Water: social responsibility and the concept of common good in the ancient city of Pompeii

Adriana Rossi, Sara Gonizzi Barsanti

Università degli Studi della Campania Luigi Vanvitelli
Department of Civil Engineering, Real Casa dell' Annunziata - Via Roma 29 - Aversa (CE) Italy
(adriana.rossi; sara.gonizzibarsanti)@unicampania.it

Abstract

Pompeii was connected to the great Serino aqueduct under the principate of Augustus. From that moment on, water became not only a precious resource for the inhabitants but also their true social indicator. It is no coincidence, in fact, that the concentration of sumptuous dwellings is in Regio VI, the district closest to the aqueduct reservoir (castellum aquae in Latin) and the one most equipped with piezometric towers, the first of the network, the ones that would never leave the decorative fountains of the peristyles dry. From this observation follows the original possibility of considering the water network a factor that contributed to designating the morphology of urban neighbourhoods and blocks.

Key works: water partitioning system, water towers, fountains, Pompeian Regiones

When the Greeks took over the primitive village on the slopes of Vesuvius, Pompeii took on the urban connotations typical of their colonies. Where the lava flow had blocked, forming a sort of natural terrace, the Forum was implanted, a sort of anomalous acropolis leaning towards the Doric temple that stood out in the triangular widening, to offer a superb panorama of the gulf, an excellent view to guarantee the city's inviolable defence from the sea. In fact, the lava that had covered the ground extending south and south-east before stopping about half a kilometre near the mouth of the Sarno made the city protected on this side, delegating the defence of the northern section to the mighty fortifications that were continually adapted. In a short time, a circuit of more than 3.3 km of walls encircled the city of Pompeii, which developed within it in an almost axial position to the north-south direction and around a slight incision that would later be transformed into the main road, namely the via Stabiana, running from Porta Vesuvio (42.30 m altitude) to Porta Stabia (8 m altitude). Large, cultivated areas were initially incorporated into the walls, intended to ensure building expansion, and at the same time provide minimum fodder for the animals, and thus sustenance for the inhabitants, in the event of a prolonged siege.

Water and pre-Roman urban morphology

If the morphology of the lava plateau is responsible for the subdivision into urban parts that the city would progressively acquire, it is the availability of water that is responsible for their division into Regiones. The division into districts, in fact, already present in the Samnite age, was preserved in the Roman age, as the toponymic permanence referring to the Salinienses, the Gampanienses, the Urbulanenses, and the Forenses, to be understood as inhabitants of the respective 'vici' of the city (districts), rather than as members of professional associations, seem to testify. However, the availability of water, somewhat congruent with the needs of the community, had repercussions on the character of the distribution of the social classes, due to a singular selective mechanism of prices recorded according to the distance of the areas from the water cisterns. Being devoid of springs, Pompeii's volcanic soil forced its residents to obtain water by collecting rainwater, drawn, in an inconvenient manner, from a few very deep wells (just 5 and over 30 m deep) or by drawing it from the Sarno river below. It is not surprising, therefore, that in Roman times it would be precisely the derivation from the new-born Serino aqueduct that would highlight and emphasise, within the city, the formal subdivision generated by social classes and through these the building character that characterised the different urban parts.

Roman insulae and waterworks

When they were free to choose, the Romans always preferred to find their cities on flat areas. Among the preeminent reasons for this choice was the far easier distribution of water in flat urbanism compared to the complexity of the morphologically rugged one. In Pompeii, the great difference in

