



## **Investigation of Water Dams Built in Istanbul in the Ottoman State Period**

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### **ABSTRACT**

In Istanbul, which has been the capital of the Ottoman State for hundreds of years, there are historical water facilities that have been built to meet the water needs of the city and a large part of which has survived. Within the scope of this study, water dams built in Istanbul during the Ottoman State were discussed. First of all, the dams made during this period were identified and a resource search was made for these dams. Later, the usage conditions of these dams, the problems and deteriorations in the structures were examined and the situation related to their protection was tried to be determined. It is of great importance to transfer these works that have come from the past to the present, to future generations. Since it is seen that there is not enough awareness about the protection of these works, this study draws attention to this issue and makes suggestions for the protection of these works.

**Keywords:** Ottoman State, historical water facilities, dams, preservation, deterioration

### **1. INTRODUCTION**

Water, which is vital for living things, is one of the natural resources that sustain both biological life and human activities. Therefore, water has been one of the most important problems of all societies. Various water structures such as cisterns and reservoirs, embankments, aqueducts, scales, collection pools, fountains, waterfalls, floodplains were made in order to benefit from snow and rain water in all periods of history [1].

Some of these structures were built for the purpose of accumulating the water obtained from various sources before its distribution, or for resting and cleaning during distribution, some for the distribution of water and some for the use of water. We can count structures such as dams, reservoirs / wells, cisterns and pools in this building group built for collecting water. Maxims and masks were used for the distribution of water, fountains, waterfalls, floodplains and baths were used for the use of water. Within the scope of this study, dams, which are constructed for collecting water, are discussed and dams in Istanbul during the Ottoman Empire Period are examined. After the source research was done on these subparagraphs, an on-site inspection was made and the problems and deteriorations observed in these structures were identified. Then, an evaluation was made on the causes of these problems and deteriorations.

### **2. DAMS BUILT IN ISTANBUL IN THE OTTOMAN STATE PERIOD**

In the Turkish Language Association Dictionary, dam is described as a set in front of flowing water to accumulate water [2]. These are small dams seen in the Ottoman State Period [3]. The dams built in this period and the lakes behind it were used for the purpose of preventing floods and irrigation as well as providing drinking and utility water to the city.

In the Ottoman Empire Period, water dams were built in three different types as flat walls, elbow walls and curved walls (Figure 1). Water dams consist of sections such as body, open sluice and water reservoir [4]. In the valleys, dams made to hold the water coming from above between the two slopes were built using stone and masonry material [1].



Figure 1. Sultan Mahmud Bendi with curved walls [5]

During the Ottoman Empire Period, Edirne-Taşlımüsellim Waterway, Istanbul Kırkçeşme Waterway and Süleymaniye Waterway which is part of the Istanbul Halkalı Waterway, have an important place among the historical water systems built during this period [6]. There are 5 tunnels with a length of 3,8 km on the Edirne-Taşlımüsellim Waterway and 12 aqueducts, 4 of which are on the Taşlımüsellim branch, 1 on the Sinanköy branch and 7 in the section after the merger, and their length varies between 20 m and 105 m. [7].

Istanbul has never lost its feature of being an important city that served as a capital during both Roman and Byzantine Empire and Ottoman Empire periods. During the Roman Period, the people made wells by using the water sources they found and met their water needs by making cisterns [8]. During the Byzantine Empire, which continued in the east after the Roman Empire was divided into East and West Rome; the city's water problem was tried to be eliminated by making various water systems [9]. During this period, many open and closed cisterns were built in the city [10]. But; the water network became unusable in the period until the city was conquered by Fatih Sultan Mehmet in 1453 due to wars, earthquakes and destructions over time due to natural causes [4].

After the conquest of Istanbul, Fatih Sultan Mehmet did not want the cisterns to be used, had the old water systems repaired, and added new resources to them and provided the city's water needs [11]. But; with the expansion of the borders during the period of Suleyman the Magnificent, the population in Istanbul increased and water shortage emerged in the city. Finding a permanent solution to the water problem in Istanbul was in the period of Suleyman the Magnificent [12].

In the Ottoman Empire Period, the waterways constructed in the capital Istanbul are named as Halkalı Water Facilities, Kırkçeşme Water Facilities, Üsküdar Water Facilities, Taksim Water Facilities, Hamidiye Water Facilities and Terkos Water Facilities.

The construction of Kırkçeşme Water Facilities, which was built by Mimar Sinan by Süleyman the Magnificent, started in 1554 and was completed in 1563. The transmission line length of the facility is 55274 meters and it starts from the Belgrad Forests and finally reaches Eğrikapı Maxim[13]. Structures in Kırkçeşme Water Facilities are aqueducts, dams, water intake and pools and urban distribution network. This network consists of weirs and domes, spirit levels and small distribution areas.

When the facility was first built, there were no embankments today. However, since the water could not be stored, the waters were very low in August and September. For this reason, in order to be able to store the water in the months when there is a lot of water, four dams were made as Topuz Bendi (Karanlıkbent-1620), Büyükbent (1723-24), Ayvad Bendi (1765) and Kirazlibent (1818) (Figure 2) [14].



