

# The Building of the Hydraulic System in Madrid (Spain) in the Middle Ages

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**ABSTRACT:** At the end of the Middle Ages, the city of Madrid had a perfect system of water supply to the population formed by a wide network of "qanats" or "viajes de agua" (water trips). This network improved and spread as the same time as the city and its needs. The city subterranean water sources proved to be insufficient and it was necessary to look for new ones more distant and remote. New "water trips" were, therefore, needed. This water supply system was in constant renewal, and it was still until today, where the actual system is the descendant of the primitive constructions. The original construction basis of the primitive system has been maintained, taking always account of the innovation of the building techniques, the current water needs and the care of environment.

## INTRODUCTION

This document will focus on the building of the hydraulic system or water network in Madrid during the first times of the foundation of the City by the Muslims (IX century). The system was conceived to assist the human water supply. Water was mainly for people use but it was also for watering the orchards and gardens within the city walls or surrounding areas where the city expanded. This system proved to be very useful and efficient, therefore, its first nucleus developed along with the growing of the city needs. It remained in use until the XIX century and we can find traces of it even today.

For an easier understanding of the matter, I will like to start with a short historical introduction. I then will study and asses the writing documents that make reference to the system. I will also analyze the material ruins and construction remains that can be found even nowadays. Finally, I will describe the building of the system/network and how it assisted the population water supply.

It is true that after the Christian Conquest (1085) Muslim population remained in the city and continued to keep all its activities. Therefore, we don't know certainly if Muslims continued with the maintenance and increase of the hydraulic system or if they transferred their building techniques to Christians. I think that both possibilities can be possible. The final result was that the City of Madrid remained with a satisfactory water supply network that totally fulfilled the requirements of its population

We have to remember that during the first part of the Middle Ages, the City was under Islam domination. It was only in 1085 when it took part of the Castilian Crown. Therefore, we must establish two different and well determined periods: One, Islamic, where the first elements of the hydraulic system were built and other, Christian, where such system was developed and consolidated. The Christian conquest did not destroy the previous elements but reinforced, preserve and developed them. The builders of the system were all very expert, either the Muslims (the creators) and the Christians that preserved and developed it.

## FOUNDATION AND DEVELOPMENT OF THE CITY OF MADRID DURING THE MIDDLE AGES

The word "Madrid" is an Arabic name that makes reference to a water conduction and has a close relationship with the Muslim origins of the city. In the middles of the IX century, (the exact date is not known), the Emir of Cordoba, Muhammad I, decided to build an "alcázar" or castle in a military strategic place doted with

good conditions for the development of the population. The place had to enjoy of a good water supply. The origin of Madrid is, therefore, Islamic and its name is related to the water. Water that flows abundantly inside the walls of the city. The walls were built in the second part of the IX century. From that time, the City spread even outside these walls. At the beginning of the XI century, new walls to surround the new areas were built (we can still find ruins of those). The water supply system had to grow and expand at the same time as the city to assist the needs of the population (Segura, 2004).

At the end of the XI century, in 1085, the king of Castile Alfonso VI, made the conquest of Toledo, the most important city in the border between the Muslim and the Christian worlds. Madrid was part of the Toledo land and when Toledo was conquered by the Christians, all its lands (included Madrid) were transferred to the king of Castile. Madrid then transformed in a Christian city and started to grow in territory and population. It also acquired political relevance (Segura, 1994). All this process ended at the end of XVI century, in 1562, when the king Felipe II stated the city as the capital of all its territories (Santos, J. 1984). From that relevant date, important changes happened in the social organization.

This paper will focus mainly in the building and origins of the water supply network and its development in the city of Madrid in the Middle Ages. After the status of capital of Madrid (1562), as previously said, relevant changes also happened but they are not the subject of this document because they respond to another social situation. Along this paper we are going to study origin and early development of the hydraulic system. A network good enough to assist the supply of a medieval city, first under the Islam and then under the Castile Crown. (*Historia del abastecimiento ...* 2000).

