

## The Project PILAE, For an Inventory of the Submerged Roman Piers. A Preliminary Overview

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### Abstract

In the coastal territories between northern Tuscany and southern Campania, on the Tyrrhenian Sea, constitute a privileged observation post for any study on the port facilities in the Roman time. Along these shores, in fact, there is an amazing concentration of ancient remains connected to port infrastructures, often not very far from the modern cities, and in many cases still recognizable beneath the sea or near it, despite the big changes suffered by the Italian coastal landscape over the past two millennia.

**Keywords:** Pilae, port, Roman, Tuscany, Campania

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### Introduction

Italy, and in particular the coastal territories between northern Tuscany and southern Campania, on the Tyrrhenian Sea, constitute a privileged observation post for any study on the port facilities in the Roman time. Along these shores, in fact, there is an amazing concentration of ancient remains connected to port infrastructures, often not very far from the modern cities, and in many cases still recognizable beneath the sea or near it, despite the big changes suffered by the Italian coastal landscape over the past two millennia (see, for example, Schmidt, 1972).

This extraordinary richness, so important for the historical and archaeological research, is the result of a variety of factors: the very high settlement density of these areas already in the ancient world (Cambi and Terrenato, 2004); the presence of Rome, with the consequent need for supplies of very large scale; the flourishing of the phenomenon of the maritime villas (Lafon 2001), particularly along the coasts of Campania (D'Arms, 1970), almost always characterized by the presence of private landing facilities; the geological and volcanological peculiarities of the territory, which in many cases led to the sinking of many

coastal structures; the presence, in large quantities, of the pozzolana, which is essential for the construction of buildings in concrete in the water.

Despite this abundance, however, many of these structures lie on the seafloor (see for example Stefanile, 2012), including the numerous pilae, we are dealing with in this short preliminary paper, often not studied or just published in a summary manner. Little has been done so far to organize and systematize these remains, so unique and interesting, that are a tangible reflection of the descriptions provided in ancient times by Vitruvius.

### The Pilae

The pilae, massive pillars in opus caementicium, built under water (Fig. 1), with functions of breakwaters and piers (Felici 2006, 75-77), are very well-known thanks to the literary sources. Vitruvius, in his famous work on architecture, explains that in the absence of natural shelters for navigation, it is necessary to proceed with the construction of artificial structures, according to these dictates:

*"if we have a situation without natural advantages, and unfit to shelter ships from*

storms, it is obvious that we must proceed as follows. If there is no river in the neighborhood, but if there can be a roadstead on one side, then, let the advances be made from the other side by means of walls or embankments, and let the enclosing harbor be

thus formed. Walls which are to be under water should be constructed as follows. Take the powder which comes from the country extending from Cumae to the promontory of Minerva, and mix it in the mortar trough in the proportion of two to one.” [Vitr. 5.12.2]



Fig 1. A diver in front of a huge pila at the Secca Fumosa, in the Phlaegrean area (Photo: Michele Stefanile).

The special reference to the ingredient that can be found between Cumae (modern Cuma in Campania) and the promontory of Minerva (i.e. the Cape Athenaion at the end of the Sorrento Peninsula, on the other side of the Gulf of Naples) is fundamental: he is talking about the pozzolana, the ancient lapis puteolanus, a volcanic ash present in great abundance in the Campi Flegrei and around Pozzuoli (Puteoli, hence the name) (on the pozzolana, see now Gianfrotta 2009).

In the second book of his work Vitruvius describes its properties with interesting details:

*“There is also a kind of powder which from natural causes produces astonishing results. It is found in the neighborhood of Baiae and in the country belonging to the towns round about Mt. Vesuvius. This substance, when mixed with lime and rubble, not only lends strength to buildings of other kinds, but even when piers of it are constructed in the sea, they set hard under water. The reason for this seems to be that the soil on the slopes of the mountains in these neighborhoods is hot and full of hot springs. This would not be so unless the mountains had beneath them huge fires of burning Sulphur or alum or asphalt. So the fire*

*and the heat of the flames, coming up hot from far within through the fissures, make the soil there light, and the tufa found there is spongy and free from moisture. Hence, when the three substances, all formed on a similar principle by the force of fire, are mixed together, the water suddenly taken in makes them cohere, and the moisture quickly hardens them so that they set into a mass which neither the waves nor the force of the water can dissolve.” [Vitr. 2.6.1]*

The properties of the pozzolana are thus at the basis of the exceptional resilience of marine structures built in the Roman age. The chemical reaction not only lends strength to buildings of other kinds, but even when piers of it are constructed in the sea, they set hard under water.

