

The Civil Forum cisterns in Pompeii (Italy)

Graziano Ferrari^{1,*}, Daniele De Simone¹, Alberta Martellone², Bruno De Nigris², Massimo Osanna²

Abstract

Thanks to an agreement between the Pompeii Archaeological Park Applied Research Laboratory and the Cocceius Association, we investigated a rain-water drainage system located under the Pompeii Civil Forum. The system was recovered and cleared-up in 1900 and it is still in operation. The pivotal element of such system is represented by twin water tanks, designed to hold about 350 m³ of water. Their structure resembles the Jupiter temple favissae, ascribed to the 2nd century BC. The tank development is strictly related to the Forum evolution in pre-Roman and Roman age. We were able to enter and inspect the southernmost tank, well-preserved and still holding rain-water. This essay illustrates the safety measures applied to the exploration operations, the system description, evolutionary hypotheses, conservation and maintenance suggestions. The tank is 27.80 m long and 1.91 m wide. The overall height is about 4 m, but the bottom is filled with 2.90 m of thick debris and mud layer, collected after the 1900 clean-up. The northernmost tank has been identified through the outtake hole, although no vertical access is evident on the Civil Forum surface. Rainwater is still collected by Augustan age channels under the Civil Forum southern area and stored into the southern tank, where debris settles. Water then fills the northern tank. The excess water spills over the outtake hole and flows westwards into a 160 m long drainage channel under Via Marina, then reaching a square hole in the Samnite walls near Porta Marina.

Keywords: Pompeii, Ancient drainage systems, Roman hydraulics, Samnite hydraulics.

Introduction

The hydraulic management of the ancient city of Pompeii is a subject of considerable interest for understanding ancient water technologies and the historical and social evolution of the city. Several researchers investigated the topic of fresh water supply in Pompeii, with particular attention to the *castellum aquae* at Porta Vesuvio and to the distribution network to the public fountains (e.g. Eschbach, 1998; Ohlig, 2000; Olsson, 2015). Some papers have been dedicated to private cisterns and latrines (e.g. Jansen, 2000), but little attention has been paid to the drainage systems of public spaces. Understanding these systems is of considerable interest not only from a scientific point of view, but also to allow accurate and sustainable management of the Pompeii site, through the correct re-functionalization of the ancient conduits. As early as 1861, the Director of the Excavations Giuseppe Fiorelli decreed that: “*Contemporaneamente alle strade dovranno essere scavati e puliti gli antichi condotti di acque, e le fosse del loro assorbimento*” (Fiorelli, 1861).

¹ “At the same time as the roads, the ancient water conduits and their drainage ditches will have to be excavated and cleaned” (translation by the authors).

Thanks to an agreement signed in 2018 between the Applied Research Laboratory of the Pompeii Archaeological Park and the COCCEIVS Association, it was possible to examine a system intended for the drainage of rainwater in the Civil Forum, as well as its storage and delivery outside the ancient city walls. The key element of this system consists of two underground cisterns located under the very level of the Forum. They were intended to guarantee a reserve of water for collective use at a time when Pompeii did not have an aqueduct and the related distribution network yet. The paper presents the preliminary results obtained from an inspection inside the southern cistern, the only one whose accesses are currently visible on the Forum floor.

Materials and methods

The Civil Forum cisterns are connected to a network of underground ducts, that run at a little depth under the surface of the southern part of the Civil Forum and under Via Marina, with an east-west direction, until they emerge from the ancient walls just south of Porta Marina. In the modern age, the system was largely cleared of ancient deposits, in order to restore its rainwater drainage functions. Summary information on this cleaning operation, carried out in 1900,

¹ Associazione Cocceivs

² Ministero della Cultura

* Reference author: Graziano Ferrari, Associazione Cocceivs, via della Grotta Vecchia 3, 80125 Napoli - associazione. cocceivs@gmail.com

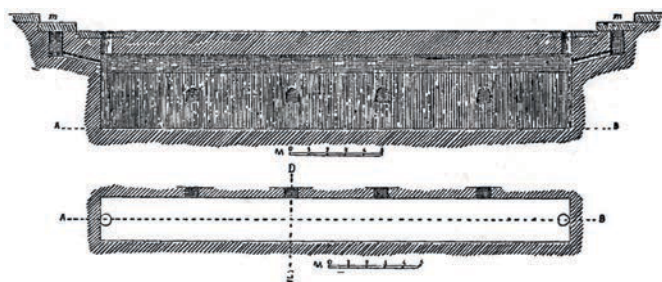


Fig. 1 – Pompeii: the south cistern survey (from Cozzi & Sogliano, 1900).

emerges from only one publication (Cozzi & Sogliano, 1900), which ascertains the existence of a single cistern and supposes the presence of a second similar structure, located immediately to the north of the first one. An architectural survey of the southern cistern is also reported (Fig. 1).