Figure 2. Kirazlibent [15]

Table 1. Dams in Kırkçeşme Water Facilities [16] [17]

Name of Water System	Name of Dam	Construction Date	Volume of Reservoir (thousand m <sup>3</sup> )	Area of Reservoir (thousand m <sup>2</sup> )	Body length (m)	Body height (m)	Body Thickness (m)		Water amount (pipe bowl)
							At the bottom	At the top	
Kırkçeşme water System	Karanlıkbent	1620	70	28	64,5	8,6	5,9-7,4	5,2	200/250 mm pipe
	Büyükbent	1723	1318	264	84,5	12,15	9,7	2,3	250
	Ayvad Bendi	1765	156	50	65,8	13,45	8,42	5,6-6,90	46
	Kirazlibent	1818	104	27	59,45	11,25	9	7,15	56

Topuz Bendi (Karanlık Bent) is on Topuzlu Stream and feeds the Büyükbent through the Belgrat Stream [12, 13]. It is 3 km away from Büyükbent and it was built by Sultan II Osman in 1620 [8]. There is no flow measurement scheme on Topuz Bendi, and water is taken from the bottom with two pipes of 200 and 1 of 250 mm [16].

Büyük Bent is on the Belgrade Stream in the Belgrade forest. It is located in the south downstream of the Topuz Bendi and near the ruins of the village of Belgrade [12, 13]. It was built by Sultan Ahmet III in 1723-24. It was rebuilt by Sultan Mahmut I since it was demolished towards 1748. In 1900, a second stage was made by Abdülhamit II and the dam was raised [8]. It is the largest dam that feeds Kırkçeşme facilities, and a total of 250 nozzles (13,000 m<sup>3</sup>) of water can be taken from a total of 18 nozzles on the measuring box [16].

Ayvad Bendi is on the Ayvad Stream in the Belgrade Forest and is approximately 4,3 km northwest of the Büyükbent [12, 13]. It was built by Sultan Mustafa III in 1765 [8]. The axis of the bend in the plan is broken. It is of massive dam type and has no inscription. 46 nozzles (2392 m<sup>3</sup> / day) of water can be taken from the 10 nozzles on the measuring chest [16].

Kirazlıbent is on Kirazlı Stream in Belgrat Forest and is located in the southeast of Büyükbent [12, 13]. It was built by Mahmut II in 1818 [8]. The axis of the bend in the plan is linear and is of massive mass. Water can be taken from 11 nozzles on the measuring chest to 56 nozzles (2912 m<sup>3</sup> / day) [16].

Taksim Water Facilities, which was opened in 1731 and built to supply water to the Beyoğlu side, were unable to meet the needs over time, although it initially provided great relief to the region. For this reason, dams were made on various dates to store water in rainy seasons. Firstly, Topuzlubent was built on the Bağlar Deresi by Sultan Mahmut I in 1750 [11]. Sultan III. Selim's mother Mihrişah Sultan built the Valide Bendi (Figure 3) on the Arabacı Mandırası Deresi. The water of this dam was combined with the water of Topuzlubent [12]. In the next stage, Sultan II. Mahmut had Sultan Mahmut Dam built in 1839 and had this dam connected to the facilities. [11].

Table 2. Dams in Taksim Water Facilities [16]

Name of Water System	Name of Dam	Construction Date	Volume of Reservoir (thousand m <sup>3</sup> )	Area of Reservoir (thousand m <sup>2</sup> )	Body length (m)	Body height (m) *	Body Thickness (m)		Water amount (pipe bowl)
							At the bottom	At the top	
Taksim water System	Topuzlu Bent	1750	160	26	80,65	14,00	7,00	5,47	24
	Valide Bendi	1796	225	53	103,90	11,25	6,32	4,75	56
	Sultan Mahmut Bendi	1839	343	49	101,55	15,45	9,40	6,90	73

\* Body heights are the distance measured from the bottom of the stream on the downstream side to the top of the weir guard on the downstream side.



Figure 3. Valide Bendi [18]

Topuzlubent, built by Mahmut I in 1750, is on the old vineyards of Eski Bağlar [24]. The height of the dam was initially built as 10,99 m, but it was increased to 14.13 meters by the Algerian Gazi Hasan Pasha in 1786. Topuzlubent is in the form of a belt with a broken line between the two large buttresses in the middle. The masonry arch was built in the form of a weight or gravity dam. There are two shafts surrounded by handrails on the buttresses, and one column at each of the four corners. The buttresses are approximately 3,60 m thicker than the hull. In the middle, there is an inscription stone with 15 couplets written on the side of the bazaar, written in the letter of sulus [11, 16].

Valide Dam was built by Mihrişah Sultan, the mother of Selim III, in 1796 and is on the eastern tributary of the Arabacı Mandırası Stream [11, 24]. The axis of the bend in the plan is broken and two pillars were built on the body [8, 13]. You can climb the buttresses with three steps; this area was arranged as a prayer and a railing was built around it [8]. It is bent masonry dam type. It is covered with marble and the marble railings on the side of the bare are reinforced with marble struts. In the middle, there is an inscription stone with 34 couplets on the upstream side [16, 11].