## PAPERS AND DOCUMENTS USED

Written documents for the study of Madrid in the Middle Ages are very few in general. We have a "Fuero" or Main Law, passed in 1202 (...1932) and the Minutes of the Meetings of the Madrid Council kept from 1464 (Libros ...1932). This Meeting Minutes are compiled in the "Minutes Book of the Council of Madrid" . In these documents we can find many information related to quotidian problems of the supply system and other matters related to water. We can also find information about some Abbeys settled in the city, mainly about the Santo Domingo Abbey, where there was an important water source, called "la de la Priora" (the prioress's). Nevertheless, in written documents there are not many references to the matter dealt in this document, already studied by me in different occasions (Segura, C. 1984, 1998, 2000, 2003, 2005, 2006)

The main source for the study of the hydraulic system and network of the City are the material ruins preserved in the city until now. There are also very useful the references to the hydraulic system of Madrid made in other periods of History, because, as already mentioned, the system kept in use until the XIX century with the necessary rebuilds to assist an increasing population. Subsequent information about the Middle Ages is wide and important. We can understand that information and descriptions about the elements of the hydraulic system are acceptable for those in use in the Middle Ages with the widening and expansion needed by demands at every period. This information must be studied together with the old material ruins kept until nowadays or very recent times.

We can, therefore, understand that the medieval hydraulic system is the origin of the posterior development and is the precedent of the one in use now with the needed changes according to the times. I also want to say that in the archaeological works done inside the walls of the city there was found a water conduction built in the late Middle Ages in perfect conditions of use. I will insist on that important fact later.

## DEVELOPMENT OF THE HYDRAULIC TECHNIQUES. 'QANATS' AND/OR "WATER TRIPS"

The origin of the name of Madrid, as already said, comes from the Arabic word "mayra", in Spanish "water trip" or water conduction. Madrid means "place of mayras". This word makes specific mention to the water sources in the ground of Madrid and to the conductions made by very efficient constructions, the "mayras". These conductions transported water from its sources to the places where it was needed for human purposes – mainly drink and watering-. This water richness, as already stated, was one of the reasons to impulse the Muslims to settle the "alcazar" or castle there, origin of the city that soon started to expand and to be surrounded by a wall. The city could develop thanks to its abundant water sources.

However, the water was not the only reason for the development of the city. The water was a natural good that was well exploited with important results due to the use of very efficient techniques. Thanks to this techniques, a very sophisticated system and network was built to carry water from its source to the needed points. These mains, pipes or "mayras" were soon called "qanats" also an Arabic name that kept longer. "Qanat" or "canal" in Spanish (channel, mains or pipe) had the peculiarity of being in the underground at least inside the city walls. To help water to flow inside this pipes or channels a sophisticated technique was needed to obtain and gain the water in the appropriate place with the appropriate altitude to allow water to flow and walk its designed itinerary.

During the Christian period (from the XII century) the "qanats" started to be called "water trips", name perpetuated along History. Even now, we can find some of this water trips in very good conditions that still are supplying water to a public fountain. We can quote, for instance, the *Fuente del Re*" at the *Carretera de Castilla*, next to the confluence with the *Carretera de la Coruña* . We can also find a water trip that waters a public garden, as it is the case of the *Parque de la Fuente del Berro*. We can find documents, dated at the begin-

ning of the XX century, that establish that some houses of Madrid in old and suburb areas still used water trips for their water supply. The current water supply of Madrid started in 1858 with the foundation of the *Canal de Isabel II* that brought water to Madrid from reservoirs built at the headings of some rivers of the Northern Mountains of Madrid at 77Km of distance.

The *Canal de Isabel II* has the same technique as the "qanats". The main difference is that water doesn't come from sources but from reservoirs. It is an underground –or covered sometimes- network of channels that transports water from very far places until the city using the adequate constructions like aqueducts, u-bends, pipes, deposits or "azudes".

Even in the seventy's of the last century, the water of the *Canal de Isabel II*, flew by *el Canalillo* (the little Channel) inside the city and supplied water to some houses. We can see some constructions in the city, such as deposits and aqueducts as monuments that are part of the cultural and artistic heritage of our city. Sadly, these constructions don't have enough protection, as it is the case of the main hydraulic heritage. In essence the *Canal de Isabel II* is a big "qanat", because it has the same purposes. It also uses the same building principle as the "qanats" of the Islamic period, being its function the establishment of a water-pipe network. It also uses the theory of the interrelated vessels and the outline of the ground to be able to conduct good quality water along big distances where it is needed.

The "qanats" could flow along the city, bringing water to it was needed and they could expand according to the necessities of the city. At the needed places, a fountain could be established to give part of the water that flew through the "qanat". Therefore an underground network to transport and supply water to the city was established. The first "qanats", origin of this important hydraulic system, started at the X century,

The water supply system was completed by the construction of wells and wheels. The building of these devices could be related to a "qanat" or could be independent. The existence of the wells is perfectly documented during the medieval period of the city, mainly during the Christian period, but we can certainly state the hypothesis that the wells found during the excavation works in the city have an Islamic origin.

