Underground Hydraulic Structures of Gaziantep (Southeast Turkey): *Livas* and *Qastels*

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Abstract
It has been long known that Gaziantep, possessing a continuous inhabitancy since 3.000 BC, has hundreds of underground structures carved in sandy limestone. Some of those underground structures were used as storage facilities or cisterns, while some others are as yarn ateliers today. Furthermore, despite forming a huge and complex system, underground water structures, only a small part of which can be researched due to destructions, are another important phase of our project. It is extremely difficult to determine the roots of this extensive, technologically advanced water distribution system. While the section that can be seen above ground is fairly limited, it is difficult not to consider this system as an important engineering achievement for its era. This water distribution system is a network of water canals carved into limestone rock layer, locally known as *"livas"*, onto which the city was built upon. This system is similar to the one first applied in Persia 2000 - 3000 years ago and used today in many countries such as Morocco, Algeria, Egypt, China and known as *"qanat"* or *"karez"* while displaying a set of unique characteristics unique to Gaziantep. The system relies on the principle of distributing water originating from a source far away from the settlement area, by using well designed underground canals with gentle slopes to distribute the water to a large settlement area and by using wells in locations of need or by clear water underground reservoirs known as *"qastel"*. As a result of our studies, limited length "*livas*" and all existing "*qastel*"s were surveyed and mapped in Gaziantep.

Keywords: Gaziantep, underground hydraulic structures, *livas*, *qastel*

• INTRODUCTION

The city of Gaziantep, located in Southeastern Turkey (Fig. 1), developed around a castle built in the 11th century, during the First Crusade. Archeological excavations documented that the previous location of the city was at the Düllük Village, 9 km away from the castle. This settlement, dating back to the Paleolithic Period, was abandoned and the city developed in its current location.

The greatest problem of the city of Gaziantep is that it does not have a water table. The city that was built on a hill and that developed in time, has solved this problem by transporting the water from nearby springs through underground aqueducts. The plateau that houses the city of Gaziantep and its periphery mostly consists of limestone and chalk, Upper - Middle Eocene in age [MTA, 1997]. Although it mostly made of soft rocks, thicker layers of massive limestones can also be observed. Argillaceous limestone consist of whitish, gray, cream, dingy yellow, loose and thin middle-layered and chalky layers. Tens of kilometers of underground aqueducts, called "*livas*" locally, were dug under the city that is situated over this easy-to-dig soft limestone. Although it is not possible to determine the date when the digging of this aqueduct system started, it is known that the system was used until mid-20th century. On the other hand, apart from this water distribution system with similar examples throughout the world [Judson & Kahane, 1963; Castellani & Dragoni, 1991; Wessels, 2000; Parise et al., 2015], there are impressive underground public areas, locally called "*qastel*", unique to Gaziantep and where the water coming through these underground channels were used publicly. During our survey in Gaziantep as the OBRUK Cave Research Group, we have conducted the first scientific study of both these underground aqueducts, and the "*qastel*" connections of these channels.



Figure 1: Location map showing the area of exploration

1.1 Underground Aqueducts of Gaziantep; *"Livas"*

There are numerous water resources around the plateau upon which Gaziantep is located. Despite all these resources, there is no water table under the city. Therefore, long tunnels were dug in order to bring water to Gaziantep from those springs. Length of some of these tunnels reaches a few kilometers, and they are the very image of ancient *"qanat"* or *"karez"* that were first implemented 2000-3000 years ago in Iran, and encountered in many countries such as Morocco, Persia, Algeria, Egypt and China.



Figure 2: 3D sketch of a *'livas'* and a well connection. (Drawing M. Egrikavuk)



Figure 3: An active *'livas'* under Nadir Bey House (Photo A.E. Keskin)



Figure 4: A *'livas'* in Tutuncu Han (Photo A.E. Keskin)