It was built by Sultan Mahmut II in 1839 on the western branch of Arabacı Mandırası Stream. Sultan Mahmut Bendi, also called Bend-i Cedit, is in the shape of an arch and is different from the Topuzlu and Valide Dams. The upstream face of the bend is in the form of a solid cylinder surface and the downstream face in the form of a solid cone surface [24]. It is of the stone weight dam type and the reservoir of the dam is very large compared to its hydrological zone, so many years are not full. The hydrological region of Valide Bendi is much larger than its reservoir; for this reason, water is transferred from the Valide Bendi to the Sultan Mahmut Bendi as the excess water overflows from the war [11, 13]. The top of the bend is inclined towards the downstream side and is covered with marble plates. Marble slabs, supported by marble struts, allow me to collect more water [11, 13]. In the middle of the bend, there is an inscription stone with 13 couplets written by Ziver and its line by Mustafa İzzet [11, 13].

Other dams constructed in Istanbul during the Ottoman Empire Period are Istanbul-Küçükçekmece-Şamlar Bendi (Figure 4) and Elmalı Barajı [19]. Şamlar Bendi was built by Sultan II. Mahmud in 1826-1828 on Sazlı Deresi to meet the water needs of Azatlı Baruthane. Bent is 10,14 m high, 12,22 m peak and 15,58 m base width. Elmalı Dam was built in 1893 on Elmalı Creek to meet the water needs of the Anatolian side. This dam is excluded from the scope of this study since its second part is a Republican Period work built in 1950.



Figure 4. Şamlar Bendi [20]

### **2.1. The Problems Detected in Historical Dams in Istanbul and Their Reasons**

Various problems and deteriorations were identified in the dams covered in this study, in the on-site examinations. The main problems seen in the dams are contamination, algae-lichen formation, vegetation (Figure 5), abrasion and fragmentation on stone surfaces, cracks and cement completions. But; the problem that is thought to be more important than these are water leaks in the bodies of the dams. It is necessary to determine whether the cracks causing these leaks are structural cracks with more detailed studies. The dams in Kırkçeşme Water Facilities and Taksim Water Facilities are better protected than Şamlar

Bendi because they are in the Belgrad Forests. The marble stones were broken by piercing the walls of Şamlar Bendi by the treasure seekers. Also; this dam has been ruined due to the rubbish spilled around.



Figure 5. Plantations in Topuz Bendi and Kirazlibent [21]

The causes of these changes and deteriorations can be grouped as nature-based and human-based. [22]. Most of these disruptions are due to long-term natural events. Climate events such as moisture, frost, rain, insects, various microorganisms and groundwater are natural events that cause deterioration in these structures over time. Apart from these, there are distortions caused by people knowingly or unknowingly. Especially during the wrong repairs, it was observed that cement-containing mortars that are not compatible with the original material were used and irreversible damages were given to the dams, causing melting and deterioration in the stones. Apart from that, deliberate damage to the works of art called Vandalism is among the causes of individual deterioration. Also; It causes the deterioration in dams in social factors such as various public works, infrastructure works and road works. [22]. Considering the historical water facilities in Istanbul, many works face the risk of being destroyed due to intense construction, road and tunnel works. Mağlova Aqueduct, which is one of the most important works of Mimar Sinan, has been submerged up to a certain level in the area where Alibey Dam was built. Likewise, Şamlar Bendi is flooded with the increase of the Sazlıbosna Dam waters during the winter months.

Another problem with the historical water facilities and water structures in Istanbul is that their ownership status is not clarified. Although it is accepted that the owner of these works is the Istanbul Water and Sewerage Administration in accordance with the relevant provisions of the Istanbul Water and Sewerage Administration Law No. 2560 dated 20/11/1981, it is important to clarify this issue [23]. After this issue is clarified, the institution responsible for its repairs, which should intervene in these structures, will be clarified.

### 3. CONCLUSION

Most of the historical water facilities built in the Ottoman State and the embankments that are part of these facilities are still standing today and maintain their water storage properties. In fact, Kırkçeşme Water Way work up to a certain point and continue to supply water to the city. But; these structures, where serious deterioration and problems are detected, face the danger of extinction. In order for these works to be passed on to future generations, it is necessary to develop the necessary policies for the protection of these works and take measures for protection. In addition, it is of vital importance for the General Directorate of State Hydraulic Works, which is the authorized institution for dams in our country, to carry out a detailed study on these structures, to take necessary measures to prevent cracks in the body of the dams and to prevent water leaks and to carry out the necessary studies. For the protection of these works, it is important for the owners of the ownership organization and other organizations working in the field of protection to work together and develop solutions.



In addition to these; While planning new building areas, while planning the structures such as road-tunnel works, infrastructure works and dams, historical water facilities should be taken into consideration and care should be taken not to make decisions that would damage these structures.

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