altitude forced the adoption of sophisticated hydraulic solutions to ensure effective urban water destruction.
Enclosed within the mighty Greek walls, most of the dwellings exhumed from ashes and lapilli are of undoubtedly Roman design and certainly built after the conquest of Lucius Cornelius Sulla (89 BC). With the settlement of the dictator's veterans in the city, their peculiar residential needs were introduced, first and foremost the construction of thermal baths, characterised by a huge consumption of running water, a further stimulus for the construction of a more adequate aqueduct [Staccioli, 2002].
The more than 30 m of urban gradient recorded in Pompeii, equal to a water pressure in the pipelines and lead pipes of 3 kg/cm2, made them unsuitable for supporting the load, forcing them to devise or adopt a system capable of limiting the pressure without, however, reducing the flow [Fassitelli, 1972].
The need had in fact increased with the spread of wealth and especially at the most luxurious residences where decorative fountains became the distinctive element of wealth (Fig.1). In fact: '[...] It seems that it is not only due to chance that no less than eight dwellings with rich decorative fountains belong to Regio VI, as opposed to between one and three in the other regiones, and that of these seven no less than four overlook Mercury Street. It can be observed that the extreme proximity of the castellum aquae of Porta Vesuvio and the steep slope of the road in the opposite direction to that of the castellum, must have facilitated the distribution of water in this regio, main due to the extent of its carriageway and its commercial importance (Fig.2). Those who lived there must probably have become rich through trade and poured much of their wealth into the decorative apparatus, in which a privileged place was given to water,' [Borghi, 1997: 43].
In this last clarification insists the key to the reflections and findings aimed at recognising and critically recording the interrelationships established between the design of the urban blocks and the implementation of an urban water network, whose primary conduits were directly accessible from the running quays on the sides of the streets: a disposition imposed by the frequent need to replace conduits and pipes that were progressively and rapidly obstructed by calcium carbonate concretions that the low circulation pressure favoured inside them. This was the main reason for the new urban layout dictated not by the demand for drinking water, which had to be available even to the most modest dwellings, but for water to be destined for the fountains of the residences of the new rich, as an emblematic manifestation of their fortune.

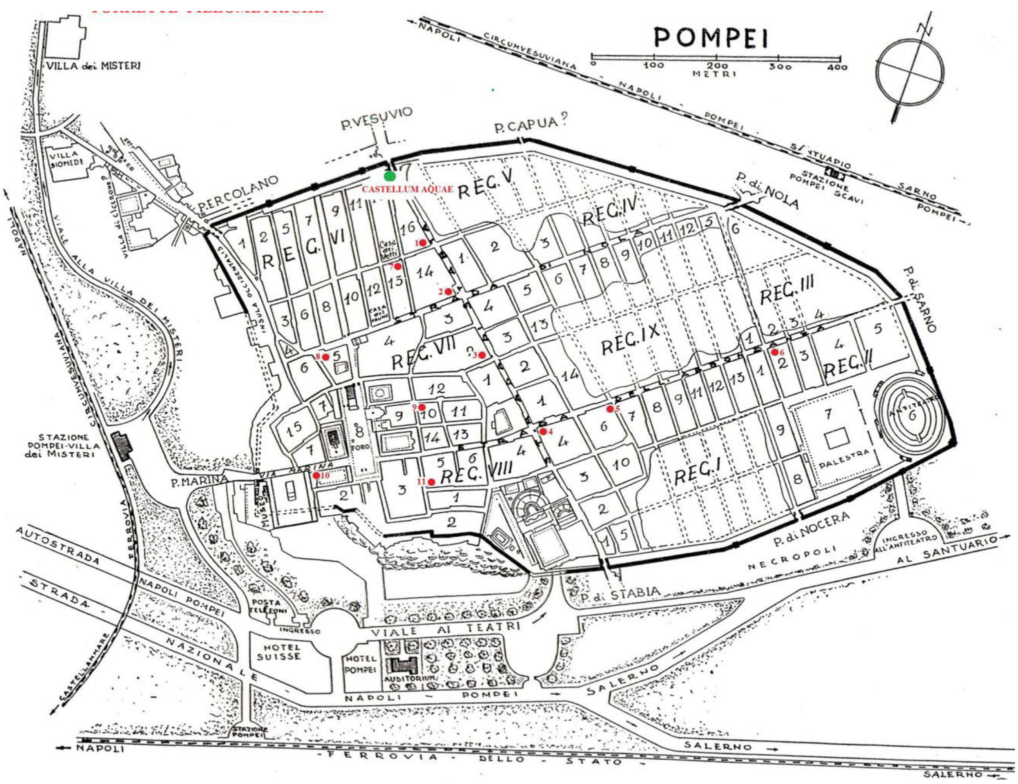

Figure 1. Pompeii, plan. Piezometric turret, bases listed sea level: Castellum Aquae (42,28 m); n.°1 (35,38 m), n°2 (32, 68 m), n°3 (28,91 m), n°4 (24,31 m), n°5 (30,40 m), n°6 (24,46 m), n°7 (35,69 m), n°8 (38,07 m), n° 9 (29,90 m), n° 10 (30 m), n° 11 (29,46 m)

