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Justinian System: One of the Oldest Flood Control Facilities in the World

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INTRODUCTION

Şanlıurfa (or Urfa or Edessa in Roman Time) is located in the South-Eastern Anatolia. It is known as one of the oldest city in the world. Occupation of the Şanlıurfa area begins from the 8th millennium BCE through Mitanni times in the 2nd millennium and continuous from Hittites, Assyrian, Persian and early Roman periods of the 1st millennium BCE into the Imperial Roman and Byzantine era of the first millennium of our era. Settlement continues through the Arab occupation beginning in the 7th century CE through and continuous from Seljuk, Safavid and AqQoyunlu periods of the 15th century. Turkish occupation begins from the 16th century and continues until the present.

The city is located between longitudes 36°40 and 38°02 East and latitude 37°50 and 40° North. The altitude of the city ranges between 500-1000m, decreasing from north to south. Considering the topography, the foothills on the south and the river on the north and east are the natural boundaries.

Water of the city was mainly supplied by the Karakoyun river (called “Daisan” in Syrian, “Scirtos” in Greek) flowing from the north along a channel to circuit the city in the east. In the past, however, it flowed from the northwest along a deep valley to enter the city in the southwest. Its water was swollen by the onrush of the winter rains and the melting snows of the mountains that caused serious disasters in the city several times.

In order to prevent the recurrence of such disasters, the central government ruled by the Byzantine Emperor Justinian set up a huge wall of stones to the northwest of the city that conducted the river by an artificial channel outside the north and east walls of the city in 525. By means of this wall, called Justinian Dam, the remainder of the stream would pass under constraint into the channel devised by Justinian (Segal, 1970). Justinian’s system, which also includes some other water structures, remained to the present day (Figures 1-2).

There are several publications focused on the archeological features of the Justinian System. However there has not been any publication to evaluate the functionality of the system including engineering assessments.

This study aims to evaluate Justinian System by the engineering point of view together with its ongoing functionality.

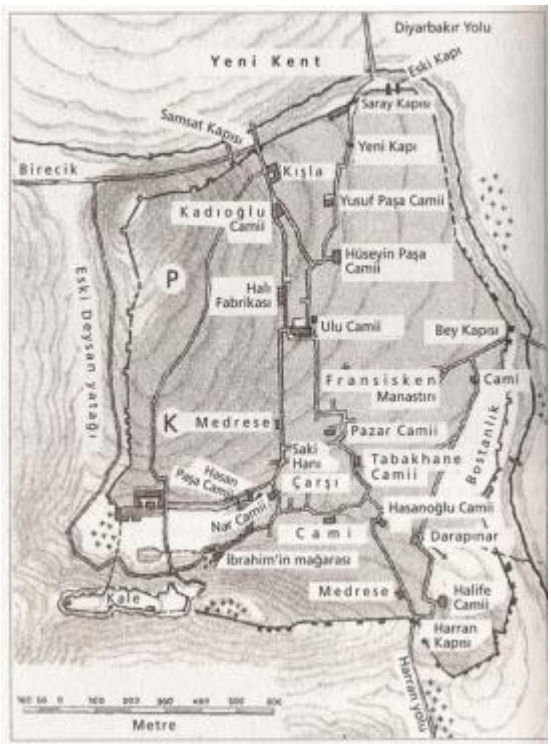

Figure 1. City wall of Old Urfa and Old water course of Daisan River(Kieser, 2005; Kürkçüoğlu, 2011)

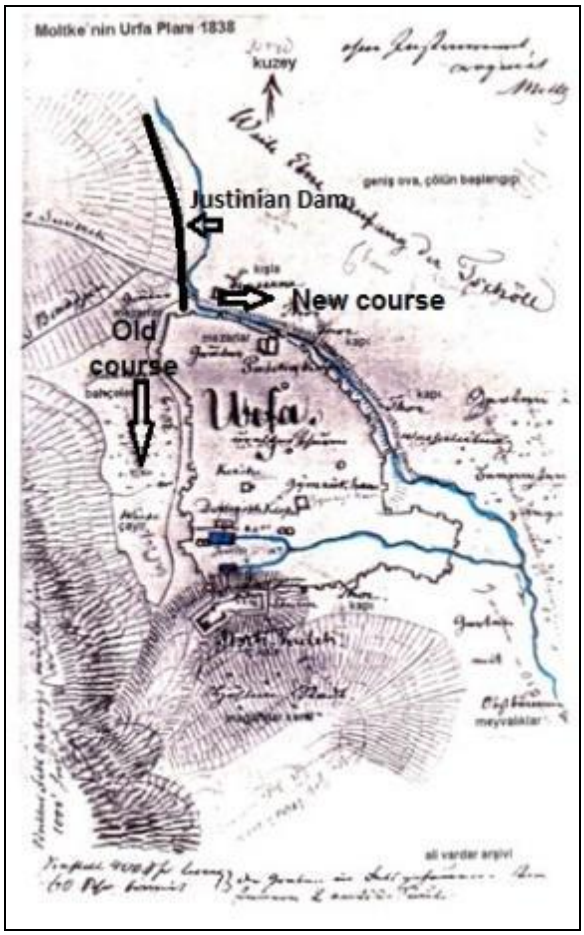

Figure 2. One of the oldest map of Urfa - New and Old courses of the Karakoyun River (Moltke,1995; Kürkçüoğlu, 2011)

