

Portus Lupiae: new data for a reconstructive proposal.

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Abstract – The pier of San Cataldo (Le), located along the Adriatic coast about 10 Km from the ancient city of *Lupiae*, is the best preserved port structure of the Roman Age in Apulia. An initial survey, conducted between 2004 and 2007 by the Laboratory of Topography and Photogrammetry of University of Salento, allowed a direct analysis of the remains and the elaboration of a detailed survey of the visible portion on the mainland. Since 2013, the structure has been the subject of an excavation campaign: a further portion of the pier about 20 m longer was discovered at the end on the mainland, and, the underwater remains were revealed for a linear length of about 70 m. The use of aerial photography was very helpful for achieving the expected result of the exhaustive and complete research: the creation of a photogrammetric survey and the realization of a 3D Image-Based model for a through understanding of the monument.

Roman pier, archaeological survey, 3D reconstruction, virtual heritage, ancient harbor.

I. INTRODUCTION

The pier of San Cataldo (Le) is the only Roman port structure in Puglia having a remarkable *status* of conservation. The structures was located about 10 km in the direction of E-NE from the ancient city of *Lupiae*, Lecce, on the low and sandy Adriatic coast, near Piazza Adriano [1].

Thanks to the interest of some historians like Giovanni Cota [2] and Antonio Edoardo Foscarini [3], we have information about the importance and the use of the pier during the last centuries, while with Raffaele Congedo there are first data about the backdrop [4]. Archaeological investigations in the immediate hinterland and in the sea have made it possible to identify a production fabric of brindisine amphoras between II and I century B.C. and traces of ancient roads [5].

Since 2004, a series of multidisciplinary investigations were carried out within the project “Portus Lupiae” by of the Topography and Photogrammetry Lab (LabTAF) of the University of Salento, with the collaboration of several laboratories of the Department of Cultural Heritage of Unisalento. Thanks to this project, it was possible to define the constructive and structural characteristic of the pier and the historical-topographical maps of the surrounding area.

II. HISTORY OF THE STUDIES

Pausania mentioned the Roman pier of San Cataldo by placing the port infrastructure in Adrian Age (Paus VI, 19, 9); other sources mention the port as the place where the emperor Ottaviano landed from Apollonia (Nic Damasc, *Vita Caesaris*, 130, XVII-XVIII, Appian., *Bella Civ.*, III 2, 10). The first historical information on the presence of an ancient port structure in San Cataldo date back to the 16th century, about some interventions wanted by Maria d’Enghien concerning an “ingentem



Fig. 1. Southern aerial image of the remains of the Roman pier.

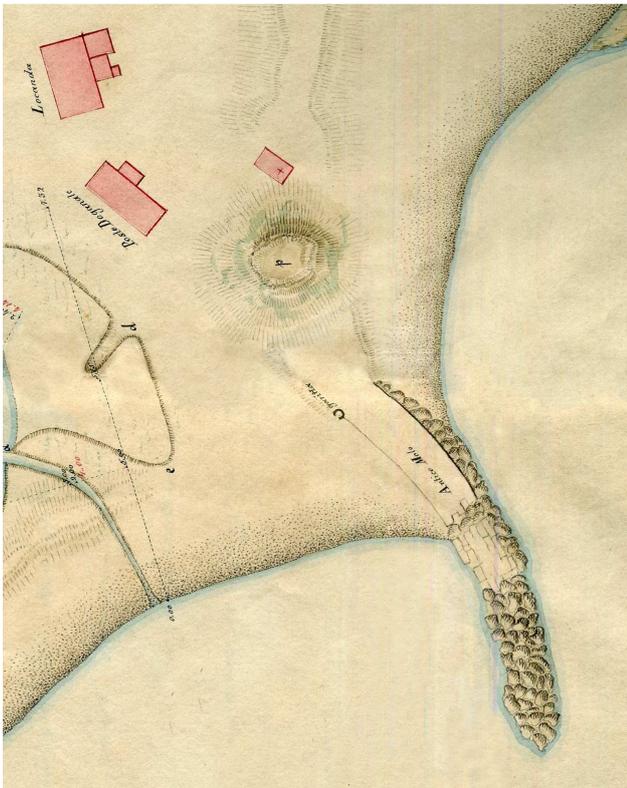


Fig. 2. An historical technical drawing of the Roman pier by I. Bernandini (1860, State Archive of Lecce).

molem longis iunctam lapidibus miro” [6]. From the 16th to 18th centuries, archival documents say of the need to restore the structure, when the port of San Cataldo was an important point for commercial traffics on the Adriatic coast, until at the end of the 18th century when this traffics started to decrease and then to finish completely [7].