The restoration operation was followed by a structural investigation on the upper surface of the cistern system (Sogliano, 1925), which also demonstrated the existence of the second cistern, with interesting considerations about the possible genesis and evolution of the Forum (Fig. 2).

Recently, the drainage system has been intercepted by the works for the construction of easy access routes on the surface, and this has allowed a new speleological exploration of the hypogeal conduits. During this research, it was possible to identify the intake and outtake holes of the cisterns and to obtain an initial documentation of their characteristics, including that they are still occupied by a considerable amount of water.

In the southern portion of the Civil Forum floor, two circular stone manholes covers are visible, as parts of the Sarno limestone paving, whose construction is

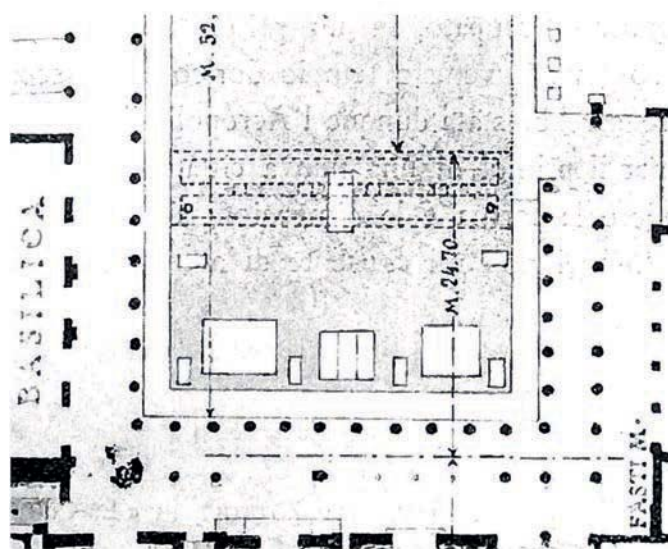


Fig. 2 – Pompeii, Civil Forum: plan showing the twin cistern position (from Sogliano, 1925).

attributed to the early imperial age (Pesando & Guidobaldi, 2006). They allow access to the southern cistern, while similar manhole covers for the northern cistern are not evident on the surface. In accordance with the direction of the Applied Research Laboratory of the Pompeii Archaeological Park, an inspection was therefore planned and carried out inside the southern cistern, to visually establish its state of preservation. Given its peculiarity, in addition to the normal use of speleological techniques and equipment, the exploration required the draft of a specific safety protocol and the application of operating methodologies suitable to allow the presence of an operator in a confined, flooded space, filled with thick mud and with a narrow vertical access.

On January 17th, 2019, with the support of ALES company technicians, a worksite was installed that included both the southern cistern western manhole and the access manhole to the drainage tunnels to Via Marina. A drainage pump was then activated, its discharge pipe positioned inside the underground conduit of Via Marina, thus avoiding water spills on the surface by using the conduit under via Marina in its original function.

Before any drainage procedure was carried out, speleologists conducted an initial exploration inside the cistern to check its condition. The operation strictly followed the safety procedures for accessing a confined environment with suspected hazards, with the use of a five-sensors personal gas analyser (O_2 , CO , CO_2 , NH_3 , H_2S). Dry suit and a metal frame for lowering the operator into the manhole were also employed. At all times, the operator was secured to the frame by means of a caving rope in case of an emergency rescue. In addition, a two-way voice communication protocol was activated to assess the operator's safety conditions in the tank for the whole duration of the process. Only after the operator had completed the inspection and left the tank, the pumping started. Unfortunately, the intake pipe did not allow to reach the furthest and deepest part of the cistern, it was only possible to drain the water under the access manhole, about 0.50 m high. After removing the drainage pipe, a further inspection into the cistern was carried out, in order to document its overall condition. Some samples of hydraulic plaster were also collected for laboratory analyses. The operations were performed without any risk, despite the fact that the confined environment was particularly demanding. It was only observed that the operator's footsteps in the mud caused the release of non-dangerous quantities of methane.