JUSTINIAN SYSTEM

Justinian system consisting of a flood control dam, 3 bridges and an artificial channel is built in the first half of 6th century. All these facilities were built at the same time as it is known. The system is constructed by Justinian, a prolific builder among the Roman Emperors. He had the Hagia Sophia splendidly rebuilt according to a completely different ground plan. He was also ensured the water supply of Istanbul with construction of Basilica Cistern. To prevent floods from damaging the strategically important border town Dara (Lebanon), an advanced arch dam was built in his time. During his reign the large Sangarius Bridge was built in Bithynia region (northwest of Anatolia), securing a major military supply route to the east (Bildirici, 2004).

The details of the facilities of Justinian system are given in the following sections.

Justinian Dam

Starting from the west of the city, Karakoyun River was flowing into Balıklıgöl (historical fish lake) through the original course along the west wall of the city. Especially in the winter times, the rains and the melting snows of the mountains increased the amount of water in the river causing serious floods in 201, 303, 413, and 525. There has been heavily loss in life and the destruction of the chief buildings (Fig.3 and 4).

Figure 3. A flood in Karakoyun River at the end 19th Century –- from Ali Kayısı Library (Kürkçüoğlu, 2011)

Figure 4. Another flood in Karakoyun River in Feb 21, 1928 (Kürkçüoğlu, 2011)

The first flood known was occurred in November of 201. At least 2000 people were drowned or died under the debris. The flood of 201, repeated in the spring of 303 and the walls of the city were demolished. The city had another flood in April of 413. Although no one was died, the city had large extent of damage in buildings.

The disaster recurred on an even more serious scale in April of 525. It took place in the evening when many were asleep and 30 000 people, half of the population, were died according to Mar Yeşua (Segal, 1970).

After the last flood, Abgar, the king of the city, requested help from Justinian I, Byzantine Emperor. Byzantine Emperor Justinian made initial attempts to prevent the recurrence of such disasters. This event proved a turning point in the architectural development of Şanlıurfa. He sent his engineers and workers to the city. The engineers of Justinian carried out important alterations to the course of the river to the north and west of the city and of the spring waters that joined it. They set up a huge wall of stones to the northwest of the city that conducted the river by an artificial channel outside the north and east walls of the city. When the river raised to an exceptional height, the excess waters passed over the dam on the

southern or right bank of the river and followed the old course of the valley bed southwards alongside the west walls. The remainder of the stream would pass under constraint into the channel devised by Justinian (Fig. 5) (Segal, 1970).

They made serious excavation on the channel. The land on the right of the river was formerly both flat and low, while on the left stood a steep hill which did not permit the stream to turn aside at all or to deviate from its customary course. So the engineers cut down this whole hill and made a huge excavation around the wall of the city. The length of excavation was about the 2.5 km while the depth was about 50 meters in some places.

Besides the adaptation in the course of river, aqueducts were constructed on the new course of the river. Aqueducts served both as water supply canals and also bridges across valleys. The main features of the aqueducts were that they extended from distant spring-fed sources or the river in the form of tunnels through the hills and over bridges across valleys bringing water into reservoirs for onward distribution to the city. In the case of Şanlıurfa, aqueducts brought water in to the city from twenty-five springs lie at some distance in the highlands to the north (Temizsoy, 2005).

Although the Justinian dam prevented the city against the moderate size floods, the city had similar problems in 667, 835, 1103, and 1115. However none of them had never damaged the city as much as that of 525.

Figure 5. Sluice system in old course of Karakoyun River in Haleplibahçe region (Segal, 1970)

Justinian dam was constructed by stones. The height of the dam is 2.50 m and the length is approximately 200 m (Figures 6-7).

The excess water derived by Justinian dam, was directed to Karakoyun river on which at least 5 bridges were constructed (3 of them by Justinian). The general layout of the bridges and the cross sections are given Fig.8 and 3 dimensional view of bridges in Fig.9, respectively.