In the 19th century, the Roman pier appeared in the archival cartography thanks to technical drawings linking to the project of creating a new pier; then realized between 1901 and 1908. In this case the blocks of the ancient pier were reused for the construction of the new structure, now also in the state of ruin. Further damage to the ancient structures took place in the 1930s, for the construction of bathing booths, as well as during the Second World War when were made bunkers and service

walkways for war purpose. Afterward and until 2004, the ruins were in a state of complete abandonment and exposed to the erosive action of the sea, when a project for the study and recovery of the structure led a new interest by the local authorities.

III. OBSERVATIONS ON THE STRUCTURE OF THE PIER

The “Portus Lupiae” project began in 2004 by the Topography and Photogrammetry Laboratory of the Department of Cultural Heritage of Lecce (LabTAF) - University of Salento. The studies allowed a direct analysis of the remains and the elaboration of a detailed survey of the visible portion on the mainland. In 2013, the structures has been subject of new research aimed to a better comprehension of structural articulation: thanks to the new excavation campaign, a new portion of the pier of about 20 m has been discovered in the N-W end, near Piazza Adriano.

Underwater analysis have cleaned the submerged portion of the pier of about 70 m, making it better visible in the aerial photos. Overall, the structure develops for a total length of about 140 m, with a slight curvature towards S from the median sector, which gives to the pier the characteristic semilunate profile.

The construction technique show the curtain walls of square local limestone blocks, with dimensions between 0.50 and 3.10 m of length, an average width of 1.00 m and an average height of 0.80 m. The core in *opus caementicium* is composed of irregular stones mixed to the lime with brick fragments.

Observing the planimetry, the lateral walls are not parallel to each other but tend to diverge and expand the width of the pier towards the submerged portion: the variation in width between the northern part and the southern portion is about 5 m.

The analysis of NE and SO front walls showed that the pier is not perfectly horizontal but has a slight inclination from the mainland to the sea; moreover, there is the absence of an exact correspondence of levels between the rows of the blocks of the two wall curtains. At the southern portion there are two chains of blocks perpendicular to the side walls: the first has an average thickness of about 1.20 m while the second, visible on the

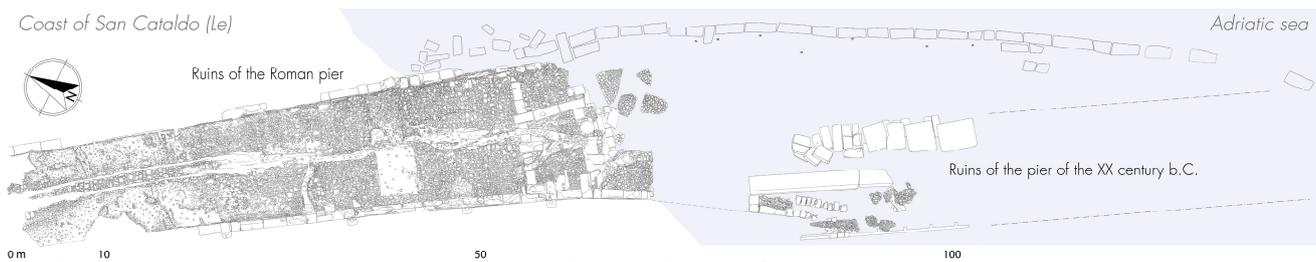


Fig. 3. Survey of the Roman pier structures.