System description

The access pit is made up of an *opus incertum* facing, topped by a stone ring about 0.15 m high and about 0.50 m in diameter. The pit is circular and leads to the top of the vault of the cistern with a 0.8 m high vertical, near the western wall of the structure. In the area immediately below, there is an airspace of about 0.6 m



Fig. 3 – Pompeii, Civil Forum, south cistern: the western side and the intake hole (photo G. Ferrari).

in height and water 0.5 m. deep. The southern cistern has the following characteristics:

- Measurements: length 27.80 m; width 1.91m; the total height, from the Cozzi survey (Cozzi & Sogliano, 1900), appears to be about 4 m; during the inspection, a free span of 0.60 m from the vault to the water surface and 0.50 m from the water surface to the bottom solid deposit was verified, at the western end of the tank. These data would imply a solid deposit thickness of about 2.90 m, decreasing to about 2 m at the east end.
- Cross section: rectangular vaulted.
- Roof: lowered arch vault, covered with hydraulic plaster.
- Side walls: vertical, covered with hydraulic plaster.
- Floor: not visible, as it is covered by water and a thick layer of fine debris and mud.

In addition to the access manhole, located at the western end of the cistern, there is a similar manhole at the eastern end, and two inlets located in the centre of the shorter walls (fig. 3). The eastern inlet is clogged with soil and is no longer functional, while the western inlet still allows for rainwater to enter the cistern. Interestingly, the inlet holes open as breaks in the cistern walls.

On the vault of the cistern, two sub-circular breaks covered with stone slabs are visible. These are probably holes opened to facilitate the cleaning operations of the 1900s.

According to Cozzi's survey (Cozzi & Sogliano, 1900), on the north wall of the southern cistern there are four windows in direct communication with the northern cistern. The limited amount of water that has been re-

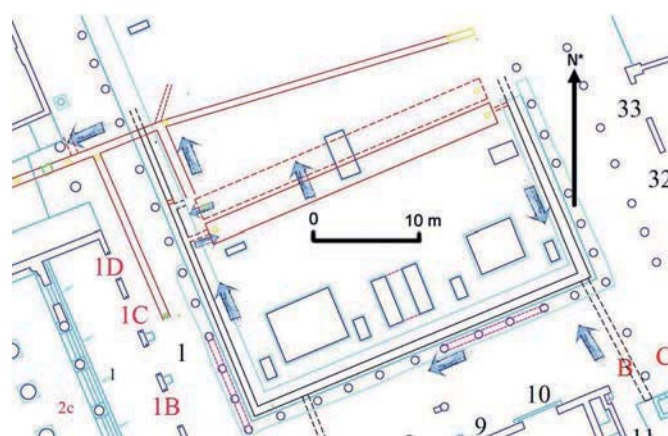


Fig. 4 – Pompeii, Civil Forum: plan of the hydraulic system with present water flow directions (drawing by D. de Simone).

moved has not made it possible to identify these windows yet. The northern cistern has so far only been examined from its western outlet; its characteristics appear quite similar to those of the southern cistern. The northern cistern is equipped with at least one inspection pit at the western end, located above the discharge hole. It is assumed it should open on the level of the Civil Forum, currently not visible on the surface. It is also conceivable that there is a similar well at the eastern end. The walls and vaults of both cisterns are made of *opus incertum* covered with a layer of hydraulic plaster.

It is currently possible to define the following water path (fig. 4): rainwater is drained by circular inlets made in the pavement of the southern sector of the Forum; water flows into a system of channels that conveys it towards the inlet of the southern cistern, working as a decanter for suspended solids while water flows towards the northern cistern through the connecting windows. The overflow of the northern cistern runs through the outlet towards the network of tunnels under Via Marina.

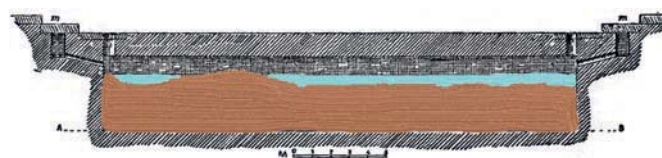


Fig. 5 – Pompeii, Civil Forum: the south cistern present status (from Cozzi & Sogliano, 1900, modified). The mud filling is in brown, while the water left after the pumping operation is in cyan.

Discussion

Sogliano (1925) pointed out that the internal measurements of the south cistern are multiples of the Italic foot (27.5 cm), respectively 100 feet long, 7 feet wide and 14 feet high. Analogies were also found with the structure of the Temple of Jupiter *favissae*, located at the opposite end of the Civil Forum with respect to the cisterns and whose construction is attributed to the late 2nd century BC. (Pesando & Guidobaldi, 2006).