Figure 6. South view of Justinian dam (Segal, 1970)

Figure 7. Close view of Justinian dam (Kürkçüoğlu, 1993)

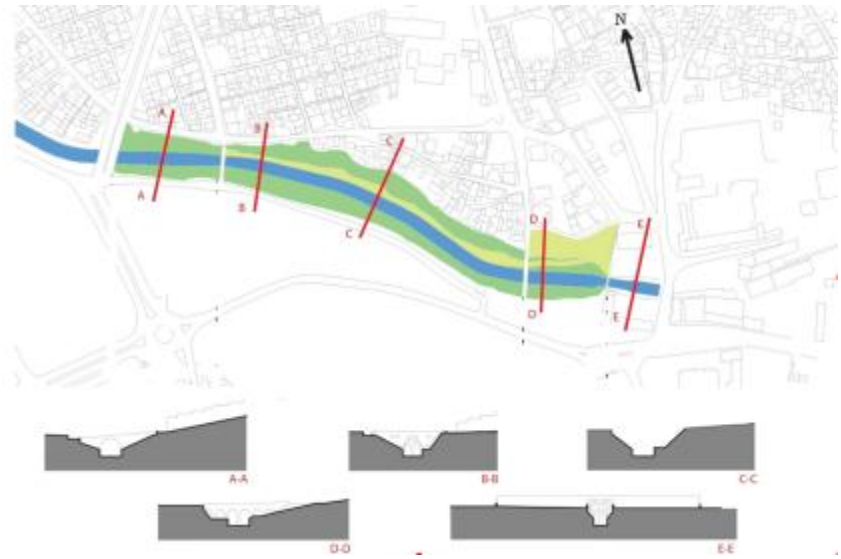

Figure 8. The general layout and the cross sections of the bridges (Şanlıurfa Municipality, 2011)
A) Hızmalı Bridge
B) Millet Bridge
C) Justinian Aqueduct
D) Samsat Bridge
E) Hacı Kamil Bridge

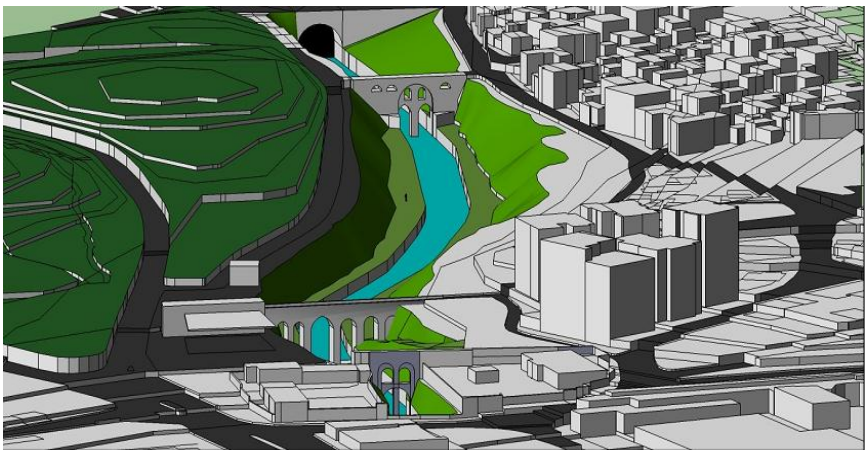

Figure 9. Three dimensional view of the bridges on Justinian system (Şanlıurfa Municipality, 2011)

Samsat Bridge

It is two-arch stone bridge built on the outside of the city wall near the Samsat door. The exact construction date of the bridge is not known. However, asthe name of the bridge is given as “Old Bridge” in old Yearbook of Urfa (1926), the bridge is accepted as to be constructed as a part of Justinian system in the 6th century (Fig 10, 11 and 12).

Figure 10. Samsat Bridge (Kürkçüoğlu, 2011)

Figure11. West Side of Samsat Bridge 1913 (Photo: Max von Oppenheim)

Figure12. Today’s view of Samsat Bridge (Kürkçüoğlu, 2011)

Kısas Bridge (BeyKapısı Bridge)

It is two-arch stone bridge built on the outside of the city wall near the Beykapısı door. It is also called as Kısas bridge since it is on the road of Kısas town. The construction time is not clear; however it is expected to be built together with Samsat Bridge in the 6th Century within Justinian System (Fig.13, 14 and 15).

Figure 13. Kısas (Beykapısı) Bridge in the beginning of 1900's (Photo: Max von Oppenheim)

Figure14. South side of Kısas (Beykapısı) Bridge in 1911 (Photo: Gertrude Bell)

Figure15. The very last picture of Kısas (Beykapısı) Bridge. (The bridge is demolished in 1997 during the application of "Renovation Project of Karakoyun River")

Justinian Aqueducts

It is the only aqueduct in Urfa built for transportation of "Kehriz Water" to the city. It is placed between Samsat Bridge and Millet Bridge on Karakoyun River. It was built within Justinian System and renovated by Turkish Karakoyunlu Sultanate in XVth Century. KehrizWater, was transmitted to Maksem (water distribution structure) in the Kadioglu Mosque by water balance structure placed in the south side of the bridge and it is distributed to other buildings of the city from there (Fig.16 and 17).