Besides, according to the non writing tradition, it is said that the Patron Saint of the city, Isidro -with more accuracy, Isidris-, lived in the Islamic period and his employment or job was related to the building and keeping of the "qanats". There is also famous a miracle made by the Saint where he rescued a child, his son, that fell inside a well. In the main part of the archeological works, we found constructions and structures related with wells and vessels that dated of the IX until XI centuries -the Islamic period- These constructions were indispensable for the function of the watermills. It is also large the number of "cangilones" or cups to collect water in the watermills found during some archeological works made in Madrid.

Wells and watermills can also be used for the construction of a fountain. Also "qanats" can be the origin of a fountain with the use of a watermill to obtain water. Fountains, therefore, depended on water sources, but they could be built very far away from those with the help of a "qanat" or water trip, to transfer water from its source until the fountain.

The 'qanats' were built in promontories or high level places to help water to flow until far and lower places. The system is simple but the construction demands sophisticated building techniques. At the least error, water would not flow alongside the "qanat".

## **CONSTRUCTION ELEMENTS AND BUILDING OF A 'QANAT'**

Water is gained or obtained at the water source. Water is also cleaned from possible sand or dust with the help of a drainage. At the reception of the water some connected wells are usually opened. All this process helps to the purification of water. Since then, alongside an artificial canalization, water flows. The origin of the "qanat", where the reception of water is made, must be built in high level places. According to the necessities of the population, "qanats" were built further and further of the city center. At the end of the Middle Age, the origins of the "qanats" were built outside the city and water flew for long distances.

'Qanats' were built with bricks and they had enough altitude to allow a person to walk easily inside. The reason was to facilitate a possible reparation. On the floor there was a clay made pipe or channel (open or close) but always artificial where water flew. There were also two small platforms alongside the way of the water, to allow a person to walk. All along the course of the "qanat" there was a bed made of sand and stones to allow water to decant. Galleries also had a gentle slope to allow water to flow quicker. At the first times, the water was gained inside the city walls but, with the expansion of the Villa, as necessities of water increased, the water was gained outside the city in further places. Therefore, conducts must be longer, but they had always the same building principles. They also worked in a very satisfactory manner. In these cases, when the water was next to the city, some deposits were built to store water and then to distribute it by different pipes or conducts inside the city to supply its different areas.

A team of archeologists specialized in Medieval History and in the History of the city of Madrid at that times (Caballero et al, 1984), developed an urgency archeological work in year 1983 when the Council planned some public works in the *Plaza de los Carros* in the center of Madrid. They expected to find a portion of the ancient city wall from the Christian period. They didn't find the wall, but a 'qanat', possibly built before the Christian Conquest (1085). It was only possible to study a small portion of 10 m. After the study, the 'qanat' had to be covered again. These works have been documented and published. It is possible to visit the "qanat", even if the entry is difficult and not public. The results of the study of this "qanat" show that it is a rectangular structure with a lateral platform 43 cm wide. It has middle size stones on its floor to ensure purification of water and to make easier the speed of water. This small course, that I was lucky to see, was not covered. Inside the

"qanat", at the expected place, water still flew. The slope was 1/1000 and it has small dams to produce small pools to prevent water to flow too fast.

During the archeological works some rubble was found and also an important quantity of Islamic pottery. All this made us think that this "qanat" dated before the Christian conquest (1085) or that this kind of pottery were used after the conquest, at least during the first years. It is possible that the use of this "qanat" were not only for human use. Its emplacement outside the city walls, in an area without houses at that time, helps the hypothesis that the function of this "qanat" was bringing water to the orchards of the area.

### **QANATS AND/OR MEDIEVAL "WATER TRIPS"**

There are many constructions to carry water that can be dated at the Middle Ages. The most famous are *Caños Viejos* and *Caños del Peral*.

*Los Caños Viejos* took water near the current Church of *San Pedro*, in the surroundings of an area called *el Pozacho*, from the Islamic period. Its function is not well known neither what it really was. We only know that it was an hydraulic structure to water some farming lands also apparently used as public baths. It was placed at the current Segovia Street, near *San Pedro*. It is also possible that it had some device to use the power motion of water for some industrial purposes not determined. Polluting industries such as tanning, dying, etc needed water and were located outside the cities in the lower part of the course rivers to prevent disturbing the rest of the neighborhood. It is not easy to make a true assessment, the 'qanat' of *el Pozacho* flew along the current Segovia street and it was likely the first hydraulic construction to supply water to an industrial and farming complex and to give drinking water for the people of this suburb.