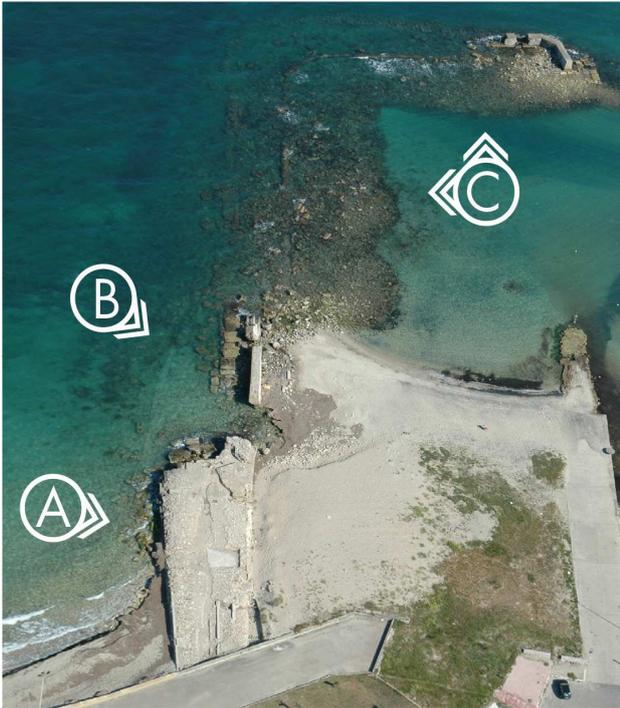


Fig. 4: A) remains of the Roman dock; B) submerged remains of the old dock; C) remains of the 20th century pier.

one, is divided into five rows with distributed blocks head and cut, not in axle but protruding, some of which have a cutout that allows the upper rows to be housed. The chains are interconnected by wall seals that strengthen the points of the pier most stressed by the action of the sea, where the structure has a greater width and draws a slight curvature. The fixing of the blocks are documented only by seven “C” clamps inserted in housings originally provided for double “T” clamps; they are positioned in correspondence of the two transverse chains.

On the Southern side and near the S-E end of the pier, some merchant graffiti consisting in letters are still visible despite the erosion of the material. One of these engravings are composed by the letters “S” and “Z” bound together by a horizontal line surmounted by a latin cross, [8], which may be attributed to a shipowner or to the author of the graffiti itself [9].

The cross is a very common symbol in merchant brands, like a call to God to recommend the protection of the sailors and the cargo: usually the most elaborate brands were relevant to companies while private merchants used the initial letters of their name [11].