The essence of the system is transporting the water to the city center by channels from a main source fairly outside the settlement to wide settlement areas by well-calculated, smooth-sloped underground

galleries, and distributing the water through wells dug where water was needed.
The wells almost never went down directly to the water flow in the *livas*, but reached a point nearby. The wells were dug a little deeper than the *livas* level, and connected to the *livas* through a short, horizontal connection gallery and as the water waited in this reservoir, the residues settled to the bottom and the water was purified (Fig. 2).
The dimensions of this system are very impressive in Gaziantep. The main water source that fed the old settlement was situated at the current location of the Alleben Pond. Although the distance of Alleben to the city center is around 10 km, the total distance of the interconnected *livas* system would reach hundreds of kilometers. Various water tunnels like those in Gaziantep War Museum Cave, Tutun Han Cave, Nadir Bey House and Omer Ersoy Culture Center are all connected to the same underground water system (Fig. 3 and 4). On the other hand, it is determined that many shafts investigated during the project are also connected to these water tunnels.
Apart from its scope, the engineering calculations for the system are also impressive for the period. It is obvious that obtaining the correct slope at every point to ensure a constant flow in the channels for tens of kilometers was very important in terms of the performance of the system. The scope of the labor may be better understood by considering that the work was conducted under the ground, in the dark, in very hard conditions and with limited technological means.
Another problem was meeting the *livas* below from the wells to be dug at the surface. It is difficult today to determine how this was achieved. The landscape in downtown Gaziantep is very rugged and there are serious differences between the levels of neighborhoods, or even houses in the same neighborhood. Making a well being dug from the yard of a house meet with an active *livas* through a gallery that is precisely calculated, and that is dug from the correct level in the correct direction, is not a small feat. We could determine that the work flow was in this direction, i.e. from the well to the *livas*, for certain in at least one sample.

1.2 Public Underground Water Structures; *"Qastel"*

Apart from these aqueducts, another impressive feature of the underground water structure of Gaziantep are the structures unique to this city called "*qastel*". The difference of these structures from the individual wells in the city is that these are public places created to allow access to the clean water distribution in the *livas* for a wider audience. In all known samples, wide stairs provide access to a large underground space dug inside the main block of rock. These spaces were planned to allow many people from various classes to have an easy access to clean water, provision of washing and using water, and moreover, as social spaces. In a city where it is not possible to carry the water transported through underground aqueducts to the surface through water fountains, we can think of the *qastel*s as a social area of the past [Çam, 1982].
Although these structures seem religious, because some of the six samples preserved until today are next to mosques, there are findings that suggest that the *qastel* structures date farther back in time.
As evidenced in samples such as the Ahmet Celebi Qastel (Fig. 5 and 6), Ihsaniye Qastel, Imam-ı Gazali and Pisirici Qastel there are no connections between the mosque structure and the *qastel* structure. Moreover, the fact that most of these *qastels* contain a small underground mosque suggests that they were built before the mosques above. The best example for this is the fact that the Pisirici *qastel*, built in 1283, is one of the oldest structures in the city (Fig. 7 and 8). It may be thought that, in many cases, the mosques that were built in a later period took over the existing *qastel* structures.
Although there were at least 15 *qastel*s until 60 years ago, only 6 examples remain today. Yet, even the remaining ones give us an idea about the impressive architecture of these interesting underground structures. Among those *qastel* s, only Pisirici and Ahmet Celebi fits the purpose with slight changes. The remaining 4 qastels; İhsaniye, Kozluca, Imam-ı Gazali and Şeyh Fethullah are unprotected and have been victims of wrong modifications.

