Osmanlı mimarlık kültürü, Kubbealtı, 19-66.

Mülâyim, S. (2009), *Sinan*. TDV İslâm Ansiklopedisi, (c. 37), 2009, 224-227.

Negiş, D. (2024). Balkan Harbi'ne mikro bir bakış: Çatalca hattı-Kalikratya (Mimarsinan) Cephesi (1912-1913). *Zeyrek Tarih Araştırmaları Dergisi* (1), 57-100.

Öziş, Ü. Özdemir, Y., & Atalay, A. (1997). Sinan dönemi Türk taş köprüleri. *Türkiye inşaat mühendisliği 14. teknik kongresi,* 1145-1160.

Pašić, A. (1994*). Islamic architecture in Bosnia and Hercegovina*, IRCICA.

Tanyeli, U. (2021). *Mimar Sinan: Tarihsel ve muhayyel*, Metis.

White, L., & Prentis, E. A. (1940). *Cofferdams*, Columbia University Press.

Yazıcı, H. (2024). Mühimmelere göre Osmanli klasik döneminde İstanbul'un et iaşesinin teminine dair bazı notlar. *Asya Araştırmaları Uluslararası Sosyal Bilimler Dergisi, 8*(2), 183-198.