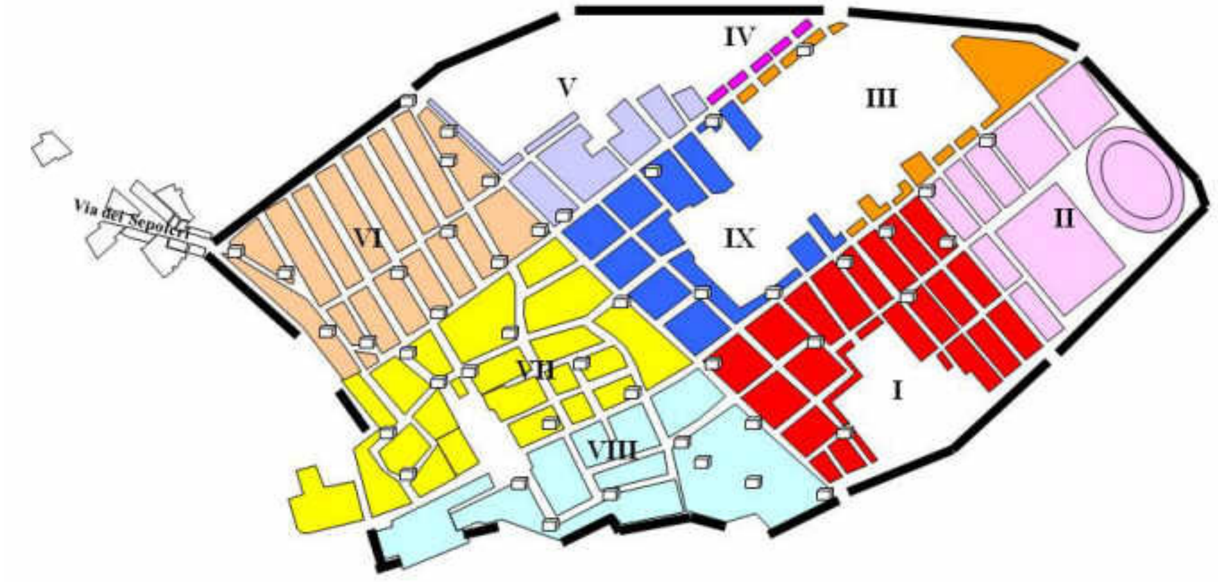

Figure 2. Pompeii. Plan Fountains [http://www.pompeiiinpictures.com/pompeiiinpictures/Plans/ Fountains.htm].

Water works and the Roman city

From the connection to the aqueduct branched the urban water supply, which before being introduced into the city was decanted into a large pool. The pool, known as a limaria, whatever its type, in fact doubled the capacity of an aqueduct, storing enormous quantities of water during the night, when demand was practically nil, water that during the day was added to the distribution of electricity.

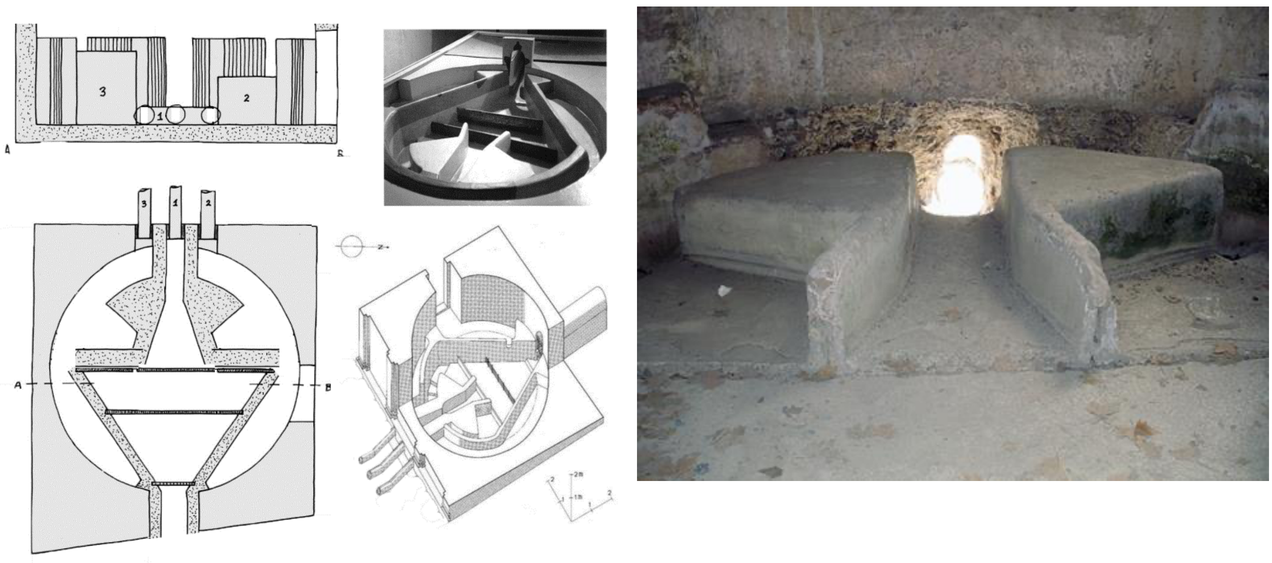

Figure 3. Pompeii. Exterior and interior of three-way water distribution system. Details.