The Romans were very well aware of this, and for this reason they carried the original pozzolana from the Campi Flegrei to distant sites, such as the one in which they built the port of Caesarea Maritima, in Israel (Oleson 1985; Brandon, 1996 and 1999).

In recent years, an interesting project (ROMACONS) promoted by the University of Victoria, has allowed us to analyze with

scientific precision the hydraulic concrete of the ancient Roman port facilities, highlighting the prevalence and relevance of the Phlegraean pozzolana (Oleson et al., 2004).

In several years of work, various samples were collected from different locations in Italy and abroad, and it was set up a reliable and useful database. It was also possible to proceed to the reconstruction of a concrete pila in the water, with excellent results (Hohlfelder, Oleson and Brandon, 2005).

Even for the process of construction of pilae, Vitruvius is a key source. He informs us that there were three different methods of construction, chosen because of the context.

The first consisted in the construction of the facility within a wet cofferdam:

*“Then, in the place previously determined, a cofferdam, with its sides formed of oaken stakes with ties between them, is to be driven down into the water and firmly propped there; then, the lower surface inside, under the water, must be levelled off and dredged, working from beams laid across; and finally, concrete from the mortar trough—the stuff having been mixed as prescribed above—must be heaped up until the empty space which was within the cofferdam is filled up by the wall. This, however, is possessed as a gift of nature by such places as have been described above” [Vitr. 5.12.3].*

The second consisted in the construction of the pila within a dry cofferdam:

*“But in places where this powder is not found, the following method must be employed. A cofferdam with double sides, composed of charred stakes fastened together with ties, should be constructed in the appointed place, and clay in wicker baskets made of swamp rushes should be packed in among the props. After this has been well packed down and filled in as closely as possible, set up your water-screws, wheels, and drums, and let the space now bounded by the enclosure be emptied and dried. Then, dig out the bottom within the enclosure. If it proves to be of earth, it must be cleared out and dried till you come to solid*

*bottom and for a space wider than the wall which is to be built upon it, and then filled in with masonry consisting of rubble, lime, and sand” [Vitr. 5.12.5].*

Finally, there was a third possibility: it was possible to proceed to the creation of prefabricated blocks on the ground, letting them to fall into the water later:

*“But if by reason of currents or the assaults of the open sea the props cannot hold the cofferdam together, then, let a platform of the greatest possible strength be constructed, beginning on the ground itself or on a substructure; and let the platform be constructed with a level surface for less than half its extent, while the rest, which is close to the beach, slopes down and out. Then, on the water's edge and at the sides of the platform, let marginal walls be constructed, about one and one half feet thick and brought up to a level with the surface above mentioned; next, let the sloping part be filled in with sand and levelled off with the marginal wall and the surface of the platform. Then, upon this level surface construct a block as large as is required, and when it is finished, leave it for not less than two months to dry. Then, cut away the marginal wall which supports the sand. Thus, the sand will be undermined by the waves, and this will cause the block to fall into the sea. By this method, repeated as often as necessary, an advance into the water can be made” [Vitr. 5.12.4].*

It's not just the literary sources to give us back the image of the ancient pilae: in more than one representation, in particular in wall-paintings from the Vesuvian cities, harbor scenes with buildings and structures standing on piers emerging from the sea have been recognized. We can count also on a famous series of archaeological finds of exceptional value for the reconstruction of the ancient landscape: some glass flasks, now scattered among museums all over Europe, on whose surface is drawn the waterfront of Puteoli and Baiae (Ostrow, 1979). Prominent element in the scene is the long pier of the port of Pozzuoli, on which an indication in capital letters PILAE stands (Fig. 2).

The pier, probably built by Nero (Camodeca 1994, 110-112), although long considered as a work of Caligula (having been assimilated to the famous 'Bridge of Caligula' mentioned by Suetonius – see for example Paget 1971), had to be at least 300 meters long, and be based on fifteen massive pilae. These structures, as it can

be easily seen in the representations of the nineteenth century, were still visible, on the surface of the water, until the early twentieth century, when the great modern pier of Pozzuoli was built on top of them (Castagnoli, 1977; Dubois, 1907) (Fig.3).



Fig 2. A glass flask depicting the waterfront of Puteoli, with the indication of the PILAE (Ostrow, 1979).