The second water trip chronologically speaking came from the *Caños del Peral*. The origin was outside the city walls and it is also possible dated at the Islamic period. It flew along the current Arenal Street until the *Plaza de Oriente*. Some materials from the Islamic period were found at this place during the urgency archeological works. There was also found the basement of one of the wall towers, possibly to survey the water trip, to protect people that came for the supply and to survey water distribution when entering into the city walls.

It is possible that water trips were built open air outside the city walls, but inside the city, -or even approaching its walls- there were always covered to preserve the good quality of water. Nevertheless it is also very possible that the water trips were always covered from the very beginning of its gaining. Open water means more risks of being polluted. Also water in a closed pipe prevents its theft from people that can use it to water its farms or at home. The perforation of a "qanat" and the theft of water was an often issue punished by the law. But above all these reasons, when water was not covered, it suffered the effects of the evaporation by the sun. Therefore, to carry water inside closed constructions (the "qanats" ) was the best of the solutions.

### **CONCLUSIONS**

'Qanats' were an essential part of the development of life in Al-Andalus and in the Islamic city of Madrid. They were a very important technical advance and they used very refined techniques. These techniques were known empirically by the "plumbers" of "fontaneros". This was the name of the "qanats" builders. With this system, good quality water was supplied to the population in a very efficient manner, either to drink or to water the orchards. All this helped to the development of the city and to the increasing importance that the city gained along the Middle Age until being considered as the capital city under the Austrian Monarchy. I am not seeing that the whole urban development of the city was due to its water richness and to the good techniques used to build the water devices and trips, but I want to stress the importance and the essential role that all this had in the development of Madrid. The city expanded and at the same time, its hydraulic network, conceived at the Andalusi period and designed to be able to expand according to the necessities of the population of Madrid. I want to end my study quoting the beginning of the logo of the Villa: "Fui sobre agua edificada ..." (I was built on water...)

### **REFERENCES**

- Burguete, L., 1999: Aprovechamientos hidráulicos en Madrid (S. XV). *Madrid. Revista de Arte, Geografía e Historia* I, pp. 47-72.
- Caballero, L.; Priego, C.; Retuerce, M. 1984: Madrid: Barrio histórico. Informe de las excavaciones arqueológicas efectuadas en la Plaza de los Carros (Noviembre-Diciembre, 1983). *Estudios de Prehistoria y Arqueología Madrileñas*, pp.169-190.
- El Fuero de Madrid*, 1932, Madrid, Ayuntamiento.
- Historia del abastecimiento y usos del agua en la Villa de Madrid*, 2000. Madrid, Confederación Hidrográfica del Tajo.
- Julia, S. ed. 1994: *Madrid. Historia de una capital*. Madrid, Alianza Editorial.
- Libros de acuerdos del Concejo Madrileño 1932-1987*, Madrid, Ayuntamiento. 5 vols.
- Segura, C. 1984: El abastecimiento de agua en Almería a fines de la Edad Media. *En la España Medieval* IV, pp. 1005-1017
- Segura, C. 1994: Madrid en la Edad Media. Génesis de una capital (873?-1561). *Historia de una capital*, pp. 13-119.
- Segura, C. 1998: Aprovechamientos hidráulicos en las encomiendas de la Orden Militar de Santiago en la Ribera del Tajo. Siglos XIII- XV. *Anuario de Estudios Medievales* 28, pp. 97-108.

- Segura, C. 2000: Los oficios del agua. *Historia del abastecimiento y usos del agua en la Villa de Madrid*. Madrid, pp. 129-138.
- Segura, C. ed. 2003: *Agua y sistemas hidráulicos en la Edad Media Hispana*. Madrid, A. C. Almuayna.
- Segura, C. 2004: *El origen islámico de Madrid y las relaciones con los reinos cristianos*. Testimonios del Madrid Medieval. El Madrid Musulmán, pp. 19-41.
- Segura, C. 2005: Hydraulic Managements Systems in Madrid (Spain) XV-XVI century. *Integrated Land and Water Resources Management in History*. Sierburg, pp. 57-70.
- Segura, C. 2006: Los oficios del agua. Vivir del agua en las ciudades Medievales. Valladolid, pp. 11-24.
- Troll, C.; Braun, C. 1974: El abastecimiento de agua de la ciudad por medio de 'qanates' a lo largo de la Historia. *Geographica* 16, pp. 235-313.