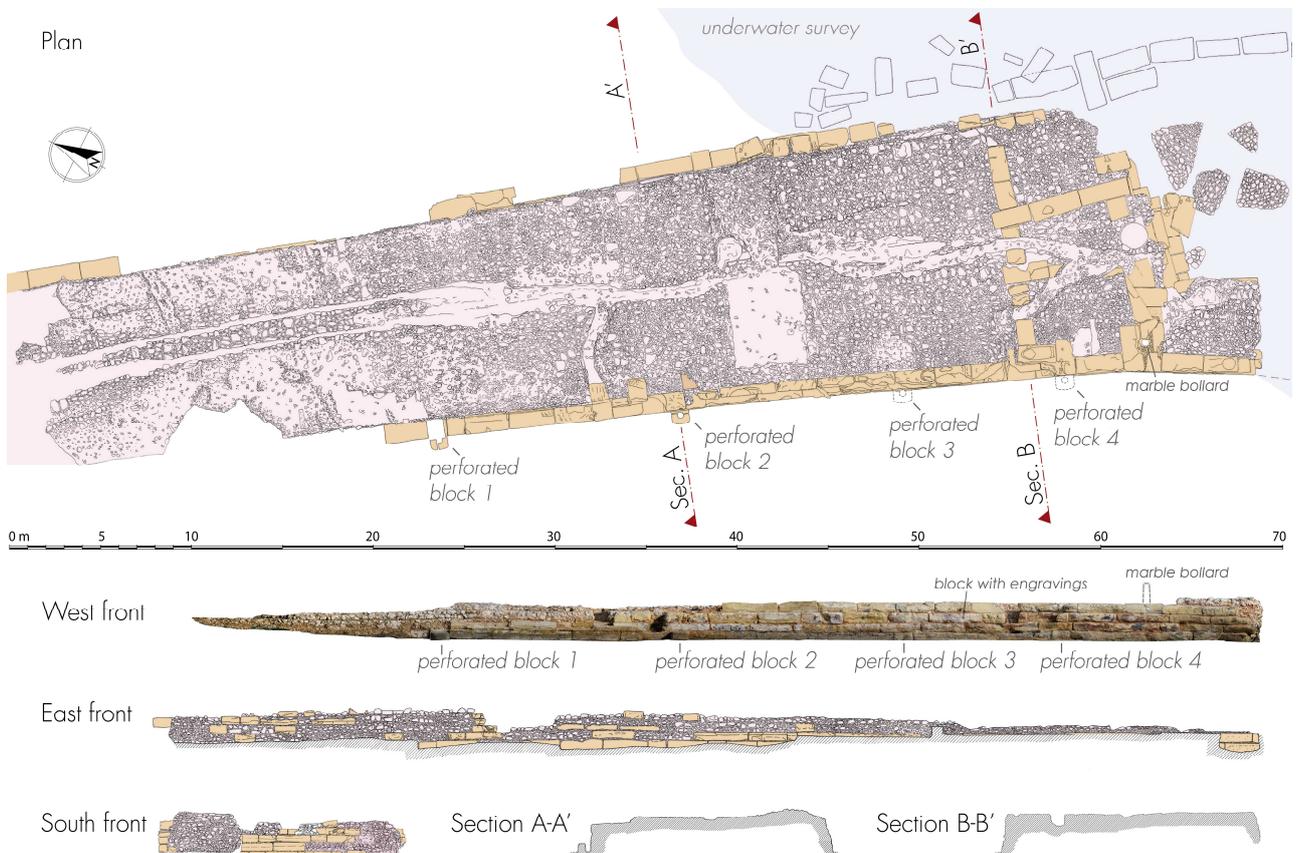


Fig. 5. Detail of the survey of the Roman pier structures above sea level.

V. 3D MODEL OF A RECONSTRUCTIVE PROPOSAL

The historical-archaeological investigations of the structure and the topographic survey of the surrounding area provided a great deal of information for a logical and deductive process, which led to the elaboration of a 3D reconstructive proposal. Along with the acquisition of the technical reliefs of the pier, further photogrammetric

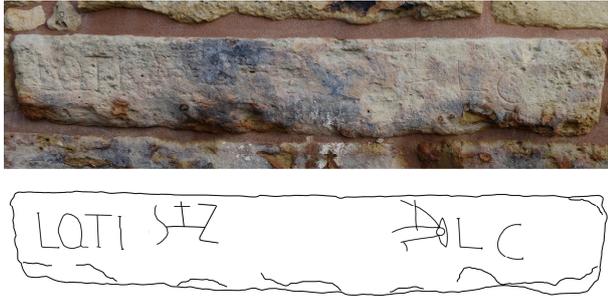


Fig. 6. Detail of the graffiti of merchant brands .

reliefs have been developed based on Structure for Motion algorithms. The analysis of the historical photos of the late 19th and early 20th centuries reveals that at that time the ruins were much wider than today, and this was before the construction of the twentieth century pier that caused a partial demolition of the ancient structures [12]. The comparative study of the old photographic documents with the photogrammetric data shows a number of key elements for the 3D reconstructive proposal process. Even though, the difficulty of analyzing and comparing prospective photos of a century ago with modern orthographic images, it can still be seen how the extension of the demolished part was quite corresponding



Fig. 8. Example of T-shaped cutting with a C-shaped clamp.

to that currently submerged.

The identification of the exact point of contact between the present ruins and those of the late 19th century is due to two blocks of the western wall placed exactly at the southern end of the pier, one of which is easily recognizable for a recess in the upper corner, due to the housing of the now missing block, well visible in photographic documents. Another important element is the attestation of a fifth row of blocks above the sea level, now perceived only by the presence of a lump of conglomerate, which in the E end is over the upper blocks of the wall. There is also the presence of two marble bollards in the destroyed portion, to which a third still partially visible is added.