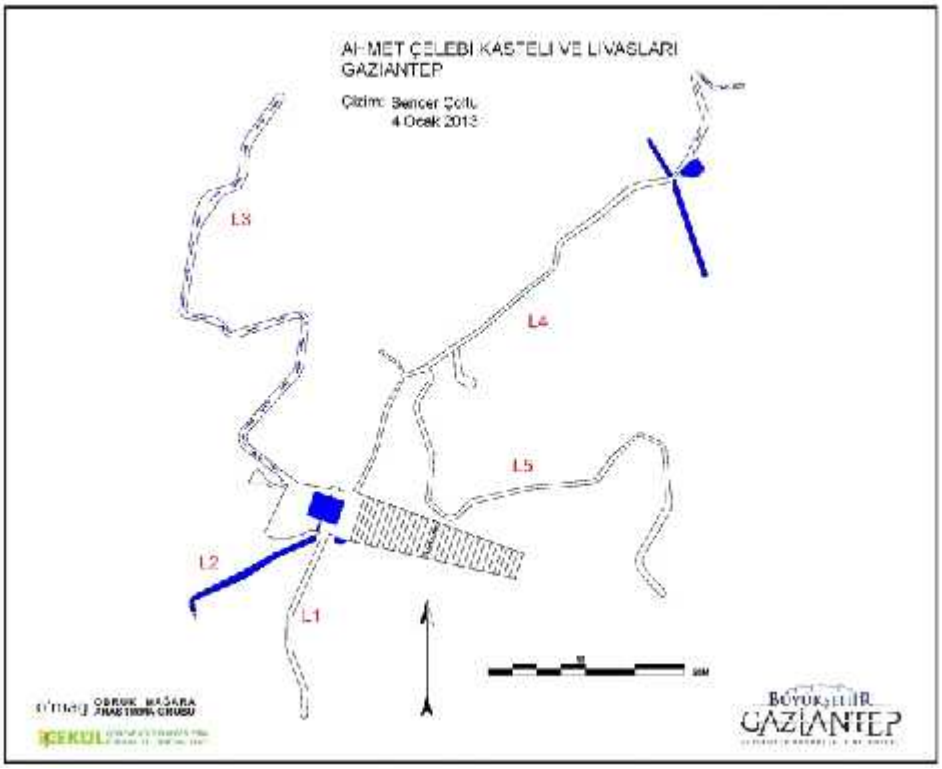


Figure 5: Map of Ahmet Celebi Qastel and adjoining *'livas'* (Drawing S. Coltu)



Figure 6: Ahmet Celebi Qastel (Photo A.Yamac)

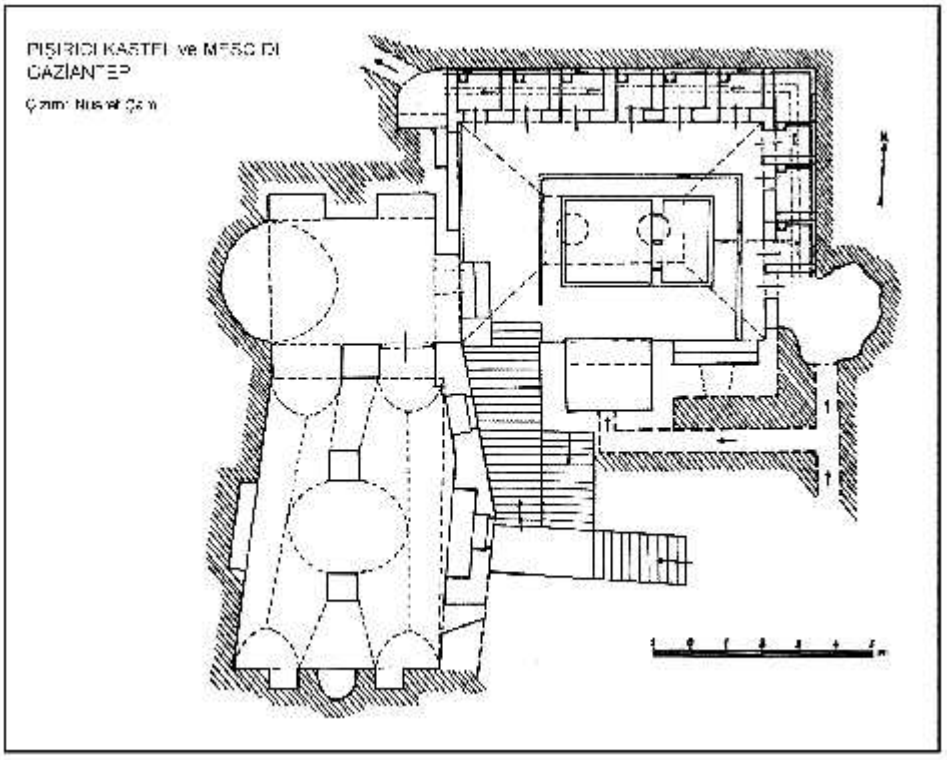


Figure 7: Map of Pisirici Qastel (Drawing N. Çam 2006)



Figure 8: Pisirici Qastel (Photo A.E. Keskin)

2. CONCLUSION

Modern water distribution reached the city of Gaziantep only in the 1950s. Unfortunately, two kinds of destruction and neglect have brought this ancient *livas* system that served the city for centuries near destruction. One of these two factors is individual users filling the wells that they do not need anymore, and even worse, filling them completely with mortar. The other one is that the modern municipalities did not understand the historic value of the system and have damaged it underground beyond repair during infrastructure works for electricity, natural gas, water, etc.

As can be seen, the current level of destruction of this system is a priceless loss for the identity and historic past of the city of Gaziantep. It is particularly sad that this destruction happened in such a short

time. We believe that, in order to be able to reach the future generations, these structures need to be protected immediately.

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