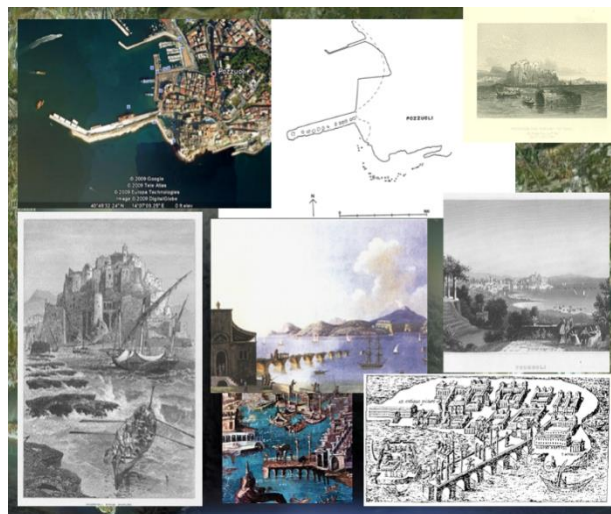


Fig 3. Ancient images and modern situation of the big 'Caligolian pier' in Puteoli (Photocomposition: Michele Stefanile).

### The Project

Research on Roman ports in opus caementicium, in particular along the Tyrrhenian coast of Italy, has produced very positive results. We can now read very comprehensive works as those Felici (1998, 2001, 2006) (to which this presentation owes much) and we can count on several specific studies about many problems (Gianfrotta 2007, 2009, 2011a) and many coastal sites (Felici 1993, 1997, 2006; Gianfrotta 1998, 2011b).

Nevertheless, in the region with the maximum concentration of pilae, at a minimum distance from the deposits of pozzolana, in the Gulf of Naples, the documentation is most lacking: While some pilae have been quite well analyzed, others are practically unpublished, and lack proper documentation (Fig. 4).

This deficiency gets even more serious today observing satellite maps provided by Google, where pilae, clearly visible even from the sky, because of their size, can be easily recognized

throughout the Phlegraean area, from Posillipo / Nisida to Cuma. Even from a superficial analysis, we can identify dozens of moles,

isolated pilae, private piers of villas, all over the territory.

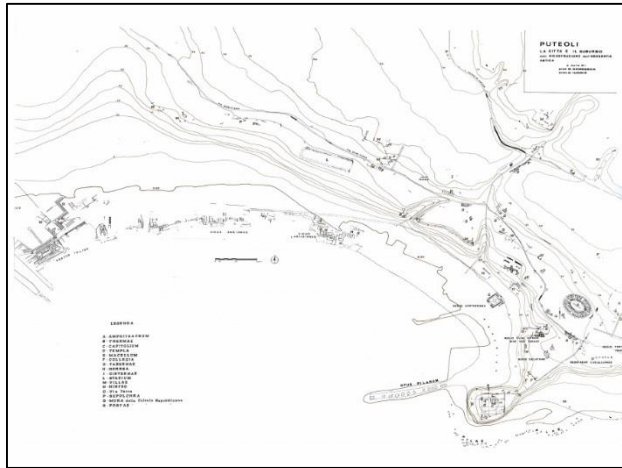


Fig 4. Puteoli's map with the indication of all the pilae recorded up to now (Camodeca 1994).

With the project PILAE, of which this communication is intended as a simple preview, we aim to document all pilae present in the waters of the Gulf of Naples, according to standardized procedures and methodologies. Thanks to a long preliminary study, and to a verification of all the targets by diving, we propose to record as many data as possible: GPS location, size, building techniques, parts of the cofferdam, decay situation, markers of the level of ancient coastline.

In detail, we will proceed to the collection of data based on the historical and actualized maps, on the ancient sources and bibliographic documentation; we will set a specific tab for the single pilae and for the alignments of pilae, and we will proceed to the registration of the data underwater. At this stage the participation of students is expected: the pilae, in fact, due to their size and their characteristics, to their proximity to the coast and to the fact that often they are in shallow waters, are ideal for the training of students in the survey and documentation of submerged archaeological evidence.

We will proceed finally to the creation of a GIS in which to enter all information collected, and we will make analyses of the data in order to recognize constants and variations, types

and differences. Growing our knowledge of ancient pilae, in fact, it is easy to see how articulated and different they may be.

The collection of such interesting and numerous samples (so far over sixty structures have been surveyed, analyzing only the basic maps, aerial photos and satellite,) can be the first brick for the construction of a corpus of reference.

To this corpus, we hope, the new pilae that will be documented along the coast of the Italian peninsula and the rest of the Mediterranean in the future, will be compared.

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