Although the Forum and the surrounding area have yielded much older traces, the analysis of the structures in the cavities allows to chronologically date the underground installations at least to the 3rd-2nd century BC. A whole series of changes in the urban structure occurred in this period. They followed the Hannibalic War when the city became an important centre in the district, thanks to the presence of the port and the river Sarno as well as to the position along the routes that crossed the Gulf of Naples. The oldest phases of the development of the drainage system of the Civil Forum could be placed in the 2nd century BC. At that time, the Via Marina - Via dell'Abbondanza axis perhaps represented the southern and lowest limit of the Forum. The twin cisterns system is located just south the above mentioned axis. Sogliano (1925) already indicated a limit along this axis, perhaps also in relation that, up to at least the 2nd century BC, the Forum could be divided into two distinct squares, placed at different heights and connected by a flight of stairs. This way, the square would fully fall within a widespread model in the Hellenistic period, similarly to the nearby Neapolis (Giampaola, 2010). In this phase, the cisterns had to be equipped with a rainwater collection system that is no longer recognizable today. In the Augustan age, the Forum underwent a series of interventions aimed at reorganizing the spaces, to ensure their correct use and functioning, including the repaving of the square using travertine slabs. As a result, the water disposal system was adapted, still functionally linked to the needs of the previous structure of the square, from the Sullan era (80 BC), which, as far as it has been possible to reconstruct through the excavation data, had been enlarged to the south. The new paving led to an increase in the walking surface, which can be observed thanks to the analysis of the facing of the western manhole cover of the southern cistern.

The archaeological analysis of the cisterns and the relative drainage system can therefore provide new information to contribute to the definition of the evolutionary phases of the Pompeii Civil Forum.

Several private cisterns are known in Pompeii, in the typical setting of the *domus italica*, equipped with an *impluvium* to collect rainwater. Similarly, thermal establishments were equipped with a dedicated cistern, typically placed on an elevated level.

However, in the case of these specific cisterns, it is a system of rather considerable capacity, estimated at about 350 m³, located under the main public space of the city. The strategic and social value of this system is easily understood. A similar water reservoir is known under the other main Pompeian public space, the Triangular Forum. In this case, however, it consists of a series of long and narrow tunnels, with barrel vaults (Osanna, 2019). In regard to the protection and maintenance of the system, the exploration allowed to obtain the following information: the south cistern appears to have a plan area of approximately 53 m²; at the time of the inspection, the height of the filling, estimated on the basis of the Cozzi survey (Cozzi & Sogliano, 1900), was approximately 2.9 m on the west side and approximately 2 m on the east side. This filling therefore has an estimated volume of about 130 m³. If the cistern had only been emptied in 1900, the filling rate would therefore amount to just over 1 m³/year and would be higher if the cistern had also been emptied again in later periods; the western inlet is placed 0.5 m above the current fill; on the basis of the estimated filling rate, the vent would therefore be blocked at a date that can be estimated between 5 and 30 years from present.

Acknowledgements

The inspection in the south cistern was possible thanks to the collaboration of cavers Berardino Bocchino and Elena Rognoni; the technicians of the ALES company took care of the workspace and of the drainage pump operations. The Hans Brand company in Milan provided the portable gas analyser used to check the safety of the air in the hypogeum.

Alessandra Ressa proofread the text.

Bibliography

- Cozzi S., Sogliano A., 1900, *La fognatura di Pompei*, Notizie degli Scavi di Antichità, pp. 588–599.
- Eschebach L., 1998, *Wasserwirtschaft in Pompeji*, in *Cura aquarum in Campania*, proceedings of the Ninth International Congress on the History of Water Management and Hydraulic Engineering in the Mediterranean Region, Pompeii, 1-8 October 1994, pp. 1-12.
- Fiorelli G., 1861, *Giornale degli scavi di Pompei*. Napoli, 160 pages.
- Giampaola D., 2010, *Il teatro e la città: storia delle trasformazioni di un comparto urbano*, in Baldassarre I., Giampaola D. (eds.). *Il teatro di Neapolis, scavo e recupero urbano*, Napoli, pp. 21-33.
- Jansen G. C. M., 2000, *Systems for the disposal of waste and excreta in roman cities. The situation in Pompeii, Herculaneum and Ostia*, in Dupré & Remolà (ed.) *Sordes Urbis. La eliminación de residuos en la ciudad romana*, Roma, pp. 42-44.
- Ohlig D. P. J., 2000, *De aquis Pompeiorum*. Dissertation, Katholieke Universiteit Nijmegen.
- Olsson R., 2015, *The water-supply system in Roman Pompeii*, Dissertation, Lund University.
- Osanna M., 2019, *Pompei, il tempo ritrovato*, Rizzoli. 444 pages.
- Pesando F., Guidobaldi M. P., 2006, *Pompei, Oplontis, Ercolano Stabiae*, Roma, 502 pages.
- Sogliano A., 1925, *Il Foro di Pompei*, Atti della R. Accademia dei Lincei, Memorie, Classe di scienze morali, storiche e filologiche, s. 6, 1 (3), pp. 220-272.