For Pompeii, estimating its population at around 20,000 inhabitants and raising its per capita water consumption to that of a contemporary citizen of Rome, the demand would have been around 10,000 cubic metres, slightly less than the volume of the Piscina Mirabilis in Miseno, or the similar one, still in service, in Albano. But of such an artefact, there is no trace so far, leaving us to believe that the flow into the city from the water distributor, to which the task of purifying the water coming from the Serino was also delegated, was sufficient to meet the needs (Fig.3). Since for the Romans the flow rate was proportional to the cross-section of the canal, the organ for distribution, generically called

castellum aquae, was in fact a construction subdivided into several small basins, geometrically equal, with the three-compartment type being the most widely adopted. A specimen is preserved in perfect condition in Pompeii, which is therefore called a water tripartite: in it, the incoming flow was made to expand in a special wide and shallow circular basin and divided into three equal streams, by means of special masonry rises and from there channelled to feed a conduit. The distributor was installed at the highest point of the city, near Porta Vesuvio, at an altitude of 42.30 m, thus taking advantage of maximum prominence, so that no point in the city was excluded from the distribution of the network [Adam & Varène, 2008]. According to De aquae ductu urbis Romae by the senator Sextus Julius Frontinus in charge of Rome's water supply, of the three conduits generally constructed, the first was intended for public fountains, the second for the baths, and the third for private users, who contributed to the maintenance costs of the entire urban network with their income [Frontinus (Orsini 1805)]. However, given that the guides through which the interception sluice gates flowed, with which a single section could be closed, if necessary, it would seem logical to assume that the primary castellum acquae had the function of distributing the water to the three distinct branches of the network mentioned above; a hypothesis that is in some way confirmed by the heights of the piezometric towers located along the city streets. A system, therefore, of distribution by regiones and not by specific users, as the many unauthorised connections directly connected to the reservoirs above the turrets, not unlike the legitimate ones, without anyone being able to prevent them, would seem to testify. As for the turrets, referred to by the Romans as castela aquae secundaria and by us as piezometric turrets, there are about 11 of them in the already excavated part of the city, and at least another 3-4 are thought to be in the remaining, still buried part. Completely devoid of pipes and reservoirs, these turrets were erected to keep the operating pressure always below 1 kg/cm2 at any point in the city, regardless of its altitude. In practice, they acted as pressure limiters: the approximately 1-square metre tank, covered and placed at the top of the turrets at a height of approximately 6 m, accumulated the water that flowed into it from an ascending pipe (coming from the distributor or from the previous turret), feeding a second descending pipe into the next one. The ingenious device thus ensured that the pressure in the pipes never exceeded the pressure produced by the height of a single turret, which was therefore about 0.6 kg/cm2, compatible with their resistance.
At the foot of the turrets or, more rarely, in their immediate vicinity were the major public fountains, the minor ones being some forty metres away. The supply of the former was provided not only by the pipe at the bottom of the tank, but also by the water overflowing from it. With respect to the public fountains, no dwelling was more than 50 metres away.
Evidence that the urban network was divided into independent branches includes the altimetrical survey of the bases of the turrets. This, highlighting that some of them are located at the same elevation above sea level, would make the cascade arrangement nonsensical, as would the others that precede them in the succession at a lower elevation. It follows, therefore, the confirmation that there are several branches, presumably three, if the characters of the primary castellum acquae are observed.