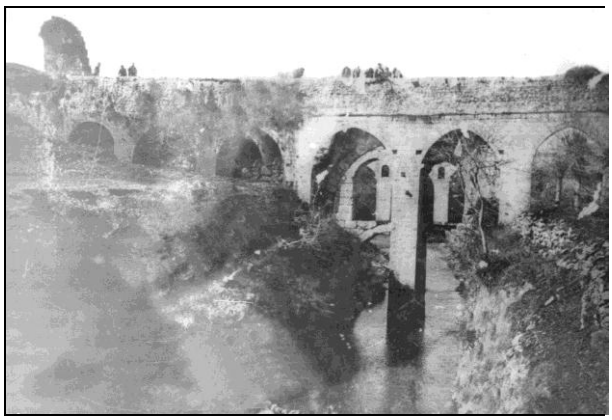

Figure 16. Old picture of Justinian aqueduct and water balance facility(on the left) (Kürkçüoğlu, 2011)

Figure 17. Another picture of Justinian aqueduct (Tezel, 1954)

WATER STRUCTURES BUILT ON KARAKOYUN RIVER AFTER THE JUSTINIAN SYSTEM

Justinian system was a milestone work for Urfa. After Roman time, the city was occupied by many civilizations and Justinian system served all civilizations as a most critical flood control facility and a set of bridges to enable transportation of goods and people. New bridges are added and some renovations were made to upgrade the system. Although the construction times were not clear, 3 bridges were built on Karakoyun River after Justinian System established. The new structures were very similar to the facilities of Justinian System from both engineering and architectural point of view.

The details of the bridges built after the Justinian Bridges on the same river course are given in the following sections.

Hacı Kamil Bridge

It is a four-arch stone bridge built near the Saray Door. It was built by Hacı Yusuf Kamil during the governorship of Ethem Bey (Paşa) in 1903 (Fig.18 and 19).

Figure 18. Hacı Kamil Bridge (Uyanık, 1951)

Figure 19. Hacı Kamil Bridge today (by Kürkçüoğlu, C.)

Millet Bridge

It is a seven-arch stone bridge built near the Millet Hospital. It is expected to be built at the beginning of 20th Century. Today, five arches of the bridge are full of soil and not working anymore. The bridge is used as an aqueduct, since it has water channels on the top. (Fig.20 and 21).

Figure 20. Millet Bridge in 1950 (Kürkçüoğlu, 2011)

Figure 21. Today's view of Millet Bridge (by Kürkçüoğlu)

Hızmalı Bridge

It is the western bridge on the Karakoyun River. Time of the construction is not known due to absence of its epigraph. The bridge has two main arches with one leg and also two arches at the upper side. These arches together with another small arch on the east side are extended with small windows. The bridge served as an aqueduct since it has secret water channels over it. The bridge has also water balance structure on the west side (Fig.22 and 23) (Kürkçüoğlu, 1992).

Figure 22. Hızmalı Bridge in the years of 1940s (Kürkçüoğlu, 2011)

Figure 23. Today's view of Hızmalı Bridge (Kürkçüoğlu, C.)

RESULTS AND CONCLUSION

Water structures were used to take advantage of water as long as the prevention of the water damage. City of Urfa, hosted lots of civilizations, has one of the oldest flood control facility used for the prevention of water damage.

Justinian system were used by many civilizations occupied the city, since the 6th century. The civilizations added some new bridges and made some renovations to upgrade the existing system. Although the cultural structures of the civilizations don't have the same characteristics, it is noticed that water structures has similar features in terms of engineering and architectural perspective. Also, in Şanlıurfa (like in other places) it is noticed that although the settled communities have ruined the cultural structures, they have protected and have developed water resource systems. This situation enables the protection of water structures to the present.

One of the amazing characteristic of Justinian system is the large excavation in the new course of the river. Today, it is a point of interest how this large excavation of hard ground was achieved by the technologies of 6th century.

Justinian System has great importance not only for surviving since 1500 years but also being in use today. As an example, in 1985, a temporary hole in the Justinian dam, due to the operation by the municipality, caused a serious flood and damage on the residential buildings.

In terms of engineering, water structures of ancient time are similar to today's structures. However, they were built with less technological capabilities, as expected. Also compared with the contemporary ones, it is noticed that they were designed to give minimum damage to the environment.

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