Another important aspect of the emerged portion concern the understanding of the three different levels linked with the foundations, the floor plan and the water level in the past. It can be presumed that the current sea level is not very different from the ancient one and that the original floor plan of the pier had to be approximately

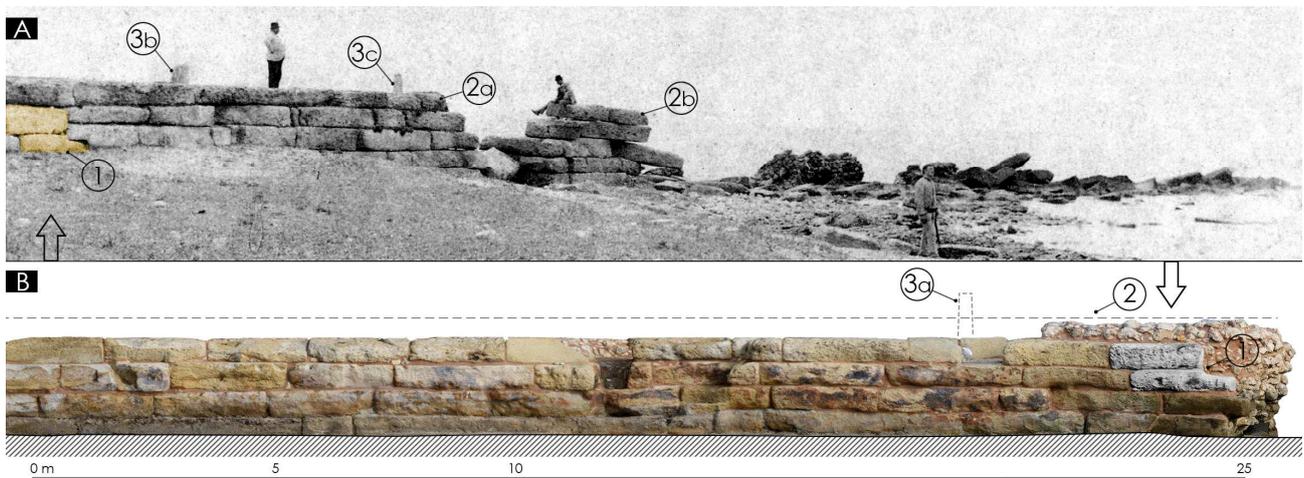


Fig. 7: A) Historical photo (1896): highlighted in yellow the two blocks still visible in the surviving structures of the pier (1), the presence of a fifth upper row now disappeared (2) and two cylindrical bollards also lost (3); B) Photogrammetric survey (2016) showing the two blocks found in the photo of 1896 in grayscale (1), the conglomerate without the upper row of blocks (2) and the position of the bollard today partly preserved (Fig. 17) (3).



Fig. 8: Eastern view of the 3D reconstruction of the Roman dock and of the surrounding coastal landscape.

270 cm from the water surface, since originally there were five rows of blocks each 54 cm high. As evidenced by archaeological analysis, although it has not been possible to determine the overall height of the pier, there are at least two additional rows of blocks under those currently visible in the W wall. In the 3D model it is proposed an overall height of around 5 m, to ensure enough space of draft for the boats mooring.

Another topic of discussion regard two jutting blocks, plus the traces of the other two, embedded in the W wall, with a circular vertical hole of 33 cm in diameter. Such blocks were initially interpreted as bollards. However, a more careful analysis has progressively contributed to discard this hypothesis, primarily for their position, about 220 cm lower than the hypothetical floor plan of the quay and just above the sea level, which makes them objectively not at all small practical for a nimble mooring of ships. Secondly, for the complete absence of traces due to the rubbing of the ropes. A likely hypothesis is that they could be functional in supporting wooden poles linked to machines for the loading and unloading of goods: the 3D reconstruction proposes cranes equipped with winches. According to the example of other Roman piers, the floor plane was imagined covered of limestone square blocks, an element that can offer greater protection and durability on the platform's pavement. The absence of clear archaeological evidence to date would exclude a second W arm; therefore, in the digital proposal that replicates the entire ancient coastal landscape, there is a single structure connected with the ancient path, identified by the analysis of historical aerial photographs.

CONCLUSION

This new studies gave new importance and visibility to the Roman structure that has remained for decades in a state of complete abandon, activating a series of

initiatives aimed to the enhancement and fruition of the site by the local institutions; this has recently led to the finalization of the work of consolidation and restoration and the realization of a specific itinerary to visit the site. Special thanks goes to Prof. Giuseppe Ceraudo (coordinator of the "Portus Lupiae" project), to Prof. Carla Maria Amici and D.rs Silvia Marchi and Mariangela Sammarco for the technical-scientific support given to the documentation and study of the Roman pier of San Cataldo.

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