Impact on the built city

Regardless of the greater or lesser difference in height, the turrets ensured a limited pressure, independent of the aqueduct's flow rate and essentially identical at every point in the city. The constant flow rate in the pipes was a function of their diameter and, above all, of the relative distance from the castellum aquae. The first turrets, in fact, were not affected by the eventual and inevitable flow rate reductions
The first turrets, in fact, were not affected by the eventual and inevitable reductions in the flow rate of the subject aqueduct on its upper edge, leaving the supply to the public fountains, whose pipes were grafted onto the bottom of the reservoirs, unaffected.
The dimensions of the longitudinally soldered lead pipes are described in detail in chapter 26 of Frontino's text: these are not measurements of the diameter, as the geometric section is not circular but pear-shaped, but of the width of the lead sheet, which by curvature generated them with a precise maximum diameter. It should be noted, however, that we have no archaeological evidence of the largest ones, as not even modest fragments have ever been found. Perhaps they were never built, but more likely they were vandalically stolen when the excavations began, as it was more profitable to remove them. The unit of measurement of the Roman aqueducts was the fistula quinaria, a 3 m

long pipe, made from a sheet of metal about 5/4 of a finger wide (before being bent), hence the name, corresponding to about 1.25 inches in diameter, itself equal to 23 mm; the flow rate has been estimated at 0.483 litres per second, or 41.5 m3 per day (Fig.4) [Di Fenizio, 1947].

Figure 4. Pompeii: hydraulic keys stop.

Considering that the new Serino aqueduct, completed in 1885, had a daily flow rate of 170,000 cubic metres, with a minimum of 2 cubic metres per second, we are not far from the truth if we assume that the flow rate of the ancient Roman aqueduct, which drew from the same springs as the Serino, was not much lower. It can therefore be deduced that a rate of around 20,000 cubic metres withdrawn during the day would not affect the per capita requirement of around 500 litres at all. Approximately 7 litres per second would have passed through each branch, capable of cascading to the successive towers and thus to the entire water network. The estimate, if contracted in the flow rate, obliged more conusumi guaranteed by the many spanners that in fact penalised the lower parts of the city, those inhabited by the less well-off. This last observation must be considered one of the main concauses of the concentration of the domus of the wealthiest citizens close to the first turrets, those that would never have left them dry, thus justifying the unique social characterisation of the Regiones.

References

Adam, Jean-Pierre & Varène,Pierre. 2008. Le castellum aquae de pompéi, étude architecturale. In: « Revue archéologique» 2008/1 (n° 45), pp 37-72.

Borghi, Rachele. 1997. L'acqua come ornamento nella domus Pompeiana. In: Quilici, Lorenzo & Stefania Gigli (a cura di). Architettura e pianificazione urbana nell'Italia antica. Roma: L'Erma di Bretschneider, 1997; pp. 262, 184 ill. b/n, cm 21x26. ISBN: 88-8265-007-3

Brogi, Giacomo. 1912. Pitture, Vedute, Sculture, ecc. Napoli e. Campania, Roma e Lazio, Sicilia, Bologna, Rimini, ecc., Firenze, 1912. In. Catalogo delle fotografie, 1903-26 UND Giacomo Brogi 1912-32).

Castellum Aquae Pompeii. In: «Notizie degli scavi di antichità, comunicate alla R. Accademia del Lincei per ordine di S. E. il ministro della pubb. istruzione». Period: 1876-1903. Roma: Acc. Naz. dei Lincei.

Di Fenizio, Claudio. 1947. L'Acqua Appia. La misura delle acque more romano e la tecnica delle condotte nel I sec. Dell'era volgare. In: «Il Giornale del Genio Civile», Roma fasc. 9/10 (1947). p. 391-401; fasc. 11/12 (1948) p.451-463.

Fassitelli, Enzo. 1972. Duemila anni di impianti in Italia: tubi e valvole dell'antica Roma. Milano: Petrolieri d'Italia, 152 p.

Frontino, Sesto Giulio. I-II sec. De aquaeductu urbis Romae. In: Commentario di Sesto Giulio Frontino. Degli Acquedotti della Città di Roma, con note e figure, illustrato da Baldassarre Orsini.

Perugia: Stamperia camerale di Carlo Baduel, 1805. [(2012) ISBN 10: 5885264260 (2015) ISBN 13: 9785885264266].

Ohlig, Christoph.P.J. 2001. De aquis Pompeianorum. Das Castellum Aquae in Pompeji: herkunft, Zeleitung und Verteilung des Wasseres, (Circumvesuviana, volume 4). Nijmegen: Demand GmbH. 2001. 483p. (p.49-83). ISBN 3-8311-2614-3.

Russo, Flavio. 2005. 89 a.C.: assedio a Pompei: la dinamica e le tecnologie belliche della conquista sillana di Pompei. Pompei: Flavius Editore 2005.

Staccioli, Romolo Augusto. 2002. Acquedotti, fontane e terme di Roma antica. I grandi monumenti che celebrarono il 'trionfo dell'acqua' nella città più potente dell'antichità. Roma: Newton Compton. ISBN-10: 8882897931; ISBN-13: 978-8882897932